Request IR-1:

Reference: "This project was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the embankment and spillway/sluiceway structures. The refurbishment of the dam is scheduled to begin in 2019 with the procurement of the rubber dams and vertical lift gates, followed by construction in 2020." (ATO, p. 3)

(a) Please confirm whether refurbishment began in 2019 with the procurement of the rubber dams and vertical lift gates. If there were any delays, please identify and explain.

(b) Please confirm whether construction started in 2020. If there were any delays, please identify and explain.

Response IR-1:

(a) Confirmed.

(b) The refurbishment of the dam was originally scheduled to begin in 2019 with the procurement of the rubber dams and vertical lift gates, followed by construction in 2020. Following their procurement in 2019, rubber dams were delivered to site in June 2020 followed by the vertical lift gates in February 2021. Construction could not proceed as scheduled as NS Power had not yet received the required permits from its environmental regulators to allow in-stream construction and is now planned to commence in July 2025.

Request IR-2:

Reference: NS Power indicates that "Option 4" was the preferred option from the five options initially considered, for the following reason: "Option 4 is approximately $500,000 less costly than the next closest option. Option 4 also meets the operational requirements to manage system and the design flows" (ATO, p. 4)

(a) Given current projected costs, does Option 4 remain the most economical option?

(b) Do any of these previously considered options remain viable alternatives at this time?

Response IR-2:

(a-b) Please refer to NSUARB IR-7.

Request IR-3:

Reference: "The increase of approximately $8.2 million compared to the approved 2019 ACE Plan budget of $7,244,422 is due to increased environmental permitting requirements, extended construction timeline, and costs associated with Mi'kmaq Engagement". (ATO, p. 4)

(a) Please discuss the process used by NS Power to develop the original environmental permitting timelines and budgets? In particular, did NS Power consult with DFO, NSECC and/or Transport Canada prior to developing the original timelines and budgets?

(b) What sources of information, advice and/or experience did NS Power rely on in developing the original environmental permitting timelines and budgets?

(c) Please provide a table the compares the original environmental permitting budgets with the revised environmental permitting budgets.

(d) Please provide a table or figure that compares the original environmental permitting schedule/timeline with the revised environmental permitting schedule/timelines.

(e) Please explain when NS Power became aware of each of the following:

(i) Increase environmental permitting requirements

(ii) extended construction timeline;

(iii) costs associated with Mi'kmaq Engagement.

(f) Please explain why none of these issues or the associated costs were foreseen or identified previously?

Response IR-3:

(a) The original environmental timelines and budget were developed based on internal subject matter expertise using previous refurbishment projects conducted with a similar scope to Ruth Falls, and the environmental regulatory approval process understood at that time.

At the time of the original filing, hydro capital refurbishment projects generally only required a NSECC watercourse alteration approval unless the project included an increase in the permanent footprint for dam refurbishment. If a new footprint was established, the requirement for a DFO Fisheries Act Authorization (FAA) was triggered. As the footprint at Ruth Falls is not increasing, there was no FAA required at the time of original filing. There were also no Transport Canada requirements at that time.

However, the 2019 Fisheries Act and 2019 Canadian Navigable Waters Act were enacted after the NSUARB approval of the Original Project. The enactment of the new Acts resulted in increased permitting requirements for hydro capital refurbishment projects, including the requirement for a Fisheries Act Authorization.

NS Power regularly engages with DFO and NSECC on various projects and initiatives, including hydro capital refurbishment Projects.

(b) Please refer to part (a).

1 (c) Please refer to the table below:

	In Thousands ($)		
Description	Original Submission	ATO Submission	Increase in costs
INTERNAL LABOUR & TRAVEL			
Environmental Services labour and travel expenses	$19	$126	$107
MATERIALS			
Fish Passage upgrades	$0	$667	$667
CONTRACTS			
Fish Passage upgrades	-	$1,630	$1,630
Engineering support for environmental permit application	-	$15	$15
Barn Swallow nest removal	-	$11	$11
Pre-tree clearing nesting bird survey	-	$10	$10
Bird habitat building construction	-	$10	$10
CONSULTING			
Offsetting (West River Project)	-	$547	$547
Post-construction monitoring (drawdown, post construction, barn swallow)	-	$309	$309
Fishway passage improvements design	-	$192	$192
Fish count	-	$122	$122
Juvenile Gaspereau Entrainment study	-	$120	$120
3D Hydraulic modelling	-	$118	$118
Drawdown monitoring plan	-	$55	$55
Barn Swallow Monitoring Plan and monitoring	-	$19	$19
Aerial Imagery Collection for the Juvenile Gaspereau Entrainment Study	[redacted]		
Environmental Permitting Application fees			

Environmental maintenance flow assessment	-	$1	$1
Wetland delineation and functional assessment	$5	$4	-$1
OTHER GOODS AND SERVICES			
Contingency for Offsetting (Wet River Project)	-	$500	$500
TOTAL:	**$24**	**$4,472**	**$4,448**

(d) Please refer to the table below.

Organization	**Approval Requirement**	**Legislative Timeline**	**Original Expected Timeline**	**Current Expected Timeline**
NSECC	Watercourse Alteration Approval	60 days	2-6 months	5 years
DFO	Fisheries Act Authorization	150 days	N/A	5 years
TC	Navigable Waters Authorization	90 days	N/A	5 years

Based on the permitting process as understood at the time of the original filing, the legislated timeline for the Watercourse Alteration Approval process was 60 days. This excludes time for NSECC to review information, for proponents to respond to additional information requests, and Crown Consultation with the Mi'kmaq of NS. This means that the permitting process typically exceeds the legislated timelines as the legislated timeline is paused when additional information or consultation is required. At the time of the original filing, the time to receive a Watercourse Alteration Approval from NSECC was typically 2-6 months.

As indicated in NS Power's response to CA IR-5, part (a), these timelines were exceeded due to requirements for additional information and consultation. The total timeline to receive the watercourse alteration approval for Ruth Falls was 4.5 years.

The legislated timeline for a Fisheries Act Authorization is 150 days and the legislated timeline for a Navigable Waters Authorization is 90 days. This excludes time for DFO and TC to review information, for proponents to respond to additional information requests, and Crown Consultation with the Mi'kmaq of NS. The legislated timeline for the NSECC Watercourse Alteration Approval is still 60 days. This means the permitting process typically exceeds the legislated timelines as the legislated timeline is paused when additional information or consultation is required.

As indicated in Attachment 1 of the ATO Application, the legislated timelines were exceeded due to requirements for additional information, studies and engineering design to satisfy DFO application requirements. The total time taken for the DFO FAA process for Ruth Falls is now 4 years and is expected to take at minimum an additional 6 months to receive the FAA.

(e)

(i) NS Power submitted a request for DFO to review the Ruth Falls project in December 2019 as a result of the enactment of the 2019 Fisheries Act. DFO stated that an authorization was required in March 2020. At this time, it was understood that a Navigable Waters Authorization would also be required.

(ii) Extended construction timelines are associated with the additional time required to gather information and respond to additional information requirements through the Fisheries Act Authorization process. The first Project deferral was associated with notification from DFO that an authorization was required in March 2020, as there was insufficient time to complete the legislated regulatory review with construction in 2020. The construction timeline became further extended after each subsequent

review and request for additional information by DFO. In-stream construction work cannot proceed without securing all of the required permits in and can only proceed in the in accordance with the granted permits.

(iii) Increases in costs associated with Mi'kmaq engagement and archaeology became known through NS Power's continued engagement with the Mi'kmaq, the course of the environmental regulatory review and Crown consultation process. Additional archaeological requirements were associated with evolving expectations for archaeological protection during extended drawdowns for NS Power hydro refurbishment projects. Increased costs also include the continuation of KMKNO Capacity Payments and the addition of First Nation community monitor participation in the Project, which was not an expectation at the time of the original filing.

(f) As described in response (e)(i) and (iii), the increased environmental and archaeological requirements and associated costs for the Ruth Falls Project are a result of changing legislation, which occurred after the original filing for the Project, and evolving standards and processes that occurred during the environmental regulatory review process.

Request IR-4:

Reference: "Subsequent to the approval of the original filing, NS Power was required to obtain a Fisheries Act Authorization (FAA) for the work from DFO, which was not required at the time of original filing. This FAA contained new conditions around fish passage requirements as well as requirements for NS Power to implement an Environmental Offsetting Program. The costs associated with the required studies, design, and construction of fish passage per the FAA were approximately $3 million and the project costs associated with the Environmental Offsetting Program were approximately $1.3 million." (ATO, p. 4)

(a) When were the new FAA conditions implemented?

(b) When did NS Power became aware that these FAA conditions would be implemented?

(c) Please provide specific detail on the legislation or policy changes that resulted in the new requirements for a Fisheries Act Authorization and the fish passage and environmental offsetting programs.

Response IR-4:

(a) On June 21, 2019, the modernized Fisheries Act received royal ascent and became law. Between 2020 and 2023, through the regulatory review process for the Ruth Project, DFO provided direction on how the modernized Act would be applied to the Project through each review and incomplete letter issued. Please refer to NSUARB IR-12(a) Attachments 1-14 for a summary of additional information requests on NS Power's FAA application for the Ruth Project.

(b) NS Power became aware a DFO Fisheries Act Authorization (FAA) was required for the Project in March 2020 and submitted an FAA application in June 2020. Please refer to

NSUARB IR-12(a) for a complete timeline of communication with DFO. DFO's review of NS Power's FAA application remains ongoing.

(c) Please refer to part (a). The modernization of the Fisheries Act in 2019 included the addition of previously removed provisions on "death of fish" and the "Harmful Alteration, Disruption or Destruction (HADD) of fish habitat", and considerations for impacts to Indigenous Peoples of Canada. These provisions directly relate to the interpretation of impacts to fish and fish habitat as a result of the temporary drawdown and overall regulatory review process for the Ruth Project. Policy developed to support the modernized Act which apply to the Ruth Project includes "Applying Measures to Offset Adverse Effects on Fish and Fish Habitat under the *Fisheries Act* (2019), "The Management of Existing Facilities and Structures under the *Fisheries Act* and the *Species at Risk Act"* (2023) and "The Management of Death of Fish (other than fishing), under the *Fisheries Act* and the *Species at Risk Act*" (2023).

Request IR-5:

Reference: "NS Power applied for the Watercourse Alternation Permit on December 17, 2019 and received the Permit Approval on June 30, 2024. The Company applied for an authorization in accordance with Transport Canada's Navigation Protection Program on April 30, 2021. The Watercourse Alteration Permit was received on July 30, 2024." (ATO, p. 4)

(a) Please provide a detailed timeline of NS Power's application for the Watercourse Alteration Permit, including any follow-up discussions or correspondence with the relevant agencies concerning the application once filed. Please include supporting documentation with the response.

(b) Please provide a detailed timeline of NS Power's application for the Navigation Protection Program, including any follow-up discussions or correspondence with the relevant agencies concerning the application once filed. Please include supporting documentation with the response.

Response IR-5:

(a) The timeline is shown below in Table 1:

NSECC Communication	Date Received	NS Power Response	NS Power Response Date	Attachment Reference
		Watercourse Alteration Approval Application submitted to NSECC	December 16, 2019	1
Additional Information Requested	January 7, 2020	NS Power provided a letter response to NSECC	February 27, 2020	2 & 3
Additional Information Requested	March 25, 2020	NS Power provided a letter response to NSECC	June 22, 2020	4 & 5

Additional Information Requested	March 31, 2021	NS Power provided an updated project and environmental description and associated appendices to NSECC	April 9, 2021	6 & 7
Additional Information Requested	June 18, 2021	NS Power provided an updated project and environmental description and associated appendices to NSECC	February 14, 2022	8, 11 & 12
		NS Power submits standalone Watercourse Alteration Approval Application for the sluice gate and control building scope of work	July 17, 2021	9
Approval issued for sluice gate and control building scope of work	October 22, 2021			10
Additional Information Requested	April 1, 2022	NS Power provided and updated project and environmental description and associated appendices to NSECC	May 6, 2022	13 & 14
		NS Power applied for an amendment to extend the expiry date of the Watercourse Alteration Approval for the sluice gate and control building scope	July 8, 2022	15
Amended Approval issued for sluice gate and control building scope	September 7, 2022	NS Power submitted a completion of work form to NSECC indicating the control building scope had been completed. The Sluice gate scope was not completed	September 22, 2022	16 & 17
Additional Information Requested	December 9, 2022	NS Power submitted an updated project and environmental description and associated appendices	March 20, 2023	18 & 19

Additional Information Requested	May 25, 2023	NS Power submitted an updated project and environmental description and associated appendices	August 21, 2023	20 & 21
Watercourse Alteration Approval Received	July 31, 2024			22

(b) NS Power applied for a Navigable Waters Authorization on April 30, 2021. This application is submitted through TC's online Navigation Protection portal. A copy of the email confirming submission of the application is provided in Attachment 23. Authorization has not yet been received and is expected to be issued at the same time as DFO authorization.

Nova Scotia POWER
An Emera Company

PO Box 910 ● Halifax, Nova Scotia ● Canada ● B3J 2W5

December 20, 2019

Kelly Henderson
Nova Scotia Environment
30 Damascus Road, Suite 115
Bedford, NS
B4A 0C1

Re: Sheet Harbour Hydro System – Ruth Falls Dam Refurbishment

Dear Ms. Henderson,

NSPI is planning refurbishment activities at the Ruth Falls Headpond located on the Sheet Harbour Hydro System. Work involves refurbishment of the main dam in order to meet the Canadian Dam Association (CDA) Dam Safety Guidelines.

Please find enclosed a completed Application for Approval for the planned work and NSPI's project description for the proposed construction activities. The latter outlines a general description of the project, the scope of work and various environmental protective measures that will be implemented in compliance with the *Environment Act*.

The project is scheduled to take approximately 6 months to complete beginning in May/June 2020. NSPI will forward a copy of this package to the Department of Fisheries and Oceans (DFO) for their review and input in the evaluation of our application. NSPI will notify NSE of any changes to the work plan or schedule. If you have any questions or require clarification or additional information, please do not hesitate to contact the undersigned at (902) 719-5990.

Best regards,

Nadine Thomas | Environmental Scientist | Nova Scotia Power
T: 902-428-7559 | F: 902-428-7564
E: nadine.thomas@nspower.ca

APPLICATION FOR APPROVAL

OFFICE USE ONLY	
Date Received: (yyyy/mm/dd)	Application #

PLEASE PRINT OR TYPE. Complete Sections 1, 2, 3, 4 and 7 for ALL Applications. Complete areas of Sections 5 and 6 that are applicable to the specific activities of this application only.

Type of Application:

(●) New Application ( ) Renewal ( ) Amendment ( ) Transfer

If applicable, provide the previous Approval #

SECTION 1 – APPLICANT

If there is more than one applicant, click Add Applicant or attach a complete list of applicants with the information below. The first applicant listed will be considered the primary applicant for this project.

Nova Scotia Power Inc.
Company/Organization/Municipality

Business Number (BN) if applicable

Nadine	A	Thomas
First Name	Middle Initial	Last Name

902-719-5990				
Primary Phone Number	Ext.	Secondary Phone Number	Ext.	Fax

nadine.thomas@nspower.ca
E-mail

25 Lakeside Park Drive
Civic/Street Address

PO Box 910
Mailing Address (if different than Civic)

Halifax	Halifax	
County	Community	
Nova Scotia	B3J 2W5	Canada
Province	Postal Code	Country

Return Correspondence? (●) Yes ( ) No
Preferred Method of Contact? (●) Email ( ) Letter

Note: Following application decision, all correspondence will go to the applicant

Certification Number

Applicant Type (if applicable)

( ) Installer ( ) Sizer ( ) Hydrogeologist ( ) Professional Engineer

Applicant 1 of 1

SECTION 2 - APPLICATION CONTACT

Is the Application Contact the same as Section 1 – Applicant? ◉ **Yes** ○ **No** **If yes, please skip to Section 3.**

If there is more than one contact, click Add Contact or attach a complete list of contacts with the information below.

Company/Organization/Municipality

Business Number (BN) if applicable

First Name | Middle Initial | Last Name

Primary Phone Number | Ext. | Secondary Phone Number | Ext. | Fax

E-mail

Civic/Street Address

Mailing Address (if different than Civic)

County | Community

Province | Postal Code | Country

Return Correspondence? ○ Yes ○ No

Preferred Method of Contact? ○ Email ○ Letter

Note: Following application decision, all correspondence will go to the applicant

Certification Number

Contact Type

○ Installer ○ Sizer ○ Professional Engineer ○ Hydrogeologist

Contact 1 of 1

SECTION 3 - SITE/LOCATION OF PROPOSED ACTIVITIES

Property Identification numbers (PID) are available at the Nova Scotia Land Registry.
1:50,000 Topo Maps (identifying Easting and Northing) are available at Nova Scotia Environment offices.

If more than one Site, click Add Site or Copy this section and attach for each Site.

Ruth Falls Headpond
Watercourse Name

East River
Tributary To

East River
Watershed Name (if applicable)

If Applying for a Wetland Alteration, please specify the Site Type ◯ Alteration ◯ Compensation

Site Name

Is Watercourse a Fish Habitat? ◉ Yes ◯ No

Is this location within a municipal drinking water watershed? ◯ Yes ◉ No

If there is more than one activity per property, click Add Property or Copy this section and attach for each activity.

Property 1 of 1

935 Highway 374
Civic/Street Address

Halifax | Sheet Harbour
County | Community

40221673 | 11D16
Property Identification # (PID) | Topographical Map Number

If there is more than one location per activity, click Add Activity Location or Copy this section and attach for each Easting/Northing coordinates.

Coordinates 1 of 1

539486 E	4978146	20T
Easting (6)	Northing (7)	Zone

Please use NAD83 or WGS84

Access via NSPI gated road off Highway 374. Coming from Sheet Harbour, NSPI road is approximately 2 km beyond East River Road on right side. Gate is closed.
Additional Directions to Site (if applicable)

Site 1 of 1

SECTION 4 - ACTIVITY

Proposed Activity - Please check (✓) all that apply.

Activity	Complete Sections	Activity	Complete Sections
Boat Launch	◯ 4, 5A, 6A ,7	Bridge/Open Bottom Structure	◯ 4, 5A, 5C, 6A, 7
Culvert/Closed Bottom Structure	◯ 4, 5A, 5B, 6A, 7	Dam	◉ 4, 5A, 6A, 6B, 7
Dredging	◯ 4, 5A, 6A, 7	Erosion Protection	◯ 4, 5A, 6A ,7
Instream Structure	◯ 4, 5A, 6A, 7	Pipeline or Other Utility	◯ 4, 5A, 6A, 7
Removal of Beaverdam	◯ 4, 5A, 6A, 7	Removal of Material	◯ 4, 5A, 6A, 7
Storage of Water	◯ 4, 5D, 6A, 6B, 7	Water Intake/Dry Hydrant	◯ 4, 5A, 6A, 7
Water Withdrawal	◯ 4, 5E, 6A, 6B, 7	Watercourse Diversion	◯ 4, 5A, 5E, 6A, 6B, 7
Wetland Alteration	◯ 4, 5G, 6A, 6C, 7	Wharf	◯ 4, 5A, 6A, 7
Work to Improve Fish Habitat	◯ 4, 5A, 5F, 6A, 7	Other Alteration	◯ 4, 5A, 5F, 6A, 7

Is this a Pilot Activity? ◯ Yes ◉ No

Variance Requested? ◯ Yes* ◉ No

*If yes, please fill out a request for variance form

Proposed Project Dates, if applicable (yyyy/mm/dd)

Start Date of Construction	Start Date of Operations	End Date of Activities
2020/06/01		2020/11/30

SECTION 5 - ACTIVITY DETAILS

Complete Section 5 to the best of your knowledge. Please provide measurements in the metric units indicated.
5A – Complete for all applicable Watercourse Alteration Applications.

Type of Alteration

◯ New Construction ◯ Removal ◉ Replacement ◯ Expansion

rock, silt

Description of Channel Bottom

Refurbishing dam by replacing stop log bays with rubber dams, installing an uncontrolled overflow spillway, installing sluice gates.

Description of Alteration

approximately 150 m

Length of Alteration (m)

5B - Complete only for Culvert or Closed Bottom Structure
Information about the Watercourse

Upstream watershed area (km²) | Watercourse Slope (%) | Watercourse Velocity (m/s)

Watercourse Channel Width (m) | Watercourse Channel Depth (m)

Crossing Type ◯ Culvert with fish passage ◯ Culvert without fish passage

If Culvert without fish passage, was a fish passage assessment completed? ◯ Yes ◯ No

Length of culvert (m) | Diameter of culvert (mm) | Length of dissipation pool (m)

Width of dissipation pool (m) | Date of installation (yyyy/mm/dd)

5C - Complete only for Bridge or other open bottomed structure
Information about the Watercourse

Up-stream Drainage Area (km2) | Watercourse Slope (%) | Watercourse Velocity (m/s)

Watercourse Channel Width (m) | Watercourse Channel Depth (m)

Crossing Type ◯ Bridge/concrete span ◯ Pipe arch/open bottom structure

Width of Span/Bridge (m) | Width of Structure/Arch (mm) | Length of Structure (m)

Bridge Piles? ◯ Yes ◯ No

5D - Complete only for Storage of Water

Total Volume (m^3)

Method of Storage ◯ Dam ◯ Reservoir ◯ Offline Pond ◯ Tank ◯ Other If Other, please specify

Source of Withdraw ◯ Groundwater ◯ Surface Water

5E - Complete only for Water Withdrawal/Diversion

Source of Withdraw ◯ groundwater ◯ surface water

Well Log #

Average Withdrawal Rate (litres/day) Maximum Withdraw Rate (litres/day)

Usage ◯ Agriculture ◯ Industry ◯ Aquaculture ◯ Municipal Domestic ◯ Bottled Water ◯ Hydroelectric

◯ Public Drinking Water Supply(excluding municipal) ◯ Recreational ◯ Other If Other, please specify

Description of Channel Bottom (Only Applicable for Water Diversion)

5F - Complete for Other Alteration and Work to Improve Fish Habitat

Description of Alteration

Length of Alteration (m)

5G - Wetland

Wetland Type - Alteration

Salt Marsh ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Freshwater Marsh – Shallow ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Freshwater Marsh - Deep ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Freshwater Marsh – Shoreline ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Fen - Open ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Fen - Shrub ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Fen – Treed ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Bog – Open ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Bog – Shrub ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Bog – Treed ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Swamp – Shrub ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Swamp - Treed ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Vernal Pool ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Unknown ◯	Size of Wetland (ha)	Size of Alteration(ha)	

Wetland Type - Compensation (check all that apply)

Type	Compensation Area (ha)	Type	Compensation Area (ha)
◯ Salt Marsh		◯ Freshwater Marsh - Shallow	
◯ Freshwater Marsh - Deep		◯ Freshwater Marsh – Shoreline	
◯ Fen – Open		◯ Fen – Shrub	
◯ Fen – Treed		◯ Bog – Open	
◯ Bog - Shrub		◯ Bog – Treed	
◯ Swamp – Shrub		◯ Swamp – Treed	
◯ Vernal Pool		◯ Unknown	

Compensation Type

◯ Restoration	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Enhancement	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Creation	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Expansion	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Research	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started

Compensation Value($)

◯ Study Area (ha) _____ Compensation Status ◯ Approved ◯ In Progress ◯ Not Started

Compensation Value($)

◯ Education Area (ha) _____ Compensation Status ◯ Approved ◯ In Progress ◯ Not Started

Compensation Value($)

◯ Other Area (ha) _____ Compensation Status ◯ Approved ◯ In Progress ◯ Not Started

If Other, please specify _____

SECTION 6 - SUPPORTING DOCUMENTATION

All supporting documentation is to be submitted in accordance with the "Approvals Procedures Regulations." If applicable, the following documents must be submitted with this Application. However, additional information may be requested.

Note: A legend must be supplied for all mapping describing symbols used, scale and north orientation.

Description	Submitted	Waiver requested	Reason for Waiver
6A - Attach for all applicable Water Applications			
Proof of Ownership/Agreement/Legal right to conduct Activity	◉	○	
Site Plan or Survey	◉	○	
Detailed Plans/Specifications	◉	○	
Substance Descriptions and Controls	◉	○	
Description of Adverse Effect	◉	○	
Info Required under Checklists/Guidelines/Standards/Policies	◉	○	
6B - Attach only for Storage of Water/Dam, and Water Withdrawal/Diversion			
Environmental Assessment Study	○	○	
Rehabilitation Plan	○	○	
Description Contingency Plan	○	○	
Explanation of Substances Released	○	○	
Details of Site Suitability and Sensitivity	○	○	
Detailed Description of Activity	○	○	
Public Consultation Description	○	○	
6C – Attach only for Wetland			
Details of Site Suitability and Sensitivity	○	○	
Detailed Description of Activity	○	○	
Public Consultation Description	○	○	

If information submitted is incomplete, or if supporting documentation is of poor quality (plans, maps, etc.), the application may be delayed, returned or rejected.

SECTION 7 – DECLARATION

Information in this application package which the applicant considers to be confidential business information should be clearly identified.

Are you making this request? ○ Yes ◉ No

If yes, please indicate which information in the Supporting Documentation is considered confidential.

◉ I acknowledge it is an offense under Section 158 of the *Environment Act* to provide false or misleading information, and confirm to the best of my knowledge and belief the information provided in this form and supporting documentation is true and accurate and complies with the relevant provisions of the *Environment Act* and Regulations.

Applicant's Signature: _____ Date: (yyyy/mm/dd) 2019/12/17

Name (Please print or type): Nadine Thomas

OR

I certify that I am acting with the applicant's full consent.

Signature: _____ Date: (yyyy/mm/dd) _____

Name (Please print or type): _____

NOVA SCOTIA
Environment

Submission Checklist for Watercourse Alteration

This checklist must accompany every application for a watercourse alteration approval. Complete Section A for all applications, Section B must be completed for flowing watercourses (such as rivers, streams, etc). Section C is specific to erosion protection. If you require assistance with completing this form or preparing the information required in support of the application, please contact your local NSE office to obtain a list of Watercourse Alteration Certified Individuals. If an item is not provided, the submission will be considered incomplete.

SECTION A (FOR ALL APPLICATIONS) ALL INFORMATION MUST BE PROVIDED:

- ☑ Name of watercourse and watercourse it is a tributary to
- ☑ Community and County name
- ☑ 1:50,000 Topographic map with alteration location marked
- ☑ 1:50,000 Topographic map number with grid reference (easting and northing)
- ☑ Preconstruction site photos (colour or electronically)
- ☑ Work plan for in-the-dry installation (water control)
- ☑ Erosion and sedimentation control plan
- ☑ Plan and profile drawing of proposed alteration (including dimensions)
- ☑ Description of channel bottom (ie. rock (size, quantity), muck, etc.)
- ☑ Plans, drawing and specifications (including whether the alteration will be in accordance with the NS Watercourse Alterations Standard, latest edition, or a description of an alterative plan)

SECTION B (INCLUDE FOR FLOWING WATERCOURSES) :

- ☐ Watercourse velocity (metres/second)
- ☐ Watercourse channel width (top of bank to top of bank)
- ☐ Watercourse channel depth (from top of bank)
- ☐ Calculations for sizing of structure, including but not limited to watershed area (1:100 yr return event for permanent structures)

SECTION C (INCLUDE FOR EROSION PROTECTION):

- ☐ Calculations for erosion protection material sizing

It is an offense under Sections 158 (a) and 158 (b) of the Environment Act to provide false or misleading information. I certify all of the above required information has been submitted and complies with the requirements set out in the Environment Act and the Activities Designation Regulations, including design and construction requirements.

Applicant Section	Certified Installer Section (required as of Oct 1, 2016)
Applicant Name (please print) Nadine Thomas	Certified Watercourse Alteration Installer Name (please print)
Applicant Signature [redacted]	Certified Watercourse Alteration Installer Phone Number
Date Signed Dec. 17, 2019	Certification Number

Updated October, 2014

Nova Scotia POWER
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Environmental & Project Description for Construction Activities

Sheet Harbour Hydro System

Ruth Falls Dam Refurbishment

2020

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PROJECT OVERVIEW

NSPI is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2020. This work is necessary in order to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. The project involves refurbishing the main dam by replacing the existing stop log bays with rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section, and replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates.

Activities proposed for the Project include lowering the Ruth Falls Headpond and canal approximately 7-15 feet and dewatering the Ruth Falls fish ladder and downstream bypass during construction. A fish conveyance system will be put in place to ensure continued movement of fish upstream during the Project. Fish will be moved downstream via the sluiceway and/or spillway.

The Project is scheduled to take approximately six months to complete starting approximately May 1st, 2020.

1.0 INTRODUCTION

The Sheet Harbour Hydro system is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The system has a drainage area of 573.9 km^2. Presently there are 6 controlled reservoirs, including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond and Ruth Falls Headpond. Ten Mile Reservoir was previously controlled until the dam was removed in 2012.

Governor Reservoir is located at the head waters of Twelve Mile Stream, which flows through Union Flowage into Marshall Reservoir. Sloane Reservoir is located near the headwaters of Seventeen Mile Stream which passes through Anti Dam Reservoir and into Marshall. Marshall Reservoir comprises the principle reservoir for the Sheet Harbour System. Malay Falls Headpond is directly downstream from Marshall; the Malay Falls power canal conducts water from the Malay Falls Headpond to the generating station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel.

Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power. Mapping of the Sheet Harbour System can be found in Appendix A.

2.0 CONSTRUCTION

Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the embankment and spillway/sluiceway structures. The project involves refurbishing the main dam by replacing the existing 30 stop log bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section, and replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates.

NSPI is anticipating an additional permanent instream footprint of approximately 60 m^2 on the downstream side of the dam to accommodate additional concrete requirements for certain ogee sections. The reservoir will be temporarily drawn down approximately 7-15 feet and a temporary cofferdam or bulkhead installed to isolate the existing sluiceway. The fish ladder and fish bypass will be dewatered, however, a fish conveyance system will be put in place to ensure continued movement of fish upstream during the Project. Fish will be moved downstream via the sluiceway or spillway sections as required.

2.1 Existing Project Area

Ruth Falls Headpond is located immediately downstream of the Malay Falls Headpond. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, a 15.2 m long three-bay stoplog-controlled sluiceway section in the centre, and two short concrete gravity bulkhead sections that abut either side of the spillway. The crest elevation of the spillway is 31.7 m and stoplogs can be installed to an elevation of 33.3 m. The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix B for pre-construction site photos.

Flow in the area is controlled by NSPI Hydro Operations. Water levels can fluctuate between the full supply level of 33.6 m (110.4') and the low supply level of 27.5 m (90.1'). A minimum operating level of 33.3 m (109.4') is observed from April 1 - Nov. 30 each year. As per NSE Approval, a 35 cfs maintenance flow is provided downstream year round in order to operate the Ruth Falls louvers. This flow is targeting downstream migration of Atlantic salmon smolts and kelts. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers. This flow is targeting downstream migration of American eel. The fish ladder at Ruth Falls operates from May 15-November 1st annually with a flow of 6 cfs. During this time frame a fish trap is operated in the ladder. DFO is contacted if the trap exceeds 50 salmon in order to determine the target release locations. Of note, only 9 salmon have been captured since 2007 and none since 2017.

2.2 Proposed Refurbishment Activities

The proposed maintenance activities are as follows:

- installation of fish conveyance system near the entrance of the fish ladder;
- lowering of Ruth Falls reservoir approximately 7-15 feet; the actual elevation will be the lowest elevation possible while ensuring proper functioning of the fish conveyance system, passage of fish migrating downstream from Malay Falls, and provision of a 35 cfs maintenance flow below Ruth Falls;
- dewatering of the Ruth Falls fishladder during the construction activities;
- provision of temporary access for machinery on both the upstream and downstream sides of the dam consisting of rock, swamp mats, or other material. This will be evaluated once the area is dry and the bottom conditions assessed;
- removal of the existing stoplog bays, piers, and walkway;
- reface the concrete on the crest and downstream slope of the main dam ogee sections;
- installation of new rubber dam bladders on the crest of the existing ogee spillway sections;
- construction of a free overflow spillway section at the right end of the main dam;
- installation of cofferdam or bulkhead to isolate the existing sluiceway section;
- refurbishment of the existing low level sluiceway section of the dam and the installation of three new low level sluice gates, which will replace the existing low level stoplogs. The existing piers will remain in-place;
- install a new steel walkway for access across the main dam;
- removal of bulkhead/cofferdam and temporary access material;
- watering Ruth Falls Headpond to within normal operating levels.

2.3 Construction Schedule

The Project is expected to take six months starting in May/June and finishing in late November 2020. This includes both the lowering and subsequent recharging of water in the headpond.

3.0 REGULATORY PERMITS/APPROVALS

A Watercourse Alteration Approval is required in accordance with Section 5(A)(1)(c) of the Activities Designation Regulations of the *Environment Act*. A separate request for review has been submitted to DFO to determine if a Fisheries Act Authorization is required.

4.0 ENVIRONMENTAL PROTECTION

4.1 Water Management

In order to expose the portions of the concrete dam to be refurbished, the Ruth Falls Headpond will be lowered between 2-4.5 m (7-15 feet) from the 33.3 m (109.4') minimum operating level maintained April 1st to November 30th each year. The amount will be determined once the fish conveyance system is installed and lowering of the reservoir begins in May/June. The canal, fishladder, and fish bypass will also be dewatered. The amount will depend on how low the water level can go while operating the fish conveyance system properly and ensuring fish can migrate downstream from Malay Falls. A 35 cfs flow will also be maintained downstream of the dam. Supplemental flow required as part of the operating approval will not be provided during construction and the fish trap will not be operated.

Dewatering activities will begin between early May and early June by closing the gates at Malay Falls and lowering primarily through generation at Ruth Falls until water levels have dropped below generation level. At this point, a staged approach will be used to remove remaining stop logs until the desired headpond elevation is reached. The fish conveyance system will be put in place prior to dewatering and will remain in place for the duration of construction. The 35 cfs maintenance flow and downstream fish passage will be provided through the sluiceway or via the concrete ogee sections as required. Once the headpond is lowered to the desired elevation, temporary access upstream and downstream of the dam will be installed in the dry, if practical, based on the ground conditions.

Qualified NSPI personnel will be on site during the drawdown to monitor water quality (visual silt) and conduct a fish rescue for any isolated fish in the headpond and canal. The headpond will be subsequently recharged at a controlled rate and monitored for silt and fish issues.

4.2 Erosion and Sedimentation Control

Erosion and sedimentation control materials such as hay, silt fencing, etc., will be used to control sediment laden water from entering the headpond while it is dewatered. Any silt-laden water in the work area will be recovered and pumped away from the headpond to areas with sufficient vegetation to facilitate filtration. The headpond will be recharged at a controlled rate with NSPI personnel monitoring for any visible water quality issues.

4.3 Construction Material and Debris

Measures will be taken to prevent any materials used in the various work activities from entering the watercourse. All such materials will be applied in a controlled manner and any excess material will be contained during application. All construction debris will be stored on NSPI property or disposed to an approved landfill. Any debris that requires disposal will be done so in accordance with **NSE Construction and Demolition Debris Disposal Site Guidelines**.

4.4 Equipment and Machinery

All equipment and machinery required to be operated on or near a body of water will be mechanically sound with no leaking fuel tanks or hydraulic connections. Refuelling and lubrication shall be in designated areas not within 30 m of any wetland or water body. Storage of petroleum products will be at least 100 m from a water body. Machinery and equipment will be stored above flood water levels. Oil spill contingency plans will be followed and spill kits maintained on-site, in the event a petroleum product spill occurs.

4.5 Rehabilitation

Following any excavation and placement activities, areas disturbed by machinery or equipment will be returned to pre-construction condition. Any exposed soil areas will be stabilized to prevent erosion. In the event that long-term erosion problems, resulting from the clearing of the area, cannot be dealt with at the time construction is complete, temporary measures shall be taken.

5.0 ARCHAEOLOGICAL CONSIDERATIONS

An Archaeological Screening and Reconnaissance (ARIA) for the Ruth Falls Headpond was completed in 2017. The purpose of the ARIA was to assess the potential for archaeological resources in the project area, which included approximately 5 hectares surrounding the dam and earthen embankment primarily on the downstream side. The ARIA included a background study and visual assessment of the study area. The assessment identified three areas considered to exhibit high potential for encountering Precontact and/or early historic Native archaeological resources and/or historic Euro-Canadian archaeological resources. It was recommended that if these areas could not be avoided, shovel testing be conducted.

Shovel testing in 2 of the identified areas was conducted in 2018 and included 64 shovel tests. No archaeological resources were encountered and no evidence of historically significant cultural modification was identified during the course of the shovel testing. Based on the results of the 2018 shovel testing, the potential for encountering significant, intact archaeological resources within the two areas is considered to be low. It was recommended that the two shovel tested areas be cleared of any requirement for further archaeological investigation and that development within these areas may proceed as planned.

6.0 ABORIGINAL ENGAGEMENT

NS Power initiated engagement regarding the Ruth Falls Main Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant project information with the KMKNO throughout 2018

providing six project updates, the project was deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window Meeting with KMKNO. NS Power continued to provide monthly Project updates and share relevant project information throughout 2019, working towards a preferred design option and planning for the Project to be completed in 2020. NS Power further presented the Project and design option with the KMKNO during the One Window meeting to discuss 2020 hydro capital projects. NS Power will continue engagement regarding the project with monthly project updates to the KMKNO and notifications regarding the permitting schedule for the submission of an NSE Watercourse Alteration application. Weekly project manager communications will be provided to the KMKNO, as construction begins, currently scheduled for May to November 2020.

APPENDIX A – HYDRO SYSTEM OVERVIEW

1. Sheet Harbour Hydro System Map
2. Ruth Falls Bathymetry
3. Ruth Falls Plan View

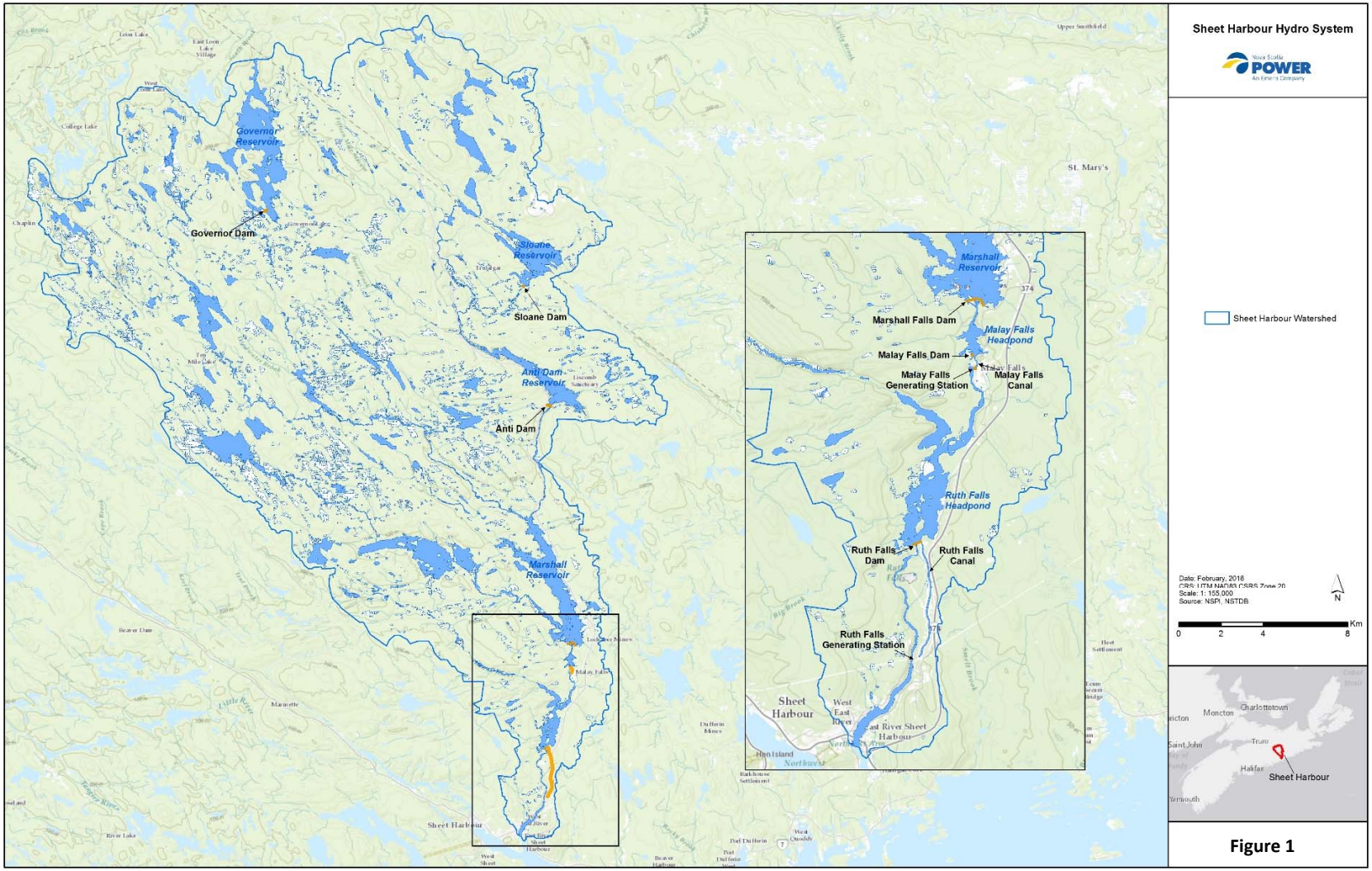

Governor Reservoir
Governor Dam
Sloane Reservoir
Sloane Dam
Anti Dam Reservoir
Anti Dam
Marshall Reservoir
Marshall Falls Dam
Malay Falls Headpond
Malay Falls Dam
Malay Falls Generating Station
Malay Falls Canal
Ruth Falls Headpond
Ruth Falls Dam
Ruth Falls Canal
Ruth Falls Generating Station
Sheet Harbour
Sheet Harbour Hydro System
Sheet Harbour Watershed
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Halifax
Sheet Harbour

Figure 1

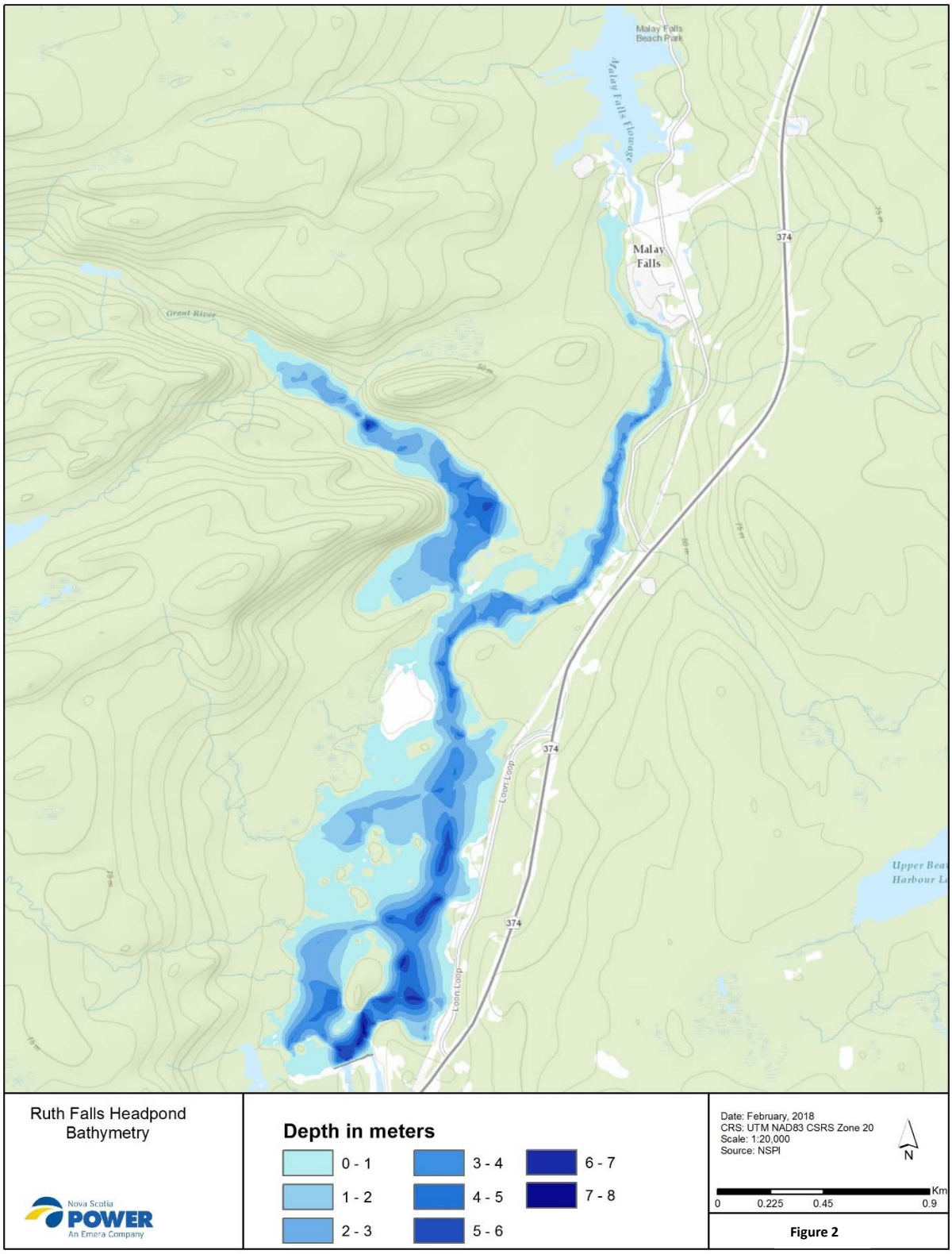

Malay Falls Beach Park
Malay Falls Flowage
Malay Falls
374
Grant River
Loon Loop
Upper Bea
Harbour L
Ruth Falls Headpond Bathymetry
Depth in meters
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
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0.9

Figure 2



Figure 3. Ruth Falls Plan View

APPENDIX B – SITE PHOTOS



Photo 1: View of Ruth Falls Dam, facing north



Photo 2: View of Ruth Falls Dam, facing west



Photo 3: Ruth Falls fishladder and bypass pipe



Photo 4: Downstream of Ruth Falls Dam



Photo 5. Upstream of Ruth Falls Dam

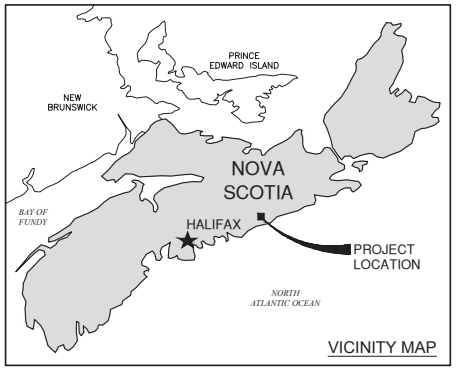
APPENDIX C – ENGINEERING DRAWINGS

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NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP

DRAWING LIST

SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS
100-01	COVER AND DRAWING LIST	2018-06-27	A	30% REVIEW
200-01	OVERALL SITE PLAN	2018-06-27	A	30% REVIEW
200-02	EXISTING CONDITIONS PLAN AND SECTIONS I	2018-06-27	A	30% REVIEW
200-03	EXISTING CONDITIONS PLAN AND SECTIONS II	2018-06-27	A	30% REVIEW
200-04	EXISTING CONDITIONS EMBANKMENT PLAN AND SECTIONS	2018-06-27	A	30% REVIEW
200-05	NEW CONDITIONS DAM PLAN AND ELEVATION	2018-06-27	A	30% REVIEW
200-06	NEW CONDITIONS RUBBER AND SLIDE GATES PLAN AND SECTIONS	2018-06-27	A	30% REVIEW
200-07	NEW CONDITIONS UNCONTROLLED SPILLWAY PLAN AND SECTIONS	2018-06-27	A	30% REVIEW





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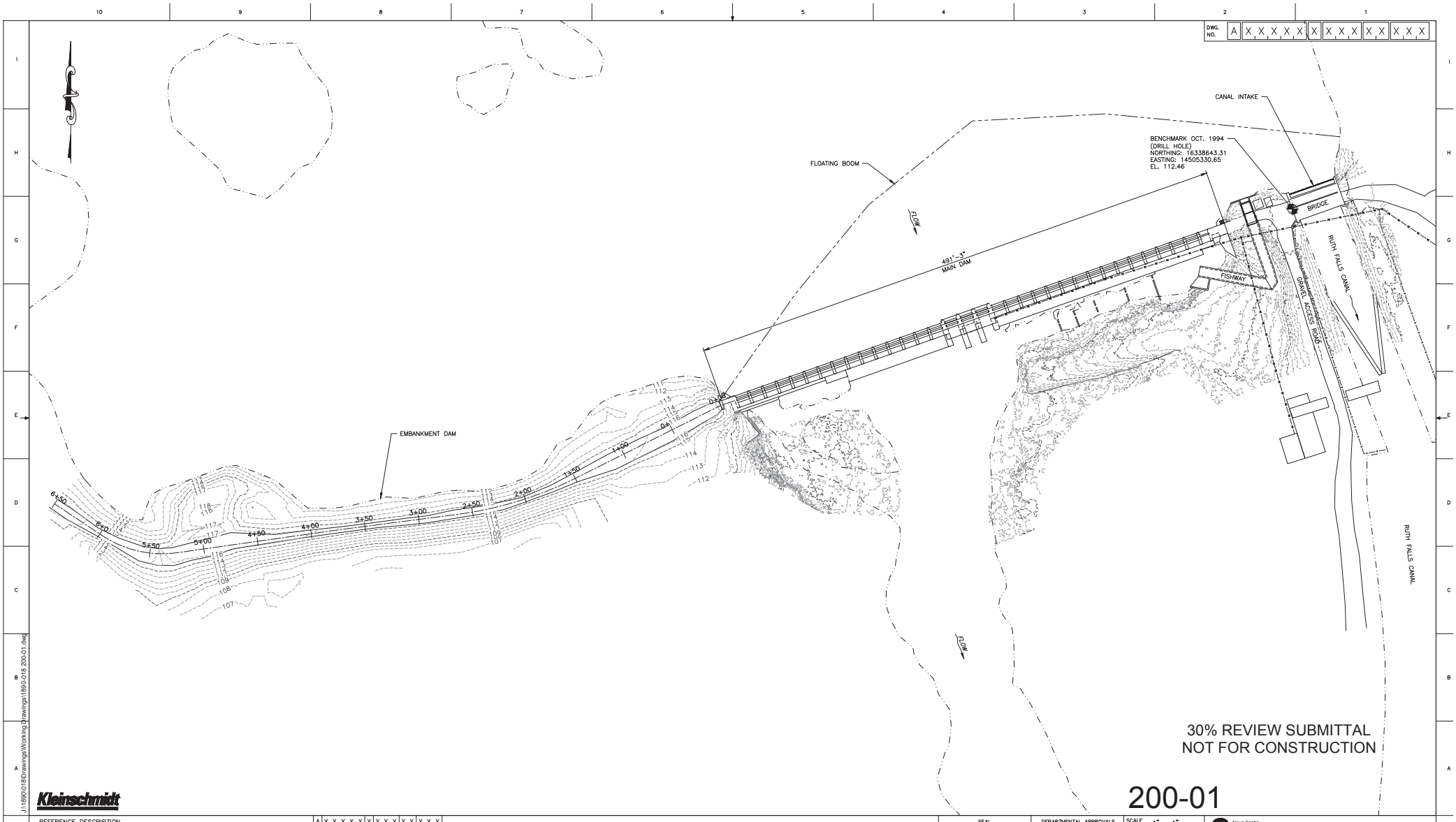
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

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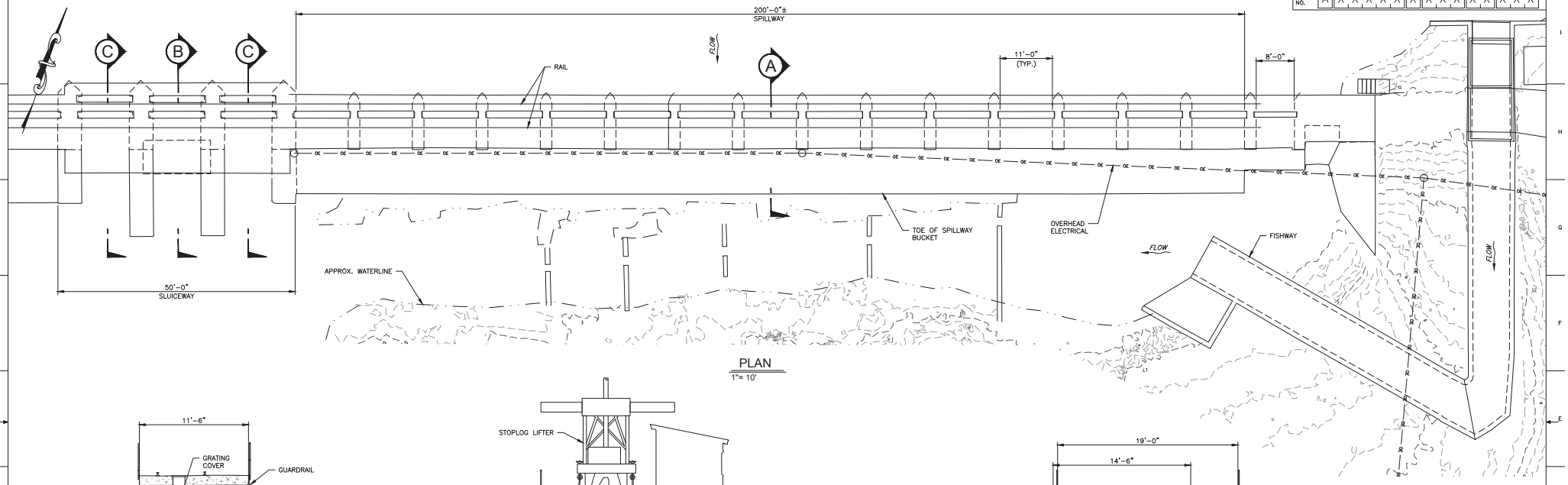
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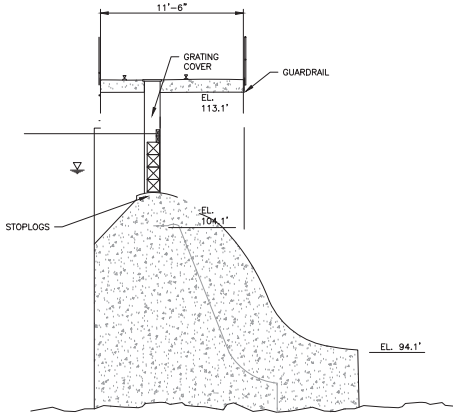
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OVERALL SITE PLAN

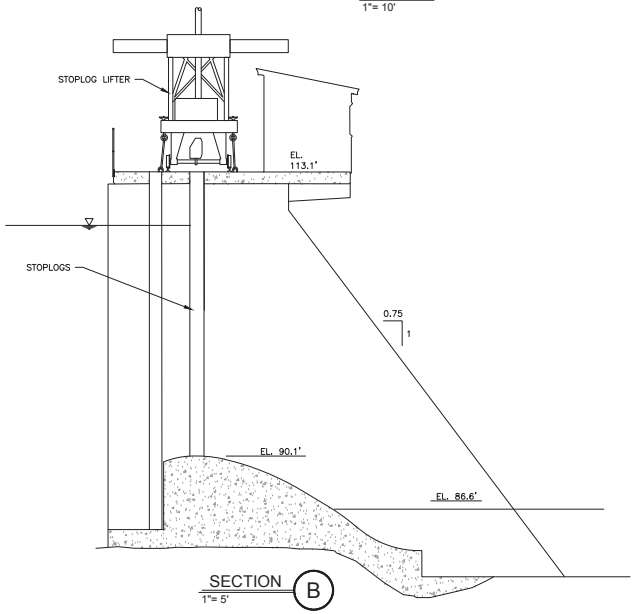
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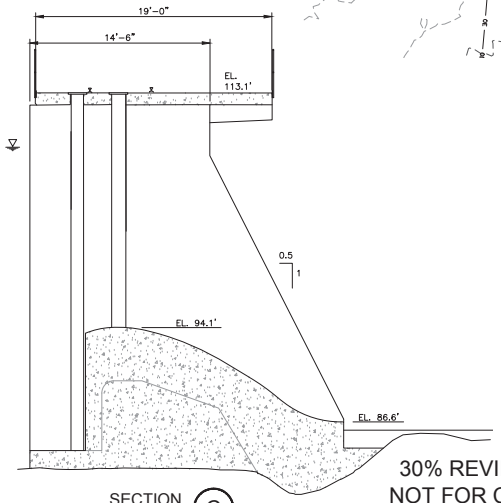
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SECTION B
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SECTION C
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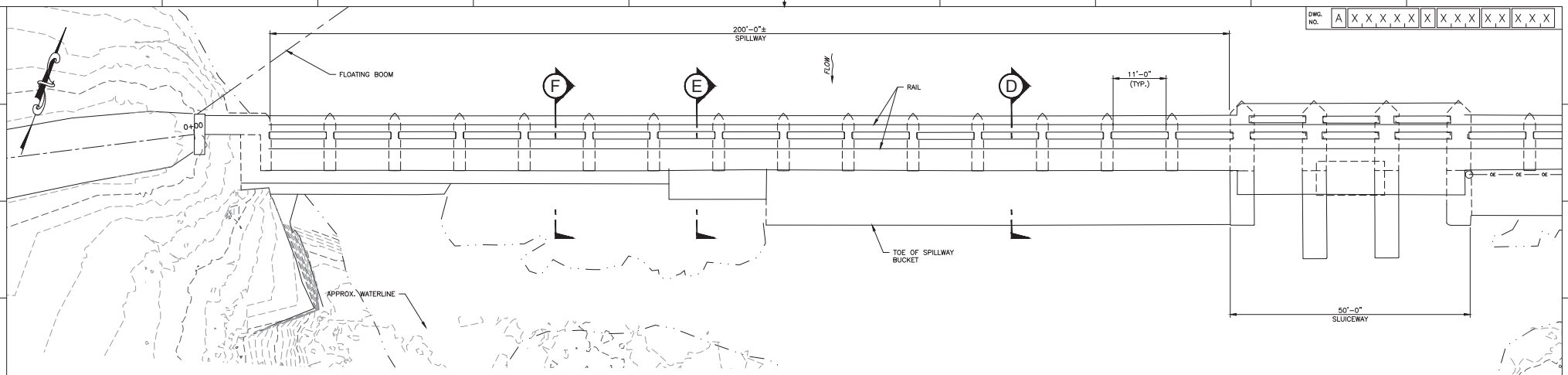
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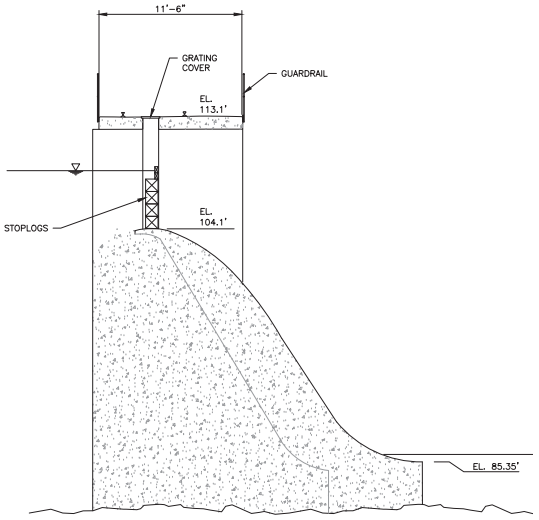
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

EXISTING CONDITIONS
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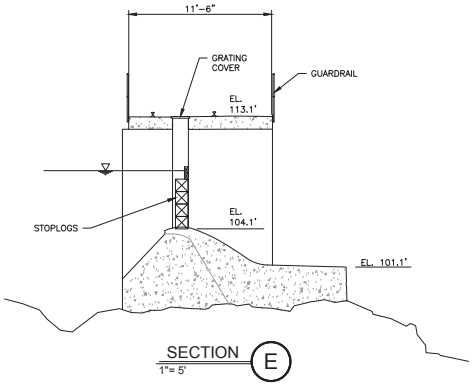
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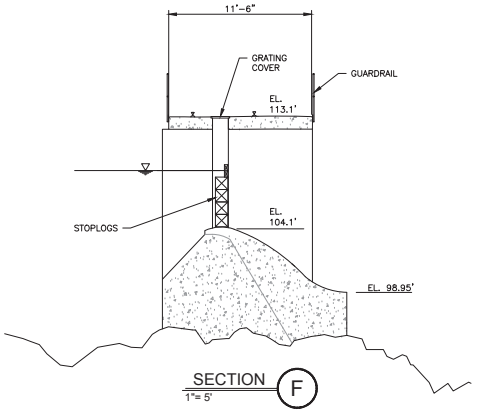
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SECTION E
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SECTION F
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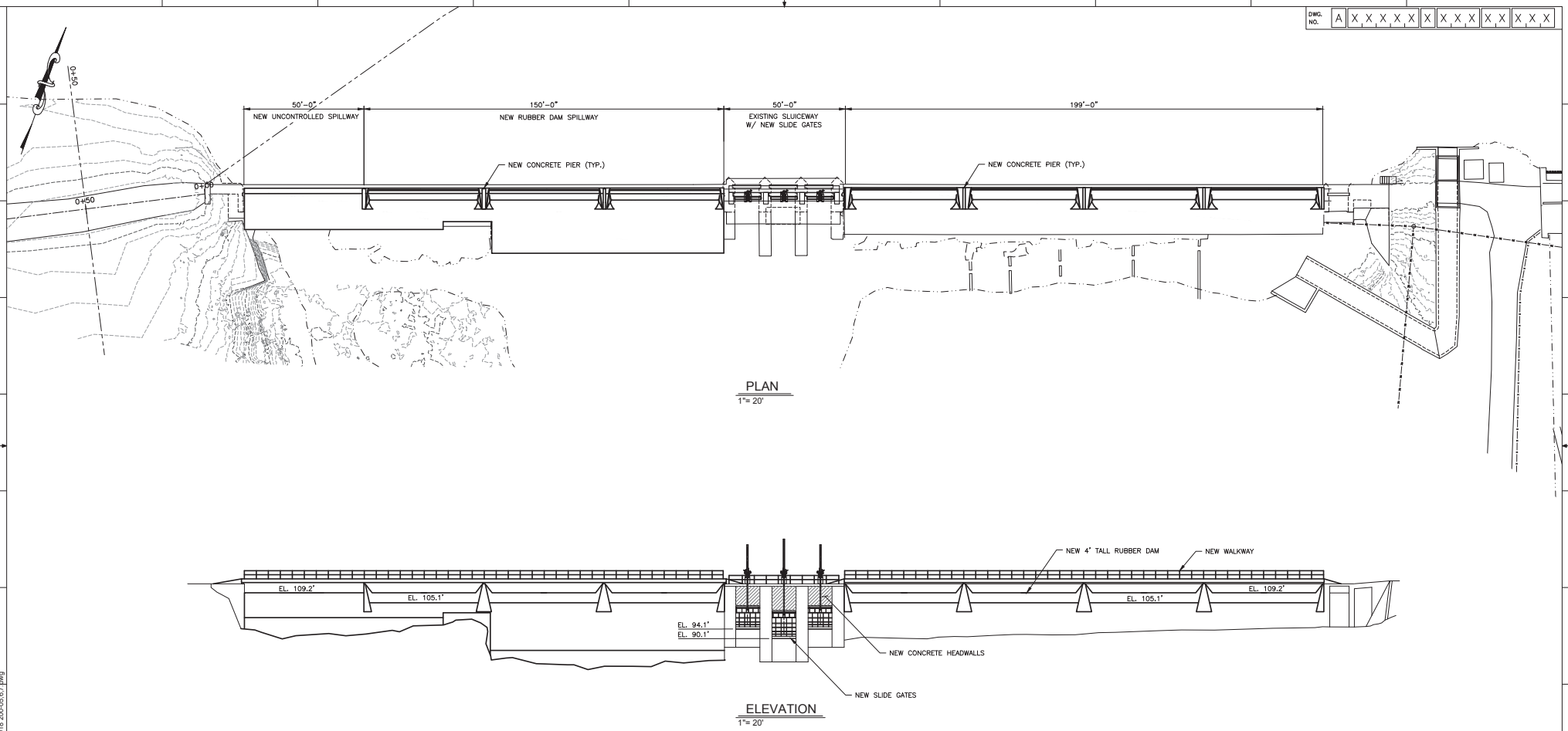
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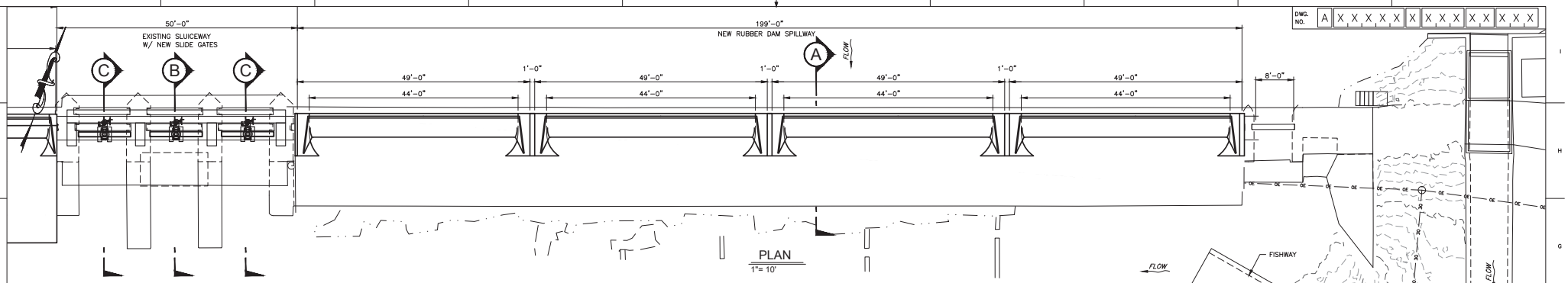
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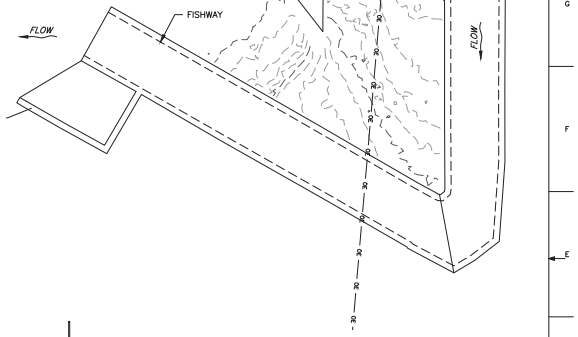
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RUTH FALLS REFURBISHMENT PRJECT

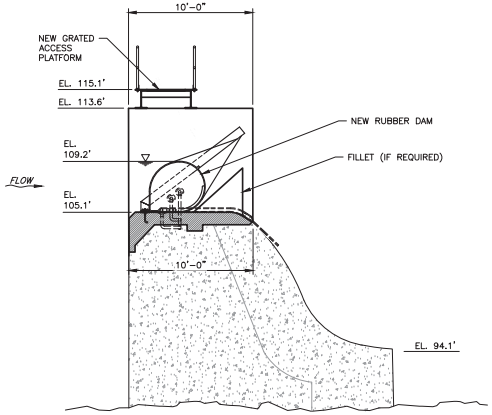
NEW CONDITIONS
DAM PLAN AND ELEVATION

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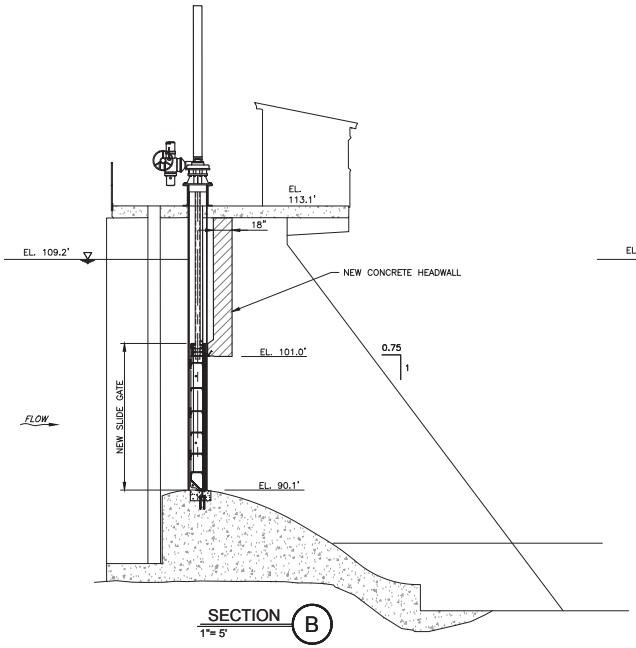


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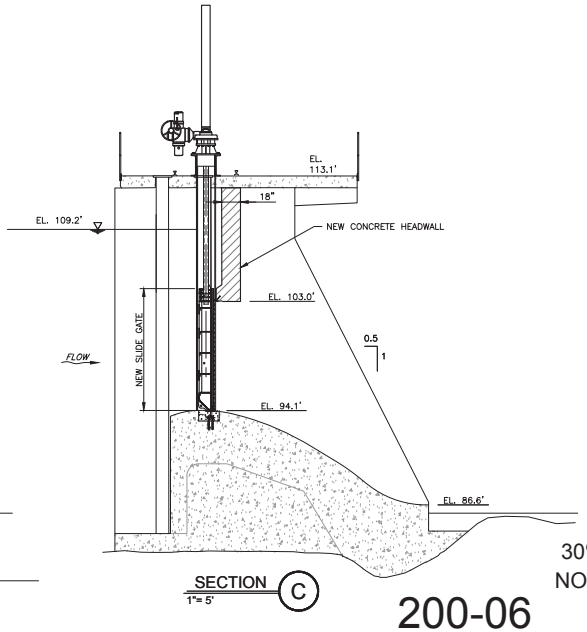




SECTION A
1"= 5'



SECTION B
1"= 5'



SECTION C
1"= 5'

30% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

200-06

Kleinschmidt

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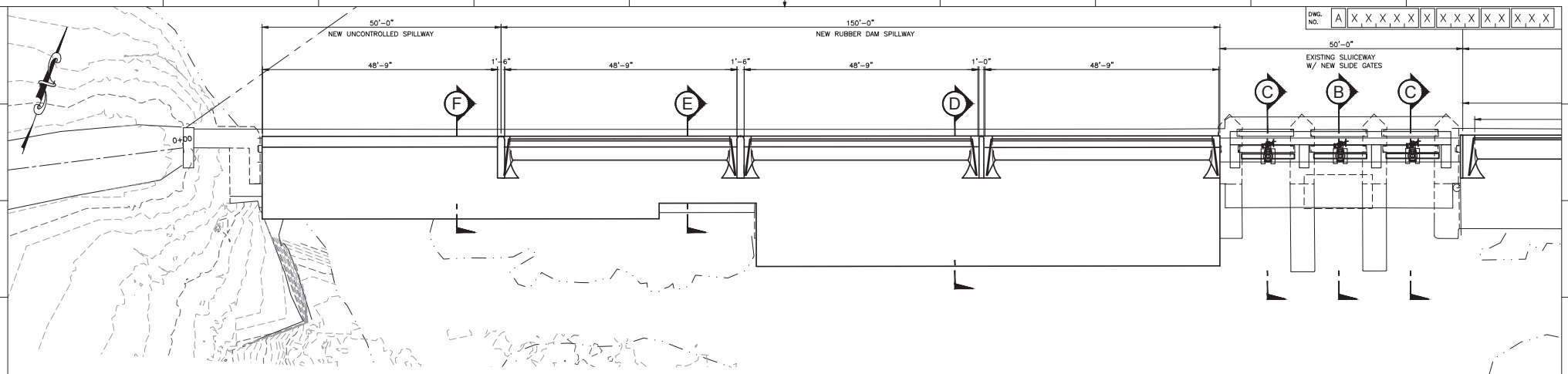
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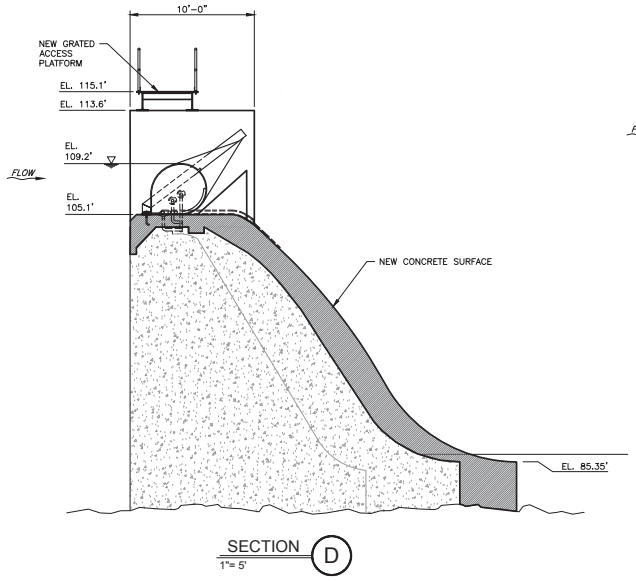
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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW CONDITIONS
RUBBER DAM AND SLIDE GATES
PLAN AND SECTIONS

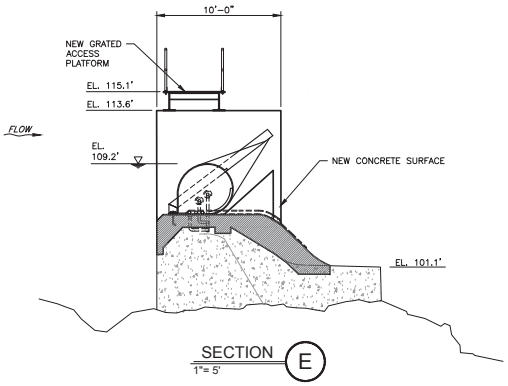
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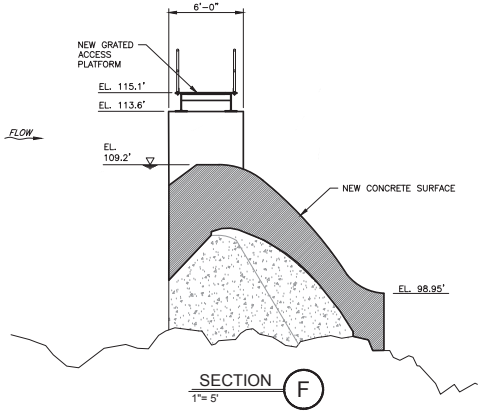
PLAN
1"= 10'



SECTION D
1"= 5'



SECTION E
1"= 5'



SECTION F
1"= 5'

30% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

200-07

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DEPARTMENTAL APPROVALS

CIVIL	E & I
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APPROVED

DATE

SCALE	1" = 1"
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DESIGNED	ENG
DRAWN	TECH
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DATE	2018-06-27
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT
NEW CONDITIONS
UNCONTROLLED SPILLWAY
PLAN AND SECTIONS

DWG.NO. A X X X X X X X X X X X X X X REV. A

NOVA SCOTIA

30 Damascus Road, Suite 115
Bedford, NS
Canada B4A 0C1

902-424-7773 T
902-424-0597 F
www.novascotia.ca

Our File Number: 95100-30-BED-2019-2638165

January 7, 2020

NOVA SCOTIA POWER INCORPORATED
PO BOX 910, 25 LAKESIDE PARK DR
HALIFAX, NS
B3J 2W5

Dear NOVA SCOTIA POWER INCORPORATED

RE: Application # 2019-2638165-00

With reference to your application please be advised that as a result of an initial review, your application has been deemed incomplete. As a result, Nova Scotia Environment (NSE) is requesting the following information to process your application.

- Provide the final, full size engineering drawing, which includes the actual scale and have been signed/stamped by an engineer recognised to operate in Nova Scotia.
- Provide a detailed construction schedule.
- Provide a detailed erosion and sedimentation control plan.
- Provide a detailed description of the potential adverse effects from all the proposed construction materials and the proposed mitigation measures.

NSE is requesting this information be submitted by April 7th, 2020. Please note that in accordance with *Section 7 of the Approval and Notification Procedure Regulations,* if information is not supplied by an applicant within 3 months of a request, the Minister may reject your application. Should your application be rejected, you will be informed of that decision in writing.

Yours truly,
Grant Brown



Nova Scotia POWER
An Emera Company

PO Box 910 ● Halifax, Nova Scotia ● Canada ● B3J 2W5

February 27, 2020

Grant Brown
Nova Scotia Environment
30 Damascus Road, Suite 115
Bedford, NS
B4A 0C1

Dear Mr. Brown:

As requested in your letter dated January 7, 2020, please find below the additional information requested as part of your review of application # 2019-2638165-00.

NSE Request:
Provide the final, full size engineering drawing, which includes the actual scale and have been signed/stamped by an engineer recognised to operate in Nova Scotia.

NSPI Response:
NSPI does not typically have signed/stamped drawings as part of the Request for Proposal stage of the project. The signed and stamped drawings are typically issued after the project has been awarded. Appendix A includes a letter from Kleinschmidt Associates Canada providing explanation regarding the 30% drawings. Appendix B includes revised 30% drawings with the scale in the footer removed. Printed full size engineering drawings will be delivered to your office this week. Please note the drawings submitted with the application had a Plan Scale on each page with the exception of the first page. The procurement phase for this project will commence in late February/early March with the intent to award the construction works by early April.

February 27, 2020
Grant Brown

NSE Request:
Provide a detailed construction schedule.

NSPI Response:
NPSI does not develop the detailed construction schedule as this is completed by the contractor after award of the contract. NSPI has provided a tentative high level schedule of the work as part of the application. Detailed construction schedules are provided by the contractors as they will be responsible for the work and will assume the liability based on the schedule and timelines. The project will begin in early May with dewatering starting in early to mid-May. Refilling will begin between late October and mid-November.

NSE Request:
Provide a detailed erosion and sedimentation control plan.

NSPI Response:
Detailed erosion and sedimentation control plans are completed by the contractor as they will assume the responsibility/liability of the plans throughout the length of the project. NSPI will develop a project Environmental Protection Plan once the Erosion and Sedimentation Control plan is received from the contractor.

In general, all work operations will be conducted with measures taken to cause a minimum disruption to adjacent and downstream areas. Appropriately installed silt fencing will be placed in any location required to prevent silt from entering a watercourse or wetland and/or to isolate areas of work, where applicable. Mulch, straw, hay and/or geotextile will be employed as temporary erosion control on exposed areas. This temporary erosion control shall be applied immediately as required. Natural vegetation will be left in place where possible. Sediment that has formed and been contained by the sediment containment barriers is to be removed and disposed of prior to the removal of the sediment barriers. Sediment barriers will be inspected regularly during the course of construction and cleaned/repaired as required. Appropriate erosion controls will be installed before work begins.

If necessary, water (resulting from precipitation events, groundwater seepage, etc.) shall be pumped from work site areas to enable dry work conditions. If encountered, any silt-laden water will be recovered and pumped away from the adjacent watercourse to areas with sufficient vegetation to facilitate filtration; or through sediment control devices (i.e.

settling areas or silt bags) before reaching a watercourse.

NSE Request:
Provide a detailed description of the potential adverse effects from all the proposed construction materials and the proposed mitigation measures.

NSPI Response:
The temporary lowering of the reservoir by 7-15 feet will cause the biggest disruption. The fish ladder and downstream fish bypass pipe will also be dewatered during construction. As well, NSPI is anticipating an additional permanent instream footprint of approximately 60 m^2 to accommodate additional concrete requirements for certain ogee sections. Mitigation measures to minimize disruption include preventing the death of fish by providing upstream and downstream fish passage, lowering the reservoir prior to spawning in order to avoid exposing eggs, lowering water levels the least amount possible for the shortest period of time possible, monitoring for silt and fish stranding during reservoir drawdown, transferring any stranded fish found during dewatering by qualified NSPI personnel, ensuring proper sediment control, and preventing entry of deleterious substances to water. Flow regimes and water management will not be changed as a result of the completed project.

Upstream fish passage will be provided via a fish conveyance/pump system designed to transfer fish without damage. The system is being custom built for the Ruth Falls site and is targeted to pass fish as large as salmon. The pump is mobile and sits on a trailer which will be parked where the downstream fish bypass pipe is located below the Ruth Falls dam (see photo below). The hose for the fish will be installed in the water in front of the pipe where there is a deep spot and attraction water provided. Fish will be transferred over the dam and released in an area with a sufficient amount of water. The fish transfer system will be in operation during upstream migration. The system will be monitored closely to ensure proper functioning and safe transfer of fish. The fish conveyance system will be installed by qualified personnel from the Supplier and will conduct initial monitoring to ensure the system is functioning properly. The Supplier will also provide training to NSPI personnel.

February 27, 2020
Grant Brown



The required 35 cfs maintenance flow will be maintained throughout the construction works via the stoplog sluice bays. The installation of the sluice gates will likely be a staged approach where two of the gates would be bulkheaded for work in the dry and installed first, while maintaining the flow through the third gate. During the installation of the third gate, gates one and two would be able to maintain the discharge of the maintenance flows, thus allowing fish passage. There is currently no plan to install a cofferdam on the upstream side of the dam given the required size and associated challenges. The access road below the dam will be built to bypass the flow through the gates, likely with a clear span bridge, to be determined by contractor. This can be accomplished with steel beams and building abutments out of swamp maps as an example. This will be determined by the contractor.

Temporary access roads will not impact fish passage and will be installed in the dry with the reservoir lowered. The details related to the temporary road, if needed, will be developed once the contractor has been selected. The contractor will determine where the access road will be located. The area just downstream of the dam, where the

temporary access road may be required, currently consists of exposed bedrock and boulders. Typically, temporary access roads are constructed using geotextiles and clean rockfill materials. All materials will be removed following the work and the site remediated back to its original condition. The access road below the dam will be built to bypass the flow through the gates, likely with a clear span bridge, to be determined by the contractor. This can be accomplished with steel beams and building abutments out of swamp maps or other materials. This will be determined by the contractor.

NSPI is targeting early to mid-May to dewater the Ruth Falls Reservoir in order to allow fish to spawn once the reservoir has been lowered to construction levels thus avoiding eggs being exposed.

Construction materials include rubber dams, concrete for headwalls and portions of ogee, and slide gates. A list of other products to be used by the contractor will be submitted to NSPI prior to start of work for approval based on health, safety, and environmental parameters. All materials stored on site shall be stored, handled and labeled according to Workplace Hazardous Materials Information System (WHMIS) regulations, as well as any other applicable federal or provincial regulation. Product Safety Data Sheets (SDS) shall be available on site at all times. All construction material and debris will be stored in designated areas on NSPI property away from watercourses and wetlands and in a manner that will prevent materials from entering a watercourse, for example, in seacans and/or on containment as required. Any debris that requires disposal will be done so in accordance with application regulations and guidelines.

While working with and/or applying materials, measures will be taken to prevent any materials from entering the watercourse by applying materials in a controlled manner and containing excess material during application.

All equipment and machinery required to be operated on or near a body of water will be mechanically sound with no leaking fuel tanks or hydraulic connections. Fuel storage, refuelling and lubrication shall be in designated areas not within 30 m of any wetland or water body. Storage of petroleum products will be at least 100 m from a wetland or water body. Machinery and equipment will be stored above flood water levels. The selected contractor will develop oil spill contingency plans and spill kits will be maintained on-site.

February 27, 2020
Grant Brown

I hope this additional information is sufficient for your needs.

Sincerely,



Nadine Thomas | Environmental Scientist | Nova Scotia Power
T: 902-428-7559 | C: 902-719-5990
E: nadine.thomas@nspower.ca

February 27, 2020
Grant Brown

Appendix A

Memo from Kleinschmidt Associates Canada

MEMORANDUM

TO: Aaron Alderman – Nova Scotia Power Inc.

FROM: Chris Vella – Kleinschmidt Associates Canada Inc.

DATE: February 27, 2020 **PROJECT NO.:** 1890018.01

RE: Permit Drawings

THIRTY PERCENT DRAWING PACKAGE

The thirty percent complete drawing package provided in June of 2018 is an accurate representation of the modifications planned for the Ruth Falls dam. The subsequent planned submittals will add details for concrete, rebar and rubber dam components but the footprint, and overall design plan will remain unchanged. The current level of design definition provides the information required to determine the scope of water management before, during, and after construction. It is our opinion that the 30% drawings are suitable for communicating the planned design. A 100% complete drawing package stamped final and released for construction can not be completed until after Nova Scotia Power Inc. selects a contractor and that contractor has had an opportunity to review and provide input on the drawing package. Contractor comments will be limited to constructability issues and clarity in the details but will not impact the overall intended design, rubber dam size, or limits of concrete modifications.

Best Regards,

Chris Vella, P.Eng.
Project Manager

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Appendix B

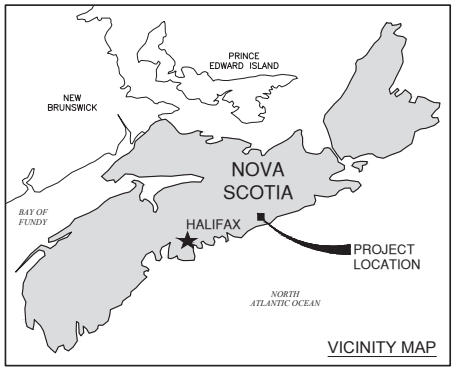
Engineering Drawings

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NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP

DRAWING LIST

SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS
100-01	COVER AND DRAWING LIST	2018-06-27	A	30% REVIEW
200-01	OVERALL SITE PLAN	2018-06-27	A	30% REVIEW
200-02	EXISTING CONDITIONS PLAN AND SECTIONS I	2018-06-27	A	30% REVIEW
200-03	EXISTING CONDITIONS PLAN AND SECTIONS II	2018-06-27	A	30% REVIEW
200-04	EXISTING CONDITIONS EMBANKMENT PLAN AND SECTIONS	2018-06-27	A	30% REVIEW
200-05	NEW CONDITIONS DAM PLAN AND ELEVATION	2018-06-27	A	30% REVIEW
200-06	NEW CONDITIONS RUBBER AND SLIDE GATES PLAN AND SECTIONS	2018-06-27	A	30% REVIEW
200-07	NEW CONDITIONS UNCONTROLLED SPILLWAY PLAN AND SECTIONS	2018-06-27	A	30% REVIEW





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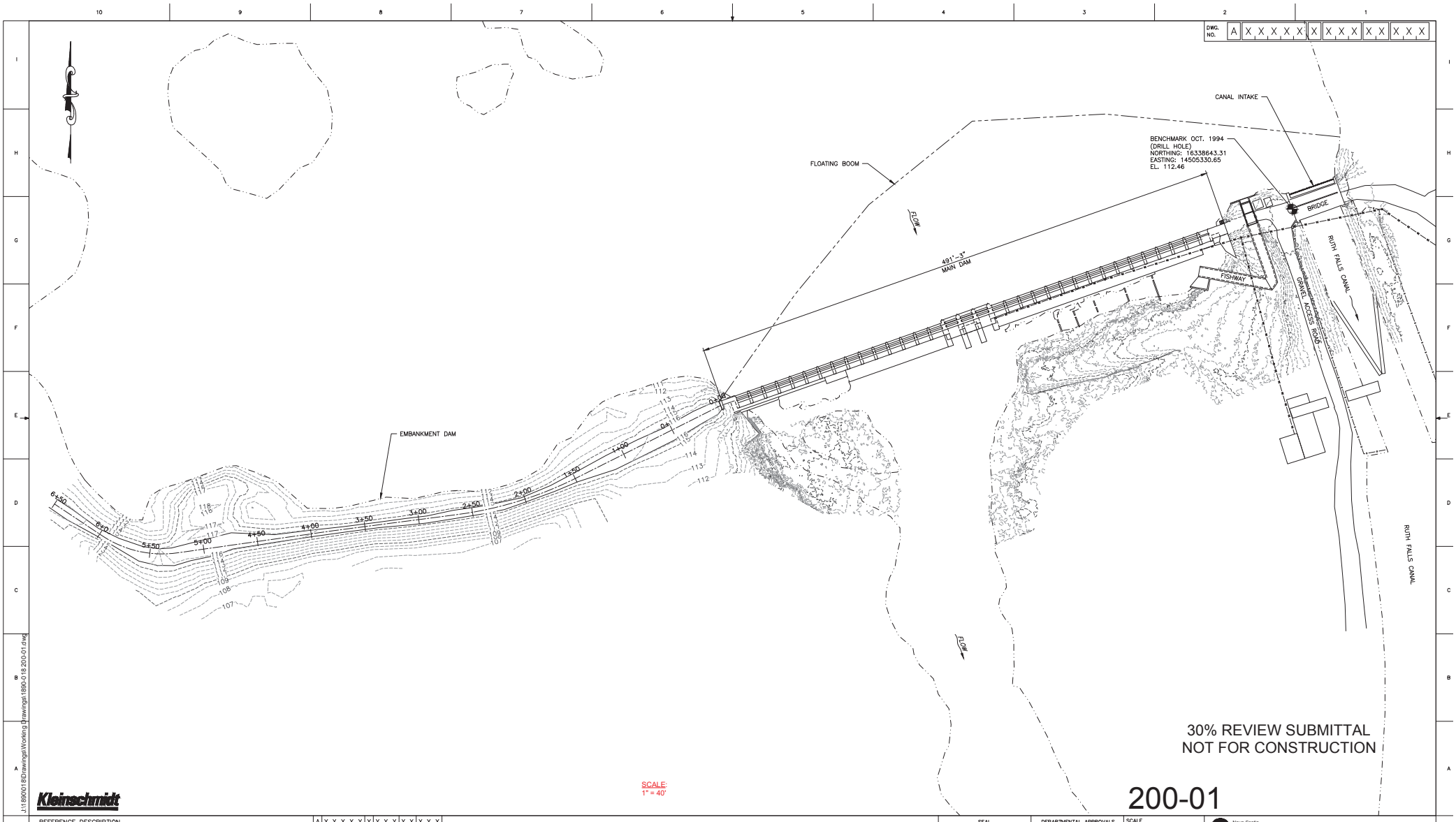
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DATE 2018-06-27
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT
COVER AND DRAWING LIST
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DATE 2018-06-27

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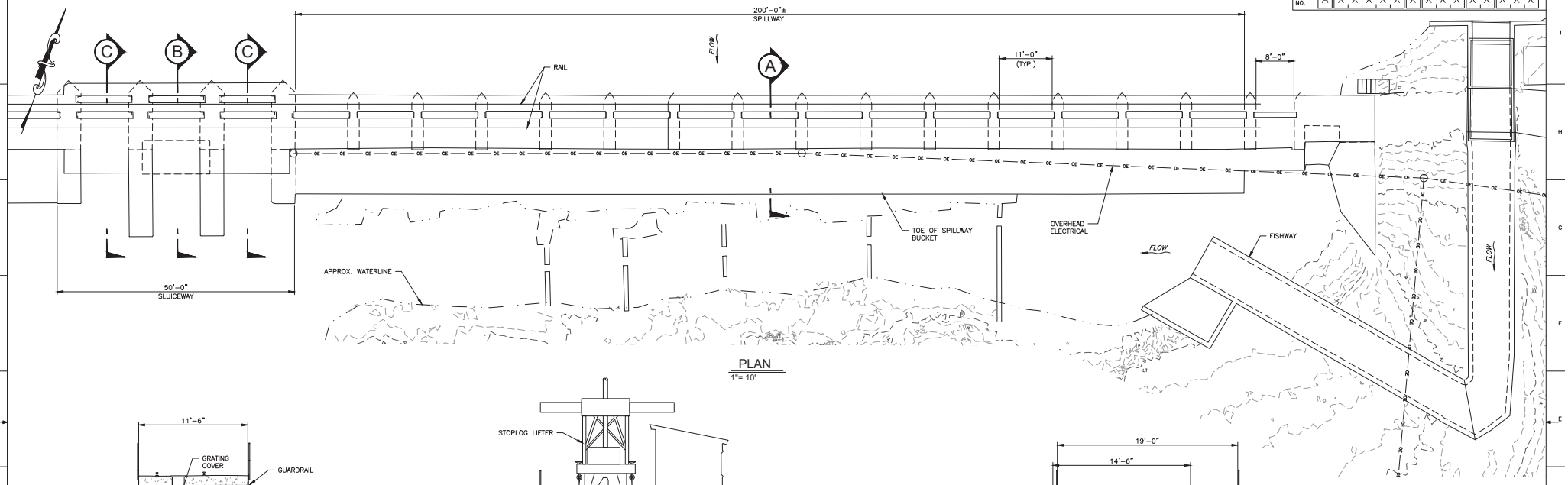
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RUTH FALLS

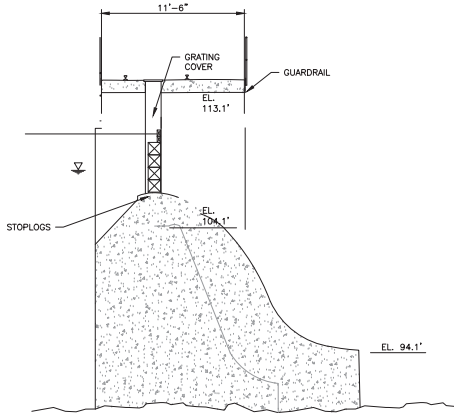
RUTH FALLS REFURBISHMENT PROJECT

OVERALL SITE PLAN

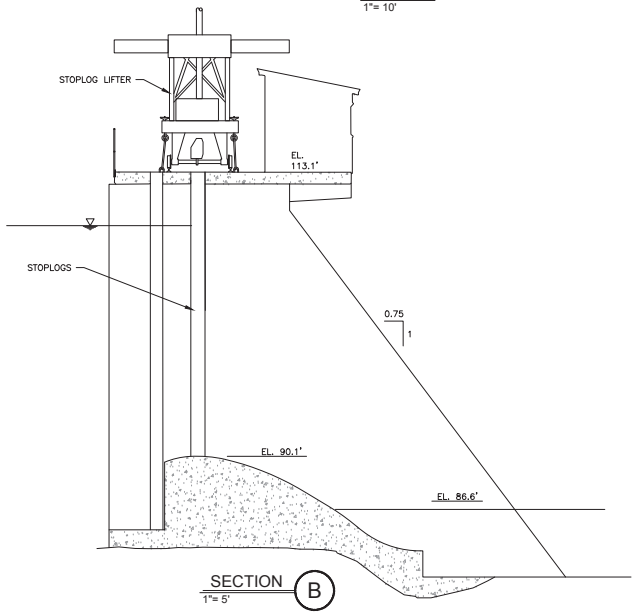
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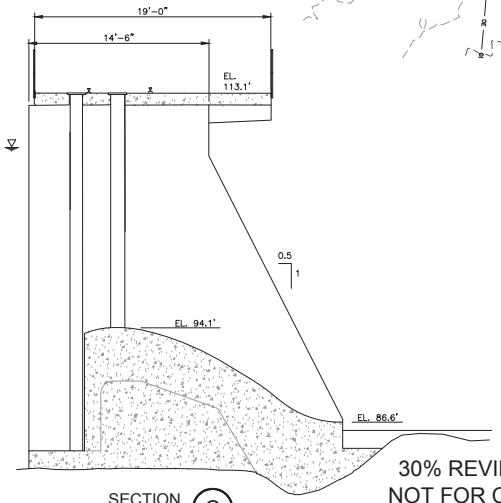
PLAN
1"= 10'



SECTION A
1"= 5'



SECTION B
1"= 5'



SECTION C
1"= 5'

30% REVIEW SUBMITTAL
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200-02

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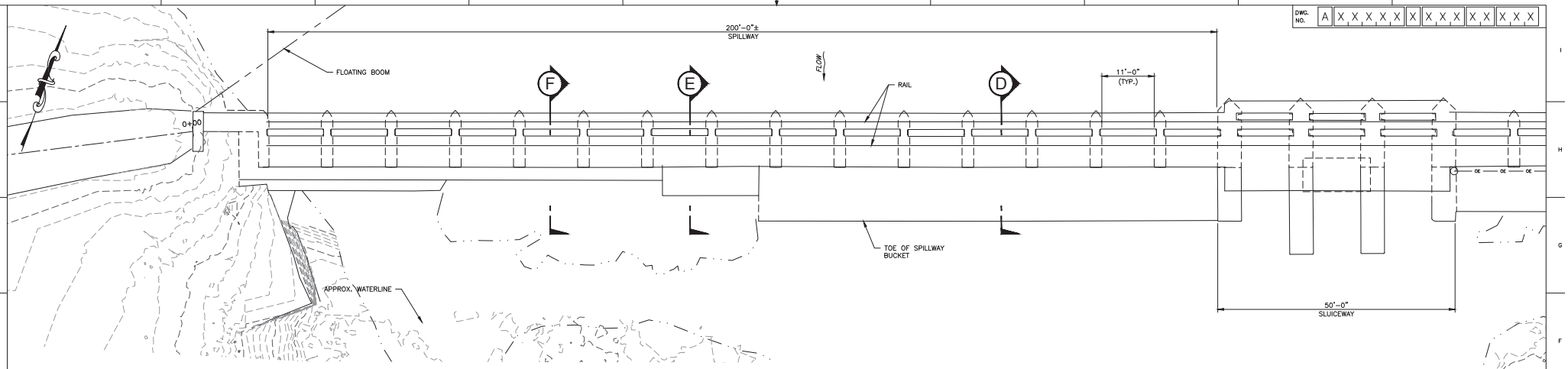
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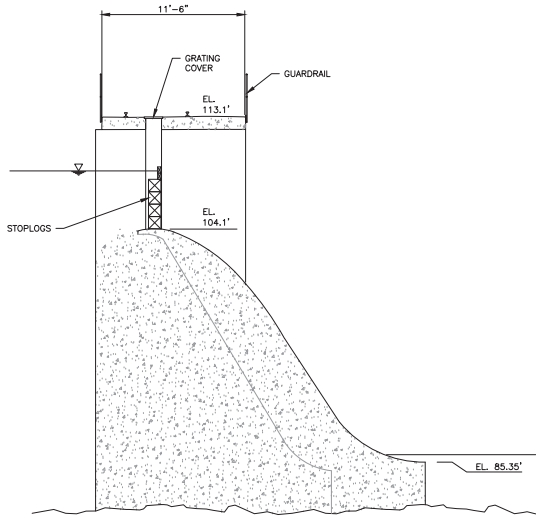
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

EXISTING CONDITIONS
PLAN AND SECTION I

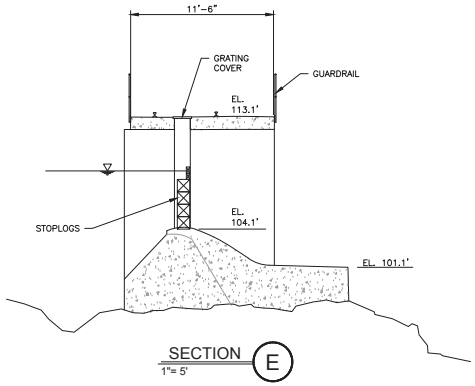
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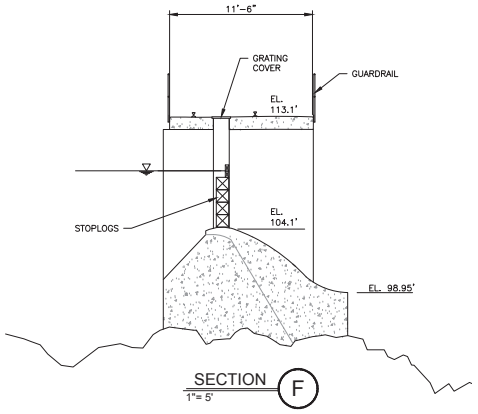
PLAN
1"= 10'



SECTION D
1"= 5'



SECTION E
1"= 5'



SECTION F
1"= 5'

30% REVIEW SUBMITTAL
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200-03

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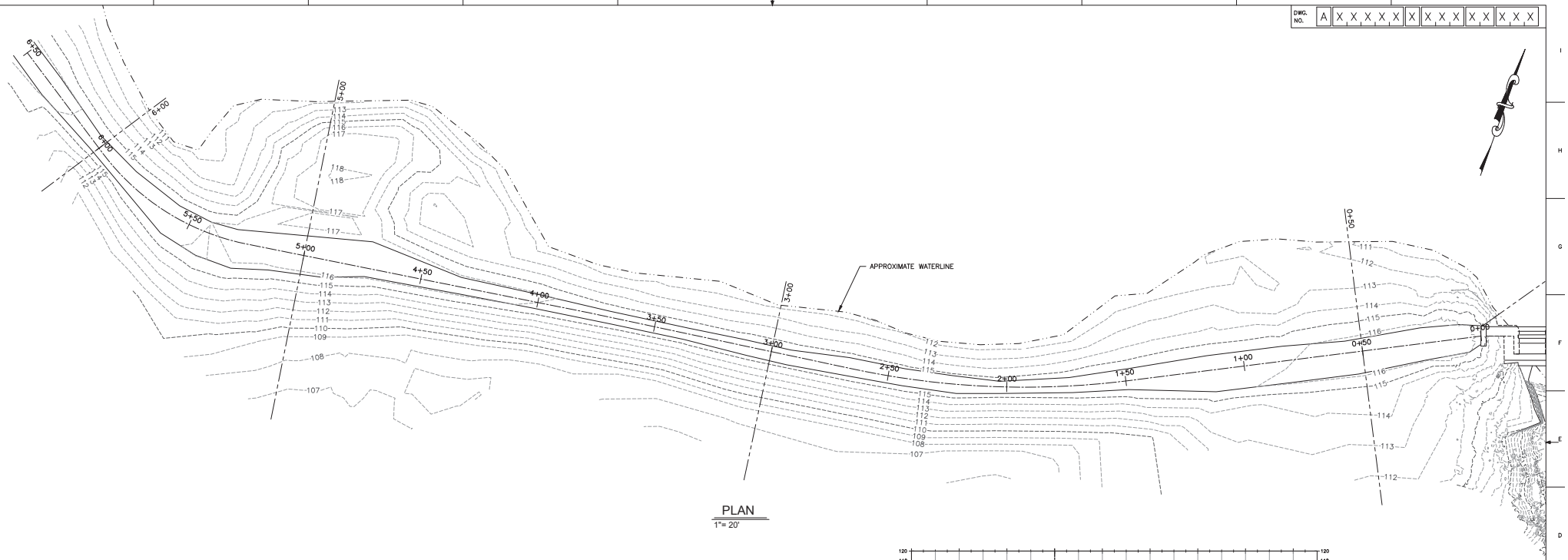
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RUTH FALLS REFURBISHMENT PROJECT

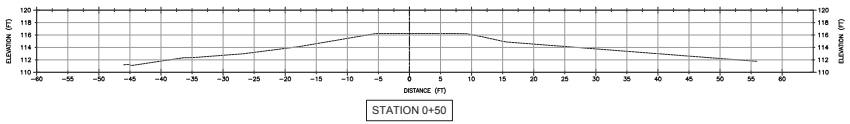
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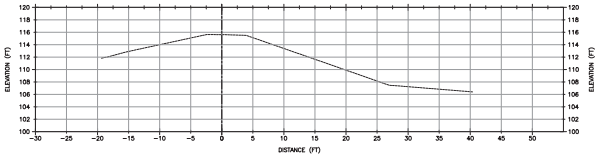
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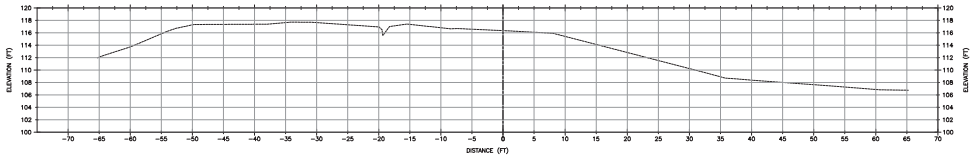
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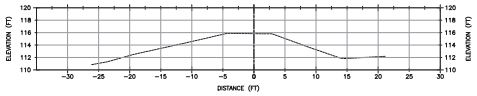
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STATION 6+00

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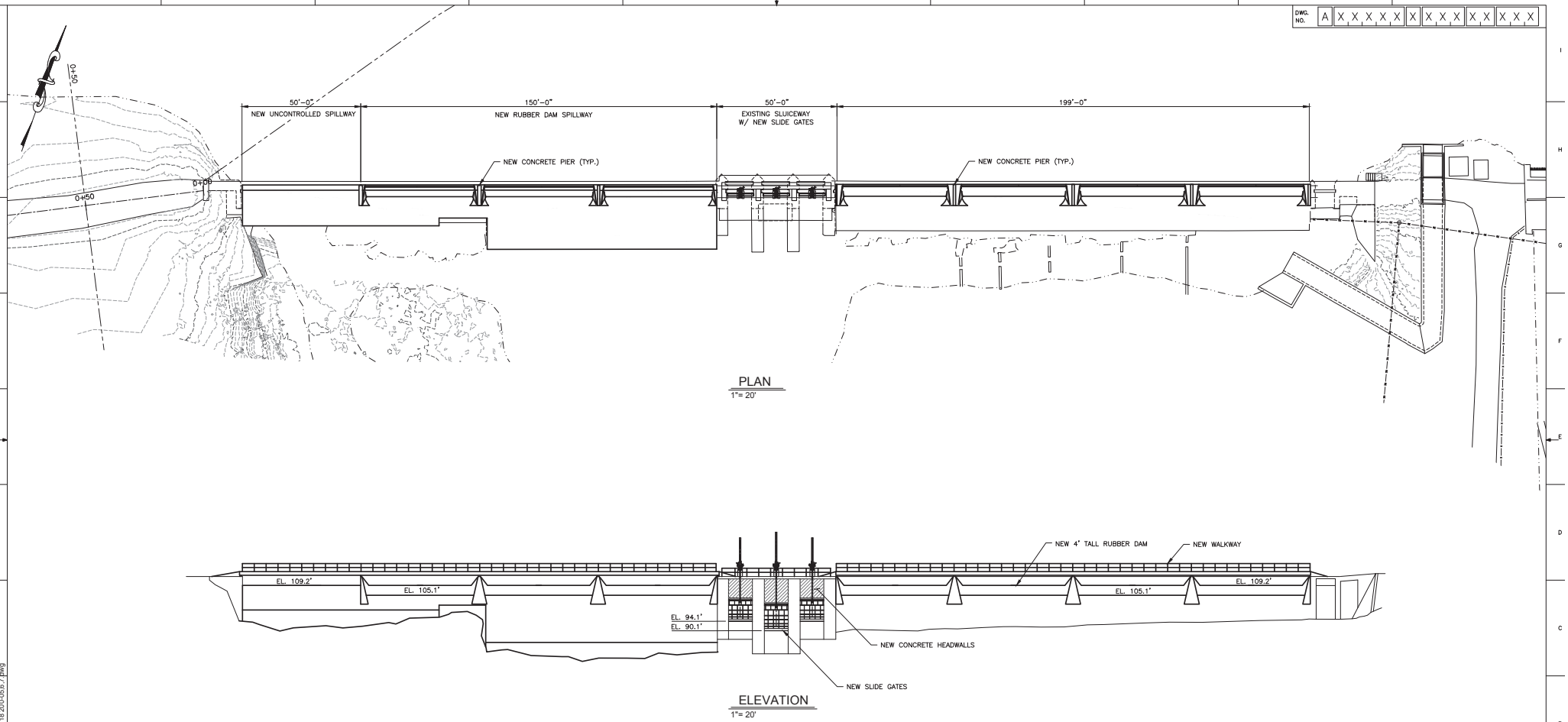
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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
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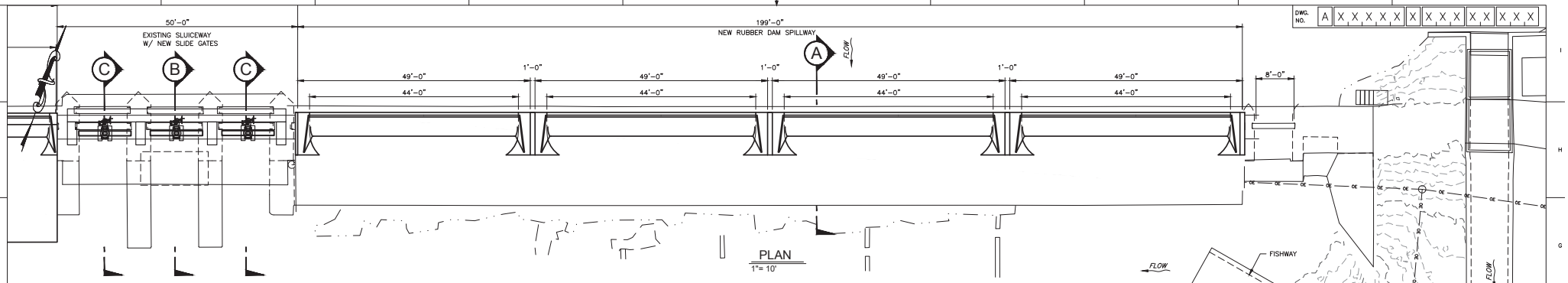
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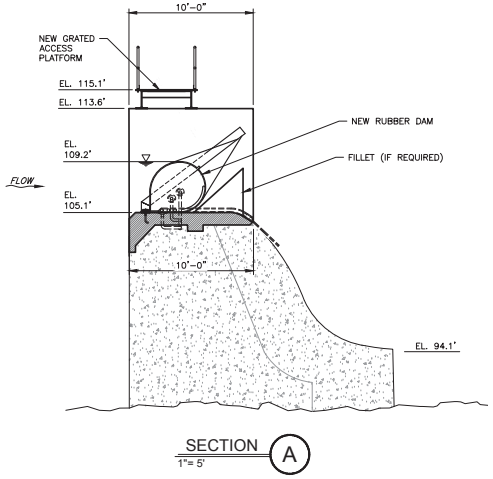
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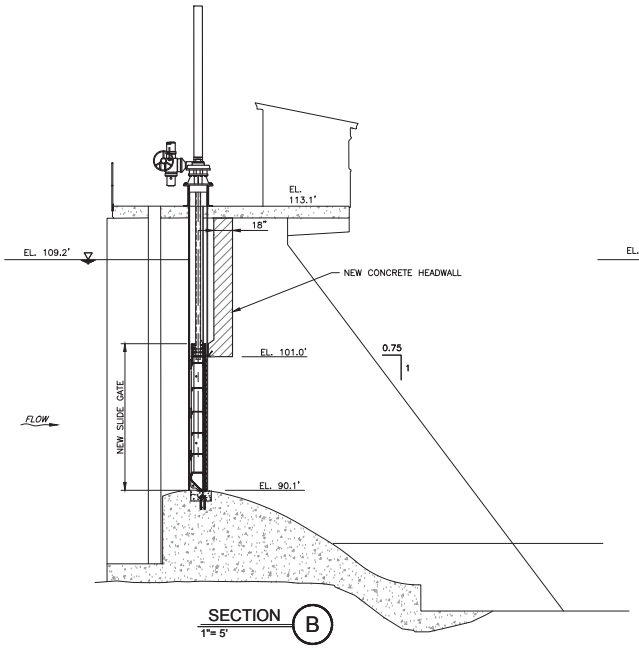
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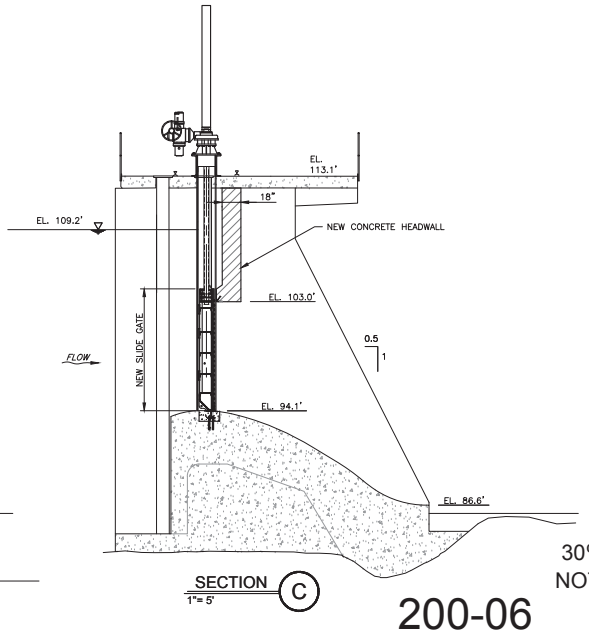
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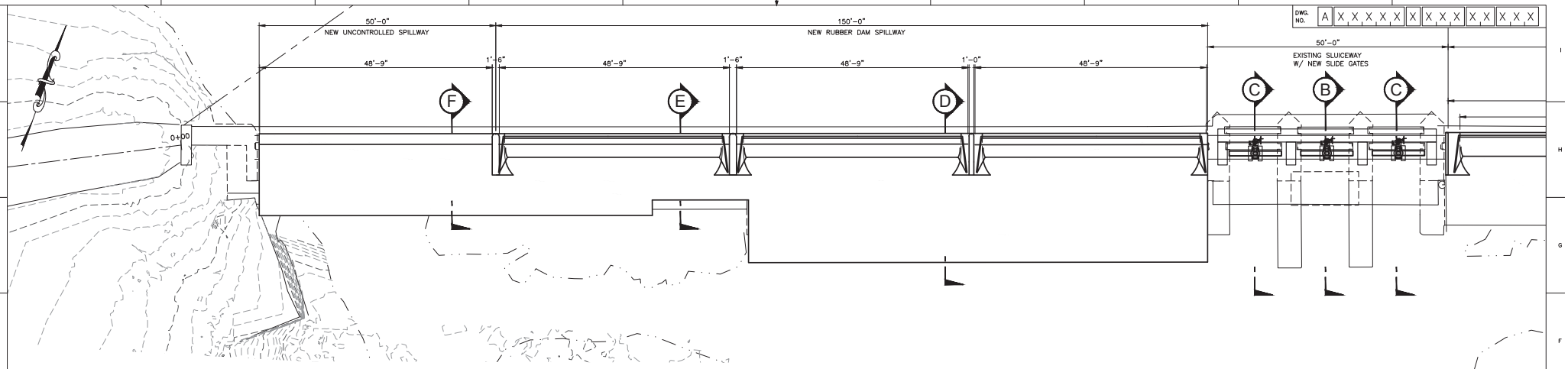
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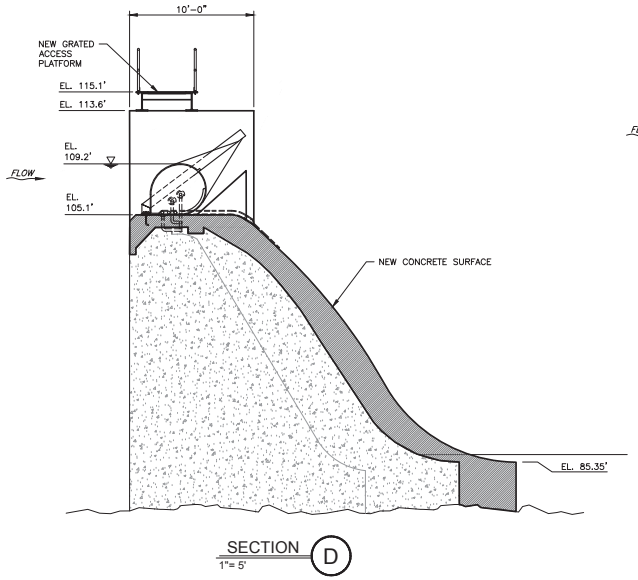
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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW CONDITIONS
RUBBER DAM AND SLIDE GATES
PLAN AND SECTIONS

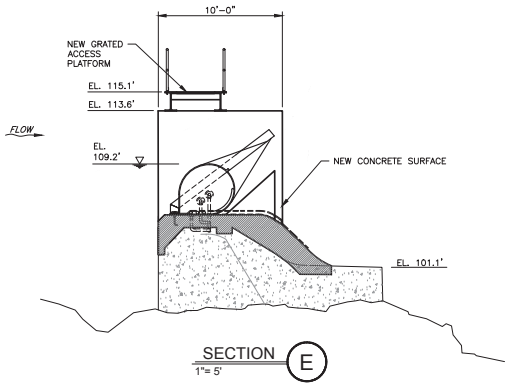
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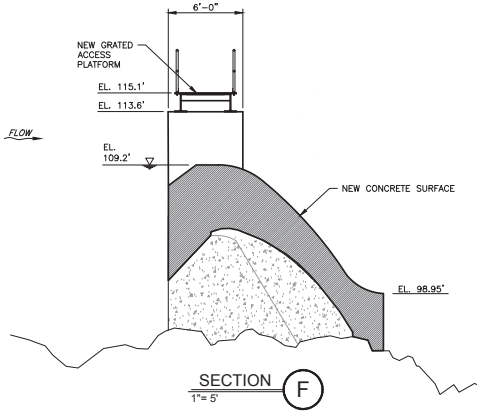
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SECTION E
1"= 5'



SECTION F
1"= 5'

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
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PLAN AND SECTIONS

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NOVA SCOTIA

30 Damascus Road, Suite 115
Bedford, NS
Canada B4A 0C1

902-424-7773 T
902-424-0597 F
www.novascotia.ca

Our File Number: 95100-30-BED-2019-2638165

March 25, 2020

NOVA SCOTIA POWER INCORPORATED
PO BOX 910, 25 LAKESIDE PARK DR
HALIFAX, NS
B3J 2W5

Dear NOVA SCOTIA POWER INCORPORATED

RE: Application # 2019-2638165-00

With reference to your application please be advised that as a result of an initial review, your application has been deemed incomplete. As a result, Nova Scotia Environment (NSE) is requesting the following information to process your application:

The design drawings provided to date are insufficient to provide record of the proposed works, their methods, and mitigations used.

Additional information is requested as follows:

1. Provided design drawings to record of the proposed works, their methods, and mitigations used.

2. What considerations and contingencies will be available to NSP to ensure construction completion in November given the potential impacts from COVID-19?

3. Provide a detailed water management plan including: construction staging including cofferdam placement and dewatering and maintenance of flows, contingency plans for high precipitation events, and erosion and sediment control. The detailed water management plan should be determined by qualified professional engineer(s) licensed to practice in Nova Scotia.

4. NSP has confirmed work is proposed to occur outside of the Timing Window for watercourse alteration (per letter dated February 27, 2020). Work is therefore proposed to occur in seasons with higher than standard precipitation and flow as well as season when extreme events are more common. A description of how high flow scenarios will be managed is requested: including the free overflow spillway, and how this may be addressed in the erosion and scour protection plan. Additional description of the proposed works, and the scope of potential impact by the proposed works, is sought specifically with respect to erosion and sediment control and temporary works construction and removal.

5. Confirm that proposed high level water management approach described in the application is still the intended approach (closing gates at Malay and lowering primarily through generation at Ruth Falls and a subsequent staged removal of stop logs). NSP noted in letter to DFO that drawdown work is expected to be completed in a single day.

6. Will velocities downstream of the system during drawdown exceed current typical operations and create risk of downstream erosion and scour?

7. In order to monitor and address potential impacts, monitoring pre-, active, and post-construction periods will be needed. Water quality monitoring is recommended to be able to demonstrate comparison with the Canadian Council of Ministers of the Environment water quality guidelines for the protection of freshwater aquatic life, turbidity and total suspended solids criteria. Provide a proposed methodology to accomplish appropriate water quality monitoring.

8. Information to date has only been provided with respect to fish. Provide similar discussion on potential impacts to other aquatic organisms and habitat that may be affected by the drawdown, and associated mitigation measures to reduce these potential negative impacts. For example, describe the presence and potential alteration of wetlands.

9. Please update and provide further information on public engagement and consultation as related to these works that may now be available.

NSE is requesting this information be submitted by June 25th, 2020. Please note that in accordance with *Section 7 of the Approval and Notification Procedure Regulations,* if information is not supplied by an applicant within 3 months of a request, the Minister may reject your application. Should your application be rejected, you will be informed of that decision in writing.

Yours truly,
Grant Brown



Nova Scotia POWER
An Emera Company

PO Box 910 ● Halifax, Nova Scotia ● Canada ● B3J 2W5

June 22, 2020

Grant Brown
Nova Scotia Environment
30 Damascus Road, Suite 115
Bedford, NS
B4A 0C1

Dear Mr. Brown:

As requested in your letter dated March 25, 2020, please find below the additional information requested as part of your review of application # 2019-2638165-00.

1. **Provided design drawings to record of the proposed works, their methods, and mitigations used.**

NSPI Response:

Further explanation of the project and new footprint were provided during a conference call between NSPI and NSE on March 27th. A version of the drawings with explanatory notes was submitted via email to NSE on April 3rd.

The construction methods will be outlined by the selected contractor after the project is awarded. It is the responsibility of the contractor to understand and determine the proposed scope of work for the construction activities including development of methods.

The mitigation measures are not developed by NSPI at this stage of the project. Any required mitigation measures are discussed and identified with the contractor after the project is awarded.

2. **What considerations and contingencies will be available to NSP to ensure construction completion in November given the potential impacts from COVID-19?**

NSPI Response: The project has been postponed until 2021.

June 22, 2020
Grant Brown

3. Provide a detailed water management plan including: construction staging including cofferdam placement and dewatering and maintenance of flows, contingency plans for high precipitation events, and erosion and sediment control. The detailed water management plan should be determined by qualified professional engineer(s) licensed to practice in Nova Scotia.

NSPI Response:

The water management plan will be developed in conjunction with the selected contractor upon award of the project. The construction sequencing plan will be the responsibility of the selected contractor. Due to liability issues, NSPI does not define the construction sequencing plan for the contractors as it is the contractor's responsibility and assumes liability for their plans.

The reservoir will be lowered primarily through generation. Water will flow through the power canal to the generating station until the reservoir level reaches the level of the intake. While the generating station is online, a flow of 35 – 45 cfs will be flowing through the sluice bay and into the river channel as per year round requirements. Once the reservoir reaches the level of the intake, the plant will stop generating. The reservoir will continue to be lowered by removing stop logs individually from each bay in a controlled manner, releasing flow into the river channel, until the reservoir reaches the desired level for construction. The flow downstream will be controlled in order to avoid scour and sedimentation. The drawdown will be monitored by Environmental Services employees for stranded fish in the reservoir as well as issues downstream when stop logs are being pulled. The drawdown is expected to take a day.

There are currently no plans to install cofferdams as part of the project. However, should the need for cofferdams arise, the design of the cofferdam is the responsibility of the contractor and the information associated with the cofferdam can be submitted to NSE at that point in time. Typically, cofferdams are constructed using 1m x 1m sandbags and clear stone rockfill covered with plastic.

The 35 cfs required maintenance flow will be maintained throughout the length of construction. The plan for supplying the flow will be developed in conjunction with the selected contractor but is expected to be provided primarily through the existing sluiceway by sequencing the gate installations such that at least one gate bay will be available for flow.

For high precipitation events, the goal will be to move the flows though the construction site. Weather forecasts will be monitored and water flow in the construction site managed though the low level stoplog bays throughout the construction period. High inflows will be managed across the hydro system by hydro operations staff using established processes.

4. **NSP has confirmed work is proposed to occur outside of the Timing Window for watercourse alteration (per letter dated February 27, 2020). Work is therefore proposed to occur in seasons with higher than standard precipitation and flow as well as season when extreme events are more common. A description of how high flow scenarios will be managed is requested: including the free overflow spillway, and how this may be addressed in the erosion and scour protection plan. Additional description of the proposed works, and the scope of potential impact by the proposed works, is sought specifically with respect to erosion and sediment control and temporary works construction and removal.**

NSPI Response:

The erosion and sedimentation control (ESC) plan will be developed by the selected contractor after the project is awarded. An Environmental Protection Plan will be developed by NSP and will include the site specific ESC Plan developed by the contractor. The ESC can be made available to NSE prior to the start of construction. Previous NSE approvals have stipulated this requirement as part of the terms and conditions.

It should be noted that the project timeline will be refined as part of the RFP stage with the selected contractor. The November timeline noted in the application was an estimate by NSPI based on our understanding of the construction activities. However, the goal of the project will be to have the rubber bladders installed by September in order to manage the fall rain season. The free overflow spillway will not be functional until the rubber bladders have been installed.

As noted in #3, water management during high inflow events will be managed by hydro operations personnel. Flows and reservoir levels are managed across the hydro system in preparation for seasonal heavy rain events. Water flow will be continuous through the low level stoplog bays throughout the construction period. While the reservoir is drawn down, high inflows could potentially impact the construction works. The selected contractor will provide mitigation plans as part of the water management plan.

Erosion and scour protection will be identified as part of the ESC plan. Flows will be managed through the low level stoplog bays as it has been for approximately 55 years, therefore, the risk of erosion and scouring should be minimal. Also, the downstream toe area mainly consists of exposed bedrock and boulders.

5. **Confirm that proposed high level water management approach described in the application is still the intended approach (closing gates at Malay and lowering primarily through generation at Ruth Falls and a subsequent staged removal of stop logs). NSP noted in letter to DFO that drawdown work is expected to be completed in a single day.**

NSPI Response:

The reservoir will be lowered primarily through generation. Water will flow through the power canal to the generating station until the reservoir level reaches the level of the intake. While the generating station is online, a flow of 35 – 45 cfs will be flowing through the sluice bay and into the river channel as per year round requirements. Once the reservoir reaches the level of the intake, the plant will stop generating. The reservoir will continue to be lowered by removing stop logs individually from each bay in a controlled manner until the reservoir reaches the desired level for construction. The flow downstream will be controlled in order to avoid scour and sedimentation. The drawdown will be monitored by Environmental Services employees for stranded fish in the reservoir as well as issues downstream when stop logs are being pulled. The drawdown is expected to take a day.

6. **Will velocities downstream of the system during drawdown exceed current typical operations and create risk of downstream erosion and scour?**

NSPI Response:

As noted in #3 and #5, NSPI does not intend to lower the reservoir in a manner that would create downstream impacts. The reservoir will be drawn down in a controlled manner.

7. **In order to monitor and address potential impacts, monitoring pre-, active, and post-construction periods will be needed. Water quality monitoring is recommended to be able to demonstrate comparison with the Canadian Council of Ministers of the Environment water quality guidelines for the protection of freshwater aquatic life, turbidity and total suspended solids criteria. Provide a proposed methodology to accomplish appropriate water quality monitoring.**

NSPI Response:

Short-term monitoring will be completed during construction to ensure mitigation measures for potential impacts are effective. The effectiveness of erosion and sedimentation control measures to prevent impacts will be monitored daily by on site staff. Regular compliance audits will be completed by Environmental Services staff throughout the duration of the Project (typically weekly), which includes inspection of installed controls, water management, fish conveyance, etc. The Contractor will be required to provide a site-specific water management and erosion and sedimentation control plan to address all construction activities as part of the tender process. All construction personnel will be provided with environmental orientation prior to the start

of construction to ensure compliance with NSPI standards and best practices and all project-specific approvals or authorizations. Water quality sampling will be performed as required by associated environmental approvals.

Typically, Watercourse Alteration Approvals stipulate the following:

The Approval Holder(s) shall ensure that the following discharge limits are met for any water which is discharged from the Site to a watercourse or wetland:

i. Total Suspended Solids Clear Flows (Normal Background Conditions):

(a) Maximum increase of 25 mg/L from background levels for any short term exposure (24 hours or less)
(b) Maximum average increase of 5 mg/L from background levels for longer term exposure (inputs lasting between 24 hours and 30 days)

ii. Total Suspended Solids High Flow (Spring Freshets and Storm Events):

(a) Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 mg/L and 250 mg/L
(b) Shall not increase more than 10% over background levels when background is >250 mg/L.

Background water samples will be taken downstream of the project site as well as in the headpond prior to the start of construction for both a non-precipitation event and a precipitation event. Should visible sediment appear in the watercourse, the source will be eliminated, and water samples taken until the TSS meets the above criteria, or other criteria as determined by NSE. If requested, weekly water samples can be taken at an established site downstream of the construction site.

8. Information to date has only been provided with respect to fish. Provide similar discussion on potential impacts to other aquatic organisms and habitat that may be affected by the drawdown, and associated mitigation measures to reduce these potential negative impacts. For example, describe the presence and potential alteration of wetlands.

NSPI Response:

A rare species assessment, wetland delineation, and functional assessment of the area surrounding the project site was conducted by Strum Consulting in September 2017, see the report included in this submission. It is not expected that the four wetlands identified during the study will be impacted by the project given their proximity to the construction site and given water management and levels will not change as a result of the project. A

field survey of riparian vegetation for rare plants and wetlands on the Ruth Falls Headpond was completed by Jacques Whitford in 2007. There were 21 wetlands identified around the Ruth Falls reservoir during the survey, see the report included with this submission. The reservoir will not be lowered below the low supply level of 27.5 m (90.1') during construction. The amount of drawdown required to conduct work in dry conditions while maintaining the fish conveyance system will be determined at the start of the project. The amount of the drawdown will be minimized as much as possible, however, the level will be below the 33.3 m (109.4') minimum operating level maintained April 1st to November 30th each year as per NSE Operating Approval 2008-062826-01. A request for variance from the operating approval will be submitted to NSE.

9. Please update and provide further information on public engagement and consultation as related to these works that may now be available.

NS Power initiated Mi'kmaq engagement regarding the Ruth Falls Main Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant Project information with the KMKNO throughout 2018 providing six project updates, the project was deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window meeting with KMKNO. NS Power continued to provide monthly Project updates and share relevant Project information throughout 2019, working towards a preferred design option and planning for the Project to be completed in 2020.

NS Power presented the updated project information and design option to the KMKNO during the 2019 One Window meeting to discuss 2020 hydro capital projects. NS Power initiated engagement with the Millbrook Mi'kmaw community in January 2020 to provide an overview of the project and discuss next steps and approach to engagement for the project. This included working with the Mi'kmaw Conservation Group and the Millbrook Mi'kmaw community for a DFO Fisheries Act authorization offsetting project. In January 2020, NS Power initiated engagement with the Mi'kmaw Conservation Group to collaborate on an offsetting project. NS Power, in February and March 2020, continued engagement with the Mi'kmaw Conservation Group, continuing discussions to identify an offsetting project with the group and the Millbrook Mi'kmaw community. NS Power will continue to engage the Millbrook Mi'kmaq community regarding the project. Weekly project manager communications will be available to the Millbrook Mi'kmaw community, as construction begins, currently scheduled for May to November 2020.

NS Power is planning to conduct public engagement for the Project with an Open House and provide local residents, along the Ruth Falls headpond, with relevant Project information and notification of the drawdown activities to conduct the Project. The public Open House and local resident communications will provide information in a timely manner about the Project, prior to drawdown activities and construction, increasing

awareness and understanding of the Project scope, objectives, and timelines and addressing public areas of interest and potential concern.

I hope this additional information is sufficient for your needs.

Sincerely,



Nadine Thomas | Environmental Scientist | Nova Scotia Power
T: 902-428-7559 | C: 902-719-5990
E: nadine.thomas@nspower.ca

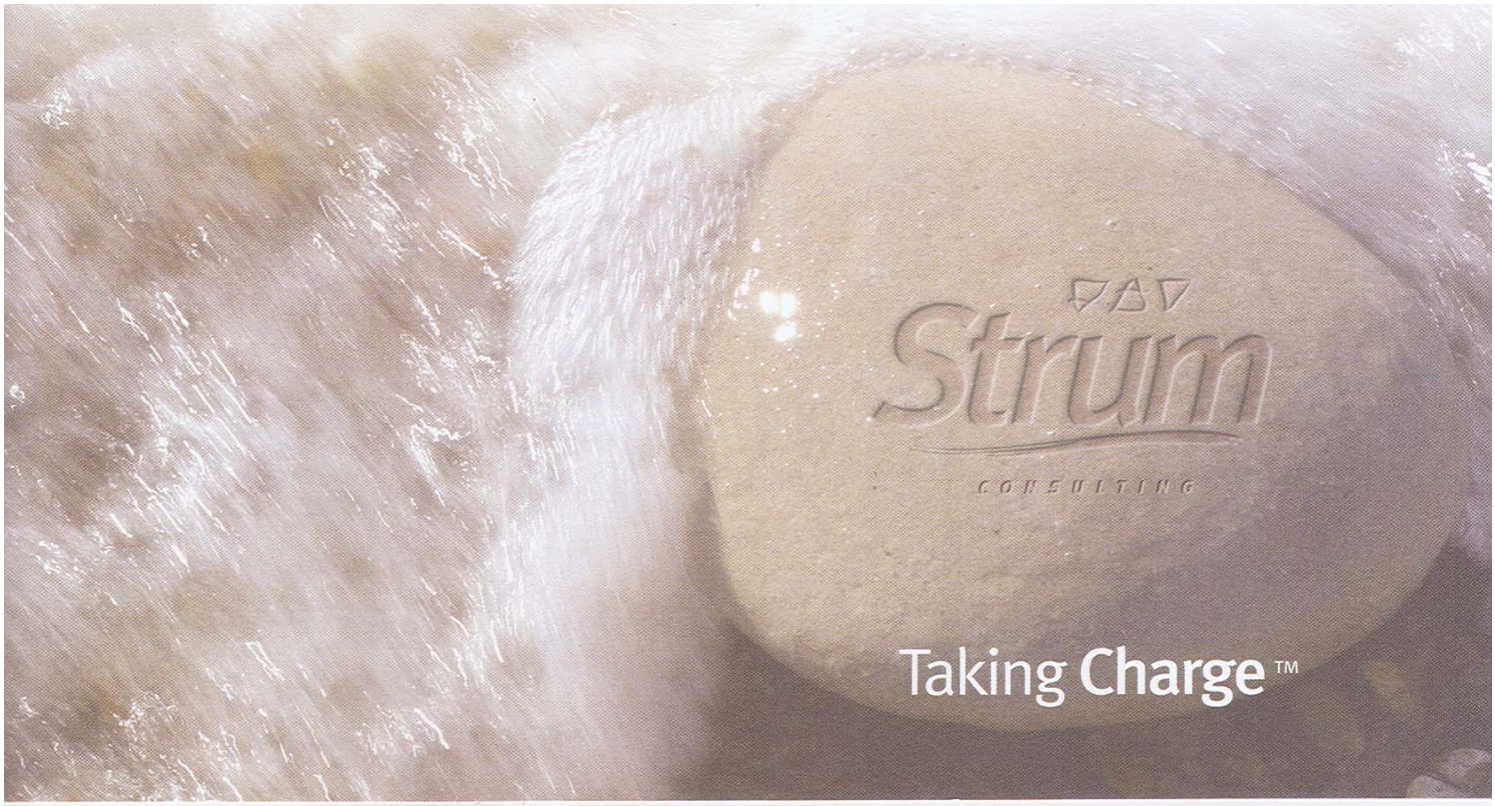
June 22, 2020
Grant Brown

Appendix A

2017 Rare Species Assessment, Wetland Delineation, and Functional Assessment

RARE SPECIES ASSESSMENT, WETLAND DELINEATION, AND FUNCTIONAL ASSESSMENT
Ruth Falls Dam

September 29, 2017



Strum CONSULTING

September 29, 2017

Ms. Jenny LeBlanc
Nova Scotia Power Inc.
1223 Lower Water Street
Halifax, NS B3J 3S8

Ms. Jenny LeBlanc,

Re: Rare Species Assessment, Wetland Delineation, and Functional Assessment
Ruth Falls Dam

Attached is the Rare Species Assessment, Wetland Delineation, and Functional Assessment report prepared for the Ruth Falls Dam site.

This report documents our observations, findings, and recommendations.

We trust this report to be satisfactory at this time. Once you have had an opportunity to review this correspondence, please contact us to address any questions you may have.

Thank you,

Heather Mosher, MSc.
Environmental Scientist
hmosher@strum.com

Shawn Duncan, BSc.
Vice President
sduncan@strum.com

EXECUTIVE SUMMARY

Strum Consulting completed a rare species assessment, wetland delineation, and functional assessment at the Ruth Falls Dam on behalf of Nova Scotia Power Inc. in September 2017. The Ruth Falls Dam is located within the Malay Falls Hydro System in Sheet Harbour, NS.

The scope of the study included a desktop review of various data sources; preliminary mapping for site wetlands, watercourses and species at risk.

Field assessments were completed in September of 2017. Wetland delineation identified four wetlands within the Study area, consisting of two treed swamps, one shrub swamp, and one shrub marsh. Functional assessments were completed on each wetland to identify important functions and benefits of each wetland. Rare species assessments identified no rare flora, however, one rare bird species was identified within the vicinity of the Study area.

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Appendix B: Species at Risk Tables
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Appendix D: Glossary
Appendix E: Photograph Log
Appendix F: Functional Assessment Forms

1.0 INTRODUCTION

Strum Consulting completed a rare species assessment, wetland delineation, and functional assessment study (the Study) on behalf of Nova Scotia Power Inc. (NSPI) in September 2017 at the Ruth Falls Dam Site. The Ruth Falls Dam is located within the Malay Falls Hydro System in Sheet Harbour, NS.

The Study employed both desktop and field based assessments to determine the biophysical character of the Study area. Specifically, multiple data sources were reviewed at the desktop level, followed by the implementation of a field program to verify ground conditions. The Study focused on the identification and baseline conditions of wetlands, watercourses, and flora and fauna species of conservation interest (SOCI) within the Study Area.

1.1 Site Details

The Ruth Falls Dam (the Dam) is located in the community of Sheet Harbour on the Eastern Shore of Nova Scotia (Drawing 1, Appendix A). The dam is located in the Malay Falls Flowage, which is a flowage of East River. The dam was built in 1922-23 to provide power to the surrounding area. The dam consists of a concrete spillway and dam, with an earthen berm extending towards the west of the dam. Additionally, there is a generating station, canal, and fishway.

1.2 Study Scope

The intent of the Study was to identify wetland and potential rare species habitat located within the vicinity of the dam and generating station (the Study area) in preparation for further capital works projects. Wetland delineation and functional assessments were completed at all identified wetlands.

2.0 RARE SPECIES ASSESSMENT

2.1 Desktop Review

2.1.1 Methodology

An ACCDC data request was made for species within 100 km of the Study Area. Based on the criteria outlined in the document “Guide to Addressing Wildlife Species and Habitat in an EA Registration Document” (NSE 2009) species having the following designations were designated as SOCI:

- “Endangered”, “Threatened”, or “Special Concern” under the *Species at Risk Act* (*SARA);* and
- “Endangered”, “Threatened “or “Vulnerable” under the *NS Endangered Species Act* (NS *ESA)*;
- Ranked as “1 – At Risk”, “2 – May Be At Risk”, “3 - Sensitive” or “5 - Undetermined” under the NSDNR General Status Ranks of Wild Species in Nova Scotia;

- Listed “Endangered”, “Threatened”, or “Special Concern” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC); and
- Ranked as “S1”, “S2”, or “S3” under the ACCDC provincial conservation status rank.

A shortlist of Priority Species was compiled of flora and fauna SOCI identified within a 5 km radius of each Study Area. The known habitat requirements for Priority Species were screened against habitat types known to occur at the Study site to evaluate the likelihood for these species to occur within the Study Area.

2.1.2 Species of Conservation Interest

Flora and fauna SOCI which have been recorded within 100 km of the Study Area are provided in Table 1 (Appendix B). The following SOCI were recorded within 100 km of the Study area:

- 9 fish;
- 2 mammals;
- 115 birds/bats;
- 3 herptiles;
- 51 invertebrates;
- 60 non-vascular plants; and
- 248 vascular plants.

Priority Species which have been recorded within 5 km of the Study Area are provided in Table 2 (Appendix B) and consist of the following species:

- 1 mammals;
- 43 birds;
- 2 invertebrates;
- 2 non-vascular plants; and
- 4 vascular plants.

Table A lists the SOCI species most likely to occur in the Study area, based on the known habitat occurrence within the general area and the availability of suitable habitat.

Table A: SOCI Species Most Likely to Occur in the Study Area

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
BIRDS						
American Bittern	*Botaurus lentiginosus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
American Kestrel	*Falco sparverius*	Not Listed	Not Listed	4 Secure	Not Listed	S3B
Baltimore Oriole	*Icterus galbula*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3B

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
Barn Swallow	*Hirundo rustica*	Not Listed	Endangered	1 At Risk	Threatened	S2S3B
Bay-breasted Warbler	*Dendroica castanea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Black-backed Woodpecker	*Picoides arcticus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3B
Blackpoll Warbler	*Dendroica striata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Blue-winged Teal	*Anas discors*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3S4B
Boreal Chickadee	*Poecile hudsonica*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Brown-headed Cowbird	*Molothrus ater*	Not Listed	Not Listed	4 Secure	Not Listed	S2B
Bufflehead	*Bucephala albeola*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4N
Canada Warbler	*Wilsonia canadensis*	Threatened	Endangered	1 At Risk	Threatened	S3B
Cape May Warbler	*Dendroica tigrina*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2B
Chimney Swift	*Chaetura pelagica*	Threatened	Endangered	1 At Risk	Threatened	S2B, S1M
Common Eider	*Somateria mollissima*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Common Goldeneye	*Bucephala clangula*	Not Listed	Not Listed	4 Secure	Not Listed	S2B, S5N
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	1 At Risk	Threatened	S2B
Common Tern	*Sterna hirundo*	Not Listed	Not Listed	3 Sensitive	Not At Risk	S3B
Eastern Kingbird	*Tyrannus tyrannus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Eastern Wood-Pewee	*Contopus virens*	Not Listed	Vulnerable	3 Sensitive	Special Concern	S3S4B

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
Evening Grosbeak	*Coccothraustes vespertinus*	Not Listed	Not Listed	4 Secure	Special Concern	S3S4B, S3N
Gray Catbird	*Dumetella carolinensis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3B
Gray Jay	*Perisoreus canadensis*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Greater Yellowlegs	*Tringa melanoleuca*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B, S3S4M
Killdeer	*Charadrius vociferus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened	1 At Risk	Threatened	S2B
Philadelphia Vireo	*Vireo philadelphicus*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2?B
Pine Grosbeak	*Pinicola enucleator*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3B, S5N
Pine Siskin	*Carduelis pinus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Red Crossbill	*Loxia curvirostra*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Red-breasted Nuthatch	*Sitta canadensis*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3B
Ruby-crowned Kinglet	*Regulus calendula*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Endangered	2 May Be At Risk	Special Concern	S2B
Swainson's Thrush	*Catharus ustulatus*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4B
Tennessee Warbler	*Vermivora peregrina*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Veery	*Catharus fuscescens*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4B
Willet	*Tringa semipalmata*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3B
Wilson's Snipe	*Gallinago delicata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
Wilson's Warbler	*Wilsonia pusilla*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
INVERTEBRATES						
Aphrodite Fritillary	*Speyeria aphrodite*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Baltimore Checkerspot	*Euphydryas phaeton*	Not Listed	Not Listed	4 Secure	Not Listed	S2S3
NON-VASCULAR PLANTS						
a Moss	*Tortula truncata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Salted Shell Lichen	*Coccocarpia palmicola*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
VASCULAR PLANTS						
Michaux's Dwarf Birch	*Betula michauxii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Northern Comandra	*Geocaulon lividum*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Pink Pyrola	*Pyrola asarifolia*	Not Listed	Not Listed	4 Secure	Not Listed	S3

2.2 Field Assessment

2.2.1 Methodology

An on-site rare species assessment was completed targeting vegetative SOCI. The vegetative SOCI method employed a random-meander methodology. Special attention was made for SOCI species identified as likely to occur within the Study area during the desktop review. Incidental observations for birds and mammals were also noted. Confirmatory species assessments were made using the Roland's Flora of Nova Scotia (Zinck, 1998), Sedges of Maine (Arsenault et al., 2013), and Nova Scotia Plants (Munro et al., 2014).

2.2.2 Results

One SOCI was identified at the Project site. A Common Loon (listed as 'May be at Risk' by NS DNR) was heard within the vicinity of the dam, however, it was not visually observed nor was any nesting habitat observed within the Study area. No plant SOCI were observed in the Study area during the wetland and rare species assessment.

3.0 WETLAND DELINEATION

3.1 Desktop Review

3.1.1 Methodology

A desktop identification of the location and extent of potential wetlands across the Project site was completed by reviewing the following information sources:

- Satellite and aerial photography;
- Nova Scotia Wet Areas Mapping (WAM) database (NSDNR 2013a);
- Nova Scotia Geomatics Centre; and
- NS Significant Species and Habitats database (NSDNR 2014).

3.1.2 Results

The NSDNR wetlands database identifies one wetland within the Study area (Drawing 2A, Appendix A). The wetland is labeled as a 'Swamp' and appears to be contiguous with the lake. It is located in the western end of the Study area, extending beyond the Study area boundaries.

The WAM database identifies potential wet areas along the edge of the reservoir, particularly immediately east of the Dam and along the western edge.

The Study area is located within the East River/Ruth Falls Flowage/ Northeast Arm Tertiary Watershed, within the East/West (Sheet Harbour) Primary Watershed (Drawing 2B, Appendix A).

3.2 Field Delineation

3.2.1 Methodology

Wetland delineation was completed September 21, 2017. Wetland boundaries, data points, and watercourse (and drainage) flow paths were recorded using a GPS receiver capable of sub 5 m accuracy.

The location of wetland boundaries was determined by confirming the presence/absence of wetland vegetation, hydrology, and soils in the areas of proposed alteration. In order for a wetland determination to be made, the following three criteria must be met:

- Presence of hydrophytic (water loving) vegetation;
- Presence of hydrologic conditions that result in periods of flooding, ponding, or saturation during the growing season; and
- Presence of hydric soils.

A positive indicator must typically be present for all three parameters in order to definitively identify any given site as a wetland (US Army Corp of Engineers 1987). Detailed wetland

delineation methodologies are provided in Appendix C. A Glossary of Commonly Used Terms is provided in Appendix D.

3.2.2 Results

Wetland delineation identified four areas of wetland habitat within the Study area (Drawing 3, Appendix A). Identified wetlands included two treed swamps, one shrub swamp, and one fringe shrub swamp.

Wetland 1 is an outflow Treed Swamp dominated by Red maple (*Acer rubrum*), Balsam fir (*Abies balsamea*), Yellow birch (*Betula allegheniensis*), with a subcanopy of regenerating trees. It has a well-developed herbaceous canopy dominated by Cinnamon fern (*Osmunda cinnamomea*), Sensitive fern (*Onoclea sensibilis*), Fowl manna grass (*Glyceria striata*), and Brownish sedge (*Carex brunnescens*). Additional herbaceous species are present in the form of Water horehound (*Lycopus uniflorus*), Marsh bedstraw (*Galium palustre*), Bluejoint reed grass (*Calamagrostis canadensis*), Whorled wood aster (*Oclemena acuminata*), and Marsh St.John's-wort (*Triadenum fraseri*).

A small area of ponded water with water depths greater than 1 m. Hydrology is present through the remainder of the wetland through surface saturation and water-stained leaves. One outflow drainage channel exists connecting Wetland 1 to Wetland 2. Hydric soil is present as a redox dark surface (F6).

Wetland 2 is a throughflow Treed Swamp dominated by Black spruce (*Picea mariana*), Red maple, and Balsam fir. There is a dense shrub canopy of Lambkill (*Kalmia angustifolia*), Wild raisin (*Viburnum nudum*), Speckled alder (*Alnus incana*), Black spruce, and Steeplebush (*Spiraea tomentosa*). Herbaceous species consist of abundant Cinnamon fern, with Tawny cottongrass (*Eriophorum virginicum)*, Bog aster (*Oclemena nemoralis*), White beakrush (*Rhynchospora alba*), and Fowl manna grass.

Wetland 2 receives hydrology from Wetland 1 as well as through overland flow and is present though overland flow. The substrate is almost entirely covered with *Sphagnum* moss and soils consist of Histosol (120 cm on rock).

Wetland 3 is a small, isolated shrub swamp located at the base of the Dam's earthen berm. It receives water draining down the slope. It is dominated by Leatherleaf (*Chamaedaphne calyculata*) and Sweet gale (*Myrica gale*), with some Red maple and Black spruce trees along the edge. Herbaceous species are dominated by Canada rush (*Juncus canadensis),* White beakrush, Tawny cottongrass, and Small cranberry (*Vaccinium oxycoccos*).

Although located in close proximity to Wetland 2, Wetland 3 is separated by a small ridge with no apparent outflow channels. Hydrology is present through surface saturation and soils consist of shallow histosol (17 cm on rock).

Wetland 4 is a fringe shrub swamp, located downstream of the Dam. It consists largely of emergent shrub species amongst boulders with some small areas of *Sphagnum* on small islands or along the shoreline. The shrub canopy is dominated by White meadowsweet (*Spiraea alba*), Red maple, Sweet gale, Speckled alder, and Canada holly (Ilex verticillata). Herbaceous species are distributed in patches amongst the otherwise dominant shrub canopy and consist of Royal fern (*Osmunda regalis*), Nodding sedge (*Carex gynandra*), New York fern (*Thelypteris noveboracensis*), Tall meadow-rue (*Thalictrum pubescens*), Bluejoint reed grass, and Atlantic manna grass (Glyceria obtusa).

Wetland 4 receives hydrology primarily from overland flow from the river, with water flowing through much of the watercourse. Soils are shallow and consist of histosol on rock (~18 cm).

Wetland characteristics for the wetland pits for all wetlands identified on site are summarized in Table B. A photo log is provided in Appendix E.

Table B: Summary of Wetland Characteristics for Wetland 1

Wetland Identification		Wetland 1	Wetland 2	Wetland 3	Wetland 4
Wetland Area within Project site (ha)		0.0709	0.1266	0.0311	0.0866
UTM Coordinates (NAD83 zone 20T)		539223.6 E, 497802.9 N	539269 E, 4978012.8 N	539276.4 E, 4978055.5 N	539460.6 E, 4977972.7 N
Wetland Type		Treed Swamp	Treed Swamp	Shrub Swamp	Shrub Marsh
Landscape Position		Terrene	Terrene	Terrene	Lotic River - Confined
Landform		Basin	Basin	Basin	Fringe
Waterflow		Outflow	Throughflow	Isolated	Throughflow
Soil Type		F6: Redox Dark Surface	A1: Histosol (120 cm on rock)	A1: Histosol (17 cm on rock)	A1: Histosol (18 cm on boulders)
Surface/Hydrologic Conditions		1) Standing water (> 1m) 2) Surface saturation 3) Water stained leaves	1) Surface saturation	2) Surface saturation	1) Standing water (> 1m) 2) Surface saturation
Wetland Boundary		Moderate	Moderate	Steep/moderate	Moderate
Vegetative Composition	**Herbaceous**	*Glyceria striata* (15%), *Onoclea sensibilis* (65%), *Cornus Canadensis* (8%), *Lycopus uniflorus* (4%)	*Eriophorum virginicum* (10%), *Oclemena nemoralis (1%),* *Kalmia angustifolia* (3%), *Picea mariana* (5%), *Rhynchospora alba* (15%), *Viburnum nudum* (4%), *Osmunda cinnamomea* (10%), *Vaccinium oxycoccos* (2%)	*Juncus canadensis* (3%), *Rhynchospora alba* (8%), *Eriophorum virginicum* (5%), Vaccinium oxycoccos (1%), *Chamaedaphne calyculata* (15%), *Myrica gale* (11%)	*Glyceria striata* (7%), *Osmunda regalis* (43%), Carex gynandra (5%), *Thalictrum pubescens*(15%), *Calamagrostis canadensis* (12%)
	Shrub	*Abies balsamea* (7%), *Betula allegheniensis* (4%)	Picea *mariana (12%),* *Acer rubrum* (12%)	*Chamaedaphne calyculata* (15%), *Myrica gale* (11%)	*Spiraea alba* (20%), *Acer rubrum* (13%), *Myrica gale* (20%), *Alnus incana* (18%), *Ilex verticillata* (3%)
	Tree	*Abies balsamea* (15%), *Betula allegheniensis* (25%), *Acer rubrum* (70%)	*Picea mariana* (15%), *Acer rubrum* (22%)	*Acer rubrum* (7%), *Picea mariana* (8%)	*Acer rubrum* (35%), *Picea mariana* (4%)

3.2.3 Upland Habitat

Upland habitat consists of mixedwood forest dominated by Balsam fir, Paper birch (*Betula papyrifera*), and Red maple. A well-developed shrub canopy of regenerating tree species exists, dominated by Balsam fir. There is a minimal herbaceous canopy of Canada mayflower (Maianthemum candensis), Starflower (*Trientalis borealis*), Wild sarsaparilla (*Aralia nudicaulis*), Wood fern (*Dryopteris* sp.), Bracken fern (*Pteridium aquilinum),* and Red maple seedlings. Soils are loamy and the substrate is covered in leaf and needle detritus, with occasional mossy patches. There is abundant deadfall.

4.0 FUNCTIONAL ASSESSMENT

4.1 Methodology

A wetland functional assessment was completed using the Wetland Ecosystem Services Protocol – Atlantic Canada Version 1.2 (WESP-AC) protocol (Adamus, 2016). WESP-AC is a standardized rapid assessment methodology for the important natural functions of all types of non-tidal wetlands in Atlantic Canada. Users input answers for 38 multiple-choice questions about a wetland by consulting aerial imagery and consulting specific regulatory sources into a spreadsheet. Upon visiting the wetland, an additional 75 questions are answered based on field observations.

WESP-AC generates scores (0 to 10) and ratings (Lower, Moderate, Higher) for each of a wetland's 15 functions and benefits based on the input answers. In addition, scores are provided for 5 grouped functions based on environmental similarities. Scoring is based on logic models programmed into the calculator spreadsheet. The spreadsheet contains a rationale for use of each metric or indicator in every model, often with citation of supporting scientific literature. WESP-AC scores are presented in their raw form and as normalized, relative to other wetlands in a specified region. The current version of WESP-AC pertains to New Brunswick, having been calibrated to 98 non-tidal wetlands throughout New Brunswick. The calibration wetlands were selected with minimal bias through a statistical procedure intended to encompass as much variation as possible.

Table C outlines the benefits of wetland functions scored by WESP-AC [taken from the WESP-AC manual (Adamus, 2016)].

Table C: Benefits of Wetland Functions Scored by WESP-AC in Atlantic Canada

FUNCTION	DEFINITION	POTENTIAL BENEFITS
Hydrologic Functions		
Water Storage and Delay	The effectiveness for storing runoff or delaying the downslope movement of surface water for long or short periods.	Flood control, maintain ecological systems.
Stream Flow Support	The effectiveness for contributing water to streams especially during the driest part of a growing season.	Support fish and other aquatic life.

FUNCTION	DEFINITION	POTENTIAL BENEFITS
Water Quality Maintenance Functions		
Water Cooling	The effectiveness for maintaining or reducing temperature of downslope waters.	Support coldwater fish and other aquatic life.
Sediment Retention & Stabilization	The effectiveness for intercepting and filtering suspended inorganic sediments thus allowing their deposition, as well as reducing energy of waves and currents, resisting excessive erosion, and stabilizing underlying sediments or soil.	Maintain quality of receiving waters. Protect shoreline structures from erosion.
Phosphorus Retention	The effectiveness for retaining phosphorus for long periods (>1 growing season).	Maintain quality of receiving waters.
Nitrate Removal & Retention	The effectiveness for retaining particulate nitrate and converting soluble nitrate and ammonium to nitrogen gas while generating little or no nitrous oxide (a potent greenhouse gas).	Maintain quality of receiving waters.
Organic Nutrient Export	The effectiveness for producing and subsequently exporting organic nutrients (mainly carbon), either particulate or dissolved.	Support food chains in receiving waters.
Ecological (Habitat) Functions		
Fish Habitat	The capacity to support an abundance and diversity of native fish (both anadromous and resident species).	Support recreational and ecological values.
Aquatic Invertebrate Habitat	The capacity to support or contribute to an abundance or diversity of invertebrate animals which spend all or part of their life cycle underwater or in moist soil. Includes dragonflies, midges, clams, snails, water beetles, shrimp, aquatic worms, and others.	Support salmon and other aquatic life. Maintain regional biodiversity.
Amphibian & Reptile Habitat	The capacity to support or contribute to an abundance or diversity of native frogs, toads, salamanders, and turtles.	Maintain regional biodiversity.
Waterbird Feeding Habitat	The capacity to support or contribute to an abundance or diversity of waterbirds that migrate or winter but do not breed in the region.	Support hunting and ecological values. Maintain regional biodiversity.
Waterbird Nesting Habitat	The capacity to support or contribute to an abundance or diversity of waterbirds that nest in the region.	Maintain regional biodiversity.
Songbird, Raptor, & Mammal Habitat	The capacity to support or contribute to an abundance or diversity of native songbird, raptor, and mammal species and functional groups, especially those that are most dependent on wetlands or water.	Maintain regional biodiversity.
Native Plant Habitat, Pollinator Habitat	The capacity to support or contribute to a diversity of native, hydrophytic, vascular plant species, communities, and/or functional groups, as well as the pollinating insects linked to them.	Maintain regional biodiversity and food chains.

FUNCTION	DEFINITION	POTENTIAL BENEFITS
Public Use & Recognition*	Prior designation of the wetland, by a natural resource or environmental agency, as some type of special protected area. Also, the potential and actual use of a wetland for low- intensity outdoor recreation, education, or research.	Commercial and social benefits of recreation. Protection of prior public investments.
Grouped Functions		
Hydrologic	Identical to the Surface Water Storage score.	
Water Quality Support	A function of Sediment Retention, Phosphorous Retention, Nitrate Removal and Retention, and Carbon Sequestration.	
Aquatic support	A function of Stream Flow Support, Aquatic Invertebrate Habitat, Organic Nutrient Export, and Water Cooling.	
Aquatic Habitat	A function of Anadromous Fish Habitat, Resident Fish Habitat, Amphibian and Turtle Habitat, Waterbird Feeding Habitat, and Waterbird Nesting Habitat.	
Transition Habitat	A function of Songbird, Raptor, & Mammal Habitat, Native Plant Habitat, and Pollinator Habitat.	

* a benefit rather than a function of wetlands

4.2 Results

The results of the WESP-AC functional assessment identified that Wetlands 1-4 serve high benefit to the surrounding area for the following wetland functions:

- Water Cooling (WL4);
- Phosphorus Retention (WL4);
- Nitrate Removal & Retention (WL4);
- Amphibian & Turtle Habitat (WL 1-4);
- Native Plant Habitat (WL 1-3);
- Hydrologic Group (WL1 and 2);
- Water Quality Support Group (WL4); and
- Transition Habitat (WL 1-4).

Wetlands 1 and 2 had similar WESP-AC scores due to their similarities as predominantly treed swamps. They had moderate or high function scores for surface water storage, sediment retention & stabilization, phosphorus retention, and carbon sequestration, largely related to their lack of permanent hydrologic outflow connection. Additionally, they both provide good habitat for local wildlife, birds, pollinators, and amphibians. They are both in good ecologic condition, likely due to their remote nature. However, their pristine nature also makes them sensitive to natural and anthropogenic disturbances, represented by their high wetland sensitivity and wetland risk scores. They scored higher for stressors due to the impact of the dam on their formation.

Wetland 3 also had similar WESP-AC scores to Wetlands 1 and 2. They all constitute swamp wetlands, dominated by native plants with no permanent outflow connection. However, as the existence of Wetland 3 is much more closely tied to the presence of the dam, it scored

moderately for wetland ecological condition. As it is in a lesser condition, the wetland sensitivity score was also moderate.

Wetland 4 is a hydrologically different wetland than the others and thus its WESP-AC scores reflect that. It is connected to a large permanent watercourse, and has high function providing stream flow support and water cooling. Additionally, its importance for sediment retention & stabilization, phosphorus retention, and nitrate removal & retention are evident through the high benefit score, yet low function scores. It scored high function for organic nutrient export, and for providing habitat for aquatic invertebrates. As it has a permanent watercourse connection, it scored higher benefit for the Water Quality Support group, unlike the other wetlands. It is in good wetland condition, and due to its location, is considered only moderate sensitive. Like the other wetlands, it also scored high for wetland risk and stressors.

Table D outlines the WESP-AC scores for Wetlands 1-4. The WESP-AC Office, Field, and Stressor Forms and output score spreadsheets are available in Appendix F.

Table D: Normalized Function and Benefit Scores for Wetland 1-4

Wetland Functions or Other Attributes	Wetland 1		Wetland 2		Wetland 3		Wetland 4	
	Functions	Benefits	Functions	Benefits	Functions	Benefits	Functions	Benefits
Specific Functions								
Surface Water Storage (WS)	6.85 Higher	1.43 Lower	7. 82 Higher	1.43 Lower	8.12 Higher	1.43 Lower	1.17 Lower	0.48 Lower
Stream Flow Support (SFS)	0.97 Lower	0.00 Lower	1.56 Lower	0.00 Lower	0.00 Lower	0.00 Lower	6.88 Higher	4.85 Moderate
Water Cooling (WC)	1.96 Lower	0.00 Lower	0.00 Lower	0.00 Lower	1.80 Lower	0.00 Lower	8.10 Higher	6.25 Higher
Sediment Retention & Stabilization (SR)	3.02 Moderate	0.67 Lower	6.07 Higher	0.37 Lower	10.00 Higher	1.29 Lower	1.15 Lower	7.11 Moderate
Phosphorus Retention (PR)	3.64 Moderate	0.00 Lower	5.25 Higher	0.00 Lower	10.00 Higher	0.78 Lower	0.88 Lower	6.85 Higher
Nitrate Removal & Retention (NR)	6.27 Higher	0.00 Lower	3.04 Lower	0.00 Lower	10.00 Higher	2.50 Lower	2.35 Lower	10.00 Higher
Carbon Sequestration (CS)	5.06 Moderate		8.82 Higher		5.79 Moderate		2.46 Lower	
Organic Nutrient Export (OE)	4.75 Moderate		6.33 Higher		0.00 Lower		7.48 Higher	
Anadromous Fish Habitat (FA)	0.00 Lower	0.00 Lower	0.00 Lower	0.00 Lower	0.00 Lower	0.00 Lower	4.05 Moderate	2.43 Moderate
Resident Fish Habitat (FR)	0.00 Lower	0.00 Lower	0.00 Lower	0.00 Lower	0.00 Lower	0.00 Lower	4.06 Moderate	2.54 Moderate
Aquatic Invertebrate Habitat (INV)	5.85 Moderate	5.12 Moderate	5.75 Moderate	1.18 Moderate	4.32 Moderate	4.95 Moderate	7.76 Higher	5.12 Moderate
Amphibian & Turtle Habitat (AM)	7.52 Higher	7.43 Higher	3.31 Moderate	2.64 Moderate	7.25 Higher	6.34 Higher	6.19 Higher	4.37 Higher
Waterbird Feeding Habitat (WBF)	7.57 Higher		0.00 Lower		5.73 Moderate		4.56 Moderate	
Waterbird Nesting Habitat (WBN)	5.42 Higher		0.00 Lower		6.46 Higher		4.01 Moderate	

Wetland Functions or Other Attributes	Wetland 1		Wetland 2		Wetland 3		Wetland 4	
	Functions	Benefits	Functions	Benefits	Functions	Benefits	Functions	Benefits
Songbird, Raptor, & Mammal Habitat (SBM)	7.72 Higher		8.29 Higher		7.98 Higher		6.33 Moderate	
Pollinator Habitat (POL)	7.99 Higher		8.90 Higher		9.04 Higher		7.96 Higher	
Native Plant Habitat (PH)	4.85 Moderate	7.51 Higher	6.77 Higher	8.22 Higher	6.63 Higher	8.14 Higher	8.13 Higher	6.83 Moderate
Public Use & Recognition (PU)		2.02 Lower		2.02 Lower		2.10 Lower		2.24 Moderate
Grouped Functions								
Hydrologic Group (WS)	6.85 Higher	1.43 Lower	7.82 Higher	1.43 Lower	8.12 Higher	1.43 Lower	1.17 Lower	0.48 Lower
Water Quality Support (SR, PR, NR, CS)	2.98	2.12 Lower	5.74	2.08 Lower	9.90	3.78 Moderate	0.34	9.99 Higher
Aquatic Support (SFS, INV, OE, WC)	4.01	2.99 Lower	4.03	0.62 Lower	1.70	2.89 Lower	8.09	5.22 Moderate
Aquatic Habitat (FA, FR, AM, WBF, WBN)	6.53	3.96 Moderate	1.67	1.50 Lower	6.09	3.40 Moderate	5.92	3.57 Moderate
Transition Habitat (SBM, PH, POL)	5.25	8.67 Higher	6.86	9.49 Higher	6.91	9.39 Higher	7.88	7.88 Higher
Other Attributes								
Wetland Ecological Condition (EC)		8.62 Higher		7.24 Higher		4.48 Moderate		7.93 Higher
Wetland Sensitivity (Sens)		8.10 Higher		7.68 Higher		6.02 Moderate		4.64 Moderate
Wetland Risk		10.00 Higher		10.00 Higher		10.00 Higher		10.00 Higher
Wetland Stressors (STR)		9.75 Higher		9.49 Higher		10.00 Higher		10.00 Higher

5.0 CONCLUSIONS

Field surveys completed in the Study area at the Ruth Falls Dam identified 4 wetlands; 2 treed swamps, 1 shrub swamp, and 1 shrub marsh. Functional assessments were completed on these wetlands identifying important functions and benefits of each wetland.

A rare species assessment was also completed within the Study area, focusing on plant species of conservational interest. One bird SOCI was observed at the Study area. The Common Loon is listed by NSDNR as 'May be at Risk', however, no nesting habitat was observed within the Study area.

6.0 STATEMENT OF QUALIFICATIONS AND LIMITATIONS

This report (the "Report") has been prepared by Strum Consulting ("Consultant") for the benefit of Nova Scotia Power Inc. ("Client") in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the "Agreement").

The information, data, recommendations, and conclusions contained in the Report (collectively, the "Information"):

- Is subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the "Limitations");
- Represents Consultant's professional judgement in light of the Limitations and industry standards for the preparation of similar reports;
- May be based on information provided to Consultant which has not been independently verified;
- Has not been updated since the date of issuance of the Report and its accuracy is limited to the time period and circumstances in which it was collected, processed, made or issued;
- Must be read as a whole and sections thereof should not be read out of such context;
- Was prepared for the specific purposes described in the Report and the Agreement; and
- In the case of subsurface, environmental, or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time.

Consultant shall be entitled to rely upon the accuracy and completeness of information that was provided and has no obligation to update such information. Consultant accepts no responsibility for any events or circumstances that may have occurred since the date on which the Report was prepared and, in the case of subsurface, environmental, or geotechnical conditions, is not responsible for any variability in such conditions, geographically or over time.

Consultant agrees that the Report represents its professional judgement as described above and that the Information has been prepared for the specific purpose and use described in the Report and the Agreement, but Consultant makes no other representations, or any guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof.

The Report is to be treated as confidential and may not be used or relied upon by third parties, except:

- As agreed in writing by Consultant and Client;
- As required by law; and
- For use by governmental reviewing agencies.

Consultant accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss, or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information ("improper use of the Report"), except to the extent those parties have obtained the prior written consent of Consultant to use and rely upon the Report and the Information. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations forms part of the Report and any use of the Report is subject to the terms hereof.

Should additional information become available, Strum requests that this information be brought to our attention immediately so that we can re-assess the conclusions presented in this report. This report was prepared by Heather Mosher, M.Sc., Environmental Scientist, and was reviewed by Shawn Duncan, B.Sc., Vice President.

7.0 REFERENCES

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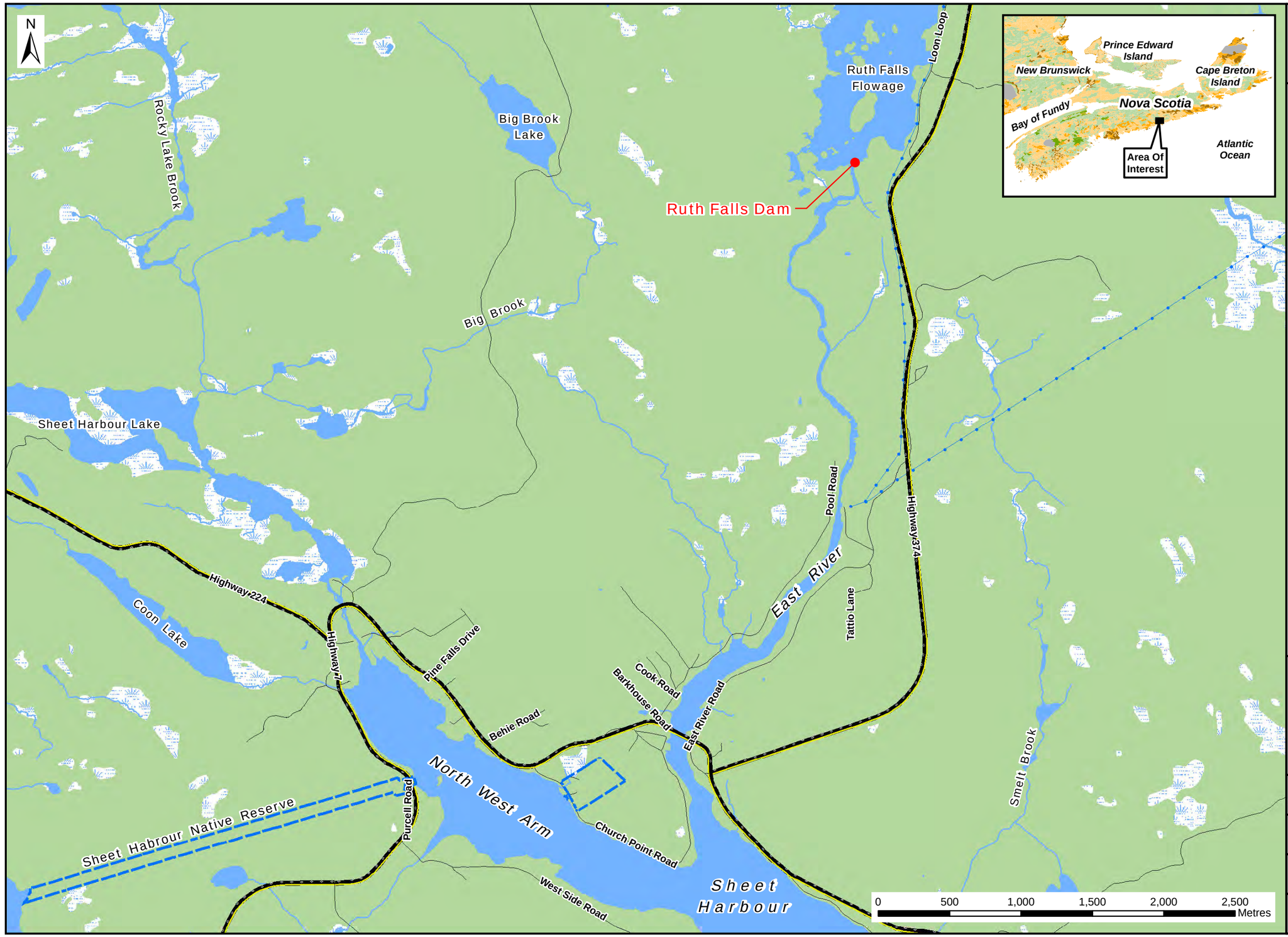
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APPENDIX A
DRAWINGS



Notes:

1. Reference: Digital Topographic Mapping by Nova Scotia Geomatics Centre.
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

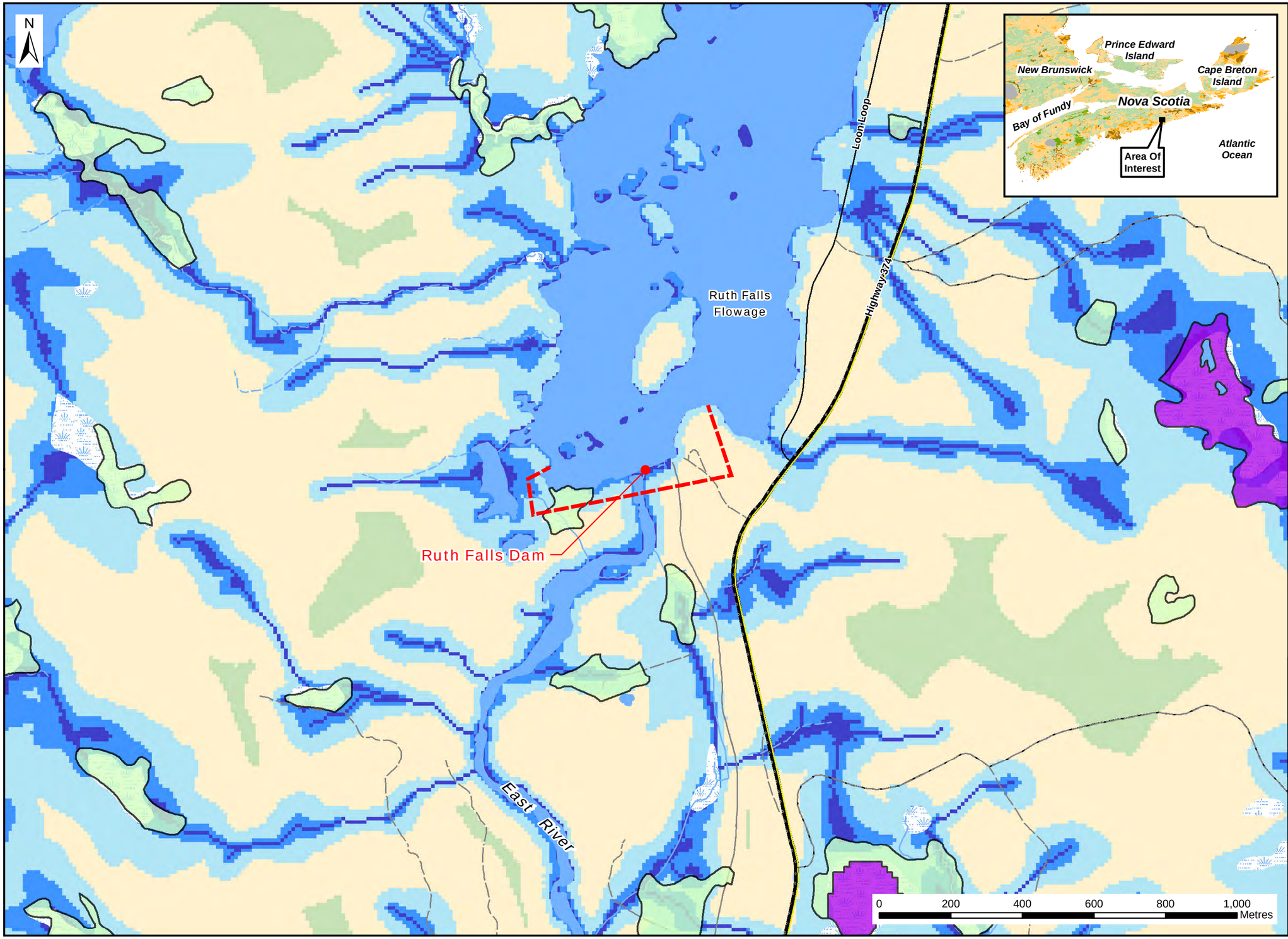
- Native Reserve
- Public Roads
- Major Roads and Highways
- Existing Transmission Lines
- Mapped Stream
- Water Bodies
- Mapped Wet Areas

Ruth Falls Dam Site Location

Strum CONSULTING

*Engineering * Surveying * Environmental*
*Bedford * Antigonish * Moncton * Deer Lake*

Date: September 2017	Project #: 17-6170
Scale: 1:25,000	Drawing #: 1
Drawn By: H. Serhan	
Checked By: M. Henley	



Notes:

1. Reference: Digital Topographic Mapping by Nova Scotia Geomatics Centre. Wetland Inventory & Wet Areas Mapping By Nova Scotia Department of Natural Resources (NS DNR).
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Study Area
- Major Roads and Highways
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies
- Mapped Wet Area

NS DNR Wetland Inventory (Habitat)

- Bog
- Bog or Fen
- Fen
- Marsh
- Salt Marsh
- Swamp
- Water

Depth to Water Table (m)

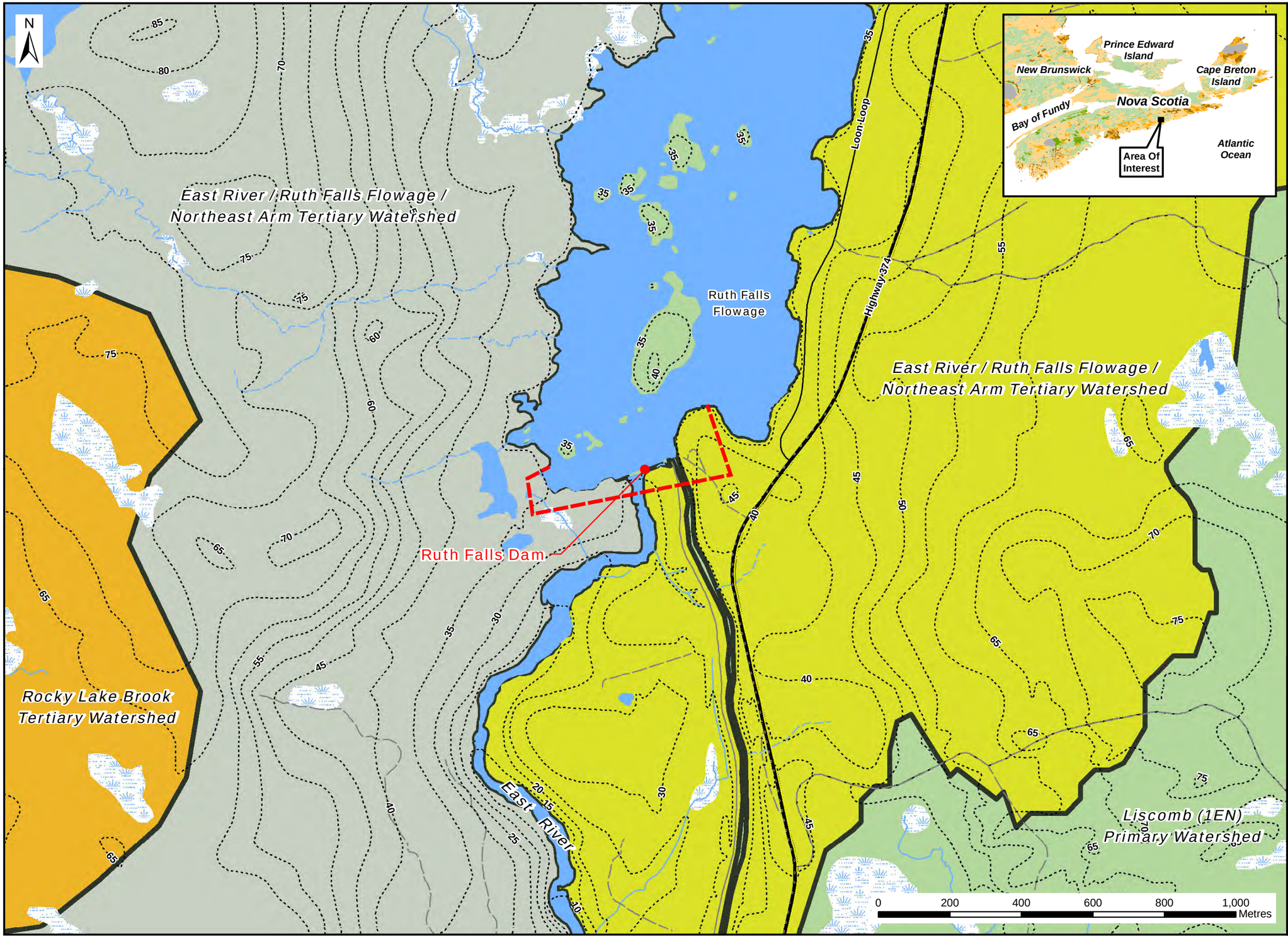
- 0 - 0.10 m
- 0.11 - 0.50 m
- 0.51 - 2 m
- 2.01 - 10 m
- > 10 m

Ruth Falls Dam Desktop Review Results

Strum CONSULTING

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*Bedford * Antigonish * Moncton * Deer Lake*

Date: September 2017	Project #: 17-6170
Scale: 1:10,000	Drawing #: **2A**
Drawn By: H. Serhan	
Checked By: M. Henley	



Notes:

1. Reference: Digital Topographic Mapping by Nova Scotia Geomatics Centre. East/West (Sheet Harbour-1EM) Primary Watershed by Nova Scotia Department of Natural Resources (NS DNR).
2. Projection: NAD83(CSRS), UTM Zone 20 North.

Legend:

- Study Area
- Major Roads and Highways
- Public Roads
- Access Roads / Trails
- Mapped Stream
- Mapped Indefinite Stream
- Water Bodies
- Mapped Wet Area

Ruth Falls Dam Tertiary Watershed

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Date: September 2017	Project #: 17-6170
Scale: 1:10,000	Drawing #: **2B**
Drawn By: H. Serhan	
Checked By: M. Henley	



Notes:

1. Reference: Digital Topographic Mapping by Nova Scotia Geomatics Centre. Bing Maps Satellite Imagery.
2. Projection: NAD83(CSRS), UTM Zone 20 North.
3. GPS Data Collected is Typically to +/-5m Accuracy.

Legend:

- Study Area
- Field Identified Drainage Channel
- Confirmed Wetland Boundary

Field Identified Wetland (Habitat)

- Shrub Marsh
- Shrub Swamp
- Treed Swamp

Ruth Falls Dam Survey Results

Strum CONSULTING

*Engineering * Surveying * Environmental*
*Bedford * Antigonish * Moncton * Deer Lake*

Date: September 2017	Project #: 17-6170
Scale: 1:3000	Drawing #: 3
Drawn By: H. Serhan	
Checked By: M. Henley	

APPENDIX B
SPECIES AT RISK TABLES

Table 1: Flora and Fauna SOCI within 100 km of the Study Area, Ruth Falls ***Project#17-6170***

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
FISH						
Alewife	*Alosa pseudoharengus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
American Eel	*Anguilla rostrata*	Not Listed	Not Listed	4 Secure	Threatened	S2
Atlantic Salmon	*Salmo salar*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Atlantic Salmon - Inner Bay of Fundy pop.	*Salmo salar pop. 1*	Endangered	Not Listed	2 May Be At Risk	Endangered	S1
Atlantic Sturgeon	*Acipenser oxyrinchus*	Not Listed	Not Listed	2 May Be At Risk	Threatened	S2
Brook Trout	*Salvelinus fontinalis*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Lake Trout	*Salvelinus namaycush*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Striped Bass- Bay of Fundy pop.	*Morone saxatilis pop. 2*	Not Listed	Not Listed	2 May Be At Risk	Endangered	S1B
Striped Bass- Southern Gulf of St Lawrence pop.	*Morone saxatilis pop. 1*	Not Listed	Not Listed	2 May Be At Risk	Special Concern	S2S3N
BIRDS AND BATS						
American Bittern	*Botaurus lentiginosus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
American Coot	*Fulica americana*	Not Listed	Not Listed	5 Undetermined	Not At Risk	S1B
American Golden-Plover	*Pluvialis dominica*	Not Listed	Not Listed	3 Sensitive	Not Listed	S1S2M
American Kestrel	*Falco sparverius*	Not Listed	Not Listed	4 Secure	Not Listed	S3B
American Three-toed Woodpecker	*Picoides dorsalis*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1?
Arctic Tern	*Sterna paradisaea*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3B
Atlantic Puffin	*Fratercula arctica*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B,S5N
Baltimore Oriole	*Icterus galbula*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3B
Bank Swallow	*Riparia riparia*	Not Listed	Not Listed	2 May Be At Risk	Threatened	S2S3B
Barn Swallow	*Hirundo rustica*	Not Listed	Endangered	1 At Risk	Threatened	S2S3B
Barrow's Goldeneye - Eastern pop.	*Bucephala islandica (Eastern pop.)*	Special Concern	Not Listed	1 At Risk	Special Concern	S1N
Bay-breasted Warbler	*Dendroica castanea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Black-backed Woodpecker	*Picoides arcticus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4
Black-bellied Plover	*Pluvialis squatarola*	Not Listed	Not Listed	4 Secure	Not Listed	S3M
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3B
Black-crowned Night-heron	*Nycticorax nycticorax*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1B
Black-headed Gull	*Chroicocephalus ridibundus*	Not Listed	Not Listed	4 Secure	Not Listed	S3N
Black-legged Kittiwake	*Rissa tridactyla*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B,S5N
Blackpoll Warbler	*Dendroica striata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Blue-winged Teal	*Anas discors*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3S4B
Bobolink	*Dolichonyx oryzivorus*	Not Listed	Not Listed	3 Sensitive	Threatened	S3S4B
Boreal Chickadee	*Poecile hudsonica*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Boreal Owl	*Aegolius funereus*	Not Listed	Not Listed	5 Undetermined	Not At Risk	S2?B
Brown Thrasher	*Toxostoma rufum*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1B
Brown-headed Cowbird	*Molothrus ater*	Not Listed	Not Listed	4 Secure	Not Listed	S2B
Buff-breasted Sandpiper	*Tryngites subruficollis*	Not Listed	Not Listed	8 Accidental	Special Concern	SNA
Bufflehead	*Bucephala albeola*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4N
Canada Warbler	*Wilsonia canadensis*	Threatened	Endangered	1 At Risk	Threatened	S3B
Cape May Warbler	*Dendroica tigrina*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2B
Chimney Swift	*Chaetura pelagica*	Threatened	Endangered	1 At Risk	Threatened	S2B,S1M
Cliff Swallow	*Petrochelidon pyrrhonota*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3B
Common Eider	*Somateria mollissima*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Common Goldeneye	*Bucephala clangula*	Not Listed	Not Listed	4 Secure	Not Listed	S2B,S5N
Common Moorhen	*Gallinula chloropus*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1B
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	1 At Risk	Threatened	S2B
Common Tern	*Sterna hirundo*	Not Listed	Not Listed	3 Sensitive	Not At Risk	S3B
Cooper's Hawk	*Accipiter cooperii*	Not Listed	Not Listed	5 Undetermined	Not At Risk	S1?B
Eastern Bluebird	*Sialia sialis*	Not Listed	Not Listed	3 Sensitive	Not At Risk	S3B
Eastern Kingbird	*Tyrannus tyrannus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Eastern Meadowlark	*Sturnella magna*	Not Listed	Not Listed	3 Sensitive	Threatened	SHB
Eastern Pipistrelle	*Perimyotis subflavus*	Endangered	Endangered	1 At Risk	Endangered	S1
Eastern Wood-Pewee	*Contopus virens*	Not Listed	Vulnerable	3 Sensitive	Special Concern	S3S4B
Evening Grosbeak	*Coccothraustes vespertinus*	Not Listed	Not Listed	4 Secure	Special Concern	S3S4B,S3N
Fox Sparrow	*Passerella iliaca*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4B
Gadwall	*Anas strepera*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2B
Gray Catbird	*Dumetella carolinensis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3B
Gray Jay	*Perisoreus canadensis*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Great Cormorant	*Phalacrocorax carbo*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Great Crested Flycatcher	*Myiarchus crinitus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1B
Greater Yellowlegs	*Tringa melanoleuca*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B,S3S4M
Harlequin Duck - Eastern pop.	*Histrionicus histrionicus pop. 1*	Special Concern	Endangered	1 At Risk	Special Concern	S2N
Hoary Bat	*Lasiurus cinereus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2B, S1M
Hudsonian Godwit	*Limosa haemastica*	Not Listed	Not Listed	3 Sensitive	Not Listed	S1S2M
Hudsonian Whimbrel	*Numenius phaeopus hudsonicus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3M
Indigo Bunting	*Passerina cyanea*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1?B
Killdeer	*Charadrius vociferus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Lapland Longspur	*Calcarius lapponicus*	Not Listed	Not Listed	4 Secure	Not Listed	S3?N
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Not Listed	Not Listed	4 Secure	Not Listed	S3B,S5M
Least Sandpiper	*Calidris minutilla*	Not Listed	Not Listed	4 Secure	Not Listed	S1B,S3M
Lesser Yellowlegs	*Tringa flavipes*	Not Listed	Not Listed	4 Secure	Not Listed	S3M
Little Brown Myotis	*Myotis lucifugus*	Endangered	Endangered	1 At Risk	Endangered	S1
Long-eared Owl	*Asio otus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3
Nelson's Sparrow	*Ammodramus nelsoni*	Not Listed	Not Listed	4 Secure	Not At Risk	S3S4B
Northern Bobwhite	*Colinus virginianus*	Endangered	Not Listed	Not Listed	Endangered	Not Listed
Northern Goshawk	*Accipiter gentilis*	Not Listed	Not Listed	4 Secure	Not At Risk	S3S4
Northern Harrier	*Circus cyaneus*	Not Listed	Not Listed	4 Secure	Not At Risk	S3S4B
Northern Long-eared Myotis	*Myotis septentrionalis*	Endangered	Endangered	1 At Risk	Endangered	S1
Northern Mockingbird	*Mimus polyglottos*	Not Listed	Not Listed	4 Secure	Not Listed	S1B
Northern Pintail	*Anas acuta*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1B
Northern Shoveler	*Anas clypeata*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2B
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened	1 At Risk	Threatened	S2B
Pectoral Sandpiper	*Calidris melanotos*	Not Listed	Not Listed	4 Secure	Not Listed	S2S3M
Philadelphia Vireo	*Vireo philadelphicus*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2?B
Pine Grosbeak	*Pinicola enucleator*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3B,S5N
Pine Siskin	*Carduelis pinus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Pine Warbler	*Dendroica pinus*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1B
Piping Plover melodus ssp	*Charadrius melodus melodus*	Endangered	Endangered	1 At Risk	Endangered	S1B

Table 1: Flora and Fauna SOCI within 100 km of the Study Area, Ruth Falls *Project#17-6170*

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
Purple Martin	*Progne subis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	SHB
Purple Sandpiper	*Calidris maritima*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3?N
Red Crossbill	*Loxia curvirostra*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Red Knot rufa ssp	*Calidris canutus rufa*	Not Listed	Endangered	1 At Risk	Endangered	S2M
Red Phalarope	*Phalaropus fulicarius*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3M
Red-breasted Merganser	*Mergus serrator*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4B,S5N
Red-breasted Nuthatch	*Sitta canadensis*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Red-necked Phalarope	*Phalaropus lobatus*	Not Listed	Not Listed	3 Sensitive	Special Concern	S2S3M
Roseate Tern	*Sterna dougallii*	Endangered	Endangered	1 At Risk	Endangered	S1B
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3B
Rough-legged Hawk	*Buteo lagopus*	Not Listed	Not Listed	4 Secure	Not At Risk	S3N
Ruby-crowned Kinglet	*Regulus calendula*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Ruddy Duck	*Oxyura jamaicensis*	Not Listed	Not Listed	4 Secure	Not Listed	S1B
Ruddy Turnstone	*Arenaria interpres*	Not Listed	Not Listed	4 Secure	Not Listed	S3M
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Endangered	2 May Be At Risk	Special Concern	S2B
Sanderling	*Calidris alba*	Not Listed	Not Listed	4 Secure	Not Listed	S3M,S2N
Savannah Sparrow princeps ssp	*Passerculus sandwichensis princeps*	Special Concern	Not Listed	3 Sensitive	Special Concern	S1B
Scarlet Tanager	*Piranga olivacea*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2B
Semipalmated Plover	*Charadrius semipalmatus*	Not Listed	Not Listed	4 Secure	Not Listed	S1B,S3S4M
Semipalmated Sandpiper	*Calidris pusilla*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3M
Short-billed Dowitcher	*Limnodromus griseus*	Not Listed	Not Listed	4 Secure	Not Listed	S3M
Short-eared Owl	*Asio flammeus*	Special Concern	Not Listed	2 May Be At Risk	Special Concern	S1S2B
Spotted Sandpiper	*Actitis macularius*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Swainson's Thrush	*Catharus ustulatus*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4B
Tennessee Warbler	*Vermivora peregrina*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Turkey Vulture	*Cathartes aura*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3B
Veery	*Catharus fuscescens*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4B
Vesper Sparrow	*Pooecetes gramineus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2B
Virginia Rail	*Rallus limicola*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2S3B
Warbling Vireo	*Vireo gilvus*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1B
Whip-Poor-Will	*Caprimulgus vociferus*	Threatened	Threatened	1 At Risk	Threatened	S1?B
White-rumped Sandpiper	*Calidris fuscicollis*	Not Listed	Not Listed	4 Secure	Not Listed	S3M
Willet	*Tringa semipalmata*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3B
Willow Flycatcher	*Empidonax traillii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2B
Wilson's Snipe	*Gallinago delicata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Wilson's Warbler	*Wilsonia pusilla*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Wood Thrush	*Hylocichla mustelina*	Not Listed	Not Listed	5 Undetermined	Threatened	SUB
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
HERPTILES						
Four-toed Salamander	*Hemidactylium scutatum*	Not Listed	Not Listed	4 Secure	Not At Risk	S3
Snapping Turtle	*Chelydra serpentina*	Special Concern	Vulnerable	3 Sensitive	Special Concern	S3
Wood Turtle	*Glyptemys insculpta*	Threatened	Threatened	3 Sensitive	Threatened	S2
MAMMALS						
Long-finned Pilot Whale	*Globicephala melas*	Not Listed	Not Listed	Not Listed	Not At Risk	S2S3
Moose	*Alces americanus*	Not Listed	Endangered	1 At Risk	Not Listed	S1
INVERTEBRATES						
Acadian Hairstreak	*Satyrium acadica*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1
Aphrodite Fritillary	*Speyeria aphrodite*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Arctic Fritillary	*Boloria chariclea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Baltimore Checkerspot	*Euphydryas phaeton*	Not Listed	Not Listed	4 Secure	Not Listed	S2S3
Banded Hairstreak	*Satyrium calanus*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2
Banded Hairstreak	*Satyrium calanus falacer*	Not Listed	Not Listed	1 At Risk	Not Listed	S2
Black Meadowhawk	*Sympetrum danae*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Bog Elfin	*Callophrys lanoraieensis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3
Broadtailed Shadowdragon	*Neurocordulia michaeli*	Not Listed	Not Listed	Not Listed	Not Listed	S1
Bronze Copper	*Lycaena hyllus*	Not Listed	Not Listed	4 Secure	Not Listed	S2
Brook Floater	*Alasmidonta varicosa*	Not Listed	Threatened	3 Sensitive	Special Concern	S1S2
Clamp-Tipped Emerald	*Somatochlora tenebrosa*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Common Roadside-Skipper	*Amblyscirtes vialis*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Compton Tortoiseshell	*Nymphalis l-album*	Not Listed	Not Listed	4 Secure	Not Listed	S1S2
Eastern Comma	*Polygonia comma*	Not Listed	Not Listed	1 At Risk	Not Listed	S1?
Eastern Lampmussel	*Lampsilis radiata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4
Eastern Pearlshell	*Margaritifera margaritifera*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Eastern Red Damsel	*Amphiagrion saucium*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Elfin Skimmer	*Nannothemis bella*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Forcipate Emerald	*Somatochlora forcipata*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3
Green Comma	*Polygonia faunus*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Grey Comma	*Polygonia progne*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Harlequin Darner	*Gomphaeschna furcillata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Henry's Elfin	*Callophrys henrici*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Jutta Arctic	*Oeneis jutta*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3
Juvenal's Duskywing	*Erynnis juvenalis*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Kennedy's Emerald	*Somatochlora kennedyi*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Lance-Tipped Darner	*Aeshna constricta*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Maine Snaketail	*Ophiogomphus mainensis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3
Milbert's Tortoiseshell	*Aglais milberti*	Not Listed	Not Listed	4 Secure	Not Listed	S2
Monarch	*Danaus plexippus*	Special Concern	Not Listed	3 Sensitive	Endangered	S2B
Mottled Darner	*Aeshna clepsydra*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Northern Cloudywing	*Thorybes pylades*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Northern Pygmy Clubtail	*Lanthus parvulus*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Ocellated Darner	*Boyeria grafiana*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Orange Bluet	*Enallagma signatum*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Pepper and Salt Skipper	*Amblyscirtes hegon*	Not Listed	Not Listed	4 Secure	Not Listed	S2S3
Prince Baskettail	*Epitheca princeps*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Quebec Emerald	*Somatochlora brevicincta*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Question Mark	*Polygonia interrogationis*	Not Listed	Not Listed	4 Secure	Not Listed	S3B
Rusty Snaketail	*Ophiogomphus rupinsulensis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3

Table 1: Flora and Fauna SOCI within 100 km of the Study Area, Ruth Falls ***Project#17-6170***

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
Salt Marsh Copper	*Lycaena dospassosi*	Not Listed	Not Listed	1 At Risk	Not Listed	S2
Satyr Comma	*Polygonia satyrus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S1?
Skillet Clubtail	*Gomphus ventricosus*	Not Listed	Not Listed	2 May Be At Risk	Endangered	S1
Spot-Winged Glider	*Pantala hymenaea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?B
Striped Hairstreak	*Satyrium liparops*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2S3
Striped Hairstreak	*Satyrium liparops strigosum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Taiga Bluet	*Coenagrion resolutum*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Triangle Floater	*Alasmidonta undulata*	Not Listed	Not Listed	4 Secure	Not Listed	S2S3
Vernal Bluet	*Enallagma vernale*	Not Listed	Not Listed	5 Undetermined	Not Listed	S3
Zebra Clubtail	*Stylurus scudderi*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
NON-VASCULAR PLANTS						
a Feather Moss	*Hylocomiastrum pyrenaicum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4
a Moss	*Tortula obtusifolia*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1?
a Moss	*Sematophyllum demissum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S1S2
a Moss	*Anacamptodon splachnoides*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
a Moss	*Campylium polygamum*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2?
a Moss	*Ditrichum rhynchostegium*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
a Moss	*Philonotis marchica*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2?
a Moss	*Sematophyllum marylandicum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
a Moss	*Ephemerum serratum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
a Moss	*Tortula truncata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
a Moss	*Anomodon tristis*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3?
Appressed Jellyskin Lichen	*Leptogium subtile*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Beaded Jellyskin Lichen	*Leptogium teretiusculum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Bearded Jellyskin Lichen	*Leptogium saturninum*	Not Listed	Not Listed	5 Undetermined	Not Listed	S3S4
Birdnest Jellyskin Lichen	*Leptogium tenuissimum*	Not Listed	Not Listed	6 Not Assessed	Not Listed	S2S3
Black-foam Lichen	*Anzia colpodes*	Not Listed	Not Listed	3 Sensitive	Threatened	S3
Black-footed Reindeer Lichen	*Cladina stygia*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3?
Blistered Jellyskin Lichen	*Leptogium corticola*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Blistered Tarpaper Lichen	*Collema nigrescens*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Blue Dew Moss	*Saelania glaucescens*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Blue Felt Lichen	*Degelia plumbea*	Special Concern	Vulnerable	4 Secure	Special Concern	S3
Blue-gray Moss Shingle Lichen	*Moelleropsis nebulosa*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Blue-gray Rosette Lichen	*Physcia caesia*	Not Listed	Not Listed	5 Undetermined	Not Listed	S3S4
Boreal Felt Lichen - Atlantic pop.	*Erioderma pedicellatum (Atlantic pop.)*	Endangered	Endangered	1 At Risk	Endangered	S1
Bottlebrush Frost Lichen	*Physconia detersa*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4
Coastal Bushy Beard Lichen	*Usnea flammea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Corrugated Shingles Lichen	*Fuscopannaria ahlneri*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Eastern Waterfan	*Peltigera hydrothyria*	Not Listed	Not Listed	2 May Be At Risk	Threatened	S1
Elf Bloom Moss	*Schistidium agassizii*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Finger Ring Lichen	*Arctoparmelia incurva*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Flat-leaved Peat Moss	*Sphagnum platyphyllum*	Not Listed	Not Listed	Not Listed	Not Listed	S1S2
Fragile Coral Lichen	*Sphaerophorus fragilis*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Fringe Lichen	*Heterodermia neglecta*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Fringed Rosette Lichen	*Physcia tenella*	Not Listed	Not Listed	6 Not Assessed	Not Listed	S3S4
Frosted Glass-whiskers Lichen - Nova Scotia pop.	*Sclerophora peronella (Nova Scotia pop.)*	Special Concern	Not Listed	Not Listed	Special Concern	S1?
Ghost Antler Lichen	*Pseudevernia cladonia*	Not Listed	Not Listed	3 Sensitive	Not At Risk	S2S3
Graceful Felt Lichen	*Erioderma mollissimum*	Not Listed	Endangered	2 May Be At Risk	Endangered	S1S2
Gray Starburst Lichen	*Parmeliopsis hyperopta*	Not Listed	Not Listed	5 Undetermined	Not Listed	S3S4
Hairlike Dichelyma Moss	*Dichelyma capillaceum*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Lesser Smoothcap Moss	*Atrichum angustatum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Light Beaked Moss	*Eurhynchium hians*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Lustrous Peat Moss	*Sphagnum subnitens*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Marine Seaweed Lichen	*Lichina confinis*	Not Listed	Not Listed	6 Not Assessed	Not Listed	S1?
Naked Kidney Lichen	*Nephroma bellum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Peppered Moon Lichen	*Sticta fuliginosa*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Poor-man's Shingles Lichen	*Parmeliella parvula*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1?
Powdered Fringe Lichen	*Heterodermia speciosa*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Rimmed Shingles Lichen	*Fuscopannaria leucosticta*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3
Salted Shell Lichen	*Coccocarpia palmicola*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Shaggy Fringed Lichen	*Anaptychia palmulata*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Short-pointed Lantern Moss	*Cyrtomnium hymenophylloides*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Slender Extinguisher Moss	*Encalypta procera*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Slender Monk's Hood Lichen	*Hypogymnia vittata*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Small Mouse-tail Moss	*Myurella julacea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4
Starke's Fork Moss	*Kiaeria starkei*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Tiny Cedar Moss	*Cyrto-hypnum minutulum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S1S2
Tiny-leaved Haplocladium Moss	*Bryohaplocladium microphyllum*	Not Listed	Not Listed	Not Listed	Not Listed	S1S2
Toothed-leaved Nitrogen Moss	*Tetraplodon angustatus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Tree Pelt Lichen	*Peltigera collina*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Wetland-plume Moss	*Helodium blandowii*	Not Listed	Not Listed	4 Secure	Not Listed	S3?
VASCULAR PLANTS						
a Pussytoes	*Antennaria parlinii*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Acadian Quillwort	*Isoetes acadiensis*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Alder-leaved Buckthorn	*Rhamnus alnifolia*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Alpine Bilberry	*Vaccinium uliginosum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
American False Pennyroyal	*Hedeoma pulegioides*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
American Yellow Rocket	*Barbarea orthoceras*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Appalachian Fir-Clubmoss	*Huperzia appalachiana*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Appalachian Polypody	*Polypodium appalachianum*	Not Listed	Not Listed	5 Undetermined	Not Listed	S3
Arrow-Leaved Violet	*Viola sagittata var. ovata*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Autumn Willow	*Salix serissima*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Balsam Groundsel	*Packera paupercula*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Bastard's Toadflax	*Comandra umbellata*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Bearded Sedge	*Carex comosa*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Bebb's Sedge	*Carex bebbii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Black Ash	*Fraxinus nigra*	Not Listed	Threatened	1 At Risk	Not Listed	S1S2

Table 1: Flora and Fauna SOCI within 100 km of the Study Area, Ruth Falls ***Project#17-6170***

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
Blood Milkwort	*Polygala sanguinea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Bloodroot	*Sanguinaria canadensis*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Blue Cohosh	*Caulophyllum thalictroides*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Blue Vervain	*Verbena hastata*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Blueberry Willow	*Salix myrtillifolia*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Blunt Broom Sedge	*Carex tribuloides*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Blunt-leaved Pondweed	*Potamogeton obtusifolius*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Bog Birch	*Betula pumila*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Bog Willow	*Salix pedicellaris*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Boreal Aster	*Symphyotrichum boreale*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Branched Bartonia	*Bartonia paniculata ssp. paniculata*	Threatened	Not Listed	Not Listed	Threatened	SNA
Bristle-leaved Sedge	*Carex eburnea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Broad-Glumed Brome	*Bromus latiglumis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Bulblet Bladder Fern	*Cystopteris bulbifera*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Buttonbush Dodder	*Cuscuta cephalanthi*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2?
Canada Cinquefoil	*Potentilla canadensis*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Canada Germander	*Teucrium canadense*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Canada Lily	*Lilium canadense*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Canada Rice Grass	*Piptatherum canadense*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Canada Tick-trefoil	*Desmodium canadense*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Canada Waterweed	*Elodea canadensis*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Canada Wood Nettle	*Laportea canadensis*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Carey's Smartweed	*Polygonum careyi*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1
Chestnut Sedge	*Carex castanea*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Chinese Hemlock-parsley	*Conioselinum chinense*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Clammy Hedge-Hyssop	*Gratiola neglecta*	Not Listed	Not Listed	3 Sensitive	Not Listed	S1S2
Climbing False Buckwheat	*Polygonum scandens*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Clustered Sanicle	*Sanicula odorata*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Coast Pepper-Bush	*Clethra alnifolia*	Special Concern	Vulnerable	1 At Risk	Special Concern	S1
Comb-leaved Mermaidweed	*Proserpinaca pectinata*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Common Bedstraw	*Galium aparine*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Common Moonwort	*Botrychium lunaria*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Common Scouring-rush	*Equisetum hyemale var. affine*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Cursed Buttercup	*Ranunculus sceleratus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Cut-Leaved Coneflower	*Rudbeckia laciniata*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Cut-leaved Moonwort	*Botrychium dissectum*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Deer-tongue Panic Grass	*Dichanthelium clandestinum*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Dense Blazing Star	*Liatris spicata*	Threatened	Not Listed	Not Listed	Threatened	SNA
Disguised St John's-wort	*Hypericum dissimulatum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Downy Rattlesnake-Plantain	*Goodyera pubescens*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Downy Willowherb	*Epilobium strictum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Drummond's Rockcress	*Arabis drummondii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Dudley's Rush	*Juncus dudleyi*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Dwarf Bilberry	*Vaccinium caespitosum*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Dwarf Clearweed	*Pilea pumila*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Dwarf Scouring-Rush	*Equisetum scirpoides*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Eastern Leatherwood	*Dirca palustris*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Eastern White Cedar	*Thuja occidentalis*	Not Listed	Vulnerable	1 At Risk	Not Listed	S1
Estuarine Sedge	*Carex vacillans*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1S3
Estuary Beggarticks	*Bidens hyperborea*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
False Mermaidweed	*Floerkea proserpinacoides*	Not Listed	Not Listed	3 Sensitive	Not At Risk	S2
Farwell's Water Milfoil	*Myriophyllum farwellii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Fernald's Hay Sedge	*Carex foenea*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Fernald's Serviceberry	*Amelanchier fernaldii*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2S3
Flat-stemmed Pondweed	*Potamogeton zosteriformis*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Fleshy Hawthorn	*Crataegus succulenta*	Not Listed	Not Listed	5 Undetermined	Not Listed	S3S4
Fowler's Knotweed	*Polygonum fowleri*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Foxtail Sedge	*Carex alopecoidea*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Fragrant Green Orchid	*Platanthera huronensis*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1S2
Fragrant Wood Fern	*Dryopteris fragrans var. remotiuscula*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Fries' Pondweed	*Potamogeton friesii*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Fringed Blue Aster	*Symphyotrichum ciliolatum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Garber's Sedge	*Carex garberi*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Gasp ├– Arrowgrass	*Triglochin gaspensis*	Not Listed	Not Listed	5 Undetermined	Not Listed	S3S4
Gmelin's Water Buttercup	*Ranunculus gmelinii*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Golden Alexanders	*Zizia aurea*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Greene's Rush	*Juncus greenei*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Greenish Sedge	*Carex viridula var. saxilittoralis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Greenland Stitchwort	*Minuartia groenlandica*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Ground-Fir	*Lycopodium sabinifolium*	Not Listed	Not Listed	4 Secure	Not Listed	S3?
Hairy Goldenrod	*Solidago hispida*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1?
Hairy Lettuce	*Lactuca hirsuta var. sanguinea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Halberd-leaved Tearthumb	*Polygonum arifolium*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Hayden's Sedge	*Carex haydenii*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Heart-leaved Foamflower	*Tiarella cordifolia*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Hidden-scaled Sedge	*Carex cryptolepis*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Highbush Blueberry	*Vaccinium corymbosum*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Hooked Agrimony	*Agrimonia gryposepala*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Hooker's Orchid	*Platanthera hookeri*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Hop Flatsedge	*Cyperus lupulinus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Hop Flatsedge	*Cyperus lupulinus ssp. macilentus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Hop Sedge	*Carex lupulina*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Horned Sea-blite	*Suaeda calceoliformis*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Houghton's Sedge	*Carex houghtoniana*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Hyssop-leaved Fleabane	*Erigeron hyssopifolius*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Inflated Narrow-leaved Sedge	*Carex grisea*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Intermediate Mermaidweed	*Proserpinaca intermedia*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Knotted Pearlwort	*Sagina nodosa*	Not Listed	Not Listed	4 Secure	Not Listed	S2S3

Table 1: Flora and Fauna SOCI within 100 km of the Study Area, Ruth Falls ***Project#17-6170***

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
Knotted Pearlwort	*Sagina nodosa ssp. borealis*	Not Listed	Not Listed	4 Secure	Not Listed	S2S3
Labrador Bedstraw	*Galium labradoricum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Lance-Leaf Grape-Fern	*Botrychium lanceolatum var. angustisegm*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Lance-leaved Figwort	*Scrophularia lanceolata*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1
Large Purple Fringed Orchid	*Platanthera grandiflora*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Large Round-Leaved Orchid	*Platanthera macrophylla*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Large St John's-wort	*Hypericum majus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Least Moonwort	*Botrychium simplex*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Lesser Brown Sedge	*Carex adusta*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Lesser Pyrola	*Pyrola minor*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Lesser Rattlesnake-plantain	*Goodyera repens*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Limestone Scurvy-grass	*Cochlearia tridactylites*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Little Curlygrass Fern	*Schizaea pusilla*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Livid Sedge	*Carex livida var. radicaulis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Loesel's Twayblade	*Liparis loeselii*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Long-leaved Pondweed	*Potamogeton nodosus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Long-leaved Starwort	*Stellaria longifolia*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Marsh Bellflower	*Campanula aparinoides*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Marsh Grass-of-Parnassus	*Parnassia palustris var. parviflora*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Marsh Mermaidweed	*Proserpinaca palustris*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Marsh Mermaidweed	*Proserpinaca palustris var. crebra*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Meadow Horsetail	*Equisetum pratense*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Meadow Willow	*Salix petiolaris*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Michaux's Dwarf Birch	*Betula michauxii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Mistassini Primrose	*Primula mistassinica*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Narrow False Oats	*Trisetum spicatum*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Narrow-leaved Evening Primrose	*Oenothera fruticosa ssp. glauca*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2
Narrow-leaved Panic Grass	*Dichanthelium linearifolium*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Nodding Fescue	*Festuca subverticillata*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Northern Adder's-tongue	*Ophioglossum pusillum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Northern Blueberry	*Vaccinium boreale*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Northern Bog Sedge	*Carex gynocrates*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Northern Bog Violet	*Viola nephrophylla*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Northern Burreed	*Sparganium hyperboreum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S1S2
Northern Clubmoss	*Lycopodium complanatum*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Northern Comandra	*Geocaulon lividum*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Northern Maidenhair Fern	*Adiantum pedatum*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Nova Scotia Agalinis	*Agalinis neoscotica*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Orange-fruited Tinker's Weed	*Triosteum aurantiacum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Ovate Spikerush	*Eleocharis ovata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Pale Green Orchid	*Platanthera flava var. herbiola*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2
Pale Jewelweed	*Impatiens pallida*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Pale-Spiked Lobelia	*Lobelia spicata*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Panicled Hawkweed	*Hieracium paniculatum*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Pennsylvania Sedge	*Carex pensylvanica*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1?
Pennsylvania Smartweed	*Polygonum pensylvanicum*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Philadelphia Fleabane	*Erigeron philadelphicus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Pinebarren Golden Heather	*Hudsonia ericoides*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Pink Crowberry	*Empetrum eamesii ssp. atropurpureum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Pink Crowberry	*Empetrum eamesii ssp. eamesii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Pink Crowberry	*Empetrum eamesii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Pink Pyrola	*Pyrola asarifolia*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Plantain-Leaved Sedge	*Carex plantaginea*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Porcupine Sedge	*Carex hystericina*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Prickly Hornwort	*Ceratophyllum echinatum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Pubescent Sedge	*Carex hirtifolia*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Purple-stemmed Angelica	*Angelica atropurpurea*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Purple-veined Willowherb	*Epilobium coloratum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Quebec Hawthorn	*Crataegus submollis*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2?
Racemed Milkwort	*Polygala polygama*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1
Red Pigweed	*Chenopodium rubrum*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Richardson's Pondweed	*Potamogeton richardsonii*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Robinson's Hawkweed	*Hieracium robinsonii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Robinson's Hawthorn	*Crataegus robinsonii*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1?
Rosy Sedge	*Carex rosea*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Round-lobed Hepatica	*Hepatica nobilis var. obtusa*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Rugel's Plantain	*Plantago rugelii*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Running Serviceberry	*Amelanchier stolonifera*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Russet Cottongrass	*Eriophorum russeolum*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Saltmarsh Agalinis	*Agalinis maritima*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Saltmarsh Starwort	*Stellaria humifusa*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Satiny Willow	*Salix pellita*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Seabeach Ragwort	*Senecio pseudoarnica*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Seaside Brookweed	*Samolus valerandi ssp. parviflorus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Sea-Side Dock	*Rumex maritimus*	Not Listed	Not Listed	Not Listed	Not Listed	S3S4
Seaside Spurge	*Chamaesyce polygonifolia*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Sharp-Fruit Rush	*Juncus acuminatus*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Sharp-fruited Knotweed	*Polygonum raii*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2S3
Shining Ladies'-Tresses	*Spiranthes lucida*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Short-awned Foxtail	*Alopecurus aequalis*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Showy Lady's-Slipper	*Cypripedium reginae*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Siberian Water Milfoil	*Myriophyllum sibiricum*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Silky Willow	*Salix sericea*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Sitka Clubmoss	*Lycopodium sitchense*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Slender Blue Flag	*Iris prismatica*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Slender Cottongrass	*Eriophorum gracile*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Small Burreed	*Sparganium natans*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Small Round-leaved Orchid	*Platanthera orbiculata*	Not Listed	Not Listed	4 Secure	Not Listed	S3

Table 1: Flora and Fauna SOCI within 100 km of the Study Area, Ruth Falls ***Project#17-6170***

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
Small Yellow Pond-lily	*Nuphar lutea ssp. pumila*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Small-flowered Agalinis	*Agalinis paupercula var. borealis*	Not Listed	Not Listed	Not Listed	Not Listed	S1
Small-flowered Bittercress	*Cardamine parviflora var. arenicola*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Small-flowered Woodrush	*Luzula parviflora*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Small's Knotweed	*Polygonum buxiforme*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2S3
Small-spike False-nettle	*Boehmeria cylindrica*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Smooth Sweet Cicely	*Osmorhiza longistylis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Southern Mudwort	*Limosella australis*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Southern Twayblade	*Listera australis*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Sparse-Flowered Sedge	*Carex tenuiflora*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Spotted Pondweed	*Potamogeton pulcher*	Not Listed	Vulnerable	3 Sensitive	Not Listed	S2S3
Spreading Wild Rye	*Elymus hystrix var. bigeloviana*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Spurred Gentian	*Halenia deflexa*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Squashberry	*Viburnum edule*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Stalked Bulrush	*Scirpus pedicellatus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2?
Swamp Milkweed	*Asclepias incarnata ssp. pulchra*	Not Listed	Not Listed	5 Undetermined	Not Listed	S3?
Swan's Sedge	*Carex swanii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Sweet Wood Reed Grass	*Cinna arundinacea*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1S2
Tender Sedge	*Carex tenera*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Thyme-Leaved Speedwell	*Veronica serpyllifolia ssp. humifusa*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Tierra del Fuego Dock	*Rumex maritimus var. fueginus*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Tinged Sedge	*Carex tincta*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Triangular-valve Dock	*Rumex salicifolius var. mexicanus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Tuckerman's Sedge	*Carex tuckermanii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Variegated Horsetail	*Equisetum variegatum*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Vasey Rush	*Juncus vaseyi*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Virginia Anemone	*Anemone virginiana var. alba*	Not Listed	Not Listed	3 Sensitive	Not Listed	S1S2
Virginia Anemone	*Anemone virginiana*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Virginia Anemone	*Anemone virginiana var. virginiana*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Water Beggarticks	*Megalodonta beckii*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Water Blinks	*Montia fontana*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Water Smartweed	*Polygonum amphibium var. emersum*	Not Listed	Not Listed	5 Undetermined	Not Listed	S3?
Wavy-leaved Aster	*Symphyotrichum undulatum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
White Sea-blite	*Suaeda maritima ssp. richii*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1
White Snakeroot	*Ageratina altissima*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
White-stemmed Pondweed	*Potamogeton praelongus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
White-Tinged Sedge	*Carex peckii*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2?
Whorled Water Milfoil	*Myriophyllum verticillatum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Wiegand's Sedge	*Carex wiegandii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Wiegand's Wild Rye	*Elymus wiegandii*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Wild Black Currant	*Ribes americanum*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1
Wild Celery	*Vallisneria americana*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Wild Chives	*Allium schoenoprasum var. sibiricum*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2
Wild Leek	*Allium tricoccum*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Wood Anemone	*Anemone quinquefolia*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Woodland Strawberry	*Fragaria vesca ssp. americana*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Woods-Rush	*Juncus subcaudatus var. planisepalus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Woolly Beach-heath	*Hudsonia tomentosa*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Woolly Panic Grass	*Dichanthelium acuminatum var. lindheime*	Not Listed	Not Listed	5 Undetermined	Not Listed	S1?
Woolly Sedge	*Carex pellita*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S1
Yellow Bartonia	*Bartonia virginica*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Yellow Ladies'-tresses	*Spiranthes ochroleuca*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Yellow Lady's-slipper	*Cypripedium parviflorum var. pubescens*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Yellow Lady's-slipper	*Cypripedium parviflorum*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Yellow Marsh Marigold	*Caltha palustris*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2
Yellow Spikerush	*Eleocharis olivacea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Yellow-seeded False Pimperel	*Lindernia dubia*	Not Listed	Not Listed	4 Secure	Not Listed	S3

Table 2: Flora and Fauna SOCI within 5 km of the Study Area, Ruth Falls ***Project#17-6170***

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
BIRDS AND BATS						
American Bittern	*Botaurus lentiginosus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
American Kestrel	*Falco sparverius*	Not Listed	Not Listed	4 Secure	Not Listed	S3B
Baltimore Oriole	*Icterus galbula*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3B
Barn Swallow	*Hirundo rustica*	Not Listed	Endangered	1 At Risk	Threatened	S2S3B
Bay-breasted Warbler	*Dendroica castanea*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Black-backed Woodpecker	*Picoides arcticus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3B
Blackpoll Warbler	*Dendroica striata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Blue-winged Teal	*Anas discors*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3S4B
Boreal Chickadee	*Poecile hudsonica*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Brown-headed Cowbird	*Molothrus ater*	Not Listed	Not Listed	4 Secure	Not Listed	S2B
Bufflehead	*Bucephala albeola*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4N
Canada Warbler	*Wilsonia canadensis*	Threatened	Endangered	1 At Risk	Threatened	S3B
Cape May Warbler	*Dendroica tigrina*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2B
Chimney Swift	*Chaetura pelagica*	Threatened	Endangered	1 At Risk	Threatened	S2B,S1M
Common Eider	*Somateria mollissima*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Common Goldeneye	*Bucephala clangula*	Not Listed	Not Listed	4 Secure	Not Listed	S2B,S5N
Common Nighthawk	*Chordeiles minor*	Threatened	Threatened	1 At Risk	Threatened	S2B
Common Tern	*Sterna hirundo*	Not Listed	Not Listed	3 Sensitive	Not At Risk	S3B
Eastern Kingbird	*Tyrannus tyrannus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Eastern Wood-Pewee	*Contopus virens*	Not Listed	Vulnerable	3 Sensitive	Special Concern	S3S4B
Evening Grosbeak	*Coccothraustes vespertinus*	Not Listed	Not Listed	4 Secure	Special Concern	S3S4B,S3N
Gray Catbird	*Dumetella carolinensis*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S3B
Gray Jay	*Perisoreus canadensis*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3
Greater Yellowlegs	*Tringa melanoleuca*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B,S3S4M
Killdeer	*Charadrius vociferus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Threatened	1 At Risk	Threatened	S2B
Philadelphia Vireo	*Vireo philadelphicus*	Not Listed	Not Listed	5 Undetermined	Not Listed	S2?B
Pine Grosbeak	*Pinicola enucleator*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3B,S5N
Pine Siskin	*Carduelis pinus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Red Crossbill	*Loxia curvirostra*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
Red-breasted Nuthatch	*Sitta canadensis*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3B
Ruby-crowned Kinglet	*Regulus calendula*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Endangered	2 May Be At Risk	Special Concern	S2B
Spotted Sandpiper	*Actitis macularius*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Swainson's Thrush	*Catharus ustulatus*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4B
Tennessee Warbler	*Vermivora peregrina*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
Veery	*Catharus fuscescens*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4B
Willet	*Tringa semipalmata*	Not Listed	Not Listed	2 May Be At Risk	Not Listed	S2S3B
Wilson's Snipe	*Gallinago delicata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Wilson's Warbler	*Wilsonia pusilla*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3B
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Not Listed	Not Listed	3 Sensitive	Not Listed	S3S4B
MAMMALS						
Long-finned Pilot Whale	*Globicephala melas*	Not Listed	Not Listed	Not Listed	Not At Risk	S2S3

Table 2: Flora and Fauna SOCI within 5 km of the Study Area, Ruth Falls *Project#17-6170*

Common Name	Scientific Name	SARA	NSESA	NSDNR	COSEWIC	ACCDC
INVERTEBRATES						
Aphrodite Fritillary	*Speyeria aphrodite*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Baltimore Checkerspot	*Euphydryas phaeton*	Not Listed	Not Listed	4 Secure	Not Listed	S2S3
NON-VASCULAR PLANTS						
a Moss	*Tortula truncata*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Salted Shell Lichen	*Coccocarpia palmicola*	Not Listed	Not Listed	4 Secure	Not Listed	S3S4
VASCULAR PLANTS						
Michaux's Dwarf Birch	*Betula michauxii*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3
Northern Comandra	*Geocaulon lividum*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Pink Pyrola	*Pyrola asarifolia*	Not Listed	Not Listed	4 Secure	Not Listed	S3
Seabeach Ragwort	*Senecio pseudoarnica*	Not Listed	Not Listed	3 Sensitive	Not Listed	S2S3

APPENDIX C
WETLAND METHODOLOGY

WETLAND DELINEATION IDENTIFICATION METHODOLOGY

Wetlands and Watercourses in Nova Scotia

Wetlands in Nova Scotia are regulated by NSE under Section 105 of the *Environment Act*. Under the Act, wetlands are:

> *Land referred to as a marsh, swamp, fen, or bog that either periodically or permanently has water table at, near, or above the land surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation, and biological activities adapted to wet conditions.*

Watercourses are defined in the *Environment Act* as:

> *Any creek, brook, stream, river, lake, pond, spring, lagoon, or any other natural body of water, and includes all the water in it, and also the bed and the shore (whether there is actually any water in it or not). It also includes all groundwater.*

Watercourses are defined in Halifax Regional Municipality (HRM) land use by-laws as:

> *A lake, river, stream, ocean, or other natural body of water.*

Delineation Methodology

In order for a wetland determination to be made, the following three criteria were assessed the field:

- Presence of hydrophytic (water loving) vegetation;
- Presence of hydrologic conditions that result in periods of flooding, ponding, or saturation during the growing season; and
- Presence of hydric soils (anaerobic conditions in upper part).

Soil pits were completed frequently to confirm the presence/absence of wetland hydrology and hydric soils, as per the methodology below. A general vegetation survey was also completed within the wetlands to confirm hydrophytic vegetation.

Identification of Hydrophytic Vegetation

Hydrophytic vegetation is defined as the sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanent or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present (Environmental Laboratory 1987). Hydrophytic vegetation should be the dominant plant type in wetland habitat (Environmental Laboratory 1987).

WETLAND DELINEATION IDENTIFICATION METHODOLOGY

Dominant plant species observed in each wetland were classified according to indicator status (probability of occurrence in wetlands), in accordance with the U.S. Fish and Wildlife Service (USFWS) National List of Vascular Plant Species that Occur in Wetlands: NE Region (Region 1) (Reed 1988). Please refer to Table 1 (below) for these classifications. These indicators are used as this region most closely resembles the flora of Nova Scotia and climate regime. Further relevant information was reviewed in Flora of Nova Scotia (Zinck, 1998).

Table 1: Classification of Wetland-Associated Plant Species[1]

Plant Species Classification	Abbreviation[2]	Probability of Occurring in Wetland
Obligate	OBL	>99%
Facultative Wetland	FACW	66-99%
Facultative	FAC	33-66%
Facultative Upland	FACU	1-33%
Upland	UPL	<1%
No indicator status	NI	Insufficient information to determine status
Plants That Are Not Listed (assumed upland species)	NL	Does not occur in wetlands in any region.

[1] Source: Reed 1988

[2] A '+' or '–' symbol can be added to the classification to indicate greater or lesser probability, respectively, of occurrence in a wetland.

If the majority (greater than 50%) of the dominant vegetation at a data point is classified as obligate (OBL), facultative wetland (FACW), or facultative (FAC), then the location of the data point is considered to be dominated by hydrophytic vegetation.

Identification of Hydric Soils

A hydric soil is a soil that has formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA-NRCS 2010). Indicators of the presence of a hydric soil include soil colour (gleyed soils and soils with bright mottles and/or low matrix chroma), aquic or preaquic moisture regime, reducing soil conditions, sulfidic material (odour), soils listed on the hydric soils list, iron and manganese concretions, organic soils (histosols), histic epipedon, high organic content in surface layer in sandy soils, and organic streaking in sandy soils.

Soil pits were excavated to a maximum depth of 40 cm or refusal. The soil in each was then examined for hydric soil indicators. The matrix colour and mottle colour (if present) of the soil were determined using the Munsell Soil Colour Charts.

Determination of Wetland Hydrology

Wetland habitat, by definition, either periodically or permanently, has a water table at, near, or above the land surface or that is saturated with water. To be classified as a wetland, a site should have at least one primary indicator or two secondary indicators of wetland hydrology, as shown in Table 2.

WETLAND DELINEATION IDENTIFICATION METHODOLOGY

Table 2: Indicators of Wetland Hydrology

Examples of Primary Indicators	Examples of Secondary Indicators
Water marks	Oxidized Root Channels in the Upper 30 cm
Drift Lines	Local Soil Survey Data
Sediment Deposition	Dry season Water Table
Drainage Patterns	Stunted or Stressed Plants
Water-stained leaves	
Visual Observation of Saturated Soils	
Visual Observation of Inundation	

Wetland habitat is assessed for signs of hydrology, via visual observations across the area and through assessment of soil pits.

References

Environmental Laboratory (1987), Corps of Engineers Wetlands Delineation Manual, US Army Corp of Engineers, 1987.

Reed. 1988. National List of Plant Species that Occur in Wetlands: NE Region (Region 1) U.S. Fish and Wildlife Service, Washington, DC.

USDA-NRCS. (United States Department of Agriculture- Natural Resources Conservation Service). 2010. *Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils*. Version 7.0. 53 pp.

Zinck, M. 1998. *Rolands Flora of Nova Scotia*. Nimbus Publishing, Nova Scotia.

Environmental Laboratory. (1987). "Corps of Engineers wetlands delineation manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A176 912 (Note: Appendix C information is outdated and must be obtained from regional Wetlands offices)

APPENDIX D
GLOSSARY

Glossary of Commonly Used Terms

Anaerobic – A situation in which molecular oxygen is absent (or effectively so) from the environment.

Artificial Wetland – A created wetland requiring constant maintenance to remain a wetland.

Aerobic – A situation in which molecular oxygen is part of the environment.

Aquic moisture regime – A mostly reducing soil moisture regime nearly free of dissolved oxygen due to saturation by ground water or its capillary fringe and occurring at periods when the soil temperature at 19.7 in. is greater than 5 ^{o}C.

Baseline Study – An inventory of an existing community or environment that may provide information for planning or establishing goals for success criteria.

Basin – a depression.

Bidirectional-non-tidal – water levels subject to rise and fall due to fluctuations in lake levels; only applied to lentic wetlands (excluding those with a stream bisecting them = throughflow).

Bidirectional tidal – water levels subject to ebb and flood by tides.

Bog – acidic, nutrient-poor peatland characterized by woody plants (shrub bogs by ericaceous shrubs or treed bogs by black spruce, for example) and nearly permanently saturated soils.

Braided – Where streams or rivers divide into a network of smaller channels which are divided by often temporary islands.

Buffer – An area of land bordering a waterbody and/or wetland habitat which has been designated as a no activity zone, in order to protect the marine or freshwater resource.

Chroma – The relative purity or saturation of a colour; intensity of distinctive hue as related to grayness; one of the three variables of colour.

Concretion – A local concentration of chemical compounds (e.g. calcium carbonate, iron oxide) in the form of a grain or nodule of varying size, shape, hardness, and colour. Concretions of significance in hydric soils are usually iron and/or manganese oxides occurring at or near the soil surface, which develop under conditions of prolonged soil saturation.

Conservation – Ensuring that loss or degradation of wetland ecosystem functions does not occur and that previously lost or damaged functions are recovered.

Contiguous – Whereby two or more areas of wetland habitat are hydrologically connected via a watercourse and/or drainage channel.

Contour – An imaginary line of constant elevation. The corresponding line on a map is called a contour line.

Created Wetland – The conversion of a persistent upland vegetation community or ephemeral shallow water area into a permanent wetland where no previous wetland existed.

Diked – wetland surrounded by berms (dykes), may be flooded or not

Farmed – area still wet enough to be considered wetland buy subject to tillage or cultivation or wet-dependent plants (e.g., cranberries).

Glossary of Commonly Used Terms

Disturbed Wetland – A wetland that is directly or indirectly altered by external human or natural forces.

Dominance – A descriptor of vegetation that is related to the standing crop of a species in an area, usually measured by height, areal cover or basal area (for trees).

Dominant Species – A plant species that exerts a controlling influence on or defines the character of a community.

Drained – A condition in which the level or volume of groundwater or surface water has been reduced or eliminated from an area by artificial means.

Emergent Plant – A rooted plant that has parts extending above the water surface, at least during portions of the year but does not tolerate prolonged inundation.

Enhanced Wetland – An existing wetland where some planned activity by humans addresses stresses or limitations that result in an increase of one or more functions or values.

Entrenched – wetland along a stream that has undergone significant erosion, creating a deep channel.

Estuarine-Embayment – located along the shores of an open bay or similar embayment in salt-brackish tidal waters.

Estuarine-Channel – located along the shores of a tidal river in the salt-brackish zone.

Eutrophic – Refers to a water body with more nutrients than its aquatic plant community can use, occasionally resulting in algal blooms.

Excavated – material removed from the wetland creating a depression.

Exotic – Not indigenous to a region; intentionally or accidentally introduced.

Fen – a mineral-rich peatland that can be dominated by a variety of plants both herbaceous and woody including calcium-loving plants (calciphiles); examples are graminoid fen, shrub fen, and treed fen

Fill Material – Any material placed in an area to increase surface elevation.

Flat – a nearly level area with no detectable slope.

Flooded – A condition in which the soil surface is temporarily covered in flowing water from any source, such as streams overflowing their bank, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of these sources.

Floodplain – a plain subject to river overflow and characterized by alluvial (water-deposited) soils; basin – depressions on the floodplain; flat – nearly level land

Flora – A list of all plant species that occur in an area.

Fringe – bordering a water body and in tidal areas, any salt marsh or other wetland that is flooded by typical high tides and in non-tidal areas, usually a marsh in standing water (typically flooded all year in most years) and no-vegetated wetlands within the stream or river banks (in the ordinary high water mark zone).

Float mat – wetland that is not rooted to the underlying substrate; may float around in a lake, for example.

Function – The physical, chemical and biological processes, attributes and linkages related to a particular wetland.

Gleyed – A soil condition resulting from prolonged soil saturation, which is manifested by the presence of bluish or greenish colours through the soil mass or in mottles spots or streaks) among other colours. Gleying occurs under reducing soil conditions resulting from soil saturation, by which iron is reduced predominantly to the ferrous state.

Grazed – wetland actively used as pasture.

Growing Season – The portion of the year when soil temperatures at 19.7 in. below the soil surface are higher than biologic zero (5^{o}) (U.S. Department of Agriculture-soil Conservation Service 1985). For ease of determination this period can be approximated by the number of frost free days (U.S Department of the Interior 1970). The growing season in Nova Scotia is June 01 – September 30.

Habitat – The environment occupied by individuals of a particular species, population or community, including everything required during the life cycle such as food, shelter and breeding places.

Headwaters – The origins of streams and rivers.

Herb – A non-woody individual of a macrophytic species.

Herbaceous Layer – Any vegetative stratum of a plant community that is composed predominantly of herbs.

Histic epipedon – A 20-40cm soil layer at or near the surface that is saturated for 30 consecutive days or more during the growing season in most years and contains a minimum of 20 percent organic matter when no clay is present or a minimum of 30 percent organic matter when 60 percent or greater clay is present.

Histosol – An order in soil taxonomy composed of organic soils that have organic soil materials in more than half of the upper 8 cm or that are of any thickness if directly over bedrock.

Hue – A characteristic of colour that denotes a colour in relation to red, yellow, blue, etc; one of the three variables of colour. Each colour chart in the Munsell Colour Book (Munsell Colour 1975) consists of a specific hue.

Hydric Soil – Soil characterized by abundance of moisture and much reduced oxygen levels, to the extent that the soil tolerates water-tolerant vegetation.

Hydrologic Regime – The distribution and circulation of water in an area during a given period including its fluctuations periodicity.

Hydrology – The science dealing with the properties, distribution and circulation of water both on and under the surface.

Hydrophytic Vegetation (plants) – Vegetation adapted to growing in water or in hydric soil.

Indicator – An event, entity or condition that typically characterizes a prescribed environment or situation; indicators determine or aid in determining whether or not certain stated circumstances exist.

Indicator status – One of the categories (e.g. OBL) that describes the estimated probability of a plant species occurring in wetlands.

Indigenous – Species which are native to a region.

Glossary of Commonly Used Terms

Inflow – water flows into the subject wetland from an upstream channel

Inundation – A condition in which water from any source temporarily or permanently floods land surface.

Irregularly flooded-tidal – inundated less than daily by the tides

Isolated – water flow comes from high groundwater levels or from surface or subsurface runoff; no channeled flow in or out of the wetland; may be subject to overflow during extreme precipitation or snowmelt events; wetland is "geographically isolated" – surrounded completely by upland (non-hydric soils).

Logged – forested wetland where timber has been recently harvested

Lotic River-Unconfined – Located along a river (width ≥20 m) with a distinct floodplain

Lotic River-Confined – Located along a river (width ≥20 m) with little or no floodplain

Lotic Stream-Unconfined – Located along a stream (width <20 m) with a distinct floodplain

Lotic Stream-Confined – Located along a stream (width <20 m) with little or no floodplain

Lotic Pond – Located along an in-stream pond.

Lentic Lake – Located along the shores of a lake.

Lentic Reservoir –Located along the shores of a reservoir.

Macrophyte – Any plant species that can be readily observed without the aid of optical magnification including all vascular plant species and mosses, as well as some attached and filamentous algae.

Marsh – Freshwater wetland usually flooded for the entire growing season and dominated by herbaceous vegetation.

Mesophytic – Any plant species growing where soil moisture and aeration conditions lie between extremes. These species are typically found in habitats with average moisture conditions, neither very dry nor very wet.

Mineral soil – A soil consisting predominantly of, and having its properties determined predominantly by, mineral matter (sand, silt, clay) usually containing less than 20 percent organic matter.

Minerotrophic – Referring to waters rich in dissolved minerals, and to plant species and communities which grow well in these conditions.

Mitigation – The prevention, modification, or alleviation of impacts on the natural environment including any action with the intent to enhance beneficial effects.

Monitoring – Periodic evaluation of a site to determine success in achieving goals.

Mottles/Mottling – Spots or blotches of different colour or shades of colour interspersed within the dominant colour in a soil layer, usually resulting from the presence of periodic reducing soil conditions.

Muck – Highly decomposed organic material in which the original plant parts are not recognizable.

Glossary of Commonly Used Terms

Natural Wetland – Dominated by native biota and occurring within a biophysical system which has developed through processes devoid of human intervention. Formed by natural processes (e.g. deglaciation, Aeolian processes, tectonic forces, or karst)

Nuisance Species – Species that detract from or interfere with wetland functions and/or values.

Ombrotrophic – Referring to waters poor in nutrients, where nutrients are obtained mostly from precipitation, and to plant species and communities which grow well in these conditions.

Organic soil – A soil is classified as an organic soil when it is 1) saturated for prolonged periods (unless artificially drained) and has more than 30 percent of organic matter if the mineral fraction is more than 50 percent clay, or more than 20 percent organic matter if the mineral fraction has no clay; or 2) never saturated with water for more than a few days and having more than 34 percent organic matter.

Outflow – Water flows out of the wetland, downslope from this source; no channeled surface water inflow.

Overbank flooding – Any situation in which inundation occurs as a result of the water level of a stream rising above bank level.

Paludified – Water levels or saturation affected by paludification processes, i.e., peat mosses wicking up water from a depression, spring, or seep and thereby allowing the wetland to creep uphill, smothering upland vegetation and converting these sites to wetland

Partly drained – Ditched or tile-drained but still wet enough to be considered wetland

Peat – An accumulation of partially decayed vegetation matter or histosol formed in areas where full decomposition is inhibited by acidic and anaerobic conditions.

Periodically – Detectable regular or irregular saturated soil conditions or inundation, resulting in ponding of groundwater, precipitation, overland flow, stream flooding or tidal influences that occur(s) with hours, days, weeks, months or even years between events.

Permanently flooded – Inundated year-round in all years.

Permanently saturated – High water tables virtually year-round, conditions favor development of peat.

Plant Community – All of the plant populations occurring in a shared habitat or environment.

Ponded – A condition in which water stands in a closed depression. Water may be removed only by percolation, evaporation and/or transpiration.

Poorly Drained – Soils that commonly are wet at or near the surface during a sufficient part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these conditions.

Positive Wetland Indicator – Any evidence of the presence of hydrophytic vegetation, hydric soil and/or wetland hydrology in an area.

Preliminary Wetland Determination – The process or procedure by which an area is adjudged a wetland or non-wetland outside of the accepted growing season (May 1 – September 30).

Reduced soil – A soil in which oxygen has been removed and chemical reduction of ions has taken place.

Redox Features – A distinct soil morphological characteristic most readily observable by a change in soil colour. Redox features are formed by the reduction of iron and manganese oxides in the soil when in an anaerobic state i.e. soil is saturated and there is an absence of oxygen.

Regularly flooded-tidal – Inundated by the tides at least once daily.

Rehabilitation – Improving the function and values of a degraded wetland.

Relief – The elevation of a land surface between two points; including the configuration of features such as hills and valleys.

Restoration – Changing existing function and structure of wetland habitat so that it is similar to historical conditions.

Restored – Former wetland that was destroyed (e.g., effectively drained, filled, or excavated) that has regained its wetland functions by human intervention, or existing wetland with impaired functions whose functions have been completely or partially improved by human action where the goal is to restore natural functions

Rhizosphere – The zone of soil in which interactions between living plant roots and microorganisms occur.

Riparian – Inhabiting, or situated on the bank of a river, stream or watercourse.

Root Zone – The portion of a soil profile in which plant roots occur.

Salt Marsh – Tidal wetland flooded by salt water and characterized by halophytic plants

Sapling/shrub – A layer of vegetation composed of woody plants <0.8 m in diameter at breast height but greater than 1 m in height, exclusive of woody vines.

Saturated soil – A condition where all easily drained voids (pores) between soil particles in the root zone are temporarily or permanently filled with water to the soil surface at pressures greater than the atmosphere.

Seasonally flooded – Inundated for extended periods usually early in the growing season, typically flooded for more than a week

Seasonally saturated – High water tables for extended periods during the year, usually from late fall into spring, conditions favor development of mineral hydric soils

Semi-permanently flooded – Inundated year-round in most years, except extended dry periods (including droughts.

Soil matrix – The portion of a given soil having the dominant colour. In most cases, the matrix will be the portion of the soil having more than 50 percent of the same colour.

Soil texture – The relative proportions of the various sizes of particles in a soil.

Stunted – The inhibition of growth and development of trees and shrubs attributed to an excess of soil moisture (hydrology) and/or shallow rooting zones i.e. shallow bedrock.

Substrate – The base on which an attached species is growing.

Succession – Replacement of one vegetation community by another. Succession may be human induced or natural due to forces such as climate, hydrology or species competition.

Swamp – Freshwater wetland dominated by woody plants (shrub swamp or forested swamp), often growing on mineral soils or mucks, and subject to seasonally flooded for extended periods.

Terrene – Located at the uppermost area in a subbasin (i.e., the source of a stream), or located along a river or stream but at an elevation not subject to overbank flooding, or located in an isolated basin, on an isolated flat, or on an isolated slope

Terrene Pond –Located along the shores of an isolated pond (no outlet)

Temporarily flooded – Inundated for brief periods usually at the beginning of the growing season, typically flooded for a week or less

Throughflow – Water flows in and out of wetland, typically as overbank flow, but also includes wetlands along lakes (lentic wetlands) that have a stream coursing through them from locations outside the lake

Topography – The pattern of the soil surface, including its relief and the position of its natural and manmade features.

Transect – A line on the ground along which observations are made at some interval.

Transition Zone – The area in which a change from one vegetation community to another, or from wetland to non-wetland habitat occurs.

Tree – A woody plant > 0.8 m in diameter at breast height, regardless of height (exclusive of woody vines).

Upland – Any area that does not qualify as a wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soils and/or hydrologic characteristics associated with wetlands. Such areas occurring within floodplains are more appropriately termed non-wetlands.

Value (soil colour) – The relative lightness or intensity of a colour.

Vegetation layer – A subunit of a plant community in which all component species exhibit the same growth form (e.g. trees, saplings/shrubs, herbs).

Watercourse (as defined under Section 105 of the *Environment Act*) – Any creek, brook, stream, river, lake, pond, spring, lagoon, or any other natural body of water, and includes all the water in it, and also the bed and the shore (whether there is actually in it or not). It also includes groundwater.

Watercourse – (as defined in the Halifax Regional Municipality [HRM] land use by-laws) – A lake, river, stream, ocean or other natural body of water.

Watershed – An area of land where water from rain and melting snow or ice drains downhill into a body of water, such as a river, lake reservoir, estuary etc. The watershed includes the streams and rivers that convey the water as well as wetlands and other natural heritage features and land surfaces from which water drains. The principle of ‘everything is connected’ is clearly evident in a watershed, as it involves water and any other feature or function that affects or is affected by water.

Water Table (groundwater) – The surface below which the soil is saturated with water.

Wetland – Lands that are seasonally or permanently covered by shallow water, including lands where the water table is at or very close to the surface. In either case, the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic or water-tolerant plants.

Glossary of Commonly Used Terms

Wetland boundary – The point on the ground at which a shift from wetlands to nonwetlands or aquatic habitats occurs.

Wetland determination – The process or procedure by which an area id adjudged a wetland or non wetland.

APPENDIX E
PHOTOGRAPH LOG



Photo 1: Ponded area of Wetland 1.



Photo 2: Forested swamp area of Wetland 1.



Photo 3: Open part of Wetland 2.



Photo 4: More treed in part of Wetland 2.



Photo 5: Wetland 3.



Photo 6: Wetland 4.



Photo 7: Typical upland habitat.

APPENDIX F
FUNCTIONAL ASSESSMENT FORMS

WETLAND 1

Cover Page: Basic Description of Assessment	**WESP-AC version 1.2**
Site Name:	Ruth Falls Dam
Investigator Name:	Heather Mosher
Date of Field Assessment:	9/21/2017
Nearest Town:	Sheet Harbour, NS
Latitude (decimal degrees):	44.9546
Longitude (decimal degrees):	-62.5027
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in acres):	0.0709 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	100%
What percent (approx.) of the **wetland** were you able to visit?	100%
What percent (approx.) of the **AA** were you able to visit?	100%
Were you able to ask the site owner/manager about any of the questions?	Yes
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes, rare plants
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	July 2016 (Maryville, NB)
How many wetlands have you assessed previously using WESP-AC? (approx.)	15
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D
3	#	Indicators	Condition Choices	Data
4	OF1	Province	Mark the province in which the AA is located by changing the column next to it to a "1". Mark only one.	
5			New Brunswick	0
6			Nova Scotia	1
7			Prince Edward Island	0
8			Newfoundland-Labrador	0
9	OF2	Wetland Herbaceous Area	From "duck's eye" (aerial) view, the area of woody vegetation (grasslike plants, excluding moss & ferns) in the Assessment Area (AA) plus in any contiguous woody wetland is:	
10			<0.01 hectare (about 10 m x 10 m)	0
11			0.01 - 0.1 hectare	1
12			0.1 - 1 hectare	0
13			1 to 10 hectares	0
14			10 to 100 hectares	0
15			>100 hectares	0
16	OF3	Wetland + Water Total Area	The total area of the AA including ponded water within or adjacent to it is:	
17			<0.01 hectare (about 10 m x 10 m)	0
18			0.01 - 0.1 hectare	0
19			0.1 - 1 hectare	1
20			1 to 10 hectares	0
21			10 to 100 hectares	0
22			>100 hectares	0
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	Including the AA's vegetated area, the largest patch or corridor that is unmanaged vegetation cover (excluding lawn, row crops, heavily grazed lands, conifer plantation) and is contiguous with vegetation in the AA (i.e., not completely separated by highways or channels that are uniformly wider than 50 m), occupies:	
24			<0.01 hectare (about 10 m x 10 m)	0
25			0.01 - 0.1 hectare	0
26			0.1 - 1 hectare	0
27			1 to 10 hectares	0
28			10 to 100 hectares	0
29			100 to 1000 hectares	0
30			>1000 hectares [*This is nearly always the answer in relatively undeveloped landscapes.*]	1

	A	B	C	D
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the AA edge to the edge of the closest patch or corridor of *unmanaged vegetated land* (excluding row crops, lawn, conifer plantation) larger than 375 hectares, is:	
32			<50 m, and not separated from the 375-ha vegetated area by any width of roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. *[This is often the answer in relatively*	1
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0
34			50-500 m, and not separated.	0
35			50-500 m, but separated by those features.	0
36			0.5 - 5 km, and not separated.	0
37			0.5 - 5 km, but separated by those features.	0
38			none of the above (the closest patches or corridors which are that large are >5 km away).	0
39	OF6	Herbaceous Uniqueness	The AA's vegetation is mostly herbaceous but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation is mostly herbaceous but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation is mostly herbaceous but uplands within 100 m have <10% herbaceous cover. If so, enter "1" [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0
40	OF7	Woody Uniqueness	The AA's vegetation is mostly woody but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is mostly woody but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is mostly woody but uplands within 100 m have <10% woody cover. If so, enter "1" [*NOTE: woody = Shrubland and forest, but exclude conifer plantations.]	0
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:	
42			<5% of the land.	0
43			5 to 20% of the land.	0
44			20 to 60% of the land.	0
45			60 to 90% of the land.	1
46			>90% of the land. SKIP to OF9.	0
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:	
48			impervious surface, e.g., paved road, parking lot, building, exposed rock.	0
49			bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:	
51			<100 m	0
52			100 - 500 m	0
53			0.5- 1 km	0
54			1 - 5 km	0
55			>5 km	1
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:	
57			<10 m	0
58			10 - 25 m	0
59			25 - 50 m	0
60			50 - 100 m	0

	A	B	C	D
61			100 - 500 m	0
62			>500 m	1
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no *other* wetlands within 5 km.	0
64	OF13	Distance to Ponded Water	The distance from the AA edge to the closest (but separate) pond or lake larger than 0.01 ha (about 10 x 10 m) is:	
65			<50 m, and not separated by any width of roads, stretches of open water, row crops, lawn, bare ground, or impervious surface	1
66			<50 m, but completely separated by those features.	0
67			50-500 m, and not separated.	0
68			50-500 m, but separated by those features.	0
69			0.5 - 1 km, and not separated.	0
70			0.5 - 1 km, but separated by those features.	0
71			none of the above (the closest patches or corridors that large are >1 km away).	0
72	OF14	Distance to Lake	The distance from the AA edge to the closest (but separate) lake (a non-tidal body of water that is ponded during most of the year and is larger than 8 hectares) during most of a normal year is:	
73			<100 m	1
74			100 m - 1 km	0
75			1 -2 km	0
76			2-5 km	0
77			5-10 km	0
78			>10 km	0
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:	
80			<100 m	0
81			100 m - 1 km	0
82			1 - 5 km	1
83			5-10 km	0
84			10-40 km	0
85			>40 km	0

	A	B	C	D
86	OF16	Upland Edge Contact	Select one:	
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	1
92	OF17	Flood Zone	The AA is within a mapped Flood Zone or Flood Risk area, or an area in which river- or stream-associated floods within the past 20 years have damaged bridges, roads, buildings, or other infrastructure (not farmlands) within 5 km downslope from the AA. The floods must not be related to tidal influence or waves. If true, enter "1" in next column. If neither are true and AA is not in a river floodplain, enter "0" and SKIP to OF18. Otherwise, change to blank before skipping to OF18.	0
93	OF18	Flood Damage	Within the mapped Flood Zone, Flood Risk area, or area with known flood damage, ALL the following are true (If all true, enter "1" in next column. If false, enter "0") (a) there are bridges, roads, buildings, or other infrastructure (not just farmlands) within 5 km downslope from the AA that are vulnerable to damaging floods; (b) the damages would be caused mainly by rising river levels associated with precipitation and/or snowmelt, not primarily by high tides, hillslope runoff, or river ice jams, AND (c) between the AA and the damage area, peak flow in a connecting channel (if any) is NOT regulated by dams.	0
94	OF19	Relative Elevation in Watershed	To view watersheds, open Google Earth and then the NB_Watersheds.kmz file that accompanies this calculator. Determine the AA's position in its watershed as follows: 1) If the AA is on a channel wider than 10 m, or has both inlet & outlet and is closer to the watershed's outlet than to its upper end, check "lower 1/3." 2) If the AA is the source of a headwater stream, or lacks an outlet and is close to the watershed's outer margin, then check "upper 1/3." For all other conditions, check "middle 1/3".	
95			in the upper one-third of its watershed.	0
96			in the middle one-third of its watershed.	1
97			in the lower one-third of its watershed.	0
98	OF20	Water Quality Sensitivity	The AA is in an area: (a) legally protected from most land uses because it feeds an aquifer, a well that serves many users, or a reservoir or other surface water source that provides drinking water to multiple domestic users, OR (b) where research or map analysis has indicated groundwater may be at higher risk of contamination due to geological conditions. Enter 1= yes, 0= no. Change to blank if no information.	0

	A	B	C	D
99	OF21	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, high temperatures) being present at levels harmful to aquatic life or humans, and:	
100			The condition is present within the AA.	0
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream).This is the situation for nearly all wetlands in this region.	1
104	OF22	Degraded Water Downstream	The problem described above is downslope from the AA, and:	
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream).This is the situation for nearly all wetlands in this region.	1
109	OF23	Wetland as a % of Its Contributing Area (Catchment)	Estimate the approximate boundaries of the wetland's catchment (CA) from a topographic map.Then adjust those boundaries necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:	
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0
111			0.01 to 0.1	0
112			0.1 to 1	1
113			>1 (wetland is larger than its catchment (e.g., wetland is isolated by dikes with no input channels, is fed entirely by groundwater, or is a raised bog).	0
114	OF24	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :	
115			<10%	1
116			10 to 25%	0
117			>25%	0
118	OF25	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:	
119			Mostly true	0
120			Somewhat true	0
121			Mostly untrue	1
122	OF26	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:	
123			Northward (N, NE). north-facing contributing area.	0
124			Southward (S, SW). south-facing contributing area.	1
125			other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0
126	OF27	Internal Flow Distance (Path	The horizontal flow distance from the wetland's inlet to outlet is:	

	A	B	C	D
127		Distance (Path Length)	<10 m	0
128			10 - 50 m	1
129			50 - 100 m	0
130			100 - 1000 m	0
131			1- 2 km	0
132			>2 km, or wetland lacks an inlet and outlet.	0
133	OF28	Growing Degree Days	According to Figure A-1 in Appendix A of the Manual, the mean annual Growing Degree Days (GDD) in the vicinity of the AA is approximately:	
134			800-1000 days	0
135			1000-1200	0
136			1200-1400	1
137			1400-1600	0
138			1600-1800	0
139			>1800 days	0
140	OF29	Fish Access or Use	According to agency biologists and/or your own observations, the AA: [*mark just the first choice that is true]*:	
141			is known to support **Atlantic salmon** rearing and/or spawning. In NB, consult Figure A-2 in Appendix A of the Manual, or local fishery biologists.	0
142			has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters containing Atlantic salmon and is probably salmon-accessible during some conditions.	0
143			is not accessible to any anadromous fish species but is known or likely to have **other fish** at least seasonally.	0
144			is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily).	1
145	OF30	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented [*mark all applicable*]:	
146			Presence of one or more of the **plant** species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or (in NS only) the AA is within a mapped **Atlantic Coastal Plain Flora Buffer** as shown in Special Management Practice Zones at: https://nsgi.novascotia.ca/plv/	0
147			Presence of one or more of the **amphibian or reptile** species of conservation concern (AM) as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0
148			Presence of one or more of the **waterbird** species of conservation concern (WBF, WBN) as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0
149			Presence of one or more of the nesting **songbird or raptor** species of conservation concern (SBM) as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0
150			none of the above, or no data.	1
151	OF31	Important Bird Area (IBA)	The AA is all or part of the West Shepody Bay or St. Johns River Important Bird Area, or other designated IBA. See Figures A-3 & A-4 in Appendix A of the Manual. Enter 1= yes, 0= no.	0
152	OF32	Black Duck Nesting Area	The AA is within an area mapped as generally high suitability (>20 pairs/25 sq km) for nesting American Black Duck. See Figure A-5 in Appendix A of the Manual. Enter 1= yes, 0= no. If outside of region shown in map, change to blank.	0
153	OF33	Wintering Deer or Mainland Moose Concentration Area	The AA is all or part of a Deer Wintering Area or (in NS only) a Mainland Moose Concentration Area. If AA is on private land with no information, change to **blank**. Otherwise, in NB: In Google Earth, view the KMZ overlay that accompanies this calculator, or download the shapefile (Crown Lands Conservation Areas) at http://www.snb.ca/geonb1/e/DC/catalogue-E.asp In NS: go to https://nsgi.novascotia.ca/plv/ and view Special Management Practice Zones> Mainland Moose Concentration Areas).	0
154	OF34	Other Conservation Designation	The AA is all or part of an area designated by the provincial government for its exceptional ecological features or highly intact natural conditions. Enter: yes= 1, no= 0. In NB: Provincially Significant Wetland, Environmentally Significant Area, Protected Natural Area (go to http://www.snb.ca/geonb1/e/apps/apps-E.asp and see Candidate PNA Map Viewer) In NS: go to https://nsgi.novascotia.ca/plv/ and view Protected Areas)	0

	A	B	C	D
155	OF35	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Enter: yes= 1, no= 0. If no information, change to blank.	0
156	OF36	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Enter: yes= 1, no= 0. If no information, change to blank.	0
157	OF37	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Enter: yes= 1, no= 0. If no information, change to blank.	

	A	B	C	D
2	**Form F (Field).** Non-tidal Wetland Data Form. WESP-AC version 1.2. DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU=	
3	#	**Indicators**	**Condition Choices**	**Data**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:	
5			A. Moss and/or lichen cover more than 25% of the ground. Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.	
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is <100 µS/cm (about 64 ppm TDS). Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew). Sedge cover usually sparse or absent. Trees, if present, are mainly limited to black spruce. Surrounding landscape is mostly flat and wetland surface is never sloping, except sometimes from wetland center towards outer edges (convex). Inlet and outlet channels are usually absent..	0
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is >100 µS/cm. Sedges and/or cottongrass often dominate the ground cover, while ericaceous shrubs and black spruce may also be present. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1, often with many small persistent pools.	0
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:	
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	1
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0
11			*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent lakes larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, "adjacent" is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*	
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.	
13			A1	0
14			A2	0
15			B1	0
16			B2	0
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the of the living vegetation in the AA is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none):	
18			coniferous trees (may include tamarack) taller than 3 m.	2
19			deciduous trees taller than 3 m.	5
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	0
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	0
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	0
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	0

	A	B	C	D
24	*Note: If you marked ALL of the F3 rows 0 or 1, SKIP to F9 (N fixers).*			
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species (<3 m tall) comprise the greatest portion of the woody cover (<3 m tall). Then choose one:	
26			those species together comprise > 50% of such cover.	1
27			those species together do not comprise > 50% of such cover.	0
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% of the woody canopy cover in the AA or >5% of the wooded areas (if any) along its upland edge (perimeter). The edge should include only the trees whose canopies extend into the AA.	
29			coniferous, 1-9 cm diameter and >1 m tall.	1
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1
31			coniferous, 10-19 cm diameter.	1
32			broad-leaved deciduous 10-19 cm diameter.	1
33			coniferous, 20-40 cm diameter.	0
34			broad-leaved deciduous 20-40 cm diameter.	1
35			coniferous, >40 cm diameter.	0
36			broad-leaved deciduous >40 cm diameter.	0
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:	
38			A. Neither the vegetation taller than 1 m nor the vegetation shorter than that comprise >70% of the vegetated part of the AA. They each comprise 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.	
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:	
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (diameter >20 cm) in the AA plus adjacent upland area within 10 m of the wetland edge is:	
45			None, or fewer than 8/ hectare which exceed this diameter.	1
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0
47			Several (>8/hectare) but above not true.	0
48	F8	Downed Wood	The number of downed wood pieces longer than 2 m and with diameter >10 cm, and not persistently submerged, is:	
49			Few or none that meet these criteria.	0
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	1
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:	
52			<1% or none	1
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:	
58			<5% of the vegetated part of the AA.	0
59			5-25% of the vegetated part of the AA.	1
60			25-50% of the vegetated part of the AA.	0
61			50-95% of the vegetated part of the AA.	0
62			>95% of the vegetated part of the AA.	0

	A	B	C	D
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:	
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	0
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	1
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0
67			Other conditions.	0
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0
69	F12	Ground Irregularity	Consider the parts of the AA that lack surface water at some time of the year. The number of hummocks, small pits, raised mounds, upturned trees, animal burrows, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area immediately surrounding them is:	
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0
71			Intermediate.	0
72			Several (extensive micro-topography).	1
73	F13	Upland Inclusions	Within the AA, inclusions of upland that individually are >100 sq.m. are:	
74			Few or none.	1
75			Intermediate (1 - 10% of vegetated part of the AA).	0
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).	0
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: *[To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (Figure A-7 in the Manual.]*	
78			Loamy: includes loam, sandy loam.	0
79			Fines: includes silt, clay, clay loam, silty clay, silty clay loam, sandy clay, sandy clay loam.	0
80			Peat, to 40 cm depth or greater.	0
81			Peat or organic <40 cm deep.	1
82			Coarse: includes sand, loamy sand, gravel, cobble, stones, boulders, fluvents, fluvaquents, riverwash.	0
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [include also any area that is adjacent to the AA].	
84			none, or <100 sq. m.	1
85			100-1000 sq. m.	0
86			1000 – 10,000 sq. m.	0
87			>10,000 sq. m.	0
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (excluding moss but including ferns) is:	
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	1
90			5-25% of the vegetated part of the AA.	0
91			25-50% of the vegetated part of the AA.	0
92			50-95% of the vegetated part of the AA.	0
93			>95% of the vegetated part of the AA.	0
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:	
95			<5% of the herbaceous part of the AA.	0
96			5-25% of the herbaceous part of the AA.	0
97			25-50% of the herbaceous part of the AA.	0
98			50-95% of the herbaceous part of the AA.	0
99			>95% of the herbaceous part of the AA.	0
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:	
101			<5% of the vegetated area, or none.	0
102			5-50% of the vegetated area.	0
103			50-95% of the vegetated area.	0
104			>95% of the vegetated area.	0
105	F19	Dominance of Most Abundant Herbaceous	Determine which two native herbaceous species (excluding mosses) comprise the greatest portion of the herbaceous cover that is unshaded by a woody canopy. Then choose one of the following:	

	A	B	C	D
106		Species	those species together comprise > 50% of the areal cover of native herbaceous plants at any time during the year.	0
107			those species together do not comprise > 50% of the areal cover of native herbaceous plants at any time during the year.	0
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.	
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:	
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1
116			some (but <5%) of the upland edge.	0
117			5-50% of the upland edge.	0
118			most (>50%) of the upland edge.	0
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated AA (in a lake, stream, or river) is much wider than the vegetated wetland. Enter "1" if true, "0" if false.	0
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a lake, i.e., a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	0
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:	
122			<1% AND <0.01 hectare (about 10 m on a side) never has surface water. In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	1
123			1-25% of the AA, or <1% but >0.01 ha, never contains surface water.	0
124			25-50% of the AA never contains surface water.	0
125			50-75% of the AA never contains surface water.	0
126			75-99% of the AA never contains surface water.	0
127			99-100%. True for many bogs, meadow marshes, swamps that lack vernal pools. Enter "1" and SKIP to F42 (Channel Connection).	0
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:	
129			none. The AA dries up completely (no water in channels either) or never has surface water during most years.	0
130			1-20% of the AA.	0
131			20-50% of the AA.	1
132			50-95% of the AA.	0
133			>95% of the AA. True for many fringe wetlands.	0
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:	
135			<5% of the water is shaded, or no surface water is present then.	0
136			5-25% of the water is shaded.	1
137			25-50% of the water is shaded.	0
138			50-75% of the water is shaded.	0
139			>75% of the water is shaded.	0
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA that is covered by unfrozen surface water only during the wettest time of the year during most years is:	
141			None, or <0.01 hectare and <1% of the AA.	0
142			1-20% of the AA, or <1% but >0.01 ha.	1
143			20-50% of the AA.	0

	A	B	C	D
144			50-95% of the AA.	0
145			>95% of the AA.	0
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water is:	
147			<10 cm change (stable or nearly so).	0
148			10 cm - 50 cm change.	1
149			0.5 - 1 m change.	0
150			1-2 m change.	0
151			>2 m change.	0
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and **SKIP TO F42** (Connection).			0
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:	
154			<10 cm deep (but >0).	0
155			10 - 50 cm deep.	0
156			0.5 - 1 m deep.	1
157			1 - 2 m deep.	0
158			>2 m deep. True for many fringe wetlands.	0
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):	
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0
161			One depth class that comprises 50-90% of the AA's inundated area.	1
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) is:	
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0
165			5-30% of the water.	0
166			30-70% of the water.	0
167			70-95% of the water.	0
168			>95% of the water.	1
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of open water that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and SKIP to F41 (Floating Algae & Duckweed).	1
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is open (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:	
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0
172			1-4% of the ponded water. Enter "1" and SKIP to F40 (Floating Algae & Duckweed).	0
173			5-30% of the ponded water.	0
174			30-70% of the ponded water.	0
175			70-99% of the ponded water.	1
176			100% of the ponded water.	0
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:	
178			<1 m	0
179			1 - 9 m	1
180			10 - 29 m	0
181			30 - 49 m	0
182			50 - 100 m	0
183			> 100 m, or open water is absent.	0
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's water edge length that is nearly flat (a slope less than about 5% measured within 5 m landward of the water) is:	
185			<1% of the water edge.	0
186			1-25% of the water edge.	1
187			25-50% of the water edge.	0

	A	B	C	D
188			50-75% of the water edge.	0
189			>75% of the water edge.	0
190	F36	Robust Emergents	The percentage of the emergent vegetation cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:	
191			<1% of the emergent vegetation, or emergent vegetation is absent.	1
192			1-25% of the emergent vegetation.	0
193			25-75% of the emergent vegetation.	0
194			>75%, of the emergent vegetation.	0
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial patternof emergent vegetation is mostly:	
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0
197			Intermediate.	0
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	1
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and SKIP to F42.(Connection).	1
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of dead wood and undercut banks is:	
201			Little or none.	1
202			Intermediate.	0
203			Extensive.	0
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore by water depths >1 m on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0
206	F42	Channel Connection & Outflow Duration	The most persistent outlet connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the least permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network]	
207			persistent (surface water flows out for >9 months/year, regardless of whether frozen or not).	0
208			seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive, including times when frozen).	0

	A	B	C	D
209			temporary (surface water flows out for <14 days, not necessarily consecutive, but must be unfrozen).	0
210			none -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	1
211			no surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0
212	F43	Outflow Confinement	During major runoff events, in the places where surface water exits the AA or connected waters nearby, the water:	
213			mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0
214			leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0
215			is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by most of the incoming water].	
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0
220			bumps into herbaceous vegetation but mostly remains in fairly straight channels.	0
221			bumps into herbaceous vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0
222			bumps into tree trunks and/or shrub stems but mostly remains in fairly straight channels.	0
223			bumps into tree trunks and/or shrub stems and follows a fairly indirect path from entrance to exit (meandering, multi-branched, or braided).	0
224	F47	pH Measurement	The pH in most of the AA's surface water:	
225			was not measured because no surface water could be found during this visit. Enter "1".	0
226			was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0
227			was measured, and is: [*enter the reading in the column to the right*]:	6.1
228	F48	TDS and/or Conductivity	The Total Dissolved Solids (TDS) in most of the AA's surface water:	
229			was not measured because no surface water could be found during this visit. Enter "1".	0
230			was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0
231			TDS is: [*enter the reading in ppm in the column to the right, if measured, or answer next row*]:	350
232			Conductivity is [*enter the reading in µS/cm in the column to the right*]:	401
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):	
234			evident from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0
235			likely based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0
236			unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1
237	F50	Groundwater Strength of Evidence	Select first applicable choice.	
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0
239			The upper end of the AA is located very close to the base of (but mostly not ON) a natural slope much steeper (usually >15%) than that within the AA and longer than 100 m AND if surface water was measured, its pH (Q47) is >5.5.	0
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:	
242			<2% or the AA has no surface water outlet (not even seasonally)	1
243			2-5%	0
244			6-10%	0

	A	B	C	D
245			>10%	0
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.			
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:	
248			<5%	0
249			5 to 30%	0
250			30 to 60%	0
251			60 to 90%	0
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	1
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):	
254			impervious surface, e.g., paved road, parking lot, building, exposed rock.	0
255			bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	0
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:	
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0
258			2-5%	0
259			5-30%	0
260			>30%	0
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	1
262	F56	New or Expanded Wetland	Part or all of the AA resulted from human actions that persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):	
263			No.	1
264			yes, and created 20 - 100 years ago.	0
265			yes, and created 3-20 years ago.	0
266			yes, and created within last 3 years.	0
267			yes, but time of origin unknown.	0
268			unknown if new within 20 years or not.	0
269	F57	Burn History	More than 1% of the AA's previously vegetated area:	
270			burned within past 5 years.	0
271			burned 6-10 years ago.	0
272			burned 11-30 years ago.	0
273			burned >30 years ago, or no evidence of a burn and no data.	1
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:	
275			<25%	1
276			25-50%	0
277			>50%	0
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:	
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	1
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail]*	
283			<5% and no inhabited building is within 100 m of the AA.	0

	A	B	C	D
284			<5% and inhabited building is within 100 m of the AA.	0
285			5-50% and no inhabited building is within 100 m of the AA.	0
286			5-50% and inhabited building is within 100 m of the AA.	0
287			50-95%, with or without inhabited building nearby.	0
288			>95% of the AA with or without inhabited building nearby.	1
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[see note above].*	
290			<5%. If F61 was answered ">95%" (mostly never visited), SKIP to F65.	1
291			5-50%	0
292			50-95%	0
293			>95% of the AA.	0
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.	
297			low-impact commercial timber harvest (e.g., selective thinning).	0
298			commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0
299			waterfowl hunting.	0
300			fishing.	0
301			trapping of furbearers.	0
302			none of the above.	1
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:	
304			Within 0-100 m of the AA.	0
305			100-500 m away.	0
306			>500 m away, or no information.	1
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.	

Stressor (S) Data Form for Non-Tidal Wetlands. WESP for Atlantic Canada. Version 1.2

					Data
S1	**Aberrant Timing of Water Inputs**				
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]				
	stormwater from impervious surfaces that drains directly to the wetland				
	water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation				
	regular removal of surface or groundwater for irrigation or other consumptive use				
	flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland				
	a dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines)				x
	excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch				
	artificial drains or ditches in or near the wetland				
	accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level)				
	logging within the wetland				
	subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles				
	straightening, ditching, dredging, and/or lining of tributary channels				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of timing shift within the wetland	>95% of wetland	5-95% of wetland	<5% of wetland	3
	When most of the timing shift began	<3 yrs ago	3-9 yrs ago	10-100 yrs ago	1
	Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
	Input timing now vs. previously	shift of weeks	shift of days	shift of hours or minutes	0
	Flashiness or muting	became very flashy or controlled	intermediate	became mildly flashy or controlled	0
				Sum=	4
				Final Score=	0.33
S2	**Accelerated Inputs of Contaminants and/or Salts**				
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]				
	stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities				
	metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1				
	road salt				
	spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Usual toxicity of most toxic contaminants	industrial effluent, mining waste, unmanaged landfill	cropland, managed landfill, pipeline or transmission rights-of-way	low density residential	0
	Frequency & duration of input	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	0
	AA proximity to main sources (actual or potential)	0 - 15 m	15-100 m or in groundwater	in more distant part of contributing area	0
				Sum=	0
				Final Score=	0.00
S3	**Accelerated Inputs of Nutrients**				
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]				
	stormwater or wastewater effluent (including failing septic systems), landfills				
	fertilizers applied to lawns, ag lands, or other areas in the CA				
	livestock, dogs				
	artificial drainage of upslope lands				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Type of loading	high density of unmaintained septic, some types of industrial sources	moderate density septic, cropland, secondary wastewater treatment plant	livestock, pets, low density residential	0
	Frequency & duration of input	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	0
	AA proximity to main sources (actual or potential)	0 - 15 m	15-100 m or in groundwater	in more distant part of contributing area	0
				Sum=	0
				Final Score=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires	
erosion from construction, in-channel machinery in the CA	
erosion from off-road vehicles in the CA	
erosion from livestock or foot traffic in the CA	
stormwater or wastewater effluent	
sediment from road sanding, gravel mining, other mining, oil/ gas extraction	
accelerated channel downcutting or headcutting of tributaries due to altered land use	
other human-related disturbances within the CA	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA	extensive evidence, high intensity*	potentially (based on high-intensity* land use) or scattered evidence	potentially (based on low-intensity* land use) with little or no direct evidence	0
Recentness of significant soil disturbance in the CA	current & ongoing	1-12 months ago	>1 yr ago	0
Duration of sediment inputs to the wetland	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	0
AA proximity to actual or potential sources	0 - 15 m	15-100 m	in more distant part of contributing area	0
* **high**-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; **low**-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment			Sum=	0
			Final Score=	0.00

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods	
leveling or other grading not to the natural contour	
tillage, plowing (but excluding disking for enhancement of native plants)	
fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland	
excavation	
ditch cleaning or dredging in or adjacent to the wetland	
boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments	
artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil	>95% of wetland or >95% of its upland edge (if any)	5-95% of wetland or 5-95% of its upland edge (if any)	<5% of wetland and <5% of its upland edge (if any)	0
Recentness of significant soil alteration in wetland	current & ongoing	1-12 months ago	>1 yr ago	0
Duration	long-lasting, minimal veg recovery	long-lasting but mostly revegetated	short-term, revegetated, not intense	0
Timing of soil alteration	frequent and year-round	frequent but mostly seasonal	mainly during one-time or scattered events	0
			Sum=	0
			Final Score=	0.00

WETLAND 1

Wetland ID:	Ruth Falls Dam
Date:	9/21/2017
Observer:	Heather Mosher
Latitude & Longitude (decimal degrees):	44.954621 , -62.502727

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed. Note: Benefits scores will be provided in the final calculator for WBF, WBN, SBM, and POL; their models are currently being revised.

Results for this Assessment Area (AA):

Wetland Functions or Other Attributes:	Function Score (normalized)	Function Rating	Benefits Score (normalized)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	6.85	Higher	1.43	Lower	6.97	1.67
Stream Flow Support (SFS)	0.97	Lower	0.00	Lower	0.52	0.00
Water Cooling (WC)	1.96	Lower	0.00	Lower	1.31	0.00
Sediment Retention & Stabilisation (SR)	3.02	Moderate	0.67	Lower	5.07	0.41
Phosphorus Retention (PR)	3.64	Moderate	0.00	Lower	5.79	0.33
Nitrate Removal & Retention (NR)	6.27	Higher	0.00	Lower	6.08	3.33
Carbon Sequestration (CS)	5.06	Moderate			6.67	
Organic Nutrient Export (OE)	4.75	Moderate			3.77	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.85	Moderate	5.39	Moderate	5.65	4.20
Amphibian & Turtle Habitat (AM)	7.52	Higher	7.70	Higher	7.42	4.26
Waterbird Feeding Habitat (WBF)	7.92	Higher			6.35	
Waterbird Nesting Habitat (WBN)	6.03	Higher			5.02	
Songbird, Raptor, & Mammal Habitat (SBM)	7.77	Higher			6.43	
Pollinator Habitat (POL)	7.99	Higher			6.43	
Native Plant Habitat (PH)	5.11	Higher	7.54	Higher	5.53	4.29
Public Use & Recognition (PU)			2.02	Lower		1.53
Wetland Sensitivity (Sens)			8.10	Higher		4.81
Wetland Ecological Condition (EC)			8.62	Higher		9.17
Wetland Stressors (STR) (higher score means more)			9.75	Higher		4.78

WETLAND 2

Cover Page: Basic Description of Assessment	**WESP-AC version 1.2**
Site Name:	Ruth Falls Dam Wetland 2
Investigator Name:	Heather Mosher
Date of Field Assessment:	9/21/2017
Nearest Town:	Sheet Harbour, NS
Latitude (decimal degrees):	44.9545
Longitude (decimal degrees):	-62.5022
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in acres):	0.1266 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	70%
What percent (approx.) of the **wetland** were you able to visit?	70%
What percent (approx.) of the **AA** were you able to visit?	100%
Were you able to ask the site owner/manager about any of the questions?	Yes
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes, rare plants
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Yes, July 2016 (Marysville, NB)
How many wetlands have you assessed previously using WESP-AC? (approx.)	15
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D
3	#	Indicators	Condition Choices	Data
4	OF1	Province	Mark the province in which the AA is located by changing the column next to it to a "1". Mark only one.	
5			New Brunswick	0
6			Nova Scotia	1
7			Prince Edward Island	0
8			Newfoundland-Labrador	0
9	OF2	Wetland Herbaceous Area	From "duck's eye" (aerial) view, the area of woody vegetation (grasslike plants, excluding moss & ferns) in the Assessment Area (AA) plus in any contiguous woody wetland is:	
10			<0.01 hectare (about 10 m x 10 m)	0
11			0.01 - 0.1 hectare	0
12			0.1 - 1 hectare	1
13			1 to 10 hectares	0
14			10 to 100 hectares	0
15			>100 hectares	0
16	OF3	Wetland + Water Total Area	The total area of the AA including ponded water within or adjacent to it is:	
17			<0.01 hectare (about 10 m x 10 m)	0
18			0.01 - 0.1 hectare	0
19			0.1 - 1 hectare	1
20			1 to 10 hectares	0
21			10 to 100 hectares	0
22			>100 hectares	0
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	Including the AA's vegetated area, the largest patch or corridor that is unmanaged vegetation cover (excluding lawn, row crops, heavily grazed lands, conifer plantation) and is contiguous with vegetation in the AA (i.e., not completely separated by highways or channels that are uniformly wider than 50 m), occupies:	
24			<0.01 hectare (about 10 m x 10 m)	0
25			0.01 - 0.1 hectare	0
26			0.1 - 1 hectare	0
27			1 to 10 hectares	0
28			10 to 100 hectares	0
29			100 to 1000 hectares	0
30			>1000 hectares [*This is nearly always the answer in relatively undeveloped landscapes.*]	1

	A	B	C	D
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the AA edge to the edge of the closest patch or corridor of *unmanaged vegetated land* (excluding row crops, lawn, conifer plantation) larger than 375 hectares, is:	
32			<50 m, and not separated from the 375-ha vegetated area by any width of roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. *This is often the answer in relatively*	1
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0
34			50-500 m, and not separated.	0
35			50-500 m, but separated by those features.	0
36			0.5 - 5 km, and not separated.	0
37			0.5 - 5 km, but separated by those features.	0
38			none of the above (the closest patches or corridors which are that large are >5 km away).	0
39	OF6	Herbaceous Uniqueness	The AA's vegetation is mostly herbaceous but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation is mostly herbaceous but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation is mostly herbaceous but uplands within 100 m have <10% herbaceous cover. If so, enter "1" [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0
40	OF7	Woody Uniqueness	The AA's vegetation is mostly woody but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is mostly woody but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is mostly woody but uplands within 100 m have <10% woody cover. If so, enter "1" [*NOTE: woody = Shrubland and forest, but exclude conifer plantations.]	0
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land,	
42			<5% of the land.	0
43			5 to 20% of the land.	0
44			20 to 60% of the land.	0
45			60 to 90% of the land.	1
46			>90% of the land. SKIP to OF9.	0
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:	
48			impervious surface, e.g., paved road, parking lot, building, exposed rock.	0
49			bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:	
51			<100 m	0
52			100 - 500 m	0
53			0.5- 1 km	0
54			1 - 5 km	0
55			>5 km	1
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:	
57			<10 m	0
58			10 - 25 m	0
59			25 - 50 m	0
60			50 - 100 m	0
61			100 - 500 m	0

	A	B	C	D
62			>500 m	1
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no *other* wetlands within 5 km.	0
64	OF13	Distance to Ponded Water	The distance from the AA edge to the closest (but separate) pond or lake larger than 0.01 ha (about 10 x 10 m) is:	
65			<50 m, and not separated by any width of roads, stretches of open water, row crops, lawn, bare ground, or impervious surface	1
66			<50 m, but completely separated by those features.	0
67			50-500 m, and not separated.	0
68			50-500 m, but separated by those features.	0
69			0.5 - 1 km, and not separated.	0
70			0.5 - 1 km, but separated by those features.	0
71			none of the above (the closest patches or corridors that large are >1 km away).	0
72	OF14	Distance to Lake	The distance from the AA edge to the closest (but separate) lake (a non-tidal body of water that is ponded during most of the year and is larger than 8 hectares) during most of a normal year is:	
73			<100 m	1
74			100 m - 1 km	0
75			1 -2 km	0
76			2-5 km	0
77			5-10 km	0
78			>10 km	0
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:	
80			<100 m	0
81			100 m - 1 km	0
82			1 - 5 km	1
83			5-10 km	0
84			10-40 km	0
85			>40 km	0

	A	B	C	D
86	OF16	Upland Edge Contact	Select one:	
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	1
92	OF17	Flood Zone	The AA is within a mapped Flood Zone or Flood Risk area, or an area in which river- or stream-associated floods within the past 20 years have damaged bridges, roads, buildings, or other infrastructure (not farmlands) within 5 km downslope from the AA. The floods must not be related to tidal influence or waves. If true, enter "1" in next column. If neither are true and AA is not in a river floodplain, enter "0" and SKIP to OF18. Otherwise, change to blank before skipping to OF18.	0
93	OF18	Flood Damage	Within the mapped Flood Zone, Flood Risk area, or area with known flood damage, ALL the following are true (If all true, enter "1" in next column. If false, enter "0") (a) there are bridges, roads, buildings, or other infrastructure (not just farmlands) within 5 km downslope from the AA that are vulnerable to damaging floods; (b) the damages would be caused mainly by rising river levels associated with precipitation and/or snowmelt, not primarily by high tides, hillslope runoff, or river ice jams, AND (c) between the AA and the damage area, peak flow in a connecting channel (if any) is NOT regulated by dams.	0
94	OF19	Relative Elevation in Watershed	To view watersheds, open Google Earth and then the NB_Watersheds.kmz file that accompanies this calculator. Determine the AA's position in its watershed as follows: 1) If the AA is on a channel wider than 10 m, or has both inlet & outlet and is closer to the watershed's outlet than to its upper end, check "lower 1/3." 2) If the AA is the source of a headwater stream, or lacks an outlet and is close to the watershed's outer margin, then check "upper 1/3." For all other conditions, check "middle 1/3".	
95			in the upper one-third of its watershed.	0
96			in the middle one-third of its watershed.	1
97			in the lower one-third of its watershed.	0
98	OF20	Water Quality Sensitivity	The AA is in an area: (a) legally protected from most land uses because it feeds an aquifer, a well that serves many users, or a reservoir or other surface water source that provides drinking water to multiple domestic users, OR (b) where research or map analysis has indicated groundwater may be at higher risk of contamination due to geological conditions. Enter 1= yes, 0= no. Change to blank if no information.	

	A	B	C	D
99	OF21	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, high temperatures) being present at levels harmful to aquatic life or humans, and:	
100			The condition is present within the AA.	0
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream).This is the situation for nearly all wetlands in this region.	1
104	OF22	Degraded Water Downstream	The problem described above is downslope from the AA, and:	
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream).This is the situation for nearly all wetlands in this region.	1
109	OF23	Wetland as a % of Its Contributing Area (Catchment)	Estimate the approximate boundaries of the wetland's catchment (CA) from a topographic map.Then adjust those boundaries necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:	
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0
111			0.01 to 0.1	0
112			0.1 to 1	1
113			>1 (wetland is larger than its catchment (e.g., wetland is isolated by dikes with no input channels, is fed entirely by groundwater, or is a raised bog).	0
114	OF24	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :	
115			<10%	1
116			10 to 25%	0
117			>25%	0
118	OF25	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:	
119			Mostly true	0
120			Somewhat true	0
121			Mostly untrue	1
122	OF26	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:	
123			Northward (N, NE). north-facing contributing area.	0
124			Southward (S, SW). south-facing contributing area.	1
125			other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0
126	OF27	Internal Flow Distance (Path	The horizontal flow distance from the wetland's inlet to outlet is:	

	A	B	C	D
127		Distance (Path Length)	<10 m	0
128			10 - 50 m	0
129			50 - 100 m	1
130			100 - 1000 m	0
131			1- 2 km	0
132			>2 km, or wetland lacks an inlet and outlet.	0
133	OF28	Growing Degree Days	According to Figure A-1 in Appendix A of the Manual, the mean annual Growing Degree Days (GDD) in the vicinity of the AA is approximately:	
134			800-1000 days	0
135			1000-1200	0
136			1200-1400	1
137			1400-1600	0
138			1600-1800	0
139			>1800 days	0
140	OF29	Fish Access or Use	According to agency biologists and/or your own observations, the AA: *[mark just the first choice that is true]*:	
141			is known to support Atlantic salmon rearing and/or spawning. In NB, consult Figure A-2 in Appendix A of the Manual, or local fishery biologists.	0
142			has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters containing Atlantic salmon and is probably salmon-accessible during some conditions.	0
143			is not accessible to any anadromous fish species but is known or likely to have other fish at least seasonally.	0
144			is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily).	1
145	OF30	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable]*:	
146			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or (in NS only) the AA is within a mapped Atlantic Coastal Plain Flora Buffer as shown in Special Management Practice Zones at: https://nsgi.novascotia.ca/plv/	0
147			Presence of one or more of the amphibian or reptile species of conservation concern (AM) as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0
148			Presence of one or more of the waterbird species of conservation concern (WBF, WBN) as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0
149			Presence of one or more of the nesting songbird or raptor species of conservation concern (SBM) as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0
150			none of the above, or no data.	1
151	OF31	Important Bird Area (IBA)	The AA is all or part of the West Shepody Bay or St. Johns River Important Bird Area, or other designated IBA. See Figures A-3 & A-4 in Appendix A of the Manual. Enter 1= yes, 0= no.	0
152	OF32	Black Duck Nesting Area	The AA is within an area mapped as generally high suitability (>20 pairs/25 sq km) for nesting American Black Duck. See Figure A-5 in Appendix A of the Manual. Enter 1= yes, 0= no. If outside of region shown in map, change to blank.	0
153	OF33	Wintering Deer or Mainland Moose Concentration Area	The AA is all or part of a Deer Wintering Area or (in NS only) a Mainland Moose Concentration Area. If AA is on private land with no information, change to blank. Otherwise, in NB: In Google Earth, view the KMZ overlay that accompanies this calculator, or download the shapefile (Crown Lands Conservation Areas) at http://www.snb.ca/geonb1/e/DC/catalogue-E.asp In NS: go to https://nsgi.novascotia.ca/plv/ and view Special Management Practice Zones> Mainland Moose Concentration Areas).	0
154	OF34	Other Conservation Designation	The AA is all or part of an area designated by the provincial government for its exceptional ecological features or highly intact natural conditions. Enter: yes= 1, no= 0. In NB: Provincially Significant Wetland, Environmentally Significant Area, Protected Natural Area (go to http://www.snb.ca/geonb1/e/apps/apps-E.asp and see Candidate PNA Map Viewer) In NS: go to https://nsgi.novascotia.ca/plv/ and view Protected Areas)	0

	A	B	C	D
155	OF35	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Enter: yes= 1, no= 0. If no information, change to blank.	0
156	OF36	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Enter: yes= 1, no= 0. If no information, change to blank.	0
157	OF37	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Enter: yes= 1, no= 0. If no information, change to blank.	0

	A	B	C	D
2	**Form F (Field).** Non-tidal Wetland Data Form. WESP-AC version 1.2. DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU=	
3	**#**	**Indicators**	**Condition Choices**	**Data**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:	
5			A. Moss and/or lichen cover more than 25% of the ground. Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.	
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is <100 µS/cm (about 64 ppm TDS). Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew). Sedge cover usually sparse or absent. Trees, if present, are mainly limited to black spruce. Surrounding landscape is mostly flat and wetland surface is never sloping, except sometimes from wetland center towards outer edges (convex). Inlet and outlet channels are usually absent..	0
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is >100 µS/cm. Sedges and/or cottongrass often dominate the ground cover, while ericaceous shrubs and black spruce may also be present. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1, often with many small persistent pools.	1
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:	
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0
11			*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent lakes larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, "adjacent" is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*	
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.	
13			A1	0
14			A2	0
15			B1	1
16			B2	0
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the of the living vegetation in the AA is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none):	
18			coniferous trees (may include tamarack) taller than 3 m.	3
19			deciduous trees taller than 3 m.	3
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	2
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2

	A	B	C	D
24	*Note: If you marked ALL of the F3 rows 0 or 1, SKIP to F9 (N fixers).*			
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species (<3 m tall) comprise the greatest portion of the woody cover (<3 m tall). Then choose one:	
26			those species together comprise > 50% of such cover.	0
27			those species together do not comprise > 50% of such cover.	1
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% of the woody canopy cover in the AA or >5% of the wooded areas (if any) along its upland edge (perimeter). The edge should include only the trees whose canopies extend into the AA.	
29			coniferous, 1-9 cm diameter and >1 m tall.	1
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1
31			coniferous, 10-19 cm diameter.	1
32			broad-leaved deciduous 10-19 cm diameter.	1
33			coniferous, 20-40 cm diameter.	0
34			broad-leaved deciduous 20-40 cm diameter.	1
35			coniferous, >40 cm diameter.	0
36			broad-leaved deciduous >40 cm diameter.	0
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:	
38			A. Neither the vegetation taller than 1 m nor the vegetation shorter than that comprise >70% of the vegetated part of the AA. They each comprise 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.	
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:	
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	0
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	1
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (diameter >20 cm) in the AA plus adjacent upland area within 10 m of the wetland edge is:	
45			None, or fewer than 8/ hectare which exceed this diameter.	1
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0
47			Several (>8/hectare) but above not true.	0
48	F8	Downed Wood	The number of downed wood pieces longer than 2 m and with diameter >10 cm, and not persistently submerged, is:	
49			Few or none that meet these criteria.	0
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	1
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:	
52			<1% or none	0
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	1
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:	
58			<5% of the vegetated part of the AA.	0
59			5-25% of the vegetated part of the AA.	0
60			25-50% of the vegetated part of the AA.	0
61			50-95% of the vegetated part of the AA.	0
62			>95% of the vegetated part of the AA.	1

	A	B	C	D
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:	
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0
67			Other conditions.	0
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0
69	F12	Ground Irregularity	Consider the parts of the AA that lack surface water at some time of the year. The number of hummocks, small pits, raised mounds, upturned trees, animal burrows, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area immediately surrounding them is:	
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0
71			Intermediate.	0
72			Several (extensive micro-topography).	1
73	F13	Upland Inclusions	Within the AA, inclusions of upland that individually are >100 sq.m. are:	
74			Few or none.	1
75			Intermediate (1 - 10% of vegetated part of the AA).	0
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).	0
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (Figure A-7 in the Manual.]*	
78			Loamy: includes loam, sandy loam.	0
79			Fines: includes silt, clay, clay loam, silty clay, silty clay loam, sandy clay, sandy clay loam.	0
80			Peat, to 40 cm depth or greater.	1
81			Peat or organic <40 cm deep.	0
82			Coarse: includes sand, loamy sand, gravel, cobble, stones, boulders, fluvents, fluvaquents, riverwash.	0
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [include also any area that is adjacent to the AA].	
84			none, or <100 sq. m.	1
85			100-1000 sq. m.	0
86			1000 – 10,000 sq. m.	0
87			>10,000 sq. m.	0
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (excluding moss but including ferns) is:	
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0
90			5-25% of the vegetated part of the AA.	0
91			25-50% of the vegetated part of the AA.	1
92			50-95% of the vegetated part of the AA.	0
93			>95% of the vegetated part of the AA.	0
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:	
95			<5% of the herbaceous part of the AA.	0
96			5-25% of the herbaceous part of the AA.	1
97			25-50% of the herbaceous part of the AA.	0
98			50-95% of the herbaceous part of the AA.	0
99			>95% of the herbaceous part of the AA.	0
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:	
101			<5% of the vegetated area, or none.	0
102			5-50% of the vegetated area.	1
103			50-95% of the vegetated area.	0
104			>95% of the vegetated area.	0
105	F19	Dominance of Most Abundant Herbaceous	Determine which two native herbaceous species (excluding mosses) comprise the greatest portion of the herbaceous cover that is unshaded by a woody canopy. Then choose one of the following:	

	A	B	C	D
106		Species	those species together comprise > 50% of the areal cover of native herbaceous plants at any time during the year.	1
107			those species together do not comprise > 50% of the areal cover of native herbaceous plants at any time during the year.	0
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.	
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:	
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1
116			some (but <5%) of the upland edge.	0
117			5-50% of the upland edge.	0
118			most (>50%) of the upland edge.	0
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated AA (in a lake, stream, or river) is much wider than the vegetated wetland. Enter "1" if true, "0" if false.	0
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a lake, i.e., a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	0
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:	
122			<1% AND <0.01 hectare (about 10 m on a side) never has surface water. In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0
123			1-25% of the AA, or <1% but >0.01 ha, never contains surface water.	0
124			25-50% of the AA never contains surface water.	0
125			50-75% of the AA never contains surface water.	0
126			75-99% of the AA never contains surface water.	0
127			99-100%. True for many bogs, meadow marshes, swamps that lack vernal pools. Enter "1" and SKIP to F42 (Channel Connection).	1
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:	
129			none. The AA dries up completely (no water in channels either) or never has surface water during most years.	0
130			1-20% of the AA.	0
131			20-50% of the AA.	0
132			50-95% of the AA.	0
133			>95% of the AA. True for many fringe wetlands.	0
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:	
135			<5% of the water is shaded, or no surface water is present then.	0
136			5-25% of the water is shaded.	0
137			25-50% of the water is shaded.	0
138			50-75% of the water is shaded.	0
139			>75% of the water is shaded.	0
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA that is covered by unfrozen surface water only during the wettest time of the year during most years is:	
141			None, or <0.01 hectare and <1% of the AA.	0
142			1-20% of the AA, or <1% but >0.01 ha.	0
143			20-50% of the AA.	0

	A	B	C	D
144			50-95% of the AA.	0
145			>95% of the AA.	0
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water is:	
147			<10 cm change (stable or nearly so).	0
148			10 cm - 50 cm change.	0
149			0.5 - 1 m change.	0
150			1-2 m change.	0
151			>2 m change.	0
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and **SKIP TO F42** (Connection).			0
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:	
154			<10 cm deep (but >0).	0
155			10 - 50 cm deep.	0
156			0.5 - 1 m deep.	0
157			1 - 2 m deep.	0
158			>2 m deep. True for many fringe wetlands.	0
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):	
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0
161			One depth class that comprises 50-90% of the AA's inundated area.	0
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) is:	
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0
165			5-30% of the water.	0
166			30-70% of the water.	0
167			70-95% of the water.	0
168			>95% of the water.	0
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of open water that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and SKIP to F41 (Floating Algae & Duckweed).	0
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is open (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:	
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0
172			1-4% of the ponded water. Enter "1" and SKIP to F40 (Floating Algae & Duckweed).	0
173			5-30% of the ponded water.	0
174			30-70% of the ponded water.	0
175			70-99% of the ponded water.	0
176			100% of the ponded water.	0
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:	
178			<1 m	0
179			1 - 9 m	0
180			10 - 29 m	0
181			30 - 49 m	0
182			50 - 100 m	0
183			> 100 m, or open water is absent.	0
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's water edge length that is nearly flat (a slope less than about 5% measured within 5 m landward of the water) is:	
185			<1% of the water edge.	0
186			1-25% of the water edge.	0
187			25-50% of the water edge.	0

	A	B	C	D
188			50-75% of the water edge.	0
189			>75% of the water edge.	0
190	F36	Robust Emergents	The percentage of the emergent vegetation cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:	
191			<1% of the emergent vegetation, or emergent vegetation is absent.	0
192			1-25% of the emergent vegetation.	0
193			25-75% of the emergent vegetation.	0
194			>75%, of the emergent vegetation.	0
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial patternof emergent vegetation is mostly:	
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0
197			Intermediate.	0
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and SKIP to F42.(Connection).	0
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of dead wood and undercut banks is:	
201			Little or none.	0
202			Intermediate.	0
203			Extensive.	0
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore by water depths >1 m on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0
206	F42	Channel Connection & Outflow Duration	The most persistent outlet connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the least permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network]	
207			persistent (surface water flows out for >9 months/year, regardless of whether frozen or not).	0
208			seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive, including times when frozen).	0

	A	B	C	D
209			temporary (surface water flows out for <14 days, not necessarily consecutive, but must be unfrozen).	0
210			none -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	1
211			no surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0
212	F43	Outflow Confinement	During major runoff events, in the places where surface water exits the AA or connected waters nearby, the water:	
213			mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0
214			leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0
215			is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by most of the incoming water].	
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0
220			bumps into herbaceous vegetation but mostly remains in fairly straight channels.	0
221			bumps into herbaceous vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0
222			bumps into tree trunks and/or shrub stems but mostly remains in fairly straight channels.	0
223			bumps into tree trunks and/or shrub stems and follows a fairly indirect path from entrance to exit (meandering, multi-branched, or braided).	0
224	F47	pH Measurement	The pH in most of the AA's surface water:	
225			was not measured because no surface water could be found during this visit. Enter "1".	1
226			was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0
227			was measured, and is: [*enter the reading in the column to the right*]:	
228	F48	TDS and/or Conductivity	The Total Dissolved Solids (TDS) in most of the AA's surface water:	
229			was not measured because no surface water could be found during this visit. Enter "1".	1
230			was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0
231			TDS is: [*enter the reading in ppm in the column to the right, if measured, or answer next row*]:	
232			Conductivity is [*enter the reading in µS/cm in the column to the right*]:	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):	
234			evident from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0
235			likely based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0
236			unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1
237	F50	Groundwater Strength of Evidence	Select first applicable choice.	
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0
239			The upper end of the AA is located very close to the base of (but mostly not ON) a natural slope much steeper (usually >15%) than that within the AA and longer than 100 m AND if surface water was measured, its pH (Q47) is >5.5.	0
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:	
242			<2% or the AA has no surface water outlet (not even seasonally)	0
243			2-5%	1
244			6-10%	0

	A	B	C	D
245			>10%	0
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.			
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:	
248			<5%	0
249			5 to 30%	0
250			30 to 60%	0
251			60 to 90%	0
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	1
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):	
254			impervious surface, e.g., paved road, parking lot, building, exposed rock.	0
255			bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	0
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:	
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0
258			2-5%	0
259			5-30%	0
260			>30%	0
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	1
262	F56	New or Expanded Wetland	Part or all of the AA resulted from human actions that persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):	
263			No.	1
264			yes, and created 20 - 100 years ago.	0
265			yes, and created 3-20 years ago.	0
266			yes, and created within last 3 years.	0
267			yes, but time of origin unknown.	0
268			unknown if new within 20 years or not.	0
269	F57	Burn History	More than 1% of the AA's previously vegetated area:	
270			burned within past 5 years.	0
271			burned 6-10 years ago.	0
272			burned 11-30 years ago.	0
273			burned >30 years ago, or no evidence of a burn and no data.	1
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:	
275			<25%	1
276			25-50%	0
277			>50%	0
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:	
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	1
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail]*	
283			<5% and no inhabited building is within 100 m of the AA.	0

	A	B	C	D
284			<5% and inhabited building is within 100 m of the AA.	0
285			5-50% and no inhabited building is within 100 m of the AA.	0
286			5-50% and inhabited building is within 100 m of the AA.	0
287			50-95%, with or without inhabited building nearby.	0
288			>95% of the AA with or without inhabited building nearby.	1
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[see note above].*	
290			<5%. If F61 was answered ">95%" (mostly never visited), SKIP to F65.	1
291			5-50%	0
292			50-95%	0
293			>95% of the AA.	0
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.	
297			low-impact commercial timber harvest (e.g., selective thinning).	0
298			commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0
299			waterfowl hunting.	0
300			fishing.	0
301			trapping of furbearers.	0
302			none of the above.	1
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:	
304			Within 0-100 m of the AA.	0
305			100-500 m away.	0
306			>500 m away, or no information.	1
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.	

Stressor (S) Data Form for Non-Tidal Wetlands. WESP for Atlantic Canada. Version 1.2

					Data
S1	**Aberrant Timing of Water Inputs**				
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]				
	stormwater from impervious surfaces that drains directly to the wetland				
	water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation				
	regular removal of surface or groundwater for irrigation or other consumptive use				
	flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland				
	a dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines)				x
	excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch				
	artificial drains or ditches in or near the wetland				
	accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level)				
	logging within the wetland				
	subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles				
	straightening, ditching, dredging, and/or lining of tributary channels				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of timing shift within the wetland	>95% of wetland	5-95% of wetland	<5% of wetland	2
	When most of the timing shift began	<3 yrs ago	3-9 yrs ago	10-100 yrs ago	1
	Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
	Input timing now vs. previously	shift of weeks	shift of days	shift of hours or minutes	0
	Flashiness or muting	became very flashy or controlled	intermediate	became mildly flashy or controlled	0
				Sum=	3
				Final Score=	0.25
S2	**Accelerated Inputs of Contaminants and/or Salts**				
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]				
	stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities				
	metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1				
	road salt				
	spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Usual toxicity of most toxic contaminants	industrial effluent, mining waste, unmanaged landfill	cropland, managed landfill, pipeline or transmission rights-of-way	low density residential	0
	Frequency & duration of input	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	0
	AA proximity to main sources (actual or potential)	0 - 15 m	15-100 m or in groundwater	in more distant part of contributing area	0
				Sum=	0
				Final Score=	0.00
S3	**Accelerated Inputs of Nutrients**				
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]				
	stormwater or wastewater effluent (including failing septic systems), landfills				
	fertilizers applied to lawns, ag lands, or other areas in the CA				
	livestock, dogs				
	artificial drainage of upslope lands				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Type of loading	high density of unmaintained septic, some types of industrial sources	moderate density septic, cropland, secondary wastewater treatment plant	livestock, pets, low density residential	0
	Frequency & duration of input	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	0
	AA proximity to main sources (actual or potential)	0 - 15 m	15-100 m or in groundwater	in more distant part of contributing area	0
				Sum=	0
				Final Score=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires	
erosion from construction, in-channel machinery in the CA	
erosion from off-road vehicles in the CA	
erosion from livestock or foot traffic in the CA	
stormwater or wastewater effluent	
sediment from road sanding, gravel mining, other mining, oil/ gas extraction	
accelerated channel downcutting or headcutting of tributaries due to altered land use	
other human-related disturbances within the CA	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA	extensive evidence, high intensity*	potentially (based on high-intensity* land use) or scattered evidence	potentially (based on low-intensity* land use) with little or no direct evidence	0
Recentness of significant soil disturbance in the CA	current & ongoing	1-12 months ago	>1 yr ago	0
Duration of sediment inputs to the wetland	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	0
AA proximity to actual or potential sources	0 - 15 m	15-100 m	in more distant part of contributing area	0
* **high**-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; **low**-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment			Sum=	0
			Final Score=	0.00

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods	
leveling or other grading not to the natural contour	
tillage, plowing (but excluding disking for enhancement of native plants)	
fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland	
excavation	
ditch cleaning or dredging in or adjacent to the wetland	
boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments	
artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil	>95% of wetland or >95% of its upland edge (if any)	5-95% of wetland or 5-95% of its upland edge (if any)	<5% of wetland and <5% of its upland edge (if any)	0
Recentness of significant soil alteration in wetland	current & ongoing	1-12 months ago	>1 yr ago	0
Duration	long-lasting, minimal veg recovery	long-lasting but mostly revegetated	short-term, revegetated, not intense	0
Timing of soil alteration	frequent and year-round	frequent but mostly seasonal	mainly during one-time or scattered events	0
			Sum=	0
			Final Score=	0.00

Wetland ID:	Ruth Falls Dam Wetland 2
Date:	9/21/2017
Observer:	Heather Mosher
Latitude & Longitude (decimal degrees):	44.954467 , -62.502153

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed. Note: Benefits scores will be provided in the final calculator for WBF, WBN, SBM, and POL; their models are currently being revised.

Results for this Assessment Area (AA):

Wetland Functions or Other Attributes:	Function Score (normalized)	Function Rating	Benefits Score (normalized)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	7.82	Higher	1.43	Lower	7.74	1.67
Stream Flow Support (SFS)	1.56	Lower	0.00	Lower	0.83	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	6.07	Higher	0.37	Lower	7.22	0.22
Phosphorus Retention (PR)	5.25	Higher	0.00	Lower	6.86	0.33
Nitrate Removal & Retention (NR)	3.04	Lower	0.00	Lower	5.08	3.33
Carbon Sequestration (CS)	8.82	Higher			8.36	
Organic Nutrient Export (OE)	6.33	Higher			5.02	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.75	Moderate	1.18	Moderate	5.60	2.02
Amphibian & Turtle Habitat (AM)	3.31	Moderate	2.64	Moderate	5.26	2.29
Waterbird Feeding Habitat (WBF)	0.00	Lower			0.00	
Waterbird Nesting Habitat (WBN)	0.00	Lower			0.00	
Songbird, Raptor, & Mammal Habitat (SBM)	8.29	Higher			6.86	
Pollinator Habitat (POL)	8.90	Higher			7.16	
Native Plant Habitat (PH)	6.77	Higher	8.22	Higher	6.23	4.68
Public Use & Recognition (PU)			2.02	Lower		1.53
Wetland Sensitivity (Sens)			7.68	Higher		4.68
Wetland Ecological Condition (EC)			7.24	Higher		8.33
Wetland Stressors (STR) (higher score means more)			9.49	Higher		4.67

WETLAND 4

Cover Page: Basic Description of Assessment	**WESP-AC version 1.2**
Site Name:	Ruth Falls Dam Wetland 4
Investigator Name:	Heather Mosher
Date of Field Assessment:	9/21/2017
Nearest Town:	Sheet Harbour, NS
Latitude (decimal degrees):	44.9551
Longitude (decimal degrees):	-62.4997
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in acres):	0.0866 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	100%
What percent (approx.) of the **wetland** were you able to visit?	100%
What percent (approx.) of the **AA** were you able to visit?	100%
Were you able to ask the site owner/manager about any of the questions?	Yes
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes, rare plants
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	Yes, July 2016 (Marysville, NB)
How many wetlands have you assessed previously using WESP-AC? (approx.)	15
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D
3	#	Indicators	Condition Choices	Data
4	OF1	Province	Mark the province in which the AA is located by changing the column next to it to a "1". Mark only one.	
5			New Brunswick	0
6			Nova Scotia	1
7			Prince Edward Island	0
8			Newfoundland-Labrador	0
9	OF2	Wetland Herbaceous Area	From "duck's eye" (aerial) view, the area of woody vegetation (grasslike plants, excluding moss & ferns) in the Assessment Area (AA) plus in any contiguous woody wetland is:	
10			<0.01 hectare (about 10 m x 10 m)	0
11			0.01 - 0.1 hectare	1
12			0.1 - 1 hectare	0
13			1 to 10 hectares	0
14			10 to 100 hectares	0
15			>100 hectares	0
16	OF3	Wetland + Water Total Area	The total area of the AA including ponded water within or adjacent to it is:	
17			<0.01 hectare (about 10 m x 10 m)	0
18			0.01 - 0.1 hectare	1
19			0.1 - 1 hectare	0
20			1 to 10 hectares	0
21			10 to 100 hectares	0
22			>100 hectares	0
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	Including the AA's vegetated area, the largest patch or corridor that is unmanaged vegetation cover (excluding lawn, row crops, heavily grazed lands, conifer plantation) and is contiguous with vegetation in the AA (i.e., not completely separated by highways or channels that are uniformly wider than 50 m), occupies:	
24			<0.01 hectare (about 10 m x 10 m)	0
25			0.01 - 0.1 hectare	0
26			0.1 - 1 hectare	0
27			1 to 10 hectares	0
28			10 to 100 hectares	0
29			100 to 1000 hectares	0
30			>1000 hectares [*This is nearly always the answer in relatively undeveloped landscapes.*]	1

	A	B	C	D
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the AA edge to the edge of the closest patch or corridor of *unmanaged vegetated land* (excluding row crops, lawn, conifer plantation) larger than 375 hectares, is:	
32			<50 m, and not separated from the 375-ha vegetated area by any width of roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [*This is often the answer in relatively*	1
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0
34			50-500 m, and not separated.	0
35			50-500 m, but separated by those features.	0
36			0.5 - 5 km, and not separated.	0
37			0.5 - 5 km, but separated by those features.	0
38			none of the above (the closest patches or corridors which are that large are >5 km away).	0
39	OF6	Herbaceous Uniqueness	The AA's vegetation is mostly herbaceous but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation is mostly herbaceous but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation is mostly herbaceous but uplands within 100 m have <10% herbaceous cover. If so, enter "1" [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0
40	OF7	Woody Uniqueness	The AA's vegetation is mostly woody but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is mostly woody but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is mostly woody but uplands within 100 m have <10% woody cover. If so, enter "1" [*NOTE: woody = Shrubland and forest, but exclude conifer plantations.]	0
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land,	
42			<5% of the land.	0
43			5 to 20% of the land.	0
44			20 to 60% of the land.	0
45			60 to 90% of the land.	1
46			>90% of the land. SKIP to OF9.	0
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:	
48			impervious surface, e.g., paved road, parking lot, building, exposed rock.	0
49			bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:	
51			<100 m	0
52			100 - 500 m	0
53			0.5- 1 km	0
54			1 - 5 km	0
55			>5 km	1
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:	
57			<10 m	0
58			10 - 25 m	0
59			25 - 50 m	0
60			50 - 100 m	0
61			100 - 500 m	1
62			>500 m	0

	A	B	C	D
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no *other* wetlands within 5 km.	0
64	OF13	Distance to Ponded Water	The distance from the AA edge to the closest (but separate) pond or lake larger than 0.01 ha (about 10 x 10 m) is:	
65			<50 m, and not separated by any width of roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	1
66			<50 m, but completely separated by those features.	0
67			50-500 m, and not separated.	0
68			50-500 m, but separated by those features.	0
69			0.5 - 1 km, and not separated.	0
70			0.5 - 1 km, but separated by those features.	0
71			none of the above (the closest patches or corridors that large are >1 km away).	0
72	OF14	Distance to Lake	The distance from the AA edge to the closest (but separate) lake (a non-tidal body of water that is ponded during most of the year and is larger than 8 hectares) during most of a normal year is:	
73			<100 m	1
74			100 m - 1 km	0
75			1 -2 km	0
76			2-5 km	0
77			5-10 km	0
78			>10 km	0
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:	
80			<100 m	0
81			100 m - 1 km	0
82			1 - 5 km	1
83			5-10 km	0
84			10-40 km	0
85			>40 km	0

	A	B	C	D
86	OF16	Upland Edge Contact	Select one:	
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0
92	OF17	Flood Zone	The AA is within a mapped Flood Zone or Flood Risk area, or an area in which river- or stream-associated floods within the past 20 years have damaged bridges, roads, buildings, or other infrastructure (not farmlands) within 5 km downslope from the AA. The floods must not be related to tidal influence or waves. If true, enter "1" in next column. If neither are true and AA is not in a river floodplain, enter "0" and SKIP to OF18. Otherwise, change to blank before skipping to OF18.	
93	OF18	Flood Damage	Within the mapped Flood Zone, Flood Risk area, or area with known flood damage, ALL the following are true (If all true, enter "1" in next column. If false, enter "0") (a) there are bridges, roads, buildings, or other infrastructure (not just farmlands) within 5 km downslope from the AA that are vulnerable to damaging floods; (b) the damages would be caused mainly by rising river levels associated with precipitation and/or snowmelt, not primarily by high tides, hillslope runoff, or river ice jams, AND (c) between the AA and the damage area, peak flow in a connecting channel (if any) is NOT regulated by dams.	0
94	OF19	Relative Elevation in Watershed	To view watersheds, open Google Earth and then the NB_Watersheds.kmz file that accompanies this calculator. Determine the AA's position in its watershed as follows: 1) If the AA is on a channel wider than 10 m, or has both inlet & outlet and is closer to the watershed's outlet than to its upper end, check "lower 1/3." 2) If the AA is the source of a headwater stream, or lacks an outlet and is close to the watershed's outer margin, then check "upper 1/3." For all other conditions, check "middle 1/3".	
95			in the upper one-third of its watershed.	0
96			in the middle one-third of its watershed.	0
97			in the lower one-third of its watershed.	1
98	OF20	Water Quality Sensitivity	The AA is in an area: (a) legally protected from most land uses because it feeds an aquifer, a well that serves many users, or a reservoir or other surface water source that provides drinking water to multiple domestic users, OR (b) where research or map analysis has indicated groundwater may be at higher risk of contamination due to geological conditions. Enter 1= yes, 0= no. Change to blank if no information.	

	A	B	C	D
99	OF2 1	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, high temperatures) being present at levels harmful to aquatic life or humans, and:	
100			The condition is present within the AA.	0
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1
104	OF2 2	Degraded Water Downstream	The problem described above is downslope from the AA, and:	
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1
109	OF2 3	Wetland as a % of Its Contributing Area (Catchment)	Estimate the approximate boundaries of the wetland's catchment (CA) from a topographic map.Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:	
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	1
111			0.01 to 0.1	0
112			0.1 to 1	0
113			>1 (wetland is larger than its catchment (e.g., wetland is isolated by dikes with no input channels, is fed entirely by groundwater, or is a raised bog).	0
114	OF2 4	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :	
115			<10%	0
116			10 to 25%	0
117			>25%	0
118	OF2 5	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:	
119			Mostly true	0
120			Somewhat true	0
121			Mostly untrue	1
122	OF2 6	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:	
123			Northward (N, NE). north-facing contributing area.	0
124			Southward (S, SW). south-facing contributing area.	1
125			other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0

	A	B	C	D
126	OF27	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:	
127			<10 m	0
128			10 - 50 m	1
129			50 - 100 m	0
130			100 - 1000 m	0
131			1- 2 km	0
132			>2 km, or wetland lacks an inlet and outlet.	
133	OF28	Growing Degree Days	According to Figure A-1 in Appendix A of the Manual, the mean annual Growing Degree Days (GDD) in the vicinity of the AA is approximately:	
134			800-1000 days	0
135			1000-1200	0
136			1200-1400	1
137			1400-1600	0
138			1600-1800	0
139			>1800 days	0
140	OF29	Fish Access or Use	According to agency biologists and/or your own observations, the AA: [*mark just the first choice that is true]*:	
141			is known to support Atlantic salmon rearing and/or spawning. In NB, consult Figure A-2 in Appendix A of the Manual, or local fishery biologists.	0
142			has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters containing Atlantic salmon and is probably salmon-accessible during some conditions.	1
143			is not accessible to any anadromous fish species but is known or likely to have other fish at least seasonally.	0
144			is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily).	0
145	OF30	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:	
146			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or (in NS only) the AA is within a mapped Atlantic Coastal Plain Flora Buffer as shown in Special Management Practice Zones at: https://nsgi.novascotia.ca/plv/	0
147			Presence of one or more of the amphibian or reptile species of conservation concern (AM) as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0
148			Presence of one or more of the waterbird species of conservation concern (WBF, WBN) as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0
149			Presence of one or more of the nesting songbird or raptor species of conservation concern (SBM) as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0
150			none of the above, or no data.	1
151	OF31	Important Bird Area (IBA)	The AA is all or part of the West Shepody Bay or St. Johns River Important Bird Area, or other designated IBA. See Figures A-3 & A-4 in Appendix A of the Manual. Enter 1= yes, 0= no.	0
152	OF32	Black Duck Nesting Area	The AA is within an area mapped as generally high suitability (>20 pairs/25 sq km) for nesting American Black Duck. See Figure A-5 in Appendix A of the Manual. Enter 1= yes, 0= no. If outside of region shown in map, change to blank.	0
153	OF33	Wintering Deer or Mainland Moose Concentration Area	The AA is all or part of a Deer Wintering Area or (in NS only) a Mainland Moose Concentration Area. If AA is on private land with no information, change to blank. Otherwise, in NB: In Google Earth, view the KMZ overlay that accompanies this calculator, or download the shapefile (Crown Lands Conservation Areas) at http://www.snb.ca/geonb1/e/DC/catalogue-E.asp In NS: go to https://nsgi.novascotia.ca/plv/ and view Special Management Practice Zones> Mainland Moose Concentration Areas).	0
154	OF34	Other Conservation Designation	The AA is all or part of an area designated by the provincial government for its exceptional ecological features or highly intact natural conditions. Enter: yes= 1, no= 0. In NB: Provincially Significant Wetland, Environmentally Significant Area, Protected Natural Area (go to http://www.snb.ca/geonb1/e/apps/apps-E.asp and see Candidate PNA Map Viewer) In NS: go to	0

	A	B	C	D
155	OF35	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Enter: yes= 1, no= 0. If no information, change to blank.	0
156	OF36	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Enter: yes= 1, no= 0. If no information, change to blank.	0
157	OF37	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Enter: yes= 1, no= 0. If no information, change to blank.	0

	A	B	C	D
2	**Form F (Field).** Non-tidal Wetland Data Form. WESP-AC version 1.2. DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU=	
3	#	**Indicators**	**Condition Choices**	**Data**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:	
5			A. Moss and/or lichen cover more than 25% of the ground. Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.	
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is <100 µS/cm (about 64 ppm TDS). Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew). Sedge cover usually sparse or absent. Trees, if present, are mainly limited to black spruce. Surrounding landscape is mostly flat and wetland surface is never sloping, except sometimes from wetland center towards outer edges (convex). Inlet and outlet channels are usually absent..	0
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is >100 µS/cm. Sedges and/or cottongrass often dominate the ground cover, while ericaceous shrubs and black spruce may also be present. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1, often with many small persistent pools.	0
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:	
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	1
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0
11			*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent lakes larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, "adjacent" is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*	
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.	
13			A1	0
14			A2	0
15			B1	0
16			B2	0
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the of the living vegetation in the AA is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none):	
18			coniferous trees (may include tamarack) taller than 3 m.	1
19			deciduous trees taller than 3 m.	2
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	4
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	5
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	2
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2

	A	B	C	D
24	*Note: If you marked ALL of the F3 rows 0 or 1, SKIP to F9 (N fixers).*			
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species (<3 m tall) comprise the greatest portion of the woody cover (<3 m tall). Then choose one:	
26			those species together comprise > 50% of such cover.	0
27			those species together do not comprise > 50% of such cover.	1
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% of the woody canopy cover in the AA or >5% of the wooded areas (if any) along its upland edge (perimeter). The edge should include only the trees whose canopies extend into the AA.	
29			coniferous, 1-9 cm diameter and >1 m tall.	1
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1
31			coniferous, 10-19 cm diameter.	0
32			broad-leaved deciduous 10-19 cm diameter.	1
33			coniferous, 20-40 cm diameter.	0
34			broad-leaved deciduous 20-40 cm diameter.	0
35			coniferous, >40 cm diameter.	0
36			broad-leaved deciduous >40 cm diameter.	0
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:	
38			A. Neither the vegetation taller than 1 m nor the vegetation shorter than that comprise >70% of the vegetated part of the AA. They each comprise 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.	
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:	
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (diameter >20 cm) in the AA plus adjacent upland area within 10 m of the wetland edge is:	
45			None, or fewer than 8/ hectare which exceed this diameter.	1
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0
47			Several (>8/hectare) but above not true.	0
48	F8	Downed Wood	The number of downed wood pieces longer than 2 m and with diameter >10 cm, and not persistently submerged, is:	
49			Few or none that meet these criteria.	1
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:	
52			<1% or none	0
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:	
58			<5% of the vegetated part of the AA.	0
59			5-25% of the vegetated part of the AA.	1
60			25-50% of the vegetated part of the AA.	0
61			50-95% of the vegetated part of the AA.	0
62			>95% of the vegetated part of the AA.	0

	A	B	C	D
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:	
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0
67			Other conditions.	0
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0
69	F12	Ground Irregularity	Consider the parts of the AA that lack surface water at some time of the year. The number of hummocks, small pits, raised mounds, upturned trees, animal burrows, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area immediately surrounding them is:	
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0
71			Intermediate.	1
72			Several (extensive micro-topography).	0
73	F13	Upland Inclusions	Within the AA, inclusions of upland that individually are >100 sq.m. are:	
74			Few or none.	1
75			Intermediate (1 - 10% of vegetated part of the AA).	0
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).	0
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (Figure A-7 in the Manual.]*	
78			Loamy: includes loam, sandy loam.	0
79			Fines: includes silt, clay, clay loam, silty clay, silty clay loam, sandy clay, sandy clay loam.	0
80			Peat, to 40 cm depth or greater.	0
81			Peat or organic <40 cm deep.	1
82			Coarse: includes sand, loamy sand, gravel, cobble, stones, boulders, fluvents, fluvaquents, riverwash.	0
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [include also any area that is adjacent to the AA].	
84			none, or <100 sq. m.	1
85			100-1000 sq. m.	0
86			1000 – 10,000 sq. m.	0
87			>10,000 sq. m.	0
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (excluding moss but including ferns) is:	
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	1
90			5-25% of the vegetated part of the AA.	0
91			25-50% of the vegetated part of the AA.	0
92			50-95% of the vegetated part of the AA.	0
93			>95% of the vegetated part of the AA.	0
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:	
95			<5% of the herbaceous part of the AA.	0
96			5-25% of the herbaceous part of the AA.	0
97			25-50% of the herbaceous part of the AA.	0
98			50-95% of the herbaceous part of the AA.	0
99			>95% of the herbaceous part of the AA.	0
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:	
101			<5% of the vegetated area, or none.	0
102			5-50% of the vegetated area.	0
103			50-95% of the vegetated area.	0
104			>95% of the vegetated area.	0
105	F19	Dominance of Most Abundant Herbaceous	Determine which two native herbaceous species (excluding mosses) comprise the greatest portion of the herbaceous cover that is unshaded by a woody canopy. Then choose one of the following:	

	A	B	C	D
106		Species	those species together comprise > 50% of the areal cover of native herbaceous plants at any time during the year.	0
107			those species together do not comprise > 50% of the areal cover of native herbaceous plants at any time during the year.	0
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.	
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:	
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1
116			some (but <5%) of the upland edge.	0
117			5-50% of the upland edge.	0
118			most (>50%) of the upland edge.	0
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated AA (in a lake, stream, or river) is much wider than the vegetated wetland. Enter "1" if true, "0" if false.	1
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a lake, i.e., a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	0
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:	
122			<1% AND <0.01 hectare (about 10 m on a side) never has surface water. In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0
123			1-25% of the AA, or <1% but >0.01 ha, never contains surface water.	1
124			25-50% of the AA never contains surface water.	0
125			50-75% of the AA never contains surface water.	0
126			75-99% of the AA never contains surface water.	0
127			99-100%. True for many bogs, meadow marshes, swamps that lack vernal pools. Enter "1" and SKIP to F42 (Channel Connection).	0
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:	
129			none. The AA dries up completely (no water in channels either) or never has surface water during most years.	0
130			1-20% of the AA.	0
131			20-50% of the AA.	0
132			50-95% of the AA.	1
133			>95% of the AA. True for many fringe wetlands.	0
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:	
135			<5% of the water is shaded, or no surface water is present then.	0
136			5-25% of the water is shaded.	0
137			25-50% of the water is shaded.	1
138			50-75% of the water is shaded.	0
139			>75% of the water is shaded.	0
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA that is covered by unfrozen surface water only during the wettest time of the year during most years is:	
141			None, or <0.01 hectare and <1% of the AA.	0
142			1-20% of the AA, or <1% but >0.01 ha.	1
143			20-50% of the AA.	0

	A	B	C	D
144			50-95% of the AA.	0
145			>95% of the AA.	0
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water is:	
147			<10 cm change (stable or nearly so).	0
148			10 cm - 50 cm change.	1
149			0.5 - 1 m change.	0
150			1-2 m change.	0
151			>2 m change.	0
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and **SKIP TO F42** (Connection).			0
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:	
154			<10 cm deep (but >0).	0
155			10 - 50 cm deep.	0
156			0.5 - 1 m deep.	0
157			1 - 2 m deep.	0
158			>2 m deep. True for many fringe wetlands.	1
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):	
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	1
161			One depth class that comprises 50-90% of the AA's inundated area.	0
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) is:	
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	1
165			5-30% of the water.	0
166			30-70% of the water.	0
167			70-95% of the water.	0
168			>95% of the water.	0
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of open water that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and SKIP to F41 (Floating Algae & Duckweed).	0
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is open (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:	
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0
172			1-4% of the ponded water. Enter "1" and SKIP to F40 (Floating Algae & Duckweed).	0
173			5-30% of the ponded water.	0
174			30-70% of the ponded water.	0
175			70-99% of the ponded water.	0
176			100% of the ponded water.	0
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:	
178			<1 m	0
179			1 - 9 m	0
180			10 - 29 m	1
181			30 - 49 m	0
182			50 - 100 m	0
183			> 100 m, or open water is absent.	0
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's water edge length that is nearly flat (a slope less than about 5% measured within 5 m landward of the water) is:	
185			<1% of the water edge.	1
186			1-25% of the water edge.	0
187			25-50% of the water edge.	0

	A	B	C	D
188			50-75% of the water edge.	0
189			>75% of the water edge.	0
190	F36	Robust Emergents	The percentage of the emergent vegetation cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:	
191			<1% of the emergent vegetation, or emergent vegetation is absent.	1
192			1-25% of the emergent vegetation.	0
193			25-75% of the emergent vegetation.	0
194			>75%, of the emergent vegetation.	0
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial patternof emergent vegetation is mostly:	
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0
197			Intermediate.	0
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	1
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and SKIP to F42.(Connection).	1
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of dead wood and undercut banks is:	
201			Little or none.	1
202			Intermediate.	0
203			Extensive.	0
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore by water depths >1 m on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0
206	F42	Channel Connection & Outflow Duration	The most persistent outlet connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the least permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network]	
207			persistent (surface water flows out for >9 months/year, regardless of whether frozen or not).	1
208			seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive, including times when frozen).	0

	A	B	C	D
209			temporary (surface water flows out for <14 days, not necessarily consecutive, but must be unfrozen).	0
210			none -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0
211			no surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0
212	F43	Outflow Confinement	During major runoff events, in the places where surface water exits the AA or connected waters nearby, the water:	
213			mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0
214			leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	1
215			is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	1
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	1
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by most of the incoming water].	
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0
220			bumps into herbaceous vegetation but mostly remains in fairly straight channels.	1
221			bumps into herbaceous vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0
222			bumps into tree trunks and/or shrub stems but mostly remains in fairly straight channels.	0
223			bumps into tree trunks and/or shrub stems and follows a fairly indirect path from entrance to exit (meandering, multi-branched, or braided).	0
224	F47	pH Measurement	The pH in most of the AA's surface water:	
225			was not measured because no surface water could be found during this visit. Enter "1".	0
226			was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0
227			was measured, and is: [*enter the reading in the column to the right*]:	5.5
228	F48	TDS and/or Conductivity	The Total Dissolved Solids (TDS) in most of the AA's surface water:	
229			was not measured because no surface water could be found during this visit. Enter "1".	0
230			was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0
231			TDS is: [*enter the reading in ppm in the column to the right, if measured, or answer next row*]:	225
232			Conductivity is [*enter the reading in µS/cm in the column to the right*]:	263
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):	
234			evident from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0
235			likely based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0
236			unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1
237	F50	Groundwater Strength of Evidence	Select first applicable choice.	
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0
239			The upper end of the AA is located very close to the base of (but mostly not ON) a natural slope much steeper (usually >15%) than that within the AA and longer than 100 m AND if surface water was measured, its pH (Q47) is >5.5.	0
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:	
242			<2% or the AA has no surface water outlet (not even seasonally)	0
243			2-5%	1
244			6-10%	0

	A	B	C	D
245			>10%	0
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.			
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:	
248			<5%	0
249			5 to 30%	0
250			30 to 60%	1
251			60 to 90%	0
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):	
254			impervious surface, e.g., paved road, parking lot, building, exposed rock.	0
255			bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:	
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0
258			2-5%	1
259			5-30%	0
260			>30%	0
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	1
262	F56	New or Expanded Wetland	Part or all of the AA resulted from human actions that persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):	
263			No.	1
264			yes, and created 20 - 100 years ago.	0
265			yes, and created 3-20 years ago.	0
266			yes, and created within last 3 years.	0
267			yes, but time of origin unknown.	0
268			unknown if new within 20 years or not.	0
269	F57	Burn History	More than 1% of the AA's previously vegetated area:	
270			burned within past 5 years.	0
271			burned 6-10 years ago.	0
272			burned 11-30 years ago.	0
273			burned >30 years ago, or no evidence of a burn and no data.	1
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:	
275			<25%	1
276			25-50%	0
277			>50%	0
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:	
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail]*	
283			<5% and no inhabited building is within 100 m of the AA.	0

	A	B	C	D
284			<5% and inhabited building is within 100 m of the AA.	0
285			5-50% and no inhabited building is within 100 m of the AA.	0
286			5-50% and inhabited building is within 100 m of the AA.	0
287			50-95%, with or without inhabited building nearby.	1
288			>95% of the AA with or without inhabited building nearby.	0
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[see note above].*	
290			<5%. If F61 was answered ">95%" (mostly never visited), SKIP to F65.	1
291			5-50%	0
292			50-95%	0
293			>95% of the AA.	0
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	1
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.	
297			low-impact commercial timber harvest (e.g., selective thinning).	0
298			commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0
299			waterfowl hunting.	0
300			fishing.	0
301			trapping of furbearers.	0
302			none of the above.	1
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:	
304			Within 0-100 m of the AA.	0
305			100-500 m away.	0
306			>500 m away, or no information.	1
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.	0

Stressor (S) Data Form for Non-Tidal Wetlands. WESP for Atlantic Canada. Version 1.2

					Data
S1	**Aberrant Timing of Water Inputs**				
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]				
	stormwater from impervious surfaces that drains directly to the wetland				
	water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation				
	regular removal of surface or groundwater for irrigation or other consumptive use				
	flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland				
	a dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines)				x
	excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch				
	artificial drains or ditches in or near the wetland				
	accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level)				
	logging within the wetland				
	subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles				
	straightening, ditching, dredging, and/or lining of tributary channels				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of timing shift within the wetland	>95% of wetland	5-95% of wetland	<5% of wetland	3
	When most of the timing shift began	<3 yrs ago	3-9 yrs ago	10-100 yrs ago	1
	Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
	Input timing now vs. previously	shift of weeks	shift of days	shift of hours or minutes	0
	Flashiness or muting	became very flashy or controlled	intermediate	became mildly flashy or controlled	0
				Sum=	4
				Final Score=	0.33
S2	**Accelerated Inputs of Contaminants and/or Salts**				
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]				
	stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities				
	metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1				
	road salt				
	spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Usual toxicity of most toxic contaminants	industrial effluent, mining waste, unmanaged landfill	cropland, managed landfill, pipeline or transmission rights-of-way	low density residential	0
	Frequency & duration of input	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	0
	AA proximity to main sources (actual or potential)	0 - 15 m	15-100 m or in groundwater	in more distant part of contributing area	0
				Sum=	0
				Final Score=	0.00
S3	**Accelerated Inputs of Nutrients**				
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]				
	stormwater or wastewater effluent (including failing septic systems), landfills				
	fertilizers applied to lawns, ag lands, or other areas in the CA				
	livestock, dogs				
	artificial drainage of upslope lands				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Type of loading	high density of unmaintained septic, some types of industrial sources	moderate density septic, cropland, secondary wastewater treatment plant	livestock, pets, low density residential	0
	Frequency & duration of input	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	0
	AA proximity to main sources (actual or potential)	0 - 15 m	15-100 m or in groundwater	in more distant part of contributing area	0
				Sum=	0
				Final Score=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires	
erosion from construction, in-channel machinery in the CA	
erosion from off-road vehicles in the CA	
erosion from livestock or foot traffic in the CA	
stormwater or wastewater effluent	
sediment from road sanding, gravel mining, other mining, oil/ gas extraction	
accelerated channel downcutting or headcutting of tributaries due to altered land use	
other human-related disturbances within the CA	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA	extensive evidence, high intensity*	potentially (based on high-intensity* land use) or scattered evidence	potentially (based on low-intensity* land use) with little or no direct evidence	0
Recentness of significant soil disturbance in the CA	current & ongoing	1-12 months ago	>1 yr ago	0
Duration of sediment inputs to the wetland	frequent and year-round	frequent but mostly seasonal	infrequent & during high runoff events mainly	0
AA proximity to actual or potential sources	0 - 15 m	15-100 m	in more distant part of contributing area	0
* **high**-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; **low**-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment			Sum=	0
			Final Score=	0.00

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods	
leveling or other grading not to the natural contour	
tillage, plowing (but excluding disking for enhancement of native plants)	
fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland	
excavation	
ditch cleaning or dredging in or adjacent to the wetland	
boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments	
artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil	>95% of wetland or >95% of its upland edge (if any)	5-95% of wetland or 5-95% of its upland edge (if any)	<5% of wetland and <5% of its upland edge (if any)	0
Recentness of significant soil alteration in wetland	current & ongoing	1-12 months ago	>1 yr ago	0
Duration	long-lasting, minimal veg recovery	long-lasting but mostly revegetated	short-term, revegetated, not intense	0
Timing of soil alteration	frequent and year-round	frequent but mostly seasonal	mainly during one-time or scattered events	0
			Sum=	0
			Final Score=	0.00

WETLAND 4

Wetland ID:	Ruth Falls Dam Wetland 4
Date:	9/21/2017
Observer:	Heather Mosher
Latitude & Longitude (decimal degrees):	44.955095 , -62.499727

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed. Note: Benefits scores will be provided in the final calculator for WBF, WBN, SBM, and POL; their models are currently being revised.

Results for this Assessment Area (AA):

Wetland Functions or Other Attributes:	Function Score (normalized)	Function Rating	Benefits Score (normalized)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	1.17	Lower	0.48	Lower	2.44	1.11
Stream Flow Support (SFS)	6.88	Higher	4.85	Moderate	3.67	3.65
Water Cooling (WC)	8.10	Higher	6.25	Higher	5.40	4.03
Sediment Retention & Stabilisation (SR)	1.15	Lower	7.11	Moderate	3.75	4.32
Phosphorus Retention (PR)	0.88	Lower	6.85	Higher	3.97	6.53
Nitrate Removal & Retention (NR)	2.35	Lower	10.00	Higher	4.87	10.00
Carbon Sequestration (CS)	2.46	Lower			5.50	
Organic Nutrient Export (OE)	7.48	Higher			5.93	
Anadromous Fish Habitat (FA)	4.05	Moderate	2.43	Moderate	2.60	1.80
Resident Fish Habitat (FR)	4.06	Moderate	2.54	Moderate	2.82	1.80
Aquatic Invertebrate Habitat (INV)	7.76	Higher	5.12	Moderate	6.46	4.06
Amphibian & Turtle Habitat (AM)	6.19	Higher	4.37	Higher	6.74	2.96
Waterbird Feeding Habitat (WBF)	4.56	Moderate			3.65	
Waterbird Nesting Habitat (WBN)	4.01	Moderate			3.34	
Songbird, Raptor, & Mammal Habitat (SBM)	6.33	Moderate			5.24	
Pollinator Habitat (POL)	7.96	Higher			6.41	
Native Plant Habitat (PH)	8.13	Higher	6.83	Moderate	6.80	3.88
Public Use & Recognition (PU)			2.24	Moderate		1.68
Wetland Sensitivity (Sens)			4.64	Moderate		3.68
Wetland Ecological Condition (EC)			7.93	Higher		8.75
Wetland Stressors (STR) (higher score means more)			10.00	Higher		5.74

June 22, 2020
Grant Brown

Appendix B

2007 Report: Vegetation Surveys at the Sheet Harbour Hydroelectic System

Jacques Whitford

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REPORT

Vegetation Surveys at the Sheet Harbour Hydroelectic System

NOVA SCOTIA POWER INC.

PROJECT NO. 1026751

Jacques Whitford

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PROJECT NO. 1026751

PROJECT TO	**Nova Scotia Power Inc.** **PO Box 910** **Halifax, Nova Scotia** **B3J 2W5**
FOR	**Vegetation Surveys**
ON	**Sheet Harbour Hydroelectric System**

October 25, 2007

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1.0 SHEET HARBOUR HYDROELECTRIC SYSTEM VEGETATION SURVEYS

1.1 Vegetation and Wetlands

1.1.1 Species at Risk (SAR) Modeling

The shorelines of reservoirs and adjacent wetlands are typically areas of high productivity. The reservoirs of the Sheet Harbour Hydroelectric System were once natural lakes that were flooded to store water. Today, much of the reservoir shoreline is at an early stage of succession; species that colonize new niches (*e.g.,* grasses, sedges) are gradually replaced by a more diverse plant community. Productivity is affected by a range of influences including the climate, soil, extent of development in the area, and fluctuating water levels. The success of a plant species depends on how it responds to these factors. Nova Scotia Power Inc. (NSPI) usually has some control over water levels, and the presence of species at risk along a shoreline or adjacent wetland may have an impact on how reservoir water levels are managed. Cataloguing the plant species present at each reservoir and identifying any rare or uncommon flora is challenging because of the limitations of botanical databases in the province and the various times at which plants may be identifiable (when they bud or flower). Field surveys are therefore required to determine if rare or uncommon vascular plant species are present. One way of optimizing the timing of field surveys is to conduct a species at risk modelling exercise. In this exercise, an Atlantic Canada Conservation Data Centre (ACCDC) data search is conducted which provides a list of all plant species located within a radius of 100 km of the reservoirs that are considered to be sensitive (yellow listed) or at risk (red listed) by the Nova Scotia Department of Natural Resources (NSDNR). Aerial photography of the reservoirs is used to determine what habitat types are present in the area and this is then compared to the habitat preferences of the species recorded in the 100 km radius. In instances where suitable habitat for a particular species is present, that species is considered to be potentially present. The phenology of these species is then reviewed to determine the optimal time that the field survey should be conducted.

A species at risk modeling exercise was conducted for Ruth Falls Flowage and Governor Lake, both part of the Sheet Harbour Hydroelectric System. The results indicate that there is suitable habitat present in the littoral zone of Governor Lake for 32 species of rare or sensitive vascular plant species (Table 1).

TABLE 1 Potential Rare or Sensitive Vascular Plant Species on Governor Lake.

Common Name	Scientific Name
Short-Awn Foxtail	*Alopecurus aequalis*
Purple-Stem Swamp Beggar-Ticks	*Bidens connata*
Bristly Sedge	*Carex comosa*
Cloud Sedge	*Carex haydenii*
Woolly Sedge	*Carex pellita*
Sparse-Flowered Sedge	*Carex tenuiflora*
Tuckerman Sedge	*Carex tuckermanii*
Capitate Spikerush	*Eleocharis olivacea*
Ovate Spikerush	*Eleocharis ovata*
Purple-Leaf Willow-Herb	*Epilobium coloratum*
Downy Willow-Herb	*Epilobium strictum*
Slender Cotton-Grass	*Eriophorum gracile*

TABLE 1 Potential Rare or Sensitive Vascular Plant Species on Governor Lake.

Common Name	Scientific Name
Black Ash	*Fraxinus nigra*
Northern Comandra	*Geocaulon lividum*
Disguised St. John's-Wort	*Hypericum dissimulatum*
Larger Canadian St. John's Wort	*Hypericum majus*
Dudley's Rush	*Juncus dudleyi*
Mudwort	*Limosella australis*
Beck Water-Marigold	*Megalodonta beckii*
Farwell's Water-Milfoil	*Myriophyllum farwellii*
Adder's Tongue	*Ophioglossum pusillum*
Southern Rein-Orchid	*Platanthera flava*
Blunt-Leaf Pondweed	*Potamogeton obtusifolius*
Greater Creeping Spearwort	*Ranunculus flammula var. flammula*
Bog Willow	*Salix pedicellaris*
Northern Bur-Reed	*Sparganium hyperboreum*
Longleaf Stitchwort	*Stellaria longifolia*
Boreal American-Aster	*Symphyotrichum boreale*
Northern White Cedar	*Thuja occidentalis*
Humped Bladderwort	*Utricularia gibba*
Northern Blueberry	*Vaccinium boreale*
Eel-Grass	*Vallisneria americana*

The model also indicates that there is suitable habitat present in the littoral zone of Ruth Falls Flowage for 27 species of rare or sensitive vascular plant species (Table 2).

TABLE 2 Potential Rare or Sensitive Vascular Plant Species on Ruth Falls Flowage

Common Name	Scientific Name
Southern Twayblade	*Listera australis*
Cloud Sedge	*Carex haydenii*
Sparse-Flowered Sedge	*Carex tenuiflora*
Northern White Cedar	*Thuja occidentalis*
Eel-Grass	*Vallisneria americana*
Woolly Sedge	*Carex pellita*
Larger Canadian St. John's Wort	*Hypericum majus*
Bog Willow	*Salix pedicellaris*
Purple-Stem Swamp Beggar-Ticks	*Bidens connata*
Longleaf Stitchwort	*Stellaria longifolia*
Black Ash	*Fraxinus nigra*
Purple-Leaf Willow-Herb	*Epilobium coloratum*
Capitate Spikerush	*Eleocharis olivacea*
Northern Bur-Reed	*Sparganium hyperboreum*
Greater Creeping Spearwort	*Ranunculus flammula var. flammula*
Humped Bladderwort	*Utricularia gibba*
Beck Water-Marigold	*Megalodonta beckii*
Adder's Tongue	*Ophioglossum pusillum*
Hemlock Parsley	*Conioselinum chinense*
Downy Willow-Herb	*Epilobium strictum*
Slender Cotton-Grass	*Eriophorum gracile*
Boreal American-Aster	*Symphyotrichum boreale*
Ovate Spikerush	*Eleocharis ovata*
Blunt-Leaf Pondweed	*Potamogeton obtusifolius*
Southern Rein-Orchid	*Platanthera flava*
Bristly Sedge	*Carex comosa*
Dudley's Rush	*Juncus dudleyi*

1.1.2 Littoral Zone Vegetation Surveys

The objective of the vegetation and wetland surveys was to determine whether any rare vascular plant species were present in the littoral zones of Governor Lake (Figure 1A and 1B) and Ruth Falls Flowage (Figure 2). Field surveys were carried out on September 11 and 12, 2007. Field personnel included an EO&A staff member from NSPI and a Jacques Whitford biologist.

The vascular plant inventory was compiled for the littoral zones of each of the two reservoirs. All species observed in the littoral zone habitats were recorded. Species found on shores and in shallow water were directly observed while plant species present in deeper water were recovered using a rake tethered to the boat. The population status of each species was determined through a review of the ACCDC general status list and the NSDNR general status list.

Governor Lake Reservoir

The vascular plant survey conducted on Governor Lake reservoir did not reveal the presence of any of the rare vascular plants identified as potentially present by the species at risk modelling exercise. The timing of the survey was suitable for the detection of all of the rare species identified as potentially present in the littoral zone of the reservoir. A number of species identified in the model flower earlier than September but can be readily identified by a competent botanist using fruit or vegetative characteristics rather than flowers alone.

Appendix A lists the 117 vascular plant species found within the littoral zone of Governor Lake reservoir during the field survey. One of the species recorded during the survey, algae-like pondweed (*Potamogeton confervoides*) is listed as S3S4 in Nova Scotia by ACCDC, indicating that its status is poorly understood and ranges from uncommon to fairly common. NSDNR lists this species as status Green indicating that the Nova Scotia population is secure. Algae-like pondweed is a small filamentous, fully submerged species of pondweed which is easily overlooked and rather difficult to identify which would account for the range in the ACCDC status. Operation of the reservoir under current conditions has not adversely affected this species and it has been recorded in other NSPI reservoirs. No mitigative measures are recommended to manage the population of algae-like pondweed in Governor Lake reservoir.

Ruth Falls Flowage Reservoir

A vascular plant survey was conducted on Ruth Falls Flowage reservoir to determine if any of the rare or sensitive vascular plant species identified as potentially present in the reservoir by the species at risk modelling exercise were present in the littoral zone of the reservoir. None of these species were encountered during the survey suggesting that they are not present. The timing of the survey was suitable for the detection of all but one of the rare species identified as potentially present in the littoral zone of Ruth Falls Flowage reservoir. The early September survey was too late in the year to detect southern twayblade (*Listera australis*). This species emerges and flowers in June and quickly senesces once the plants set seed. The habitat where southern twayblade could occur on Ruth Falls Flowage reservoir is the coniferous treed shore swamp habitat found in Wetland 15. This wetland habitat is hydraulically connected to the littoral zone habitat of the reservoir but is located at an elevation high enough that it is unaffected by water level fluctuations in the reservoir. As such, this species would not be affected by operation of the hydroelectric system.

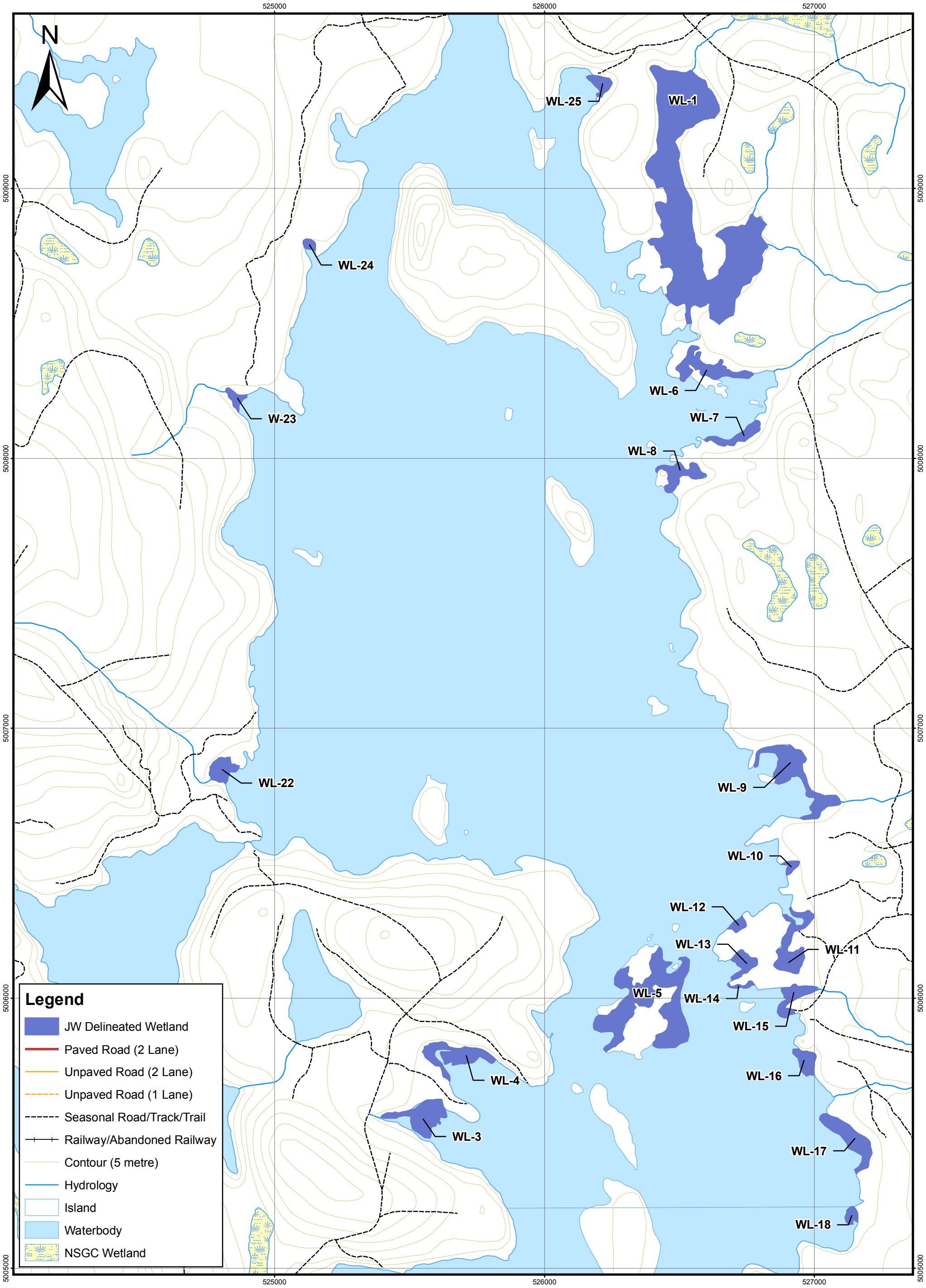


Figure 1A

Governor Lake Reservoir Wetlands

Map Parameters
Projection: UTM-Nad83-Z20
Scale 1:13,000
Date: October 15, 2007
Project No: 1026751.

0 235 470 940
Meters

Jacques Whitford

N

WL-22
WL-9
WL-10
WL-12
WL-13
WL-11
WL-5
WL-14
WL-15
WL-4
WL-16
WL-3
WL-17
WL-18
WL-21
WL-2
WL-19
WL-20

525000 526000 527000

5007000 5006000 5005000 5004000 5003000

Legend

- JW Delineated Wetland
- Paved Road (2 Lane)
- Unpaved Road (2 Lane)
- Unpaved Road (1 Lane)
- Seasonal Road/Track/Trail
- Railway/Abandoned Railway
- Contour (5 metre)
- Hydrology
- Island
- Waterbody
- NSGC Wetland

Figure 1B

Governor Lake Reservoir Wetlands

Map Parameters
Projection: UTM-Nad83-Z20
Scale 1:13,000
Date: October 15, 2007
Project No: 1026751.

0 245 490 980

Meters

Jacques Whitford

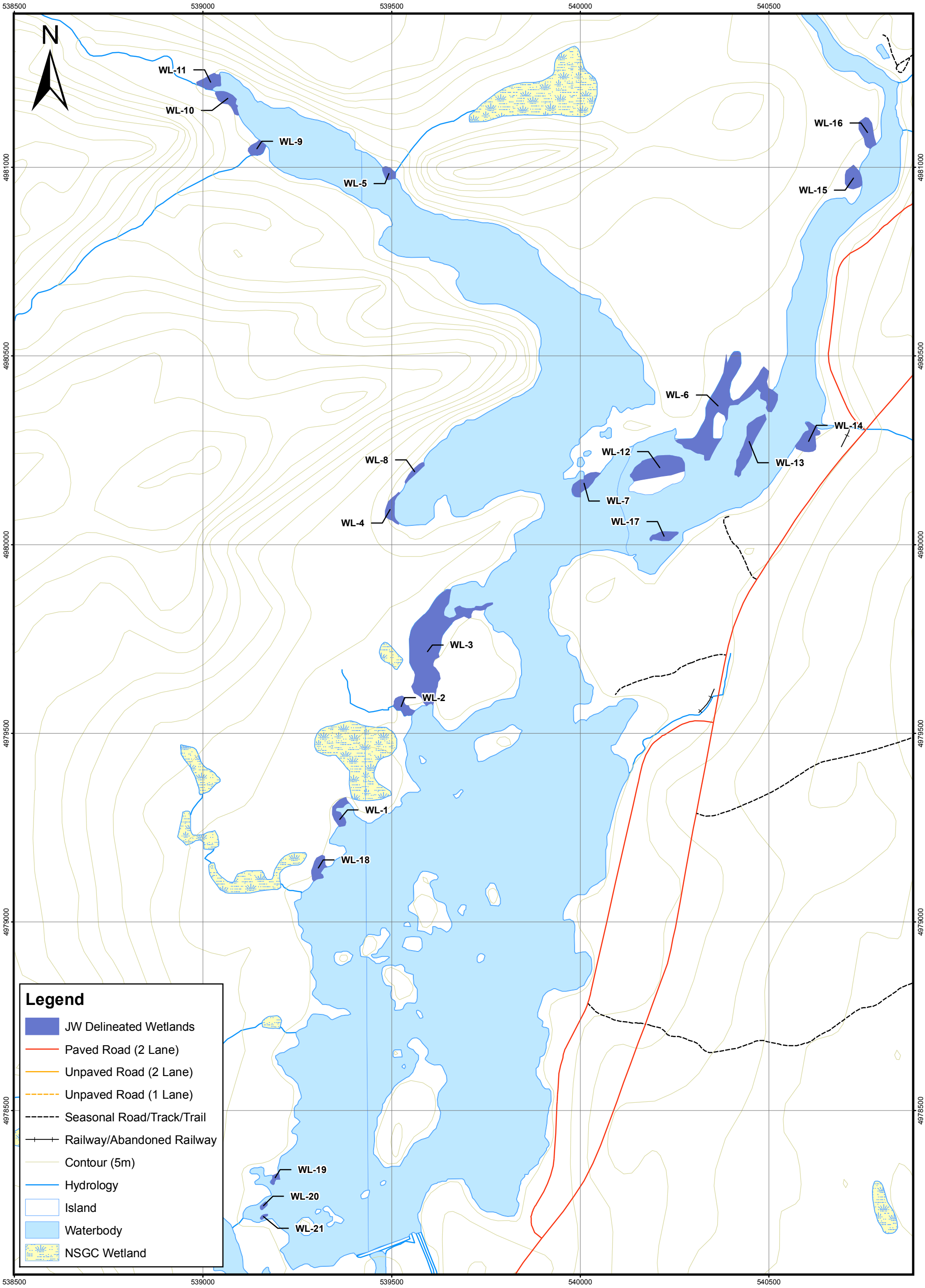


Figure 2

Ruth Falls Flowage Reservoir Wetlands

Map Parameters
Projection: UTM-Nad83-Z20
Scale 1:9,000
Date: October 24, 2007
Project No: 1026751.

0 160 320 640
Meters

Jacques Whitford

Appendix B lists the 121 vascular plant species found within the littoral zone of Ruth Falls Flowage reservoir during the field survey. None of the species encountered during the field survey are considered to be sensitive (yellow listed) or at risk (red listed) by NSDNR. One of the species recorded during the survey, algae-like pondweed is listed as S3S4 by ACCDC and listed as secure (green listed) by NSDNR. This species was also found in Governor Lake. No specific mitigative measures are recommended for this species.

1.1.3 Wetland Surveys

The objective of the wetland surveys was to map and describe wetlands found around the periphery of the reservoirs.

Topographical mapping, recent air photos and field visits were used to determine the distribution of wetlands around the margins of both reservoirs. All wetlands found around the margins of the reservoirs were identified by type and examples of each wetland type were visited and described. Plant community descriptions consisted of cover estimates for the dominant species of the tree, shrub and ground vegetation strata of each plant community encountered in each wetland. In addition, lists of all vascular plants present in each of the visited wetlands were compiled.

Governor Lake Reservoir

Twenty-five wetlands were encountered on the shores of Governor Lake Reservoir during the site visit (Figures 2A and 2B, Table 3) five of which were described during the field survey. In instances where wetland complexes were described, dominant plant cover data was collected for all wetland types present in the wetland complex. In some instances, a particular wetland type in a wetland was further divided into wetland substypes if the wetland type was composed of several different plant communities.The wetlands found at Governor Lake can be categorized into six wetland types including tall shrub dominated shore swamp, low shrub dominated shore swamp, wet meadow, shore bog, floating bog, and shore marsh. Appendix C presents the species composition for the five wetlands sampled at the Governor Lake Reservoir.

TABLE 3 Wetlands Found Within the Littoral Zone of Governor Lake Reservoir

Wetland ID Number	Wetland Type	Wetland Description
1	Wetland complex composed of low shrub dominated shore swamp, wet meadow (two subtypes), and shore bog (two subtypes)	Yes
2	Wetland complex composed of tall shrub dominated shore swamp, low shrub dominated shore swamp, shore marsh, and shore bog	Yes
3	Floating bog	Yes
4	Wetland complex composed of floating bog and shore marsh	Yes
5	Shore marsh	Yes
6	Shore marsh	No
7	Shore marsh	No
8	Shore marsh	No
9	Shore marsh	No
10	Shore marsh	No

TABLE 3 Wetlands Found Within the Littoral Zone of Governor Lake Reservoir

Wetland ID Number	Wetland Type	Wetland Description
11	Wetland complex composed of tall shrub dominated shore swamp, low shrub dominated shore swamp, shore marsh, and shore bog	No
12	Shore marsh	No
13	Shore marsh	No
14	Shore marsh	No
15	Shore marsh	No
16	Shore marsh	No
17	Shore marsh	No
18	Shore marsh	No
19	Shore marsh	No
20	Shore marsh	No
21	Shore marsh	No
22	Shore marsh	No
23	Shore marsh	No
24	Shore marsh	No
25	Shore marsh	No

Shore bog is found in three of the wetlands identified on Governor Lake. This wetland type is found in areas that are only occassionally inundated by water level fluctuations in the reservoir. This wetland type represents an intermediate stage in bog succession. These wetlands are underlain by poorly decomposed peat. Shore bogs around Governor Lake generally have a relatively heavy cover of low shrubs, the most abundant of which are leatherleaf (*Chamaedaphne calyculata*) and sweet bayberry (*Myrica gale*). Other species of low shrubs commonly found in these wetlands include dwarf huckleberry (*Gaylussacia dumosa*), sheep-laurel (*Kalmia angustifolia*), pale laurel (*Kalmia polifolia*), and rhodora (*Rhododendron canadense*). The vegetation of these wetlands is characterized by a moderate to heavy cover of sphagnum moss (*Sphagnum* spp.). Shore bogs that are rarely inundated and are relatively dry during the growing season typically have less sphagnum moss cover than those that are more frequently inundated. Other common ground vegetation species include tawny cotton-grass (*Eriophorum virginicum*), pod grass (*Scheuchzeria palustris*) and northern pitcher-plant (*Sarracenia purpurea*). Ground vegetation cover is most abundant in the more frequently inundated shore bogs.

Floating bog is characterized by a floating mat of poorly decomposed peat that is bound together by the rooting systems of the plants that occupy the surface of the wetland. The hydrology of these bogs is not significantly affected by water level fluctuations in the reservoir since the vegetation mat floats at the same level as the water in the reservoir. At Governor Lake reservoir, this wetland type is restricted to sheltered coves where the mats of peat are able to rise and fall with the fluctuating water levels but are not cast adrift in the lake. These wetlands are typically partially surrounded by strips of open water where the bogs have been torn from the shoreward margins of the bog that originally anchored the bog to the shore. The species composition of the floating bogs on Governor Lake is similar to that of the shore bogs. The ground vegetation layer consists of a continuous sphagnum moss mat on which grows a moderately dense cover of stunted leatherleaf.

Wet meadow represents an early stage in the development of bog habitat. This wetland type shares characteristics of both bog and marsh wetland types. Wet meadows on Governor Lake reservoir are typically found in relatively sheltered coves and are underlain by shallow peat deposits. In some wetlands such as Wetland 1, it appears that this peat was largely developed in wetlands that occupied the site prior to flooding of the reservoir. This wetland type appears to be flooded annually for a sufficient period of time during the growing season to prevent the establishment of most trees and shrubs. Only ground vegetation species able to tolerate extended periods of inundation are able to persist in these wetlands. The vegetation of these wetlands is characterized by a low, flat, nearly continuous mat of sphagnum moss that is punctuated by a moderately dense cover of graminoids and forbs. Shrub cover is very sparse and tree cover is absent. In addition to sphagnum moss, the dominant ground vegetation species are three-way sedge (*Dulichium arundinacea*), cottongrass bulrush (*Scirpus cyperinus*), blue-joint reedgrass (*Calamagrostis canadensis*), and marsh St. John's-wort (*Triadenum fraseri*).

Shore marsh habitat is also found in areas that are flooded for extended periods of time. These wetlands appear to be flooded mainly during the early part of the growing season but may experience periodic flooding at various times during the rest of the growing season. This wetland type is generally found in more exposed locations where wave and ice scour make it difficult for peat to accumulate. Shore marsh is a very early stage in wetland development around the margin of Governor Lake reservoir. This wetland type has become established since Governor Lake reservoir was developed as a hydroelectric system. The species composition of this wetland type typically consists of a mixture of three-way sedge and cotton-grass bulrush. Unlike the wet meadow habitat, sphagnum moss is absent or present in only small amounts. There is some variation in the species composition of shore marshes, with some marshes supporting large amounts of blue-joint reedgrass or Canada rush (*Juncus canadensis*). Shrub cover is poorly developed and consists of scattered hardhack spiraea (*Spiraea tomentosa*). The species composition of these wetlands is characteristic of early successional wetlands. Shore marsh is the most abundant wetland type around the margin of Governor Lake.

Tall shrub dominated shore swamp is found at the upland edge of two shore marshes on Governor Lake reservoir. It typically occurs in areas where small streams or seepage areas discharge into the reservoir. These wetlands are found at the upper edge of the littoral zone of the reservoir and are only rarely flooded. They are maintained as wetlands by inputs of groundwater and surface water from the seeps and streams. This wetland type is characterized by a dense tall shrub canopy composed mainly of speckled alder (*Alnus incana*). The ground vegetation understory is composed mainly of small patches of sphagnum moss along with lesser amounts of blue-joint reedgrass and marsh St. John's-wort.

At Governor Lake reservoir, low shrub dominated shore swamp is found in areas that are seasonally flooded by the reservoir but are not exposed to heavy disturbance by wave or ice scour. Most low shrub dominated shore swamps are found in sheltered coves, often on the landward side of wet meadow habitat. Low shrub dominated shore swamp represents an early stage of wetland succession. This wetland type typically consists of a relatively dense low shrub canopy composed mainly of leatherleaf and sweet bayberry as well as narrow-leaved meadow-sweet (*Spiraea alba*) and hardhack spiraea. The ground vegetation understory is very sparse and consists of scattered patches of sphagnum moss, blue-joint reedgrass and cotton-grass bulrush.

Appendix D lists the vascular plant species found in each of the five wetlands sampled on the Governor Lake reservoir. None of the vascular plant species encountered in the wetlands is considered to be rare or sensitive by NSDNR. Algae-like pondweed, a species considered to be uncommon to fairly common by ACCDC was found in one of the five wetlands sampled (Wetland 4). NSDNR considers this species to be secure in Nova Scotia.

Ruth Fall Flowage Reservoir

Twenty-one wetlands were encountered and mapped around the Ruth Fall Flowage reservoir during the field survey (Figure 2A and 2B, Table 4). Six of these wetlands were described during the field survey. Most wetlands were small and the vast majority were shore bogs. The largest wetlands were Wetlands 3 and 6 which were wetland complexes composed of coniferous treed shore bog and floating bog. In instances where wetland complexes were described dominant plant cover data was collected for all wetland types present in the wetland complex. In some instances, a particular wetland type in a wetland was further divided into wetland substypes if the wetland type was composed of several different plant communities. Appendix E presents the species composition data for each of the wetland plant communities found around Ruth Falls Flowage reservoir. The wetlands can be categorized into four wetland types including coniferous treed shore swamp, coniferous treed shore bog, shore bog, and floating bog. The coniferous treed shore bog wetland type was further subdivided into two distinct plant communities as was the floating bog wetland type.

TABLE 4 Wetlands Found Within the Littoral Zone of Ruth Falls Flowage Reservoir

Wetland ID Number	Wetland Type	Wetland Description
1	Coniferous treed shore bog	No
2	Coniferous treed shore bog	No
3	Coniferous treed shore bog (two subtypes)	Yes
4	Shore bog	Yes
5	Shore bog	No
6	Wetland complex composed of coniferous treed shore bog and floating bog (two subtypes)	Yes
7	Shore bog	Yes
8	Shore bog	No
9	Shore bog	No
10	Shore bog	No
11	Shore bog	Yes
12	Shore bog	No
13	Shore bog	No
14	Shore bog	No
15	Wetland complex composed of coniferous treed shore bog and coniferous treed shore swamp	Yes
16	Coniferous treed shore bog	No
17	Shore bog	No
18	Coniferous treed shore bog	No
19	Shore bog	No
20	Shore bog	No
21	Shore bog	No

Shore bog habitat was observed in 14 out of 21 wetlands found around the margin of Ruth Falls Flowage. Shore bogs are not tolerant of frequent or extended periods of deep flooding. The presence of large numbers of shore bogs on Ruth Falls Flowage would suggest that water levels fluctuations in this reservoir are similar to those in natural lakes. The vegetation of shore bogs around Ruth Falls Flowage consists of a sphagnum moss mat and a moderately dense cover of leatherleaf and sweet bayberry. A sparse cover of stunted trees is also present consisting mainly of black spruce (*Picea mariana*), balsam fir (*Abies balsamea*) and red maple (*Acer rubrum*). In addition to sphagnum moss, the ground vegetation layer supports a moderate cover of graminoid species including blue-joint reedgrass, little prickly sedge (*Carex echinata*), shallow sedge (*Carex lurida*), tussock sedge (*Carex stricta*), bear sedge (*Carex utriculata*), narrow-leaved cotton-grass (*Eriophorum polystachion*), and tawny cottongrass (*Eriophorum virginicum*).

Floating bog was found in Wetland 6, the largest wetland on Ruth Falls Flowage. The species composition of this bog was similar to that of shore bogs found around the reservoir except that the abundance of tree species was much lower in the floating bog. This floating bog has developed in what was once a long narrow cove. A floating mat of sphagnum moss and associated shrubs and ground vegetation species has covered the cove; however, the peat under the mat has not consolidated to the point where it can support weight. Over time, peat will build up under the vegetation mat forming a more stable substrate.

Coniferous treed shore bog is generally found in the larger wetlands on the reservoir and is typically found at the landward edge of bogs where bog habitat has been established the longest. This wetland type represents a late stage in bog succession. It is characterized by the presence of an open canopy of mature but stunted trees composed mainly of black spruce, American larch (*Larix laricina*) and red maple. Shrub cover is moderately dense and consists mainly of low shrubs including leatherleaf and sweet bayberry. Tall shrubs such as possum-haw viburnum (*Viburnum nudum*), mountain holly (*Nemopanthus mucronata*) and speckled alder (*Alnus incana*) form an open canopy over the denser low shrub layer. The ground vegetation is characterized by a dense mat of sphagnum moss. Other common ground vegetation species include tawny cottongrass and various sedge species including three-seed sedge (*Carex trisperma*), few-seeded sedge (*Carex oligosperma*), little prickly sedge (*Carex echinata*), and bog sedge (*Carex paupercula*).

Coniferous treed shore swamp was found at one location on Ruth Falls Flowage. This wetland type is similar in species composition to coniferous treed bog except that the ground vegetation layer contains large amounts of cinnamon fern (*Osmunda cinnamomea*). The substrate of this wetland has only a thin layer of peat and the rooting zone receives inputs of mineral enriched groundwater which makes the wetland more productive than a bog. This wetland is rarely if ever inundated by water level fluctuations in the reservoir.

Appendix F lists the vascular plant species found in each of the six wetlands sampled on the Ruth Falls Flowage reservoir. None of the vascular plant species encountered in the wetlands is considered to be rare or sensitive by NSDNR or ACCDC.

1.2 Summary

Governor Lake Reservoir

The vascular plant surveys conducted in the littoral zone of Governor Lake did not reveal the presence of any vascular plant species considered to be rare or sensitive by NSDNR. Algae-like pondweed, a species considered to be uncommon to fairly common in Nova Scotia by ACCDC but listed as secure by NSDNR, was found at various locations around the perimeter of the reservoir. Given the fact that this species is well established in a reservoir that has been operational for many years, continued operation of the reservoir is unlikely to adversely affect their populations.

A total of 25 wetlands were found on the Governor Lake reservoir during the field survey. Wetland types present included shore bog, floating bog, tall shrub dominated shore swamp, low shrub dominated shore swamp, and shore marsh. Shore marsh was by far the most abundant wetland type in the reservoir. All but two wetlands in the reservoir were at least partially composed of this wetland type.

The vascular plant surveys conducted in the wetlands did not reveal the presence of any provincially rare or sensitive vascular plant species. Algae-like pondweed, an uncommon to fairly common species was encountered in Wetland 4.

Ruth Falls Flowage Reservoir

No vascular plant species considered to be sensitive or at risk by NSDNR were encountered in the littoral zone of Ruth Falls Flowage. Algae-like pondweed, a species considered to be uncommon to fairly common in Nova Scotia by ACCDC but listed as secure by NSDNR was found at various locations around the perimeter of the reservoir. Continued operation of the reservoir is not expected to adversely affect the Ruth Fall Flowage population of this species.

A total of 21 wetlands were found on the Ruth Falls Flowage reservoir during the field survey. Wetland types present included shore bog, floating bog, coniferous treed shore bog, and coniferous treed shore swamp. Shore bog was the most abundant wetland type in the reservoir and was found in 14 out of 21 wetlands. The vascular plant surveys conducted in the wetlands did not reveal the presence of any vascular plant species considered to be sensitive or at risk by NSDNR or ACCDC.

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APPENDIX A

Vascular Plants Found in the Littoral Zone of Governor Lake

Jacques Whitford

Table A1 Vascular Plants Found in the Littoral Zone of Ruth Falls Flowage

Common Name	Scientific name	ACCDC Rank	NSDNR Rank
Balsam Fir	*Abies balsamea*	S5	GREEN
Red Maple	*Acer rubrum*	S5	GREEN
Colonial Bentgrass	*Agrostis capillaris*	SE	EXOTIC
Rough Bentgrass	*Agrostis hyemalis*	S5	GREEN
Perennial Bentgrass	*Agrostis perennans*	S4S5	GREEN
Speckled Alder	*Alnus incana*	S5	GREEN
Green Alder	*Alnus viridis*	S5	GREEN
Shadbush	*Amelanchier sp.*	N/A	N/A
Bog Rosemary	*Andromeda glaucophylla*	S5	GREEN
Wild Sarsaparilla	*Aralia nudicaulis*	S5	GREEN
Red Chokeberry	*Aronia arbutifolia*	S4S5	GREEN
Black Chokeberry	*Aronia melanocarpa*	S5	GREEN
Whorled Aster	*Aster acuminatus*	S5	GREEN
Farewell-Summer	*Aster lateriflorus*	S5	GREEN
Bog Aster	*Aster nemoralis*	S5	GREEN
New Belgium American-Aster	*Aster novi-belgii*	S5	GREEN
Rough-Leaved Aster	*Aster radula*	S5	GREEN
Parasol White-Top	*Aster umbellatus*	S5	GREEN
Lady-Fern	*Athyrium filix-femina*	S5	GREEN
Yellow Birch	*Betula alleghaniensis*	S5	GREEN
Heart-Leaved Paper Birch	*Betula cordifolia*	S5	GREEN
Watershield	*Brasenia schreberi*	S4S5	GREEN
Blue-Joint Reedgrass	*Calamagrostis canadensis*	S5	GREEN
Pickering's Reed Bent-Grass	*Calamagrostis pickeringii*	S4S5	GREEN
Wild Calla	*Calla palustris*	S4	GREEN
Hoary Sedge	*Carex canescens*	S5	GREEN
Little Prickly Sedge	*Carex echinata*	S5	GREEN
Long Sedge	*Carex folliculata*	S5	GREEN
A Sedge	*Carex gynandra*	S5	GREEN
Slender Sedge	*Carex lasiocarpa*	S5	GREEN
Shallow Sedge	*Carex lurida*	S5	GREEN
Few-Seeded Sedge	*Carex oligosperma*	S4S5	GREEN
Tussock Sedge	*Carex stricta*	S5	GREEN
Three-Seed Sedge	*Carex trisperma*	S5	GREEN
Bear Sedge	*Carex utriculata*	S5	GREEN
Leatherleaf	*Chamaedaphne calyculata*	S5	GREEN
White Turtlehead	*Chelone glabra*	S5	GREEN
Goldthread	*Coptis trifolia*	S5	GREEN
Dwarf Dogwood	*Cornus canadensis*	S5	GREEN
Spoon-Leaved Sundew	*Drosera intermedia*	S5	GREEN
Roundleaf Sundew	*Drosera rotundifolia*	S5	GREEN
Spinulose Shield Fern	*Dryopteris carthusiana*	S5	GREEN
Three-Way Sedge	*Dulichium arundinaceum*	S5	GREEN
Black Crowberry	*Empetrum nigrum*	S5	GREEN
Trailing Arbutus	*Epigaea repens*	S5	GREEN
Narrow-Leaved Cotton-Grass	*Eriophorum polystachion*	S5	GREEN
Tussock Cotton-Grass	*Eriophorum vaginatum*	S5	GREEN
Tawny Cotton-Grass	*Eriophorum virginicum*	S5	GREEN
Common Boneset	*Eupatorium perfoliatum*	S5	GREEN
Flat-Top Fragrant-Golden-Rod	*Euthamia graminifolia*	S5	GREEN
Red Fescue	*Festuca rubra*	S5	GREEN
Creeping Snowberry	*Gaultheria hispidula*	S5	GREEN
Teaberry	*Gaultheria procumbens*	S5	GREEN
Black Huckleberry	*Gaylussacia baccata*	S5	GREEN
Dwarf Huckleberry	*Gaylussacia dumosa*	S4	GREEN
Small Floating Manna-Grass	*Glyceria borealis*	S5	GREEN

Table A1 Vascular Plants Found in the Littoral Zone of Ruth Falls Flowage

Common Name	Scientific name	ACCDC Rank	NSDNR Rank
Canada Manna-Grass	*Glyceria canadensis*	S5	GREEN
American Mannagrass	*Glyceria grandis*	S4S5	GREEN
Blunt Manna-Grass	*Glyceria obtusa*	S4	GREEN
Fowl Manna-Grass	*Glyceria striata*	S5	GREEN
Northern St. John's-Wort	*Hypericum boreale*	S5	GREEN
Black Holly	*Ilex verticillata*	S5	GREEN
Blueflag	*Iris versicolor*	S5	GREEN
Canada Rush	*Juncus canadensis*	S5	GREEN
Soft Rush	*Juncus effusus*	S5	GREEN
Bayonet Rush	*Juncus militaris*	S5	GREEN
Brown-Fruited Rush	*Juncus pelocarpus*	S5	GREEN
Sheep-Laurel	*Kalmia angustifolia*	S5	GREEN
Pale Laurel	*Kalmia polifolia*	S5	GREEN
American Larch	*Larix laricina*	S5	GREEN
Common Labrador Tea	*Ledum groenlandicum*	S5	GREEN
Rice Cutgrass	*Leersia oryzoides*	S5	GREEN
Twinflower	*Linnaea borealis*	S5	GREEN
Water Lobelia	*Lobelia dortmanna*	S5	GREEN
Stiff Clubmoss	*Lycopodium annotinum*	S5	GREEN
Northern Bugleweed	*Lycopus uniflorus*	S5	GREEN
Swamp Loosestrife	*Lysimachia terrestris*	S5	GREEN
Sweet Bayberry	*Myrica gale*	S5	GREEN
Northern Bayberry	*Myrica pensylvanica*	S5	GREEN
Alternate-Flowered Water Milfoil	*Myriophyllum alterniflorum*	S4	GREEN
Mountain Holly	*Nemopanthus mucronata*	S5	GREEN
Yellow Pond-Lily	*Nuphar variegata*	S5	GREEN
American Water-Lily	*Nymphaea odorata*	S5	GREEN
Floating-Heart	*Nymphoides cordata*	S5	GREEN
Sensitive Fern	*Onoclea sensibilis*	S5	GREEN
Cinnamon Fern	*Osmunda cinnamomea*	S5	GREEN
Interrupted Fern	*Osmunda claytoniana*	S5	GREEN
Northern Beech Fern	*Phegopteris connectilis*	S5	GREEN
Black Spruce	*Picea mariana*	S5	GREEN
Eastern White Pine	*Pinus strobus*	S5	GREEN
Small Green Woodland Orchid	*Platanthera clavellata*	S5	GREEN
Canada Bluegrass	*Poa compressa*	SE	EXOTIC
Pickerel Weed	*Pontederia cordata*	S5	GREEN
Algae-Like Pondweed	*Potamogeton confervoides*	S3S4	GREEN
Nuttall Pondweed	*Potamogeton epihydrus*	S5	GREEN
Old-Field Cinquefoil	*Potentilla simplex*	S5	GREEN
One-Side Wintergreen	*Pyrola secunda*	S5	GREEN
Rhodora	*Rhododendron canadense*	S5	GREEN
White Beakrush	*Rhynchospora alba*	S5	GREEN
Bristly Dewberry	*Rubus hispidus*	S5	GREEN
Small Bristleberry	*Rubus setosus*	S4?	GREEN
Balsam Willow	*Salix pyrifolia*	S5	GREEN
Northern Pitcher-Plant	*Sarracenia purpurea*	S5	GREEN
Tufted Leafless-Bulrush	*Scirpus caespitosus*	S5	GREEN
Cottongrass Bulrush	*Scirpus cyperinus*	S5	GREEN
Water Bulrush	*Scirpus subterminalis*	S5	GREEN
Three-Leaf Solomon's-Plume	*Smilacina trifolia*	S4S5	GREEN
Rough-Leaf Goldenrod	*Solidago rugosa*	S5	GREEN
Bog Goldenrod	*Solidago uliginosa*	S5	GREEN
American Bur-Reed	*Sparganium americanum*	S5	GREEN
Narrow-Leaf Burreed	*Sparganium angustifolium*	S4S5	GREEN
Narrow-Leaved Meadow-Sweet	*Spiraea alba*	S5	GREEN

Table A1 Vascular Plants Found in the Littoral Zone of Ruth Falls Flowage

Common Name	Scientific name	ACCDC Rank	NSDNR Rank
Hardhack Spiraea	*Spiraea tomentosa*	S5	GREEN
New York Fern	*Thelypteris noveboracensis*	S5	GREEN
Marsh St. John's-Wort	*Triadenum fraseri*	S5	GREEN
Northern Starflower	*Trientalis borealis*	S5	GREEN
Greater Bladder-Wort	*Utricularia vulgaris*	S5	GREEN
Velvetleaf Blueberry	*Vaccinium myrtilloides*	S5	GREEN
Small Cranberry	*Vaccinium oxycoccos*	S5	GREEN
Possum-Haw Viburnum	*Viburnum nudum*	S5	GREEN
Smooth White Violet	*Viola macloskeyi*	S5	GREEN

ACCDC Ranking
S1: Extremely rare. S2: Rare. S3: Uncommon. S4: fairly common. S5: Secure. S#S#: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the element (e.g., S1S2). B: Breeding. SH: Historical and suspected to be still extant. SU: Unrankable: Possibly in peril throughout its range in the province, but status uncertain; need more information. SX: Extinct/Extirpated: Element is believed to be extirpated within the province. S?:Unranked: Element is not yet ranked. SZ: Zero occurrences: Not of practical conservation concern in the province, because there are no definable occurrences, although the species is native and appears regularly. NZ: Long distance migrants whose occurrences during their migrations are too irregular (in terms of repeated visitation to the same locations) or transitory.

NSDNR Ranking
Red: Known to be or thought to be at risk. Yellow: Sensitive to human activities or natural events. Green: Not believed too be sensitive, or at risk. Not Assessed: Known or believed to be present in Nova Scotia but yet unassessed. Undetermined: Insufficient data exists to determine status. Exotic: Introduced as a result of human activity.

APPENDIX B

Vascular Plants Found in the Littoral Zone of Ruth Falls Flowage

Jacques Whitford

Table B1 Vascular Plants Found In the Littoral Zone of Governor Lake

Common Name	Scientific name	ACCDC Rank	NSDNR Rank
Balsam Fir	*Abies balsamea*	S5	GREEN
Red Maple	*Acer rubrum*	S5	GREEN
Rough Bentgrass	*Agrostis hyemalis*	S5	GREEN
Perennial Bentgrass	*Agrostis perennans*	S4S5	GREEN
Speckled Alder	*Alnus incana*	S5	GREEN
Shadbush	*Amelanchier sp.*	N/A	N/A
Red Chokeberry	*Aronia arbutifolia*	S4S5	GREEN
Bog Aster	*Aster nemoralis*	S5	GREEN
New Belgium American-Aster	*Aster novi-belgii*	S5	GREEN
Lady-Fern	*Athyrium filix-femina*	S5	GREEN
Yellow Birch	*Betula alleghaniensis*	S5	GREEN
Gray Birch	*Betula populifolia*	S5	GREEN
Devil's Beggar-Ticks	*Bidens frondosa*	S5	GREEN
Watershield	*Brasenia schreberi*	S4S5	GREEN
Blue-Joint Reedgrass	*Calamagrostis canadensis*	S5	GREEN
Prickly Bog Sedge	*Carex atlantica*	S4	GREEN
Hoary Sedge	*Carex canescens*	S5	GREEN
Little Prickly Sedge	*Carex echinata*	S5	GREEN
Long Sedge	*Carex folliculata*	S5	GREEN
A Sedge	*Carex gynandra*	S5	GREEN
Slender Sedge	*Carex lasiocarpa*	S5	GREEN
Tussock Sedge	*Carex stricta*	S5	GREEN
Leatherleaf	*Chamaedaphne calyculata*	S5	GREEN
Small Enchanter's Nightshade	*Circaea alpina*	S5	GREEN
Eastern Hay-Scented Fern	*Dennstaedtia punctilobula*	S5	GREEN
Spoon-Leaved Sundew	*Drosera intermedia*	S5	GREEN
Roundleaf Sundew	*Drosera rotundifolia*	S5	GREEN
Three-Way Sedge	*Dulichium arundinaceum*	S5	GREEN
Creeping Spike-Rush	*Eleocharis palustris*	S5	GREEN
Slender Spike-Rush	*Eleocharis tenuis*	S5	GREEN
Black Crowberry	*Empetrum nigrum*	S5	GREEN
Water Horsetail	*Equisetum fluviatile*	S5	GREEN
Fireweed	*Erechtites hieraciifolia*	S5	GREEN
Seven-Angled Pipewort	*Eriocaulon aquaticum*	S5	GREEN
Narrow-Leaved Cotton-Grass	*Eriophorum polystachion*	S5	GREEN
Rough Cotton-Grass	*Eriophorum tenellum*	S4S5	GREEN
Tussock Cotton-Grass	*Eriophorum vaginatum*	S5	GREEN
Tawny Cotton-Grass	*Eriophorum virginicum*	S5	GREEN
Common Boneset	*Eupatorium perfoliatum*	S5	GREEN
Flat-Top Fragrant-Golden-Rod	*Euthamia graminifolia*	S5	GREEN
Creeping Snowberry	*Gaultheria hispidula*	S5	GREEN
Black Huckleberry	*Gaylussacia baccata*	S5	GREEN
Dwarf Huckleberry	*Gaylussacia dumosa*	S4	GREEN
Small Floating Manna-Grass	*Glyceria borealis*	S5	GREEN
Canada Manna-Grass	*Glyceria canadensis*	S5	GREEN
Blunt Manna-Grass	*Glyceria obtusa*	S4	GREEN
Mouseear	*Hieracium pilosella*	SE	EXOTIC
Northern St. John's-Wort	*Hypericum boreale*	S5	GREEN
Canadian St. John's-Wort	*Hypericum canadense*	S5	GREEN
Pale St. John's-Wort	*Hypericum ellipticum*	S5	GREEN
Black Holly	*Ilex verticillata*	S5	GREEN
Blueflag	*Iris versicolor*	S5	GREEN
Baltic Rush	*Juncus arcticus*	S5	GREEN
Canada Rush	*Juncus canadensis*	S5	GREEN
Bayonet Rush	*Juncus militaris*	S5	GREEN

Table B1 Vascular Plants Found In the Littoral Zone of Governor Lake

Common Name	Scientific name	ACCDC Rank	NSDNR Rank
Brown-Fruited Rush	*Juncus pelocarpus*	S5	GREEN
Sheep-Laurel	*Kalmia angustifolia*	S5	GREEN
Pale Laurel	*Kalmia polifolia*	S5	GREEN
American Larch	*Larix laricina*	S5	GREEN
Common Labrador Tea	*Ledum groenlandicum*	S5	GREEN
Rice Cutgrass	*Leersia oryzoides*	S5	GREEN
Water Lobelia	*Lobelia dortmanna*	S5	GREEN
Bog Clubmoss	*Lycopodiella inundata*	S5	GREEN
Northern Bugleweed	*Lycopus uniflorus*	S5	GREEN
Swamp Loosestrife	*Lysimachia terrestris*	S5	GREEN
Sweet Bayberry	*Myrica gale*	S5	GREEN
Alternate-Flowered Water Milfoil	*Myriophyllum alterniflorum*	S4	GREEN
Mountain Holly	*Nemopanthus mucronata*	S5	GREEN
Yellow Pond-Lily	*Nuphar variegata*	S5	GREEN
American Water-Lily	*Nymphaea odorata*	S5	GREEN
Floating-Heart	*Nymphoides cordata*	S5	GREEN
Sensitive Fern	*Onoclea sensibilis*	S5	GREEN
Cinnamon Fern	*Osmunda cinnamomea*	S5	GREEN
Interrupted Fern	*Osmunda claytoniana*	S5	GREEN
Royal Fern	*Osmunda regalis*	S5	GREEN
White Spruce	*Picea glauca*	S5	GREEN
Black Spruce	*Picea mariana*	S5	GREEN
Red Spruce	*Picea rubens*	S5	GREEN
Eastern White Pine	*Pinus strobus*	S5	GREEN
Nipple-Seed Plantain	*Plantago major*	SE	EXOTIC
Pickerel Weed	*Pontederia cordata*	S5	GREEN
Quaking Aspen	*Populus tremuloides*	S5	GREEN
Algae-Like Pondweed	*Potamogeton confervoides*	S3S4	GREEN
Nuttall Pondweed	*Potamogeton epihydrus*	S5	GREEN
Floating Pondweed	*Potamogeton natans*	S5	GREEN
Flatleaf Pondweed	*Potamogeton robbinsii*	S4	GREEN
Self-Heal	*Prunella vulgaris*	S5	GREEN
Rhodora	*Rhododendron canadense*	S5	GREEN
White Beakrush	*Rhynchospora alba*	S5	GREEN
Small Bristleberry	*Rubus setosus*	S4?	GREEN
Bebb's Willow	*Salix bebbiana*	S5	GREEN
Pussy Willow	*Salix discolor*	S5	GREEN
Balsam Willow	*Salix pyrifolia*	S5	GREEN
Northern Pitcher-Plant	*Sarracenia purpurea*	S5	GREEN
Pod Grass	*Scheuchzeria palustris*	S4S5	GREEN
Tufted Leafless-Bulrush	*Scirpus caespitosus*	S5	GREEN
Cottongrass Bulrush	*Scirpus cyperinus*	S5	GREEN
Water Bulrush	*Scirpus subterminalis*	S5	GREEN
Mad Dog Skullcap	*Scutellaria lateriflora*	S5	GREEN
Hemlock Water-Parsnip	*Sium suave*	S5	GREEN
Rough-Leaf Goldenrod	*Solidago rugosa*	S5	GREEN
Bog Goldenrod	*Solidago uliginosa*	S5	GREEN
American Mountain-Ash	*Sorbus americana*	S5	GREEN
Narrow-Leaf Burreed	*Sparganium angustifolium*	S4S5	GREEN
Narrow-Leaved Meadow-Sweet	*Spiraea alba*	S5	GREEN
Hardhack Spiraea	*Spiraea tomentosa*	S5	GREEN
New York Fern	*Thelypteris noveboracensis*	S5	GREEN
Marsh St. John's-Wort	*Triadenum fraseri*	S5	GREEN
Marsh St. John's Wort	*Triadenum virginicum*	S4S5	GREEN
Northern Starflower	*Trientalis borealis*	S5	GREEN
Horned Bladderwort	*Utricularia cornuta*	S5	GREEN

Table B1 Vascular Plants Found In the Littoral Zone of Governor Lake

Common Name	Scientific name	ACCDC Rank	NSDNR Rank
Hidden-Fruited Bladderwort	*Utricularia geminiscapa*	S4	GREEN
Greater Bladder-Wort	*Utricularia vulgaris*	S5	GREEN
Large Cranberry	*Vaccinium macrocarpon*	S5	GREEN
Small Cranberry	*Vaccinium oxycoccos*	S5	GREEN
Lance-Leaf Violet	*Viola lanceolata*	S5	GREEN
Smooth White Violet	*Viola macloskeyi*	S5	GREEN

ACCDC Ranking
S1: Extremely rare. S2: Rare. S3: Uncommon. S4: fairly common. S5: Secure. S#S#: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the element (e.g., S1S2). B: Breeding. SH: Historical and suspected to be still extant. SU: Unrankable: Possibly in peril throughout its range in the province, but status uncertain; need more information. SX: Extinct/Extirpated: Element is believed to be extirpated within the province. S?:Unranked: Element is not yet ranked. SZ: Zero occurrences: Not of practical conservation concern in the province, because there are no definable occurrences, although the species is native and appears regularly. NZ: Long distance migrants whose occurrences during their migrations are too irregular (in terms of repeated visitation to the same locations) or transitory.

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Red: Known to be or thought to be at risk. Yellow: Sensitive to human activities or natural events. Green: Not believed too be sensitive, or at risk. Not Assessed: Known or believed to be present in Nova Scotia but yet unassessed. Undetermined: Insufficient data exists to determine status. Exotic: Introduced as a result of human activity.

APPENDIX C

Species Composition for the Five Wetlands
Surveyed in the Governor Lake Reservoir

Jacques Whitford

Table C1 Species Composition for the Five Wetlands Surveyed in the Governor Lake Reservoir

Common Name	Scientific Name	ACCDC Rank	NSDNR Rank	Wetland				
				1	2	3	4	5
Red Maple	*Acer rubrum*	S5	GREEN	X	X	X	X	X
Rough Bentgrass	*Agrostis hyemalis*	S5	GREEN		X	X	X	X
Speckled Alder	*Alnus incana*	S5	GREEN	X	X		X	
Red Chokeberry	*Aronia arbutifolia*	S4S5	GREEN	X				
Bog Aster	*Aster nemoralis*	S5	GREEN		X	X		X
Devil's Beggar-Ticks	*Bidens frondosa*	S5	GREEN					X
Watershield	*Brasenia schreberi*	S4S5	GREEN			X		X
Blue-Joint Reedgrass	*Calamagrostis canadensis*	S5	GREEN	X	X	X		X
Prickly Bog Sedge	*Carex atlantica*	S4	GREEN					X
Hoary Sedge	*Carex canescens*	S5	GREEN				X	
Little Prickly Sedge	*Carex echinata*	S5	GREEN				X	
Long Sedge	*Carex folliculata*	S5	GREEN		X			
Slender Sedge	*Carex lasiocarpa*	S5	GREEN			X		
Tussock Sedge	*Carex stricta*	S5	GREEN				X	
Leatherleaf	*Chamaedaphne calyculata*	S5	GREEN	X	X	X	X	X
Spoon-Leaved Sundew	*Drosera intermedia*	S5	GREEN		X	X		
Roundleaf Sundew	*Drosera rotundifolia*	S5	GREEN	X			X	
Three-Way Sedge	*Dulichium arundinaceum*	S5	GREEN	X	X	X	X	X
Creeping Spike-Rush	*Eleocharis palustris*	S5	GREEN			X	X	X
Slender Spike-Rush	*Eleocharis tenuis*	S5	GREEN					X
Black Crowberry	*Empetrum nigrum*	S5	GREEN		X		X	
Water Horsetail	*Equisetum fluviatile*	S5	GREEN					X
Fireweed	*Erechtites hieraciifolia*	S5	GREEN					X
Seven-Angled Pipewort	*Eriocaulon aquaticum*	S5	GREEN				X	
Narrow-Leaved Cotton-Grass	*Eriophorum polystachion*	S5	GREEN				X	
Rough Cotton-Grass	*Eriophorum tenellum*	S4S5	GREEN		X			
Tussock Cotton-Grass	*Eriophorum vaginatum*	S5	GREEN	X		X		
Tawny Cotton-Grass	*Eriophorum virginicum*	S5	GREEN	X	X	X	X	
Flat-Top Fragrant-Golden-Rod	*Euthamia graminifolia*	S5	GREEN	X				X
Dwarf Huckleberry	*Gaylussacia dumosa*	S4	GREEN	X				
Small Floating Manna-Grass	*Glyceria borealis*	S5	GREEN		X		X	X
Canada Manna-Grass	*Glyceria canadensis*	S5	GREEN	X	X	X	X	X
Blunt Manna-Grass	*Glyceria obtusa*	S4	GREEN		X	X		
Northern St. John's-Wort	*Hypericum boreale*	S5	GREEN	X				
Canadian St. John's-Wort	*Hypericum canadense*	S5	GREEN		X	X	X	
Pale St. John's-Wort	*Hypericum ellipticum*	S5	GREEN			X	X	X
Black Holly	*Ilex verticillata*	S5	GREEN					X
Blueflag	*Iris versicolor*	S5	GREEN		X			
Baltic Rush	*Juncus arcticus*	S5	GREEN				X	
Canada Rush	*Juncus canadensis*	S5	GREEN		X	X	X	X

Table C1 Species Composition for the Five Wetlands Surveyed in the Governor Lake Reservoir

Common Name	Scientific Name	ACCDC Rank	NSDNR Rank	Wetland				
				1	2	3	4	5
Bayonet Rush	*Juncus militaris*	S5	GREEN			X		
Brown-Fruited Rush	*Juncus pelocarpus*	S5	GREEN		X	X	X	X
Sheep-Laurel	*Kalmia angustifolia*	S5	GREEN	X	X	X		
Pale Laurel	*Kalmia polifolia*	S5	GREEN	X		X		
American Larch	*Larix laricina*	S5	GREEN	X				
Rice Cutgrass	*Leersia oryzoides*	S5	GREEN		X			X
Water Lobelia	*Lobelia dortmanna*	S5	GREEN					X
Bog Clubmoss	*Lycopodiella inundata*	S5	GREEN			X		
Northern Bugleweed	*Lycopus uniflorus*	S5	GREEN					X
Swamp Loosestrife	*Lysimachia terrestris*	S5	GREEN	X	X	X	X	X
Sweet Bayberry	*Myrica gale*	S5	GREEN	X	X	X	X	X
Mountain Holly	*Nemopanthus mucronata*	S5	GREEN	X				
Yellow Pond-Lily	*Nuphar variegata*	S5	GREEN		X		X	
American Water-Lily	*Nymphaea odorata*	S5	GREEN		X			
Floating-Heart	*Nymphoides cordata*	S5	GREEN		X			
Cinnamon Fern	*Osmunda cinnamomea*	S5	GREEN		X			
Interrupted Fern	*Osmunda claytoniana*	S5	GREEN				X	
Black Spruce	*Picea mariana*	S5	GREEN		X	X		
Eastern White Pine	*Pinus strobus*	S5	GREEN	X				
Pickerel Weed	*Pontederia cordata*	S5	GREEN			X	X	X
Algae-Like Pondweed	*Potamogeton confervoides*	S3S4	GREEN				X	
Nuttall Pondweed	*Potamogeton epihydrus*	S5	GREEN	X	X		X	
Floating Pondweed	*Potamogeton natans*	S5	GREEN				X	
Rhodora	*Rhododendron canadense*	S5	GREEN	X				
White Beakrush	*Rhynchospora alba*	S5	GREEN		X	X	X	
Small Bristleberry	*Rubus setosus*	S4?			X			
Northern Pitcher-Plant	*Sarracenia purpurea*	S5	GREEN	X	X	X	X	
Pod Grass	*Scheuchzeria palustris*	S4S5	GREEN		X	X		
Tufted Leafless-Bulrush	*Scirpus caespitosus*	S5	GREEN	X				
Cottongrass Bulrush	*Scirpus cyperinus*	S5		X	X	X		X
Water Bulrush	*Scirpus subterminalis*	S5	GREEN		X		X	X
Bog Goldenrod	*Solidago uliginosa*	S5	GREEN	X				
Narrow-Leaf Burreed	*Sparganium angustifolium*	S4S5	GREEN	X	X			
Narrow-Leaved Meadow-Sweet	*Spiraea alba*	S5	GREEN	X		X	X	X
Hardhack Spiraea	*Spiraea tomentosa*	S5	GREEN			X	X	X
Marsh St. John's-Wort	*Triadenum fraseri*	S5	GREEN	X	X	X	X	X
Marsh St. John's Wort	*Triadenum virginicum*	S4S5	GREEN				X	
Northern Starflower	*Trientalis borealis*	S5	GREEN	X				
Horned Bladderwort	*Utricularia cornuta*	S5	GREEN			X	X	
Hidden-Fruited Bladderwort	*Utricularia geminiscapa*	S4	GREEN				X	

Table C1 Species Composition for the Five Wetlands Surveyed in the Governor Lake Reservoir

Common Name	Scientific Name	ACCDC Rank	NSDNR Rank	Wetland				
				1	2	3	4	5
Greater Bladder-Wort	*Utricularia vulgaris*	S5	GREEN	X				
Large Cranberry	*Vaccinium macrocarpon*	S5	GREEN		X	X	X	X
Small Cranberry	*Vaccinium oxycoccos*	S5	GREEN	X		X	X	
Lance-Leaf Violet	*Viola lanceolata*	S5	GREEN		X	X	X	X
Smooth White Violet	*Viola macloskeyi*	S5	GREEN	X				

ACCDC Ranking

S1: Extremely rare. S2: Rare. S3: Uncommon. S4: fairly common. S5: Secure. S#S#: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the element (e.g., S1S2). B: Breeding. SH: Historical and suspected to be still extant. SU: Unrankable: Possibly in peril throughout its range in the province, but status uncertain; need more information. SX: Extinct/Extirpated: Element is believed to be extirpated within the province. S?:Unranked: Element is not yet ranked. SZ: Zero occurrences: Not of practical conservation concern in the province, because there are no definable occurrences, although the species is native and appears regularly. NZ: Long distance migrants whose occurrences during their migrations are too irregular (in terms of repeated visitation to the same locations) or transitory.

NSDNR Ranking

Red: Known to be or thought to be at risk. Yellow: Sensitive to human activities or natural events. Green: Not believed too be sensitive, or at risk. Not Assessed: Known or believed to be present in Nova Scotia but yet unassessed. Undetermined: Insufficient data exists to determine status. Exotic: Introduced as a result of human activity.

APPENDIX D

Vascular Plant Cover of Dominant Species Found in the Five Wetlands Surveyed in the Governor Lake Reservoir

Jacques Whitford

Table D1 Vascular Plant Cover of Dominant Species Found in the Five Wetlands Surveyed in the Governor Lake Reservoir

Common Name	Scientific Name	Wetland													
		1a sb	1b sb	1c lss	1d wm	1e wm	2a lss	2b sm	2c sm	2d tss	2e sb	3 fb	4a fb	4b sm	5 sm
Red Maple	*Acer rubrum*									0.5					
Speckled Alder	*Alnus incana*									90					
Red Chokeberry	*Aronia arbutifolia*	1	1												
Blue-Joint Reedgrass	*Calamagrostis canadensis*				35	1	0.5		80	1					5
Hoary Sedge	*Carex canescens*													2	
Leatherleaf	*Chamaedaphne calyculata*	35	2	60	1		65				40	20	25		
Reindeer Lichen	*Cladina rangiferina*		1												
Roundleaf Sundew	*Drosera rotundifolia*												0.5		
Three-Way Sedge	*Dulichium arundinaceum*				15	80		80	10					70	35
Creeping Spike-Rush	*Eleocharis palustris*														5
Black Crowberry	*Empetrum nigrum*		2												
Tawny Cotton-Grass	*Eriophorum virginicum*	1	0.5								15		5		
Green Keeled Cottongrass	*Eriophorum viridicarinatum*												5		
Dwarf Huckleberry	*Gaylussacia dumosa*		30												
Small Floating Manna-Grass	*Glyceria borealis*														10
Canada Manna-Grass	*Glyceria canadensis*							1						5	
Blunt Manna-Grass	*Glyceria obtusa*										1				
Pale St. John's-Wort	*Hypericum ellipticum*													10	
Canada Rush	*Juncus canadensis*													8	30
Sheep-Laurel	*Kalmia angustifolia*	10	2									0.5			
Pale Laurel	*Kalmia polifolia*	5	5	5								0.5			
American Larch	*Larix laricina*	0.5	1												
Common Labrador Tea	*Ledum groenlandicum*	5													
Rice Cutgrass	*Leersia oryzoides*														1
Swamp Loosestrife	*Lysimachia terrestris*					5		5						1	5
Sweet Bayberry	*Myrica gale*	15		15	1		5				10		1	1	
Black Spruce	*Picea mariana*		1												
Eastern White Pine	*Pinus strobus*	0.5													
Rhodora	*Rhododendron canadense*	15													
White Beakrush	*Rhynchospora alba*											5			
Northern Pitcher-Plant	*Sarracenia purpurea*	1									5	2	1		
Pod Grass	*Scheuchzeria palustris*										20				
Tufted Leafless-Bulrush	*Scirpus caespitosus*		30												
Cotton-Grass Bulrush	*Scirpus cyperinus*			0.5	25	5	0.5	25	15					20	20
Bog Goldenrod	*Solidago uliginosa*		0.5												
Sphagnum Moss	*Sphagnum spp.*	70	50	5	80	95		10		5	95	80	95	10	
Narrow-Leaved Meadow-Sweet	*Spiraea alba*						10								
Hardhack Spiraea	*Spiraea tomentosa*						8	0.5						1	1
Marsh St. John's-Wort	*Triadenum fraseri*				10			5		0.5					
Horned Bladderwort	*Utricularia cornuta*											2			
Large Cranberry	*Vaccinium macrocarpon*							5			15			8	
Small Cranberry	*Vaccinium oxycoccos*	1										1	1		

Key:

sb-shore bog; lss-low shrob dominated shore swamp; sm- shore marsh; tss-tall shrub dominated shore swamp; fb-floating bog; wm-wet meadow.

APPENDIX E

Species Composition for the Six Wetlands Surveyed
in the Ruth Falls Flowage Reservoir

Jacques Whitford

Table E1 Species Composition for the Six Wetlands Surveyed in the Ruth Falls Flowage Reservoir

Common Name	Scientific Name	ACCDC Rank	NSDNR Rank	Wetland					
				3	4	7	8	8b	12
Balsam Fir	*Abies balsamea*	S5	GREEN		X		X		X
Red Maple	*Acer rubrum*	S5	GREEN		X			X	X
Rough Bentgrass	*Agrostis hyemalis*	S5	GREEN				X		
Perennial Bentgrass	*Agrostis perennans*	S4S5	GREEN		X			X	
Speckled Alder	*Alnus incana*	S5	GREEN	X	X	X	X	X	X
Shadbush	*Amelanchier sp.*		GREEN		X				
Bog Rosemary	*Andromeda glaucophylla*	S5	GREEN						X
Wild Sarsaparilla	*Aralia nudicaulis*	S5	GREEN		X		X		
Black Chokeberry	*Aronia melanocarpa*	S5	GREEN	X					
Bog Aster	*Aster nemoralis*	S5	GREEN						
Rough-Leaved Aster	*Aster radula*	S5	GREEN		X			X	
Lady-Fern	*Athyrium filix-femina*	S5	GREEN						X
Heart-Leaved Paper Birch	*Betula cordifolia*	S5	GREEN		X		X		
Watershield	*Brasenia schreberi*	S4S5	GREEN	X	X	X	X	X	X
Blue-Joint Reedgrass	*Calamagrostis canadensis*	S5	GREEN			X		X	X
Wild Calla	*Calla palustris*	S4	GREEN	X		X	X		X
Hoary Sedge	*Carex canescens*	S5	GREEN		X				
Little Prickly Sedge	*Carex echinata*	S5	GREEN	X	X	X	X		X
Long Sedge	*Carex folliculata*	S5	GREEN				X		X
Slender Sedge	*Carex lasiocarpa*	S5	GREEN				X		X
Shallow Sedge	*Carex lurida*	S5	GREEN			X	X	X	
Few-Seeded Sedge	*Carex oligosperma*	S4S5	GREEN					X	
A Sedge	*Carex paupercula var. irrigua*	S5	GREEN	X	X	X			
Tussock Sedge	*Carex stricta*	S5	GREEN				X		X
Three-Seed Sedge	*Carex trisperma*	S5	GREEN	X	X	X	X	X	
Bear Sedge	*Carex utriculata*	S5	GREEN			X	X	X	
Leatherleaf	*Chamaedaphne calyculata*	S5	GREEN	X	X	X	X	X	X
Goldthread	*Coptis trifolia*	S5	GREEN		X			X	
Dwarf Dogwood	*Cornus canadensis*	S5	GREEN	X		X	X	X	X
Roundleaf Sundew	*Drosera rotundifolia*	S5	GREEN		X	X		X	
Spinulose Shield Fern	*Dryopteris carthusiana*	S5	GREEN		X	X			
Three-Way Sedge	*Dulichium arundinaceum*	S5	GREEN			X	X	X	X
Trailing Arbutus	*Epigaea repens*	S5	GREEN					X	
Narrow-Leaved Cotton-Grass	*Eriophorum polystachion*	S5	GREEN			X			
Narrowleaf Cotton-Grass	*Eriophorum polystachion ssp. Triste*	SU	GREEN				X		
Tawny Cotton-Grass	*Eriophorum virginicum*	S5	GREEN	X	X	X		X	X
Flat-Top Fragrant-Golden-Rod	*Euthamia graminifolia*	S5	GREEN						
Creeping Snowberry	*Gaultheria hispidula*	S5	GREEN		X			X	
Teaberry	*Gaultheria procumbens*	S5	GREEN	X					
Black Huckleberry	*Gaylussacia baccata*	S5	GREEN			X	X	X	X
Canada Manna-Grass	*Glyceria canadensis*	S5	GREEN			X			
American Mannagrass	*Glyceria grandis*	S4S5	GREEN					X	
Blunt Manna-Grass	*Glyceria obtusa*	S4	GREEN	X	X	X	X	X	X
Fowl Manna-Grass	*Glyceria striata*	S5	GREEN	X	X				X

Table E1 Species Composition for the Six Wetlands Surveyed in the Ruth Falls Flowage Reservoir

Common Name	Scientific Name	ACCDC Rank	NSDNR Rank	Wetland					
				3	4	7	8	8b	12
Black Holly	*Ilex verticillata*	S5	GREEN						X
Blueflag	*Iris versicolor*	S5	GREEN		X	X		X	X
Canada Rush	*Juncus canadensis*	S5	GREEN		X	X	X		
Brown-Fruited Rush	*Juncus pelocarpus*	S5	GREEN	X	X	X	X	X	X
Sheep-Laurel	*Kalmia angustifolia*	S5	GREEN	X	X	X	X	X	
American Larch	*Larix laricina*	S5	GREEN	X	X	X		X	
Common Labrador Tea	*Ledum groenlandicum*	S5	GREEN	X	X	X		X	X
Twinflower	*Linnaea borealis*	S5	GREEN	X	X			X	
Northern Bugleweed	*Lycopus uniflorus*	S5	GREEN				X	X	X
Swamp Loosestrife	*Lysimachia terrestris*	S5	GREEN	X	X	X		X	
Sweet Bayberry	*Myrica gale*	S5	GREEN	X	X		X	X	
Northern Bayberry	*Myrica pensylvanica*	S5	GREEN	X					
Mountain Holly	*Nemopanthus mucronata*	S5	GREEN		X	X	X	X	X
American Water-Lily	*Nymphaea odorata*	S5	GREEN				X		X
Sensitive Fern	*Onoclea sensibilis*	S5	GREEN						X
Cinnamon Fern	*Osmunda cinnamomea*	S5	GREEN	X	X	X	X	X	X
Interrupted Fern	*Osmunda claytoniana*	S5	GREEN						X
Northern Beech Fern	*Phegopteris connectilis*	S5	GREEN		X				
Black Spruce	*Picea mariana*	S5	GREEN	X	X	X	X	X	X
Small Green Woodland Orchid	*Platanthera clavellata*	S5	GREEN		X			X	X
Pickerel Weed	*Pontederia cordata*	S5	GREEN	X	X		X	X	X
One-Side Wintergreen	*Pyrola secunda*	S5	GREEN					X	
Rhodora	*Rhododendron canadense*	S5	GREEN	X				X	X
White Beakrush	*Rhynchospora alba*	S5	GREEN	X	X	X	X	X	X
Bristly Dewberry	*Rubus hispidus*	S5	GREEN	X	X				X
Small Bristleberry	*Rubus setosus*	S4?	GREEN					X	
Balsam Willow	*Salix pyrifolia*	S5	GREEN					X	
Northern Pitcher-Plant	*Sarracenia purpurea*	S5	GREEN	X	X	X	X	X	X
Cottongrass Bulrush	*Scirpus cyperinus*	S5	GREEN	X		X	X		
Water Bulrush	*Scirpus subterminalis*	S5	GREEN		X				
Three-Leaf Solomon's-Plume	*Smilacina trifolia*	S4S5	GREEN	X		X			X
Bog Goldenrod	*Solidago uliginosa*	S5	GREEN	X	X				X
American Bur-Reed	*Sparganium americanum*	S5	GREEN	X	X	X	X		X
Narrow-Leaf Burreed	*Sparganium angustifolium*	S4S5	GREEN		X				X
Narrow-Leaved Meadow-Sweet	*Spiraea alba*	S5	GREEN	X				X	
Hardhack Spiraea	*Spiraea tomentosa*	S5	GREEN			X	X	X	X
New York Fern	*Thelypteris noveboracensis*	S5	GREEN		X			X	
Marsh St. John's-Wort	*Triadenum fraseri*	S5	GREEN		X		X	X	X
Greater Bladder-Wort	*Utricularia vulgaris*	S5	GREEN	X					X
Velvetleaf Blueberry	*Vaccinium myrtilloides*	S5	GREEN			X			
Small Cranberry	*Vaccinium oxycoccos*	S5	GREEN	X	X	X		X	
Possum-Haw Viburnum	*Viburnum nudum*	S5	GREEN	X		X		X	X
Smooth White Violet	*Viola macloskeyi*	S5	GREEN		X				

Table E1 Species Composition for the Six Wetlands Surveyed in the Ruth Falls Flowage Reservoir

Common Name	Scientific Name	ACCDC Rank	NSDNR Rank	Wetland					
				3	4	7	8	8b	12

ACCDC Ranking

S1: Extremely rare. S2: Rare. S3: Uncommon. S4: fairly common. S5: Secure. S#S#: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the element (e.g., S1S2). B: Breeding. SH: Historical and suspected to be still extant. SU: Unrankable: Possibly in peril throughout its range in the province, but status uncertain; need more information. SX: Extinct/Extirpated: Element is believed to be extirpated within the province. S?:Unranked: Element is not yet ranked. SZ: Zero occurrences: Not of practical conservation concern in the province, because there are no definable occurrences, although the species is native and appears regularly. NZ: Long distance migrants whose occurrences during their migrations are too irregular (in terms of repeated visitation to the same locations) or transitory.

NSDNR Ranking

Red: Known to be or thought to be at risk. Yellow: Sensitive to human activities or natural events. Green: Not believed too be sensitive, or at risk. Not Assessed: Known or believed to be present in Nova Scotia but yet unassessed. Undetermined: Insufficient data exists to determine status. Exotic: Introduced as a result of human activity.

APPENDIX F

Vascular Plant Cover of Dominant Species Found in the Six Wetlands Surveyed in the Ruth Falls Flowage Reservoir

Jacques Whitford

Table F1 Vascular Plant Cover of Dominant Species Found in the Six Wetlands Surveyed in the Ruth Falls Flowage Reservoir

Common Name	Scientific Name	Wetland									
		3a ctb	3b ctb	4 sb	6a fb	6b fb	6c ctb	7 sb	11 sb	15a cts	15b ctb
Balsam Fir	*Abies balsamea*								15		
Red Maple	*Acer rubrum*						1		1		1
Speckled Alder	*Alnus incana*	5	0.5	5	10	1				5	
Whorled Aster	*Aster acuminatus*									1	
Bog Aster	*Aster nemoralis*			2					5		
Rough-Leaved Aster	*Aster radula*										1
Blue-Joint Reedgrass	*Calamagrostis canadensis*								20		
Pickering's Reed Bent-Grass	*Calamagrostis pickeringii*										1
Little Prickly Sedge	*Carex echinata*	1	5						15		
Shallow Sedge	*Carex lurida*				35			20			
Few-Seeded Sedge	*Carex oligosperma*										5
A Sedge	*Carex paupercula var. irrigua*					2	5				
Tussock Sedge	*Carex stricta*							5	5		
Three-Seed Sedge	*Carex trisperma*						10			15	
Bear Sedge	*Carex utriculata*					1		10			
Leatherleaf	*Chamaedaphne calyculata*	30	10	20	30	10	10	25	35		15
Reindeer Lichen	*Cladina alpestris*		5								
Dwarf Dogwood	*Cornus canadensis*						2			5	5
Narrow-Leaved Cotton-Grass	*Eriophorum polystachion*				1	20		18			
Tawny Cotton-Grass	*Eriophorum virginicum*	5	5	10			5				0.5
Creeping Snowberry	*Gaultheria hispidula*									1	
Blunt Manna-Grass	*Glyceria obtusa*			0.5							0.5
Brown-Fruited Rush	*Juncus pelocarpus*					3					
Sheep-Laurel	*Kalmia angustifolia*		10							4	5
American Larch	*Larix laricina*		6							1	2
Common Labrador Tea	*Ledum groenlandicum*		15							1	
Swamp Loosestrife	*Lysimachia terrestris*						1				
Sweet Bayberry	*Myrica gale*	10		15	15	2	5	15	5	2	5
Mountain Holly	*Nemopanthus mucronata*	5								2	1
Cinnamon Fern	*Osmunda cinnamomea*	2			1	1				60	15
Black Spruce	*Picea mariana*	15	16	12	0.5	0.5	50	1	12	30	2
Hair-Cap Moss	*Polytrichum juniperinum*		10								
White Beakrush	*Rhynchospora alba*	5		5		15					
Balsam Willow	*Salix pyrifolia*									0.5	
Northern Pitcher-Plant	*Sarracenia purpurea*			1		2					
Cottongrass Bulrush	*Scirpus cyperinus*		1								
Three-Leaf Solomon's-Plume	*Smilacina trifolia*		3								
Bog Goldenrod	*Solidago uliginosa*			2							
American Bur-Reed	*Sparganium americanum*			0.5							
Sphagnum Moss	*Sphagnum spp.*	80	70	90	95	90	95	95	80	90	95
Small Cranberry	*Vaccinium oxycoccos*		1								
Possum-Haw Viburnum	*Viburnum nudum*	8	1								8

Key:
cts-coniferous treed shore swamp; sb-shore bog; fb-floating bog; ctb-coniferous treed shore bog.

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Our File Number: 95100-30-BED-2019-2638165

March 31, 2021

NOVA SCOTIA POWER INCORPORATED
PO BOX 910, 25 LAKESIDE PARK DR
HALIFAX, NS
B3J 2W5

Dear NOVA SCOTIA POWER INCORPORATED

RE: Application # 2019-2638165-00 Sheet Harbour Hydro System – Ruth Falls Dam Refurbishment (Watercourse Alteration)

With reference to your application please be advised that as a result of a third review prompted by Nova Scotia Power's (NSPI) submission on June 22, 2020, your application has been deemed incomplete. As a result, Department of Environment and Climate Change (ECC) is requesting the following information and providing clarification for the items previously requested March 25, 2020 to process your application (items previously requested in **Bold,** lettered items are required to be submitted to ECC, non-labeled items are explanation and information).:

1. **Provide design drawings to record of the proposed works, their methods, and mitigations used.**
   a. If NSPI does not have the necessary information (as indicated in NSPI response June 22, 2020) because it will be developed by the contractor, then submit the application for ECC review when all information is available.

2. **What considerations and contingencies will be available to NSPI to ensure construction completion in November given the potential impacts from COVID-19?**
   a. Submit an updated construction schedule to ECC.

3. **Provide a detailed water management plan including: construction staging including cofferdam placement and dewatering and maintenance of flows, contingency plans for high precipitation events, and erosion and sediment control. The detailed water management plan is to be determined by qualified professional engineers (s) licensed to practice in Nova Scotia.**

The applicant is including statements of 'potential' and 'current plans'. The approval would be considered based on the information provided.
The information provided in NSPI submission on June 22, 2020 does not demonstrate how construction debris, access & safe work area, and materials will not enter the watercourse or otherwise negatively impact the environment.
For such a large project with high potential for environmental impacts, a clear and detailed description of scope of works at each major stage of construction is necessary

in order to assess environmental risk and review that appropriate mitigations are in place related to the proposed activity.

a. If NSPI does not have the necessary information (as indicated in NSPI response June 22, 2020) because it will be developed by the contractor, then submit the application for ECC review when all information is available.

4. **NSPI has confirmed work is proposed to occur outside of the Timing Window for watercourse alteration (per letter dated February 27,2020). Work is therefore proposed to occur in seasons with higher than standard precipitation and flow as well as season when extreme events are more common. A description of how high flow scenarios will be managed is requested: including the free overflow spillway, and how this may be addressed in erosion and scour protection planning. Additional description of the proposed works, and the scope of potential impact by the proposed works, is sought specifically with respect to erosion and sediment control and temporary works construction and removal.**

a. Submit to ECC additional description of the proposed works, and the scope of potential impact by the proposed works, specifically with respect to erosion and sediment control and temporary works construction and removal.

While extreme events are expected to be managed through the gates at Malay falls, inflows from Grant River are not controlled by Malay Falls. It is typical that construction flow management demonstrate ability to accommodate a 1:2 year event in the watershed.

b. Given a 1:2 year event in the Grant River Watershed, and maintaining a 45 cfs required flow from Malay Falls, submit to ECC a plan demonstrating that water management and erosion and sedimentation control plans are adequately prepared to accommodate these conditions.

Contrary to the application submitted, the activities at this site include atypical conditions where “standard” erosion and sedimentation control measures will not function. For example, the stated reliance on silt fence seems to not be feasible for the majority of the work area, due to the presence of rock.

c. Submit an erosion and sedimentation control plan to ECC. This is a requirement under the Watercourse Alteration Application Checklist.

5. Confirm that proposed high level water management approach described in the Application is still the intended approach (closing gates at Malay and lowering primarily through generation at Ruth Falls and a subsequent staged removal of stop logs). NSPI noted in letter to DFO that drawdown work is expected to be completed in a single day.

a. Update the application as identified under other items.

It is recommended the applicant submit a single updated and detailed package to expedite review by ECC.

6. Will velocities downstream of the system during drawdown exceed current typical operations and create risk of downstream erosion and scour?

a. Demonstrate to ECC how during drawdown the velocities downstream of the system will not exceed current typical operations.

7. In order to monitor and address potential impacts, monitoring pre-, active, and post construction periods will be needed. Water quality monitoring is recommended to be able to demonstrate comparison with the Canadian Council of Ministers of the Environment water quality guidelines for the protection of freshwater aquatic life, turbidity and total suspended solids criteria. Provide a proposed methodology to accomplish appropriate water quality monitoring.

8. Information to date has only been provided with respect to fish. Provide similar discussion on potential impacts to other aquatic organisms and habitat that may be affected by the drawdown, and associated mitigation measures to reduce these potential negative impacts. For example, describe the presence and potential alteration of wetlands.

a. Submit to ECC a monitoring program for the wetlands upstream of the reservoir which may be impacted due to the drawdown.

9. Please update and provide further information on public engagement and consultation as related to these works that may now be available.

a. Continue to provide updated information on communications. NSPI June correspondence indicated a 'planned' Open House for instance.

NSE is requesting this information be submitted by June 30, 2021. Please note that in accordance with *Section 7 of the Approval and Notification Procedure Regulations,* if information is not supplied by an applicant within 3 months of a request, the Minister may reject your application. Should your application be rejected, you will be informed of that decision in writing.

Yours truly,
Krista Ogletree



cc: Nadine Thomas

Nova Scotia POWER
An Emera Company

Addendum

Sheet Harbour Hydro System

Ruth Falls Dam Refurbishment

2021 Construction and Monitoring Activities

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1.0 INTRODUCTION

Nova Scotia Power Incorporated (NS Power) is proposing construction activities in 2021 at the Ruth Falls Dam, located in Sheet Harbour NS, on NS Power's Sheet Harbour Hydro System. In December 2019, NS Power submitted a watercourse alteration approval application to the NS Department of Environment and Climate Change (ECC) for the Ruth Falls Dam Refurbishment Project (the Project); this addendum is to support ECC's letter to NS Power pertaining to NS Power's application (#2019-2638165-00), dated March 31, 2021, indicating NS Power's application remains incomplete.

The following sections provide additional information pertaining to ECC's information requests outlined in the March 31, 2021 letter. Below is a summary of ECC's information requests with the corresponding section within this addendum addressing the request.

1. **Provide design drawings to record of the proposed works, their methods, and mitigations used.**

   The most recent engineering drawings for the Project are provided in Appendix A; additional information pertaining to NS Power's proposed construction sequencing and water management plan is provided in Sections 4.1-4.4 and Appendix B.

   The engineering drawings provided in Appendix A are at 95%; no material changes from 95% to Issued for Construction drawings (IFCs), are anticipated. It is NS Power's position that the 95% drawings sufficiently demonstrate the proposed refurbishment activities to Ruth Falls Dam and any associated environmental impact. NS Power requests that a condition be incorporated into the Approval, if issued, for NS Power to provide the stamped IFCs prior to construction for the Project starting.

2. **What Considerations and contingencies will be available to NS Power to ensure construction completion in November given the potential impacts from COVID-19?**

   NS Power has provided a revised construction schedule in Section 2.2. NS Power is requesting a delayed construction start to accommodate the upstream alewife migration and fish spawning windows, as well as delayed construction completion date to accommodate the delayed start and potential weather related delays.

   NS Power has worked diligently in 2020 to develop protocols for contractor safety and pandemic planning to complete hydro refurbishment (and other capital) projects under Public Health restrictions due to COVID-19. Several projects in 2020 were successfully completed or successfully advanced under current COVID-19 restrictions, with no significant safety or environmental incident. The protocols in place allow for evolving standards and various levels of restrictions. The schedule developed for the Project takes into consideration NS Power's internal protocol and the likelihood of COVID-19 restrictions still being in place throughout construction.

3. **Provide a detailed water management plan including: construction staging including cofferdam placement and dewatering and maintenance of flows, contingency plans for high precipitation events, and erosion and sediment control. The detailed water management plan should be determined by qualified professional engineer(s) licensed to practice in Nova Scotia.**

   The water management and construction sequencing plan for the Project can be found in Appendix B and additional information on water management, contingency planning and erosion and sedimentation control is provided in Sections 4.1-4.4. The detailed water management plan was developed by the Project lead engineer, who is licensed to practice in NS.

4. **NSP has confirmed work is proposed to occur outside of the Timing Window for watercourse alteration (per letter dated February 27, 2020). Work is therefore proposed to occur in seasons with higher than standard precipitation and flow as well as season when extreme events are more common. A description of how high flow scenarios will be managed is requested: including the free overflow spillway, and how this may be addressed in the erosion and scour protection plan. Additional description of the proposed works, and the scope of potential impact by the proposed works, is sought specifically with respect to erosion and sediment control and temporary works construction and removal.**

   The water management and construction sequencing plan for the Project can be found in Appendix B and additional information on water management, contingency planning and erosion and sedimentation control is provided in Sections 4.1-4.4.

5. **Confirm that proposed high level water management approach described in the application is still the intended approach (closing gates at Malay and lowering primarily through generation at Ruth Falls and a subsequent staged removal of stop logs). NSP noted in letter to DFO that drawdown work is expected to be completed in a single day.**

   Additional information on water management during the drawdown is provided in Section 4.1.

6. **Will velocities downstream of the system during drawdown exceed current typical operations and create risk of downstream erosion and scour?**

   Additional information on water management during the drawdown is provided in Section 4.1.

7. **In order to monitor and address potential impacts, monitoring pre-, active, and post-construction periods will be needed. Water quality monitoring is recommended to be able to demonstrate comparison with the Canadian Council of Ministers of the Environment water quality guidelines for the protection of freshwater aquatic life, turbidity and total suspended solids criteria. Provide a proposed methodology to accomplish appropriate water quality monitoring.**

   Additional information on water quality monitoring is provided in Section 4.5.

8. **Information to date has only been provided with respect to fish. Provide similar discussion on potential impacts to other aquatic organisms and habitat that may be affected by the drawdown, and associated mitigation measures to reduce these potential negative impacts. For example, describe the presence and potential alteration of wetlands.**

   Additional information on wetland and rare species monitoring is provided in Section 4.6.

9. **Please update and provide further information on public engagement and consultation as related to these works that may now be available.**

   An update on Mi'kmaq and public engagement is provided in Section 5, 6 and 7.

2.0 CONSTRUCTION

2.1 Proposed Construction Activities

The following construction activities are proposed for the Project:

1. Lowering of Ruth Falls Headpond from full supply level (FSL) of elevation 109.4 ft (33.3 m) to elevation 98.0 ft (29.9 m). The majority of the drawdown will take place through the deep stoplog bays on the existing dam. Refer to Section 4.1 for more information on drawdown methodology.
2. During the lowering of Ruth Falls Headpond, the Ruth Falls fish ladder will be non-operational. NS Power is proposing to delay the drawdown until early July, after the upstream alewife migration and the majority of fish spawning windows. The Ruth Falls fish ladder will be dewatered and a fish rescue conducted to move any stranded fish to the headpond. A fish rescue will also be conducted in Ruth Falls Headpond during and after the drawdown to monitor for stranded fish.
3. Installation of a temporary cofferdam/access path on the upstream side of the existing dam, once the headpond is dewatered. The cofferdam/access path will be constructed on either side of the deep stoplog bays and will not block the deep sluiceway bays. This will consist of clean rockfill material.
4. Installation of a temporary access path on the downstream side of the existing dam, across the existing spillway channel. The majority of the access path will be on dry land connecting form the existing site access road; a portion of the access path will cross over the existing spillway channel in order to access the west side of the existing dam.
5. A section of existing concrete dam will be notched out to construct a downstream bypass for water management. Refer Section 4.2 for more information. The bypass will be used to provide the required 35 cfs maintenance flow, as well as to maintain water flow through the dam to maintain construction elevations.
6. Placement of sandbags on the upstream and downstream sides of the bypass to divert water, as required.
7. Removal of existing stoplogs, piers and walkway; the deep stoplog bays will be a focus during the summer months to allow for the new vertical lift gates to be operational during fall inflows.

8. Installation of stoplogs/other metal sheeting in existing deep stoplog bays will be undertaken to isolate the existing sluiceway section.
9. Refurbishment of the existing sluiceway to accommodate three low level sluice gates. Existing sluiceway piers will remain in place.
10. Installation of low level sluice gates and associated operators.
11. Reface existing concrete on the crest and downstream slope of the main dam ogee sections.
12. Installation of new rubber dam bladders on the crest of the existing ogee spillway sections.
13. Construction of a free overflow spillway section at the west end (right looking downstream) of the main dam.
14. Replacement of the west retaining wall, to the west of the free overflow spillway section.
15. Removal of temporary cofferdam/access path material.
16. Watering of Ruth Falls Headpond to normal operating levels.

NS Power has considered the potential environmental and archaeological risks associated with the lowering of Ruth Falls Headpond and believes that with implementing the mitigation measures discussed in the following sections of this application, the proposed approach is the safest for its employees and contractors. NS Power has evaluated whether the use of bulkheads, barges, work platforms or larger cofferdams would be an appropriate alternative, and has determined that these scenarios present significant safety risk, potential quality issues and scheduling risks to the Project should the methodologies not be sufficient in providing safe access to work areas. NS Power considers the lowering of Ruth Falls Heapdond to be the safest and most efficient solution to undertake the Project.

The 95% engineering drawings can be found in Appendix A. Refer to Appendix B for the construction sequencing and water management plan.

2.2 Construction Schedule and Sequencing

The Project is planned to start in May/June with the construction of the on-land portion of the downstream access path, the construction of the laydown area, and the stockpiling of clean rockfill material for use in the cofferdams/access paths. No instream work, or construction activities on the Ruth Falls Main Dam proper will take place until all required approvals are in place.

Following receipt of required approvals, the Ruth Falls Headpond will then be drawn down in early July 2021. Following the drawdown, the remaining portion of the temporary downstream access path and upstream cofferdams/access path will be constructed.

Following the construction of the temporary access paths, work will begin on the existing main dam and sluiceway structure with demolition of the deck and piers beginning form the east side of the dam. Chipping of the existing spillway surface will also be part of the demolition phase as well as the removal of the downstream retaining wall at the right abutment.

Concurrently during the demolition activities, the construction work will begin with the installation of the vertical lift gates. The three-low level stoplog sections will be isolated using stoplogs placed in the most upstream stoplog gains. If stoplogs are not available for use, reinforced steel sheeting may be used to block the flow of water. When the reservoir is at 98 ft, there will be approximately 8 ft of water on the upstream side of the deep stoplog bays to hold back. The existing stoplog slots will be chipped and prepped for the installation of the gate frames. Once the gate frames are placed and the headwalls are constructed, the gate frames are grouted into place. The operators and supports will be installed on the sluiceway deck.

NS Power will endeavor to complete the refurbishment of the new sluiceway structure during the summer months (prior to October 31) to allow for the operation of the new vertical lift gates as the primary water management strategy for the fall/winter months. In practice, work on the main dam and sluiceway will be taking place in parallel.

Following the demolition activities, the spillway overlay will begin with the installation of the rebar, embedded parts, and rubber dam air lines. Concrete will be placed to reform the spillway surface. New concrete priers will be constructed, and the sluiceway deck will be extended in the downstream direction and raised to accommodate the new rubber dam controls building. The controls building will be constructed off site and will be placed on the deck with a crane at the appropriate time.

A free overflow concrete spillway section will be constructed at the right end of the dam. Once the concrete spillway surfaces and piers are complete, the installation of the seven (7) rubber bladders will begin. The rubber bladders are bolted in place with clamping plates attached to the embedded parts and the bladders are attached to the air lines. The rubber dam controls will be installed in the controls building.

Work is proposed to extend until March 25, 2022 to accommodate shorter days, potential weather-related delays, and slower concrete curing during the winter months. NS Power will ensure Ruth Falls Heapdond is raised to its normal operating level prior to the 2022 upstream alewife migration (April 1). A total construction period of 8-9 months is anticipated.

3.0 REGULATORY PERMITS/APPROVALS

In addition to the Watercourse Alteration Approval required in accordance with Section 5(A)(1)(c) of the Activities Designation Regulations of the *Environment Act*, an authorization under Section 35(2)(b) of the *Fisheries Act* is required for the revised scope of work.

A variance to the Sheet Harbour Hydro System Water Approval (#2008-062826-01) for water withdrawal/storage will also be required in order to carry out the proposed scope of work. This includes a variance for the Ruth Falls fishladder, which will be non-operational throughout construction and minimum water elevations for the period of April 1-November 30th for Ruth Falls Headpond.

An authorization in accordance with Transport Canada's Navigation Protection Program is also required for construction activities for the Project.

No other provincial or federal permits or authorizations are anticipated for the Project.

4.0 ENVIRONMENTAL PROTECTION

4.1 Drawdown Methodology

NS Power intends to approach the drawdown of Ruth Falls Headpond the same way as all previous drawdowns conducted on its various hydro systems. Based on operational experience, the drawdown of Ruth Falls to elevation 98.0 ft is anticipated to take 1-2 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized.

The Ruth Falls generating units will be used to initially lower the headpond elevation to 109.4 ft, after which the drawdown will be completed using the Ruth Falls main dam stoplog bays. This is to prevent fish from passing downstream through the generating units once the bypass in the canal becomes non-operational (it is unknown at what elevation the bypass becomes less optimal/non-operational). The drawdown will begin by removing the top 2-3 stoplogs from several of the stoplog bays to achieve a discharge through the dam that is equivalent to generation at one of the Ruth Falls units (approximately 500 cfs) following NS Power's spill calculations. Depending on the length of time the headpond takes to lower to the next level of stoplogs, NS Power may increase the number of stoplogs pulled to achieve a discharge equivalent to both Ruth Falls generating units (1,000 cfs). If the drawdown is proceeding as scheduled with a discharge of 500 cfs, NS Power will continue to draw down following this method.

Once the elevation of Ruth Falls Headpond has reached the crest of the highest stoplogs in the stoplog bays, another 2-3 stoplogs will be pulled to continue to draw down the Headpond. The drawdown will continue in this manner until the desired elevation of 98.0 ft is reached. Thus, discharge into the spillway will not exceed 1,000 cfs at any given time (with the exception of leakage through the other bays of the main dam).

NS Power is not anticipating any additional impacts with respect to erosion/scour and sedimentation during the drawdown. If in the extremely unlikely event scour is observed immediately downstream of the dam during the drawdown, NS Power will report the occurrence to ECC and make necessary repairs in order to stabilize the area.

A spill in excess of 500 cfs is an extremely common occurrence at the Ruth Falls dam (equivalent of one generating unit). This is because the elevation of Ruth Falls Headpond is kept at minimum of 109.4 ft for the majority of the year (April-November) for optimal operation of the fish ladder and louvers and there is negligible storage capacity in Ruth Falls Headpond. Hydro Operations has confirmed that spill in excess of 500 cfs is very common, and a spill in excess of 1,000 cfs (equivalent to both generating units running) is common with 6-12 occurrences annually.

4.2 Water Management and Control

Once the desired construction elevation of 98.0 ft is reached, work will begin on the temporary upstream cofferdam/access paths. Cofferdams will be constructed to elevation 100.0 ft (30.5 m) with a crest width of 12.0 ft (3.6 m) and a slope of 1H:1V using clean rock material that is free of fines, geotextile fabric and a poly liner on the upstream side. Using available bathymetry, approximately 74% of the upstream

cofferdam/access path will be placed in the dry at an elevation of 98.0 ft. It is expected that elevations in Ruth Headpond will fluctuate throughout construction due to inflows from Malay Falls as well as uncontrolled inflows from Grant River watershed. The use of these cofferdams will allow for Ruth Falls Headpond to rise to elevation 100.0 ft before additional water control measures are required.

It is expected that at minimum, natural inflows from Grant River Watershed, which is uncontrolled by NS Power, as well as required maintenance flows and spill over the rubber dams (when required) from Malay Falls would be managed through the construction site. NS Power may generate at Malay Falls to continue to pass water through the system and maintain required water levels in the upper reservoirs. This will only be completed to a level that is manageable at the construction work area and with oversight from the NS Power lead engineer and Hydro System Superintendent.

To maintain water passage through the main dam during construction, a bypass will be installed approximately 65 ft from the west end of the deep stoplog bays. The bypass is intended to provide water passage during Phase I when the sluiceway is under construction. The bypass will be created by removing a section of concrete from the dam approximately 10 ft wide and down to elevation 96.0 ft (29.3 m). The upstream cofferdams will be installed to accommodate the bypass. The estimated discharge flows through the bypass, assuming a 10 ft wide opening and a 0.1% slope is shown in Table 1:

Table 1: Estimated Discharge Flows by Bypass

Reservoir Elevation (ft)	Discharge (cfs)
98	620
100	1,460

Following the drawdown of Ruth Falls Headpond, the remaining section of the downstream access for the site will be completed. To cross the existing spillway channel, clean rock material that is free of fines will be placed across the spillway to construct a road 12 ft wide at 1H:1V slope. Geotextile and an upstream poly liner will also be used. Two (2) 5 ft diameter HDPE culverts will be placed in the main flow of the channel to accommodate discharge through the bypass. Sandbags may be used to divert flows to the culverts, as necessary when the bypass is in use. NS Power acknowledges that the bypass alone will be insufficient to pass larger inflows should a larger return period event occur. Further discussion on water management contingency measures can be found in Section 4.3.

Phase II of the water management strategy has been developed for periods of expected higher inflows. Once the sluiceway gates are installed and operational, water management will switch to the use of the gates as the primary method of passing water. The estimated discharge flows from the new vertical lift gates are found in Table 2. Gates will be adjusted in the field based on the inflows and discharge requirements. Based on a typical 1:20-year return period flood for a construction season, with a peak flow of 11,946 cfs (modelling is based onthe headpond at full supply level) and the gates operational, the reservoir could be maintained at approximately El. 100 ft with all three gates fully open.

Table 2: Estimated Discharge Flow from New Vertical Lift Gates (estimated based on full open position).

Reservoir El.	98 ft	100 ft	102 ft	104 ft
Outer Gate 1	1,544 cfs	2,874 cfs	4,453 cfs	6,246 cfs
Outer Gate 2	1,544 cfs	2,874 cfs	4,453 cfs	6,246 cfs
Middle Gate	4,453 cfs	6,246 cfs	8,232 cfs	10,392 cfs
Totals	7,541 cfs	11,994 cfs	17,138 cfs	22,884 cfs

Appendix B provides a drawing of the proposed water control structures for construction.

4.3 Contingency Planning

Table 3 demonstrates the statistical flood peaks for the Ruth Falls Main Dam, from the 2008 Sheet Harbour Hydro System Flood Study.

Table 3: Instantaneous Flood Peaks for the Tusket River

Return period (years)	Instantaneous Flow Peaks (cfs)
2	5,850
5	8,340
10	10,130
20	11,940
50	14,430
100	16,420
1000	24,220

The instantaneous flood peaks outlined in Table 3 take into consideration inflows from the Grant River, which was included in the 2008 flood study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

The primary means of water management for the Project is the lowering of Ruth Falls Headpond to elevation 98.0 ft. For phase I of the water management strategy, temporary upstream cofferdams have been designed to withstand a rise to elevation 100 ft; however, it is unknown how much instantaneous inflow would result in a rise in elevation from 98.0 ft to over 100 ft as there is no storage curve for Ruth Falls Headpond (due to lack of storage). It is possible that, given that Ruth Falls Headpond is relatively small with no storage, that this could occur for a 1:2-year return period event. Should unexpected inflows be received during Phase I of water management execution, NS Power will implement contingencies to safely pass water. This may include the addition of sandbags on the upstream crest of the cofferdams to accommodate increased water levels, or the use of one or more of the existing deep stoplog sluiceway bays to pass additional water. If extreme heavy rain or significant sustained inflows are forecasted, NS Power will develop a plan to accommodate the expected increased inflows and make adjustments to construction, if needed, to allow for the use of the stoplog bays. This may involve removing stoplogs/steel

sheeting and prepping the gate check to safety pass water. Since the existing structure is being modified, rather than a new structure constructed, NS Power can revert to the use of stoplog bays, if necessary (existing stoplog bays are of similar dimension and discharge capacity as the new vertical lift gates), with minimal planning time.

For Phase II of water management execution, the new vertical lift gates will be used to pass water and have been designed to withstand a 1,000 year return period event. As outlined in Section 4.2, the new gates can sustain a rise in elevation to 100 ft for a 1:20 return period event; should more significant sustained inflows or a higher return period flood event be forecasted, NS Power will develop a plan for additional contingency, which may involve removal of any sandbags and armouring of the upstream cofferdam/access path to accommodate a breach. Upstream cofferdams will consist of only clean rockfill material; if in the event some migration of material is observed the associated risk of sedimentation is extremely low. NS Power will assess for any cofferdam material migration once water levels have receded.

If during Phase I or II of water management execution, significant discharge is anticipated downstream of the dam, NS Power may make adjustments to the downstream temporary access road to accommodate the additional flows. This may involve the removal of access road material and prepping sections of the access road to allow water to pass safely beyond it. The downstream cofferdams consist of only clean rockfill material; if in the event some migration of material is observed, the associated risk of sedimentation is extremely low. NS Power will assess for any cofferdam material migration once water levels have receded. Since Ruth Falls Headpond will be drawn down to 98.0 ft, NS Power has the ability to attenuate water in order to implement contingency measures, if necessary.

NS Power is not anticipating any issues with erosion or scour when passing the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. NS Power Project personnel will remain in regular contact with Hydro Operations personnel throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

4.4. Erosion and Sedimentation Control

NS Power is anticipating minimal impacts to the surrounding environment with respect to erosion, scour and associated sedimentation of watercourses. The proposed scope of work for the Project involves minimal excavation of soil material, as the focus of construction is the refurbishment of the existing concrete dam structure. The primary method of erosion and sedimentation control is the water management strategy outlined in Section 4.2 and 4.3.

There will be some excavation of the west abutment retaining wall that is scheduled for removal and replacement (refer to Appendix C for engineering drawings showing the west retaining wall). During construction activities for the retaining wall, silt fencing will be used along the boundary of the spillway bank to protect the adjacent spillway channel. The excavation for the retaining wall is anticipated to be small and as such, soil material will not be exposed for a significant length of time. Pumps will be used to keep the retaining wall work area dry and any silt laden water will be pumped to the west of the dam in an area designated as acceptable to filter water prior to re-entry into a watercourse. Hay will be used to

cover any temporarily exposed work areas. Based on initial scoping of surrounding lands, NS Power has identified to potential areas to be used for water filtration areas or installation of sediment traps. One area is immediately west of the Ruth Falls Dam and the other is located north east of the dam (Figure 1). Both of these areas are on NS Power property and have been evaluated for possible wetland/rare species habitat. Both of these areas are forested and provide suitable vegetation to aid in water filtration. Additional field scoping will be completed to confirm areas to be used and method of water filtration.



Figure 1: Potential locations for water filtration to support pumping activities. Areas to be field verified in spring 2021.

Silt fencing will also be used adjacent to the portion of the downstream access path that is on dry land, to capture any sediment and prevent it from entering the spillway channel. As no excavation for the temporary access path is required, and material will be rock that is free of fines, NS Power is not anticipating a high risk of sediment transport as a result of construction, use and removal of the road. Any use of silt fencing will be monitored periodically for sediment build up and will be cleaned, as necessary.

All cofferdam material will be clean, appropriately sourced rock material that is free of fines, to significantly reduce potential sedimentation of the upstream and downstream work areas. Rockfill cofferdams have been used by NS Power on other hydro refurbishment projects and have proven to have little effect on sedimentation of the surrounding watercourse, even during periods of high inflows/discharge. Pumps will be used, as required, to assist with removing any silt laden water, which will be pumped to a designated area.

NS Power will evaluate the use of silt curtains downstream during the construction of the downstream access path – silt curtains are applicable for still or very slow moving water, but can assist in providing areas where any silt-laden water can be pumped out using negative pressure.

The removal of cofferdam material will take place with Ruth Falls Headpond a elevation 98 ft, which will allow for visual observation of the majority of material being removed. The filling of Ruth Falls Headpond will be completed using a combination of natural inflows, inflows from Malay Falls, and if there is insufficient inflow, some generation using Malay Generating Station. As such, the headpond is expected to fill slowly in a controlled manner; NS Power will be on site to monitor for any potential sedimentation as a result of re-watering activities.

The chosen contractor to complete refurbishment activities will be required to submit a site-specific erosion and sedimentation control plan designed for the planned scope of work. This will include identification of any additional site-specific controls required and location of any water filtration operations or requirements for sediment traps for pumping activities. NS Power would request that, if required, a condition be incorporated into the Approval, if issued, for NS Power to provide a site-specific plan to confirm the above outlined measures prior to construction activities starting.

4.5 Water Quality

Ruth Falls Headpond is a relatively small, shallow headpond with depths of up to 26.2 ft (8 m) in the deepest parts. Water quality of the headpond is heavily influenced by inflows from the Grant River Watershed as well as by the East River and its tributaries.

NS Power conducts water quality surveys as part of the hydro relicensing program, the process by which the water approvals for storage/withdrawal are renewed for each hydro system. Relicensing studies for the Sheet Harbour Hydro System were completed in 2017 in preparation for the relicensing of this system. The water quality surveys completed for Ruth Falls Headpond show acidic conditions with an in-situ pH range of 4.43-4.52, presence of phosphorus and chlorophyll and good conductivity. Based on these results, Ruth Falls Headpond is classified as meso-eutrophic or eutrophic. A small thermocline was observed at 3.2 ft (1 m) depth; however, dissolve oxygen remained consistent to sample depth 19.7 ft (6 m).

Using available bathymetry for Ruth Falls Headpond, approximately 0.5 miles square (1.3 km^2) of total shoreline will be exposed as a result of a drawdown to 98.0 ft from FSL. The majority of shoreline to be exposed is very shallow under normal FSL of 109.4 ft, with depths of less than 9.8 ft (3 m). At an elevation of 98.0 ft, Ruth Falls Headpond will look similar to pre-inundation conditions of the East and Grant Rivers (Figure 2). It is unknown how the drawdown of approximately 11 ft for a period of 9 months will influence water quality; however, it is expected that inflows from Grant River, and small inflows from Malay Falls will provide continuous oxygenated water to Ruth Falls Headpond throughout the drawdown. It is unknown how much inflow is contributed by the Grant River Watershed.

As such, NS Power proposes to complete monthly water quality sampling from a deeper area of the headpond, to compare various water quality parameters with those observed under normal operation. NS Power will use the location of the water quality sample site used during the 2017 relicensing of the

Sheet Harbour Hydro System for direct comparison to normal operating conditions. Water quality sampling will be completed from July to October for temperature, dissolved oxygen, total suspended solids and turbidity.

In addition to monthly water quality sampling in accordance with the CCME water quality guidelines for aquatic life, NS Power will also complete construction monitoring for water quality for total suspended solids to ensure compliance to standard Approval conditions. This will involve establishing a background sample during normal and high inflow periods and comparison to weekly water sampling at a location downstream of the Ruth Falls Main Dam for TSS.

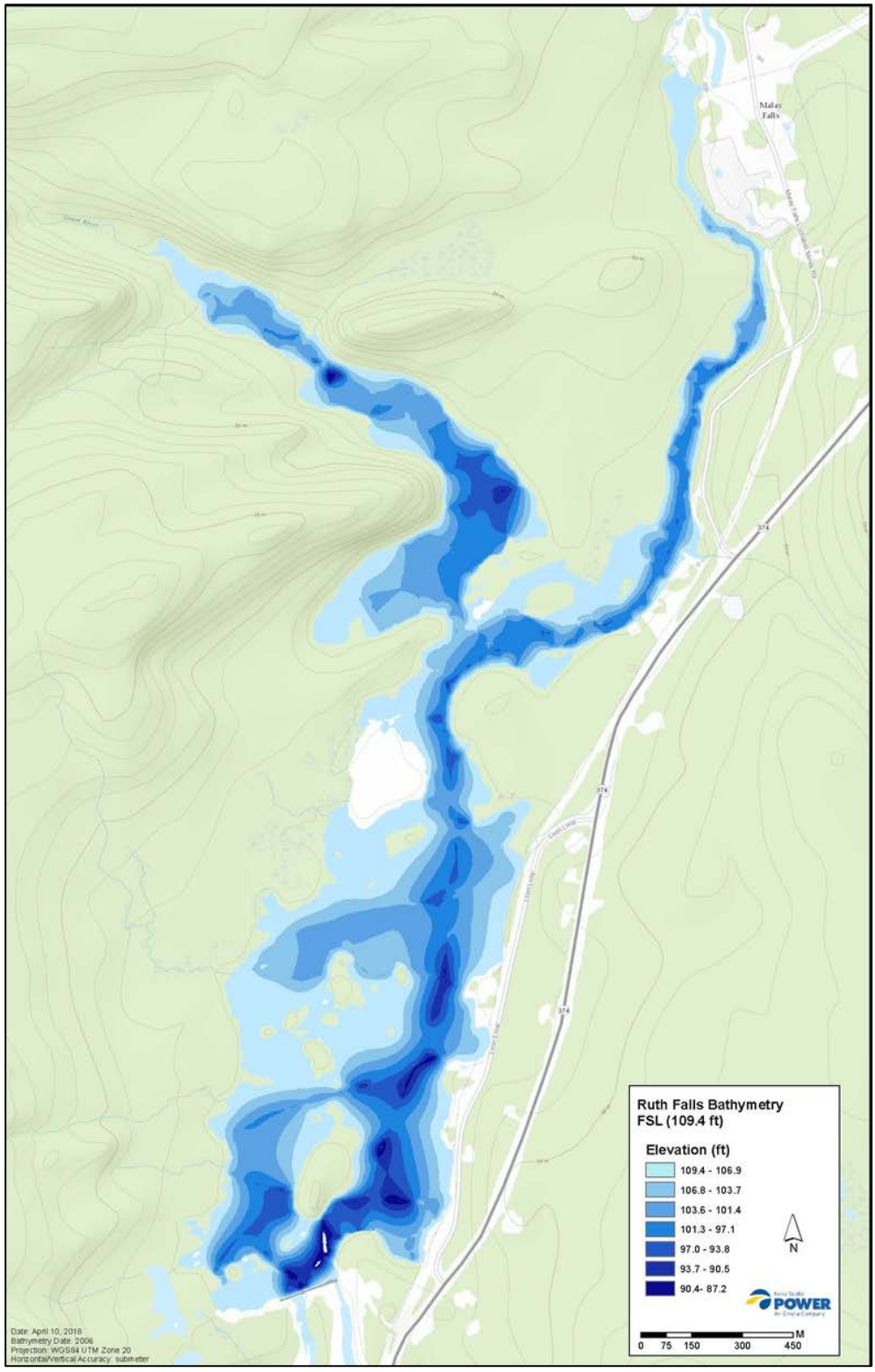


Figure 2: Bathymetry for Ruth Falls Headpond

4.6 Wetlands and Rare Plants

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. Twenty-one (21) wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey (Figure 3). In cross referencing the mapped wetlands during the 2007 with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Main Dam was not identified during the 2007 survey (Figure 4). For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond. Table 4 shows the type of each wetland mapped in 2007; 6 of the 21 wetlands identified at the time of the survey where characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extends periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered.

Table 4: Wetlands Found Within the Littoral Zone of Ruth Falls Headpond.

Wetland ID Number	Wetland Type	Wetland Description
1	Coniferous treed shore bog	No
2	Coniferous treed shore bog	No
3	Coniferous treed shore bog (two subtypes)	Yes
4	Shore bog	Yes
5	Shore bog	No
6	Wetland complex composed of coniferous treed shore bog and floating bog (two subtypes)	Yes
7	Shore bog	Yes
8	Shore bog	No
9	Shore bog	No
10	Shore bog	No
11	Shore bog	Yes
12	Shore bog	No
13	Shore bog	No
14	Shore bog	No
15	Wetland complex composed of coniferous treed shore bog and coniferous treed shore swamp	Yes
16	Coniferous treed shore bog	No
17	Shore bog	No
18	Coniferous treed shore bog	No
19	Shore bog	No
20	Shore bog	No
21	Shore bog	No

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. In examining the ACCDC search completed in 2017 for the previous relicensing of the Sheet Harbour Hydro System, 4 records of potentially rare or endangered species are found in close proximity to Ruth Falls Headpond (Figure 4). There are two records of Salted shell lichen (*Coccocarpia palmicola)* located in a wetland on the northwest portion of the headpond, which appears to be hydraulically connected by a small stream. Salted shell lichen is listed as secure within the NS General Status Rank. There are also two records of Ruby-crowned Kinglet (*Regulus calendula*) on the east side of the headpond

along the Lochaber Mines Road. Ruby-crowned Kinglet is listed as Sensitive within the NS General Status Rank. Neither of these species are anticipated to be impacted by the drawdown of Ruth Falls Headpond.

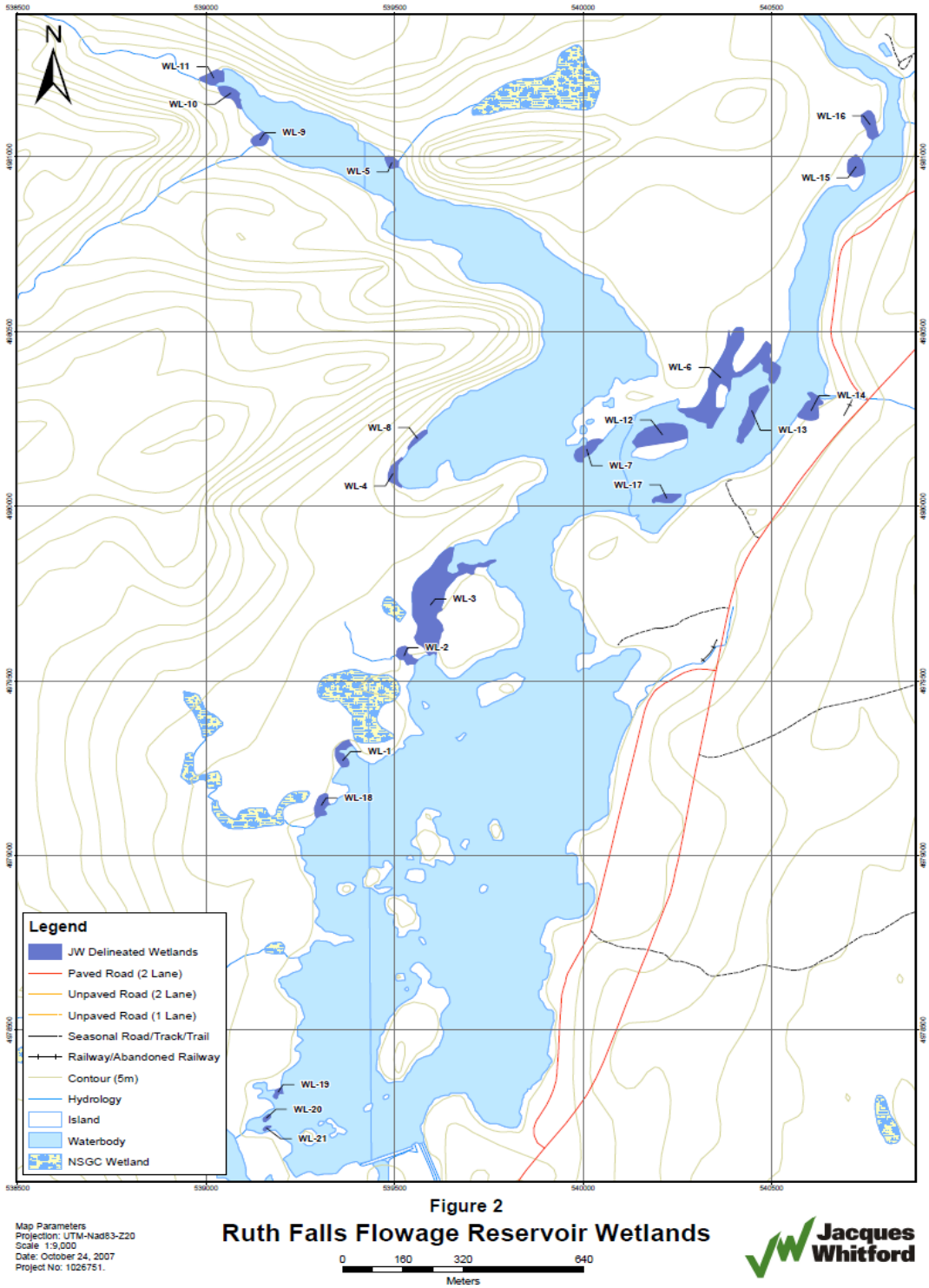


Figure 3: Mapped wetlands on Ruth Falls Headpond (2007).

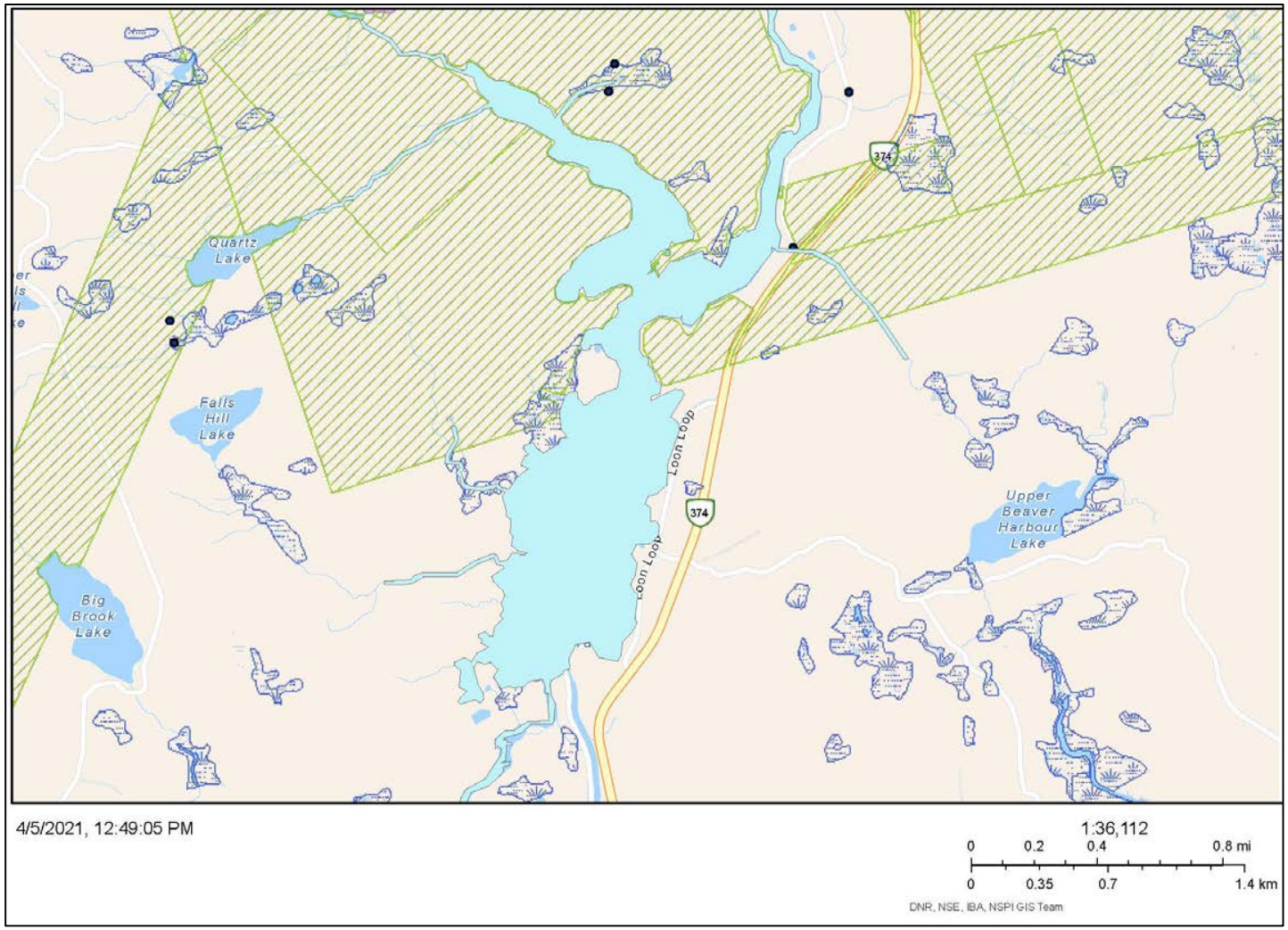


Figure 4: NS Department of Lands and Forestry Wetland Inventory Mapping and ACCDC Search Points

Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown (9 months), NS Power is not anticipating long term impact to species composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of Ruth Falls for a 9 month period is unknown.

While no permanent long-term alterations to the wetlands on Ruth Falls Headpond are anticipated, NS Power proposes to contract a third party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels and water levels throughout the duration of the Project. NS Power has recently developed a wetland monitoring plan, working with a qualified consultant, for the Tusket Main Dam Refurbishment Project, which involves a similar drawdown of the headpond and potential impacts to a similar density of littoral zone wetlands; this plan was reviewed and approved by NSE, thus NS Power is proposing to use this plan as a basis for monitoring at Ruth Falls. This includes:

- An updated desktop assessment, using an updated ACCDC search and available provincial data to verify potential wetland locations identified in the 2007 survey.
- Establishing monitoring stations on a select sample of wetlands. for the Tusket monitoring plan, 8 representative wetlands were chosen to establish monitoring stations.
- Baseline assessment, including wetland edge mapping, vegetation data collection, baseline functional assessment and baseline hydrological monitoring prior to the drawdown.
- Construction monitoring, including vegetation and hydrological monitoring while the reservoir is drawdown
- Post-construction monitoring, at minimum monitoring immediately after refilling of Ruth Falls Headpond and again the following year, but length of post-construction monitoring to be determined in consultation with the NSE Wetland Specialist. Monitoring for vegetation and hydrological conditions. NS Power understands that a post-construction monitoring program is typically 5 years, with a repeated functional assessment in the last year of monitoring.

NS Power requests that a condition be added to the Approval, if issued, for NS Power to provide a wetland monitoring plan completed by a qualified consultant to NSE prior to start of construction. A copy of the Tusket Main Dam Refurbishment Project Wetland Monitoring Plan can be found in Appendix C for reference.

A rare species assessment, wetland delineation, and functional assessment of the area surrounding the project construction footprint was conducted by Strum Consulting in September 2017, the report was included in a previous submission. It is not expected that the four wetlands identified during the study will be impacted by the Project.

5.0 ARCHAEOLOGICAL CONSIDERATIONS

An Archaeological Screening and Reconnaissance (ARIA) for the Project impact area was completed in 2017. The purpose of the ARIA was to assess the potential for archaeological resources in the project area, which included approximately 5 hectares surrounding the dam and earthen embankment primarily on the downstream side. The ARIA included a background study and visual assessment of the study area. The

assessment identified three areas considered to exhibit high potential for encountering Precontact and/or early historic Native archaeological resources and/or historic Euro-Canadian archaeological resources. It was recommended that if these areas could not be avoided, shovel testing be conducted.

Shovel testing in 2 of the identified areas was conducted in 2018 and included 64 shovel tests. No archaeological resources were encountered and no evidence of historically significant cultural modification was identified during the course of the shovel testing. Based on the results of the 2018 shovel testing, the potential for encountering significant, intact archaeological resources within the two areas are considered to be low. It was recommended that the two shovel tested areas be cleared of any requirement for further archaeological investigation and that development within these areas may proceed as planned.

NS Power also intends to undertake an archaeological reconnaissance and if required, surface collection of exposed artifacts as part of the lowering of Ruth Falls Headpond. To date, no significant archaeological investigation has been completed for Ruth Falls Headpond, thus a desktop ARIA will be completed first to inform fieldworks. Upon completion of the desktop ARIA, NS Power will work with a qualified archaeologist to develop an archaeological plan for the drawdown of Ruth Falls Headpond to ensure any Mi'kmaq and historical archaeological resources are protected during drawdown activities. NS Power will continue to engage with CCH, the KMKNO and Millbrook First Nation on the results of the desktop ARIA and development of the archaeological plan.

6.0 MI'KMAQ ENGAGEMENT

NS Power initiated engagement regarding the Ruth Falls Main Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant project information with the KMKNO throughout 2018 providing six project updates, the project was deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window Meeting with KMKNO. NS Power continued to provide monthly Project updates and share relevant project information throughout 2019, working towards a preferred design option and planning for the Project to be completed in 2020. NS Power further presented the Project and design option with the KMKNO during the One Window meeting to discuss 2020 hydro capital projects and continued to provide monthly Project updates and share relevant project information throughout 2020, working towards a preferred design option and planning for the Project to be completed in 2021. NS Power then provided an updated on the project and 2021 scope of work in the December 2020 One Window meeting for 2021 Hydro Capital Projects.

NS Power will continue monthly updates with the KMKNO on 2021 hydro capital projects, including Ruth Falls in 2021 and will continue to share information with respect to new information pertaining to water management, fish and fish habitat monitoring, archaeology and wetland monitoring as well as share updates on the status of Approval applications.

In January 2020, NS Power initiated engagement with the Mi'kmaw Conservation Group to collaborate on an offsetting project. NS Power, in February and March 2020, continued engagement with the Mi'kmaw Conservation Group, continuing discussions to identify an offsetting project with the group and the Millbrook Mi'kmaw community. NS Power continued to engage with Millbrook throughout 2020 but was

not able to share any new information on the Project due the Project deferral to 2021. During this time, NS Power has been working with the Mi'kmaw Conservation Group (MCG) of the Confederacy of Mainland Mi'kmaq (CMM) to collaborate with Millbrook First Nation on an offsetting plan for potential impacts to fish and fish habitat that are anticipated as a result of the Project. This offsetting Project will be included with NS Power's Application for Authorization to DFO.

In 2021, NS Power re-initiated engagement with Millbrook First Nation and has been invited to attend a Chief and Council meeting on April 20th, to share updated information on the Project and to review the draft offsetting plan.

7.0 OTHER STAKEHOLDER ENGAGEMENT

NS Power is planning to conduct public engagement for the Project with an Open House and provide local residents, along the Ruth Falls Headpond, with relevant Project information and notification of the drawdown activities to conduct the Project. The public Open House and local resident communications will provide information in a timely manner about the Project, prior to drawdown activities and construction, increasing awareness and understanding of the Project scope, objectives, and timelines and addressing public areas of interest and potential concern.

NS Power is currently in the planning stages of developing a public engagement plan to inform the local community of the Project and planned drawdown activities. NS Power will provide a communication plan to NSE once developed.

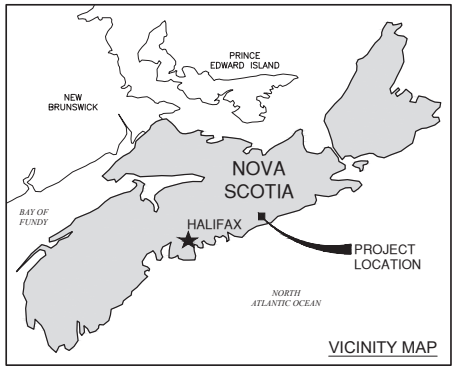
APPENDIX A - Engineering Drawings

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NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP





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COVER SHEET

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DRAWING LIST

SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS	NSPI DRAWING No.
100-01	DRAWING LIST	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-041
100-02	GENERAL NOTES	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-042
200-01	EXISTING CONDITIONS OVERALL SITE PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-043
200-02	EXISTING CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-044
200-03	EXISTING CONDITIONS WEST SPILLWAY DAM PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-045
210-01	TEMPORARY CONDITIONS/DEMO PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-046
210-02	TEMPORARY CONDITIONS/DEMO EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-047
210-03	TEMPORARY CONDITIONS/DEMO WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-048
300-01	NEW CONDITIONS DAM PLAN AND ELEVATION	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-049
300-02	NEW CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-050
300-03	NEW CONDITIONS WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-051
300-04	NEW CONDITIONS SLUICEWAY PLAN AND DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-052
310-01	NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-053
310-02	NEW CONCRETE SLUICEWAY HEADWALL DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-054
310-03	NEW CONCRETE SPILLWAY RESURFACING DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-055
310-04	NEW CONCRETE RETAINING WALL AND PIER DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-056
320-01	NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-057
320-02	NEW STEEL GRATED ACCESS PLATFORM	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-058
320-03	NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-059
330-01	RUBBER DAM PIPING AT SLUICEWAY	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-060

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GENERAL NOTES

1. GENERAL:
   - A. CONTRACTOR SHALL DETERMINE LOCATIONS, EXISTING CONDITIONS, AND DIMENSIONS BY THEIR OWN INVESTIGATION.
   - B. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON LIMITED FIELD MEASUREMENTS, REFERENCE DRAWINGS AND SURVEY. FIELD VERIFY ALL DIMENSIONS, AND NOTIFY THE OWNER AND ENGINEER OF DISCREPANCIES.
   - C. CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION, AND WILL NOTIFY THE OWNER FOR AN APPROVAL, IF REQUIRED.
2. SURVEY:
   - A. GEOMETRY OF THE EXISTING DAM STRUCTURE SURVEYED BY TALISMAN TECHNICAL SOLUTIONS, LANTZ, NS, IN 2017.
   - B. ELEVATIONS ARE BASED ON OCTOBER 1994 GEODETIC DATUM. ELEVATIONS AND DIMENSIONS ARE NOMINAL. ACTUAL ELEVATIONS VARY THROUGHOUT EXISTING STRUCTURES.
   - C. UTILITIES LOCATED BY SURVEY OR SHOWN ON DRAWINGS ARE APPROXIMATE AND SHALL BE CONFIRMED IN FIELD.
   - D. CONTRACTOR SHALL COORDINATE WITH NSPI FOR TEMPORARY RELOCATION OR PERMANENT RELOCATION OF POWER LINES AND POLES IF REQUIRED.
   - E. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65 FT
3. DESIGN LOADS:
   - A. NORMAL HEADPOND: EL. 109.25 FT
   - B. INFLOW DESIGN FLOOD HEADPOND: EL. 114.0 FT AT PEAK FLOW OF 29,183 CFS
   - C. SEISMIC COEFFICIENT: 0.1g
   - D. ICE LOAD AT NORMAL POND ELEVATION: 5,000 LB/FT
4. JOB CONDITIONS:
   - A. SITE INFORMATION:
     - I. ANY SUBSURFACE CONDITIONS SHOWN ON THE DRAWINGS ARE BASED ON INTERPRETATIONS/INTERPOLATIONS OF DATA OBTAINED FROM BACKGROUND DOCUMENTS AND WIDELY SPACED EXPLORATIONS BY OTHERS. VARIATIONS MAY EXIST AND SHOULD BE EXPECTED.
   - B. EXISTING UTILITIES:
     - I. THE CONTRACTOR SHALL LOCATE EXISTING UNDERGROUND AND OVERHEAD UTILITIES IN THE AREAS OF WORK. IF UTILITIES ARE TO REMAIN IN PLACE, PROVIDE ADEQUATE MEANS OF PROTECTION DURING EARTHWORK OPERATIONS.
     - II. NOTE THAT THERE ARE EXISTING OVERHEAD POWERLINES AND ASSOCIATED POLES ALONG AND ADJACENT TO THE EMBANKMENT DAM. THE CONTRACTOR SHALL COORDINATE WITH OWNER FOR TEMPORARY OR PERMANENT RELOCATION OF POWERLINES AND POLES; AS REQUIRED.
     - III. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATION, CONSULT THE OWNER AND UTILITY OWNER/OPERATOR IMMEDIATELY FOR DIRECTIONS.
     - IV. THE CONTRACTOR SHALL REPAIR DAMAGED UTILITIES TO SATISFACTION OF THE OWNER AND UTILITY OWNER/OPERATOR.
5. QUALITY ASSURANCE:
   - A. HORIZONTAL AND VERTICAL CONTROL:
     - I. THE CONTRACTOR IS RESPONSIBLE FOR AND SHALL PROVIDE ALL CONSTRUCTION LAYOUT.
     - II. SURVEYS FOR CONSTRUCTION ELEVATIONS AND LOCATIONS OF THE WORK SHALL BE PERFORMED BY OR UNDER THE SUPERVISION OF A QUALIFIED SURVEYOR.
   - B. OWNER'S REPRESENTATIVE:
     - I. THE OWNER'S REPRESENTATIVE WILL PROVIDE PERIODIC TO REGULAR REVIEW OF THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR REGULAR COMMUNICATION OF THE CONSTRUCTION SCHEDULE AND FOR PROVIDING AMPLE NOTICE TO THE OWNER'S REPRESENTATIVE FOR CRITICAL REVIEWS SPECIFIED HEREIN.
     - II. THE OWNER'S REPRESENTATIVE MUST REVIEW ALL EXPOSED SUBGRADES PRIOR TO PLACEMENT OF FILL MATERIALS.
     - III. THE CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY (QCTL) SHALL PERFORM QUALITY CONTROL TESTING DURING CONSTRUCTION, AS SPECIFIED HEREIN. THE CONTRACTOR'S QCTL SHALL SHARE TEST RESULTS ON–SITE WITH THE OWNER'S REPRESENTATIVE UPON REQUEST.
     - IV. THE OWNER MAY CHOOSE TO EMPLOY AN INDEPENDENT THIRD PARTY TESTING AGENCY TO PERFORM QUALITY ASSURANCE (QA) TESTING.
6. EROSION & SEDIMENT CONTROL:
   - A. EROSION PREVENTION AND SEDIMENT CONTROL SHALL BE IN ACCORDANCE WITH LOCAL AND PROVINCE STANDARDS AND OWNER'S STANDARDS. ALL MEASURES SHALL BE CONSISTENT WITH THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT EROSION AND SEDIMENTATION CONTROL HANDBOOK FOR CONSTRUCTION SITES, AT A MINIMUM.
   - B. SUBMIT PLAN AND DETAILS TO OWNER FOR REVIEW AND APPROVAL.
   - C. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE OWNER.
7. DEMOLITION:
   - A. DEMOLISH PORTIONS OF THE EXISTING CONCRETE DAM AS SHOWN IN THE PLANS.
   - B. CONTRACTOR SHALL DEWATER WORK AREAS AS NEEDED TO PERFORM DEMOLITION AND EXCAVATION AND TO ACCOMMODATE NEW CONSTRUCTION.
   - C. CONTRACTOR SHALL CONFORM TO ALL OWNER SAFETY PROCEDURES.
   - D. CONTRACTOR SHALL NOT BEGIN ANY DEMOLITION OR EXCAVATION UNTIL AFTER RECEIVING WRITTEN AUTHORIZATION TO BEGIN DEMOLITION FROM OWNER'S PROJECT MANAGER.
   - E. CONTRACTOR IS RESPONSIBLE FOR CARE OF ANY LEAKAGE INTO THE WORK AREAS DURING CONSTRUCTION.
   - F. CONTRACTOR SHALL DISPOSE ALL DEMOLITION MATERIAL AT A LOCATION THAT HAS BEEN APPROVED BY OWNER.
8. MATERIALS:
   - A. STEEL:
     - I. BOLTS ASTM A325 (THREAD EXCLUDED FROM SHEAR PLANE) COMPLETE WITH A563 HEX NUT AND HELICAL SPRING WASHER ANSI B 18.21.1 UNLESS OTHERWISE SPECIFIED. ALL HARDWARE SHALL BE GALVANIZED AS PER ASTM A153.
     - II. STRUCTURAL W SHAPES: ASTM A992, OR CSA G40.21–350W.
     - III. STEEL PLATE: ASTM A–36, OR CSA G40.21–300W.
     - IV. ANCHOR RODS: ASTM A 36, A 307, OR F1554. HOT DIPPED GALVANIZED PER ASTM A 153, AS INDICATED ON DRAWINGS.
   - B. CONCRETE:

     SUBMIT MIX DESIGN AND REINFORCEMENT SHOP DRAWINGS FOR APPROVAL BY OWNER.

     SURFACE PREP:
     - I. REMOVED DETERIORATED SURFACE MATERIAL IN DESIGNATED AREAS DOWN TO SOUND CONCRETE. SOUND CONCRETE IS DEFINED AS WHEN THE SURFACE IS STRUCK WITH A GEOLOGIST'S HAMMER, THE AGGREGATE OF THE CONCRETE FRACTURES BEFORE THE CEMENT PASTE BOND IS BROKEN.
     - II. PERFORM REMOVAL WITH POINTED TOOLS THAT DO NOT DAMAGE OR FRACTURE THE UNDERLYING SOUND CONCRETE, OR BY PRESSURE WASHING OR AIR BLASTING.
     - III. ROUGHEN ALL SURFACES TO GREATER THAN 1/4" AMPLITUDE. CLEAN SURFACE TO REMOVE ALL DELETERIOUS MATERIAL, INCLUDING DIRT, GREASE, ETC. WASH WITH HIGH PRESSURE WASH AT LEAST 6,000 PSI.
     - IV. CONCRETE SURFACE SHALL BE SATURATED AT TIME OF CONCRETE PLACEMENT, BUT NO STANDING WATER.
     - V. DO NOT PLACE CONCRETE AGAINST ACTIVE LEAKS OR SEAMS WITH FLOWING WATER. STOP FLOW OR INSTALL DRAINAGE TO DIVERT FLOW AWAY FROM FRESH CONCRETE.

     SPECIFICATIONS:
     - I. MINIMUM F'c = 30 MPa AT 28 DAYS (4,000 PSI),
     - II. MAX W/C RATIO 0.45
     - III. FLYASH: ALL FLY ASH SHALL BE CLASSIFIED "FLY ASH CLASS CI OR F", CONFORMING TO CSA A3000 AND AS FURTHER DESCRIBED IN CLAUSE 2.2.1, CONCRETE MIXES. THE TOTAL ALKALI CONTENT OF THE FLY ASH SHALL BE LIMITED TO 4.5% MAXIMUM. THE FLY ASH SHALL BE OBTAINED FROM THE TRENTON GENERATING STATION UNIT 6 AS MARKETED BY SHAW RESOURCES.
     - IV. AIR ENTRAINMENT 6–8%
     - V. SLUMP AT PLACEMENT SHALL BE 100mm +/– 25mm (4" +/– 1")
     - VI. MAX AGGREGATE SIZE SHALL BE 25mm (1")
     - VII. CONCRETE PLACEMENT AND CURING SHALL BE IN ACCORDANCE WITH CSA 23.1, EXPOSURE CLASS F–1, "SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS".
     - VIII. CONCRETE WORK SHALL CONFORM TO CSA 23.1. CONCRETE STRENGTH SHALL BE VERIFIED BY STANDARD 28 DAY TESTS.
     - IX. REINFORCEMENT = CSA G30.18, GRADE 400W DEFORMED. STANDARD HOOKS PER CSA A23.3.
     - X. NON SHRINK CEMENT GROUT: MINIMUM F'C = 35MPA AT 7 DAYS.
     - XI. ADHESIVE ANCHORS SUITABLE FOR USE IN DAMP OR WET ENVIRONMENT: HILTI–HIT HY 200 ADHESIVE OR APPROVED EQUAL. ANCHORS ASTM F1554 GRADE 55, MINIMUM Fy=380MPA; Fu=520MPA.
   - C. NON–SHRINK GROUT: CRD–C 621, FACTORY PREMIXED GROUT
     - I. EARLY VOLUME CHANGE: ASTM C–827: 0.00% SHRINKAGE
     - II. HARDENED VOLUME CHANGE: 0.00% SHRINKAGE AND EXPANSION AFTER SET.
     - III. COMPRESSIVE STRENGTH: ASTM C–109 MIN. = 35 MPA AT 7 DAYS
     - IV. ACCEPTABLE SUPPLIERS: "FIVE STAR GROUT" BY US GROUT CORP, OR APPROVED EQUIVALENT.
9. SUBMITTALS:
   - A. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO OWNER FOR APPROVAL PRIOR TO FABRICATION.
   - B. EXCAVATION AND FILL PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE A WRITTEN EXCAVATION AND FILL PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL DETAIL THE FOLLOWING ITEMS, AT A MINIMUM:
       - SCHEDULE AND SEQUENCE OF WORK IN EACH AREA.
       - ACCESS TO EACH AREA.
       - LOCATION OF MATERIAL STOCKPILES IN EACH AREA.
       - EQUIPMENT TO BE USED IN EACH AREA.
       - MONITORING AND QUALITY CONTROL PROCEDURES.
       - MEANS/METHODS AND MATERIALS TO PROTECT EXISTING FEATURES DESIGNATED TO REMAIN.
   - C. DEWATERING PLAN:
     - I. DEWATERING WILL BE DONE IN CONJUNCTION WITH NSPI HYDRO SYSTEM PERSONNEL AND THE NSPI PROJECT MANAGER/ENGINEERS. THE CONTRACTOR SHALL PROVIDE A DETAILED DEWATERING PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING ITEMS, AT A MINIMUM:
       - MEANS/METHODS OF TEMPORARY EXCAVATION DEWATERING.
       - EQUIPMENT TO BE USED.
       - SETTLEMENT BASINS, IF REQUIRED, FILTER BAG LOCATIONS AND POINTS OF DISCHARGE.
       - SEQUENCING OF DEWATERING, EXCAVATION, AND FILL PLACEMENT.
   - D. EMERGENCY SEEPAGE PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE AN EMERGENCY SEEPAGE PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING, AT A MINIMUM:
       - TYPE, QUANTITY, AND LOCATION OF EMERGENCY FILTER/BALLAST STOCKPILES.
       - OTHER MATERIALS TO BE USED, (E.G., SANDBAGS, NON–WOVEN GEOTEXTILE, FILTER STONE, SMALL RIPRAP, ETC.).
   - E. WINTERIZATION PLAN:
     - I. AT LEAST TWO (2) WEEKS PRIOR TO ANY WINTER SHUTDOWN, THE CONTRACTOR SHALL SUBMIT A PLAN FOR PROTECTING/WINTERIZING THE COMPLETED WORK.
   - F. CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY:
     - I. THE CONTRACTOR SHALL SUBMIT THE NAME AND QUALIFICATIONS OF AN INDEPENDENT THIRD PARTY COMMERCIAL TESTING LABORATORY TO BE USED FOR BORROW SOURCE TESTING OF SOILS/CONSTRUCTION MATERIALS TESTING.
       - THE TESTING AGENCY SHALL BE A RECOGNIZED COMMERCIAL LABORATORY WITH NOT LESS THAN 5 YEARS OF EXPERIENCE IN CONDUCTING RELEVANT FIELD AND LABORATORY QUALITY CONTROL TESTING.
       - THE TESTING AGENCY SHALL MEET THE REQUIREMENTS OF ASTM D–3740.
   - G. BORROW SOURCE(S):
     - I. AT LEAST TWO (2) WEEKS PRIOR TO INITIATION OF APPLICABLE WORK, THE CONTRACTOR SHALL PROVIDE THE PROPOSED SOURCE(S) OF BORROW MATERIALS AND SUPPORTING DATA/RESULTS OF THE SPECIFIED BORROW SOURCE TESTING.
       - TESTING DATA/RESULTS SHALL BE FROM CURRENT TESTING OF SAMPLES OBTAINED FROM THE ACTUAL PROPOSED SOURCE/STOCKPILE AND NOT PRIOR/FILE RESULTS FROM THE SUPPLIER.
   - H. QUALITY CONTROL TESTING REPORTS:
     - I. SUBMIT TWO (2) COPIES OF THE FOLLOWING REPORTS AS SOON AS POSSIBLE, BUT NOT MORE THAN TWO (2) BUSINESS DAYS FOLLOWING COMPLETION OF ASSOCIATED QUALITY CONTROL TESTING.
       - LABORATORY TEST REPORTS FOR PROPOSED BORROW SOURCE MATERIALS. ACCEPTANCE OR REJECTION OR FILL MATERIALS WILL BE BASED ON THE RESULTS OF CURRENT LABORATORY TESTING.
       - FIELD IN–PLACE DENSITY/COMPACTION TEST REPORTS.
10. EARTHWORK:
    - A. SEE SHEET 310–04 FOR EARTHWORK.

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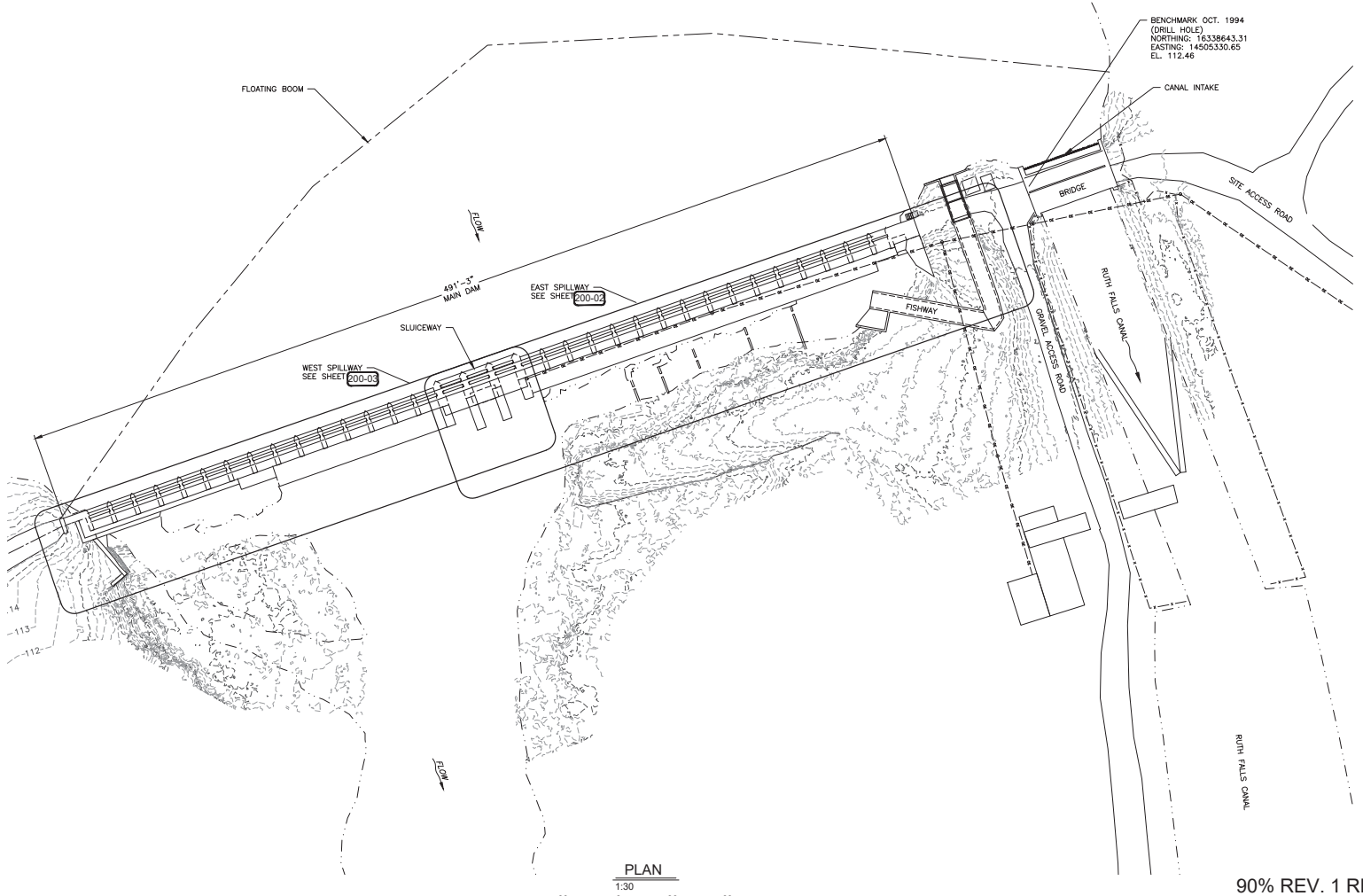
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GENERAL NOTES

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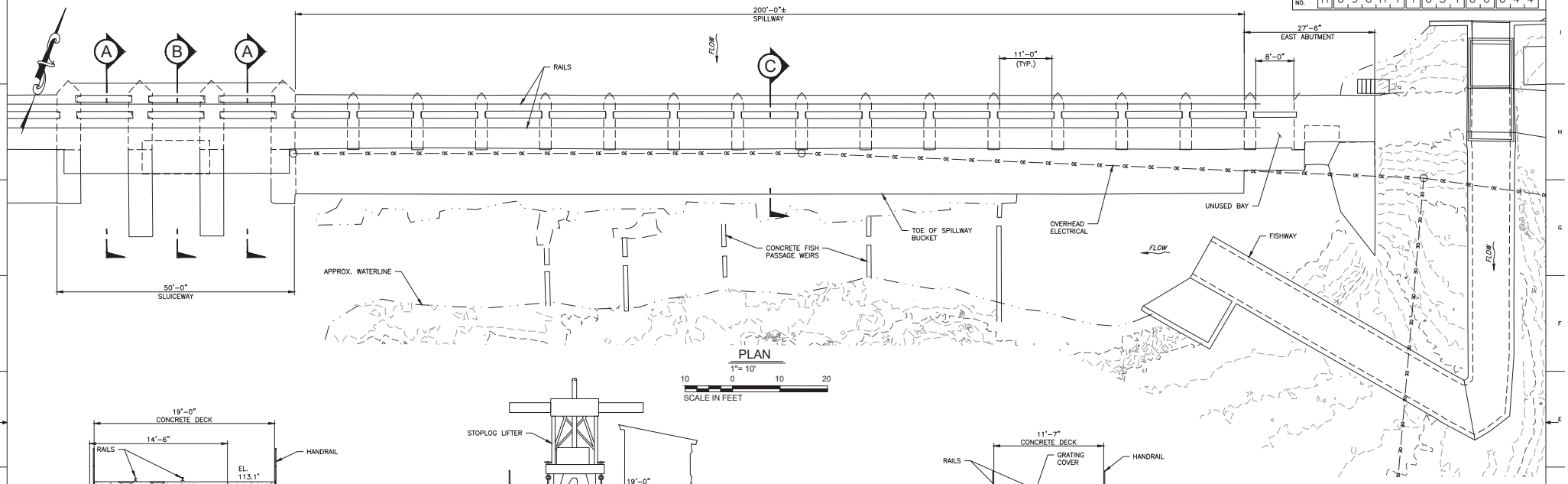
EXISTING CONDITIONS
OVERALL SITE PLAN

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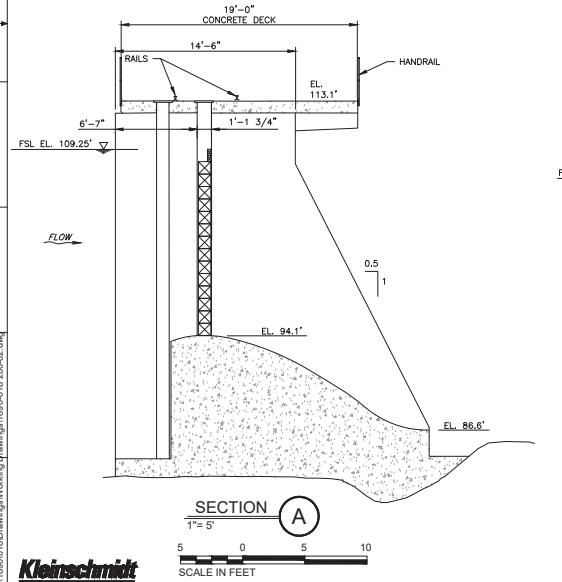


PLAN

1"= 10'

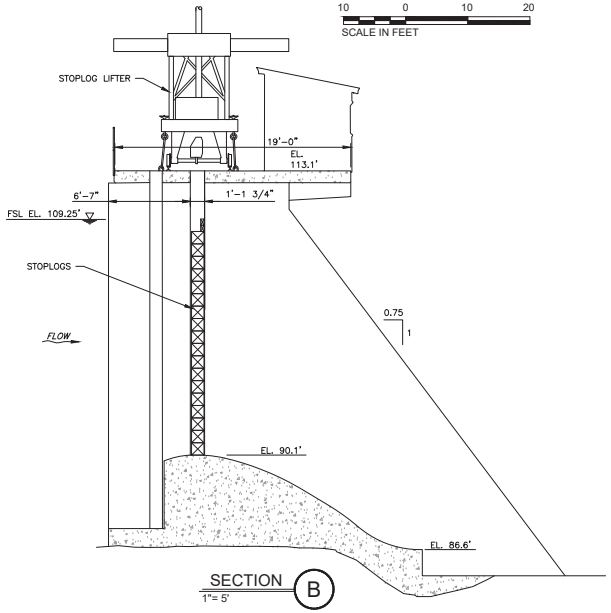
10 0 10 20

SCALE IN FEET



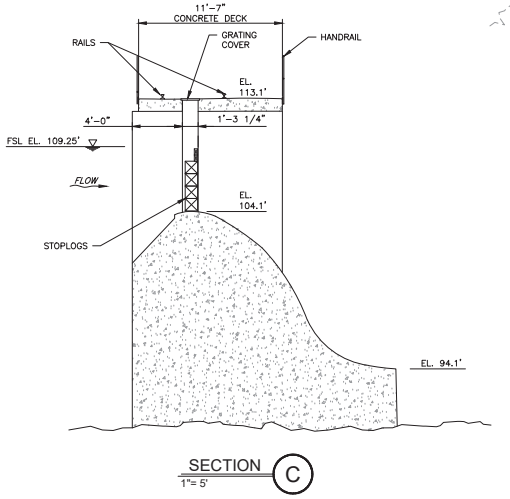
SECTION A

1"= 5'



SECTION B

1"= 5'



SECTION C

1"= 5'

5 0 5 10

SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

200-02

Kleinschmidt

J:\18900\018\Drawings\Working Drawings\1890-018 200-02.dwg

PRINTED: Dec. 11, 2020 - 2:32 PM

REFERENCE DESCRIPTION	A XXXXX XXXXX XXXXX
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H 0 9 5 H 1 1 6 7 0 0 0 3 2
REFERENCE DRAWINGS	DWG.NO.

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED ——

CHECKED ——

DATE 2020-12-11

W.O. XXXX

Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS

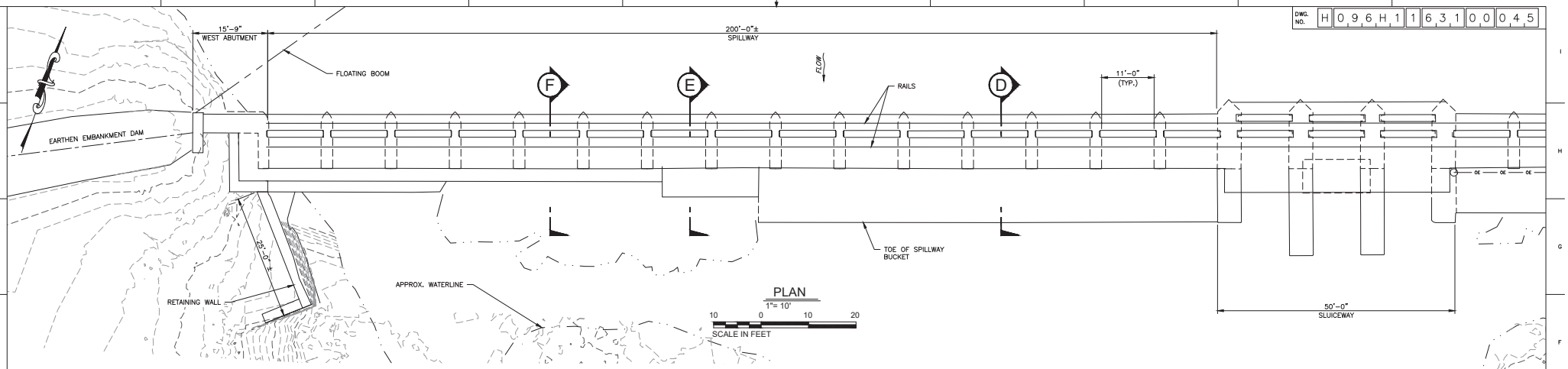
RUTH FALLS REFURBISHMENT PROJECT

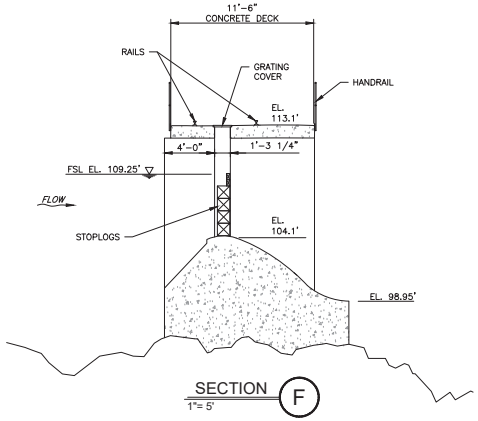
EXISTING CONDITIONS EAST SPILLWAY
PLAN AND SECTION

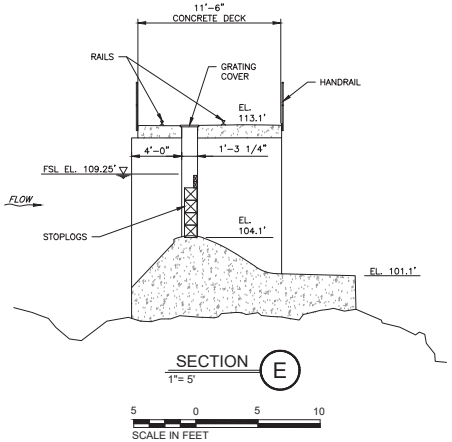
H 0 9 6 H 1 1 6 3 1 0 0 0 4 4 REV. C

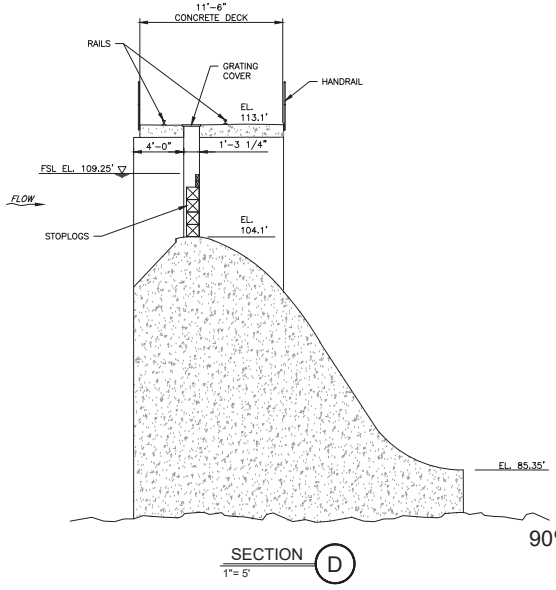
DWG.NO.

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 5









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NOT FOR CONSTRUCTION

Kleinschmidt

200-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2020-12-11
W.O.	XXXX

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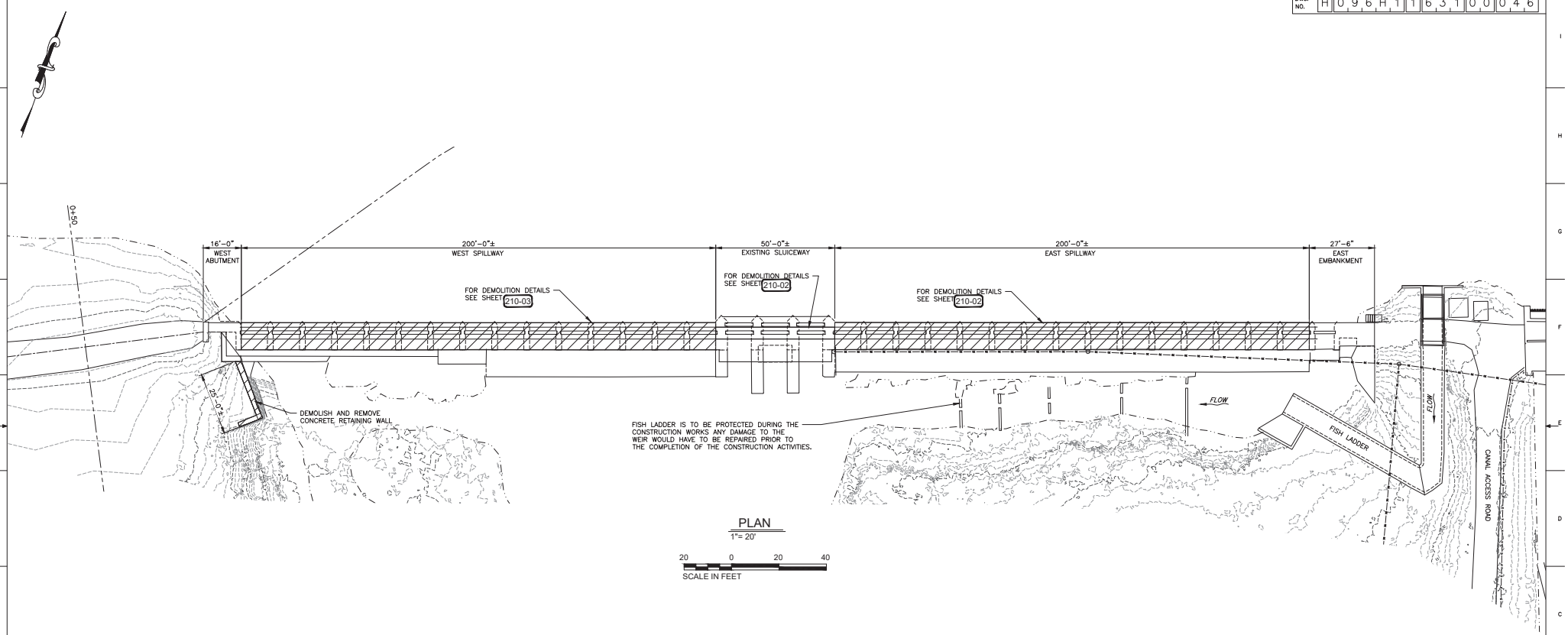
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

EXISTING CONDITIONS WEST SPILLWAY
DAM PLAN AND SECTIONS

H 0 9 6 H 1 1 6 3 1 0 0 0 4 5 REV. C
DWG.NO.

PRINTED: Dec. 9, 2020 - 3:36 PM
J:\1690\018\Drawings\Working Drawings\1690-018-200-03.dwg

DWG. NO. H096H1163100046



PLAN
1"= 20'

20 0 20 40
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

210-01

J:\1890\018\Drawings\Working Drawings\1890-018-210-01.dwg
PRINTED: Dec. 9, 2020 - 2:55 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

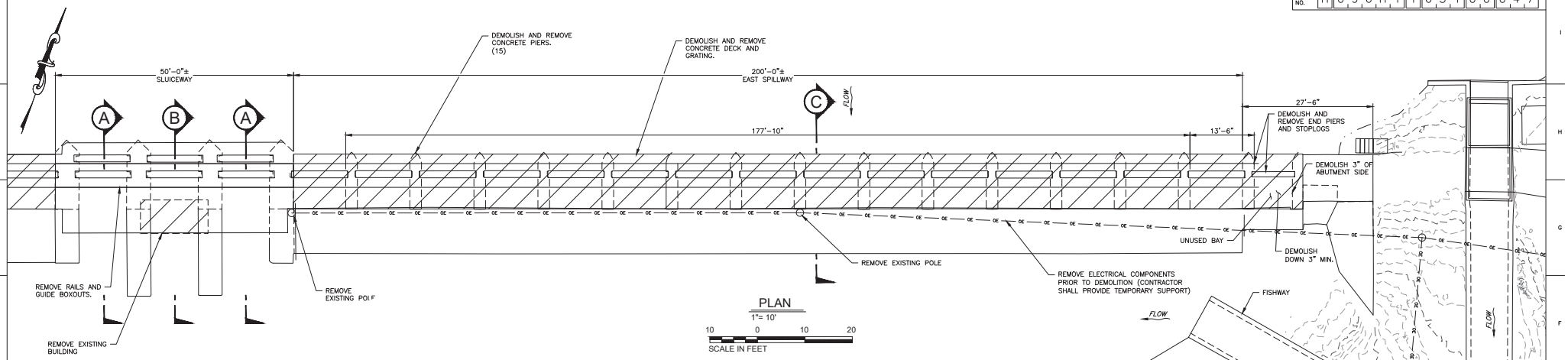
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

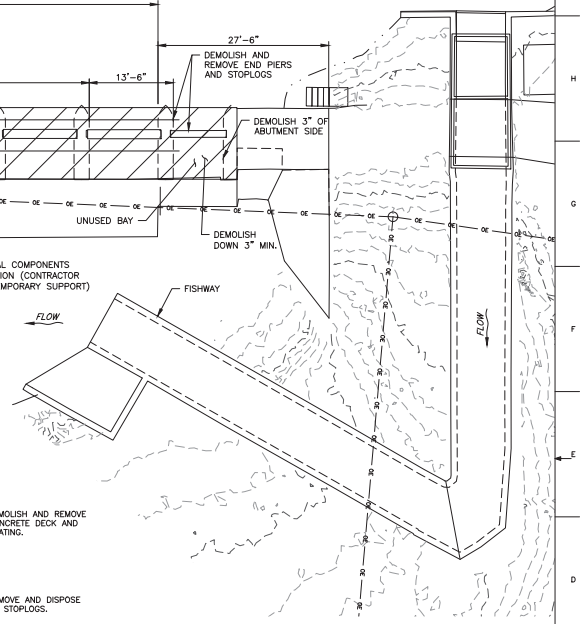
TEMPORARY CONDITIONS/DEMO PLAN

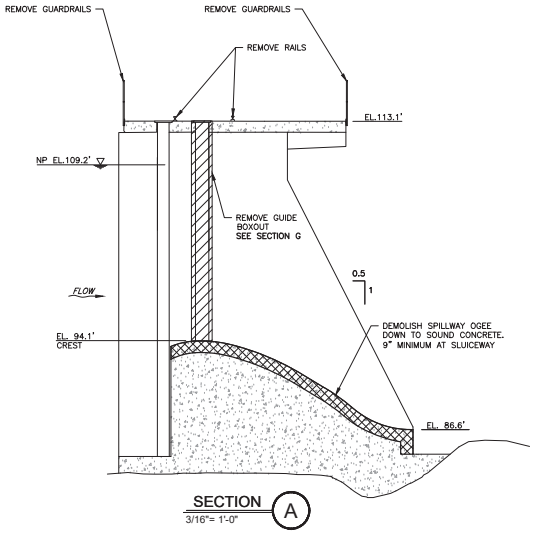
DWG.NO. H096H1163100046 REV. C

DWG. NO. H096H1163100047

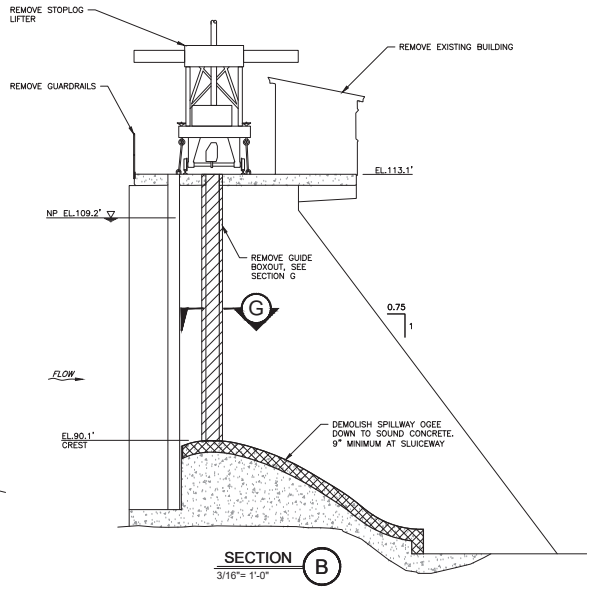


PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

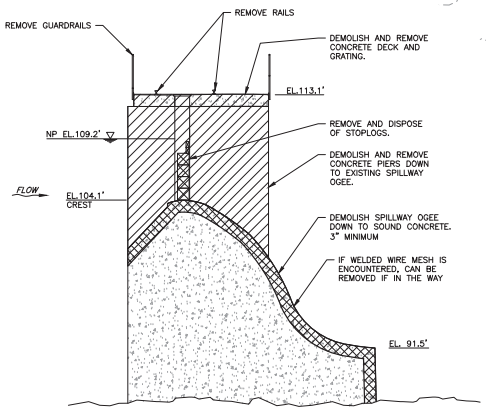




SECTION A
3/16"= 1'-0"

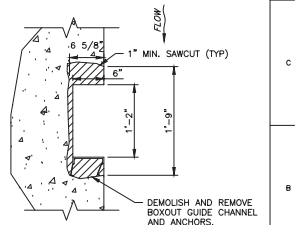


SECTION B
3/16"= 1'-0"



SECTION (TYP EAST SPILLWAY) C
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION (TYP) G
1"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

210-02

Kleinschmidt

J:\18900\018\Drawings\Working Drawings\1890-018-210-02-03.dwg

PRINTED: Dec. 9, 2020 - 2:56 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H	0	9	5	H	1	1	6	7	0	0	0	3	2
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

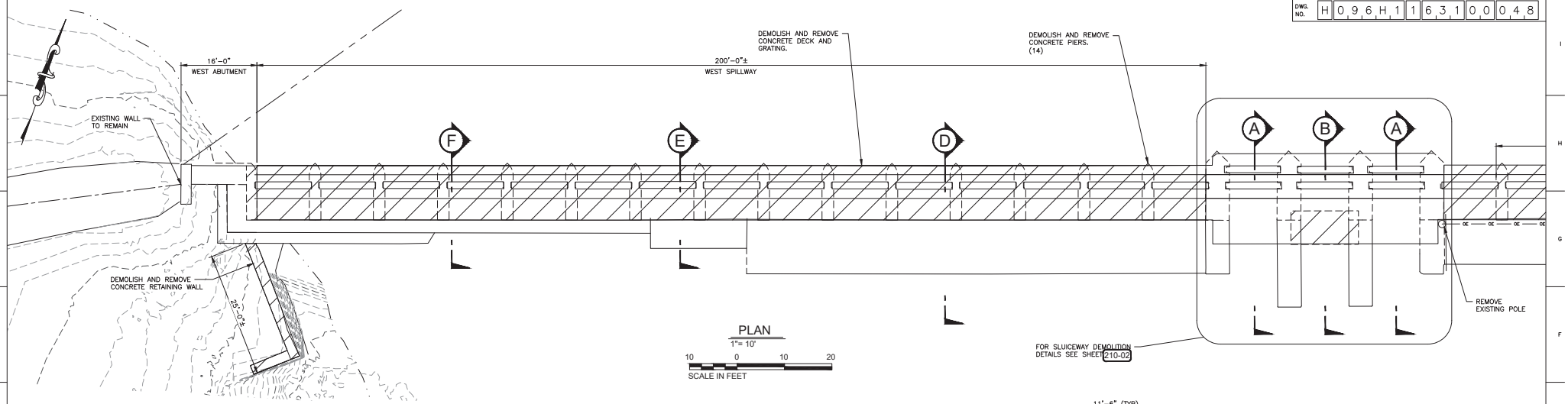
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

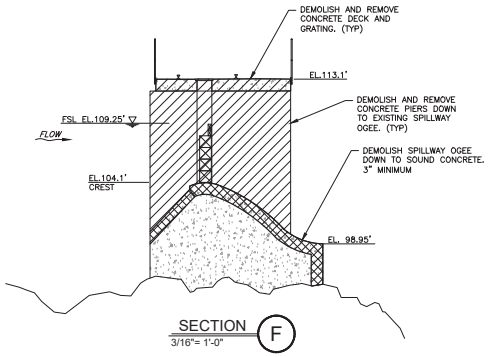
TEMPORARY CONDITIONS/DEMO
EAST SPILLWAY PLAN AND SECTIONS

H096H1163100047 REV. C
DWG.NO.

DWG. NO. H096H1163100048

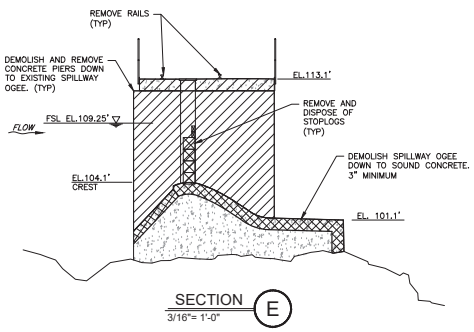


PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

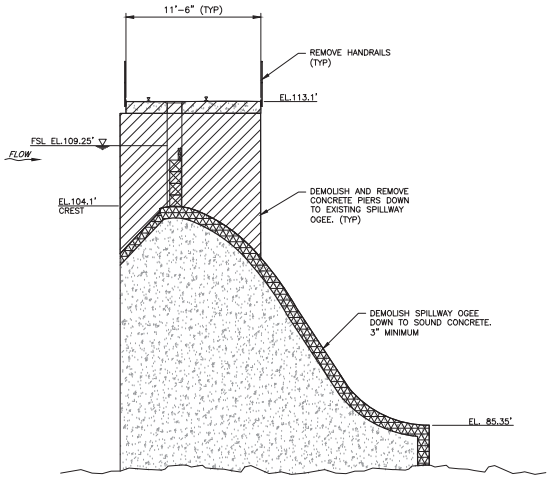


SECTION F
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION E
3/16"= 1'-0"



SECTION D
3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

210-03

J:\18900\018\Drawings\Working Drawings\18900-018-210-02-03.dwg

PRINTED: Dec. 11, 2020 - 9:55 AM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST
BY:		DATE:			

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2020-12-11
W.O.	XXXX

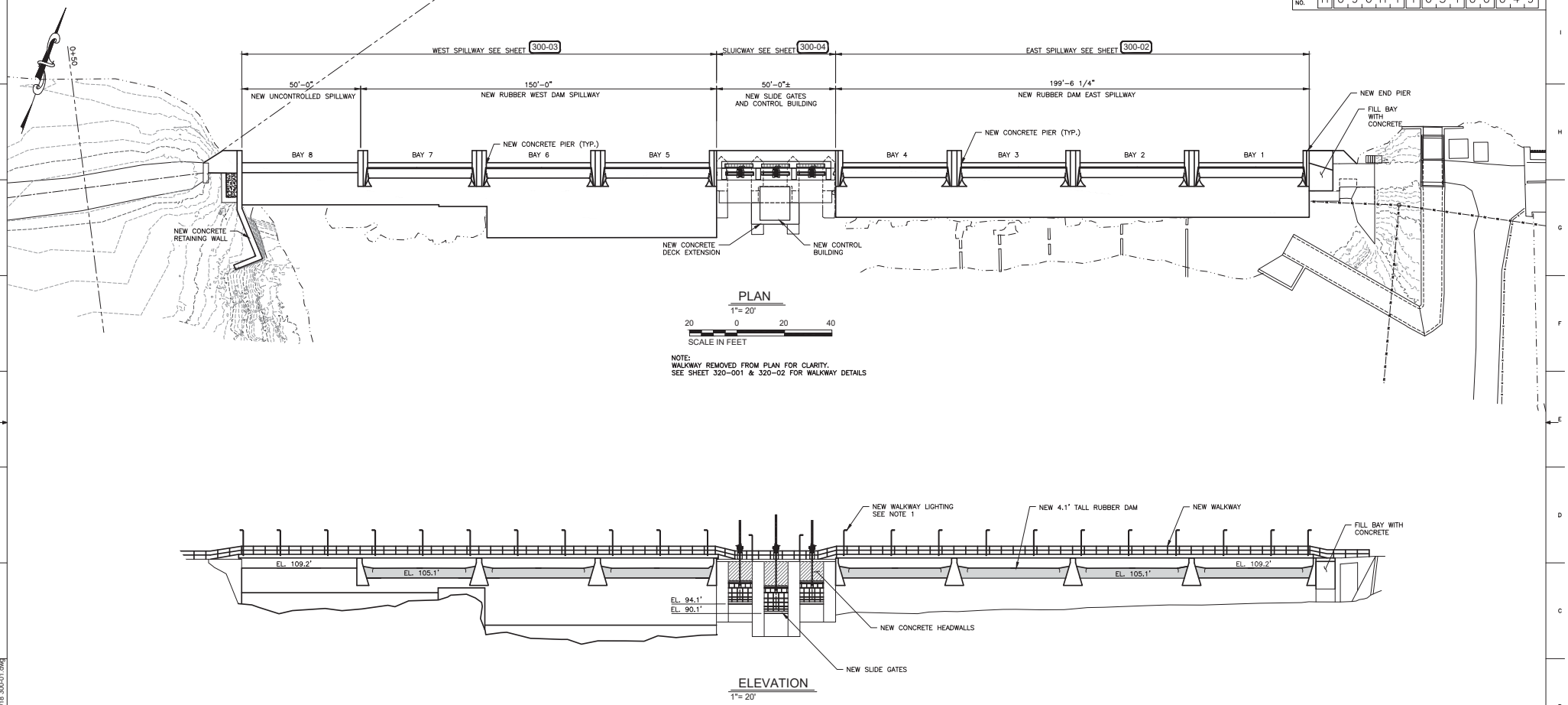
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
WEST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100048 REV. C

DWG. NO. H096H1163100049



NOTE:
1. LED LUMINAIRE MOUNTED TO A SWIVEL POLE– 5,300 LUMENS, TYPE 1 OPTIC, MULTIVOLT DRIVER, WARM (3000K) COLOR TEMP. LIGHT TO BE MOUNTED 10' ABOVE WALKWAY AND SPACED AT 20'. WIRING AND CONDUIT RESPONSIBILITY OF CONTRACTOR.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-01

J:\1890\018\Drawings\Working Drawings\1890-018 300-01.dwg
PRINTED: Dec. 9, 2020 - 3:37 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST
BY:	DATE:				

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED
DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

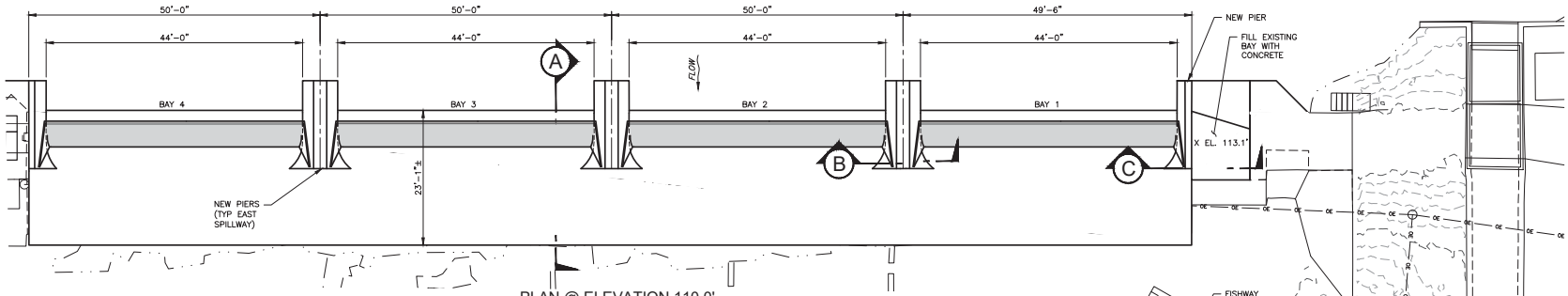
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

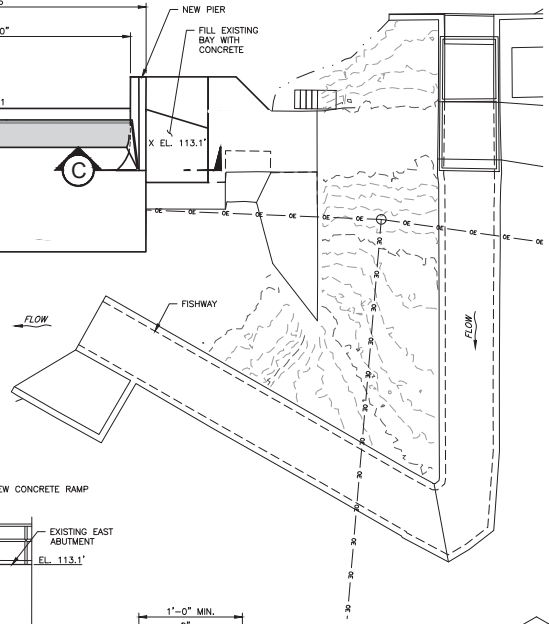
NEW CONDITIONS
DAM PLAN AND ELEVATION

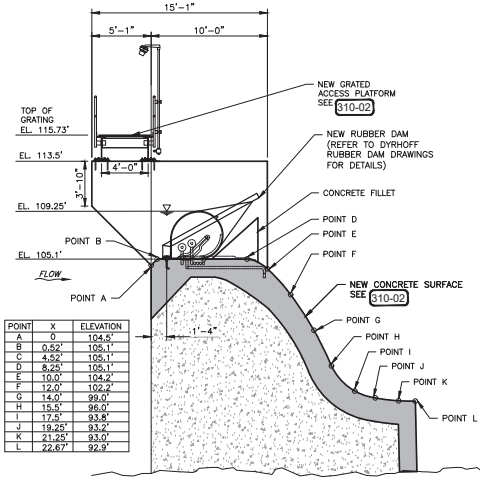
DWG.NO. H096H1163100049 REV. C

DWG. NO. H096H1163100050



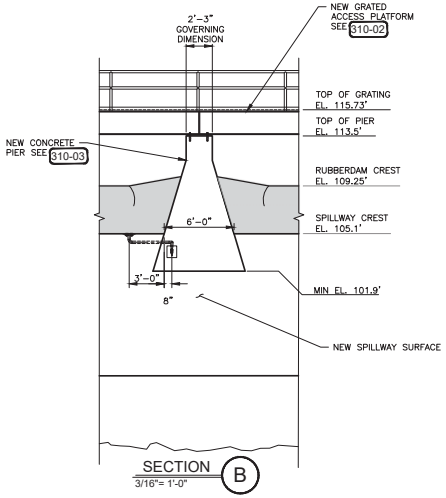
PLAN @ ELEVATION 110.0'
1"= 10'
10 0 10 20
SCALE IN FEET



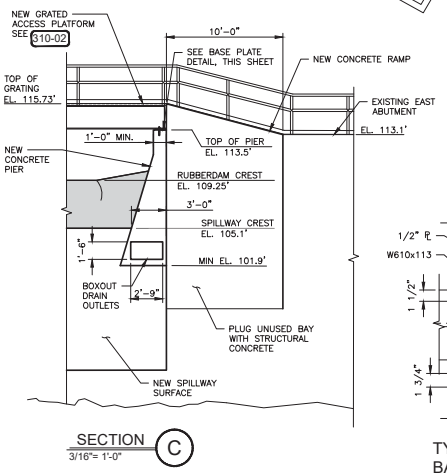


POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	4.52'	105.1'
D	8.25'	105.1'
E	10.0'	104.2'
F	12.0'	102.2'
G	14.0'	99.0'
H	15.5'	96.0'
I	17.5'	93.8'
J	19.25'	93.2'
K	21.25'	93.0'
L	22.67'	92.9'

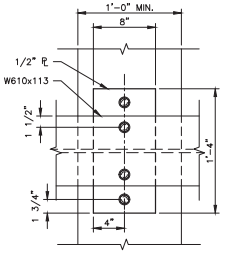
SECTION A
3/16"= 1'-0"
4 0 4 8 12
SCALE IN FEET



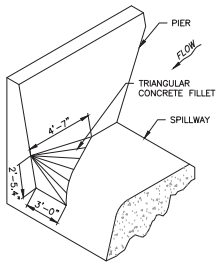
SECTION B
3/16"= 1'-0"



SECTION C
3/16"= 1'-0"



TYPICAL END PIER
BASE PLATE DETAIL
1 1/2"= 1'-0"



TRIANGULAR CONCRETE FILLET DETAIL
N.T.S.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST
BY: _____ DATE: ____-__-__					

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE , ,

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

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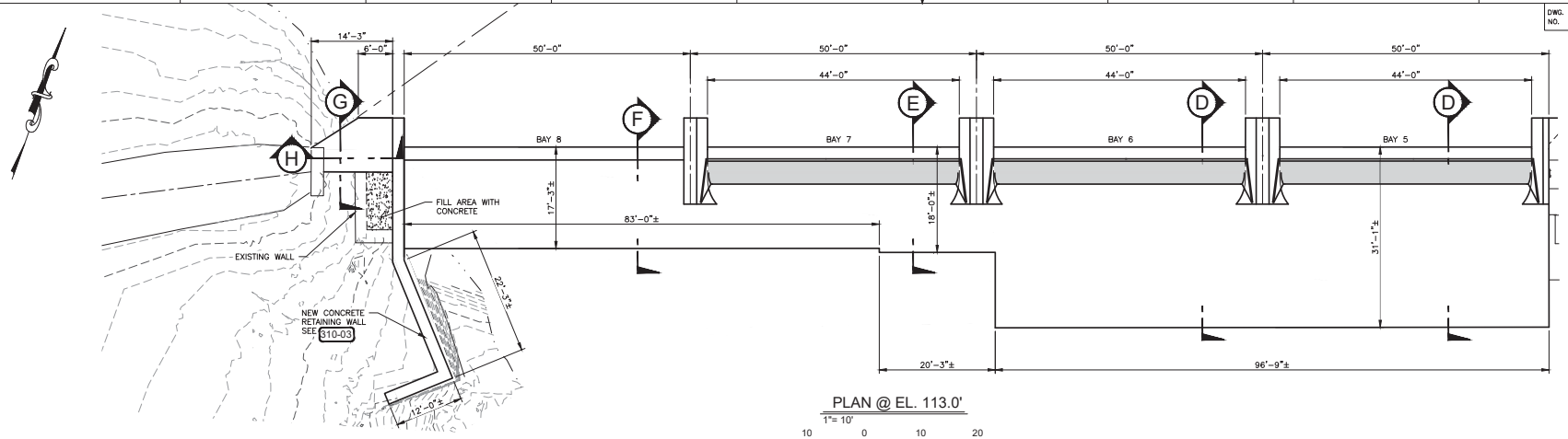
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
EAST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100050 REV. C

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DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 1

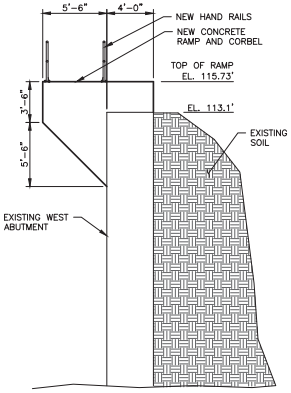


PLAN @ EL. 113.0'

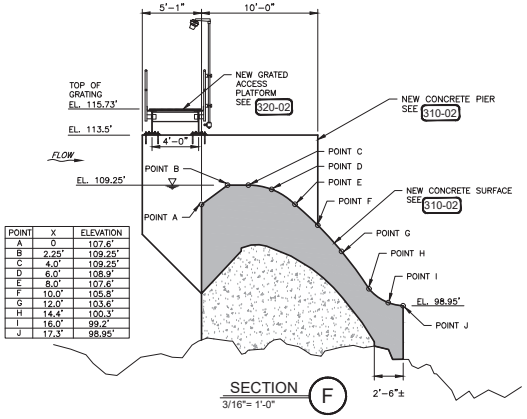
1"= 10'

SCALE IN FEET

NOTE:
WALKWAY REMOVED FROM PLAN FOR CLARITY.
SEE SHEET 320-001 & 320-02 FOR WALKWAY DETAILS

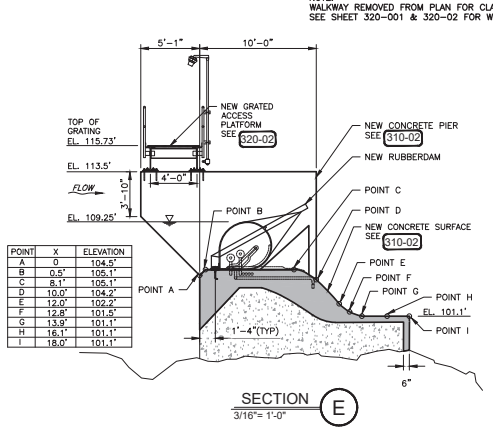


SECTION G
3/16"= 1'-0"



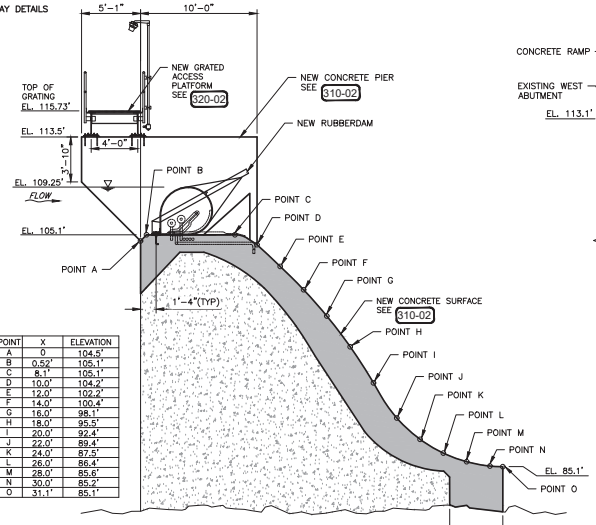
POINT	X	ELEVATION
A	0	107.6'
B	2.25'	109.25'
C	4.0'	109.25'
D	6.0'	108.9'
E	8.0'	107.6'
F	10.0'	105.8'
G	12.0'	103.6'
H	14.4'	100.3'
I	16.0'	99.2'
J	17.3'	98.95'

SECTION F
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.5'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	12.8'	101.5'
G	13.9'	101.1'
H	16.1'	101.1'
I	18.0'	101.1'

SECTION E
3/16"= 1'-0"

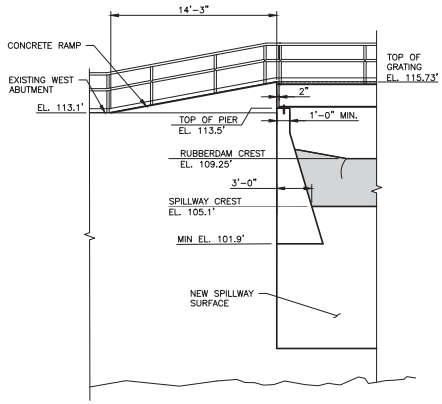


POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	14.0'	100.4'
G	16.0'	98.1'
H	18.0'	95.5'
I	20.0'	92.4'
J	22.0'	89.4'
K	24.0'	87.5'
L	26.0'	86.4'
M	28.0'	85.6'
N	30.0'	85.2'
O	31.1'	85.1'

SECTION D
3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET



SECTION H
3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2020-12-11
W.O.	XXXX

Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
WEST SPILLWAY PLAN AND SECTIONS

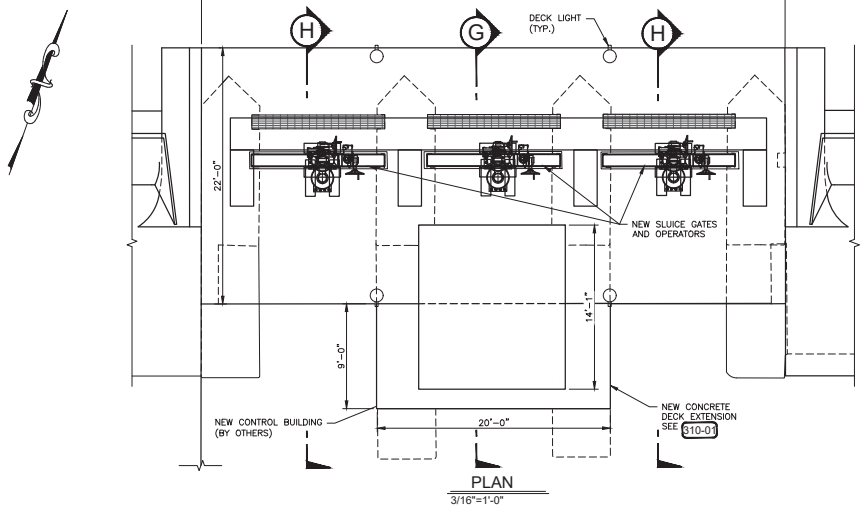
H 0 9 6 H 1 1 6 3 1 0 0 0 5 1 REV. C

DWG.NO.

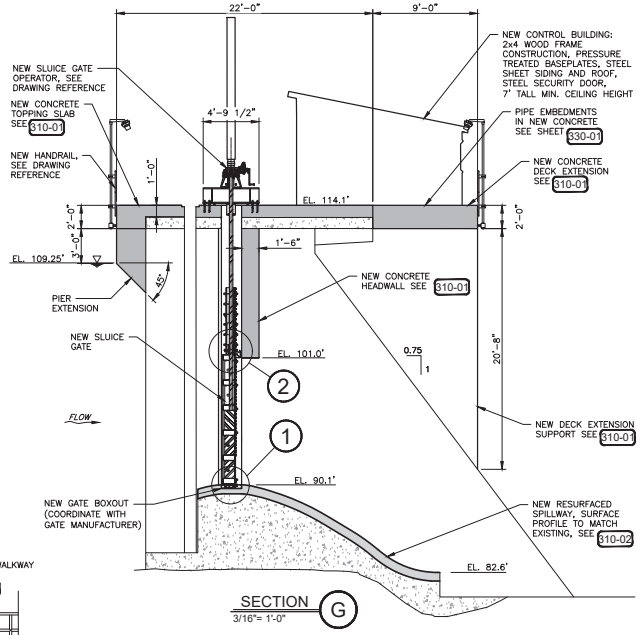
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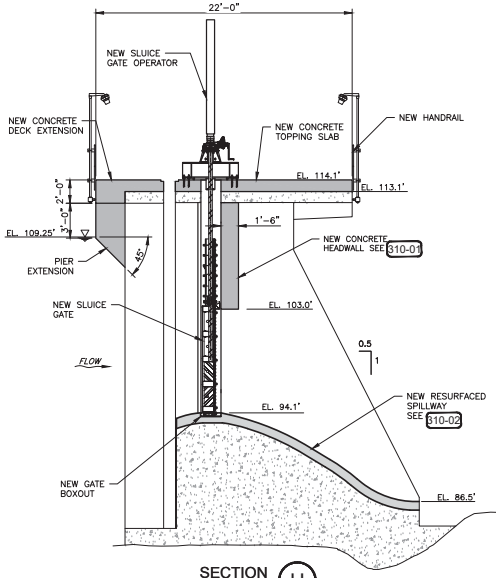
DWG. NO. H096H1163100052



PLAN
3/16"=1'-0"

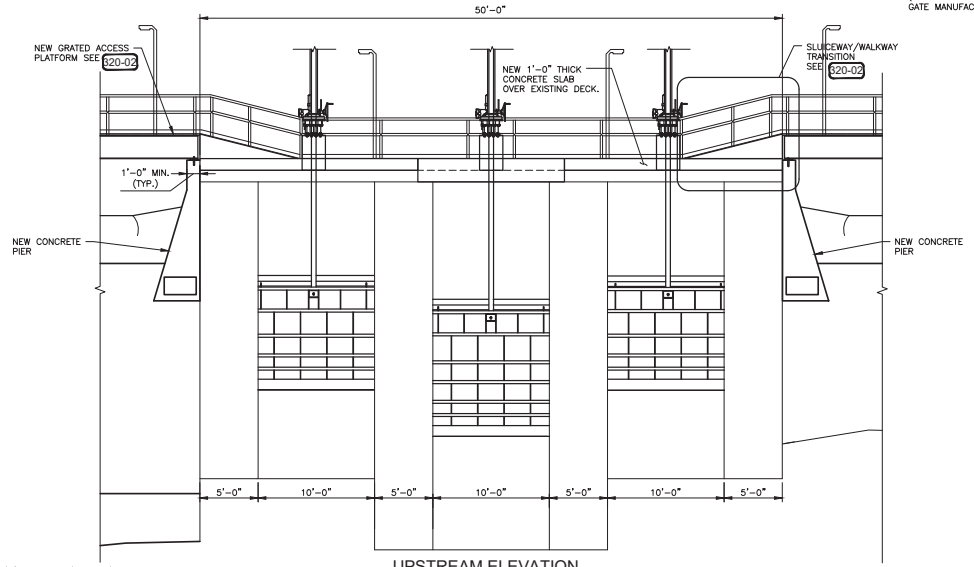


SECTION G
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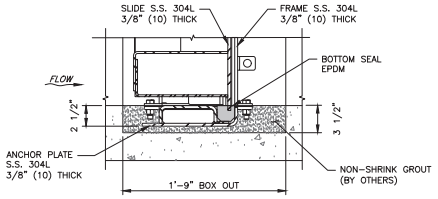


SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

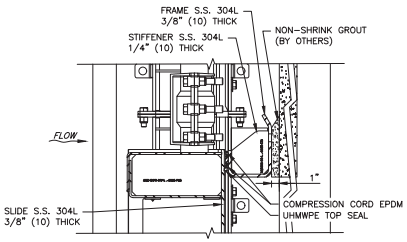


UPSTREAM ELEVATION
3/16"=1'-0"



DETAIL 1
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES



DETAIL 2
1 1/2"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-04

J:\1890\018\Drawings\Working Drawings\1890-018 300-02,03,04.dwg
PRINTED: Dec. 9, 2020 - 3:43 PM

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STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	0	1
FONTAINE AQUANOX DWG NO. D15542-01-204P2X120107BFE/CW22														
REFERENCE DRAWINGS					DWG.NO.									

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL		E & I	
MECH		CONST	

APPROVED

DATE , ,

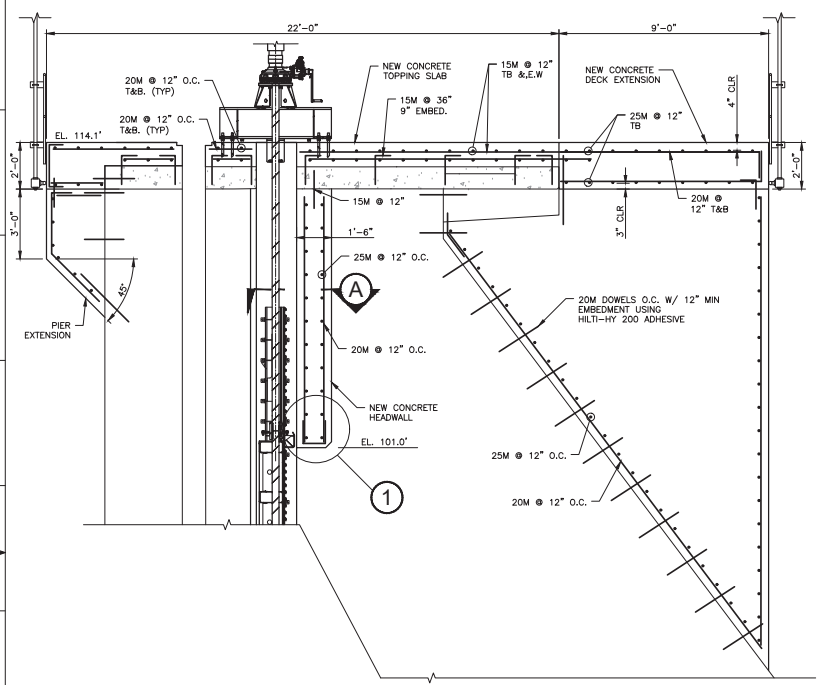
SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
SLUICEWAY PLAN AND DETAILS

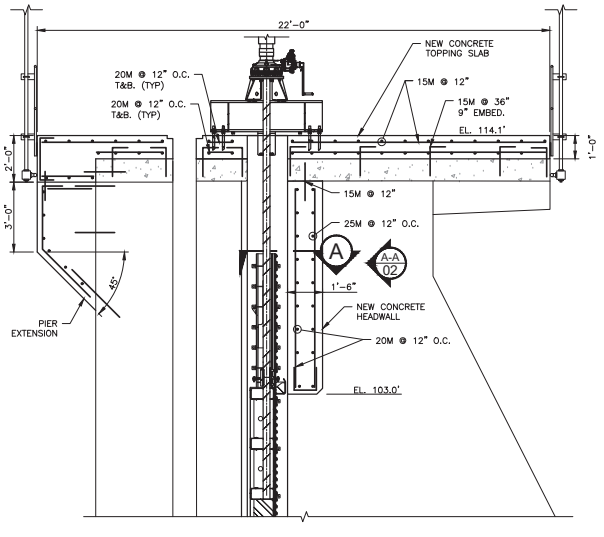
DWG.NO. H096H1163100052 REV. C



INNER SLUICEWAY DETAIL

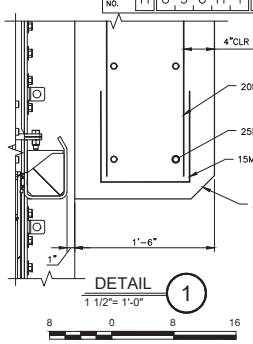
3/8"= 1'-0"

SCALE IN FEET



OUTER SLUICEWAY DETAIL

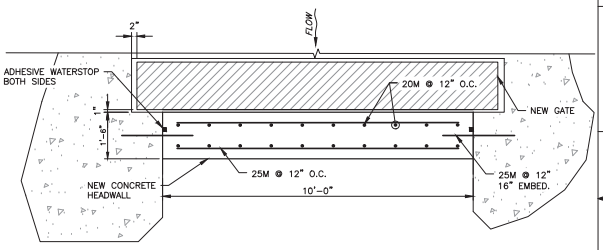
3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

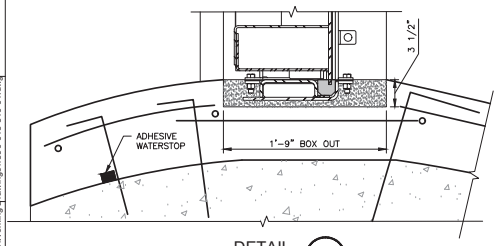
SCALE IN INCHES



SECTION A

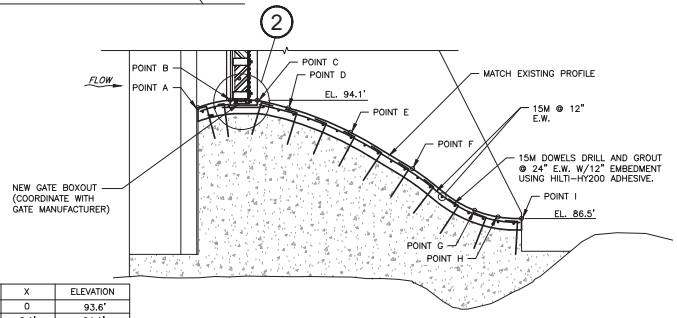
1/2"= 1'-0"

SCALE IN FEET



DETAIL 2

1 1/2"= 1'-0"

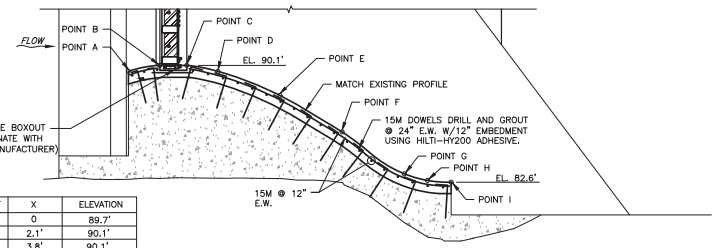


POINT	X	ELEVATION
A	0	93.6'
B	2.1'	94.1'
C	3.8'	94.1'
D	5.8'	93.6'
E	9.8'	92.0'
F	13.8'	89.7'
G	17.8'	87.0'
H	19.3'	86.6'
I	20.8'	86.5'

OUTSIDE SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

SCALE IN FEET



POINT	X	ELEVATION
A	0	89.7'
B	2.1'	90.1'
C	3.8'	90.1'
D	5.8'	89.7'
E	9.8'	88.2'
F	13.8'	85.8'
G	17.8'	83.1'
H	19.3'	82.7'
I	20.8'	82.6'

INNER SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-01

DWG. NO. H096H1163100053

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
FONTAINE AQUANOX DWG NO. D15542-01-204P2X120107BFE/CW22														
REFERENCE DRAWINGS		DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-18

W.O. XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

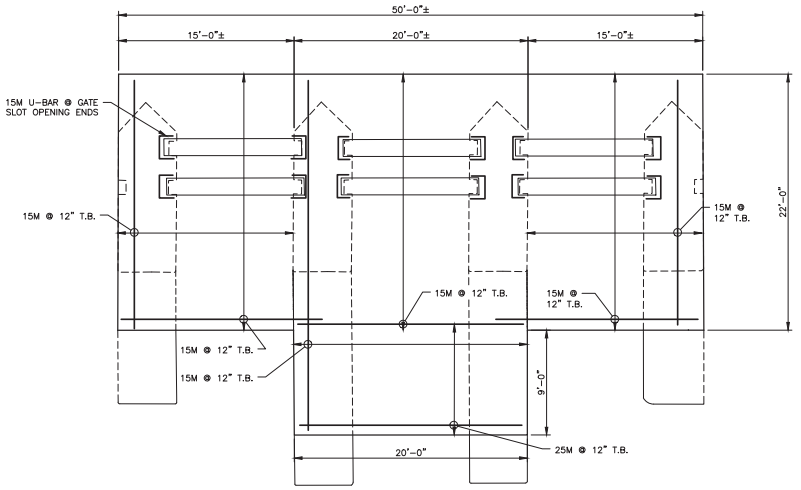
NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

DWG.NO. H096H1163100053 REV. C

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DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 4

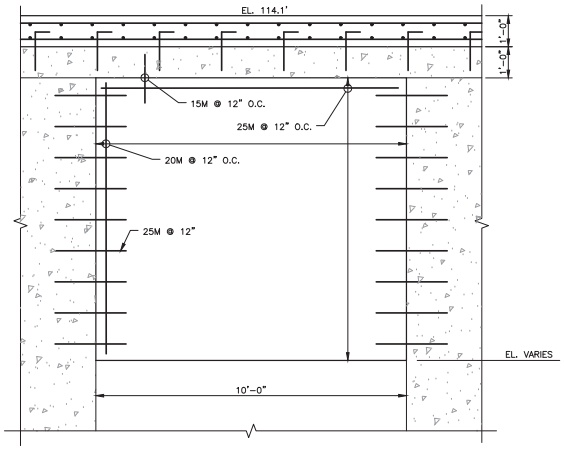


SLUICEWAY DECK REBAR PLAN

3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET

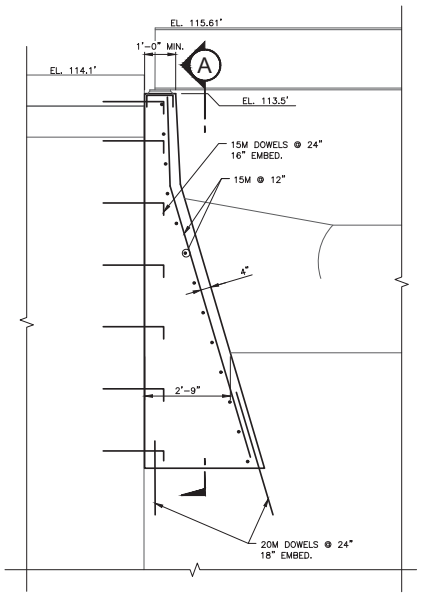


TYPICAL HEADWALL ELEVATION A-A 01

1/2"= 1'-0"

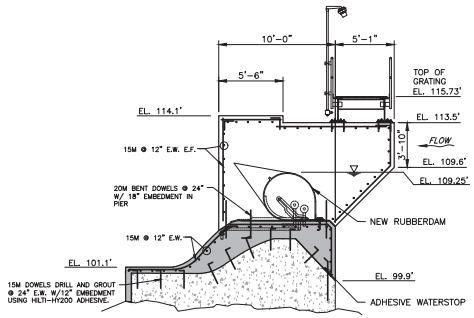
2 0 2 4

SCALE IN FEET



PIER TO SLUICEWAY REBAR DETAIL

1/2"= 1'-0"



SECTION A

3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
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REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED ——

CHECKED ——

DATE 2020-12-18

W.O. XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

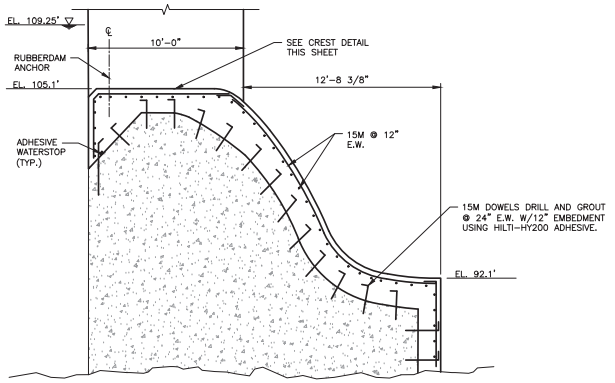
H 0 9 6 H 1 1 6 3 1 0 0 0 5 4 REV. C

DWG.NO.

PRINTED: Dec. 18, 2020 - 8:42 AM

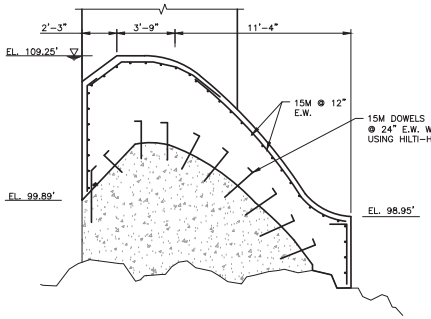
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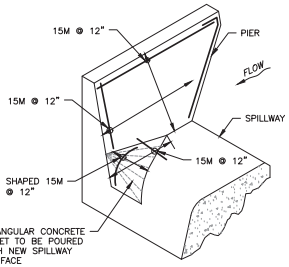
EAST SPILLWAY TYPICAL DETAIL (BAYS 1-4)

1/4"= 1'-0"



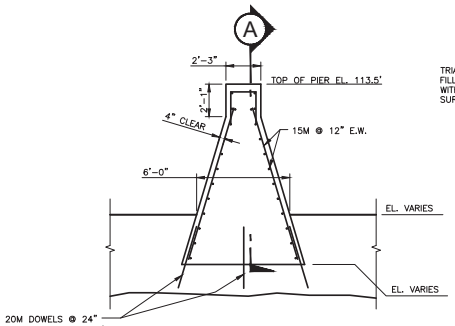
UNCONTROLLED SPILLWAY DETAIL (BAY 8)

1/4"= 1'-0"



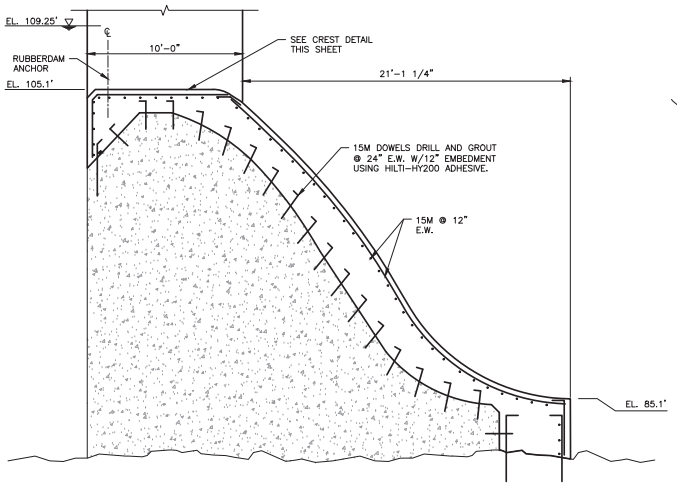
TRIANGULAR CONCRETE FILLET DETAIL

N.T.S.



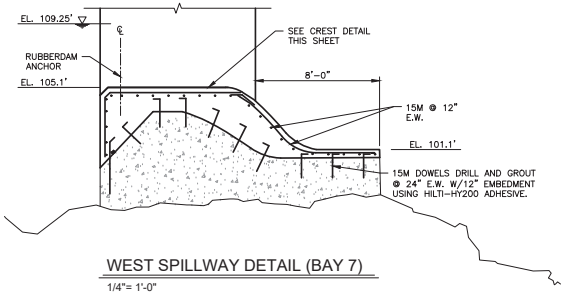
TYPICAL PIER DETAIL

1/4"= 1'-0"



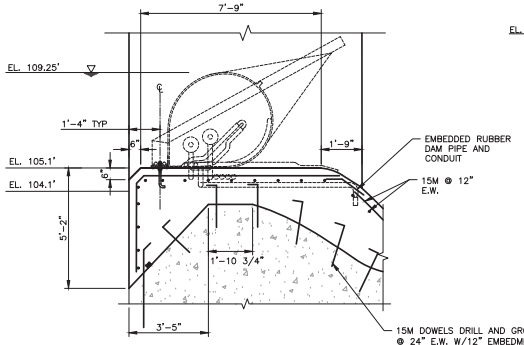
WEST SPILLWAY TYPICAL DETAIL (BAYS 6&5)

1/4"= 1'-0"



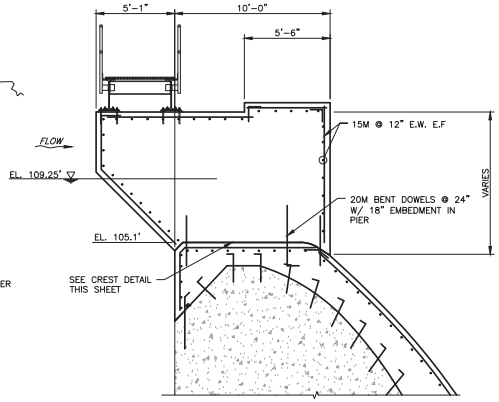
WEST SPILLWAY DETAIL (BAY 7)

1/4"= 1'-0"



RUBBERDAM CREST TYPICAL

3/8"= 1'-0"



TYPICAL PIER SECTION

1/4"= 1'-0"

A 90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

310-03

Kleinschmidt

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PRINTED: Dec. 18, 2020 - 8:42 AM

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REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-18

W.O. XXXX

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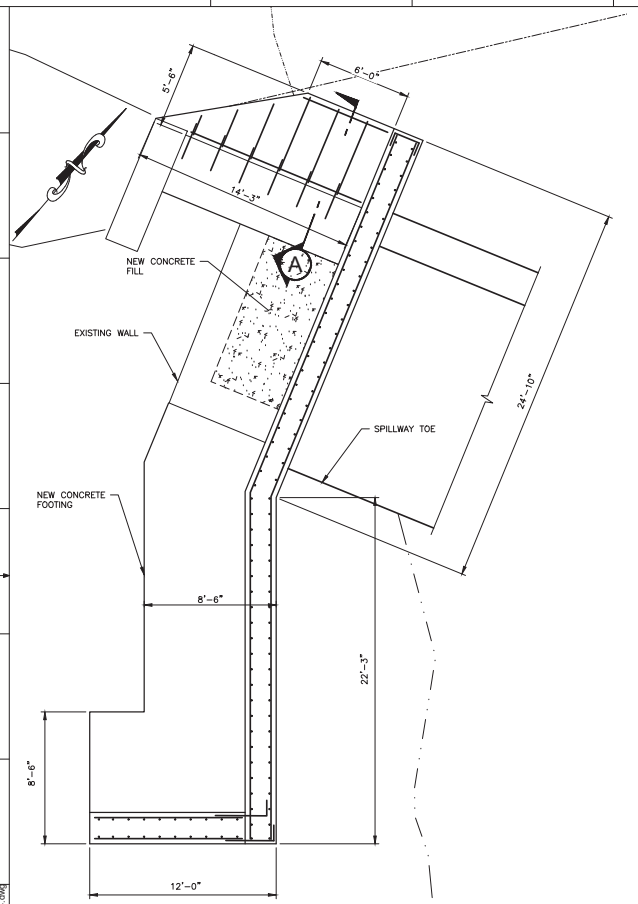
RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SPILLWAY RESURFACING DETAILS

H 0 9 6 H 1 1 6 3 1 0 0 0 5 5 REV. C

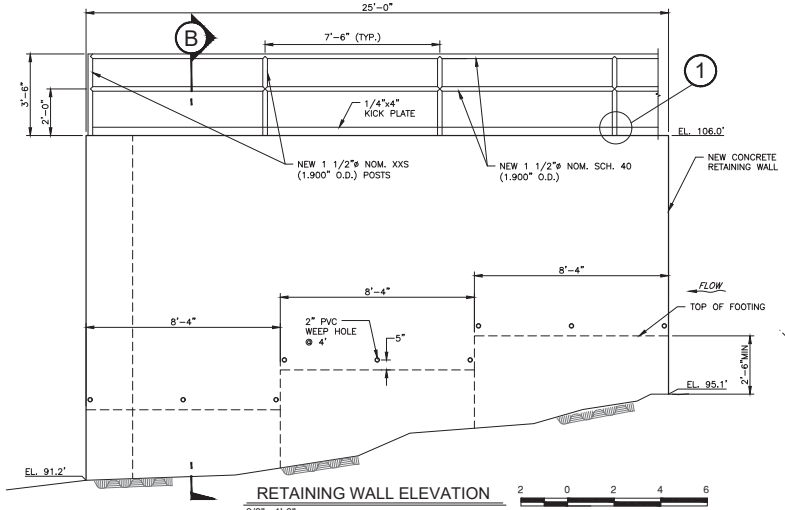
DWG.NO.



RETAINING WALL PLAN @ EL. 105.0'

1/4"= 1'-0"

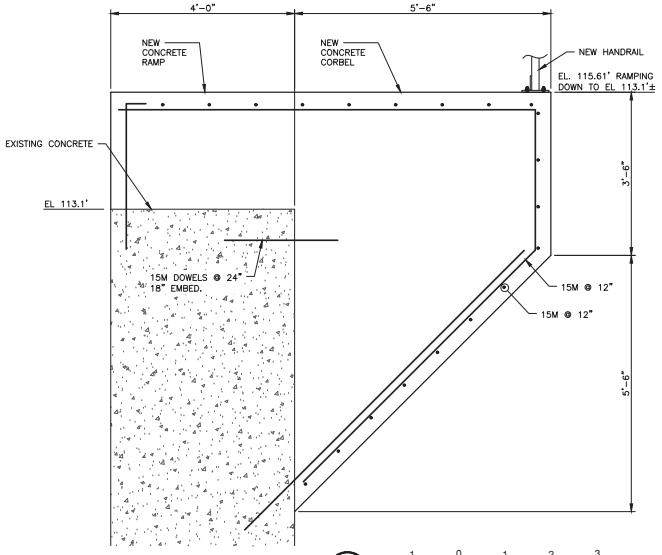
SCALE IN FEET



RETAINING WALL ELEVATION

3/8"= 1'-0"

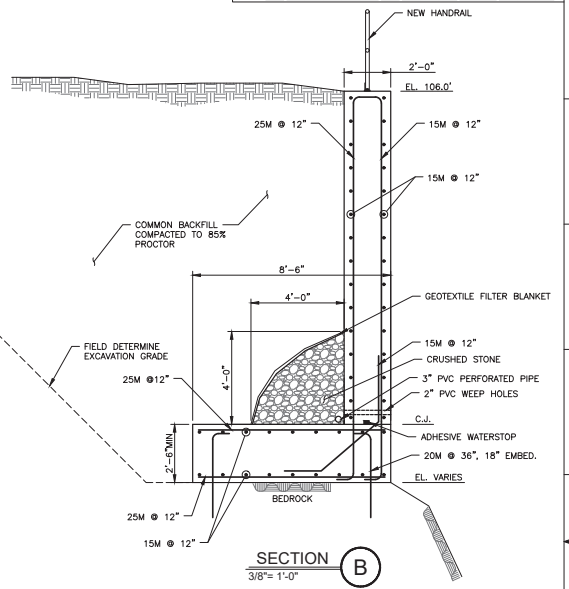
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SECTION A

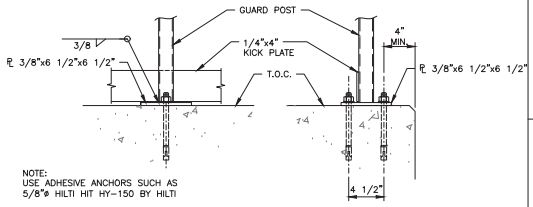
3/4"= 1'-0"

SCALE IN FEET



SECTION B

3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

SCALE IN INCHES

90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

310-04

Kleinschmidt

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PRINTED: Dec. 18, 2020 - 8:41 AM

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SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL _____ E & I _____

MECH _____ CONST _____

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-18

W.O. XXXX

Nova Scotia POWER An Emera Company energy everywhere.

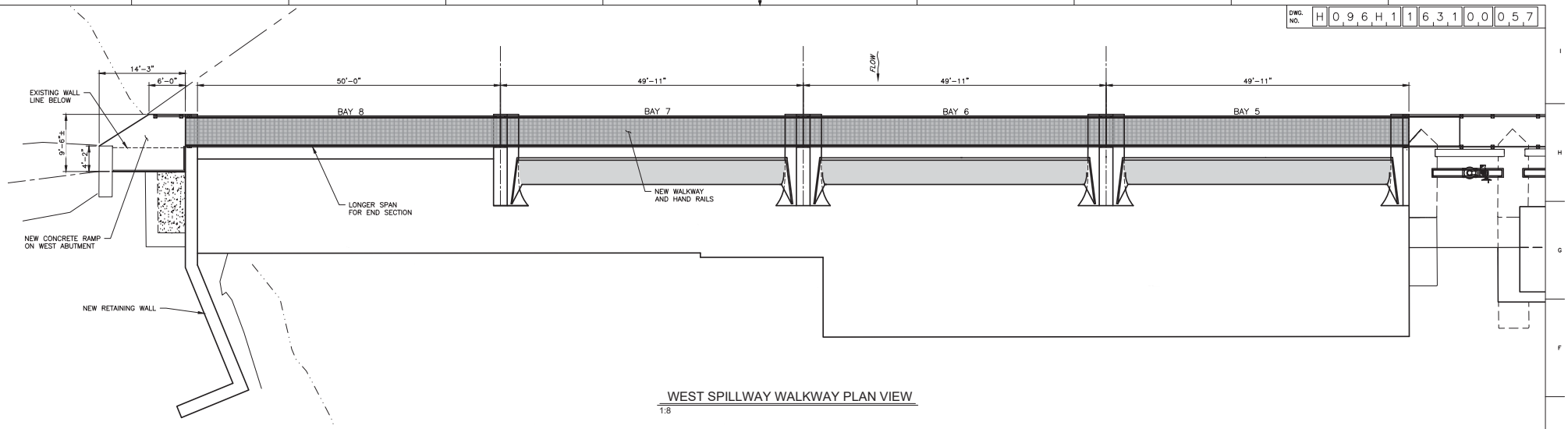
RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

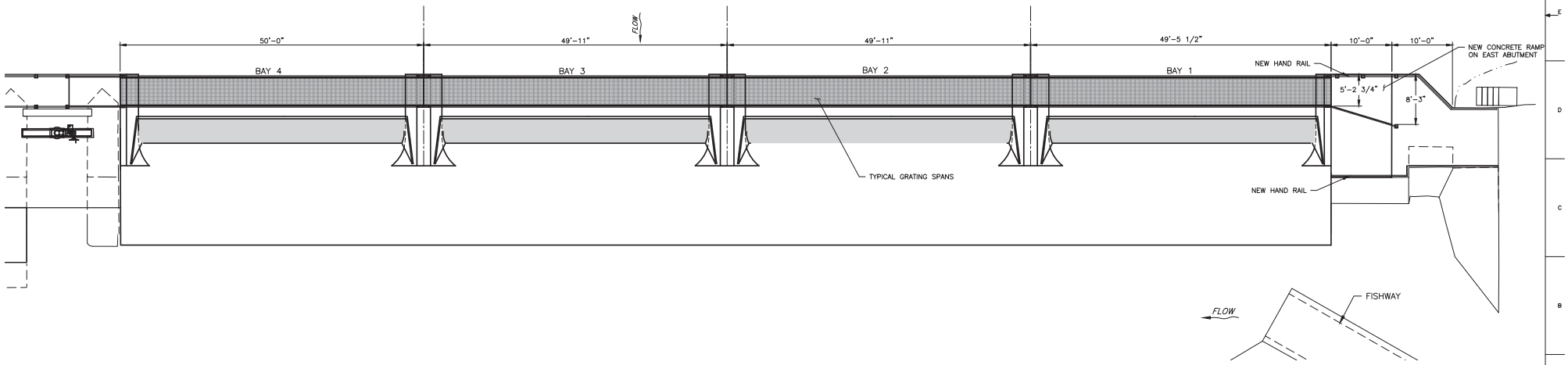
NEW CONCRETE RETAINING WALL AND PIER DETAILS

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 6 REV. C

DWG. NO. H096H1163100057



WEST SPILLWAY WALKWAY PLAN VIEW
1:8



EAST SPILLWAY WALKWAY PLAN VIEW
1:8

8 0 8 16
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

320-01

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

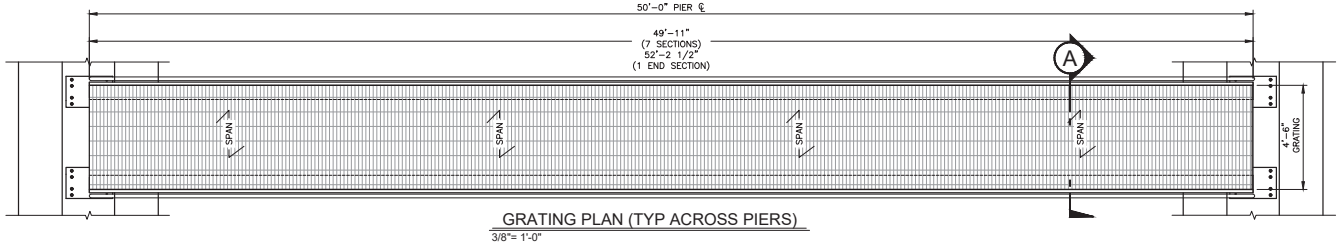
SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2020-12-11
W.O.	XXXX

Nova Scotia POWER An Emera Company energy everywhere.

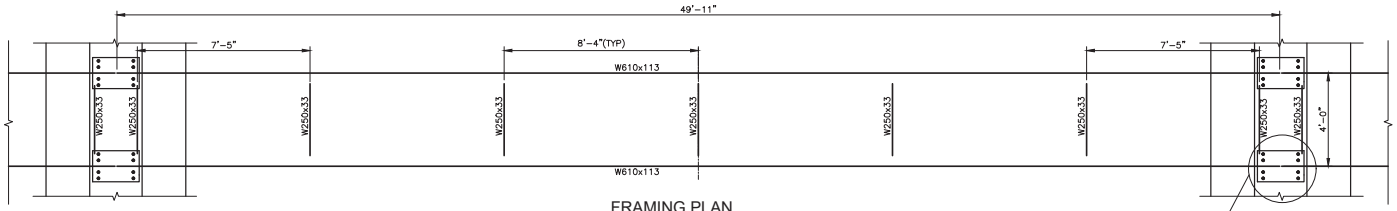
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW

DWG.NO. H096H1163100057 REV. C

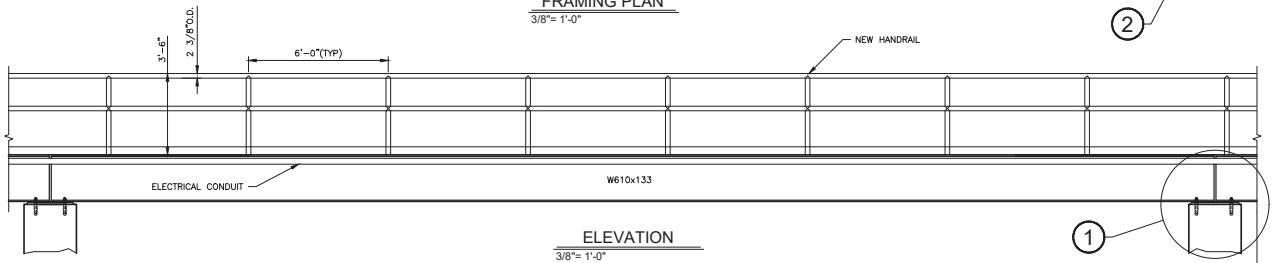
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GRATING PLAN (TYP ACROSS PIERS)
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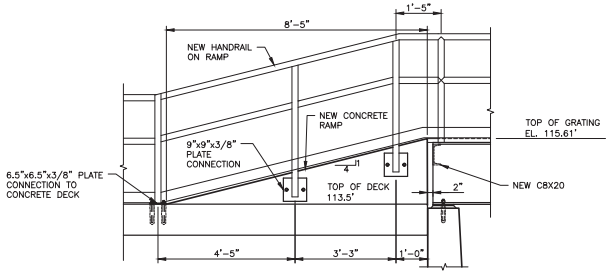


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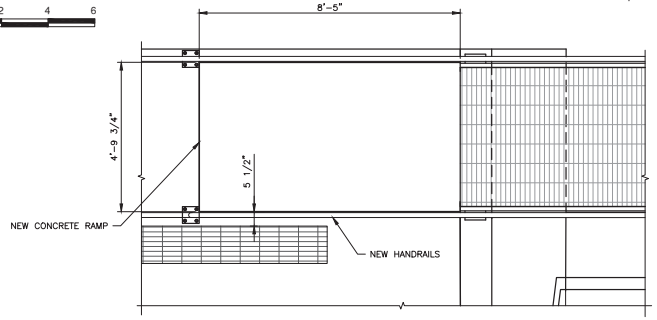


ELEVATION
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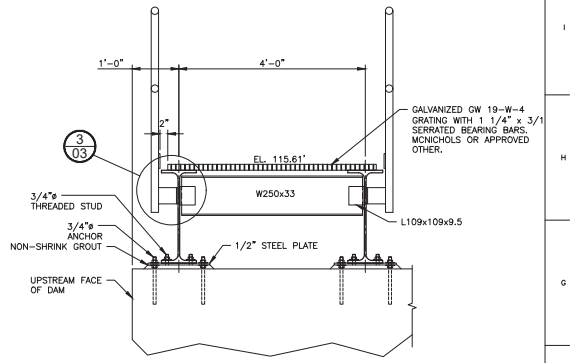


SLUICEWAY/WALKWAY TRANSITION DETAIL
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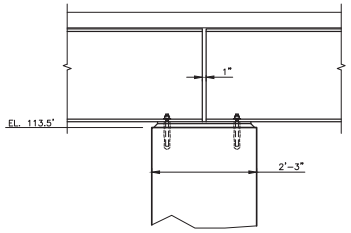


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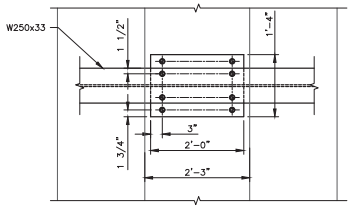


SECTION A
3/4"= 1'-0"



DETAIL 1
3/4"= 1'-0"

1 0 1 2 3
SCALE IN FEET



DETAIL 2
3/4"= 1'-0"

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320-02

Kleinschmidt

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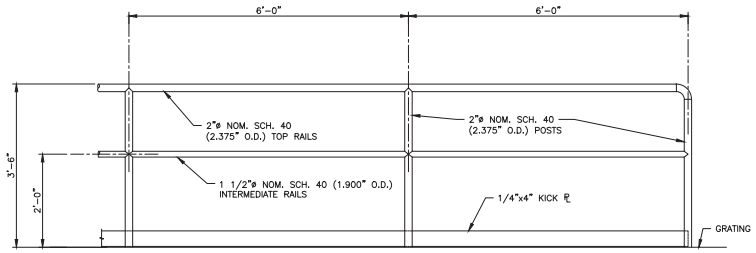
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW STEEL
GRATED ACCESS PLATFORM

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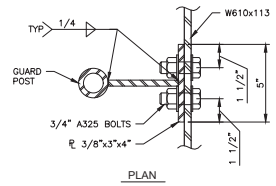


STEEL ACCESS PLATFORM TYPICAL HANDRAIL DETAIL

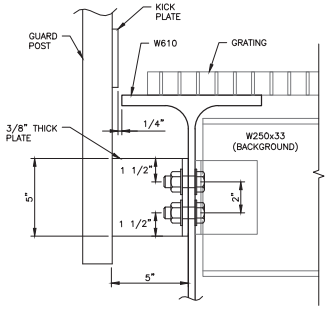
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SCALE IN FEET



PLAN



DETAIL 3/02

3"= 1'-0"

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320-03

Kleinschmidt

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

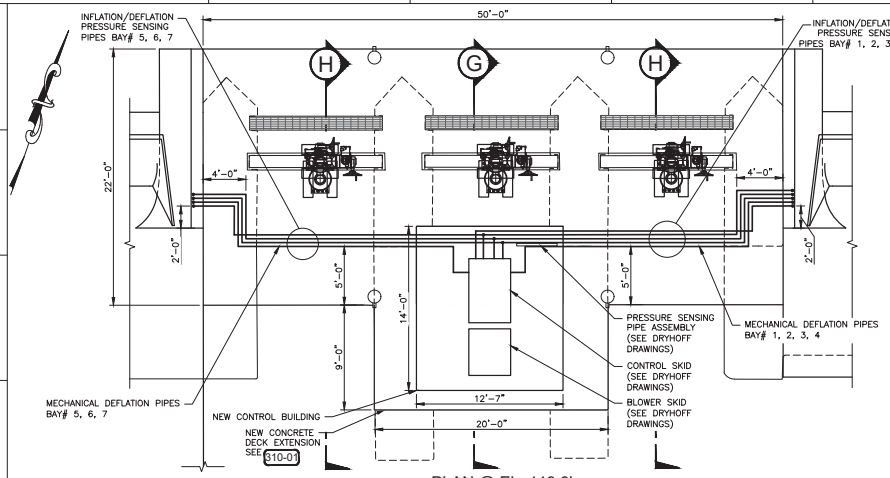
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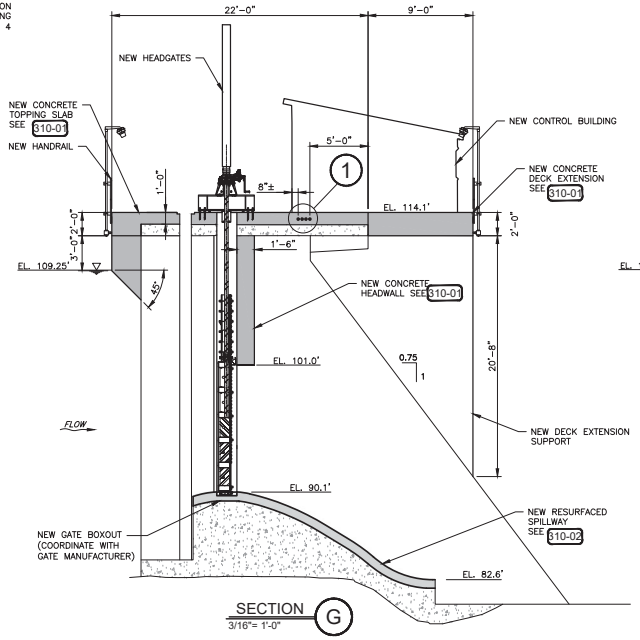
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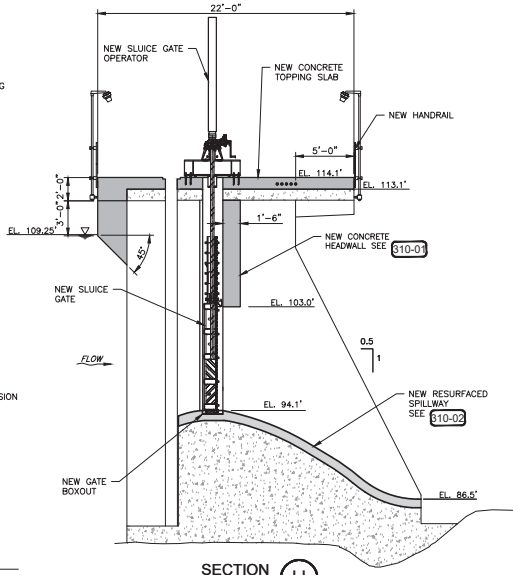
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PLAN @ EL. 113.6'
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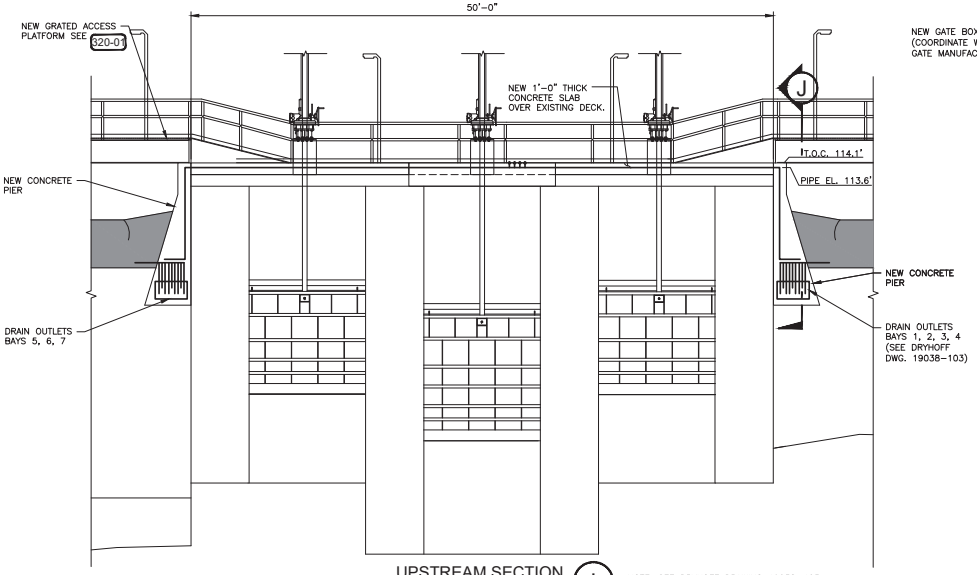


SECTION G
3/16"= 1'-0"



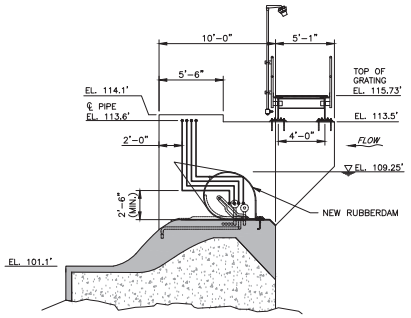
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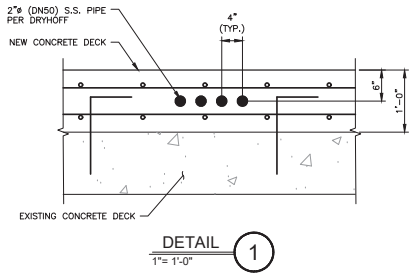


UPSTREAM SECTION I
3/16"= 1'-0"

NOTE: SEE DRYHOFF DRAWING 19038-103



SECTION J
3/16"= 1'-0"



DETAIL 1
1"= 1'-0"

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330-01

Kleinschmidt

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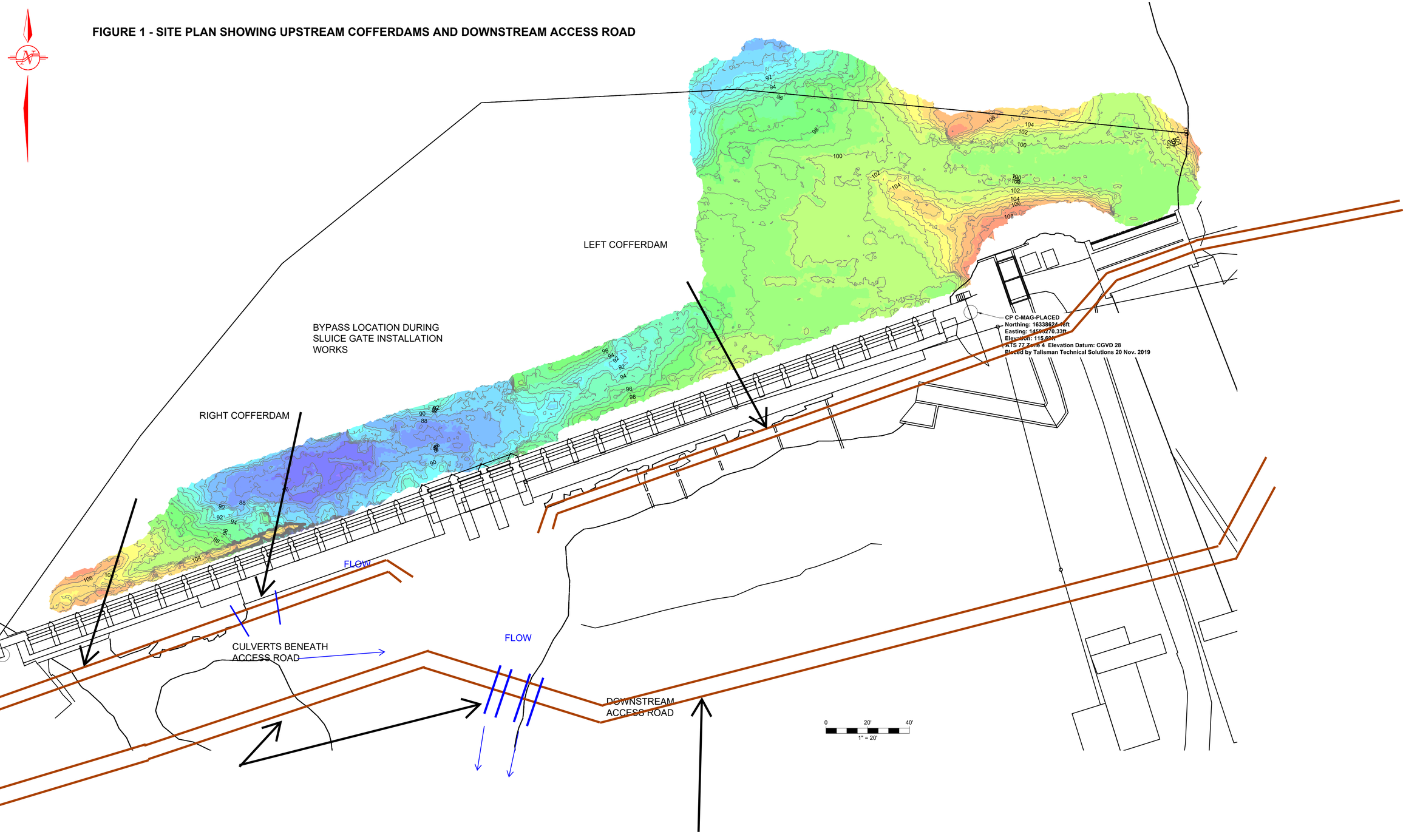
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

RUBBER DAM PIPING AT SLUICEWAY

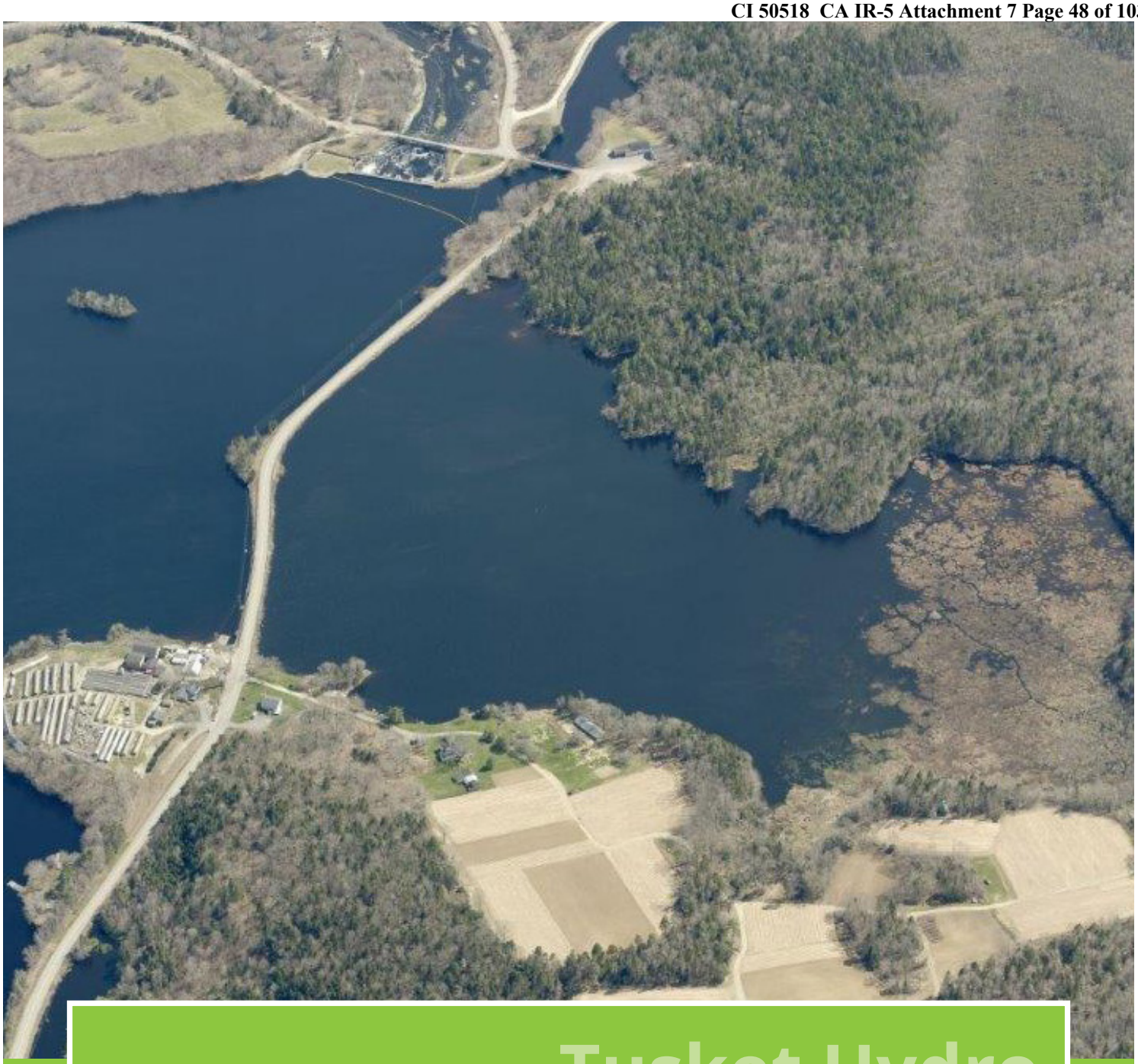
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APPENDIX B – Water Management and Construction Sequencing

FIGURE 1 - SITE PLAN SHOWING UPSTREAM COFFERDAMS AND DOWNSTREAM ACCESS ROAD



APPENDIX C – Tusket Main Dam Refurbishment Wetland Monitoring Plan



Tusket Hydro
Dam Refurbishment Wetland Monitoring Plan

Final Report

CBCL

201222.00 • August 2020

August 12, 2020

Jenny LeBlanc, MREM
Environmental Scientist
Nova Scotia Power
E-Mail: jennifer.leblanc@nspower.ca

Dear Ms. LeBlanc:

RE: Tusket Hydro Dam Refurbishment Wetland Monitoring Plan - FINAL

Please find attached CBCL's proposed Wetland Monitoring Plan for Nova Scotia Power's planned dewatering activities in the Tusket Hydro System as part of required dam refurbishment activities. We have addressed the comments you provided via email correspondence on July 7, 2020, as well as the comments provided by Ian Bryson of NSE on July 30, 2020. We trust that the foregoing material is sufficient for the purposes of establishing an ecological and shallow groundwater monitoring program for the proposed project. Please feel free to contact the undersigned with any questions.

Yours very truly,

CBCL Limited

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Project No: 201222.00

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Chapter 1 Introduction

On behalf of Nova Scotia Power Inc. (NSPI), CBCL Limited (CBCL) has developed this wetland monitoring plan for the planned lowering of water levels in Lake Vaughan, Gavels Lake, and Kings Lake (the Project Area) in Yarmouth County, NS. NSPI plans to lower the water levels in Lake Vaughn by approximately 4 metres to allow maintenance and repair of the Tusket Hydro System dam. The water levels in Gavels Lake and Kings Lake will also decrease, though to a lesser degree. NSPI has indicated that the lake level will be lowered for six to eight months in 2020, and again for a period of six to eight months in 2021. This may cause corresponding changes in Gavels Lake and Kings Lake, which are connected to Lake Vaughn by a relatively narrow channel. Lowered lake levels have the potential to affect riparian wetlands associated with these lakes. The proposed monitoring plan is designed to assess changes to wetland plant species cover values and health, soil moisture levels, and water levels throughout the duration of the Project.

The Project area is located within the Tusket Islands Ecodistrict, which is a narrow coastal band along Nova Scotia's southwestern shore. While the gentle rolling topography and underlying geology of this district are similar to neighbouring ecodistricts, the Tusket Island Ecodistrict is distinguished by the influence of the adjacent Gulf of Maine, resulting in this area having the mildest winters in the province and a longer frost-free period than any other place in Atlantic Canada. Black spruce (*Picea mariana*) is the dominant species along the shore, along with white spruce and balsam fir. In more sheltered areas, red spruce, white pine (*Pinus strobus*), red oak (*Quercus rubra*) and tolerant hardwoods occur. Rivers, lakes, inlets, and islands are abundant (Neily et al., 2005).

Chapter 2 Desktop Review

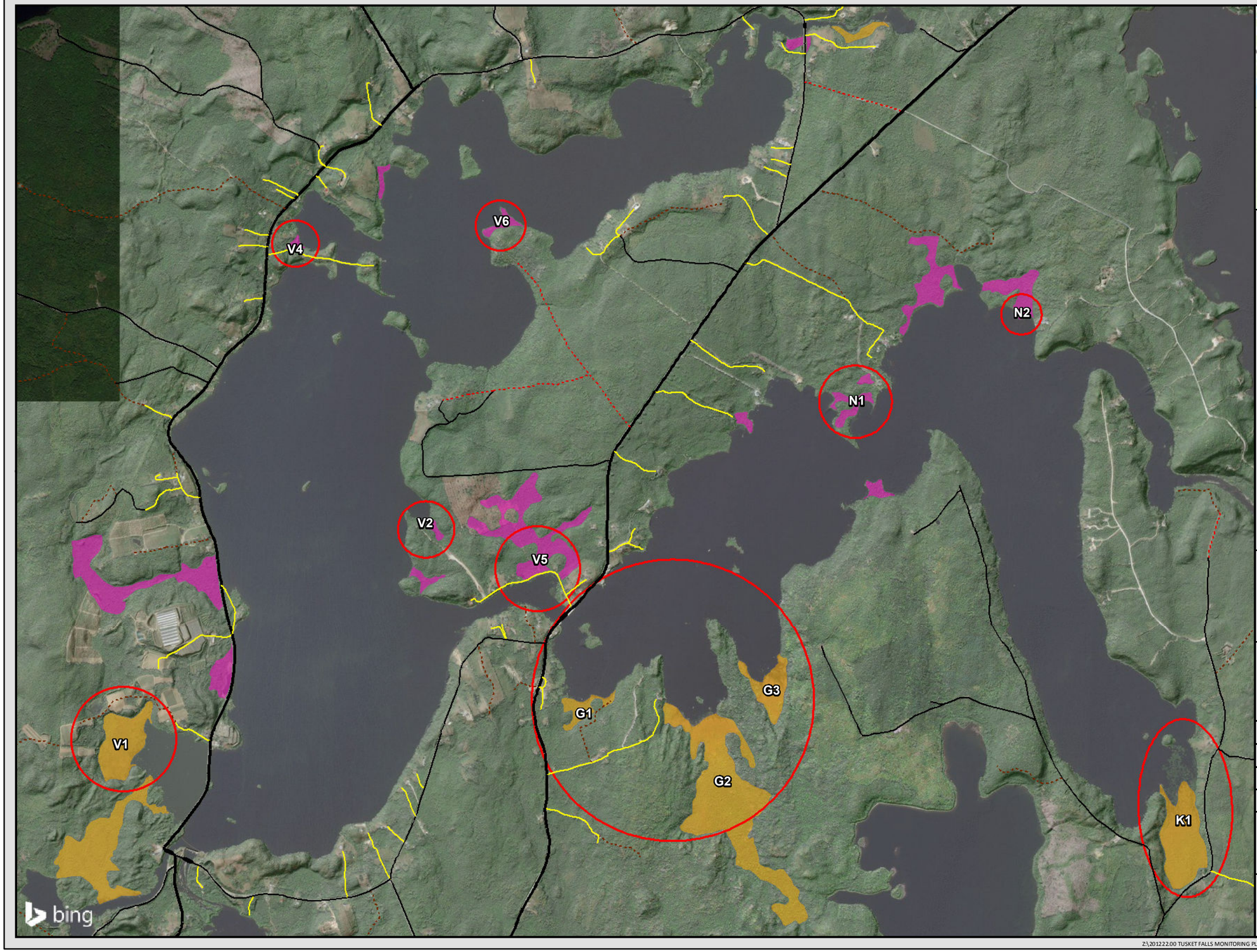
2.1 Wetlands in the Project Area

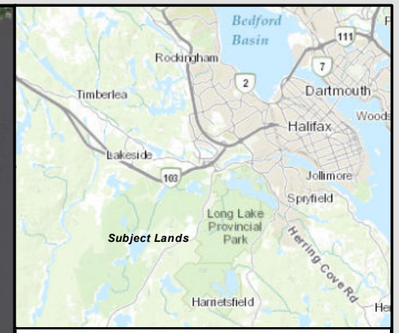
Based on a desktop review of available mapping data, a number of wetlands are present within the Project Area, particularly along the lake shorelines. These wetlands are shown on Figure 1. Many of these appear to be wetland complexes with both shrub swamp and treed swamp components, which are common in this part of the Province.

2.2 Species at Risk and Species of Conservation Concern

An Atlantic Canada Conservation Data Centre (AC CDC) listing of rare and endangered species sightings was acquired for an area within 5 km buffer zone around a polygon encompassing Lake Vaughan, Gavels Lake, The Narrows, and Kings Lake (AC CDC, 2020). This search was conducted to determine if Species at Risk (SAR) or Species of Conservation Concern (SoCC) occur on or near the property. An explanation of rarity rankings is provided in Appendix A – Definition of Rarity Ranks and Legislative Statuses; the full AC CDC report is provided in Appendix B – AC CDC Rare Taxa Report.

The review of AC CDC's databases found a number of SoCC reported within 5 km of the Project Area. Of these 120, 24 are designated as SAR per either SARA or NS ESA. These SAR species, twelve of which are flora, are presented in Table 2.1. Only nine of these species are vascular plants. Fauna SAR species are outside of the scope of this wetland monitoring plan.





Legend

- Paved Road
- Unpaved Road
- Lanes / Driveways
- ROAD ruin/inactive/abandoned
- Cart Track / Footpath
- Proposed Wetland Monitoring Locations

Wetland Interpretation - Monitoring Sites

- Candidate Sites
- Recommended Sites

CBCL LIMITED
Consulting Engineers

TUSKET FALLS WETLAND MONITORING PLAN

Wetland Locations

Drawn: MD	Date: 19/06/2020
Checked: CB	Project: 201222.00
Approved:	Scale @ 11"x17" 1:19,054

APPENDIX A

Notes:

0 225 450 900 m

Coordinate System: NAD 1983 UTM Zone 20N
Units: Meter

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Table 2.1: Species of Conservation Concern and Species at Risk reported from within 5 km of the Project Area by AC CDC (AC CDC, 2020)

Taxonomic Group	Common Name	Scientific Name	COSEWIC	SARA	NS ESA	AC CDC NS S-Rank	# Records (Closest in km)
Bird	Bank Swallow	*Riparia riparia*	T	T	E	S2S3B	2 (4.4 ± 1.0)
Bird	Barn Swallow	*Hirundo rustica*	T	T	E	S2S3B	2 (1.3 ± 7.0)
Bird	Canada Warbler	*Cardellina canadensis*	T	T	E	S3B	4 (1.3 ± 7.0)
Bird	Rusty Blackbird	*Euphagus carolinus*	SC	SC	E	S2B	3 (1.3 ± 7.0)
Bird	Common Nighthawk	*Chordeiles minor*	SC	T	T	S2B	4 (1.3 ± 7.0)
Bird	Olive-sided Flycatcher	*Contopus cooperi*	SC	T	T	S2B	2 (1.3 ± 7.0)
Bird	Eastern Wood-Pewee	*Contopus virens*	SC	SC	V	S3S4B	14 (1.3 ± 7.0)
Bird	Evening Grosbeak	*Coccothraustes vespertinus*	SC	SC	V	S3S4B,S3N	1 (1.3 ± 7.0)
Fish	Atlantic Whitefish	*Coregonus huntsmani*	E	E	E	S1	2 (3.3 ± 1.0)
Fish	Atlantic Salmon	*Salmo salar*	E,T,SC			S1	1 (5.9 ± 1.0)
Insect	Monarch	*Danaus plexippus*	E	SC	E	S2B	2 (7.8 ± 0.0)
Nonvascular Plant	Graceful Felt Lichen	*Erioderma mollissimum*	E	E	E	S1S2	1 (4.1 ± 0.0)
Nonvascular Plant	Black-foam Lichen	*Anzia colpodes*	T	T	T	S3	1 (4.9 ± 1.0)
Nonvascular Plant	Blue Felt Lichen	*Pectenia plumbea*	SC	S	V	S3	1 (4.2 ± 0.0)
Reptile	Snapping Turtle	*Chelydra serpentina*	SC	SC	V	S3	1 (7.8 ± 0.0)
Vascular Plant	Pink Coreopsis	*Coreopsis rosea*	E	E	E	S1	381 (0.6 ± 1.0)
Vascular Plant	Plymouth Gentian	*Sabatia kennedyana*	E	E	E	S1	368 (0.5 ± 1.0)

Taxonomic Group	Common Name	Scientific Name	COSEWIC	SARA	NS ESA	AC CDC NS S-Rank	# Records (Closest in km)
Vascular Plant	Coast Pepper-Bush	*Clethra alnifolia*	E	T	V	S1	1 (4.4 ± 0.0)
Vascular Plant	Eastern Baccharis	*Baccharis halimifolia*	T	T	T	S1	1 (6.5 ± 6.0)
Vascular Plant	Water Pennywort	*Hydrocotyle umbellata*	SC	SC	E	S1	133 (4.9 ± 0.0)
Vascular Plant	Eastern Lilaeopsis	*Lilaeopsis chinensis*	SC	SC	V	S2	32 (3.7 ± 0.0)
Vascular Plant	Long's Bulrush	*Scirpus longii*	SC		V	S3	5 (5.4 ± 0.0)
Vascular Plant	Eastern White Cedar	*Thuja occidentalis*			V	S1	3 (4.8 ± 0.0)
Vascular Plant	Spotted Pondweed	*Potamogeton pulcher*			V	S2S3	14 (4.9 ± 0.0)

E= Endangered, T= Threatened, V= Vulnerable, SC= Special Concern, NaR= Not at Risk
Bold text = Species at Risk

The large number of SAR and SoCC records is due to the Project Area's location within the Tusket Islands Ecodistrict, a part of Nova Scotia which occurs with the range of a group of primarily wetland plants known as the Atlantic Coastal Plain flora, many of which are uncommon or rare in NS. However, few, if any, of the wetland flora SAR records are from within or near the Project Area. Many of these records are many decades old, likely from before the water level in the Project Area rose significantly due to the construction of the Tusket dam. It is quite likely that these records are no longer still present, however, suitable habitat for these shoreline species may now be present around the new shoreline. NSE has stated that monitoring of any previously reported SAR within wetlands in the Project Area is not expected, however if wetland SAR or SoCC are detected during the baseline assessment these specimens should be incorporated into the Tusket Falls Wetland Monitoring Plan (I. Bryson, Provincial Wetland Specialist, Nova Scotia Environment*, pers. comm*. June 2020).

2.3 Wetlands of Special Significance

Wetland of Special Significance (WSS) are defined in the Nova Scotia Wetland Conservation Policy (NSE, 2011). These are generally wetlands known to support SAR or their habitat, or are special wetland types, such as salt marshes. While SAR species have historically been reported from the Lakes in the Project Area, these are primarily older records, from historical shoreline or island locations which are now submerged due to the large water level increase since these records were obtained. Therefore, as these SAR records (or their shoreline habitat) are likely no longer extant, these wetlands are unlikely to be considered Wetlands of Special Significance by NSE. It is possible, however, that new records of SAR may be found during the vegetation assessment for this Project.

Chapter 3 Monitoring Program

Monitoring stations will be established prior to alteration of the lake level in order to collect baseline data. Subsequent monitoring data will be collected during the periods that the lake level is lowered, during the first period that the lake level is restored, and following completion of repairs. Data collected during the Project will show the degree of drying of wetland areas, and of associated changes to vegetation.

Details of the plan are provided in the following subsections.

3.1 Identification of Potential Monitoring Stations

A total of seven monitoring stations will be established at several wetlands on the shores of Lake Vaughan, Gavels Lake, The Narrows, and Kings Lake, as identified from mapping from the Nova Scotia Department of Lands and Forestry (NSLF), LIDAR mapping, and aerial photography. Eleven candidate monitoring sites are shown in Figure 1, and summarized in Table 3.1. Sites which are expected to show impacts due to water level decreases have been targeted, and a mix of large and small wetlands have been included to monitor potential impacts to wetlands of varying sizes. Access to monitoring stations and specific locations for siting will be determined as a part of initial Site Reconnaissance activities. Efforts will be made to focus on sites accessible by land, as many of the lakeshore wetlands look difficult to access via boat.

Table 3.1: Candidate Wetland Monitoring Stations, Tusket Hydro Dam Refurbishment Project

Station ID	Location	PID
V1	Lake Vaughn (Southwest)	90315789; 90312893
V2	Lake Vaughn (East)	90331091; 90127622; 90313271
V4	Lake Vaughn (East)	90129909; 90129933; 90129941

Station ID	Location	PID
V5	Lake Vaughn (East)	90127606; 90127622; 90297599; 90127598; 90297607; 90127580; 90127614; 90313271
V6	Lake Vaughn (East)	90127408; 90313271
N1	The Narrows	90127382; 90127366; 90230665
N2	The Narrows	90127283; 90230616; 90230665
G1	Gavels Lake (Southwest)	90039264; 90039322; 90230665
G2	Gavels Lake (South-centre)	90325085; 90230665
G3	Gavels Lake (Southeast)	90325085; 90039348; 90230665
K1	Kings Lake (South)	90230665

3.2 Baseline Assessment

A range of baseline wetland, vegetation, and hydrological data is anticipated to be collected in July 2020 prior to initiation of drawdown activities. These are described in the following subsections.

3.2.1 Establishment of Wetland Photo Stations

Wetland photo stations should be established throughout the Project area from a series of points which are easily accessible by road and which allow a broad view of portions of the Lakes and associated wetlands. These spots (location and number to be determined) should be photographed during every site visit.

3.2.2 Baseline Wetland Edge Mapping

In the summer of 2020, partial wetland boundaries will be determined at a number of monitoring locations throughout the Project Area. Note that the entire wetland will **not** be delineated, but instead a 50 m section along the wetland perimeter at each sampling location will be delineated. Wetland determination and delineation will be performed as per the protocols outlined by the US Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory, 1987), which relies on the presence of hydrophytic vegetation, wetland hydrology, and wetlands soils to determine the wetland edge. This edge will be mapped using handheld GPS along a section of the wetland boundary roughly parallel to the lake shoreline. This will aid in ground-truthing the desktop wetland delineation exercise and will be useful in determining if the wetland boundary fluctuates post-construction.

To supplement the partial wetland field delineations, a desktop assessment of the full boundaries of each monitored wetland will be conducted using available LiDAR data and the LiDAR-based 'Wet Areas Mapping' (WAM) provided by NSE.

3.2.3 Baseline Vegetation Data Collection

Also in the summer of 2020, ecological baseline data will be collected from the same monitoring locations selected for partial wetland delineation. At each location, a number of 5 m x 5 m reference plots will be established at a minimum of two (2) presentative locations within the subject wetlands. These plots will run along a transect perpendicular to the lakeshore, and the vegetation cover within these plots will be assessed. Specific quadrat locations will be selected to accommodate changes in vegetation types along the transects. In cases where the vegetation is very homogenous, a larger number (at least 5) of smaller (1x1 m) quadrats may be conducted along the transect instead. The corners of the large quadrats and the ends of the transects will be marked with wooden stakes to aid in relocating the plots during later assessments. The data collected from each pre-construction assessment plot should include the following:

- Description of wetland type;
- Vegetative strata present (tree layer, shrub layer, herbaceous (ground) vegetation layer);
- Species present;
- Wetland indicator status of each species present;
- Percent cover value of each species;
- Percent cover value of bare soil;
- Evidence and percent cover of stressed or wilted vegetation
- Photographs of each plot, taken from same viewpoint and using same focal length each year; and
- UTM coordinates of each plot corner.

A list of all vegetation species documented in the general area of each monitoring location will also be created.

This assessment should take place in July, when vegetation is well-developed, and prior to the initiation of drawdown activities.

3.2.3.1 Species and Risk and Species of Conservation Concern

As discussed in Section 2.2, several SAR plant species are known from the area encompassing the Project Area. None are currently known to occur within the wetlands proposed for monitoring. If any are found during initial baseline surveys, their locations will be georeferenced using a handheld GPS. Data on their abundance and reproductive state (i.e., blooming or not) will be recorded. A map will be prepared documenting these locations for inclusion in the annual report.

3.2.4 Baseline Wetland Functional Assessment

A wetland functional assessment will be performed on each wetland selected for monitoring. The functional assessment protocol employed for this study will be the Wetland Ecosystem Services Protocol for Atlantic Canada (WESP-AC): Non-tidal Wetlands

(Adamus, 2018), a regionalized adaptation of the Wetland Evaluation Technique (WET; Adamus, 1983) and the Wetland Ecosystem Services Protocol for the United States (WESPUS; Adamus, 2011). WESP-AC is a standardized method for rapidly assessing important non-tidal wetland functions and their associated benefits, ultimately allowing for direct and quantitative comparison (using numeric scores) between wetlands as a means of prioritization (Adamus, 2016). WESP-AC determines 18 individual ecosystem functions and their associated benefits (Table 3.2) based upon input of upwards of 129 ecological characteristics (indicators) into a logic-based model. Indicators are obtained through a combination of field observations (in this case, executed during wetland delineation and baseline assessment activities) and desktop research using a variety of data sources (i.e., ArcGIS, Pictometry Aerial Imagery, Google Earth Pro, Nova Scotia Provincial Landscape Viewer). WESP-AC also determines outputs for other wetland attributes which are considered general indicators of wetland integrity, such as wetland sensitivity, wetland ecological condition, and wetland stress.

Table 3.2: Ecosystem Functions and Benefits Assessed by WESP-AC

Function	Definition	Potential Benefit
HYDROLOGIC FUNCTIONS		
Water Surface Storage (WS)	The effectiveness for storing runoff or delaying the downslope movement of surface water for long or short periods.	Flood control and maintaining ecological systems.
Stream Flow Support (SFS)	The effectiveness for contributing water to streams, especially during the driest part of a growing season.	Supporting fish and other aquatic life.
WATER QUALITY MAINTENANCE FUNCTIONS		
Water Cooling (WC)	The effectiveness for maintaining or reducing temperature of downslope waters.	Supporting cold water fish and other aquatic life.
Sediment Retention & Stabilisation (SR)	The effectiveness for intercepting and filtering suspended inorganic sediments thus allowing their deposition; reducing current velocity; resisting erosion; and stabilising underlying sediments or soil.	Maintaining quality of receiving waters and protecting shoreline structures from erosion.
Phosphorus Retention (PR)	The effectiveness for retaining phosphorus for long periods (>1 growing season).	Maintaining quality of receiving waters.
Nitrate Removal & Retention (NR)	The effectiveness for retaining particulate nitrate and converting soluble nitrate and ammonium to nitrogen gas while generating little or no nitrous oxide (a potent greenhouse gas).	Maintaining quality of receiving waters.
Carbon Sequestration (CS)	The effectiveness of a wetland both for retaining incoming particulate and dissolved carbon, and converting carbon dioxide gas to	Maintaining quality of receiving waters.

Function	Definition	Potential Benefit
	organic matter (particulate or dissolved) through photosynthesis. The effectiveness to then retain that organic matter on a net annual basis for long periods while emitting little or no methane (a potent "greenhouse gas").	
Organic Nutrient Export (OE)	The effectiveness for producing and subsequently exporting organic nutrients (mainly carbon), either particulate or dissolved. It does not include exports of carbon in gaseous form or as animal matter.	Supporting food chains in receiving waters.
ECOLOGICAL (HABITAT) FUNCTIONS		
Anadromous Fish Habitat (FA)	The capacity to support an abundance and diversity of native anadromous fish for functions other than spawning.	Supporting recreational and ecological values.
Resident Fish Habitat (FR)	The capacity to support an abundance and diversity of native non-anadromous fish.	Supporting recreational and ecological values.
Aquatic Invertebrate Habitat (INV)	The capacity to support an abundance and diversity of invertebrate animals which spend all or part of their life cycle underwater, on the water service, or in moist soil.	Supporting salmon and other aquatic life; and maintaining regional biodiversity.
Amphibian & Reptile Habitat (AM)	The capacity to support or contribute to an abundance and diversity of native amphibians (e.g., frogs, toads, salamanders) and turtles.	Maintaining regional biodiversity.
Waterbird Feeding Habitat (WBF)	The capacity to support an abundance and diversity of waterbirds that migrate or winter but do not breed in the region.	Supporting hunting and ecological values; and maintaining regional biodiversity.
Waterbird Nesting Habitat (WBN)	The capacity to support an abundance and diversity of waterbirds that nest in the region.	Maintaining regional biodiversity.
Songbird, Raptor, & Mammal Habitat (SBM)	The capacity to support an abundance and diversity of native songbird, raptor, and mammal species and functional groups, especially those that are most dependent on wetlands or water.	Maintaining regional biodiversity.
Native Plant Habitat (PH)	The capacity to support a diversity of native vascular and non-vascular species and functional groups, especially those that are most dependent on wetlands and water.	Maintaining regional biodiversity and food chains.

Function	Definition	Potential Benefit
Pollinator Habitat (POL)	The capacity to support pollinating insects and birds.	Maintaining regional biodiversity and food chains.
Public Use & Recognition (PU)*	Prior designation of the wetland, by a natural resource or environmental agency, as some type of special protected area. Also, the potential and actual use of a wetland for low-intensity outdoor recreation, education, or research.	Commercial and social benefits of recreation. Protection of prior public investments.

* A benefit rather than a function of wetlands.

The WESP-AC methods results in a score (0-10) for each assessed wetland Function and Benefit, which is then used to compare the currently wetland against a previously-assessed suite of similar wetlands within the province and provide a rating of Lower, Moderate, or Higher.

3.2.5 Baseline Hydrological Data Collection

In July 2020, hydrological monitoring stations will be installed in existing channels or ponded areas within or adjacent to the corresponding vegetation survey plots. Each station will consist of an anchoring stake, a stilling well, and a minipiezometer screened in the shallow sub-surface. An example of minipiezometer construction is provided in Appendix C. Each minipiezometer and two stilling wells will be instrumented with a data logger. The data loggers will programmed to measure and record continuous water levels and temperature data on an hourly basis. One station will also be instrumented with a barometric pressure and air temperature logger. The loggers will be installed at each site from April to November of each year, during the ice-free period.

Photographs of baseline conditions will be obtained at each location, and the sediment water content will be described as water covered, saturated, wet, moist, or dry. Water levels in the stilling well and minipiezometer will be measured manually using a water level tape.

The following data and observations will be collected:

- Each station will be photographed;
- The sediment water content will be described as water covered, saturated, wet, moist, or dry;
- Water levels in the stilling well and minipiezometer will be measured manually using a water level tape; and
- Check/download water level, barometric pressure, and temperature loggers.

While ideally at least several months of hydrological data would be collected prior to project initiation, it is recognized that collection of such data is not possible in this case due to the tight project timeline. Depending on the timing of initiation of Project drawdown activities in 2020, it may be possible to obtain a week or so of baseline water level data in July, which could be useful for comparison with subsequent July water levels.

3.3 Construction Monitoring

Vegetation and hydrological monitoring activities proposed to occur during the active phase of the Project (the Construction phase) are described in the following subsections.

3.3.1 Vegetation Monitoring

The ecological monitoring portion of this plan will include collection of the same data as was collected for the baseline assessment, also in July of each year prior to annual drawdown. The intention of this program is to detect any changes in the plant community composition arising from construction activities. Any observed vegetation shifts will be examined in relation to the monitoring well observations, which are paired with the reference plots.

Photographs of each monitoring station will be obtained during the hydrological monitoring visits. The wetland boundary will also be photographed. Photographs will be taken from same viewpoint and using same focal length each year. These images will allow a visual assessment of changes in vegetation communities during the Project.

3.3.1.1 Species and Risk and Species of Conservation Concern

Any SAR or SoCC plants that were detected during the initial vegetation assessment will be revisited in July of each year to monitor their apparent health and abundance.

3.3.2 Hydrological Monitoring

Each year, the loggers will be installed in April and retrieved in November, with the exception of 2020 when they will be installed in July. The hydrological monitoring stations will be visited at least three times per calendar year, as outlined in Chapter 4. During these visits, the same information as was gathered during the initial baseline visit will be gathered, including:

- Photographs of the station will be taken;
- The sediment water content will be described as water covered, saturated, wet, moist, or dry; and
- Water levels in the stilling well and minipiezometer will be measured manually using a water level tape.

Measurement of surface water and groundwater levels will provide indications of the magnitude and direction of groundwater flow either into or out of the monitored plot of

each wetland. Monitoring data will demonstrate whether surface water drainage and/or groundwater discharge helps to sustain moisture levels in the wetlands during construction. The hydrological monitoring program will provide indications of:

- Surface water levels and sediment moisture changes associated with lowered lake levels;
- Hydraulic head in the near-surface groundwater regime and/or desaturation of this zone;
- Groundwater interaction with areas of exposed water within each wetland;
- The magnitude of response of surface water and shallow groundwater levels to rain events; and
- Seasonal water level and temperature trends.

Hourly groundwater levels provide indications of seasonal and annual trends, and provide a method of comparing longer term pre- and post-construction conditions. Potential changes could include higher or lower absolute groundwater levels, with corresponding changes to the water table and/or vertical exchanges with surface water. Other effects could include increased or subdued seasonal responses to precipitation and air temperature.

A comparison of the surface water and groundwater level at each station will provide an estimate of the local vertical gradient. Vertical gradients can provide an indication of vertical flow between surface water and the shallow subsurface environment. Groundwater levels in a minipiezometer that are higher than the surrounding surface water indicate that groundwater is discharging to the water body. This effect is confirmed if surface water temperatures coincide more closely with groundwater temperatures rather than air temperature. Groundwater levels in a minipiezometer that are lower than the surrounding surface water indicate that surface water may be recharging the shallow groundwater regime. Vertical hydraulic gradients can change in response to rain events and seasonal effects. The degree and nature of surface water-groundwater interaction can serve as an indication of the function of wetlands in this context.

Pending the influence of surrounding drainage features and groundwater flow systems, the hydrological monitoring stations may be dry for some parts of the monitoring program. Hourly water level data will not be recorded if this occurs.

3.4 Post-Construction Monitoring

Post-construction monitoring is outside of the scope of this monitoring Plan, although it is known that five years of post-construction monitoring will be required by NSE once the Project has been completed and the lakes have permanently returned to normal operating levels. A post-construction monitoring plan for this project would most likely consist of a similar vegetation and hydrogeological monitoring plan as outlined for the construction monitoring plan, with an additional WESP-AC functional assessment conducted in year 5 of

post-construction monitoring for each wetland being monitored. This plan would likely run from 2022 to 2026, assuming the Project is completed in 2021.

Specific details and requirements for this monitoring will depend on wetland impacts and any subsequent NSE requirements as dictated by project approvals, and will be determined at a later date.

Chapter 4 Monitoring Schedule

During the preconstruction and construction periods, each monitoring station is proposed to be visited multiple times per year, as detailed below. Information on data to be gathered is also summarized. Note that this schedule assumes a late August start of dewatering activities in 2020 and 2021 and assumes levels will be raised in late December of those years. It is possible that not all site visits will be achievable due to seasonal ice conditions.

1. Initial visit (August 2020):
    a. Establish wetland monitoring plots;
    b. Assess wetland vegetation plots and conduct partial wetland delineations;
    c. Install hydrological monitoring stations;
    d. Document baseline hydrological conditions;
    e. Photograph existing vegetation, wetland, and hydrological conditions;
    f. Delineate partial wetland boundary at each monitoring location; and
    g. Conduct field portion of wetland functional assessment.
2. Within one week of establishment of lowered lake level (2020):
    a. Check water level, barometric pressure, and temperature loggers;
    b. Document hydrological conditions; and
    c. Photograph existing vegetation, wetland, and hydrological conditions.
3. November 2020:
    a. Retrieve water level, barometric pressure, and temperature loggers;
    b. Document hydrological conditions; and
    c. Photograph existing vegetation, wetland, and hydrological conditions.
4. One to two weeks after the lake level is restored (early 2021):
    a. Document hydrological conditions; and
    b. Photograph existing vegetation, wetland and hydrological conditions.
5. April 2021:
    a. Redeploy water level, barometric pressure, and temperature loggers;
    b. Document hydrological conditions; and
    c. Photograph existing vegetation, wetland, and hydrological conditions.
6. One to two weeks prior to the second lowering (July 2021):
    a. Assess wetland vegetation plots;
    b. Document hydrological conditions; and
    c. Photograph existing vegetation, wetland and hydrological conditions.
7. Within one week of establishment of the lowered level (summer/fall 2021):

a. Check water level, barometric pressure, and temperature loggers;
b. Document hydrological conditions; and
c. Photograph existing vegetation, wetland and hydrological conditions.

8. November 2021:
   a. Retrieve water level, barometric pressure, and temperature loggers;
   b. Document hydrological conditions; and
   c. Photograph existing vegetation, wetland, and hydrological conditions.
9. April 2022:
   a. Redeploy water level, barometric pressure, and temperature loggers;
   b. Document hydrological conditions; and
   c. Photograph existing vegetation, wetland and hydrological conditions.
10. One to two weeks after the lake has refilled (late 2021, early 2022):
    a. Check water level, barometric pressure, and temperature loggers;
    b. Document hydrological conditions; and
    c. Photograph existing vegetation, wetland and hydrological conditions.
11. One visit in July 2022 (after Project completion):
    a. Assess wetland vegetation plots;
    b. Document hydrological conditions; and
    c. Photograph existing vegetation, wetland and hydrological conditions.

Once the Project as been completed and the lake has been permanently returned to normal operating levels, five years of post-construction monitoring will be required by NSE. Assuming the Project is completed by early 2020, the post-construction monitoring schedule will be as follows for each wetland:

- 2022: Monitoring Year 1:
  - Vegetation and hydrological monitoring;
- 2023: Monitoring Year 2:
  - Vegetation and hydrological monitoring:
- 2024: Monitoring Year 3:
  - Vegetation and hydrological monitoring;
- 2025: Monitoring Year 4:
  - Vegetation and hydrological monitoring; and
- 2026: Monitoring Year 5:
  - Vegetation and hydrological monitoring; and
  - Wetland functional assessment (WESP-AC).

The post-construction monitoring plan may be modified based on the conditions observed during the construction monitoring program and any subsequent requirements from NSE. Any proposed modifications would be executed with the approval of NSE.

Chapter 5 Annual Reports

A report summarizing the result of the of the 2020 baseline vegetation, wetland, and hydrology assessments will be prepared for NSPI and submitted by the end of the fiscal year (March 30, 2021). This report will include detailed descriptions of each monitored wetlands, including detailed species lists and information on the presence of any rare or uncommon vegetation species (Species at Risk and Species of Conservation Concern). It will also document existing hydrological conditions at each monitoring station prior to the initiation of drawdown activities as well as observed changes in water levels documented in 2020.
The WESP-AC Excel worksheets completed as part of the wetland functional assessment will be submitted with the first monitoring report. The delineated and interpreted wetland boundaries will also be submitted with the report (as GIS shapefiles), and the wetland determination data sheets will also be included.

Annual monitoring reports will also be provided by the end of the fiscal year for each year of construction and post-construction monitoring. These reports will include the following information:

- Introduction;
- Methodology;
- Wetland Vegetation results from vegetation plots;
- Wetland photo station results;
- Hydrological results from minipiezometer;
- Discussion of findings; and
- Conclusion.

The final post-construction monitoring report will also include the results of the repeat wetland functional assessment.

Chapter 6 Health and Safety

As requested by NSPI, CBCL has also prepared a project-specific Health and Safety Plan (HSP) for this project. The plan is provided under separate cover.

Chapter 7 References

Adamus, P.R. 1983. *A Method for Wetland Functional Assessment. Vol. II*. Methodology. Report No. FHWA-IP-82-24. Federal Highway Administration, Washington, D.C.

Adamus, P.R. 2016. *Wetland Ecosystem Services Protocol for Atlantic Canada* (WESP-AC).

Adamus, P.R. 2018. *Wetland Ecosystem Services Protocol for Atlantic Canada* (WESP-AC) - *Update.*

Atlantic Canada Conservation Data Centre (AC CDC). 2020. Rare Taxa Data Report #6639 Yarmouth, NS, Prepared 12 June 2020 by J. Churchill.

Bryson, I. Provincial Wetland Specialist, Nova Scotia Environment*, pers. comm*. June 2020

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual,* Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS 39180-6199.

Neily,P.D., E. Quigley, L. Benjamin, B. Stewart, and T. Duke. 2005. ECOLOGICAL LAND CLASSIFICATION for NOVA SCOTIA - Revised Edition. Nova Scotia Department of Natural Resources. Renewable Resources Branch. 75 pp.

Appendix A

AC CDC List of Ranks Definitions

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

DATA REPORT 6639: Yarmouth, NS

Prepared 12 June 2020
by J. Churchill, Data Manager

CONTENTS OF REPORT

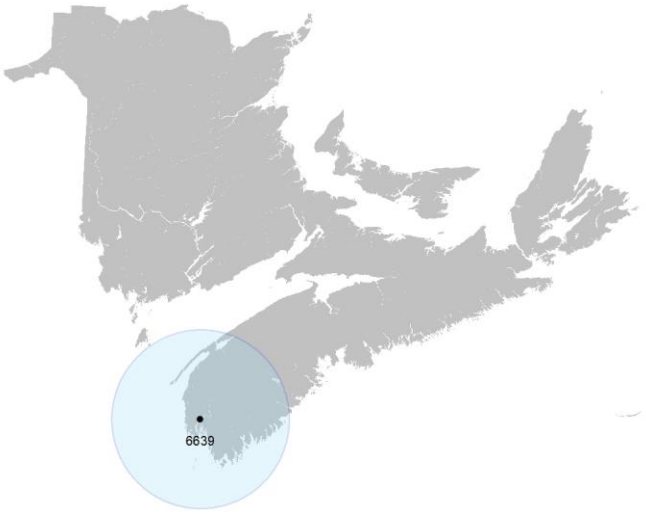
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Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	Contents
YarmouthNS_6639ob.xls	Rare and legally protected Flora and Fauna in your study area
YarmouthNS_6639ob100km.xls	A list of Rare and legally protected Flora and Fauna within 100 km of your study area
YarmouthNS_6639ma.xls	Managed Areas in your study area
YarmouthNS_6639sa.xls	Significant Natural Areas in your study area
YarmouthNS_6639ff.xls	Rare and common Freshwater Fish in your study area (DFO database)

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney, Senior Scientist, Executive Director
Tel: (506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko, Zoologist
Tel: (506) 364-2660
john.klymko@accdc.ca

Plant Communities
Sarah Robinson, Community Ecologist
Tel: (506) 364-2664
sarah.robinson@accdc.ca

Data Management, GIS
James Churchill, Data Manager
Tel: (902) 679-6146
james.churchill@accdc.ca

Billing
Jean Breau
Tel: (506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Emma Vost
(902) 670-8187
Emma.Vost@novascotia.ca

Western: Sarah Spencer
(902) 634-7555
Sarah.Spencer@novascotia.ca

Central: Shavonne Meyer
(902) 893-6350
Shavonne.Meyer@novascotia.ca

Central: Kimberly George
(902) 890-1046
Kimberly.George@novascotia.ca

Eastern: Harrison Moore
(902) 497-4119
Harrison.Moore@novascotia.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

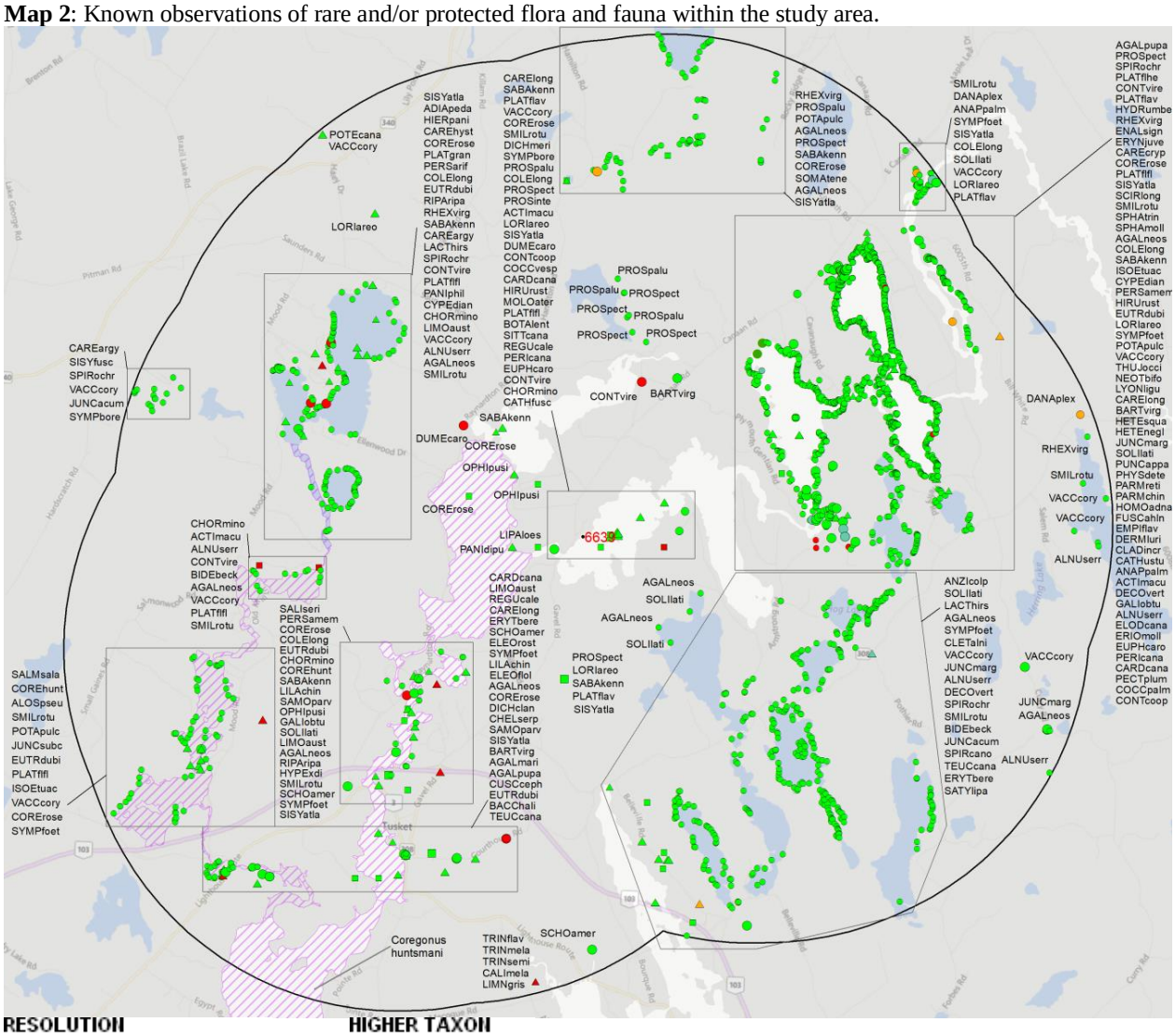
2.1 FLORA

The study area contains 2240 records of 70 vascular, 20 records of 17 nonvascular flora (Map 2 and attached: *ob.xls).

2.2 FAUNA

The study area contains 72 records of 27 vertebrate, 8 records of 6 invertebrate fauna (Map 2 and attached data files - see 1.1 Data List). Please see section 4.3 to determine if 'location-sensitive' species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within the study area.

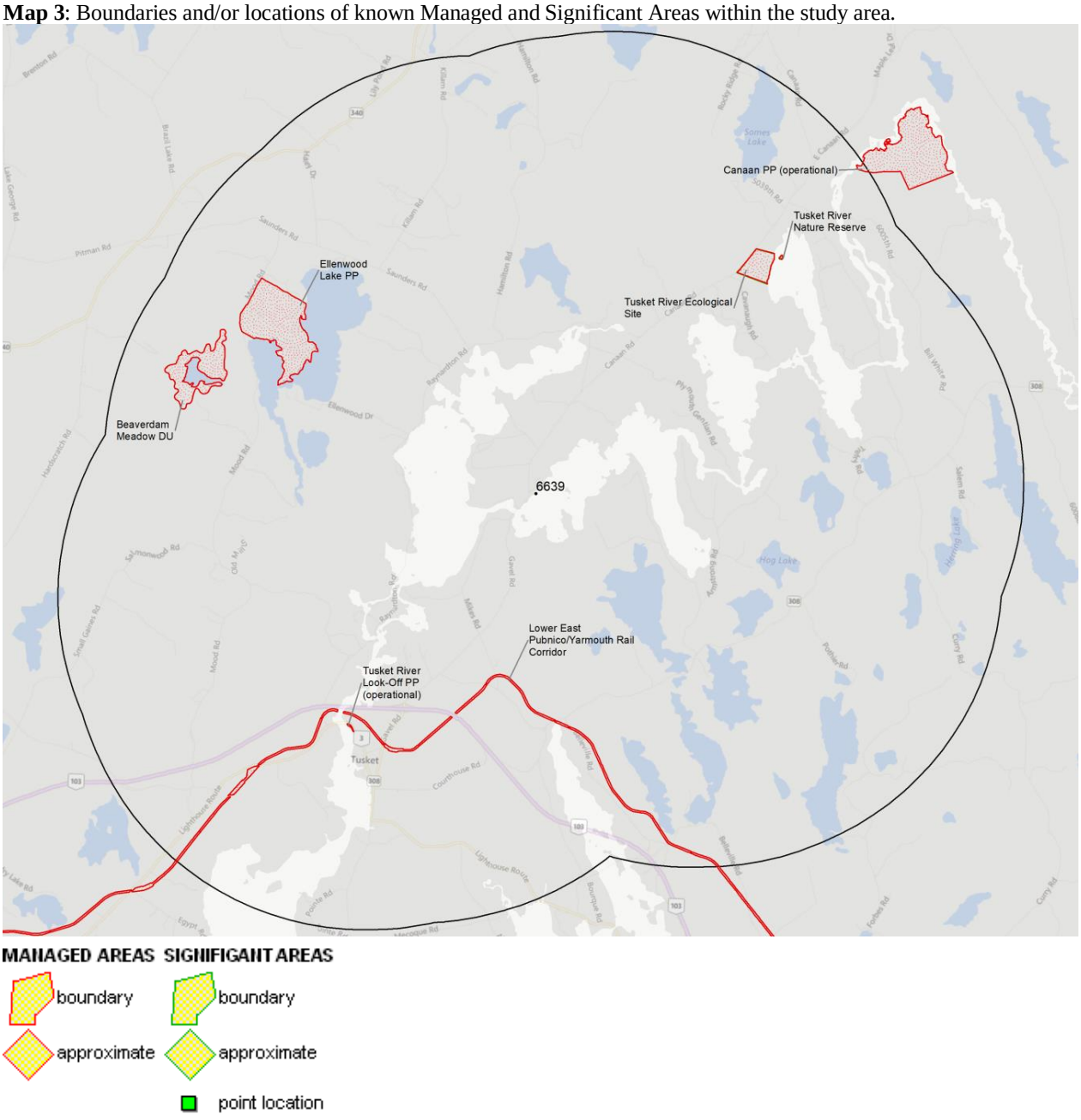


3.0 SPECIAL AREAS

3.1 MANAGED AREAS
The GIS scan identified 6 managed areas in the vicinity of the study area (Map 3 and attached file: *ma*.xls).

3.2 SIGNIFICANT AREAS
The GIS scan identified 2 biologically significant sites in the vicinity of the study area (Map 3 and attached file: *sa*.xls).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding "location-sensitive" species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
N	*Erioderma mollissimum*	Graceful Felt Lichen	Endangered	Endangered	Endangered	S1S2	2 May Be At Risk	1	4.1 ± 0.0
N	*Anzia colpodes*	Black-foam Lichen	Threatened	Threatened	Threatened	S3	3 Sensitive	1	4.9 ± 1.0
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Vulnerable	S3	4 Secure	1	4.2 ± 0.0
N	*Homomallium adnatum*	Adnate Hairy-gray Moss				S1?	3 Sensitive	1	4.0 ± 1.0
N	*Sphagnum molle*	Blushing Peat Moss				S1?		1	3.9 ± 0.0
N	*Sphagnum trinitense*	a peatmoss				S1S2		1	3.9 ± 0.0
N	*Parmotrema reticulatum*	Netted Ruffle Lichen				S2	3 Sensitive	2	4.0 ± 1.0
N	*Cladonia incrassata*	Powder-foot British Soldiers Lichen				S2S3	5 Undetermined	1	4.0 ± 1.0
N	*Fuscopannaria ahlneri*	Corrugated Shingles Lichen				S3	4 Secure	1	4.0 ± 1.0
N	*Heterodermia squamulosa*	Scaly Fringe Lichen				S3	3 Sensitive	1	4.0 ± 1.0
N	*Punctelia appalachensis*	Appalachian Speckleback Lichen				S3	3 Sensitive	1	4.0 ± 1.0
N	*Parmotrema chinense*	Powdered Ruffle Lichen				S3S4	4 Secure	1	4.0 ± 1.0
N	*Physconia detersa*	Bottlebrush Frost Lichen				S3S4	3 Sensitive	1	4.0 ± 1.0
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	4 Secure	1	4.2 ± 0.0
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	4 Secure	3	3.6 ± 0.0
N	*Dermatocarpon luridum*	Brookside Stippleback Lichen				S3S4	4 Secure	1	4.0 ± 1.0
N	*Heterodermia neglecta*	Fringe Lichen				S3S4	4 Secure	1	4.0 ± 1.0
P	*Coreopsis rosea*	Pink Coreopsis	Endangered	Endangered	Endangered	S1	1 At Risk	381	0.6 ± 1.0
P	*Sabatia kennedyana*	Plymouth Gentian	Endangered	Endangered	Endangered	S1	1 At Risk	368	0.5 ± 1.0
P	*Clethra alnifolia*	Coast Pepper-Bush	Endangered	Threatened	Vulnerable	S1	1 At Risk	1	4.4 ± 0.0
P	*Baccharis halimifolia*	Eastern Baccharis	Threatened	Threatened	Threatened	S1	1 At Risk	1	6.5 ± 6.0
P	*Hydrocotyle umbellata*	Water Pennywort	Special Concern	Special Concern	Endangered	S1	1 At Risk	133	4.9 ± 0.0
P	*Lilaeopsis chinensis*	Eastern Lilaeopsis	Special Concern	Special Concern	Vulnerable	S2	3 Sensitive	32	3.7 ± 0.0
P	*Scirpus longii*	Long's Bulrush	Special Concern		Vulnerable	S3	3 Sensitive	5	5.4 ± 0.0
P	*Smilax rotundifolia*	Round-leaved Greenbrier	Not At Risk			S3	4 Secure	144	0.5 ± 1.0
P	*Thuja occidentalis*	Eastern White Cedar			Vulnerable	S1	1 At Risk	3	4.8 ± 0.0
P	*Lyonia ligustrina*	Maleberry				S1	2 May Be At Risk	11	5.0 ± 0.0
P	*Agalinis purpurea var. parviflora*	Small-flowered Purple False Foxglove				S1		2	6.0 ± 0.0
P	*Cyperus diandrus*	Low Flatsedge				S1	2 May Be At Risk	6	4.4 ± 0.0
P	*Sisyrinchium fuscatum*	Coastal Plain Blue-eyed-grass				S1	2 May Be At Risk	1	6.8 ± 0.0
P	*Adiantum pedatum*	Northern Maidenhair Fern				S1	2 May Be At Risk	2	4.8 ± 0.0
P	*Panicum dichotomiflorum ssp. puritanorum*	Spreading Panicgrass				S1?	2 May Be At Risk	1	1.1 ± 1.0
P	*Proserpinaca intermedia*	Intermediate Mermaidweed				S1S2	2 May Be At Risk	1	0.6 ± 1.0
P	*Eutrochium dubium*	Coastal Plain Joe Pye Weed				S2	2 May Be At Risk	113	3.2 ± 0.0
P	*Lactuca hirsuta*	Hairy Lettuce				S2	3 Sensitive	2	4.0 ± 0.0
P	*Persicaria arifolia*	Halberd-leaved Tearthumb				S2	3 Sensitive	1	5.4 ± 0.0
P	*Salix sericea*	Silky Willow				S2	2 May Be At Risk	1	2.9 ± 0.0
P	*Agalinis maritima*	Saltmarsh Agalinis				S2	3 Sensitive	1	6.5 ± 6.0
P	*Carex hystericina*	Porcupine Sedge				S2	2 May Be At Risk	1	5.2 ± 1.0
P	*Carex longii*	Long's Sedge				S2	3 Sensitive	4	0.6 ± 1.0
P	*Platanthera flava*	Southern Rein-Orchid				S2	3 Sensitive	11	0.5 ± 1.0
P	*Platanthera flava var. flava*	Southern Rein Orchid				S2	3 Sensitive	99	0.3 ± 5.0
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S2	5 Undetermined	1	5.9 ± 0.0
P	*Spiranthes casei var. novaescotiae*	Case's Ladies'-Tresses				S2	3 Sensitive	1	5.3 ± 1.0
P	*Symphyotrichum boreale*	Boreal Aster				S2?	3 Sensitive	5	0.6 ± 1.0

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S2?	5 Undetermined	2	6.3 ± 1.0
P	*Potamogeton pulcher*	Spotted Pondweed			Vulnerable	S2S3	3 Sensitive	14	4.9 ± 0.0
P	*Hypericum x dissimulatum*	Disguised St. John's-wort				S2S3	3 Sensitive	1	4.9 ± 10.0
P	*Potentilla canadensis*	Canada Cinquefoil				S2S3	3 Sensitive	1	7.6 ± 3.0
P	*Galium obtusum*	Blunt-leaved Bedstraw				S2S3	3 Sensitive	7	3.7 ± 0.0
P	*Eleocharis flavescens var. olivacea*	Bright-green Spikerush				S2S3	3 Sensitive	1	7.8 ± 0.0
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	3 Sensitive	5	1.1 ± 5.0
P	*Hieracium paniculatum*	Panicled Hawkweed				S3	4 Secure	1	5.1 ± 0.0
P	*Bidens beckii*	Water Beggarticks				S3	4 Secure	6	4.4 ± 0.0
P	*Alnus serrulata*	Smooth Alder				S3	3 Sensitive	47	3.7 ± 0.0
P	*Bartonia virginica*	Yellow Bartonia				S3	4 Secure	9	2.9 ± 0.0
P	*Proserpinaca palustris*	Marsh Mermaidweed				S3	4 Secure	11	0.4 ± 2.0
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S3	4 Secure	15	0.4 ± 1.0
P	*Teucrium canadense*	Canada Germander				S3	3 Sensitive	6	5.8 ± 0.0
P	*Decodon verticillatus*	Swamp Loosestrife				S3	4 Secure	39	4.3 ± 0.0
P	*Samolus parviflorus*	Seaside Brookweed				S3	3 Sensitive	15	3.7 ± 0.0
P	*Limosella australis*	Southern Mudwort				S3	4 Secure	4	4.0 ± 0.0
P	*Carex cryptolepis*	Hidden-scaled Sedge				S3	4 Secure	1	5.6 ± 2.0
P	*Eleocharis rostellata*	Beaked Spikerush				S3	3 Sensitive	4	5.8 ± 0.0
P	*Schoenoplectus americanus*	Olney's Bulrush				S3	3 Sensitive	5	4.9 ± 5.0
P	*Elodea canadensis*	Canada Waterweed				S3	4 Secure	1	5.3 ± 0.0
P	*Juncus marginatus*	Grassleaf Rush				S3	3 Sensitive	7	3.3 ± 0.0
P	*Juncus subcaudatus*	Woods-Rush				S3	3 Sensitive	2	6.9 ± 1.0
P	*Neottia bifolia*	Southern Twayblade				S3	4 Secure	8	4.1 ± 0.0
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	4 Secure	1	4.7 ± 1.0
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S3	4 Secure	6	4.8 ± 0.0
P	*Dichanthelium clandestinum*	Deer-tongue Panic Grass				S3	4 Secure	1	5.6 ± 10.0
P	*Coleataenia longifolia*	Long-leaved Panicgrass				S3	4 Secure	86	0.4 ± 5.0
P	*Lorinseria areolata*	netted chain fern				S3	4 Secure	34	0.4 ± 1.0
P	*Isoetes tuckermanii ssp. acadiensis*	Acadian Quillwort				S3	3 Sensitive	2	4.4 ± 0.0
P	*Persicaria amphibia var. emersa*	Long-root Smartweed				S3?	5 Undetermined	2	3.0 ± 0.0
P	*Solidago latissimifolia*	Elliott's Goldenrod				S3S4	4 Secure	67	2.1 ± 0.0
P	*Vaccinium corymbosum*	Highbush Blueberry				S3S4	4 Secure	236	0.6 ± 1.0
P	*Rhexia virginica*	Virginia Meadow Beauty				S3S4	4 Secure	51	4.2 ± 0.0
P	*Agalinis neoscotica*	Nova Scotia Agalinis				S3S4	4 Secure	51	1.9 ± 0.0
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S3S4	4 Secure	77	3.4 ± 0.0
P	*Carex argyrantha*	Silvery-flowered Sedge				S3S4	4 Secure	2	4.7 ± 0.0
P	*Sisyrinchium atlanticum*	Eastern Blue-Eyed-Grass				S3S4	4 Secure	72	0.5 ± 1.0
P	*Juncus acuminatus*	Sharp-Fruit Rush				S3S4	4 Secure	4	5.4 ± 2.0
P	*Liparis loeselii*	Loesel's Twayblade				S3S4	4 Secure	1	0.7 ± 5.0
P	*Panicum philadelphicum*	Philadelphia Panicgrass				S3S4	4 Secure	1	4.7 ± 0.0
P	*Dichanthelium meridionale*	Matting Witchgrass				SH	0.1 Extirpated	2	0.4 ± 2.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
A	*Coregonus huntsmani*	Atlantic Whitefish	Endangered	Endangered	Endangered	S1	7 Exotic	2	3.3 ± 1.0
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened	Endangered	S2S3B	2 May Be At Risk	2	4.4 ± 1.0
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Endangered	S2S3B	1 At Risk	2	1.3 ± 7.0
A	*Cardellina canadensis*	Canada Warbler	Threatened	Threatened	Endangered	S3B	1 At Risk	4	1.3 ± 7.0
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	2 May Be At Risk	3	1.3 ± 7.0
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S2B	1 At Risk	4	1.3 ± 7.0
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S2B	1 At Risk	2	1.3 ± 7.0

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Vulnerable	S3	3 Sensitive	1	7.8 ± 0.0
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	3 Sensitive	14	1.3 ± 7.0
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3S4B,S3N	4 Secure	1	1.3 ± 7.0
A	*Salmo salar*	Atlantic Salmon	E,T,SC			S1	2 May Be At Risk	1	5.9 ± 1.0
A	*Molothrus ater*	Brown-headed Cowbird				S2B	4 Secure	1	1.3 ± 7.0
A	*Tringa semipalmata*	Willet				S2S3B	2 May Be At Risk	3	7.1 ± 0.0
A	*Calidris melanotos*	Pectoral Sandpiper				S2S3M	4 Secure	1	7.1 ± 0.0
A	*Perisoreus canadensis*	Canada Jay				S3	3 Sensitive	2	1.3 ± 7.0
A	*Sitta canadensis*	Red-breasted Nuthatch				S3	4 Secure	2	1.3 ± 7.0
A	*Alosa pseudoharengus*	Alewife				S3	3 Sensitive	1	5.9 ± 1.0
A	*Dumetella carolinensis*	Gray Catbird				S3B	2 May Be At Risk	2	1.3 ± 7.0
A	*Tringa melanoleuca*	Greater Yellowlegs				S3B,S3S4M	3 Sensitive	8	7.1 ± 0.0
A	*Tringa flavipes*	Lesser Yellowlegs				S3M	4 Secure	1	7.1 ± 0.0
A	*Limnodromus griseus*	Short-billed Dowitcher				S3M	4 Secure	1	7.1 ± 0.0
A	*Botaurus lentiginosus*	American Bittern				S3S4B	3 Sensitive	1	1.3 ± 7.0
A	*Actitis macularius*	Spotted Sandpiper				S3S4B	3 Sensitive	8	1.3 ± 7.0
A	*Empidonax flaviventris*	Yellow-bellied Flycatcher				S3S4B	3 Sensitive	1	4.0 ± 1.0
A	*Regulus calendula*	Ruby-crowned Kinglet				S3S4B	3 Sensitive	2	1.3 ± 7.0
A	*Catharus fuscescens*	Veery				S3S4B	4 Secure	1	1.3 ± 7.0
A	*Catharus ustulatus*	Swainson's Thrush				S3S4B	4 Secure	1	4.0 ± 1.0
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Endangered	S2B	3 Sensitive	2	7.8 ± 0.0
I	*Enallagma signatum*	Orange Bluet				S2	2 May Be At Risk	1	6.8 ± 0.0
I	*Satyrium liparops*	Striped Hairstreak				S2S3	5 Undetermined	1	6.3 ± 0.0
I	*Erythrodiplax berenice*	Seaside Dragonlet				S2S3	3 Sensitive	2	6.1 ± 1.0
I	*Somatochlora tenebrosa*	Clamp-Tipped Emerald				S3	4 Secure	1	5.8 ± 0.0
I	*Erynnis juvenalis*	Juvenal's Duskywing				S3S4	4 Secure	1	7.3 ± 2.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species “location sensitive”. Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting your study area are indicated below with “YES”.

Nova Scotia

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
Fraxinus nigra	Black Ash		Threatened	No
Emydoidea blandingii	*Blanding's Turtle - Nova Scotia pop.*	Endangered	Vulnerable	No
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.	Special Concern	Vulnerable	No
Bat Hibernaculum		**[Endangered][1]**	**[Endangered][1]**	**YES**

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NS Endangered Species Act.

4.4 SOURCE BIBLIOGRAPHY

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5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 34115 records of 150 vertebrate and 547 records of 50 invertebrate fauna; 21528 records of 219 vascular, 3597 records of 129 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including “location-sensitive” species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Coregonus huntsmani*	Atlantic Whitefish	Endangered	Endangered	Endangered	S1	7 Exotic	3	3.3 ± 1.0	NS
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	1 At Risk	26	4.1 ± 0.0	NS
A	*Perimyotis subflavus*	Eastern Pipistrelle	Endangered	Endangered	Endangered	S1	1 At Risk	24	76.1 ± 0.0	NS
A	*Emydoidea blandingii*	Blanding's Turtle - Nova Scotia pop.	Endangered	Endangered	Endangered	S1	1 At Risk	7207	50.3 ± 24.0	NS
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy pop.	Endangered	Endangered		S1	2 May Be At Risk	4	75.3 ± 1.0	NS
A	*Eubalaena glacialis*	North Atlantic Right Whale	Endangered	Endangered		S1		3	85.4 ± 50.0	NS
A	*Charadrius melodus melodus*	Piping Plover melodus ssp	Endangered	Endangered	Endangered	S1B	1 At Risk	1798	16.9 ± 0.0	NS
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1B	1 At Risk	101	18.1 ± 0.0	NS
A	*Morone saxatilis pop. 2*	Striped Bass - Bay of Fundy pop.	Endangered			S1B	2 May Be At Risk	2	37.3 ± 1.0	NS
A	*Dermochelys coriacea (Atlantic pop.)*	Leatherback Sea Turtle - Atlantic pop.	Endangered	Endangered		S1S2N		1	86.6 ± 0.0	NS
A	*Calidris canutus rufa*	Red Knot rufa ssp	Endangered	Endangered	Endangered	S2M	1 At Risk	345	15.4 ± 0.0	NS
A	*Antrostomus vociferus*	Eastern Whip-Poor-Will	Threatened	Threatened	Threatened	S1?B	1 At Risk	6	23.1 ± 7.0	NS
A	*Catharus bicknelli*	Bicknell's Thrush	Threatened	Threatened	Endangered	S1S2B	1 At Risk	1	92.3 ± 7.0	NS
A	*Limosa haemastica*	Hudsonian Godwit	Threatened			S1S2M	3 Sensitive	209	19.9 ± 0.0	NS
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2	3 Sensitive	7	55.1 ± 5.0	NS
A	*Anguilla rostrata*	American Eel	Threatened			S2	4 Secure	255	62.3 ± 0.0	NS
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Endangered	S2B,S1M	1 At Risk	220	9.9 ± 7.0	NS
A	*Thamnophis sauritus pop. 3*	Eastern Ribbonsnake - Atlantic pop.	Threatened	Threatened	Threatened	S2S3	1 At Risk	1693	29.9 ± 0.0	NS
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened	Endangered	S2S3B	2 May Be At Risk	610	4.4 ± 1.0	NS
A	*Hirundo rustica*	Barn Swallow	Threatened	Threatened	Endangered	S2S3B	1 At Risk	468	1.3 ± 7.0	NS
A	*Cardellina canadensis*	Canada Warbler	Threatened	Threatened	Endangered	S3B	1 At Risk	264	1.3 ± 7.0	NS
A	*Dolichonyx oryzivorus*	Bobolink	Threatened	Threatened	Vulnerable	S3S4B	3 Sensitive	79	9.9 ± 7.0	NS
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened		SHB	3 Sensitive	2	85.7 ± 7.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened		SUB	5 Undetermined	1	56.0 ± 0.0	NS
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened		SUB	5 Undetermined	14	10.6 ± 7.0	NS
A	*Passerculus sandwichensis princeps*	Savannah Sparrow princeps ssp	Special Concern	Special Concern		S1B	3 Sensitive	5	30.9 ± 0.0	NS
A	*Bucephala islandica (Eastern pop.)*	Barrow's Goldeneye - Eastern pop.	Special Concern	Special Concern		S1N	1 At Risk	2	16.8 ± 0.0	NS
A	*Asio flammeus*	Short-eared Owl	Special Concern	Special Concern		S1S2B	2 May Be At Risk	7	19.9 ± 0.0	NS
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	2 May Be At Risk	92	1.3 ± 7.0	NS
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Threatened	Threatened	S2B	1 At Risk	248	1.3 ± 7.0	NS
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Threatened	Threatened	S2B	1 At Risk	382	1.3 ± 7.0	NS
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern pop.	Special Concern	Special Concern	Endangered	S2N	1 At Risk	45	26.8 ± 0.0	NS
A	*Balaenoptera physalus*	Fin Whale	Special Concern	Special Concern		S2S3		3	64.8 ± 50.0	NS
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern	Special Concern		S2S3M	3 Sensitive	77	30.2 ± 2.0	NS
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Vulnerable	S3	3 Sensitive	161	7.8 ± 0.0	NS
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	3 Sensitive	341	1.3 ± 7.0	NS
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3S4B,S3N	4 Secure	210	1.3 ± 7.0	NS
A	*Phocoena phocoena pop. 1*	Harbour Porpoise - Northwest Atlantic pop.	Special Concern			S4		24	29.8 ± 16.0	NS
A	*Podiceps auritus*	Horned Grebe	Special Concern	Special Concern		S4N	4 Secure	8	53.4 ± 10.0	NS
A	*Chrysemys picta picta*	Eastern Painted Turtle	Special Concern			S4S5	4 Secure	198	9.9 ± 10.0	NS
A	*Lynx canadensis*	Canadian Lynx	Not At Risk		Endangered	S1	1 At Risk	1	60.0 ± 1.0	NS
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1?B	5 Undetermined	3	33.9 ± 0.0	NS
A	*Fulica americana*	American Coot	Not At Risk			S1B	5 Undetermined	5	41.8 ± 0.0	NS
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Not At Risk	Special Concern	Vulnerable	S1B,SNAM	3 Sensitive	67	48.7 ± 0.0	NS
A	*Glaucomys volans*	Southern Flying Squirrel	Not At Risk			S2S3	3 Sensitive	9	65.0 ± 5.0	NS
A	*Hemidactylium scutatum*	Four-toed Salamander	Not At Risk			S3	4 Secure	10	34.5 ± 0.0	NS
A	*Megaptera novaeangliae*	Humpback Whale (NW Atlantic pop.)	Not At Risk			S3		21	17.7 ± 0.0	NS
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B	3 Sensitive	315	8.1 ± 0.0	NS
A	*Sialia sialis*	Eastern Bluebird	Not At Risk			S3B	3 Sensitive	30	10.2 ± 7.0	NS
A	*Buteo lagopus*	Rough-legged Hawk	Not At Risk			S3N	4 Secure	2	25.6 ± 0.0	NS
A	*Accipiter gentilis*	Northern Goshawk	Not At Risk			S3S4	4 Secure	23	22.7 ± 7.0	NS
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4		2	54.7 ± 0.0	NS
A	*Circus hudsonius*	Northern Harrier	Not At Risk			S3S4B	4 Secure	97	10.6 ± 7.0	NS
A	*Ammospiza nelsoni*	Nelson's Sparrow	Not At Risk			S3S4B	4 Secure	85	10.2 ± 7.0	NS
A	*Morone saxatilis*	Striped Bass	E,SC			S2S3	2 May Be At Risk	8	18.7 ± 1.0	NS
A	*Salmo salar*	Atlantic Salmon	E,T,SC			S1	2 May Be At Risk	11	5.9 ± 1.0	NS
A	*Martes americana*	American Marten			Endangered	S1	1 At Risk	23	18.2 ± 0.0	NS
A	*Alces americanus*	Moose			Endangered	S1	1 At Risk	109	18.8 ± 1.0	NS
A	*Passerina cyanea*	Indigo Bunting				S1?B	5 Undetermined	26	18.7 ± 0.0	NS
A	*Uria aalge*	Common Murre				S1?B,S5N	4 Secure	26	28.7 ± 0.0	NS
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1B	2 May Be At Risk	29	31.9 ± 7.0	NS
A	*Anas acuta*	Northern Pintail				S1B	2 May Be At Risk	8	10.2 ± 7.0	NS
A	*Oxyura jamaicensis*	Ruddy Duck				S1B	4 Secure	4	98.9 ± 7.0	NS
A	*Gallinula galeata*	Common Gallinule				S1B	5 Undetermined	2	56.0 ± 0.0	NS
A	*Haematopus palliatus*	American Oystercatcher				S1B	5 Undetermined	120	20.3 ± 0.0	NS
A	*Myiarchus crinitus*	Great Crested Flycatcher				S1B	2 May Be At Risk	22	9.9 ± 7.0	NS
A	*Cistothorus palustris*	Marsh Wren				S1B	5 Undetermined	3	15.6 ± 0.0	NS
A	*Mimus polyglottos*	Northern Mockingbird				S1B	4 Secure	23	10.6 ± 7.0	NS
A	*Toxostoma rufum*	Brown Thrasher				S1B	5 Undetermined	8	14.9 ± 7.0	NS
A	*Vireo gilvus*	Warbling Vireo				S1B	5 Undetermined	11	19.0 ± 0.0	NS
A	*Setophaga pinus*	Pine Warbler				S1B	5 Undetermined	7	32.9 ± 7.0	NS
A	*Calidris minutilla*	Least Sandpiper				S1B,S3M	4 Secure	894	9.9 ± 0.0	NS
A	*Charadrius semipalmatus*	Semipalmated Plover				S1B,S3S4M	4 Secure	1307	15.1 ± 0.0	NS
A	*Vespertilionidae sp.*	bat species				S1S2		82	6.3 ± 0.0	NS
A	*Lasiurus borealis*	Eastern Red Bat				S1S2B,S1M	2 May Be At Risk	1	7.9 ± 0.0	NS

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A	*Lasiurus cinereus*	Hoary Bat				S1S2B,S1M	2 May Be At Risk	2	96.5 ± 0.0	NS
A	*Pluvialis dominica*	American Golden-Plover				S1S2M	3 Sensitive	153	16.7 ± 0.0	NS
A	*Vireo philadelphicus*	Philadelphia Vireo				S2?B	5 Undetermined	8	22.6 ± 0.0	NS
A	*Spatula clypeata*	Northern Shoveler				S2B	2 May Be At Risk	20	51.6 ± 7.0	NS
A	*Mareca strepera*	Gadwall				S2B	2 May Be At Risk	27	49.7 ± 7.0	NS
A	*Empidonax traillii*	Willow Flycatcher				S2B	3 Sensitive	18	18.9 ± 1.0	NS
A	*Setophaga tigrina*	Cape May Warbler				S2B	3 Sensitive	28	11.3 ± 7.0	NS
A	*Piranga olivacea*	Scarlet Tanager				S2B	5 Undetermined	25	9.9 ± 7.0	NS
A	*Pooecetes gramineus*	Vesper Sparrow				S2B	2 May Be At Risk	1	99.1 ± 1.0	NB
A	*Molothrus ater*	Brown-headed Cowbird				S2B	4 Secure	70	1.3 ± 7.0	NS
A	*Alca torda*	Razorbill				S2B,S4N	3 Sensitive	51	23.1 ± 7.0	NS
A	*Bucephala clangula*	Common Goldeneye				S2B,S5N	4 Secure	78	15.3 ± 10.0	NS
A	*Branta bernicla*	Brant				S2M	3 Sensitive	56	15.3 ± 10.0	NS
A	*Phalacrocorax carbo*	Great Cormorant				S2S3	3 Sensitive	91	26.1 ± 9.0	NS
A	*Asio otus*	Long-eared Owl				S2S3	2 May Be At Risk	10	31.3 ± 7.0	NS
A	*Spinus pinus*	Pine Siskin				S2S3	3 Sensitive	86	9.9 ± 7.0	NS
A	*Cathartes aura*	Turkey Vulture				S2S3B	3 Sensitive	20	14.2 ± 7.0	NS
A	*Rallus limicola*	Virginia Rail				S2S3B	5 Undetermined	5	85.7 ± 7.0	NS
A	*Tringa semipalmata*	Willet				S2S3B	2 May Be At Risk	1263	7.1 ± 0.0	NS
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B	2 May Be At Risk	105	9.9 ± 7.0	NS
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S2S3B	3 Sensitive	79	9.9 ± 7.0	NS
A	*Icterus galbula*	Baltimore Oriole				S2S3B	2 May Be At Risk	44	9.9 ± 7.0	NS
A	*Pinicola enucleator*	Pine Grosbeak				S2S3B,S5N	2 May Be At Risk	36	9.9 ± 7.0	NS
A	*Numenius phaeopus hudsonicus*	Hudsonian Whimbrel				S2S3M	3 Sensitive	455	18.0 ± 0.0	NS
A	*Calidris melanotos*	Pectoral Sandpiper				S2S3M	4 Secure	217	7.1 ± 0.0	NS
A	*Phalaropus fulicarius*	Red Phalarope				S2S3M	3 Sensitive	62	50.9 ± 0.0	NS
A	*Perisoreus canadensis*	Canada Jay				S3	3 Sensitive	171	1.3 ± 7.0	NS
A	*Poecile hudsonicus*	Boreal Chickadee				S3	3 Sensitive	181	10.2 ± 7.0	NS
A	*Sitta canadensis*	Red-breasted Nuthatch				S3	4 Secure	490	1.3 ± 7.0	NS
A	*Alosa pseudoharengus*	Alewife				S3	3 Sensitive	20	5.9 ± 1.0	NS
A	*Salvelinus fontinalis*	Brook Trout				S3	3 Sensitive	11	44.9 ± 0.0	NS
A	*Pekania pennanti*	Fisher				S3	3 Sensitive	4	37.5 ± 0.0	NS
A	*Calidris maritima*	Purple Sandpiper				S3?N	3 Sensitive	70	28.6 ± 0.0	NS
A	*Calcarius lapponicus*	Lapland Longspur				S3?N	4 Secure	2	56.0 ± 0.0	NS
A	*Falco sparverius*	American Kestrel				S3B	4 Secure	51	9.9 ± 7.0	NS
A	*Charadrius vociferus*	Killdeer				S3B	3 Sensitive	412	9.9 ± 7.0	NS
A	*Gallinago delicata*	Wilson's Snipe				S3B	3 Sensitive	183	9.9 ± 7.0	NS
A	*Sterna paradisaea*	Arctic Tern				S3B	2 May Be At Risk	141	10.2 ± 7.0	NS
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B	2 May Be At Risk	31	9.9 ± 7.0	NS
A	*Tyrannus tyrannus*	Eastern Kingbird				S3B	3 Sensitive	109	9.9 ± 7.0	NS
A	*Dumetella carolinensis*	Gray Catbird				S3B	2 May Be At Risk	266	1.3 ± 7.0	NS
A	*Cardellina pusilla*	Wilson's Warbler				S3B	3 Sensitive	26	16.4 ± 0.0	NS
A	*Tringa melanoleuca*	Greater Yellowlegs				S3B,S3S4M	3 Sensitive	1135	7.1 ± 0.0	NS
A	*Oceanodroma leucorhoa*	Leach's Storm-Petrel				S3B,S5M	4 Secure	135	23.9 ± 0.0	NS
A	*Rissa tridactyla*	Black-legged Kittiwake				S3B,S5N	3 Sensitive	3	34.1 ± 0.0	NS
A	*Fratercula arctica*	Atlantic Puffin				S3B,S5N	3 Sensitive	78	23.1 ± 7.0	NS
A	*Pluvialis squatarola*	Black-bellied Plover				S3M	4 Secure	1109	15.1 ± 0.0	NS
A	*Tringa flavipes*	Lesser Yellowlegs				S3M	4 Secure	506	7.1 ± 0.0	NS
A	*Arenaria interpres*	Ruddy Turnstone				S3M	4 Secure	608	15.4 ± 0.0	NS
A	*Calidris pusilla*	Semipalmated Sandpiper				S3M	3 Sensitive	1368	9.9 ± 0.0	NS
A	*Calidris fuscicollis*	White-rumped Sandpiper				S3M	4 Secure	477	18.0 ± 0.0	NS
A	*Limnodromus griseus*	Short-billed Dowitcher				S3M	4 Secure	775	7.1 ± 0.0	NS
A	*Calidris alba*	Sanderling				S3M,S2N	4 Secure	878	15.4 ± 0.0	NS
A	*Chroicocephalus ridibundus*	Black-headed Gull				S3N	4 Secure	3	34.0 ± 0.0	NS
A	*Somateria mollissima*	Common Eider				S3S4	4 Secure	626	14.9 ± 7.0	NS
A	*Picoides arcticus*	Black-backed Woodpecker				S3S4	3 Sensitive	30	9.9 ± 7.0	NS
A	*Loxia curvirostra*	Red Crossbill				S3S4	4 Secure	95	20.3 ± 1.0	NS

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A	*Botaurus lentiginosus*	American Bittern				S3S4B	3 Sensitive	70	1.3 ± 7.0	NS
A	*Spatula discors*	Blue-winged Teal				S3S4B	2 May Be At Risk	22	10.2 ± 7.0	NS
A	*Actitis macularius*	Spotted Sandpiper				S3S4B	3 Sensitive	620	1.3 ± 7.0	NS
A	*Empidonax flaviventris*	Yellow-bellied Flycatcher				S3S4B	3 Sensitive	183	4.0 ± 1.0	NS
A	*Regulus calendula*	Ruby-crowned Kinglet				S3S4B	3 Sensitive	389	1.3 ± 7.0	NS
A	*Catharus fuscescens*	Veery				S3S4B	4 Secure	187	1.3 ± 7.0	NS
A	*Catharus ustulatus*	Swainson's Thrush				S3S4B	4 Secure	546	4.0 ± 1.0	NS
A	*Oreothlypis peregrina*	Tennessee Warbler				S3S4B	3 Sensitive	45	9.9 ± 7.0	NS
A	*Setophaga castanea*	Bay-breasted Warbler				S3S4B	3 Sensitive	140	13.7 ± 1.0	NS
A	*Setophaga striata*	Blackpoll Warbler				S3S4B	3 Sensitive	61	14.1 ± 0.0	NS
A	*Passerella iliaca*	Fox Sparrow				S3S4B	4 Secure	35	20.2 ± 7.0	NS
A	*Mergus serrator*	Red-breasted Merganser				S3S4B,S5N	4 Secure	68	10.2 ± 7.0	NS
A	*Bucephala albeola*	Bufflehead				S3S4N	4 Secure	29	17.3 ± 9.0	NS
A	*Lanius borealis*	Northern Shrike				S3S4N	4 Secure	2	45.0 ± 0.0	NS
A	*Leucophaeus atricilla*	Laughing Gull				SHB	4 Secure	18	54.5 ± 0.0	NS
A	*Progne subis*	Purple Martin				SHB	2 May Be At Risk	1	56.0 ± 0.0	NS
A	*Eremophila alpestris*	Horned Lark				SHB,S4S5N	4 Secure	5	18.5 ± 0.0	NS
A	*Morus bassanus*	Northern Gannet				SHB,S5M	4 Secure	150	28.7 ± 0.0	NS
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Endangered	S2B	3 Sensitive	165	7.8 ± 0.0	NS
I	*Danaus plexippus plexippus*	Monarch	Endangered	Special Concern		S2B	3 Sensitive	1	51.9 ± 0.0	NS
I	*Bombus terricola*	Yellow-banded Bumblebee	Special Concern	Special Concern	Vulnerable	S3	3 Sensitive	14	9.8 ± 0.0	NS
I	*Erora laeta*	Early Hairstreak				S1	2 May Be At Risk	2	84.3 ± 2.0	NS
I	*Ophiogomphus anomalus*	Extra-Striped Snaketail				S1	6 Not Assessed	4	97.0 ± 0.0	NS
I	*Leptodea ochracea*	Tidewater Mucket				S1	3 Sensitive	1	43.1 ± 0.0	NS
I	*Chlosyne nycteis*	Silvery Checkerspot				S1?	5 Undetermined	4	85.7 ± 2.0	NS
I	*Polygonia comma*	Eastern Comma				S1?	1 At Risk	1	81.3 ± 2.0	NS
I	*Polygonia satyrus*	Satyr Comma				S1?	3 Sensitive	5	81.3 ± 2.0	NS
I	*Strymon melinus*	Grey Hairstreak				S1S2	4 Secure	6	41.8 ± 0.0	NS
I	*Nymphalis l-album*	Compton Tortoiseshell				S1S2	4 Secure	12	15.8 ± 2.0	NS
I	*Somatochlora kennedyi*	Kennedy's Emerald				S1S2	2 May Be At Risk	4	94.5 ± 0.0	NS
I	*Satyrium calanus*	Banded Hairstreak				S2	5 Undetermined	3	51.3 ± 2.0	NS
I	*Aglais milberti*	Milbert's Tortoiseshell				S2	4 Secure	3	99.1 ± 7.0	NB
I	*Epitheca princeps*	Prince Baskettail				S2	3 Sensitive	5	70.9 ± 1.0	NS
I	*Williamsonia fletcheri*	Ebony Boghaunter				S2	2 May Be At Risk	3	91.9 ± 0.0	NS
I	*Enallagma signatum*	Orange Bluet				S2	2 May Be At Risk	10	6.8 ± 0.0	NS
I	*Margaritifera margaritifera*	Eastern Pearlshell				S2	3 Sensitive	1	92.8 ± 1.0	NS
I	*Pantala hymenaea*	Spot-Winged Glider				S2?B	3 Sensitive	2	46.0 ± 0.0	NS
I	*Amblyscirtes hegon*	Pepper and Salt Skipper				S2S3	4 Secure	1	13.9 ± 2.0	NS
I	*Satyrium liparops*	Striped Hairstreak				S2S3	5 Undetermined	1	6.3 ± 0.0	NS
I	*Euphydryas phaeton*	Baltimore Checkerspot				S2S3	4 Secure	2	88.8 ± 0.0	NS
I	*Ophiogomphus aspersus*	Brook Snaketail				S2S3	2 May Be At Risk	2	60.0 ± 0.0	NS
I	*Ophiogomphus mainensis*	Maine Snaketail				S2S3	2 May Be At Risk	3	93.6 ± 0.0	NS
I	*Ophiogomphus rupinsulensis*	Rusty Snaketail				S2S3	2 May Be At Risk	1	85.1 ± 1.0	NS
I	*Somatochlora forcipata*	Forcipate Emerald				S2S3	2 May Be At Risk	2	86.9 ± 1.0	NS
I	*Somatochlora franklini*	Delicate Emerald				S2S3	3 Sensitive	1	86.9 ± 1.0	NS
I	*Erythrodiplax berenice*	Seaside Dragonlet				S2S3	3 Sensitive	36	6.1 ± 1.0	NS
I	*Enallagma vesperum*	Vesper Bluet				S2S3	3 Sensitive	16	16.0 ± 0.0	NS
I	*Hippodamia parenthesis*	Parenthesis Lady Beetle				S3	5 Undetermined	1	12.9 ± 0.0	NS
I	*Naemia seriata*	a Ladybird beetle				S3	3 Sensitive	6	9.8 ± 0.0	NS
I	*Chilocorus stigma*	Twice-stabbed Lady Beetle				S3	4 Secure	2	79.0 ± 0.0	NS
I	*Myzia pullata*	Streaked Lady Beetle				S3	4 Secure	1	9.8 ± 0.0	NS
I	*Astylopsis sexguttata*	A Longhorned Beetle				S3		1	70.2 ± 0.0	NS
I	*Callophrys henrici*	Henry's Elfin				S3	4 Secure	14	10.7 ± 0.0	NS
I	*Speyeria aphrodite*	Aphrodite Fritillary				S3	4 Secure	6	56.6 ± 7.0	NS
I	*Polygonia faunus*	Green Comma				S3	4 Secure	6	58.4 ± 20.0	NS
I	*Aeshna clepsydra*	Mottled Darner				S3	4 Secure	27	16.0 ± 0.0	NS
I	*Aeshna constricta*	Lance-Tipped Darner				S3	4 Secure	1	54.2 ± 0.0	NS
I	*Boyeria grafiana*	Ocellated Darner				S3	3 Sensitive	9	23.6 ± 0.0	NS

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I	*Gomphaeschna furcillata*	Harlequin Darner				S3	3 Sensitive	27	42.2 ± 0.0	NS
I	*Somatochlora tenebrosa*	Clamp-Tipped Emerald				S3	4 Secure	17	5.8 ± 0.0	NS
I	*Nannothemis bella*	Elfin Skimmer				S3	4 Secure	18	46.1 ± 0.0	NS
I	*Sympetrum danae*	Black Meadowhawk				S3	3 Sensitive	1	85.2 ± 0.0	NS
I	*Amphiagrion saucium*	Eastern Red Damsel				S3	4 Secure	3	47.0 ± 1.0	NS
I	*Cupido comyntas*	Eastern Tailed Blue				S3?		1	99.9 ± 0.0	NB
I	*Polygonia interrogationis*	Question Mark				S3B	4 Secure	19	13.0 ± 2.0	NS
I	*Erynnis juvenalis*	Juvenal's Duskywing				S3S4	4 Secure	56	7.3 ± 2.0	NS
I	*Amblyscirtes vialis*	Common Roadside-Skipper				S3S4	4 Secure	15	45.4 ± 0.0	NS
I	*Polygonia progne*	Grey Comma				S3S4	4 Secure	5	58.4 ± 20.0	NS
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	S1	1 At Risk	47	50.1 ± 0.0	NS
N	*Erioderma mollissimum*	Graceful Felt Lichen	Endangered	Endangered	Endangered	S1S2	2 May Be At Risk	248	4.1 ± 0.0	NS
N	*Pannaria lurida*	Wrinkled Shingle Lichen	Threatened	Threatened	Threatened	S1S2	2 May Be At Risk	49	19.2 ± 0.0	NS
N	*Fuscopannaria leucosticta*	White-rimmed Shingle Lichen	Threatened			S2S3	2 May Be At Risk	271	21.3 ± 0.0	NS
N	*Anzia colpodes*	Black-foam Lichen	Threatened	Threatened	Threatened	S3	3 Sensitive	129	4.9 ± 1.0	NS
N	*Sclerophora peronella (Atlantic pop.)*	Frosted Glass-whiskers (Atlantic population)	Special Concern	Special Concern		S1?		79	40.1 ± 0.0	NS
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Vulnerable	S3	4 Secure	688	4.2 ± 0.0	NS
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	3 Sensitive	11	20.9 ± 30.0	NS
N	*Harpalejeunea molleri ssp. integra*	a liverwort				S1		3	22.0 ± 0.0	NS
N	*Orthotrichum pallens*	Pale Bristle Moss				S1		1	79.7 ± 0.0	NS
N	*Sphagnum carolinianum*	Carolina Peat Moss				S1	2 May Be At Risk	1	51.2 ± 0.0	NS
N	*Umbilicaria vellea*	Grizzled Rocktripe Lichen				S1	5 Undetermined	3	81.1 ± 0.0	NS
N	*Heterodermia leucomela*	Elegant Fringe Lichen				S1		3	22.0 ± 0.0	NS
N	*Flavoparmelia baltimorensis*	Rock Greenshield Lichen				S1	5 Undetermined	1	89.6 ± 1.0	NS
N	*Ephebe hispidula*	Dryside Rockshag Lichen				S1	5 Undetermined	1	89.5 ± 1.0	NS
N	*Parmotrema perforatum*	Perforated Ruffle Lichen				S1	5 Undetermined	4	75.7 ± 0.0	NS
N	*Leptogium hibernicum*	Hibernia Jellyskin Lichen				S1	2 May Be At Risk	12	21.6 ± 0.0	NS
N	*Hypotrachyna horrescens*	Hairy-spined Shield Lichen				S1	2 May Be At Risk	3	24.4 ± 0.0	NS
N	*Frullania selwyniana*	Selwyn's Scalewort				S1?	5 Undetermined	8	21.6 ± 0.0	NS
N	*Campylostelium saxicola*	a Moss				S1?	3 Sensitive	1	90.6 ± 1.0	NS
N	*Grimmia anodon*	Toothless Grimmia Moss				S1?	3 Sensitive	2	77.9 ± 3.0	NS
N	*Homomallium adnatum*	Adnate Hairy-gray Moss				S1?	3 Sensitive	2	4.0 ± 1.0	NS
N	*Meesia triquetra*	Three-ranked Cold Moss				S1?		1	95.2 ± 0.0	NS
N	*Sphagnum cyclophyllum*	a Moss				S1?	5 Undetermined	11	36.3 ± 0.0	NS
N	*Sphagnum molle*	Blushing Peat Moss				S1?		2	3.9 ± 0.0	NS
N	*Syntrichia ruralis*	a Moss				S1?	3 Sensitive	1	70.0 ± 0.0	NS
N	*Parmeliella parvula*	Poor-man's Shingles Lichen				S1?	2 May Be At Risk	39	76.5 ± 0.0	NS
N	*Didymodon rigidulus*	Rigid Screw Moss				S1S2	3 Sensitive	2	83.3 ± 0.0	NS
N	*Sphagnum platyphyllum*	Flat-leaved Peat Moss				S1S2		1	18.2 ± 0.0	NS
N	*Sphagnum trinitense*	a peatmoss				S1S2		6	3.9 ± 0.0	NS
N	*Tortula mucronifolia*	Mucronate Screw Moss				S1S2	3 Sensitive	1	77.9 ± 3.0	NS
N	*Cyrto-hypnum minutulum*	Tiny Cedar Moss				S1S2	3 Sensitive	1	79.8 ± 0.0	NS
N	*Hamatocaulis vernicosus*	a Moss				S1S2	3 Sensitive	2	95.2 ± 0.0	NS
N	*Collema limosum*	Lime-loving Tarpaper Lichen				S1S2		1	27.5 ± 0.0	NS
N	*Leptogium intermedium*	Forty-five Jellyskin Lichen				S1S2	5 Undetermined	1	19.1 ± 1.0	NS
N	*Sticta limbata*	Powdered Moon Lichen				S1S2	2 May Be At Risk	2	24.4 ± 0.0	NS
N	*Metzgeria crassipilis*	Hairy Veilwort				S1S3		3	47.3 ± 0.0	NS
N	*Porella pinnata*	Pinnate Scalewort				S1S3	5 Undetermined	1	98.3 ± 0.0	NS
N	*Umbilicaria polyrhiza*	Ballpoint Rocktripe Lichen				S1S3	5 Undetermined	1	89.5 ± 1.0	NS
N	*Usnea fragilescens*	Inflationary Beard Lichen				S1S3	5 Undetermined	2	14.5 ± 40.0	NS
N	*Stereocaulon grande*	Grand Foam Lichen				S1S3	5 Undetermined	1	56.4 ± 0.0	NS
N	*Stereocaulon intermedium*	Pacific Brain Foam Lichen				S1S3		1	96.0 ± 0.0	NS
N	*Cladonia subtenuis*	Dixie Reindeer Lichen				S1S3	6 Not Assessed	1	43.1 ± 0.0	NS
N	*Cystocoleus ebeneus*	Rockgossamer Lichen				S2		2	88.4 ± 0.0	NS

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N	*Nephroma resupinatum*	a lichen				S2	2 May Be At Risk	2	67.8 ± 0.0	NS
N	*Parmotrema reticulatum*	Netted Ruffle Lichen				S2	3 Sensitive	6	4.0 ± 1.0	NS
N	*Anacamptodon splachnoides*	a Moss				S2?	3 Sensitive	1	77.3 ± 0.0	NS
N	*Atrichum angustatum*	Lesser Smoothcap Moss				S2?	3 Sensitive	7	67.5 ± 3.0	NS
N	*Bryum algovicum*	a Moss				S2?	3 Sensitive	3	35.6 ± 0.0	NS
N	*Campylium polygamum*	a Moss				S2?	5 Undetermined	1	79.8 ± 0.0	NS
N	*Campylium radicale*	Long-stalked Fine Wet Moss				S2?	5 Undetermined	2	79.6 ± 0.0	NS
N	*Climacium americanum*	American Tree Moss				S2?	3 Sensitive	9	78.2 ± 0.0	NS
N	*Dicranum condensatum*	Condensed Broom Moss				S2?	5 Undetermined	3	37.2 ± 0.0	NS
N	*Ditrichum rhynchostegium*	a Moss				S2?	3 Sensitive	5	77.0 ± 5.0	NS
N	*Fissidens bushii*	Bush's Pocket Moss				S2?	3 Sensitive	2	67.5 ± 3.0	NS
N	*Fontinalis hypnoides*	a moss				S2?	5 Undetermined	1	79.4 ± 0.0	NS
N	*Fontinalis sullivantii*	a Moss				S2?	3 Sensitive	4	41.6 ± 4.0	NS
N	*Grimmia olneyi*	a Moss				S2?	3 Sensitive	10	73.6 ± 15.0	NS
N	*Orthotrichum anomalum*	Anomalous Bristle Moss				S2?	3 Sensitive	1	79.7 ± 0.0	NS
N	*Philonotis marchica*	a Moss				S2?	5 Undetermined	1	83.3 ± 0.0	NS
N	*Physcomitrium collenchymatum*	a Moss				S2?	3 Sensitive	6	52.1 ± 2.0	NS
N	*Sematophyllum marylandicum*	a Moss				S2?	3 Sensitive	1	83.3 ± 0.0	NS
N	*Sphagnum subnitens*	Lustrous Peat Moss				S2?	3 Sensitive	4	73.8 ± 0.0	NS
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S2?	3 Sensitive	1	64.0 ± 0.0	NS
N	*Plagiomnium rostratum*	Long-beaked Leafy Moss				S2?	5 Undetermined	3	77.3 ± 0.0	NS
N	*Pseudotaxiphyllum distichaceum*	a Moss				S2?	3 Sensitive	4	13.3 ± 0.0	NS
N	*Rauiella scita*	Smaller Fern Moss				S2?	3 Sensitive	16	73.2 ± 0.0	NS
N	*Platylomella lescurii*	a Moss				S2?	3 Sensitive	4	79.6 ± 0.0	NS
N	*Usnea flavocardia*	Blood-splattered Beard Lichen				S2?	3 Sensitive	1	84.1 ± 1.0	NS
N	*Leptogium teretiusculum*	Beaded Jellyskin Lichen				S2?	3 Sensitive	2	30.5 ± 0.0	NS
N	*Rostania occultata*	Crusted Tarpaper Lichen				S2?	5 Undetermined	1	84.7 ± 2.0	NS
N	*Xanthoparmelia mougeotii*	Powdered Rock-shield Lichen				S2?	2 May Be At Risk	3	55.5 ± 5.0	NS
N	*Peltigera collina*	Tree Pelt Lichen				S2?	3 Sensitive	6	71.9 ± 0.0	NS
N	*Eurhynchium hians*	Light Beaked Moss				S2S3	3 Sensitive	1	77.0 ± 5.0	NS
N	*Platydictya subtilis*	Bark Willow Moss				S2S3	3 Sensitive	1	83.5 ± 0.0	NS
N	*Collema leptaleum*	Crumpled Bat's Wing Lichen				S2S3	3 Sensitive	8	47.4 ± 0.0	NS
N	*Ahtiana aurescens*	Eastern Candlewax Lichen				S2S3	5 Undetermined	4	50.5 ± 0.0	NS
N	*Usnocetraria oakesiana*	Yellow Band Lichen				S2S3	2 May Be At Risk	2	40.2 ± 0.0	NS
N	*Cladonia incrassata*	Powder-foot British Soldiers Lichen				S2S3	5 Undetermined	3	4.0 ± 1.0	NS
N	*Cladonia mateocyatha*	Mixed-up Pixie-cup				S2S3		1	34.9 ± 0.0	NS
N	*Cladonia parasitica*	Fence-rail Lichen				S2S3	5 Undetermined	1	82.6 ± 1.0	NS
N	*Hypotrachyna catawbiensis*	Powder-tipped Antler Lichen				S2S3	2 May Be At Risk	1	48.6 ± 0.0	NS
N	*Leptogium milligranum*	Stretched Jellyskin Lichen				S2S3	3 Sensitive	26	11.7 ± 0.0	NS
N	*Leptogium tenuissimum*	Birdnest Jellyskin Lichen				S2S3	6 Not Assessed	3	76.9 ± 0.0	NS
N	*Hypotrachyna minarum*	Hairless-spined Shield Lichen				S2S3	3 Sensitive	2	19.1 ± 1.0	NS
N	*Usnea cavernosa*	Pitted Beard Lichen				S2S3	3 Sensitive	1	87.4 ± 0.0	NS
N	*Usnea ceratina*	Warty Beard Lichen				S2S3	3 Sensitive	2	48.0 ± 3.0	NS
N	*Usnea rubicunda*	Red Beard Lichen				S2S3	3 Sensitive	7	21.1 ± 0.0	NS
N	*Physcia tenella var. tenella*	Fringed Rosette Lichen				S2S3		1	89.4 ± 0.0	NS
N	*Hypotrachyna revoluta*	Granulating Loop Lichen				S2S3	5 Undetermined	2	58.5 ± 0.0	NS
N	*Cetraria arenaria*	Sand-loving Icelandmoss Lichen				S2S3	5 Undetermined	1	41.6 ± 1.0	NS
N	*Cladonia coccifera*	Eastern Boreal Pixie-cup Lichen				S2S3	3 Sensitive	1	49.6 ± 0.0	NS

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N	*Cladonia phyllophora*	Felt Lichen				S2S3	5 Undetermined	1	56.4 ± 0.0	NS
N	*Usnea flammea*	Coastal Bushy Beard Lichen				S2S3	3 Sensitive	1	88.9 ± 0.0	NS
N	*Ramalina thrausta*	Angelhair Ramalina Lichen				S3	3 Sensitive	1	9.9 ± 2.0	NS
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	3 Sensitive	42	16.7 ± 0.0	NS
N	*Sticta fuliginosa*	Peppered Moon Lichen				S3	3 Sensitive	181	9.2 ± 0.0	NS
N	*Leptogium subtile*	Appressed Jellyskin Lichen				S3	3 Sensitive	14	9.6 ± 0.0	NS
N	*Fuscopannaria ahlneri*	Corrugated Shingles Lichen				S3	4 Secure	73	4.0 ± 1.0	NS
N	*Heterodermia speciosa*	Powdered Fringe Lichen				S3	4 Secure	27	9.9 ± 2.0	NS
N	*Heterodermia squamulosa*	Scaly Fringe Lichen				S3	3 Sensitive	14	4.0 ± 1.0	NS
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S3	3 Sensitive	239	16.7 ± 0.0	NS
N	*Nephroma bellum*	Naked Kidney Lichen				S3	3 Sensitive	10	9.9 ± 2.0	NS
N	*Punctelia appalachensis*	Appalachian Speckleback Lichen				S3	3 Sensitive	7	4.0 ± 1.0	NS
N	*Moelleropsis nebulosa ssp. frullaniae*	Blue-gray Moss Shingle Lichen				S3	4 Secure	5	69.1 ± 0.0	NS
N	*Moelleropsis nebulosa*	Blue-gray Moss Shingle Lichen				S3	4 Secure	123	16.8 ± 0.0	NS
N	*Fuscopannaria sorediata*	a Lichen				S3		4	21.0 ± 0.0	NS
N	*Ephebe lanata*	Waterside Rockshag Lichen				S3	3 Sensitive	1	87.1 ± 0.0	NS
N	*Drummondia prorepens*	a Moss				S3?	3 Sensitive	4	77.3 ± 0.0	NS
N	*Anomodon tristis*	a Moss				S3?	3 Sensitive	6	21.9 ± 0.0	NS
N	*Cladonia stygia*	Black-footed Reindeer Lichen				S3?	3 Sensitive	2	56.4 ± 0.0	NS
N	*Anomodon rugelii*	Rugel's Anomodon Moss				S3S4	3 Sensitive	6	19.1 ± 1.0	NS
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S3S4	4 Secure	6	78.8 ± 0.0	NS
N	*Dicranum leioneuron*	a Dicranum Moss				S3S4	4 Secure	2	88.6 ± 0.0	NS
N	*Hylocomiastrum pyrenaicum*	a Feather Moss				S3S4	3 Sensitive	1	77.3 ± 0.0	NS
N	*Arctoparmelia incurva*	Finger Ring Lichen				S3S4	4 Secure	3	56.4 ± 0.0	NS
N	*Hypogymnia vittata*	Slender Monk's Hood Lichen				S3S4	4 Secure	10	24.4 ± 0.0	NS
N	*Leptogium acadiense*	Acadian Jellyskin Lichen				S3S4		25	48.8 ± 0.0	NS
N	*Melanohalea olivacea*	Spotted Camouflage Lichen				S3S4	5 Undetermined	1	89.7 ± 7.0	NS
N	*Parmotrema chinense*	Powdered Ruffle Lichen				S3S4	4 Secure	25	4.0 ± 1.0	NS
N	*Peltigera hymenina*	Cloudy Pelt Lichen				S3S4	4 Secure	1	55.0 ± 2.0	NS
N	*Physconia detersa*	Bottlebrush Frost Lichen				S3S4	3 Sensitive	3	4.0 ± 1.0	NS
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	4 Secure	704	4.2 ± 0.0	NS
N	*Physcia caesia*	Blue-gray Rosette Lichen				S3S4	5 Undetermined	1	59.1 ± 20.0	NS
N	*Physcia tenella*	Fringed Rosette Lichen				S3S4	6 Not Assessed	1	89.6 ± 1.0	NS
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	4 Secure	69	3.6 ± 0.0	NS
N	*Bryoria pikei*	Pike's Horsehair Lichen				S3S4	5 Undetermined	2	80.0 ± 1.0	NS
N	*Dermatocarpon luridum*	Brookside Stippleback Lichen				S3S4	4 Secure	5	4.0 ± 1.0	NS
N	*Heterodermia neglecta*	Fringe Lichen				S3S4	4 Secure	149	4.0 ± 1.0	NS
P	*Coreopsis rosea*	Pink Coreopsis	Endangered	Endangered	Endangered	S1	1 At Risk	468	0.6 ± 1.0	NS
P	*Drosera filiformis*	Thread-leaved Sundew	Endangered	Endangered	Endangered	S1	1 At Risk	919	45.1 ± 0.0	NS
P	*Sabatia kennedyana*	Plymouth Gentian	Endangered	Endangered	Endangered	S1	1 At Risk	1247	0.5 ± 1.0	NS
P	*Geum peckii*	Eastern Mountain Avens	Endangered	Endangered	Endangered	S1	1 At Risk	3199	50.2 ± 0.0	NS
P	*Rhynchospora macrostachya*	Tall Beakrush	Endangered	Endangered	Endangered	S1	2 May Be At Risk	50	80.8 ± 0.0	NS
P	*Clethra alnifolia*	Coast Pepper-Bush	Endangered	Threatened	Vulnerable	S1	1 At Risk	299	4.4 ± 0.0	NS
P	*Baccharis halimifolia*	Eastern Baccharis	Threatened	Threatened	Threatened	S1	1 At Risk	172	6.5 ± 6.0	NS
P	*Fraxinus nigra*	Black Ash	Threatened		Threatened	S1S2	1 At Risk	69	40.1 ± 0.0	NS
P	*Hydrocotyle umbellata*	Water Pennywort	Special Concern	Special Concern	Endangered	S1	1 At Risk	205	4.9 ± 0.0	NS
P	*Lilaeopsis chinensis*	Eastern Lilaeopsis	Special Concern	Special Concern	Vulnerable	S2	3 Sensitive	36	3.7 ± 0.0	NS
P	*Eleocharis tuberculosa*	Tubercled Spike-rush	Special Concern	Special Concern	Vulnerable	S2	1 At Risk	517	9.8 ± 0.0	NS
P	*Lachnanthes caroliniana*	Redroot	Special Concern	Special Concern	Vulnerable	S2	1 At Risk	1152	91.8 ± 0.0	NS
P	*Lophiola aurea*	Goldencrest	Special Concern	Special Concern	Vulnerable	S2	1 At Risk	392	51.2 ± 1.0	NS
P	*Isoetes prototypus*	Prototype Quillwort	Special Concern	Special Concern	Vulnerable	S2	3 Sensitive	2	63.4 ± 0.0	NS
P	*Scirpus longii*	Long's Bulrush	Special Concern		Vulnerable	S3	3 Sensitive	583	5.4 ± 0.0	NS

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P	*Smilax rotundifolia*	Round-leaved Greenbrier	Not At Risk			S3	4 Secure	1017	0.5 ± 1.0	NS
P	*Crocanthemum canadense*	Long-branched Frostweed			Endangered	S1	1 At Risk	8	94.5 ± 0.0	NS
P	*Thuja occidentalis*	Eastern White Cedar			Vulnerable	S1	1 At Risk	118	4.8 ± 0.0	NS
P	*Toxicodendron vernix*	Poison Sumac				S1	2 May Be At Risk	41	82.1 ± 0.0	NS
P	*Antennaria parlinii ssp. fallax*	Parlin's Pussytoes				S1		2	90.1 ± 0.0	NS
P	*Nabalus racemosus*	Glaucous Rattlesnakeroot				S1	2 May Be At Risk	11	62.2 ± 0.0	NS
P	*Lobelia spicata*	Pale-Spiked Lobelia				S1	2 May Be At Risk	1	20.1 ± 50.0	NS
P	*Stellaria crassifolia*	Fleshy Stitchwort				S1	2 May Be At Risk	1	99.3 ± 2.0	NS
P	*Lyonia ligustrina*	Maleberry				S1	2 May Be At Risk	11	5.0 ± 0.0	NS
P	*Desmodium canadense*	Canada Tick-trefoil				S1	2 May Be At Risk	7	50.9 ± 7.0	NS
P	*Hylodesmum glutinosum*	Large Tick-trefoil				S1	2 May Be At Risk	4	79.8 ± 0.0	NS
P	*Polygala polygama*	Racemed Milkwort				S1	5 Undetermined	22	50.5 ± 0.0	NS
P	*Montia fontana*	Water Blinks				S1	2 May Be At Risk	3	53.5 ± 0.0	NS
P	*Lysimachia minima*	Chaffweed				S1	2 May Be At Risk	1	80.6 ± 0.0	NS
P	*Amelanchier nantucketensis*	Nantucket Serviceberry				S1	2 May Be At Risk	1	61.8 ± 0.0	NS
P	*Agalinis purpurea var. parviflora*	Small-flowered Purple False Foxglove				S1		2	6.0 ± 0.0	NS
P	*Veronica catenata*	Pink Water-Speedwell				S1		1	61.6 ± 0.0	NS
P	*Pilea pumila*	Dwarf Clearweed				S1	2 May Be At Risk	1	38.0 ± 0.0	NS
P	*Carex digitalis*	Slender Wood Sedge				S1	2 May Be At Risk	4	78.6 ± 0.0	NS
P	*Carex laxiflora*	Loose-Flowered Sedge				S1	2 May Be At Risk	2	73.3 ± 10.0	NS
P	*Carex ormostachya*	Necklace Spike Sedge				S1	2 May Be At Risk	2	98.1 ± 0.0	NS
P	*Carex prairea*	Prairie Sedge				S1	2 May Be At Risk	1	72.0 ± 5.0	NS
P	*Carex viridula var. saxilittoralis*	Greenish Sedge				S1	2 May Be At Risk	2	49.1 ± 5.0	NS
P	*Cyperus diandrus*	Low Flatsedge				S1	2 May Be At Risk	7	4.4 ± 0.0	NS
P	*Eleocharis erythropoda*	Red-stemmed Spikerush				S1	2 May Be At Risk	2	99.7 ± 1.0	NB
P	*Fimbristylis autumnalis*	Slender Fimbry				S1	2 May Be At Risk	3	76.3 ± 0.0	NS
P	*Scirpus atrovirens*	Dark-green Bulrush				S1		1	96.6 ± 0.0	NS
P	*Blysmopsis rufa*	Red Bulrush				S1	2 May Be At Risk	1	18.8 ± 1.0	NS
P	*Schoenoplectus torreyi*	Torrey's Bulrush				S1	2 May Be At Risk	2	87.7 ± 0.0	NS
P	*Sisyrinchium fuscatum*	Coastal Plain Blue-eyed-grass				S1	2 May Be At Risk	6	6.8 ± 0.0	NS
P	*Juncus brachycephalus*	Small-Head Rush				S1	2 May Be At Risk	2	54.8 ± 2.0	NS
P	*Juncus secundus*	Secund Rush				S1	2 May Be At Risk	2	80.7 ± 3.0	NS
P	*Allium tricoccum*	Wild Leek				S1	2 May Be At Risk	24	82.6 ± 7.0	NS
P	*Spiranthes casei var. casei*	Case's Ladies'-Tresses				S1	2 May Be At Risk	2	49.1 ± 5.0	NS
P	*Adiantum pedatum*	Northern Maidenhair Fern				S1	2 May Be At Risk	2	4.8 ± 0.0	NS
P	*Selaginella rupestris*	Rock Spikemoss				S1	2 May Be At Risk	29	67.1 ± 0.0	NS
P	*Solidago hispida*	Hairy Goldenrod				S1?	2 May Be At Risk	3	28.3 ± 7.0	NS
P	*Bolboschoenus robustus*	Sturdy Bulrush				S1?	5 Undetermined	1	8.7 ± 7.0	NS
P	*Dichanthelium lindheimeri*	Lindheimer's Panicgrass				S1?	5 Undetermined	3	19.3 ± 0.0	NS
P	*Panicum dichotomiflorum ssp. puritanorum*	Spreading Panicgrass				S1?	2 May Be At Risk	17	1.1 ± 1.0	NS
P	*Huperzia selago*	Northern Firmoss				S1?	2 May Be At Risk	3	49.1 ± 5.0	NS
P	*Cornus suecica*	Swedish Bunchberry				S1S2	3 Sensitive	2	87.6 ± 0.0	NS
P	*Proserpinaca intermedia*	Intermediate Mermaidweed				S1S2	2 May Be At Risk	2	0.6 ± 1.0	NS
P	*Conopholis americana*	American Cancer-root				S1S2	2 May Be At Risk	35	73.3 ± 0.0	NS
P	*Hepatica americana*	Round-lobed Hepatica				S1S2	2 May Be At Risk	3	87.3 ± 0.0	NS
P	*Ranunculus sceleratus*	Cursed Buttercup				S1S2	2 May Be At Risk	1	76.6 ± 0.0	NS
P	*Juncus greenei*	Greene's Rush				S1S2	2 May Be At Risk	6	51.8 ± 0.0	NS
P	*Calamagrostis stricta ssp. stricta*	Slim-stemmed Reed Grass				S1S2	3 Sensitive	1	19.4 ± 0.0	NS
P	*Selaginella selaginoides*	Low Spikemoss				S1S2	2 May Be At Risk	2	51.9 ± 2.0	NS
P	*Carex vacillans*	Estuarine Sedge				S1S3	5 Undetermined	1	91.2 ± 0.0	NS
P	*Conioselinum chinense*	Chinese Hemlock-parsley				S2	3 Sensitive	11	52.7 ± 0.0	NS
P	*Erigeron philadelphicus*	Philadelphia Fleabane				S2	3 Sensitive	1	22.4 ± 1.0	NS
P	*Eutrochium dubium*	Coastal Plain Joe Pye Weed				S2	2 May Be At Risk	185	3.2 ± 10.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Lactuca hirsuta*	Hairy Lettuce				S2	3 Sensitive	5	4.0 ± 0.0	NS
P	*Symphyotrichum undulatum*	Wavy-leaved Aster				S2	3 Sensitive	19	45.8 ± 7.0	NS
P	*Symphyotrichum ciliolatum*	Fringed Blue Aster				S2	3 Sensitive	1	76.8 ± 0.0	NS
P	*Cardamine parviflora*	Small-flowered Bittercress				S2	3 Sensitive	1	52.0 ± 5.0	NS
P	*Stellaria longifolia*	Long-leaved Starwort				S2	3 Sensitive	1	52.3 ± 5.0	NS
P	*Oxybasis rubra*	Red Goosefoot				S2	2 May Be At Risk	3	76.6 ± 0.0	NS
P	*Hudsonia ericoides*	Pinebarren Golden Heather				S2	3 Sensitive	15	32.5 ± 1.0	NS
P	*Hypericum majus*	Large St John's-wort				S2	3 Sensitive	1	68.5 ± 1.0	NS
P	*Crassula aquatica*	Water Pygmyweed				S2	3 Sensitive	2	57.1 ± 0.0	NS
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S2	3 Sensitive	8	22.7 ± 0.0	NS
P	*Utricularia resupinata*	Inverted Bladderwort				S2	3 Sensitive	41	25.3 ± 0.0	NS
P	*Oenothera fruticosa ssp. tetragona*	Narrow-leaved Evening Primrose				S2	5 Undetermined	24	13.1 ± 7.0	NS
P	*Persicaria arifolia*	Halberd-leaved Tearthumb				S2	3 Sensitive	7	5.4 ± 0.0	NS
P	*Galium boreale*	Northern Bedstraw				S2	2 May Be At Risk	3	86.5 ± 0.0	NS
P	*Salix pedicellaris*	Bog Willow				S2	3 Sensitive	20	91.3 ± 1.0	NS
P	*Salix sericea*	Silky Willow				S2	2 May Be At Risk	49	2.9 ± 0.0	NS
P	*Agalinis maritima*	Saltmarsh Agalinis				S2	3 Sensitive	51	6.5 ± 6.0	NS
P	*Viola nephrophylla*	Northern Bog Violet				S2	3 Sensitive	1	68.9 ± 1.0	NS
P	*Carex comosa*	Bearded Sedge				S2	3 Sensitive	5	95.1 ± 0.0	NS
P	*Carex hystericina*	Porcupine Sedge				S2	2 May Be At Risk	1	5.2 ± 1.0	NS
P	*Carex longii*	Long's Sedge				S2	3 Sensitive	16	0.6 ± 1.0	NS
P	*Carex tenera*	Tender Sedge				S2	3 Sensitive	2	44.0 ± 0.0	NS
P	*Eleocharis quinqueflora*	Few-flowered Spikerush				S2	3 Sensitive	2	52.4 ± 3.0	NS
P	*Vallisneria americana*	Wild Celery				S2	2 May Be At Risk	3	81.1 ± 0.0	NS
P	*Allium schoenoprasum*	Wild Chives				S2	2 May Be At Risk	1	53.5 ± 1.0	NS
P	*Allium schoenoprasum var. sibiricum*	Wild Chives				S2	2 May Be At Risk	2	53.0 ± 0.0	NS
P	*Najas gracillima*	Thread-Like Naiad				S2	3 Sensitive	20	80.4 ± 0.0	NS
P	*Cypripedium parviflorum var. pubescens*	Yellow Lady's-slipper				S2	3 Sensitive	1	92.2 ± 1.0	NS
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S2	3 Sensitive	71	51.4 ± 0.0	NS
P	*Platanthera flava*	Southern Rein-Orchid				S2	3 Sensitive	19	0.5 ± 1.0	NS
P	*Platanthera flava var. flava*	Southern Rein Orchid				S2	3 Sensitive	407	0.3 ± 5.0	NS
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S2	5 Undetermined	1	5.9 ± 0.0	NS
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S2	3 Sensitive	3	22.0 ± 1.0	NS
P	*Spiranthes casei*	Case's Ladies'-Tresses				S2	3 Sensitive	3	47.8 ± 0.0	NS
P	*Spiranthes casei var. novaescotiae*	Case's Ladies'-Tresses				S2	3 Sensitive	19	5.3 ± 1.0	NS
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2	2 May Be At Risk	4	41.7 ± 7.0	NS
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S2	3 Sensitive	1	41.8 ± 0.0	NS
P	*Piptatheropsis canadensis*	Canada Ricegrass				S2	3 Sensitive	12	14.1 ± 0.0	NS
P	*Piptatheropsis pungens*	Slender Ricegrass				S2	3 Sensitive	2	49.9 ± 10.0	NS
P	*Symphyotrichum boreale*	Boreal Aster				S2?	3 Sensitive	16	0.6 ± 1.0	NS
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S2?	5 Undetermined	7	6.3 ± 1.0	NS
P	*Epilobium coloratum*	Purple-veined Willowherb				S2?	3 Sensitive	6	12.4 ± 0.0	NS
P	*Rumex persicarioides*	Peach-leaved Dock				S2?	2 May Be At Risk	6	50.7 ± 0.0	NS
P	*Eleocharis ovata*	Ovate Spikerush				S2?	3 Sensitive	5	11.3 ± 0.0	NS
P	*Scirpus pedicellatus*	Stalked Bulrush				S2?	3 Sensitive	1	56.3 ± 5.0	NS
P	*Potamogeton pulcher*	Spotted Pondweed			Vulnerable	S2S3	3 Sensitive	38	4.9 ± 0.0	NS
P	*Hieracium robinsonii*	Robinson's Hawkweed				S2S3	3 Sensitive	4	28.0 ± 1.0	NS
P	*Iva frutescens*	Big-leaved Marsh-elder				S2S3	3 Sensitive	59	9.8 ± 0.0	NS
P	*Senecio pseudoarnica*	Seabeach Ragwort				S2S3	3 Sensitive	4	17.5 ± 1.0	NS
P	*Betula michauxii*	Michaux's Dwarf Birch				S2S3	3 Sensitive	16	49.1 ± 5.0	NS
P	*Sagina nodosa*	Knotted Pearlwort				S2S3	4 Secure	40	52.1 ± 1.0	NS
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S2S3	4 Secure	3	53.1 ± 1.0	NS
P	*Ceratophyllum echinatum*	Prickly Hornwort				S2S3	3 Sensitive	1	17.0 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Hypericum x dissimulatum*	Disguised St. John's-wort				S2S3	3 Sensitive	8	4.9 ± 10.0	NS
P	*Shepherdia canadensis*	Soapberry				S2S3	3 Sensitive	1	69.6 ± 0.0	NS
P	*Euphorbia polygonifolia*	Seaside Spurge				S2S3	3 Sensitive	10	50.9 ± 0.0	NS
P	*Hedeoma pulegioides*	American False Pennyroyal				S2S3	3 Sensitive	44	11.8 ± 5.0	NS
P	*Polygonum aviculare ssp. buxiforme*	Box Knotweed				S2S3	5 Undetermined	11	49.1 ± 7.0	NS
P	*Polygonum oxyspermum ssp. raii*	Ray's Knotweed				S2S3	5 Undetermined	12	46.4 ± 1.0	NS
P	*Amelanchier fernaldii*	Fernald's Serviceberry				S2S3	5 Undetermined	1	57.8 ± 1.0	NS
P	*Potentilla canadensis*	Canada Cinquefoil				S2S3	3 Sensitive	10	7.6 ± 3.0	NS
P	*Galium aparine*	Common Bedstraw				S2S3	3 Sensitive	5	18.3 ± 0.0	NS
P	*Galium obtusum*	Blunt-leaved Bedstraw				S2S3	3 Sensitive	22	3.7 ± 0.0	NS
P	*Carex adusta*	Lesser Brown Sedge				S2S3	3 Sensitive	1	64.9 ± 7.0	NS
P	*Carex houghtoniana*	Houghton's Sedge				S2S3	3 Sensitive	7	56.6 ± 0.0	NS
P	*Eleocharis flavescens var. olivacea*	Bright-green Spikerush				S2S3	3 Sensitive	16	7.8 ± 0.0	NS
P	*Eriophorum gracile*	Slender Cottongrass				S2S3	3 Sensitive	5	92.2 ± 1.0	NS
P	*Stuckenia filiformis*	Thread-leaved Pondweed				S2S3	3 Sensitive	1	89.9 ± 7.0	NS
P	*Botrychium lanceolatum ssp. angustisegmentum*	Narrow Triangle Moonwort				S2S3	3 Sensitive	3	15.7 ± 1.0	NS
P	*Botrychium simplex*	Least Moonwort				S2S3	3 Sensitive	1	19.0 ± 1.0	NS
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	3 Sensitive	9	1.1 ± 5.0	NS
P	*Hieracium paniculatum*	Panicled Hawkweed				S3	4 Secure	23	5.1 ± 0.0	NS
P	*Bidens beckii*	Water Beggarticks				S3	4 Secure	25	4.4 ± 0.0	NS
P	*Alnus serrulata*	Smooth Alder				S3	3 Sensitive	489	3.7 ± 0.0	NS
P	*Mononeuria groenlandica*	Greenland Stitchwort				S3	3 Sensitive	7	53.3 ± 0.0	NS
P	*Vaccinium uliginosum*	Alpine Bilberry				S3	3 Sensitive	3	50.7 ± 0.0	NS
P	*Bartonia virginica*	Yellow Bartonia				S3	4 Secure	93	2.9 ± 0.0	NS
P	*Geranium bicknellii*	Bicknell's Crane's-bill				S3	4 Secure	6	12.3 ± 0.0	NS
P	*Proserpinaca palustris*	Marsh Mermaidweed				S3	4 Secure	21	0.4 ± 2.0	NS
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S3	4 Secure	70	0.4 ± 1.0	NS
P	*Teucrium canadense*	Canada Germander				S3	3 Sensitive	37	5.8 ± 0.0	NS
P	*Decodon verticillatus*	Swamp Loosestrife				S3	4 Secure	338	4.3 ± 0.0	NS
P	*Persicaria pensylvanica*	Pennsylvania Smartweed				S3	4 Secure	2	59.7 ± 5.0	NS
P	*Fallopia scandens*	Climbing False Buckwheat				S3	3 Sensitive	3	60.5 ± 7.0	NS
P	*Plantago rugelii*	Rugel's Plantain				S3	4 Secure	1	99.2 ± 0.0	NS
P	*Primula laurentiana*	Laurentian Primrose				S3	4 Secure	18	14.1 ± 0.0	NS
P	*Samolus parviflorus*	Seaside Brookweed				S3	3 Sensitive	37	3.7 ± 0.0	NS
P	*Pyrola asarifolia*	Pink Pyrola				S3	4 Secure	1	73.0 ± 7.0	NS
P	*Pyrola minor*	Lesser Pyrola				S3	3 Sensitive	1	78.9 ± 1.0	NS
P	*Endotropis alnifolia*	alder-leaved buckthorn				S3	4 Secure	1	78.0 ± 0.0	NS
P	*Agrimonia gryposepala*	Hooked Agrimony				S3	4 Secure	9	78.7 ± 5.0	NS
P	*Amelanchier spicata*	Running Serviceberry				S3	4 Secure	10	11.4 ± 2.0	NS
P	*Cephalanthus occidentalis*	Common Buttonbush				S3	3 Sensitive	1325	15.0 ± 7.0	NS
P	*Limosella australis*	Southern Mudwort				S3	4 Secure	17	4.0 ± 0.0	NS
P	*Lindernia dubia*	Yellow-seeded False Pimperel				S3	4 Secure	6	8.9 ± 0.0	NS
P	*Carex cryptolepis*	Hidden-scaled Sedge				S3	4 Secure	4	5.6 ± 2.0	NS
P	*Carex lupulina*	Hop Sedge				S3	4 Secure	23	11.2 ± 0.0	NS
P	*Carex rosea*	Rosy Sedge				S3	4 Secure	2	84.5 ± 0.0	NS
P	*Carex swanii*	Swan's Sedge				S3	3 Sensitive	75	15.2 ± 10.0	NS
P	*Carex tribuloides*	Blunt Broom Sedge				S3	4 Secure	1	78.9 ± 0.0	NS
P	*Carex wiegandii*	Wiegand's Sedge				S3	3 Sensitive	1	56.8 ± 1.0	NS
P	*Carex foenea*	Fernald's Hay Sedge				S3	4 Secure	2	44.0 ± 2.0	NS
P	*Eleocharis nitida*	Quill Spikerush				S3	4 Secure	2	63.5 ± 7.0	NS
P	*Eleocharis rostellata*	Beaked Spikerush				S3	3 Sensitive	73	5.8 ± 0.0	NS
P	*Schoenoplectus americanus*	Olney's Bulrush				S3	3 Sensitive	98	4.9 ± 5.0	NS
P	*Elodea canadensis*	Canada Waterweed				S3	4 Secure	1	5.3 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	Prov GS Rank	# recs	Distance (km)	Prov
P	*Juncus marginatus*	Grassleaf Rush				S3	3 Sensitive	52	3.3 ± 0.0	NS
P	*Juncus subcaudatus*	Woods-Rush				S3	3 Sensitive	26	6.9 ± 5.0	NS
P	*Juncus dudleyi*	Dudley's Rush				S3	4 Secure	6	10.3 ± 0.0	NS
P	*Goodyera repens*	Lesser Rattlesnake-plantain				S3	3 Sensitive	18	16.3 ± 0.0	NS
P	*Neottia bifolia*	Southern Twayblade				S3	4 Secure	97	4.1 ± 0.0	NS
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	4 Secure	4	4.7 ± 1.0	NS
P	*Platanthera hookeri*	Hooker's Orchid				S3	4 Secure	9	22.1 ± 0.0	NS
P	*Platanthera orbiculata*	Small Round-leaved Orchid				S3	4 Secure	39	22.1 ± 0.0	NS
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S3	4 Secure	25	4.8 ± 0.0	NS
P	*Dichanthelium clandestinum*	Deer-tongue Panic Grass				S3	4 Secure	69	5.6 ± 10.0	NS
P	*Coleataenia longifolia*	Long-leaved Panicgrass				S3	4 Secure	1905	0.4 ± 5.0	NS
P	*Sparganium natans*	Small Burreed				S3	4 Secure	2	61.3 ± 3.0	NS
P	*Asplenium trichomanes*	Maidenhair Spleenwort				S3	4 Secure	2	77.9 ± 1.0	NS
P	*Lorinseria areolata*	netted chain fern				S3	4 Secure	331	0.4 ± 1.0	NS
P	*Equisetum variegatum*	Variegated Horsetail				S3	4 Secure	2	85.5 ± 2.0	NS
P	*Isoetes tuckermanii ssp. acadiensis*	Acadian Quillwort				S3	3 Sensitive	23	4.4 ± 0.0	NS
P	*Sceptridium dissectum*	Dissected Moonwort				S3	4 Secure	8	15.7 ± 5.0	NS
P	*Polypodium appalachianum*	Appalachian Polypody				S3	5 Undetermined	3	83.3 ± 0.0	NS
P	*Persicaria amphibia var. emersa*	Long-root Smartweed				S3?	5 Undetermined	11	3.0 ± 0.0	NS
P	*Diphasiastrum x sabinifolium*	Savin-leaved Ground-cedar				S3?	4 Secure	2	80.0 ± 0.0	NS
P	*Solidago latissimifolia*	Elliott's Goldenrod				S3S4	4 Secure	267	2.1 ± 0.0	NS
P	*Suaeda calceoliformis*	Horned Sea-blite				S3S4	4 Secure	12	9.6 ± 0.0	NS
P	*Vaccinium corymbosum*	Highbush Blueberry				S3S4	4 Secure	732	0.6 ± 1.0	NS
P	*Rhexia virginica*	Virginia Meadow Beauty				S3S4	4 Secure	1485	4.2 ± 0.0	NS
P	*Nuphar microphylla*	Small Yellow Pond-lily				S3S4	4 Secure	6	14.4 ± 0.0	NS
P	*Polygonum fowleri ssp. fowleri*	Fowler's Knotweed				S3S4	4 Secure	1	49.9 ± 0.0	NS
P	*Polygonum fowleri*	Fowler's Knotweed				S3S4	4 Secure	2	12.7 ± 0.0	NS
P	*Rumex fueginus*	Tierra del Fuego Dock				S3S4	4 Secure	2	23.3 ± 0.0	NS
P	*Salix petiolaris*	Meadow Willow				S3S4	4 Secure	5	15.7 ± 5.0	NS
P	*Agalinis neoscotica*	Nova Scotia Agalinis				S3S4	4 Secure	255	1.9 ± 0.0	NS
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S3S4	4 Secure	36	9.8 ± 0.0	NS
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S3S4	4 Secure	407	3.4 ± 0.0	NS
P	*Carex argyrantha*	Silvery-flowered Sedge				S3S4	4 Secure	23	4.7 ± 0.0	NS
P	*Eriophorum russeolum*	Russet Cottongrass				S3S4	4 Secure	3	66.2 ± 0.0	NS
P	*Sisyrinchium atlanticum*	Eastern Blue-Eyed-Grass				S3S4	4 Secure	354	0.5 ± 1.0	NS
P	*Triglochin gaspensis*	Gasp ├⌐ Arrowgrass				S3S4	5 Undetermined	13	8.6 ± 0.0	NS
P	*Juncus acuminatus*	Sharp-Fruit Rush				S3S4	4 Secure	12	5.4 ± 2.0	NS
P	*Liparis loeselii*	Loesel's Twayblade				S3S4	4 Secure	8	0.7 ± 5.0	NS
P	*Panicum philadelphicum*	Philadelphia Panicgrass				S3S4	4 Secure	20	4.7 ± 0.0	NS
P	*Equisetum hyemale ssp. affine*	Common Scouring-rush				S3S4	4 Secure	8	56.0 ± 1.0	NS
P	*Equisetum scirpoides*	Dwarf Scouring-Rush				S3S4	4 Secure	2	78.4 ± 1.0	NS
P	*Diphasiastrum complanatum*	Northern Ground-cedar				S3S4	4 Secure	1	11.0 ± 0.0	NS
P	*Schizaea pusilla*	Little Curlygrass Fern				S3S4	4 Secure	258	8.9 ± 0.0	NS
P	*Bidens discoidea*	Swamp Beggarticks				SH	0.1 Extirpated	1	76.5 ± 0.0	NS
P	*Dichanthelium meridionale*	Matting Witchgrass				SH	0.1 Extirpated	3	0.4 ± 5.0	NS

5.1 SOURCE BIBLIOGRAPHY (100 km)

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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422	Toms, B. & Hill, N.M.; Neily, T. 2014. Atlantic Coastal Plain Flora records, 2011. Mersey Tobeatic Research Institute, 430 recs.
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406	Hicks, Andrew. 2009. Coastal Waterfowl Surveys Database, 2000-08. Canadian Wildlife Service, Sackville, 46488 recs (11149 non-zero).
401	Amirault, D.L. & Stewart, J. 2007. Piping Plover Database 1894-2006. Canadian Wildlife Service, Sackville, 3344 recs, 1228 new.
387	Toms, Brad. 2012. Atlantic Coastal Plain Flora records, 2011. Mersey-Tobiatic Research Institute, 1109 recs.
320	Mazerolle, D.M. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
311	Blaney, C.S. & Mazerolle, D.M. 2011. 2011 botanical surveys in Kejimkujik National Park. Atlantic Canada Conservation Data Centre, 820 recs.
308	Neily, T.H. & Pepper, C.; Toms, B. 2013. Nova Scotia lichen location database. Mersey Tobeatic Research Institute, 1301 records.
306	Newell, R.E. 2000. E.C. Smith Herbarium Database. Acadia University, Wolfville NS, 7139 recs.
303	MacDonald, E.C. 2018. Piping Plover nest records from 2010-2017. Canadian Wildlife Service.
289	McNeil, J.A. 2015. Blandings Turtle (Emydoidea blandingii), Eastern Ribbonsnake (Thamnophis sauritus), and Snapping Turtle (Chelydra serpentina) sightings, 2015. Mersey Tobeatic Research Institute.
283	Benjamin, L.K. (compiler). 2012. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 4965 recs.
253	Belliveau, A.G. 2014. Plant Records from Southern and Central Nova Scotia. Atlantic Canada Conservation Data Centre, 919 recs.
249	Smith, D. 2013. Personal communication concerning Anguilla rostrata trapping results in Kejimkujik NP, NS. Winter 2013. Pers. comm.
248	McNeil, J.A. 2018. Blanding's Turtle records, 2018. Mersey Tobeatic Research Institute, 372 recs.
246	Neily, T.H. & Pepper, C.; Toms, B. 2020. Nova Scotia lichen database [as of 2020-03-18]. Mersey Tobeatic Research Institute.
237	Chapman, C.J. 2019. Atlantic Canada Conservation Data Centre 2019 botanical fieldwork. Atlantic Canada Conservation Data Centre, 11729 recs.
232	Belliveau, A.G. 2018. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2018. E.C. Smith Herbarium, 6226 recs.
222	Blaney, C.S.; Mazerolle, D.M. 2008. Fieldwork 2008. Atlantic Canada Conservation Data Centre. Sackville NB, 13343 recs.
216	Pronych, G. & Wilson, A. 1993. Atlas of Rare Vascular Plants in Nova Scotia. Nova Scotia Museum, Halifax NS, I:1-168, II:169-331. 1446 recs.
213	McNeil, J.A. 2019. Blanding's Turtle records, 2017. Mersey Tobeatic Research Institute, 372 recs.
206	Scott, F.W. 2002. Nova Scotia Herpetofauna Atlas Database. Acadia University, Wolfville NS, 8856 recs.
199	Neily, T.H. & Pepper, C.; Toms, B. 2015. Nova Scotia lichen location database [as of 2015-02-15]. Mersey Tobeatic Research Institute, 1691 records.
197	Belliveau, A.G. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
195	Toms, B. & Neily, T.; Belliveau, A.G.; Newell, R.; Mills, A.; Clapp, H.; Staicer, C.; Anderson, F.; Gray, C.; Beals, L. 2010. Inventory of Nature Conservancy of Canada Lands in Yarmouth and Shelburne Counties. Mersey Tobeatic Research Institute, approx. 1500 recs.
188	MacKinnon, D.S. & O'Brien, M.K.H.; Cameron, R.P. 2002. Fieldwork 2000. Dept of Environment & Labour, Protected Areas Branch, 252 recs.

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186	Blaney, C.S. 2018. Atlantic Canada Conservation Data Centre Fieldwork 2018. Atlantic Canada Conservation Data Centre.
178	Blaney, C.S.; Mazerolle, D.M. 2009. Fieldwork 2009. Atlantic Canada Conservation Data Centre. Sackville NB, 13395 recs.
177	Amirault, D.L. & McKnight, J. 2003. Piping Plover Database 1991-2003. Canadian Wildlife Service, Sackville, unpublished data. 7 recs.
161	McNeil, J.A. 2016. Blandings Turtle (Emydoidea blandingii), Eastern Ribbonsnake (Thamnophis sauritus), Wood Turtle (Glyptemys insculpta), and Snapping Turtle (Chelydra serpentina) sightings, 2016. Mersey Tobeatic Research Institute, 774 records.
154	Riley, J. 2019. Digby County lichen observations. Pers. comm. to J.L. Churchill, 50 recs.
148	Wilhelm, S.I. et al. 2011. Colonial Waterbird Database. Canadian Wildlife Service, Sackville, 2698 sites, 9718 recs (8192 obs).
142	MacDonald, E.C. 2018. CWS Piping Plover Census, 2010-2017. Canadian Wildlife Service.
140	Blaney, C.S.; Mazerolle, D.M.; Oberndorfer, E. 2007. Fieldwork 2007. Atlantic Canada Conservation Data Centre. Sackville NB, 13770 recs.
138	McNeil, J.A. 2011. Ribbonsnake (Thamophis sauritus) sightings, 2010. Parks Canada, 148 recs of 70+ individuals.
129	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2013.
128	Blaney, C.S.; Mazerolle, D.M. 2011. Fieldwork 2011. Atlantic Canada Conservation Data Centre. Sackville NB.
123	Cameron, R.P. 2011. Lichen observations, 2011. Nova Scotia Environment & Labour, 731 recs.
121	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database [as of 2018-03]. Mersey Tobeatic Research Institute.
119	McNeil, J.A. 2014. Blandings Turtle (Emydoidea blandingii) and Snapping Turtle (Chelydra serpentina) sightings, 2014. Mersey Tobeatic Research Institute.
117	Brunelle, P.-M. (compiler). 2009. ADIP/MDDS Odonata Database: data to 2006 inclusive. Atlantic Dragonfly Inventory Program (ADIP), 24200 recs.
116	Benjamin, L.K. 2009. NSDNR Fieldwork & Consultants Reports. Nova Scotia Dept Natural Resources, 143 recs.
116	Keddy, C.J. 1989. Habitat securement for redroot, golden crest and Long's bulrush in Ponhook Lake, NS. World Wildlife Fund (Canada), 131 recs.
114	Belland, R.J. Maritimes moss records from various herbarium databases. 2014.
113	Belliveau, A. 2013. Rare species records from Nova Scotia. Mersey Tobeatic Research Institute, 296 records. 296 recs.
109	Bayne, D.Z. 2013. 2013 Plant observations from southwest Nova Scotia. Nova Scotia Department of Natural Resources, 122 recs.
109	MacKinnon, D.S. 2005. Coastal Plains Flora GIS theme, 1999-2000. Dept of Environment & Labour, Protected Areas Branch, 109 shp files. 109 recs.
104	Klymko, J. 2018. Maritimes Butterfly Atlas database. Atlantic Canada Conservation Data Centre.
104	Toms, B. 2018. Bat Species data from www.batconservation.ca for Nova Scotia. Mersey Tobeatic Research Institute, 547 Records.
103	Haughian, S.R. 2018. Description of Fuscopannaria leucosticta field work in 2017. New Brunswick Museum, 314 recs.
101	Brazner, J. 2016. Nova Scotia Forested Wetland Bird Surveys. Nova Scotia Department of Lands and Forestry.
99	Roland, A.E. 1976. The Coastal Plain Flora of Kejimkujik National Park. Parks Canada Report, 238 pp.
98	Newell, R. & Neily, T.; Toms, B.; Proulx, G. et al. 2011. NCC Properties Fieldwork in NS: August-September 2010. Nature Conservancy Canada, 106 recs.
95	Robinson, S.L. 2014. 2013 Field Data. Atlantic Canada Conservation Data Centre.
91	Benjamin, L.K. 2012. NSDNR fieldwork & consultant reports 2008-2012. Nova Scotia Dept Natural Resources, 196 recs.
90	Chapman, C.J. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 11171 recs.
89	Churchill, J.L. 2019. Atlantic Canada Conservation Data Centre Fieldwork 2019. Atlantic Canada Conservation Data Centre.
88	Blaney, C.S.; Mazerolle, D.M.; Klymko, J; Spicer, C.D. 2006. Fieldwork 2006. Atlantic Canada Conservation Data Centre. Sackville NB, 8399 recs.
86	iNaturalist. 2018. iNaturalist Data Export 2018. iNaturalist.org and iNaturalist.ca, Web site: 11700 recs.
83	Wilhelm, S.I. et al. 2019. Colonial Waterbird Database. Canadian Wildlife Service.
80	Benjamin, L.K. (compiler). 2001. Significant Habitat & Species Database. Nova Scotia Dept of Natural Resources, 15 spp, 224 recs.
76	Herman, T.B. & Power, T.D., Eaton, B. 1995. Population status of Blanding's Turtle (Emydoidea blandingii) in Nova Scotia. Can. Field-Nat., 109: 182-191. 79 recs.
76	Staicer, C. & Bliss, S.; Achenbach, L. 2017. Occurrences of tracked breeding birds in forested wetlands. , 303 records.
73	Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB, 981 recs.
72	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
68	Benjamin, L.K. 2009. Boreal Felt Lichen, Mountain Avens, Orchid and other recent records. Nova Scotia Dept Natural Resources, 105 recs.
67	Canadian Wildlife Service, Dartmouth. 2010. Piping Plover censuses 2007-09, 304 recs.
65	Mazerolle, D.M. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 13515 recs.
64	Blaney, C.S.; Spicer, C.D.; Rothfels, C. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB, 1343 recs.
64	McNeil, J.A. 2017. Updates to Blanding's Turtle database, 1984-2014. Mersey Tobeatic Research Institute.
63	Roland, A.E. & Smith, E.C. 1969. The Flora of Nova Scotia, 1st Ed. Nova Scotia Museum, Halifax, 743pp.
62	Blaney, C.S. 2019. Sean Blaney 2019 field data. Atlantic Canada Conservation Data Centre, 4407 records.
61	McNeil, J.A. 2013. Ribbonsnake (Thamnophis sauritus) sightings, 2012 . Parks Canada, 63 records of 26+ individuals.
61	Munro, Marian K. Tracked lichen specimens, Nova Scotia Provincial Museum of Natural History Herbarium. Atlantic Canada Conservation Data Centre. 2019.
58	Richardson, D., Anderson, F., Cameron, R, McMullin, T., Clayden, S. 2014. Field Work Report on Black Foam Lichen (Anzia colpodes). COSEWIC.
56	Klymko, J.J.D.; Robinson, S.L. 2014. 2013 field data. Atlantic Canada Conservation Data Centre.
53	Patrick, A.; Horne, D.; Noseworthy, J. et. al. 2017. Field data for Nova Scotia and New Brunswick, 2015 and 2017. Nature Conservancy of Canada.
50	Burnie, B. 2013. 2013 Scirpus longii field data. Mount Saint Vincent University, 51 recs.
48	Layberry, R.A. & Hall, P.W., LaFontaine, J.D. 1998. The Butterflies of Canada. University of Toronto Press. 280 pp+plates.
46	MacKinnon, D.S. 1999. Fieldwork 1999. Dept of Environment and Labour, Protected Areas Branch, 48 recs.
46	Nussey, Pat & NCC staff. 2019. AEI tracked species records, 2016-2019. Chapman, C.J. (ed.) Atlantic Canada Conservation Data Centre, 333.
45	MacKinnon, D.S. & Maass, O.C. 1995. Fieldwork 1995. Dept Natural Resources, Parks Division, 45 recs.
44	Blaney, C.S.; Mazerolle, D.M.; Hill, N.M. 2011. Fieldwork for Sabatia kennedyana & Coreopsis rosea COSEWIC status reports.
42	MacKinnon, D.S. 2001. Fieldwork 2001. Dept of Environment & Labour, Protected Areas Branch, 43 recs.

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40	NatureServe Canada. 2019. iNaturalist Maritimes Butterfly Records. iNaturalist.org and iNaturalist.ca.
38	Blaney, C.S. 2017. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
37	LaPaix, R.W.; Crowell, M.J.; MacDonald, M. 2011. Stantec rare plant records, 2010-11. Stantec Consulting, 334 recs.
37	Roland, A.E. 1980. Checklist of Vascular Plants of Kejimkujik National Park in Lichens, Liverworts, Mosses and Flowering Plants of Kejimkujik National Park. Roland, A.E. (ed.) Parks Canada Report, pp. 52-140, 160 pp.
35	McNeil, J.A. 2019. Eastern Painted Turtle trapping records, 2017. Mersey Tobeatic Research Institute.
34	Bayne, D.Z. 2014. 2014 rare species observations from southwest Nova Scotia. Nova Scotia Department of Natural Resources, 46 recs.
33	Taylor, P.D. 2006. Long-term monitoring of Listera australis in southwestern Nova Scotia; summary report for 2006, year 3. Acadia University, 33.
32	McNeil, J.A. 2017. Eastern Ribbonsnake (Thamnophis sauritus) sightings, 2017. Mersey Tobeatic Research Institute, 36 recs.
32	Newell, R.E. 2000. Eleocharis tuberculosa records in NS, 1994-99. Acadia University, Wolfville NS, Pers. comm. to S.H. Gerriets, Feb. 11. 32 recs.
31	Zinck, M. & Roland, A.E. 1998. Roland's Flora of Nova Scotia. Nova Scotia Museum, 3rd ed., rev. M. Zinck; 2 Vol., 1297 pp.
29	Frittaion, C. 2012. NSNT 2012 Field Observations. Nova Scotia Nature Trust, Pers comm. to S. Blaney Feb. 7, 34 recs.
29	Manthorne, A. 2014. MaritimesSwiftwatch Project database 2013-2014. Bird Studies Canada, Sackville NB, 326 recs.
29	Nature Conservancy Canada. 2008. Geum peckii on Brier Island. Nature Conservancy Canada, 29 recs.
27	Bryson, I. 2020. Nova Scotia and Newfoundland rare species observations, 2018-2020. Nova Scotia Environment.
24	Bayne, D.M., Cameron, R.C. 2014. 2014 Lichen records near Little Bon Mature Lake, Queens NS. NS Department of Natural Resources.
24	Broders, H.G. 2006. Unpublished data. , 24 recs.
24	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2014.
23	Klymko, J.J.D. 2018. 2017 field data. Atlantic Canada Conservation Data Centre.
22	Tims, J. & Craig, N. 1995. Environmentally Significant Areas in New Brunswick (NBESA). NB Dept of Environment & Nature Trust of New Brunswick Inc, 6042 recs.
21	Benjamin, L.K. (compiler). 2010. Baccharis halimifolia observation records. NS Dept of Natural Resources, 40.
21	Mazerolle, D.M. 2017. Atlantic Canada Conservation Data Centre Fieldwork 2017. Atlantic Canada Conservation Data Centre.
21	Sollows, M.C,. 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
20	O'Grady, Sally. 2010. Water Pennywort in Kejimkujik National Park, 2010. Parks Canada, 20 shapefiles.
19	Bayne, D.M. 2007. Atlantic Coastal Plain Flora record, 2004-06. Nova Scotia Nature Trust. Pers. comm. to C.S. Blaney, 57 recs.
19	Benjamin, L.K. 2011. NSDNR fieldwork & consultant reports 1997, 2009-10. Nova Scotia Dept Natural Resources, 85 recs.
19	Clayden, S. Digitization of Wolfgang Maass Nova Scotia forest lichen collections, 1964-2004. New Brunswick Museum. 2018.
19	Oldham, M.J. 2000. Oldham database records from Maritime provinces. Oldham, M.J; ONHIC, 487 recs.
18	Cameron, R.P. 2017. 2017 rare species field data. Nova Scotia Environment, 64 recs.
17	MacKinnon, D.S. 2000. Fieldwork 2000. Dept of Environment and Labour, Protected Areas Branch, 17 recs.
16	Catling, P.M. 1981. Taxonomy of autumn-flowering Spiranthes species of southern Nova Scotia in Can. J. Bot. , 59:1250-1273. 30 recs.
16	LaPaix, R.W.; Crowell, M.J.; MacDonald, M.; Neily, T.D.; Quinn, G. 2017. Stantec Nova Scotia rare plant records, 2012-2016. Stantec Consulting.
15	Neily, T.H. Tom Neily NS Sphagnum records (2009-2014). T.H. Neily, Atlantic Canada Conservation Data Centre. 2019.
15	Nova Scotia Nature Trust. 2013. Nova Scotia Nature Trust 2013 Species records. Nova Scotia Nature Trust, 95 recs.
14	Plissner, J.H. & Haig, S.M. 1997. 1996 International piping plover census. US Geological Survey, Corvallis OR, 231 pp.
13	Bishop, G., M. Lovit. 2019. Vascular Plant Flora of the Three Islands. Mazerolle, D.M., Chapman, C.J. (ed.) Bowdoin College & New Brunswick Museum, 291 pp.
13	G.Proulx, R. Newell, A. Mills, D. Bayne. 2018. Selaginella rupestris records, Digby Co. Nova Scotia Lands and Forestry, 1387601 recs.
13	Klymko, J. 2019. Atlantic Canada Conservation Data Centre zoological fieldwork 2018. Atlantic Canada Conservation Data Centre.
13	McKendry, Karen. 2016. Rare species observations, 2016. Nova Scotia Nature Trust, 19 recs.
13	Toms, Brad. 2011. Species at Risk data from 2011 field surveys. Mersey Tobeatic Research Institute, 17 recs.
12	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
12	Bateman, M.C. 2001. Coastal Waterfowl Surveys Database, 1965-2001. Canadian Wildlife Service, Sackville, 667 recs.
12	MacKinnon, D.S. 1998. Ponhook Lake survey map & notes. Dept of Environment and Labour, Protected Areas Branch, 13 recs.
12	Parks Canada. 2010. Specimens in or near National Parks in Atlantic Canada. Canadian National Museum, 3925 recs.
12	Porter, C.J.M. 2014. Field work data 2007-2014. Nova Scotia Nature Trust, 96 recs.
12	Richardson, D., Anderson, F., Cameron, R, Pepper, C., Clayden, S. 2015. Field Work Report on the Wrinkled Shingle lichen (Pannaria lurida). COSEWIC.
12	Whittam, R.M. 1999. Status Report on the Roseate Tern (update) in Canada. Committee on the Status of Endangered Wildlife in Canada, 36 recs.
11	Cameron, R.P. 2018. Degelia plumbea records. Nova Scotia Environment.
11	e-Butterfly. 2016. Export of Maritimes records and photos. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
11	McNeil, J.A. 2019. Snapping Turtle records, 2017. Mersey Tobeatic Research Institute.
11	Neily, T.H. Hectanooga, Nova Scotia Liverwort records. T.H. Neily. 2017.
10	Boyne, A.W. & Grecian, V.D. 1999. Tern Surveys. Canadian Wildlife Service, Sackville, unpublished data. 23 recs.
10	Newell, R.E. 2002. A Botanical Survey of the Sand Pond National Wildlife Area. , 12 recs.
10	Smith, T.W. 2009. Eleocharis tuberculosa records in Yarmouth, Shelburne Count. COSEWIC. Pers. comm. to D.M. Mazerolle, 10 recs.
9	deGooyer, K. 2019. Snapping Turtle and Eastern White Cedar observations. Nova Scotia Environment.
9	Ferguson, D.C. 1954. The Lepidoptera of Nova Scotia. Part I, macrolepidoptera. Proceedings of the Nova Scotian Institute of Science, 23(3), 161-375.
9	MacKinnon, D.S. & Maass, O.C. 1996. Fieldwork 1996. Dept Natural Resources, Parks Division, 9 recs.
9	O'Grady, Sally. 2010. Piping Plover Nesting in Kejimkujik Seaside Annex, 2008-10. Parks Canada, 9 recs.
8	Cameron, R.P. 2013. 2013 rare species field data. Nova Scotia Department of Environment, 71 recs.

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8	Kennedy, B.; Cron, C. 2019. observations of Poison Sumac andButtonbush, Nova Scotia. pers. commun to AC CDC.
8	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database Update. Mersey Tobeatic Research Institute, 14 recs.
8	Neily, T.H. 2010. Erioderma Pedicellatum records 2005-09. Mersey Tobiatic Research Institute, 67 recs.
8	Neily, T.H. 2019. Tom Neily NS Bryophyte records (2009-2013). T.H. Neily, Atlantic Canada Conservation Data Centre, 1029 specimen records.
8	Wood, E.W. 2011. Sabatia kennedyana locations in Nova Scotia. Pers. comm. to C.S. Blaney. Gray Herbarium, Harvard University, 8 recs.
7	Basquill, S.P., Porter, C. 2019. Bryophyte and lichen specimens submitted to the E.C. Smith Herbarium. NS Department of Lands and Forestry.
7	Belliveau, A. 2013. email to Sean Blaney regarding Listera australis observations in SW Nova Scotia. Mersey Tobeatic Research Institute, 8.
7	e-Butterfly. 2019. Export of Maritimes records and photos. McFarland, K. (ed.) e-butterfly.org.
7	Klymko, J.J.D. 2011. Insect fieldwork & submissions, 2010. Atlantic Canada Conservation Data Centre. Sackville NB, 742 recs.
7	Klymko, J.J.D. 2012. Odonata specimens & observations, 2010. Atlantic Canada Conservation Data Centre, 425 recs.
7	Maddox, G.D., Cannell, P.F. 1982. The Butterflies Of Kent Island, Grand Manan, New Brunswick. Journal of the Lepidopterists' Society, 36(4): 264-268.
7	McLean, K. 2019. Species At Risk observations. Clean Annapolis River Project.
7	Misc. rare species records gathered by NSDNR staff or communicated to NSDNR and forwared to ACCDC
7	Ogden, K. Nova Scotia Museum butterfly specimen database. Nova Scotia Museum. 2017.
7	Robinson, S.L. 2011. 2011 ND dune survey field data. Atlantic Canada Conservation Data Centre, 2715 recs.
7	WIlliams, M. Cape Breton University Digital Herbarium. Cape Breton University Digital Herbarium. 2013.
6	Adams, J. & Herman, T.B. 1998. Thesis, Unpublished map of C. insculpta sightings. Acadia University, Wolfville NS, 88 recs.
6	Benedict, B. Connell Herbarium Specimens (Data) . University New Brunswick, Fredericton. 2003.
6	Blaney, C.S. 1999. Fieldwork 1999. Atlantic Canada Conservation Data Centre. Sackville NB, 292 recs.
5	Basquill, S.P. 2009. 2009 field observations. Nova Scotia Dept of Natural Resources.
5	Goltz, J.P. & Bishop, G. 2005. Confidential supplement to Status Report on Prototype Quillwort (Isoetes prototypus). Committee on the Status of Endangered Wildlife in Canada, 111 recs.
5	Keddy, C. 1986. Status report on the eastern mountain avens, Geum peckii, in Canada Ottawa, Ontario, Canada: Committee on the Status of Endangered Wildlife in Canada (COSEWIC).
5	Layberry, R.A. 2012. Lepidopteran records for the Maritimes, 1974-2008. Layberry Collection, 1060 recs.
5	McNeil, J.A. 2018. Snapping Turtle records, 2018. Mersey Tobeatic Research Institute.
5	Rothrock, P. 2002. Carex longii in NS. Taylor University, Pers. com. to L. Benjamin, forwarded to S. Blaney. 5 recs.
5	Thomas, A.W. 1996. A preliminary atlas of the butterflies of New Brunswick. New Brunswick Museum.
4	Belliveau, A.G. 2019. Maleberry (Lyonia ligustrina) count at Long Lake, Yarmouth Co., NS. E.C Smith Herbarium, Acadia University, Wolfville NS, 4 records.
4	Brunelle, P.-M. (compiler). 2010. ADIP/MDDS Odonata Database: NB, NS Update 1900-09. Atlantic Dragonfly Inventory Program (ADIP), 935 recs.
4	Brunelle, P.-M. 2009. NS Power odonata records for Mersey, Tusket & Sissiboo systems. Nova Scotia Power, 218 recs.
4	Cameron, R.P. 2009. Nova Scotia nonvascular plant observations, 1995-2007. Nova Scotia Dept Natural Resources, 27 recs.
4	Christie, D.S. 2000. Christmas Bird Count Data, 1997-2000. Nature NB, 54 recs.
4	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
4	Klymko, J.J.D.; Robinson, S.L. 2012. 2012 field data. Atlantic Canada Conservation Data Centre, 447 recs.
4	Majka, C.G. & McCorquodale, D.B. 2006. The Coccinellidae (Coleoptera) of the Maritime Provinces of Canada: new records, biogeographic notes, and conservation concerns. Zootaxa. Zootaxa, 1154: 49–68. 7 recs.
4	Marx, M. & Kenney, R.D. 2001. North Atlantic Right Whale Database. University of Rhode Island, 4 recs.
4	Newell, R.E. 2006. Rare plant observations in Digby Neck. Pers. comm. to S. Blaney, 6 recs.
4	NS DNR. 2017. Black Ash records from NS DNR Permanent Sample Plots (PSPs), 1965-2016. NS Dept of Natural Resources.
4	Pike, E., Tingley, S. & Christie, D.S. 2000. Nature NB Listserve. University of New Brunswick, listserv.unb.ca/archives/naturenb. 68 recs.
4	Toms, B. 2015. Lophiola aurea (Goldencrest) records from Molega Lake. Mersey Tobeatic Research Institute, 4 records.
4	Toms, B. 2016. Email list of four GPS locations of Golden Crest (Lophiola aurea) from the previously documented site on Molega Lake, NS. Mersey Tobeatic Research Institute, 4 records.
3	Anon. Dataset of butterfly records for the Maritime provinces. Museum of Comparative Zoology, Harvard University. 2017.
3	Bayne, D.M. 2014. 2014 insect field observations.
3	Benedict, B. Connell Herbarium Specimens, Digital photos. University New Brunswick, Fredericton. 2005.
3	Benjamin, L.K. 2002. Rare plant observations by P. MacDonald, P. Mills, S. Eaton, H. MacKinnon, B. Colpitts at Sloans Lake, NS. Pers. comm. to L.K. Benjamin, NSDNR, with P. MacDonald, 3 recs.
3	Cameron, R.P. 2009. Erioderma pedicellatum database, 1979-2008. Dept Environment & Labour, 103 recs.
3	Canadian Wildlife Service, Atlantic Region. 2010. Piping Plover censuses 2006-09. , 35 recs.
3	deGooyer, K. 2019. Eastern White Cedar observations, Norwood, Nova Scotia. Nova Scotia Environment.
3	e-Butterfly. 2018. Selected Maritimes butterfly records from 2016 and 2017. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
3	Hill, N. 1995. Rare & Uncommon Plants of the Kejimkujic Seaside Adjunct. Biology Dept., Mount Saint Vincent University, 15 recs.
3	Holder, M.L.; Kingsley, A.L. 2000. Kinglsey and Holder observations from 2000 field work.
3	Hope, P. 2002. Field survey of Goodyera pubescens population at Kejimkujik National Park. Kejimkujik National Park, 3 recs.
3	Klymko, J.J.D. 2016. 2015 field data. Atlantic Canada Conservation Data Centre.
3	Lock, A.R., Brown, R.G.B. & Gerriets, S.H. 1994. Gazetteer of Marine Birds in Atlantic Canada. Canadian Wildlife Service, Atlantic Region, 137 pp.
3	Mills, Pamela. 2008. Clethra alnifolia at Mudflat Lake. Nova Scotia Dept of Natural Resources, Wildlife Div. Pers. comm. to D.M. Mazerolle, 4 recs.
3	Ogden, J. NS DNR Butterfly Collection Dataset. Nova Scotia Department of Natural Resources. 2014.
3	Olsen, Ervin. 2018. Nova Scotia Atlantic Coastal Plain Flora observations. Halifax Field Naturalists Nova Scotia Nature Archive Facebook Page.
3	Riley, J. 2020. Digby County Pannaria lurida observations. Pers. comm. to J.L. Churchill.
3	Smith, T.W. 2009. Assessment and update status report on the Tubercled Spike-rush (Eleocharis tuberculosa) in Canada. Committee on the Status of Endangered Wildlife in Canada, 3 recs.
3	Staicer, C. 2013. Personal communication concerning Hirundo rustica nesting in and around Kejimkujik NP, NS. Pers. comm.

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2	Anon. 2017. Export of Maritimes Butterfly records. Global Biodiversity Information Facility (GBIF).
2	Austin-Smith, P. 2014. 2014 Common Nighthawk personal communication report, NS. NS Department of Natural Resources.
2	Basquill, S.P. 2011. Field observations & specimen collections, 2010. Nova Scotia Department of Natural Resources, Pers. comm. , 8 Recs.
2	Basquill, S.P. 2012. 2012 rare vascular plant field data. Nova Scotia Department of Natural Resources, 37 recs.
2	Belliveau, A. & Toms, B. 2012. Email regarding Lophiola aurea (Goldencrest) location on Molega Lake, NS. Mersey Tobeatic Research Institute, 3 records.
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Appendix B

AC CDC Report for Project Area



AC CDC Home
About Us
Our Services
AC CDC Staff
Contact Us
Maritimes Butterfly Atlas

AC CDC Data
Submit a Data Request
About Our Data
Data Interpretations
Conservation Ranks
Species at Risk

More
Submit an Observation
Publications
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Understanding Ranks

Sub-national (provincial) ranks (S-ranks)

Conservation Data Centres and NatureServe use existing information and expertise, for ranking species rarity or conservation status. Ranks help them identify gaps in knowledge for species for which element occurrence data are maintained; typically information is maintained for species ranked critically imperiled (S1) to vulnerable (S3) in given jurisdictions. Individual CDCs are responsible for developing sub-national ranks for their area. The AC CDC works with provincial and federal experts to develop rarity ranks for species in each of the following provinces: New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland & Labrador. Factors considered when ranking include: number of element occurrences, distribution, population size, abundance trends, and threats.

Sub-national element rank definitions

The following definitions refer to species and community ranks at sub-national (provincial) levels. Sub-national ranks are specific to a province. Therefore, a species that is common (S4) in New Brunswick, could be ranked as extremely rare (S1) in Prince Edward Island.

S-rank	Definition
SX	**Presumed Extirpated** - Species or community is believed to be extirpated from the province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
S1	**Critically Imperiled** - Critically imperiled in the province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
S2	**Imperiled** - Imperiled in the province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
S3	**Vulnerable** - Vulnerable in the province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4	**Apparently Secure** - Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5	**Secure** - Common, widespread, and abundant in the province.
SNR	**Unranked** - Nation or state/province conservation status not yet assessed.
SU	**Unrankable** - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
SNA	**Not Applicable** - A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
S#S#	**Range Rank** - A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).
Not Provided	Species is not known to occur in the province.

Breeding Status Qualifiers

Qualifier	Definition
B	**Breeding** - Conservation status refers to the breeding population of the species in the province.
N	**Nonbreeding** - Conservation status refers to the non-breeding population of the species in the province.
M	**Migrant** - Migrant species occurring regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in the province.

Note: A breeding status is only used for species that have distinct breeding and/or non-breeding populations in the province. A breeding-status S-rank can be coupled with its complementary non-breeding-status S-rank if the species also winters in the nation or state/province, and/or a migrant-status S-rank if the species occurs regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. The two (or rarely, three) status ranks are separated by a comma (e.g., "S2B, S3N" or "SHN, S4B, S1M").

Other Qualifiers

Qualifier	Definition
?	**Inexact or Uncertain** - Denotes inexact or uncertain numeric rank. (The ? qualifies the character immediately preceding it in the S-rank.)

National and Global Ranks

Information supporting S-ranks in turn supports broader-scale ranking, national (N-rank) and global (G-rank). Canadian CDCs, from the Atlantic to British Columbia, help develop and update N-ranks for Canadian plants and animals. Although many believe that National ranks offer great value, there is increasing interest in categories used by COSEWIC and General Status Assessments, outlined briefly below. Global ranks are assigned by staff specialists at NatureServe in consultation with CDC specialists and other science experts. Global rank definitions are similar to sub-national rank definitions but they refer to the entire range for species or communities regardless of national boarders. For instance, G1= Critically Imperiled – extremely rare and extremely vulnerable to extinction due to natural or human causes (5 or fewer global occurrences or less than 1000 individuals), while G5 = Demonstrably secure. See the NatureServe explorer for additional details.

COSEWIC and General Status of Wild Species

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) uses: extinct, extirpated, endangered, threatened, vulnerable, special concern, insufficient information, and secure to describe the status of species (but not communities) in Canada. The General Status of Wild Species in Canada, uses a ranking system similar to that used by NatureServe and all CDCs. (See Wild Species: The General Status of Species in Canada – for additional details).

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Appendix C

Example of Minipiezometer Construction

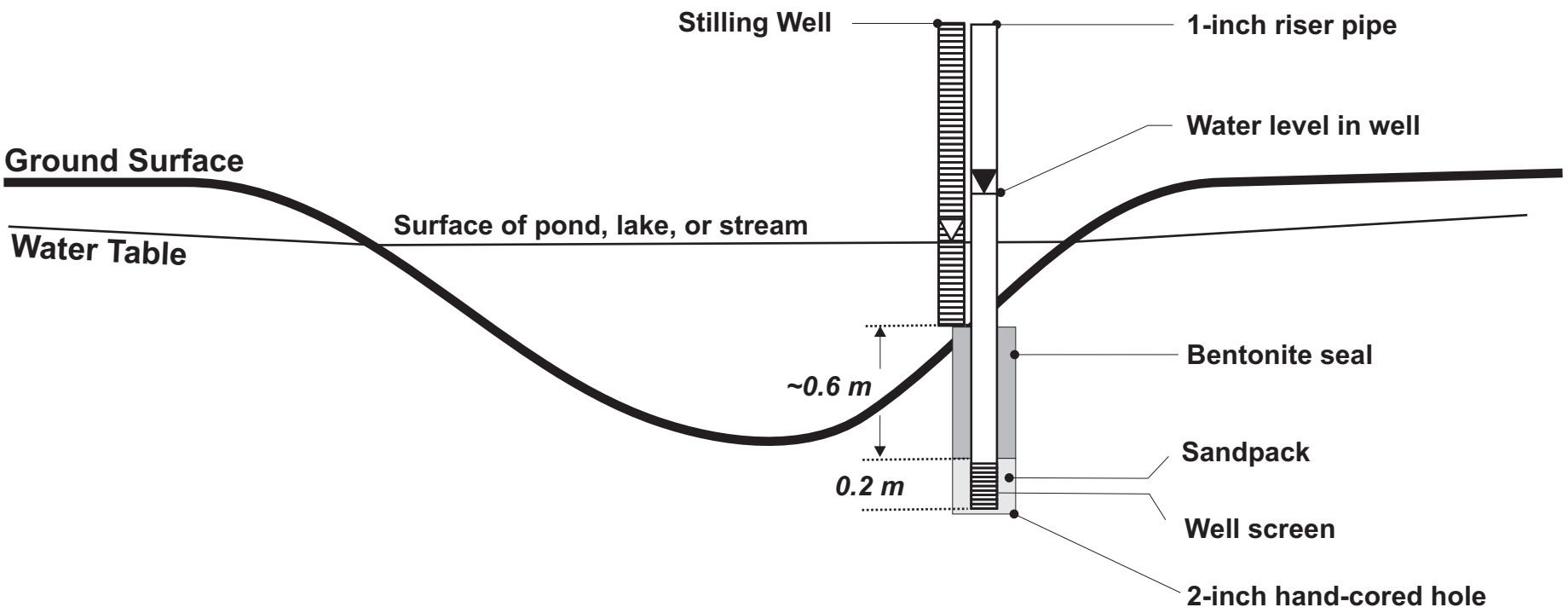


Figure C1. Sketch of streambed minipiezometer
Not to Scale


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Our File Number: 95100-30-BED-2019-2638165

June 18, 2021

NOVA SCOTIA POWER INCORPORATED
PO BOX 910, 25 LAKESIDE PARK DR
HALIFAX, NS
B3J 2W5

Dear NOVA SCOTIA POWER INCORPORATED

RE: Application # 2019-2638165-00 Sheet Harbour Hydro System – Ruth Falls Dam Refurbishment (Watercourse Alteration)

With reference to your application please be advised that as a result of a fourth review prompted by Nova Scotia Power's (NSPI) submission on April 14, 2021, your application has been deemed incomplete. As a result, Department of Environment and Climate Change (ECC) is requesting the following information to process your application. The document submission that is referred to in this letter is the NSPI submission "Addendum, Sheet Harbour Hydro System, Ruth Falls Dam Refurbishment, 2021 Construction and Monitoring Activities, which was furnished to ECC in April 2021".

1. In Section 4.2 of the April 14, 2021 submission, NSPI states that if a 1:2 year event occurs during the first stage of construction, the construction site will likely be inundated and the cofferdams the length of the whole dam will be overtopped. Section 4.3 Contingency Planning describes a list of options which could be implemented 'with minimal planning time'; however, these options describe the upstream management of water and suggest that there would likely be washout of the downstream access road.

   a. Provide rationale for the water management approach shown in Appendix B, including but not limited to: explanation for only one bay proposed for bypass / conveying normal flows during Phase I.
   b. Provide additional rationale for why a 1:2 year event cannot or need not be accommodated.
   c. Provide rationale for the sizing of the two culverts under the downstream access road.
   d. Describe how fish will be prevented from entering the culverts and becoming trapped between the access road and dam.
   e. Provide available hydrologic and hydraulic modeling or reporting for the existing system, e.g. as referenced in the submission, or for the Ruth Falls reservoir specifically.

2. The water management approach described in the submission refers to two phases of construction.

   a. State the duration and seasons/calendar months for Phase I and Phase II of construction.

3. Provide a site-specific wetland monitoring plan that addresses biodiversity elements at the Ruth Falls site.

4. DFO continues to review the Fisheries Act authorization application for the Ruth Falls project. ECC requires the following information with respect to the aquatic environment:

a. Provide comment on if the new toe of spillway has any intended or anticipated changes in performance of the fish ladder.

5. Indicate how the planning and design for the construction at Ruth Falls has mitigated the risk of debris and rock fill washing downstream during the removal of the temporary cofferdam and access path.

6. NSPI has characterized the discharge during drawdown as being in the range of very common (at a 500 cfs) to regularly occurring 6-12 times per year (at 1000 cfs).

a. Based on the information above, provide ECC with modelling results, observations, or other information and experience from discharge events where scour was observed.

7. ECC is not aware of an existing access road from the right side of the dam (looking downstream, righthand side).

a. Given the bathymetry shown in Appendix B; describe the site access for constructing the right upstream cofferdam.

b. Provide detailed plans for the construction of the right upstream cofferdam. The drawings in Appendix B do not show how the bypass would interact or be stable with respect to the cofferdam (e.g. is a culvert being placed to convey flow through the cofferdam?).

8. NSPI has noted that changes in the engineering drawings (which include removals, structural and mechanical, and geotechnical) are not anticipated. ECC acknowledges that the drawings in Appendix A do not include water management plans.

a. Provide structural drawings or assessment by a P.Eng. for the construction of the by-pass on the righthand side.

9. Provide information on whether ice action is anticipated on the temporary causeway.

10. The elevation of the crest of the new uncontrolled spillway as shown in Section F (Sheet 300-03, New Conditions, West Spillway) at 109.25 ft is below the minimum operating level for Ruth Falls Headpond of 109.4 ft. The elevation of the new rubberdam crest is also shown at 109.25 ft, which is below the minimum operating level for Ruth Falls. Confirm the maximum dam crest, and that the new uncontrolled spillway will meet operational terms.

ECC is requesting this information be submitted by September 18, 2021. Please note that in accordance with *Section 7 of the Approval and Notification Procedure Regulations,* if information is not supplied by an applicant within 3 months of a request, the Minister may reject your application. Should your application be rejected, you will be informed of that decision in writing.

Yours truly,

Krista Ogletree



cc:

APPLICATION FOR APPROVAL

OFFICE USE ONLY	
Date Received: (yyyy/mm/dd)	Application #

PLEASE PRINT OR TYPE. Complete Sections 1, 2, 3, 4 and 7 for ALL Applications. Complete areas of Sections 5 and 6 that are applicable to the specific activities of this application only.

Type of Application:

(●) New Application ( ) Renewal ( ) Amendment ( ) Transfer

If applicable, provide the previous Approval #

SECTION 1 – APPLICANT

If there is more than one applicant, click Add Applicant or attach a complete list of applicants with the information below. The first applicant listed will be considered the primary applicant for this project.

Nova Scotia Power Inc.
Company/Organization/Municipality

Business Number (BN) if applicable

Nadine	A	Thomas
First Name	Middle Initial	Last Name

902-719-5990				
Primary Phone Number	Ext.	Secondary Phone Number	Ext.	Fax

nadine.thomas@nspower.ca
E-mail

25 Lakeside Park Drive
Civic/Street Address

PO Box 910
Mailing Address (if different than Civic)

Halifax	Halifax	
County	Community	
Nova Scotia	B3J 2W5	Canada
Province	Postal Code	Country

Return Correspondence? (●) Yes ( ) No
Preferred Method of Contact? (●) Email ( ) Letter

Note: Following application decision, all correspondence will go to the applicant

Certification Number

Applicant Type (if applicable)

( ) Installer ( ) Sizer ( ) Hydrogeologist ( ) Professional Engineer

Applicant 1 of 1

SECTION 2 - APPLICATION CONTACT

Is the Application Contact the same as Section 1 – Applicant? ◉ **Yes** ○ **No** **If yes, please skip to Section 3.**

If there is more than one contact, click Add Contact or attach a complete list of contacts with the information below.

Company/Organization/Municipality

Business Number (BN) if applicable

First Name | Middle Initial | Last Name

Primary Phone Number | Ext. | Secondary Phone Number | Ext. | Fax

E-mail

Civic/Street Address

Mailing Address (if different than Civic)

County | Community

Province | Postal Code | Country

Return Correspondence? ○ Yes ○ No

Preferred Method of Contact? ○ Email ○ Letter

Note: Following application decision, all correspondence will go to the applicant

Certification Number

Contact Type

○ Installer ○ Sizer ○ Professional Engineer ○ Hydrogeologist

Contact 1 of 1

SECTION 3 - SITE/LOCATION OF PROPOSED ACTIVITIES

Property Identification numbers (PID) are available at the Nova Scotia Land Registry.
1:50,000 Topo Maps (identifying Easting and Northing) are available at Nova Scotia Environment offices.

If more than one Site, click Add Site or Copy this section and attach for each Site.

Ruth Falls Headpond
Watercourse Name

East River
Tributary To

East River
Watershed Name (if applicable)

If Applying for a Wetland Alteration, please specify the Site Type ◯ Alteration ◯ Compensation

Site Name

Is Watercourse a Fish Habitat? ◉ Yes ◯ No

Is this location within a municipal drinking water watershed? ◯ Yes ◉ No

If there is more than one activity per property, click Add Property or Copy this section and attach for each activity.

Property 1 of 1

935 Highway 374
Civic/Street Address

Halifax | Sheet Harbour
County | Community

40221673 | 11D16
Property Identification # (PID) | Topographical Map Number

If there is more than one location per activity, click Add Activity Location or Copy this section and attach for each Easting/Northing coordinates.

Coordinates 1 of 1

539486 E	4978146	20T
Easting (6)	Northing (7)	Zone

Please use NAD83 or WGS84

Access via NSPI gated road off Highway 374. Coming from Sheet Harbour, NSPI road is approximately 2 km beyond East River Road on right side. Gate is closed.
Additional Directions to Site (if applicable)

Site 1 of 1

SECTION 4 - ACTIVITY

Proposed Activity - Please check (✓) all that apply.

Activity	Complete Sections	Activity	Complete Sections
Boat Launch	◯ 4, 5A, 6A ,7	Bridge/Open Bottom Structure	◯ 4, 5A, 5C, 6A, 7
Culvert/Closed Bottom Structure	◯ 4, 5A, 5B, 6A, 7	Dam	◉ 4, 5A, 6A, 6B, 7
Dredging	◯ 4, 5A, 6A, 7	Erosion Protection	◯ 4, 5A, 6A ,7
Instream Structure	◯ 4, 5A, 6A, 7	Pipeline or Other Utility	◯ 4, 5A, 6A, 7
Removal of Beaverdam	◯ 4, 5A, 6A, 7	Removal of Material	◯ 4, 5A, 6A, 7
Storage of Water	◯ 4, 5D, 6A, 6B, 7	Water Intake/Dry Hydrant	◯ 4, 5A, 6A, 7
Water Withdrawal	◯ 4, 5E, 6A, 6B, 7	Watercourse Diversion	◯ 4, 5A, 5E, 6A, 6B, 7
Wetland Alteration	◯ 4, 5G, 6A, 6C, 7	Wharf	◯ 4, 5A, 6A, 7
Work to Improve Fish Habitat	◯ 4, 5A, 5F, 6A, 7	Other Alteration	◯ 4, 5A, 5F, 6A, 7

Is this a Pilot Activity? ◯ Yes ◉ No

Variance Requested? ◯ Yes* ◉ No

*If yes, please fill out a request for variance form

Proposed Project Dates, if applicable (yyyy/mm/dd)

Start Date of Construction	Start Date of Operations	End Date of Activities
2021/09/01		2022/01/31

SECTION 5 - ACTIVITY DETAILS

Complete Section 5 to the best of your knowledge. Please provide measurements in the metric units indicated.
5A – Complete for all applicable Watercourse Alteration Applications.

Type of Alteration

◯ New Construction ◯ Removal ◉ Replacement ◯ Expansion

rock, silt

Description of Channel Bottom

Replace deep stop log sluice bays with sluice gates; install small extension and control building on east end of dam

Description of Alteration

approximately 75 m

Length of Alteration (m)

5B - Complete only for Culvert or Closed Bottom Structure
Information about the Watercourse

Upstream watershed area (km²) | Watercourse Slope (%) | Watercourse Velocity (m/s)

Watercourse Channel Width (m) | Watercourse Channel Depth (m)

Crossing Type ◯ Culvert with fish passage ◯ Culvert without fish passage

If Culvert without fish passage, was a fish passage assessment completed? ◯ Yes ◯ No

Length of culvert (m) | Diameter of culvert (mm) | Length of dissipation pool (m)

Width of dissipation pool (m) | Date of installation (yyyy/mm/dd)

5C - Complete only for Bridge or other open bottomed structure
Information about the Watercourse

Up-stream Drainage Area (km2) | Watercourse Slope (%) | Watercourse Velocity (m/s)

Watercourse Channel Width (m) | Watercourse Channel Depth (m)

Crossing Type ◯ Bridge/concrete span ◯ Pipe arch/open bottom structure

Width of Span/Bridge (m) | Width of Structure/Arch (mm) | Length of Structure (m)

Bridge Piles? ◯ Yes ◯ No

5D - Complete only for Storage of Water

Total Volume (m^3)

Method of Storage ◯ Dam ◯ Reservoir ◯ Offline Pond ◯ Tank ◯ Other If Other, please specify

Source of Withdraw ◯ Groundwater ◯ Surface Water

5E - Complete only for Water Withdrawal/Diversion

Source of Withdraw ◯ groundwater ◯ surface water

Well Log #

Average Withdrawal Rate (litres/day) Maximum Withdraw Rate (litres/day)

Usage ◯ Agriculture ◯ Industry ◯ Aquaculture ◯ Municipal Domestic ◯ Bottled Water ◯ Hydroelectric

◯ Public Drinking Water Supply(excluding municipal) ◯ Recreational ◯ Other If Other, please specify

Description of Channel Bottom (Only Applicable for Water Diversion)

5F - Complete for Other Alteration and Work to Improve Fish Habitat

Description of Alteration

Length of Alteration (m)

5G - Wetland

Wetland Type - Alteration

Salt Marsh	◯	Size of Wetland (ha)	Size of Alteration(ha)
Freshwater Marsh – Shallow	◯	Size of Wetland (ha)	Size of Alteration(ha)
Freshwater Marsh - Deep	◯	Size of Wetland (ha)	Size of Alteration(ha)
Freshwater Marsh – Shoreline	◯	Size of Wetland (ha)	Size of Alteration(ha)
Fen - Open	◯	Size of Wetland (ha)	Size of Alteration(ha)
Fen - Shrub	◯	Size of Wetland (ha)	Size of Alteration(ha)
Fen – Treed	◯	Size of Wetland (ha)	Size of Alteration(ha)
Bog – Open	◯	Size of Wetland (ha)	Size of Alteration(ha)
Bog – Shrub	◯	Size of Wetland (ha)	Size of Alteration(ha)
Bog – Treed	◯	Size of Wetland (ha)	Size of Alteration(ha)
Swamp – Shrub	◯	Size of Wetland (ha)	Size of Alteration(ha)
Swamp - Treed	◯	Size of Wetland (ha)	Size of Alteration(ha)
Vernal Pool	◯	Size of Wetland (ha)	Size of Alteration(ha)
Unknown	◯	Size of Wetland (ha)	Size of Alteration(ha)

Wetland Type - Compensation (check all that apply)

Type	Compensation Area (ha)	Type	Compensation Area (ha)
◯ Salt Marsh		◯ Freshwater Marsh - Shallow	
◯ Freshwater Marsh - Deep		◯ Freshwater Marsh – Shoreline	
◯ Fen – Open		◯ Fen – Shrub	
◯ Fen – Treed		◯ Bog – Open	
◯ Bog - Shrub		◯ Bog – Treed	
◯ Swamp – Shrub		◯ Swamp – Treed	
◯ Vernal Pool		◯ Unknown	

Compensation Type

◯ Restoration	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Enhancement	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Creation	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Expansion	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Research	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started

Compensation Value($)

◯ Study Area (ha) _____ Compensation Status ◯ Approved ◯ In Progress ◯ Not Started

Compensation Value($)

◯ Education Area (ha) _____ Compensation Status ◯ Approved ◯ In Progress ◯ Not Started

Compensation Value($)

◯ Other Area (ha) _____ Compensation Status ◯ Approved ◯ In Progress ◯ Not Started

If Other, please specify _____

SECTION 6 - SUPPORTING DOCUMENTATION

All supporting documentation is to be submitted in accordance with the "Approvals Procedures Regulations." If applicable, the following documents must be submitted with this Application. However, additional information may be requested.

Note: A legend must be supplied for all mapping describing symbols used, scale and north orientation.

Description	Submitted	Waiver requested	Reason for Waiver
6A - Attach for all applicable Water Applications			
Proof of Ownership/Agreement/Legal right to conduct Activity	◉	○	
Site Plan or Survey	◉	○	
Detailed Plans/Specifications	◉	○	
Substance Descriptions and Controls	◉	○	
Description of Adverse Effect	◉	○	
Info Required under Checklists/Guidelines/Standards/Policies	◉	○	
6B - Attach only for Storage of Water/Dam, and Water Withdrawal/Diversion			
Environmental Assessment Study	◉	○	
Rehabilitation Plan	◉	○	
Description Contingency Plan	◉	○	
Explanation of Substances Released	◉	○	
Details of Site Suitability and Sensitivity	◉	○	
Detailed Description of Activity	◉	○	
Public Consultation Description	◉	○	
6C – Attach only for Wetland			
Details of Site Suitability and Sensitivity	○	○	
Detailed Description of Activity	○	○	
Public Consultation Description	○	○	

If information submitted is incomplete, or if supporting documentation is of poor quality (plans, maps, etc.), the application may be delayed, returned or rejected.

SECTION 7 – DECLARATION

Information in this application package which the applicant considers to be confidential business information should be clearly identified.

Are you making this request? ◯ Yes ◉ No

If yes, please indicate which information in the Supporting Documentation is considered confidential.

◉ I acknowledge it is an offense under Section 158 of the *Environment Act* to provide false or misleading information, and confirm to the best of my knowledge and belief the information provided in this form and supporting documentation is true and accurate and complies with the relevant provisions of the *Environment Act* and Regulations.

Applicant's Signature:  Date: (yyyy/mm/dd) 2021/07/10

Name (Please print or type): Nadine Thomas

OR

I certify that I am acting with the applicant's full consent.

Signature: _____ Date: (yyyy/mm/dd) _____

Name (Please print or type): _____

NOVA SCOTIA
Environment

Submission Checklist for Watercourse Alteration

This checklist must accompany every application for a watercourse alteration approval. Complete Section A for all applications, Section B must be completed for flowing watercourses (such as rivers, streams, etc). Section C is specific to erosion protection. If you require assistance with completing this form or preparing the information required in support of the application, please contact your local NSE office to obtain a list of Watercourse Alteration Certified Individuals. If an item is not provided, the submission will be considered incomplete.

SECTION A (FOR ALL APPLICATIONS) ALL INFORMATION MUST BE PROVIDED:

- ☑ Name of watercourse and watercourse it is a tributary to
- ☑ Community and County name
- ☑ 1:50,000 Topographic map with alteration location marked
- ☑ 1:50,000 Topographic map number with grid reference (easting and northing)
- ☑ Preconstruction site photos (colour or electronically)
- ☑ Work plan for in-the-dry installation (water control)
- ☑ Erosion and sedimentation control plan
- ☑ Plan and profile drawing of proposed alteration (including dimensions)
- ☑ Description of channel bottom (ie. rock (size, quantity), muck, etc.)
- ☑ Plans, drawing and specifications (including whether the alteration will be in accordance with the NS Watercourse Alterations Standard, latest edition, or a description of an alterative plan)

SECTION B (INCLUDE FOR FLOWING WATERCOURSES) :

- ☐ Watercourse velocity (metres/second)
- ☐ Watercourse channel width (top of bank to top of bank)
- ☐ Watercourse channel depth (from top of bank)
- ☐ Calculations for sizing of structure, including but not limited to watershed area (1:100 yr return event for permanent structures)

SECTION C (INCLUDE FOR EROSION PROTECTION):

- ☐ Calculations for erosion protection material sizing

It is an offense under Sections 158 (a) and 158 (b) of the Environment Act to provide false or misleading information. I certify all of the above required information has been submitted and complies with the requirements set out in the Environment Act and the Activities Designation Regulations, including design and construction requirements.

Applicant Section	Certified Installer Section (required as of Oct 1, 2016)
Applicant Name (please print) Nadine Thomas	Certified Watercourse Alteration Installer Name (please print)
Applicant Signature 	Certified Watercourse Alteration Installer Phone Number
Date Signed July 10, 2021	Certification Number

Updated October, 2014

Nova Scotia POWER
An Emera Company

Environmental & Project Description for Construction Activities

Sheet Harbour Hydro System

Ruth Falls Dam Sluice Gate Installation

2021

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PROJECT OVERVIEW

NSPI is proposing the installation of sluice gates on the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2021. This work is necessary in order to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines and improve the operability of the Ruth Falls Dam. Work in 2021 will involve replacing the three existing deep stoplog bays located in the central portion of the dam with three screw stem vertical lift gates. NS Power is proposing that the sluice gate replacement be a stand alone project, separate from the Ruth Falls Dam Refurbishment. The Ruth Falls Dam Refurbishment Project is currently proposed under application #2019-2638165-00, which has been under review by NS ECC since December 2019. Due to delays in the regulatory review process, NS Power has deferred this project in 2022.The sluice gate installation was initially is part of this application, however, in order to move forward with the sluice gate portion of the project, this aspect is being requested for approval under a separate application. NS Power will be providing a revised application package to support the deferred construction schedule and revised scope of the Ruth Falls Dam Refurbishment Project to NSECC to support Application #2019-2638165-00 in the coming weeks.

NSPI is proposing conducting the sluice gate replacement including installation of a control building starting in early September 2021 with completion in late December 2021. Completing this portion of the project will not require the reservoir to be lowered beyond the normal operating level required at this time of year as per water approval 2008-062826-01 (maintain at elevation 109.4' until November 30th) and can be conducted without altering operation of the Ruth Falls fishladder. There will be no cofferdams required and no temporary or permanent new instream footprint.

NS Power is proposing to complete the sluice gate installation in 2021 for the following reasons:

- The current Ruth Falls dam is manually operated by removing and adding stoplogs and spill planks in order to discharge water. Replacing the stoplogs with vertical lift gates will allow for increased operability of the dam, improved water management capability and reduce reaction time and increase efficiency in managing flows.
- Completing the sluice gates in advance of construction activities for the Ruth Falls Dam Refurbishment will allow for the gates to be used as the primary means of water control throughout the project. The sluice way can accommodate the entire range of potential flood events with minimal environmental impact and without modification to other proposed water control structures in order to pass reservoir outflows.
- Completing the sluice gates in advance of construction activities for the Ruth Falls Dam will allow for a smaller scope of construction for 2022, potentially reducing the length of time the headpond will be drawn down.

The following sections provide a more detailed project description including water management plans, potential adverse effects, and mitigation.

1.0 INTRODUCTION

The Sheet Harbour Hydro system is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The system has a drainage area of 573.9 km^2. Presently there are 6 controlled reservoirs, including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond and Ruth Falls Headpond. Ten Mile Reservoir was previously controlled until the dam was removed in 2012.

Governor Reservoir is located at the head waters of Twelve Mile Stream, which flows through Union Flowage into Marshall Reservoir. Sloane Reservoir is located near the headwaters of Seventeen Mile Stream which passes through Anti Dam Reservoir and into Marshall. Marshall Reservoir comprises the principle reservoir for the Sheet Harbour System. Malay Falls Headpond is directly downstream from Marshall; the Malay Falls power canal conducts water from the Malay Falls Headpond to the generating station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel.

Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power. Mapping of the Sheet Harbour System can be found in Appendix A.

2.0 CONSTRUCTION

Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the embankment and spillway/sluiceway structures. The scope of work to be completed in 2021 which is the subject of this application, involves replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates. The scope of work also includes installation of a controls building and an associated elevated concrete slab to support the building.

2.1 Existing Project Area

Ruth Falls Headpond is located immediately downstream of the Malay Falls Headpond. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, a 15.2 m long three-bay stoplog-controlled sluiceway section in the centre, and two short concrete gravity bulkhead sections that abut either side of the spillway. The crest elevation of the spillway is 31.7 m and stoplogs can be installed to an elevation of 33.3 m. The dam contains a fish ladder for the upstream migration of fish and a louver/fish bypass system located in the canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix B for pre-construction site photos.

Flow in the area is controlled by NSPI Hydro Operations. Water levels can fluctuate between the full supply level of 33.6 m (110.4') and the low supply level of 27.5 m (90.1'). A minimum operating level of 33.3 m (109.4') is observed from April 1 - Nov. 30 each year. As per NSECC Approval, a 35 cfs maintenance flow is provided downstream year round in order to operate the Ruth Falls louvers. This flow is targeting downstream migration of Atlantic salmon smolts and kelts. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers. This flow is targeting downstream migration of American eel. The fish ladder at Ruth Falls operates from May 15-November 1st annually with a flow of 6 cfs. During this time frame a fish trap is operated in the ladder. DFO is contacted if the trap exceeds 50 salmon in order to determine the target release locations. Of note, only 11 salmon have been captured since 2007 with no salmon being captured in 2017 and 2018, two in 2019, and one in 2020.

Atlantic salmon have been the species of interest historically in the system for DFO. However, the low numbers of returns on East River in recent years indicate that there is unlikely a breeding population. Work is ongoing to improve the water quality in the West River and it may be that higher returns are observed in the East River over time. High concentrations of mercury have been observed in white perch, yellow perch and speckled trout in the system.

Ruth Falls Reservoir was sampled by NSPI in 2017 during NS Power relicensing studies using gill nets, minnow traps and eel pots. Species found to be present in Ruth Falls Reservoir include American eel, alewife, brown bullhead, lake chub, golden shiner, speckled trout, white sucker and yellow perch. As noted, there have been little to no returns of Atlantic salmon to the Ruth Falls headpond. No aquatic invasive species have been observed in the project area or adjacent habitat. No critical fish habitat is found in the area as per DFO's Aquatic Species at Risk Map.

Water quality sampling was performed at two sample sites in the Ruth Falls Reservoir in 2017. pH in Ruth Falls is considerably lower than reservoirs further upstream with a range of 4.32-5.14. Other water quality parameters measured were generally good. TDS is low, ranging from 9 mg/L to 12 mg/L, and conductivity ranges from 20 µS/cm to 23 µS/cm. Laboratory measurements of pH are considerably higher than in situ measurements, with values between 6.05 and 6.41. There are elevated metals concentrations in deeper waters, with exceedances of CCME FWAL guidelines for iron and zinc. Water quality measurements were taken at a site downstream of Ruth Falls in the East River of Sheet Harbour in 2017. pH was 4.94, dissolved oxygen was 10.23 mg/L, while conductivity was 20 µS/cm.

A rare species assessment, wetland delineation, and functional assessment of the area surrounding the project site was conducted by Strum Consulting in September 2017, a copy of the report was previously provided to NSECC as part of application 2019-2638165-00. Four wetlands were identified and no plant species of conservation interest (SOCI) were observed. A Common Loon was heard within the vicinity of the dam. The Project will not impact the wetlands As water levels are not proposed to deviate from current operating conditions.

In July 2021, NSPI staff observed a Barn Swallow nest and a Tree Swallow nest on the Ruth Falls dam. The Barn Swallow nest is located in the centre of the dam on top of one of the concrete

piers and underneath the deck of the dam. The Tree Swallow nest was observed in the control building located at the centre of the dam. The NS Department of Lands and Forestry (DLF) have been notified and an application for a Species at Risk (SAR) permit submitted requesting permission to remove the nests once the birds have left the area, likely by late August/early September. No work will be done on the sluice gates until the birds have departed as directed by DLF.

2.2 Proposed Refurbishment Activities

The proposed maintenance activities are as follows:

Mobilization:

Note: all mobilization activities will be conducted above the ordinary high water mark (OHWM) and is estimated to take two weeks. Please reference Figure 1 for a layout of site access.

- A temporary access road will be constructed on the downstream side of the dam to access the worksite. The access road will be constructed of compacted gravel and will run parallel to the fishladder. The access road will start at the canal and run to the stream channel;
- A gravel crane pad will be constructed at the end of the access road;
- A temporary engineered walkway will be installed and will extend from the crane pad to the dam to allow safe access by employees to the downstream side of the dam. The walkway will then extend along the downstream side of the dam to the sluice bay area. This portion of the platform will be attached directly to the dam. The walkway will be constructed with kickplates and handrails;
- The walkway will be of sufficient height to not impede operation of the fishladder;
- All work will be conducted out of the water. This portion of the work is expected to take 1-2 weeks.

Isolation of Sluiceway:

As seen on drawing 200-02 of the drawing package (Appendix C), each of the three sluiceway bays has two sets of stoplog checks; stoplogs are currently in place in the downstream checks and the upstream checks are empty. The following steps will be taken to isolate the sluiceway:

- An engineered steel plate will be fabricated offsite to facilitate isolation of the sluiceway bays.
- Using the onsite stoplog hoist, the engineered steel plate will be installed in the upstream check of one of the sluiceway bays.
- The downstream stoplogs from the same bay will be removed and re-installed into the upstream stoplog checks of another bay to facilitate removal of that bays downstream stoplogs.
- This will continue until all downstream stoplog checks are empty.

- Once the sluiceways are isolated, installation of the gates can commence.

Sluice Gate Installation:

Once the sluiceway is isolated, the new sluicegates will be installed. Below is an overview of how the new sluicegates will be installed:

- The downstream stoplog checks will be prepared accordingly to accommodate the new sluicegates (please refer to drawing 300-04 and 310-01 of drawing package in Appendix C for details).
- Once the downstream stoplog checks are prepped, the new sluicegates will be installed with a crane and subsequently commissioned.
- It is estimated that the above will take three months.

New Control Building (see drawing 300-01, 02, and 05 in Appendix C):

The rubber dam controls will be housed in a new control building, to be installed on the eastern end of the dam on the downstream side, see Figure 1 for location. The rubber dam control building will be fabricated offsite and will be lifted in place with a crane. The deck of the dam will need to be extended as shown on drawings 300-02 and 300-05 of the drawing package (Appendix C) to accommodate the rubber dam control building. Additionally, the eastern most bay of the dam (which is below where the new control building will sit) is unused and will be filled in with concrete. The follow steps outline the modifications required to the eastern end of the dam to accommodate the new control building and the installation of the control building:

- The eastern most bay will be filled in with concrete as per drawings 300-02 and 300-05 of the drawing package.
- Two concrete piers will be constructed to support the slab extension. The eastern most pier will tie into the existing retaining wall while the western pier will be supported with a new 5’ x 18’ concrete footing (new instream footprint of 8.25 m2). The footing will be constructed on grade in a location that typically contains back water when the dam is spilling. Sandbags will be used to isolate the work area and pumps used to keep this area dry.
- Once the piers are poured, the deck extension will be poured, and a crane will be used to install the control building.
- It is estimated that the above work will take three months and will take place in parallel with the sluice gate installation works.

Demobilization:

Upon completion of the above scope of work, the site will be demobilized until construction resumes in 2022 when the permit for the remaining works is anticipated to be issued.

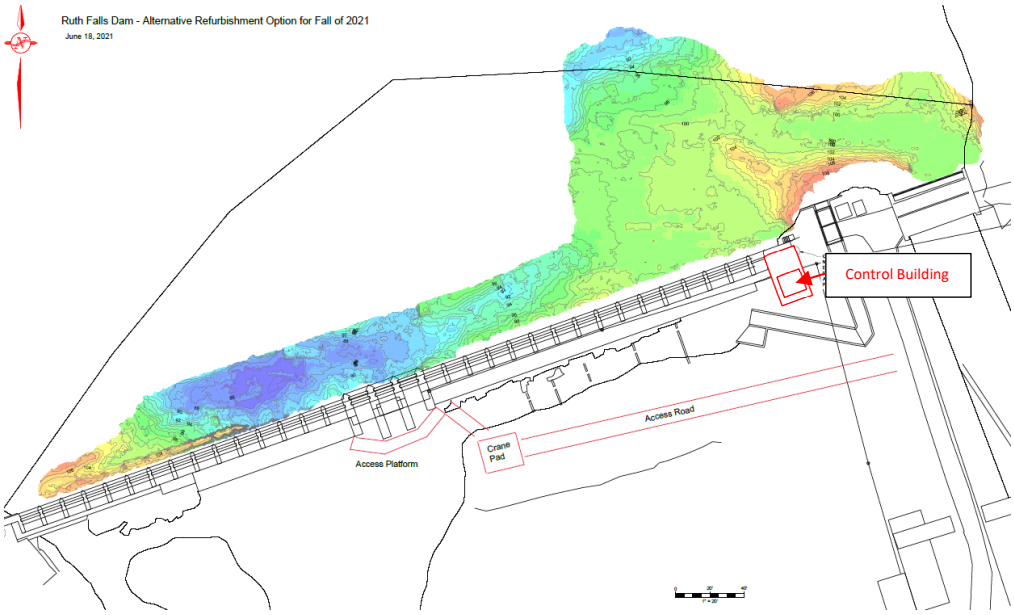


Figure 1: Location of Access Infrastructure and New Control Building

2.3 Construction Schedule

The Project is expected to take four months starting in early September and finishing in late December 2021 or potentially in late January 2022 should inclement weather delay the work schedule. No instream work is required for the 2021 scope of work. Once the SAR permit is received, work will begin with construction of the laydown area and access road as directed within the permit. The two swallows' nests located on the dam will be removed as directed by the SAR permit, likely in late August/early September when the birds have left the area. Once all other environmental permitting for the project is received, work will begin on the crane pad and engineered walkway, followed by isolation of the sluice gate work area and installation of the gates. Work on the extension slab for the new control building and installation of the building will occur concurrently with the gate work.

3.0 REGULATORY PERMITS/APPROVALS

The following regulatory permits/approvals are required:

- A Watercourse Alteration Approval in accordance with Section 5(A)(1)(c) of the Activities Designation Regulations of the *Environment Act*.
- A Species At Risk permit is required by NSDLF as per Section 50(1), 51(a) of the *Wildlife Act*, and Section 14(1) of the *Endangered Species Act*.
- A No Interference with Navigation notice of work to Transport Canada is required pursuant to paragraphs 4.1 and 9.1 of the Canadian Navigable Waters Act.
- Advice or authorization to be determined by DFO based on risk.

4.0 ENVIRONMENTAL PROTECTION

4.1 Water Management

The work area will be isolated using engineered steel plates installed in the upstream checks of the deep stoplog/sluice bays. Contractor employees will be able to conduct the gate installation from the downstream side of the sluice bays without lowering the water level in the reservoir or using cofferdams on the upstream side. Water elevations in the reservoir will be maintained at 109.4' until November 30th as required by water approval 2008-062826-01. After November 30th, water levels will be no lower than 90.1' as per the water approval. The water level in Ruth Falls headpond will be managed using the stoplog bays located on the west end of the dam at the main spillway channel during construction. Managing for high precipitation events, natural inflows from the Grant River Watershed, and inflows from Malay Falls will be overseen by NSPI hydro operating personnel in consultation with Project personnel as per regular operating procedures. All downstream flows required by approval 2008-062826-01 will be maintained as well as operation of the fishladder and salmon trap. All other work will be conducted above the OHWM.

4.2 Erosion and Sedimentation Control

NS Power is anticipating minimal impacts to the surrounding environment with respect to erosion, scour and associated sedimentation of watercourses. The proposed scope of work for the Project involves no instream work and no excavation of soil material. The access road will be constructed by pouring and spreading clean gravel on the existing ground surface and compacting with a roller. There will be no exposed soil required for installation of the crane pad and access platform and all machinery will be working above the OHWM.

Installation of the support slab for the new controls building will be conducted in dry conditions. Sand bags will be used to isolate the work area on the downstream side of the support slab where water can accumulate from rain and leakage from the dam. Water will be pumped into a heavily vegetated area.

Silt fences will be installed along the spillway shoreline upstream and downstream from the access road in order to ensure any material that may be washed from its surface during a rain event is blocked from entering the water. As no excavation for the temporary access path is required, and material will be rock that is free of fines, NS Power is not anticipating a high risk of sediment transport as a result of construction, use and removal of the road. Any use of silt fencing will be monitored periodically for sediment build up and will be cleaned, as necessary.

NS Power is not anticipating any issues with erosion or scour when passing the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. NS Power Project personnel will remain in regular contact with Hydro Operations personnel

throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

The chosen contractor to complete refurbishment activities will be required to submit a site-specific erosion and sedimentation control plan designed for the planned scope of work. This will include identification of any additional site-specific controls required and location of any water filtration operations or requirements for sediment traps for pumping activities. NS Power would request that, if required, a condition be incorporated into the Approval, if issued, for NS Power to provide a site-specific plan to confirm the above outlined measures prior to construction activities starting.

4.3 Construction Material and Debris

Construction materials include concrete, wood, gravel, and slide gates. A list of other products to be used by the contractor will be submitted to NSPI prior to start of work for approval based on health, safety, and environmental parameters. All materials stored on site shall be stored, handled and labeled according to Workplace Hazardous Materials Information System (WHMIS) regulations, as well as any other applicable federal or provincial regulation. Product Safety Data Sheets (SDS) shall be available on site at all times. All construction material and debris will be stored in a laydown area located approximately 100 m from the east side of the dam. The site is on NSPI property and is currently a road in the shape of a loop with trees in the centre. The trees will be removed and the area levelled, gravel poured and levelled, and the area compacted with a roller. The site is 100 m from the watercourse and is separated from the waterway by a road and vegetation. There are no wetlands in the area. At the end of construction, debris will be removed from site and anything requiring disposal will be will be done so in accordance with applicable regulations and guidelines.

While working with and/or applying materials, measures will be taken to prevent any materials from entering the watercourse by applying materials in a controlled manner and containing excess material during application.

4.4 Equipment and Machinery

All equipment and machinery required to be operated on or near a body of water will be mechanically sound with no leaking fuel tanks or hydraulic connections. Refuelling and lubrication shall be in designated areas not within 30 m of any wetland or water body. Storage of petroleum products will be at least 100 m from a water body. Machinery and equipment will be stored above flood water levels. The selected contractor will develop an oil spill contingency plan and spill kits will be maintained on-site.

4.5 Potential Adverse Effects

Potential adverse effects and associated mitigation are listed in Table 1 below.

Table 1: Summary of potential impacts associated with the Project and mitigation measures to prevent or minimize impacts.

Potential Effect	Measure to Mitigate
Loss of fish habitat	There will be a small permanent instream footprint of 8.25 m2 associated with a footing required for the new support slab for the new control building. Water levels in the headpond will remain within normal operating range and cofferdams will not be required to install gates in the dry.
Mortality of fish during construction activities	All machinery, materials, and access infrastructure will be located out of the water. The fish ladder will operate normally throughout the project as required per water approval 2008-062826-01 and will not be impeded by placement of the crane pad and walkway. There is not a lot of fish migration expected during the early parts of the project, however, since November is an important time for salmon, installation of the crane pad and walkway will be completed prior to November. The fish bypass pipe which is used to move fish downstream will remain operational during the project. The crane pad will be installed on land adjacent to the mouth of the bypass pipe, however, the pipe will not be impeded by the crane pad as it will be installed above the OHWM.
Effects on wetlands	Wetlands identified in the vicinity of the project area will not be impacted by the project given their distance from the project site. The closest wetland is fed by the spillway which will operate normally during construction.
Effects on flora and fauna	No plant SOCI were found in the study area during the 2017 survey. A Common Loon was heard in the area during the 2017 survey, however, no sightings of loons or nests were made. Should loons nests be present on the reservoir, they will not be impacted by the project since water levels will not be altered. A Barn Swallow and a Tree Swallow nest was found on the dam. Work will be conducted as permitted by a Species at Risk permit, the application for which is currently under review by NSDLF. NSPI have requested permission to remove the nests once the birds have left the area and will be conducted as per the NSDLF permit. Noisy or disruptive work associated with project preparation (installation of laydown area and access road) will be conducted as permitted by the SAR permit.
Effects due to sedimentation of the headpond or river	Erosion and sedimentation controls will be employed to prevent sedimentation of the reservoir or wetlands as described in section 4.2. The successful contractor will be required to submit a site specific erosion and sedimentation control plan prior to start of construction. Issues associated with sedimentation are unlikely as no work is being conducted instream and no excavation is required. The reservoir will be able to be operated normally, therefore, impacts downstream of the dam due to high water inflows are not anticipated as high return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour.
Release of hazardous materials from equipment	Equipment will be inspected daily for leaks or weeps of hydraulic fluid or fuel. Equipment will not be refueled within 30 m of the river and fuel will not be stored on site. Machinery and equipment will not be operated in the water or below the OHWM.

4.6 Rehabilitation

Following any excavation and placement activities, areas disturbed by machinery or equipment will be returned to pre-construction condition. Any exposed soil areas will be stabilized to prevent erosion. In the event that long-term erosion problems, resulting from the clearing of the area, cannot be dealt with at the time construction is complete, temporary measures shall be taken.

5.0 ARCHAEOLOGICAL CONSIDERATIONS

An Archaeological Screening and Reconnaissance (ARIA) for the Project impact area was completed in 2017. The purpose of the ARIA was to assess the potential for archaeological resources in the project area, which included approximately 5 hectares surrounding the dam and earthen embankment primarily on the downstream side. The ARIA included a background study and visual assessment of the study area. The assessment identified three areas considered to exhibit high potential for encountering Precontact and/or early historic Native archaeological resources and/or historic Euro-Canadian archaeological resources. It was recommended that if these areas could not be avoided, shovel testing be conducted.

Shovel testing in 2 of the identified areas was conducted in 2018 and included 64 shovel tests. No archaeological resources were encountered and no evidence of historically significant cultural modification was identified during the course of the shovel testing. Based on the results of the 2018 shovel testing, the potential for encountering significant, intact archaeological resources within the two areas are considered to be low. It was recommended that the two shovel tested areas be cleared of any requirement for further archaeological investigation and that development within these areas may proceed as planned.

6.0 ABORIGINAL ENGAGEMENT

NS Power initiated engagement regarding the Ruth Falls Main Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant project information with the KMKNO throughout 2018 providing six project updates, the project was deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window Meeting with KMKNO. NS Power continued to provide monthly Project updates and share relevant project information throughout 2019, working towards a preferred design option and planning for the Project to be completed in 2020. NS Power further presented the Project and design option with the KMKNO during the One Window meeting to discuss 2020 hydro capital projects and continued to provide monthly Project updates and share relevant project information throughout 2020, working towards a preferred design option and planning for the Project to be completed in 2021. NS Power then provided an updated on the project and 2021 scope of work in the December 2020 One Window meeting for 2021 Hydro Capital Projects.

NS Power will continue monthly updates with the KMKNO on 2021 hydro capital projects, including Ruth Falls in 2021 and will continue to share information with respect to new information pertaining to water management, fish and fish habitat monitoring, archaeology and wetland monitoring as well as share updates on the status of Approval applications.

In January 2020, NS Power initiated engagement with the Mi'kmaw Conservation Group to collaborate on an offsetting project. NS Power, in February and March 2020, continued engagement with the Mi'kmaw Conservation Group, continuing discussions to identify an offsetting project with the group and the Millbrook Mi'kmaw community. NS Power continued to engage with Millbrook throughout 2020 but was not able to share any new information on the Project due the Project deferral to 2021. During this time, NS Power has been working with the Mi'kmaw Conservation Group (MCG) of the Confederacy of Mainland Mi'kmaq (CMM) to collaborate with Millbrook First Nation on an offsetting plan for potential impacts to fish and fish habitat that are anticipated as a result of the Project. This offsetting Project will be included with NS Power's Application for Authorization to DFO.

In 2021, NS Power re-initiated engagement with Millbrook First Nation and attended a Chief and Council meeting on April 20th, to share updated information on the Project. An article describing the Project will be published in the Millbrook monthly newsletter in August.

APPENDIX A – HYDRO SYSTEM OVERVIEW

1. Sheet Harbour Hydro System Map
2. Ruth Falls Plan View

Sheet Harbour Hydro System
Ruth Falls Dam Sluice Gate Installation
Project and Environmental Description

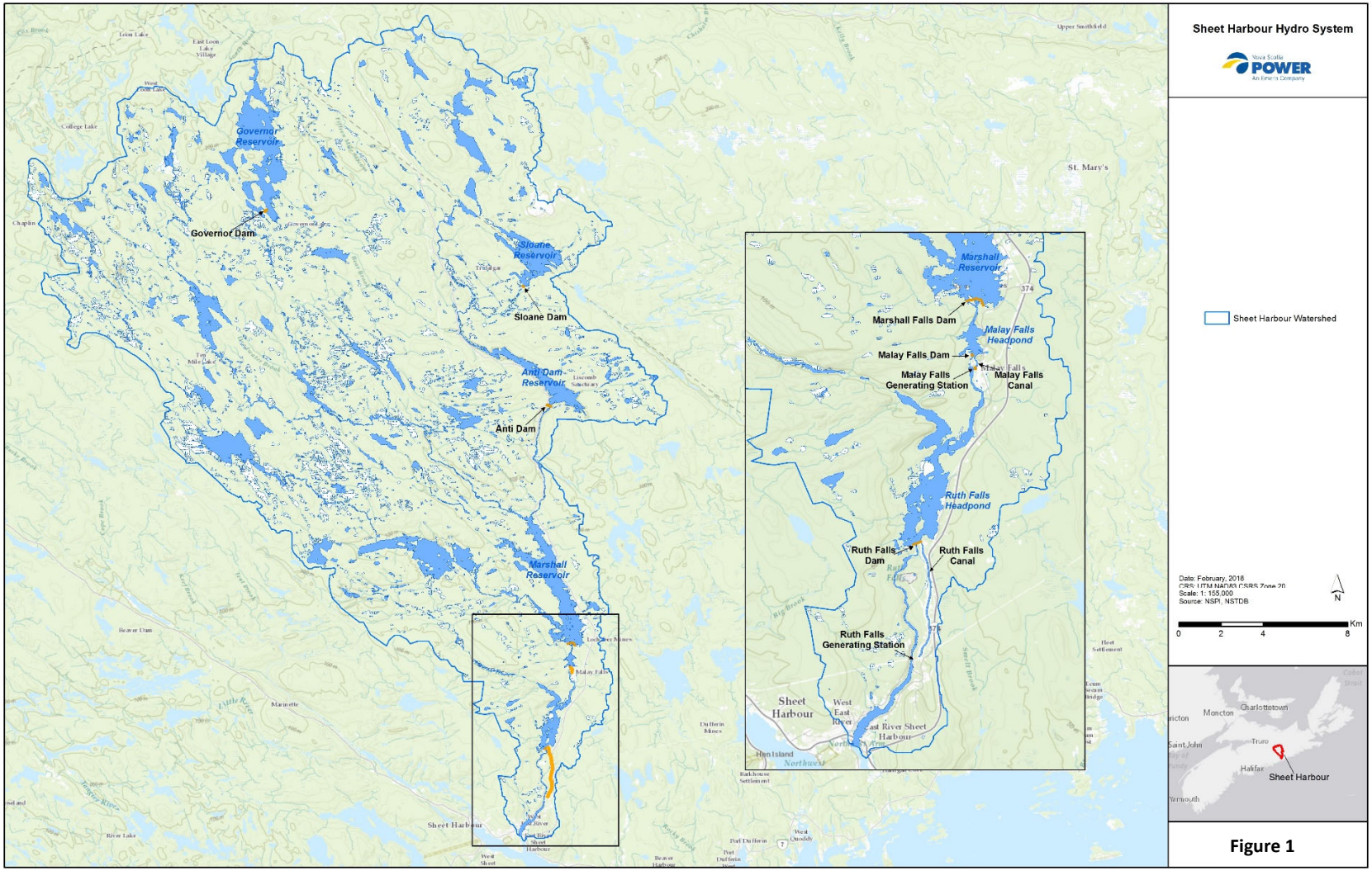


Figure 1



Figure 3. Ruth Falls Plan View

APPENDIX B – SITE PHOTOS



Photo 1: View of Ruth Falls Dam, facing north



Photo 2: View of Ruth Falls Dam, facing west



Photo 3: Ruth Falls fishladder and bypass pipe



Photo 4: Downstream of Ruth Falls Dam



Photo 5. Upstream of Ruth Falls Dam

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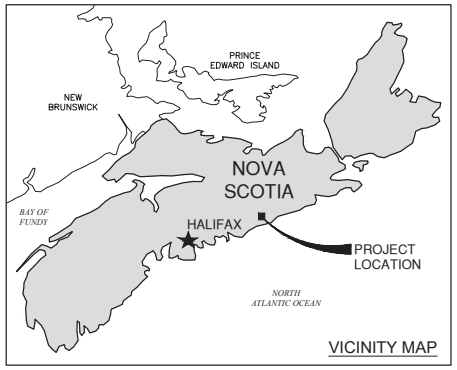
APPENDIX C – ENGINEERING DRAWINGS

DWG. NO. H096H1163100040

NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP





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COVER SHEET

DWG.NO. H096H1163100040 REV. E

DWG. NO. H096H1163100041

DRAWING LIST

SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS	NSPI DRAWING No.
100-01	DRAWING LIST	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-041
100-02	GENERAL NOTES	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-042
200-01	EXISTING CONDITIONS OVERALL SITE PLAN	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-043
200-02	EXISTING CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-044
200-03	EXISTING CONDITIONS WEST SPILLWAY DAM PLAN AND SECTIONS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-045
210-01	TEMPORARY CONDITIONS/DEMO PLAN	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-046
210-02	TEMPORARY CONDITIONS/DEMO EAST SPILLWAY PLAN AND SECTIONS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-047
210-03	TEMPORARY CONDITIONS/DEMO WEST SPILLWAY PLAN AND SECTIONS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-048
300-01	NEW CONDITIONS DAM PLAN AND ELEVATION	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-049
300-02	NEW CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-050
300-03	NEW CONDITIONS WEST SPILLWAY PLAN AND SECTIONS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-051
300-04	NEW CONDITIONS SLUICEWAY PLAN AND DETAILS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-052
300-05	NEW CONDITIONS EAST ABUTMENT PLAN AND SECTIONS	2021-05-27	B	100% REVIEW SUBMITTAL	H-096H1-1--631-00-061
310-01	NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-053
310-02	NEW CONCRETE SLUICEWAY HEADWALL DETAILS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-054
310-03	NEW CONCRETE SPILLWAY RESURFACING DETAILS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-055
310-04	NEW CONCRETE RETAINING WALL AND PIER DETAILS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-056
310-05	NEW CONCRETE EAST ABUTMENT PIER & DECK DETAILS	2021-05-27	B	100% REVIEW SUBMITTAL	H-096H1-1--631-00-062
310-06	NEW CONCRETE EAST ABUTMENT PIER & DECK DETAILS	2021-05-27	B	100% REVIEW SUBMITTAL	H-096H1-1--631-00-063
320-01	NEW STEEL WALKWAY PLAN VIEW	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-057
320-02	NEW STEEL WALKWAY	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-058
320-03	NEW STEEL WALKWAY HANDRAIL DETAILS	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-059
330-01	RUBBER DAM PIPING AT SLUICEWAY	2021-05-27	E	100% REVIEW SUBMITTAL	H-096H1-1--631-00-060

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DWG. NO. H096H1163100042

GENERAL NOTES

1. GENERAL:
   - A. CONTRACTOR SHALL DETERMINE LOCATIONS, EXISTING CONDITIONS, AND DIMENSIONS BY THEIR OWN INVESTIGATION.
   - B. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON LIMITED FIELD MEASUREMENTS, REFERENCE DRAWINGS AND SURVEY. FIELD VERIFY ALL DIMENSIONS, AND NOTIFY THE OWNER AND ENGINEER OF DISCREPANCIES.
   - C. CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION, AND WILL NOTIFY THE OWNER FOR AN APPROVAL, IF REQUIRED.
2. SURVEY:
   - A. GEOMETRY OF THE EXISTING DAM STRUCTURE SURVEYED BY TALISMAN TECHNICAL SOLUTIONS, LANTZ, NS, IN 2017.
   - B. ELEVATIONS ARE BASED ON OCTOBER 1994 GEODETIC DATUM. ELEVATIONS AND DIMENSIONS ARE NOMINAL. ACTUAL ELEVATIONS VARY THROUGHOUT EXISTING STRUCTURES.
   - C. UTILITIES LOCATED BY SURVEY OR SHOWN ON DRAWINGS ARE APPROXIMATE AND SHALL BE CONFIRMED IN FIELD.
   - D. CONTRACTOR SHALL COORDINATE WITH NSPI FOR TEMPORARY RELOCATION OR PERMANENT RELOCATION OF POWER LINES AND POLES IF REQUIRED.
   - E. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65 FT
3. DESIGN LOADS:
   - A. NORMAL HEADPOND: EL. 109.25 FT
   - B. INFLOW DESIGN FLOOD HEADPOND: EL. 114.0 FT AT PEAK FLOW OF 29,183 CFS
   - C. SEISMIC COEFFICIENT: 0.1g
   - D. ICE LOAD AT NORMAL POND ELEVATION: 5,000 LB/FT
4. JOB CONDITIONS:
   - A. SITE INFORMATION:
     - I. ANY SUBSURFACE CONDITIONS SHOWN ON THE DRAWINGS ARE BASED ON INTERPRETATIONS/INTERPOLATIONS OF DATA OBTAINED FROM BACKGROUND DOCUMENTS AND WIDELY SPACED EXPLORATIONS BY OTHERS. VARIATIONS MAY EXIST AND SHOULD BE EXPECTED.
   - B. EXISTING UTILITIES:
     - I. THE CONTRACTOR SHALL LOCATE EXISTING UNDERGROUND AND OVERHEAD UTILITIES IN THE AREAS OF WORK. IF UTILITIES ARE TO REMAIN IN PLACE, PROVIDE ADEQUATE MEANS OF PROTECTION DURING EARTHWORK OPERATIONS.
     - II. NOTE THAT THERE ARE EXISTING OVERHEAD POWERLINES AND ASSOCIATED POLES ALONG AND ADJACENT TO THE EMBANKMENT DAM. THE CONTRACTOR SHALL COORDINATE WITH OWNER FOR TEMPORARY OR PERMANENT RELOCATION OF POWERLINES AND POLES; AS REQUIRED.
     - III. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATION, CONSULT THE OWNER AND UTILITY OWNER/OPERATOR IMMEDIATELY FOR DIRECTIONS.
     - IV. THE CONTRACTOR SHALL REPAIR DAMAGED UTILITIES TO SATISFACTION OF THE OWNER AND UTILITY OWNER/OPERATOR.
5. QUALITY ASSURANCE:
   - A. HORIZONTAL AND VERTICAL CONTROL:
     - I. THE CONTRACTOR IS RESPONSIBLE FOR AND SHALL PROVIDE ALL CONSTRUCTION LAYOUT.
     - II. SURVEYS FOR CONSTRUCTION ELEVATIONS AND LOCATIONS OF THE WORK SHALL BE PERFORMED BY OR UNDER THE SUPERVISION OF A QUALIFIED SURVEYOR.
   - B. OWNER'S REPRESENTATIVE:
     - I. THE OWNER'S REPRESENTATIVE WILL PROVIDE PERIODIC TO REGULAR REVIEW OF THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR REGULAR COMMUNICATION OF THE CONSTRUCTION SCHEDULE AND FOR PROVIDING AMPLE NOTICE TO THE OWNER'S REPRESENTATIVE FOR CRITICAL REVIEWS SPECIFIED HEREIN.
     - II. THE OWNER'S REPRESENTATIVE MUST REVIEW ALL EXPOSED SUBGRADES PRIOR TO PLACEMENT OF FILL MATERIALS.
     - III. THE CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY (QCTL) SHALL PERFORM QUALITY CONTROL TESTING DURING CONSTRUCTION, AS SPECIFIED HEREIN. THE CONTRACTOR'S QCTL SHALL SHARE TEST RESULTS ON–SITE WITH THE OWNER'S REPRESENTATIVE UPON REQUEST.
     - IV. THE OWNER MAY CHOOSE TO EMPLOY AN INDEPENDENT THIRD PARTY TESTING AGENCY TO PERFORM QUALITY ASSURANCE (QA) TESTING.
6. EROSION & SEDIMENT CONTROL:
   - A. EROSION PREVENTION AND SEDIMENT CONTROL SHALL BE IN ACCORDANCE WITH LOCAL AND PROVINCE STANDARDS AND OWNER'S STANDARDS. ALL MEASURES SHALL BE CONSISTENT WITH THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT EROSION AND SEDIMENTATION CONTROL HANDBOOK FOR CONSTRUCTION SITES, AT A MINIMUM.
   - B. SUBMIT PLAN AND DETAILS TO OWNER FOR REVIEW AND APPROVAL.
   - C. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE OWNER.
7. DEMOLITION:
   - A. DEMOLISH PORTIONS OF THE EXISTING CONCRETE DAM AS SHOWN IN THE PLANS.
   - B. CONTRACTOR SHALL DEWATER WORK AREAS AS NEEDED TO PERFORM DEMOLITION AND EXCAVATION AND TO ACCOMMODATE NEW CONSTRUCTION.
   - C. CONTRACTOR SHALL CONFORM TO ALL OWNER SAFETY PROCEDURES.
   - D. CONTRACTOR SHALL NOT BEGIN ANY DEMOLITION OR EXCAVATION UNTIL AFTER RECEIVING WRITTEN AUTHORIZATION TO BEGIN DEMOLITION FROM OWNER'S PROJECT MANAGER.
   - E. CONTRACTOR IS RESPONSIBLE FOR CARE OF ANY LEAKAGE INTO THE WORK AREAS DURING CONSTRUCTION.
   - F. CONTRACTOR SHALL DISPOSE ALL DEMOLITION MATERIAL AT A LOCATION THAT HAS BEEN APPROVED BY OWNER.
8. MATERIALS:
   - A. STEEL:
     - I. BOLTS ASTM A325 (THREAD EXCLUDED FROM SHEAR PLANE) COMPLETE WITH A563 HEX NUT AND HELICAL SPRING WASHER ANSI B 18.21.1 UNLESS OTHERWISE SPECIFIED. ALL HARDWARE SHALL BE GALVANIZED AS PER ASTM A153.
     - II. STRUCTURAL W SHAPES: ASTM A992, OR CSA G40.21–350W.
     - III. STEEL PLATE: ASTM A–36, OR CSA G40.21–300W.
     - IV. ANCHOR RODS: ASTM A 36, A 307, OR F1554. HOT DIPPED GALVANIZED PER ASTM A 153, AS INDICATED ON DRAWINGS.
   - B. CONCRETE:

     SUBMIT MIX DESIGN AND REINFORCEMENT SHOP DRAWINGS FOR APPROVAL BY OWNER.

     SURFACE PREP:
     - I. REMOVED DETERIORATED SURFACE MATERIAL IN DESIGNATED AREAS DOWN TO SOUND CONCRETE. SOUND CONCRETE IS DEFINED AS WHEN THE SURFACE IS STRUCK WITH A GEOLOGIST'S HAMMER, THE AGGREGATE OF THE CONCRETE FRACTURES BEFORE THE CEMENT PASTE BOND IS BROKEN.
     - II. PERFORM REMOVAL WITH POINTED TOOLS THAT DO NOT DAMAGE OR FRACTURE THE UNDERLYING SOUND CONCRETE, OR BY PRESSURE WASHING OR AIR BLASTING.
     - III. ROUGHEN ALL SURFACES TO GREATER THAN 1/4" AMPLITUDE. CLEAN SURFACE TO REMOVE ALL DELETERIOUS MATERIAL, INCLUDING DIRT, GREASE, ETC. WASH WITH HIGH PRESSURE WASH AT LEAST 6,000 PSI.
     - IV. CONCRETE SURFACE SHALL BE SATURATED AT TIME OF CONCRETE PLACEMENT, BUT NO STANDING WATER.
     - V. DO NOT PLACE CONCRETE AGAINST ACTIVE LEAKS OR SEAMS WITH FLOWING WATER. STOP FLOW OR INSTALL DRAINAGE TO DIVERT FLOW AWAY FROM FRESH CONCRETE.

     SPECIFICATIONS:
     - I. MINIMUM F'c = 30 MPa AT 28 DAYS (4,000 PSI),
     - II. MAX W/C RATIO 0.45
     - III. FLYASH: ALL FLY ASH SHALL BE CLASSIFIED "FLY ASH CLASS CI OR F", CONFORMING TO CSA A3000 AND AS FURTHER DESCRIBED IN CLAUSE 2.2.1, CONCRETE MIXES. THE TOTAL ALKALI CONTENT OF THE FLY ASH SHALL BE LIMITED TO 4.5% MAXIMUM. THE FLY ASH SHALL BE OBTAINED FROM THE TRENTON GENERATING STATION UNIT 6 AS MARKETED BY SHAW RESOURCES.
     - IV. AIR ENTRAINMENT 6–8%
     - V. SLUMP AT PLACEMENT SHALL BE 100mm +/– 25mm (4" +/– 1")
     - VI. MAX AGGREGATE SIZE SHALL BE 25mm (1")
     - VII. CONCRETE PLACEMENT AND CURING SHALL BE IN ACCORDANCE WITH CSA 23.1, EXPOSURE CLASS F–1, "SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS".
     - VIII. CONCRETE WORK SHALL CONFORM TO CSA 23.1. CONCRETE STRENGTH SHALL BE VERIFIED BY STANDARD 28 DAY TESTS.
     - IX. REINFORCEMENT = CSA G30.18, GRADE 400W DEFORMED. STANDARD HOOKS PER CSA A23.3.
     - X. NON SHRINK CEMENT GROUT: MINIMUM F'C = 35MPA AT 7 DAYS.
     - XI. ADHESIVE ANCHORS SUITABLE FOR USE IN DAMP OR WET ENVIRONMENT: HILTI–HIT HY 200 ADHESIVE OR APPROVED EQUAL. ANCHORS ASTM F1554 GRADE 55, MINIMUM Fy=380MPA; Fu=520MPA.
   - C. NON–SHRINK GROUT: CRD–C 621, FACTORY PREMIXED GROUT
     - I. EARLY VOLUME CHANGE: ASTM C–827: 0.00% SHRINKAGE
     - II. HARDENED VOLUME CHANGE: 0.00% SHRINKAGE AND EXPANSION AFTER SET.
     - III. COMPRESSIVE STRENGTH: ASTM C–109 MIN. = 35 MPA AT 7 DAYS
     - IV. ACCEPTABLE SUPPLIERS: "FIVE STAR GROUT" BY US GROUT CORP, OR APPROVED EQUIVALENT.
9. SUBMITTALS:
   - A. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO OWNER FOR APPROVAL PRIOR TO FABRICATION.
   - B. EXCAVATION AND FILL PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE A WRITTEN EXCAVATION AND FILL PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL DETAIL THE FOLLOWING ITEMS, AT A MINIMUM:
       - SCHEDULE AND SEQUENCE OF WORK IN EACH AREA.
       - ACCESS TO EACH AREA.
       - LOCATION OF MATERIAL STOCKPILES IN EACH AREA.
       - EQUIPMENT TO BE USED IN EACH AREA.
       - MONITORING AND QUALITY CONTROL PROCEDURES.
       - MEANS/METHODS AND MATERIALS TO PROTECT EXISTING FEATURES DESIGNATED TO REMAIN.
   - C. DEWATERING PLAN:
     - I. DEWATERING WILL BE DONE IN CONJUNCTION WITH NSPI HYDRO SYSTEM PERSONNEL AND THE NSPI PROJECT MANAGER/ENGINEERS. THE CONTRACTOR SHALL PROVIDE A DETAILED DEWATERING PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING ITEMS, AT A MINIMUM:
       - MEANS/METHODS OF TEMPORARY EXCAVATION DEWATERING.
       - EQUIPMENT TO BE USED.
       - SETTLEMENT BASINS, IF REQUIRED, FILTER BAG LOCATIONS AND POINTS OF DISCHARGE.
       - SEQUENCING OF DEWATERING, EXCAVATION, AND FILL PLACEMENT.
   - D. EMERGENCY SEEPAGE PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE AN EMERGENCY SEEPAGE PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING, AT A MINIMUM:
       - TYPE, QUANTITY, AND LOCATION OF EMERGENCY FILTER/BALLAST STOCKPILES.
       - OTHER MATERIALS TO BE USED, (E.G., SANDBAGS, NON–WOVEN GEOTEXTILE, FILTER STONE, SMALL RIPRAP, ETC.).
   - E. WINTERIZATION PLAN:
     - I. AT LEAST TWO (2) WEEKS PRIOR TO ANY WINTER SHUTDOWN, THE CONTRACTOR SHALL SUBMIT A PLAN FOR PROTECTING/WINTERIZING THE COMPLETED WORK.
   - F. CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY:
     - I. THE CONTRACTOR SHALL SUBMIT THE NAME AND QUALIFICATIONS OF AN INDEPENDENT THIRD PARTY COMMERCIAL TESTING LABORATORY TO BE USED FOR BORROW SOURCE TESTING OF SOILS/CONSTRUCTION MATERIALS TESTING.
       - THE TESTING AGENCY SHALL BE A RECOGNIZED COMMERCIAL LABORATORY WITH NOT LESS THAN 5 YEARS OF EXPERIENCE IN CONDUCTING RELEVANT FIELD AND LABORATORY QUALITY CONTROL TESTING.
       - THE TESTING AGENCY SHALL MEET THE REQUIREMENTS OF ASTM D–3740.
   - G. BORROW SOURCE(S):
     - I. AT LEAST TWO (2) WEEKS PRIOR TO INITIATION OF APPLICABLE WORK, THE CONTRACTOR SHALL PROVIDE THE PROPOSED SOURCE(S) OF BORROW MATERIALS AND SUPPORTING DATA/RESULTS OF THE SPECIFIED BORROW SOURCE TESTING.
       - TESTING DATA/RESULTS SHALL BE FROM CURRENT TESTING OF SAMPLES OBTAINED FROM THE ACTUAL PROPOSED SOURCE/STOCKPILE AND NOT PRIOR/FILE RESULTS FROM THE SUPPLIER.
   - H. QUALITY CONTROL TESTING REPORTS:
     - I. SUBMIT TWO (2) COPIES OF THE FOLLOWING REPORTS AS SOON AS POSSIBLE, BUT NOT MORE THAN TWO (2) BUSINESS DAYS FOLLOWING COMPLETION OF ASSOCIATED QUALITY CONTROL TESTING.
       - LABORATORY TEST REPORTS FOR PROPOSED BORROW SOURCE MATERIALS. ACCEPTANCE OR REJECTION OR FILL MATERIALS WILL BE BASED ON THE RESULTS OF CURRENT LABORATORY TESTING.
       - FIELD IN–PLACE DENSITY/COMPACTION TEST REPORTS.
10. EARTHWORK:
    - A. SEE SHEET 310–04 FOR EARTHWORK.

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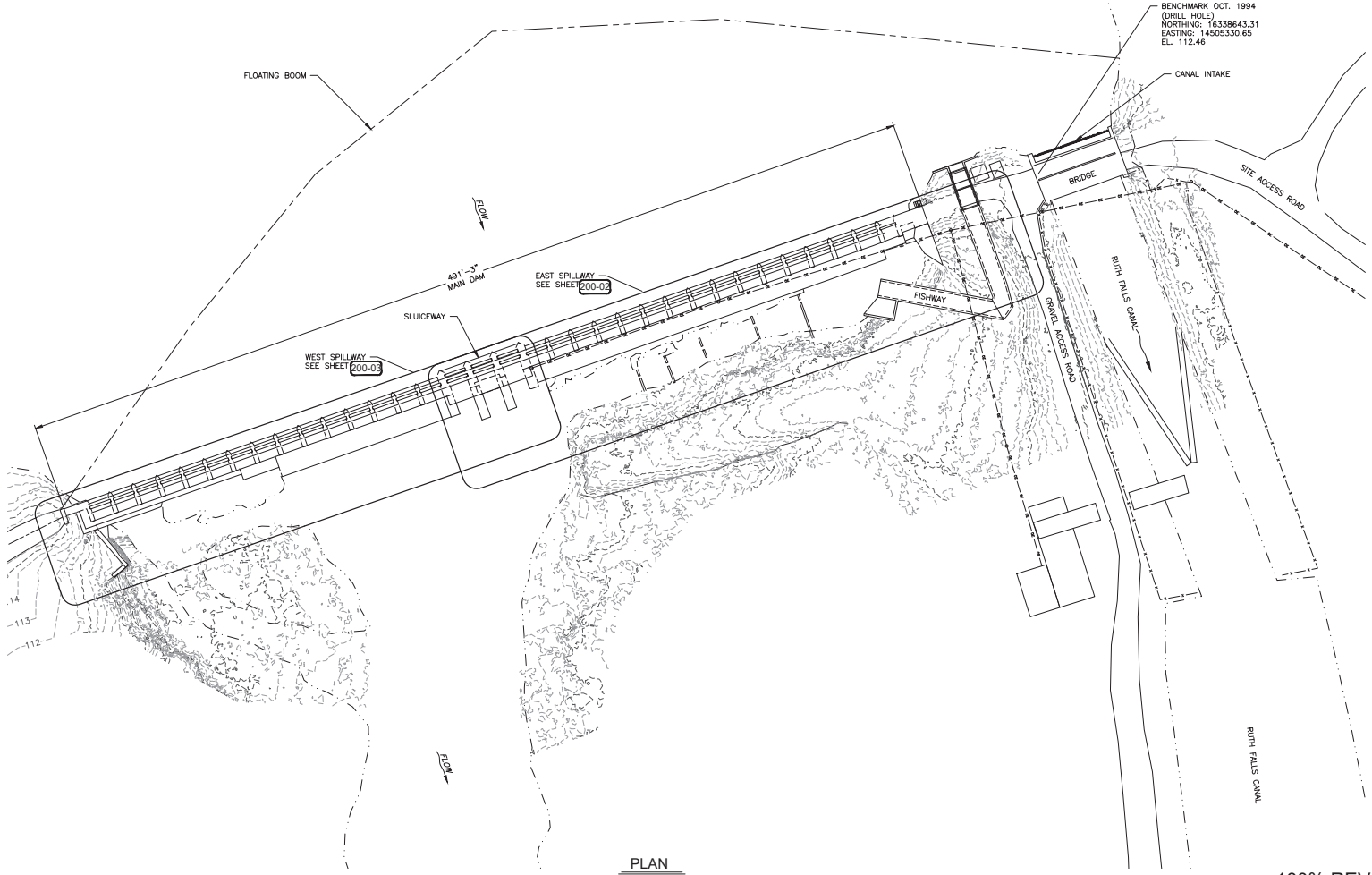
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

GENERAL NOTES

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NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

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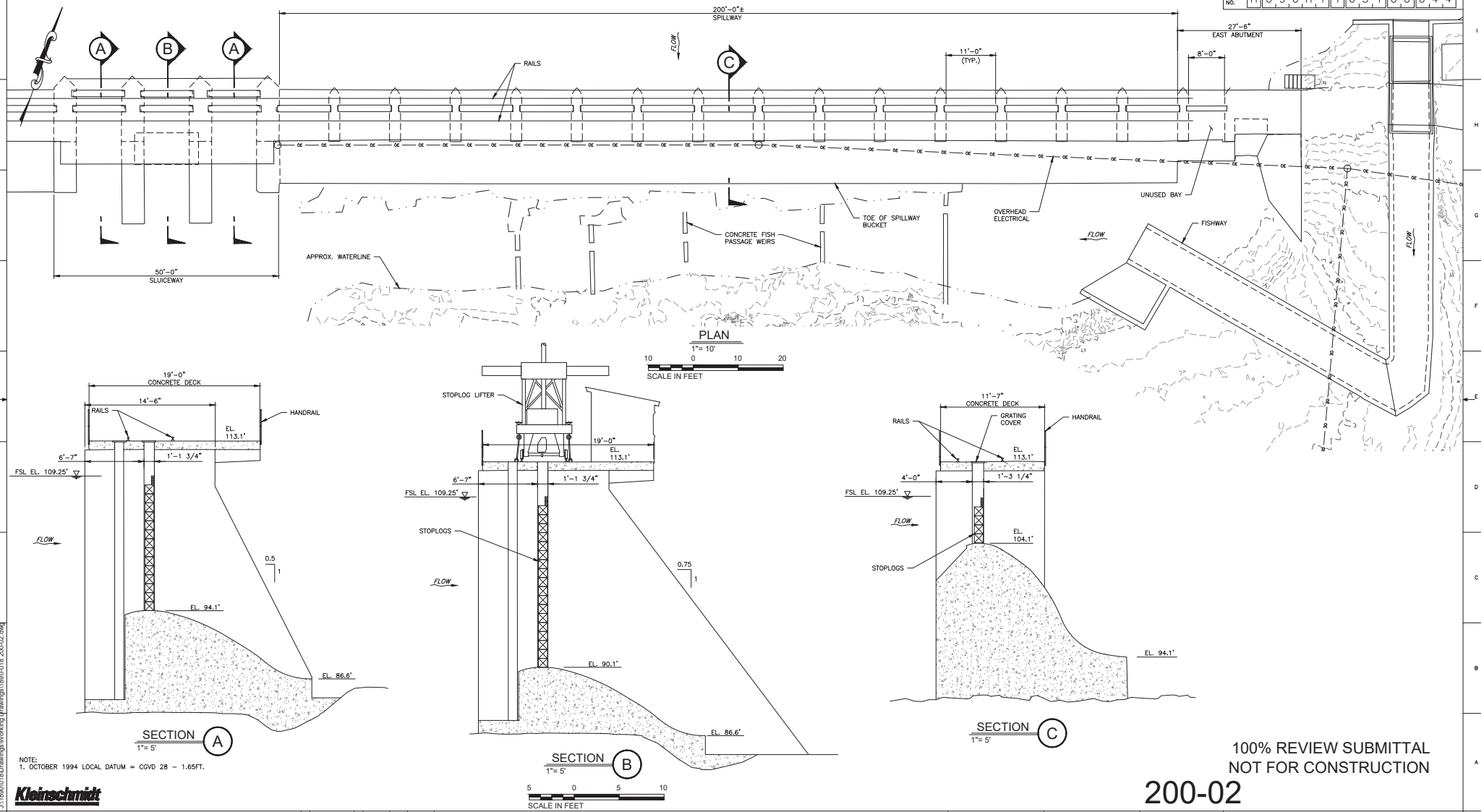
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RUTH FALLS REFURBISHMENT PRJECT

EXISTING CONDITIONS
OVERALL SITE PLAN

DWG.NO. H096H1163100043 REV. E



NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

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RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H	0	9	5	H	1	1	6	7	0	0	0	3	2
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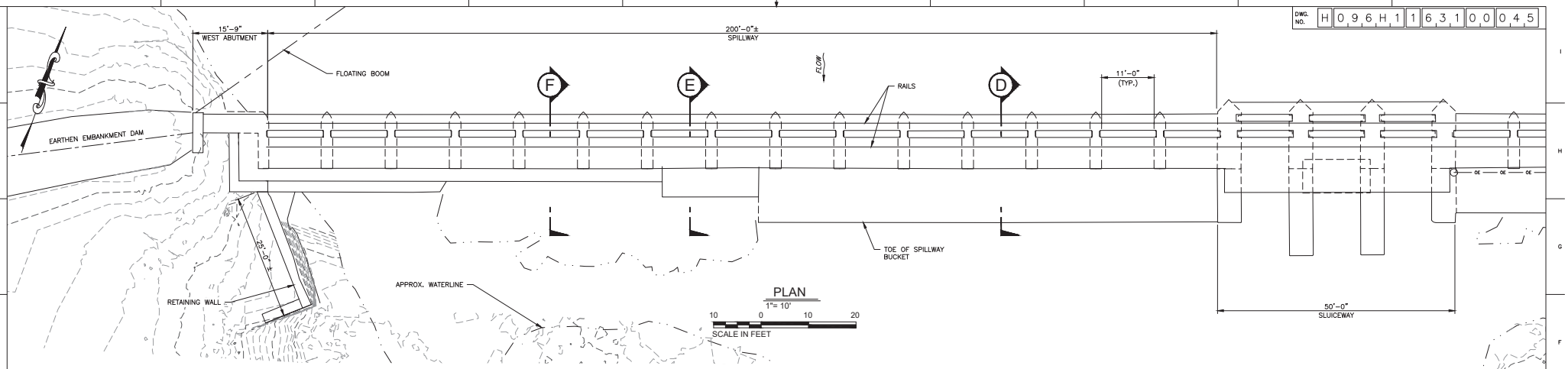
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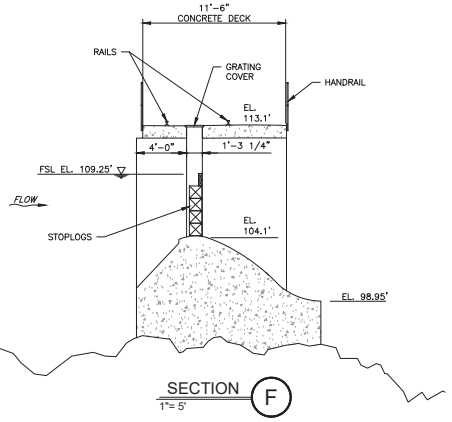
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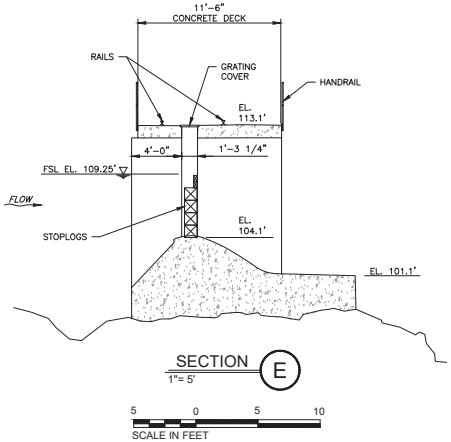
EXISTING CONDITIONS EAST SPILLWAY PLAN AND SECTION

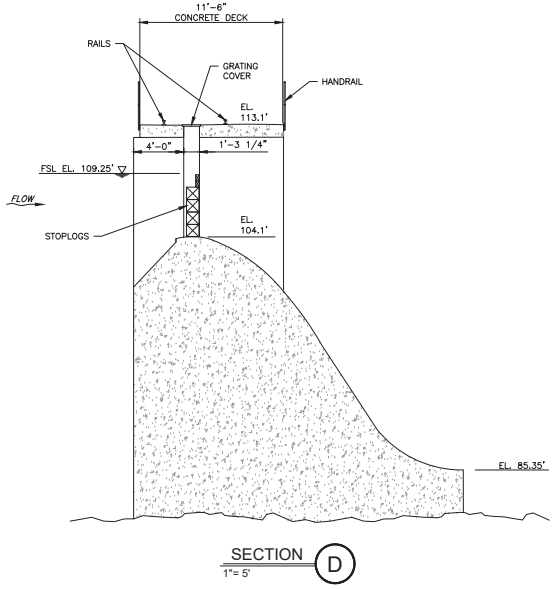
DWG.NO. H096H1163100044 REV. E

PRINTED: May. 26, 2021 - 3:54 PM
J:\1890\018\Drawings\Working Drawings\1890-018-200-02.dwg









NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 - 1.65FT.

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Kleinschmidt

200-03

J:\1890\018\Drawings\Working Drawings\1890-018 200-03.dwg
PRINTED: May. 26, 2021 - 4:28 PM

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REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST
BY:	DATE:				

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2021-05-27
W.O. XXXX

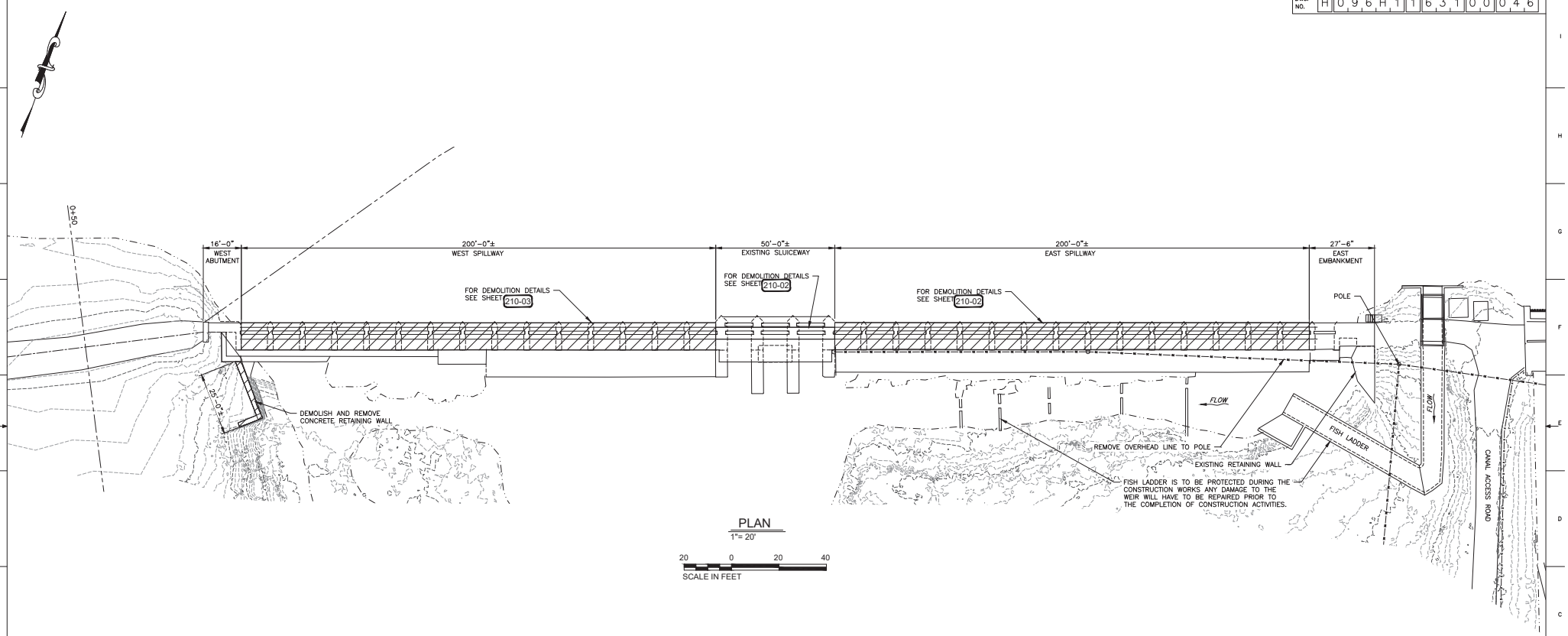
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

EXISTING CONDITIONS WEST SPILLWAY
DAM PLAN AND SECTIONS

DWG.NO. H096H1163100045 REV. E

DWG. NO. H096H1163100046



PLAN
1"= 20'

20 0 20 40
SCALE IN FEET

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

Kleinschmidt

210-01

J:\1890\018\Drawings\Working Drawings\1890-018 210-01.dwg
PLOTTED: May. 26, 2021 - 4:34 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2021-05-27
W.O. XXXX

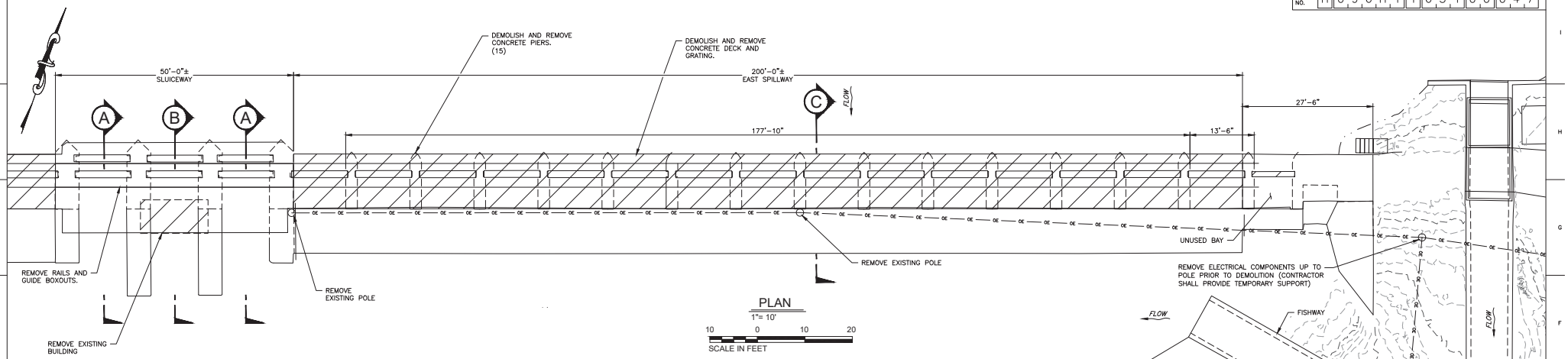
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

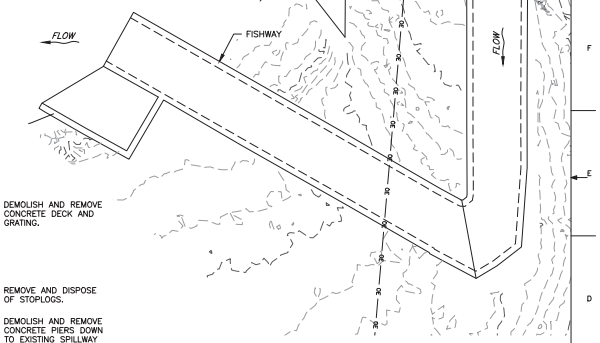
TEMPORARY CONDITIONS/DEMO PLAN

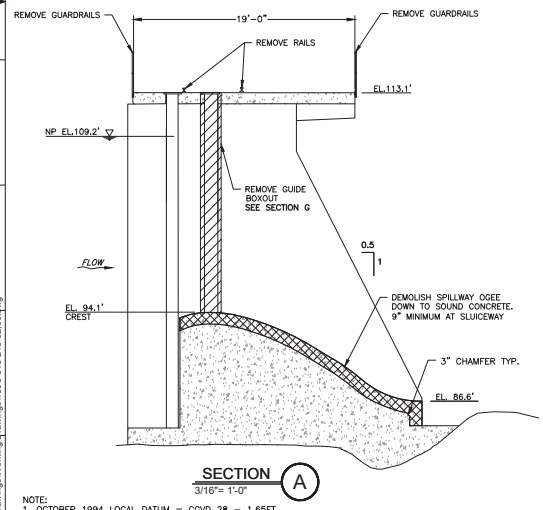
H096H1163100046 REV. E
DWG.NO.

DWG. NO. H096H1163100047

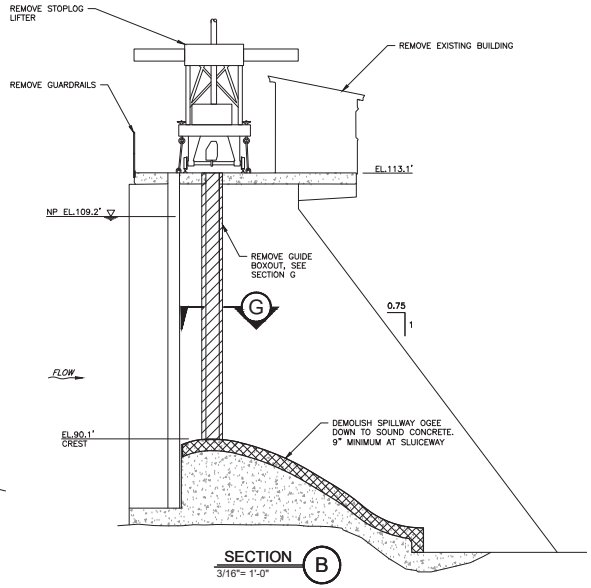


PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

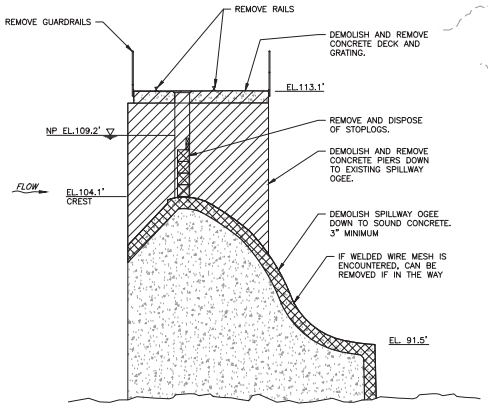




SECTION A
3/16"= 1'-0"

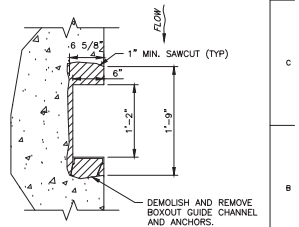


SECTION B
3/16"= 1'-0"



SECTION (TYP EAST SPILLWAY) C
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION (TYP) G
1"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

100% REVIEW SUBMITTAL
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210-02

Kleinschmidt

J:\1890\018\Drawings\Working Drawings\1890-018-210-02-03.dwg
PRINTED: May. 26, 2021 - 4:39 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H	0	9	5	H	1	1	6	7	0	0	0	3	2
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE . .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2021-05-27
W.O.	XXXX

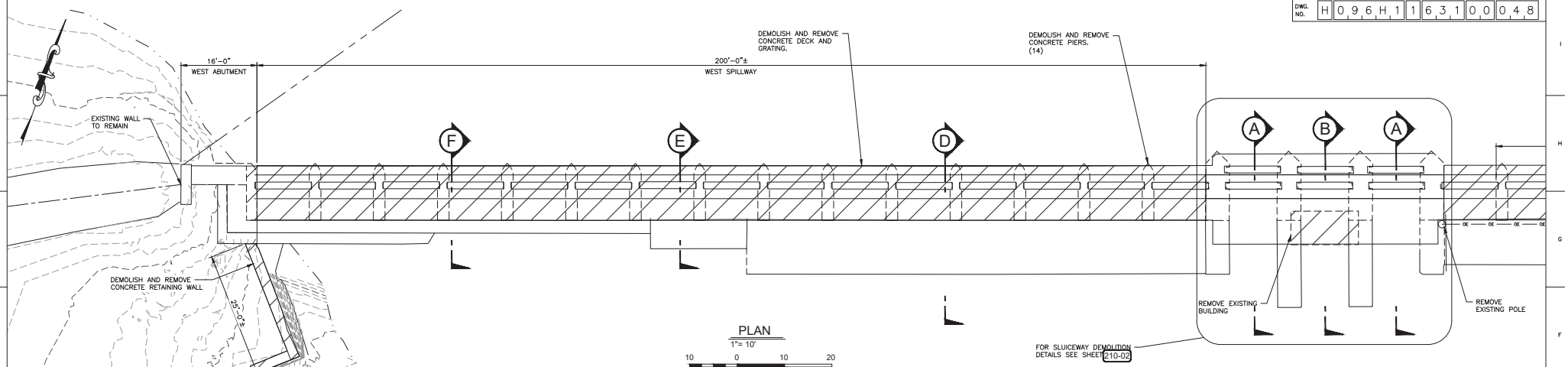
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

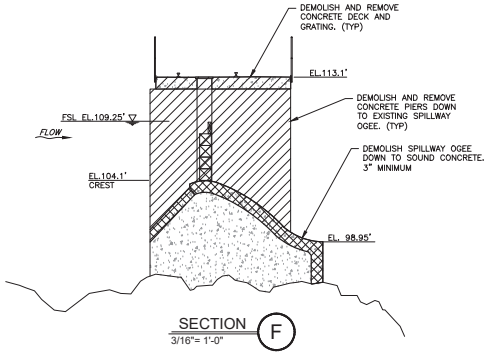
TEMPORARY CONDITIONS/DEMO
EAST SPILLWAY PLAN AND SECTIONS

H 0 9 6 H 1 1 6 3 1 0 0 0 4 7 REV. E
DWG.NO.

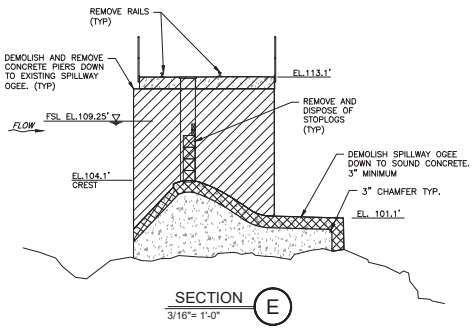
DWG. NO. H096H1163100048



PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

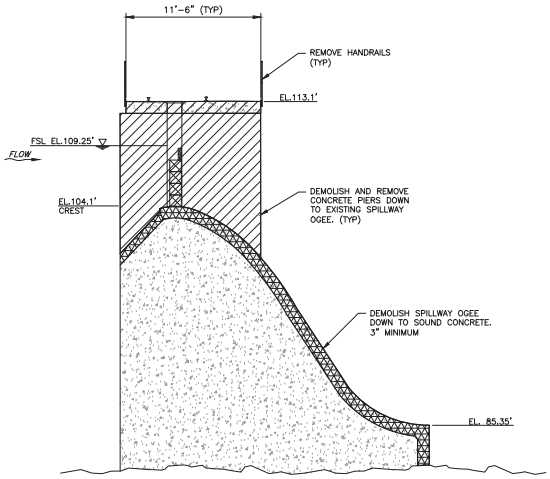


SECTION F
3/16"= 1'-0"



SECTION E
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION D
3/16"= 1'-0"

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

Kleinschmidt

210-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST
BY:	DATE:				

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED
DATE

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2021-05-27
W.O.	XXXX

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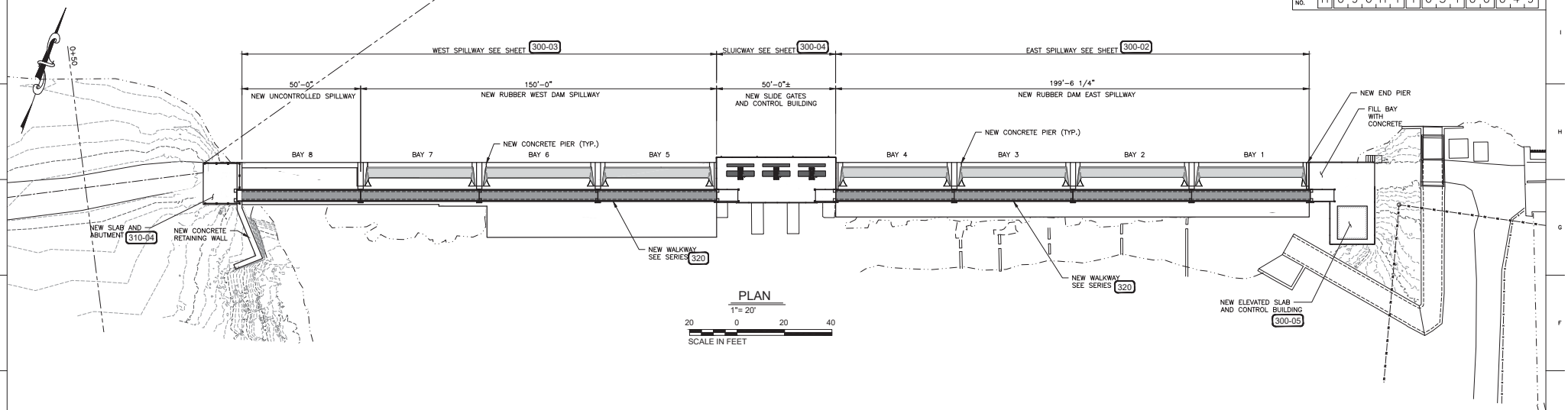
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
WEST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100048 REV. E

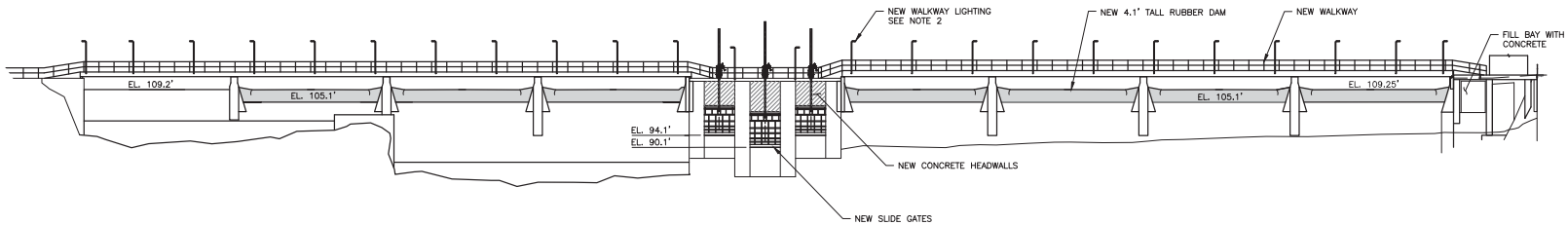
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DWG. NO. H096H1163100049



PLAN
1"= 20'

20 0 20 40
SCALE IN FEET



ELEVATION
1"= 20'

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

2. LED LUMINAIRE MOUNTED TO A SWIVEL POLE– 5,300 LUMENS, TYPE 1 OPTIC, MULTIVOLT DRIVER, WARM (3000K) COLOR TEMP. LIGHT TO BE MOUNTED 10' ABOVE WALKWAY AND SPACED AT 20'. WIRING AND CONDUIT RESPONSIBILITY OF CONTRACTOR.

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-01

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST
BY:	DATE:				

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———
MECH ——— CONST ———

APPROVED

DATE , ,

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED ——
CHECKED ——
DATE 2021-05-27
W.O. XXXX

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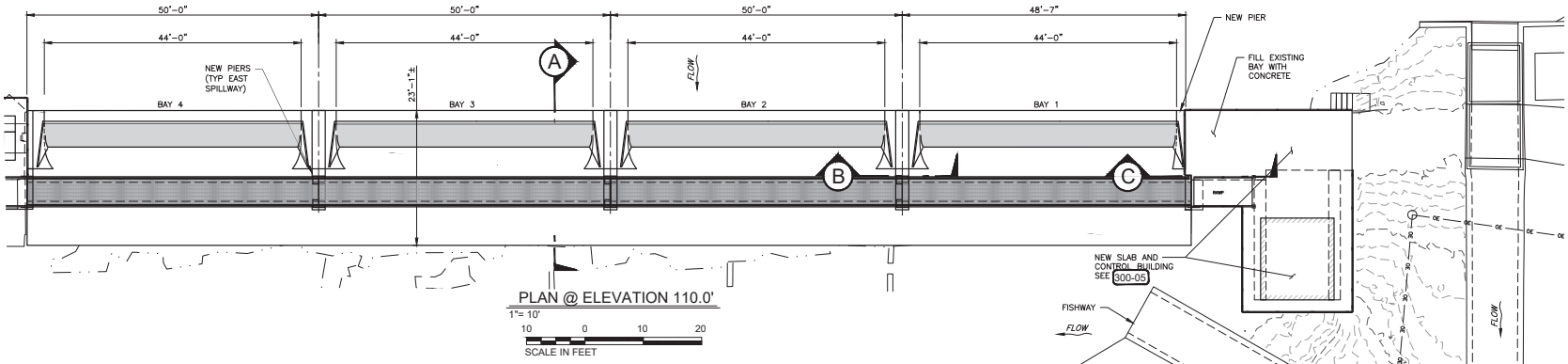
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
DAM PLAN AND ELEVATION

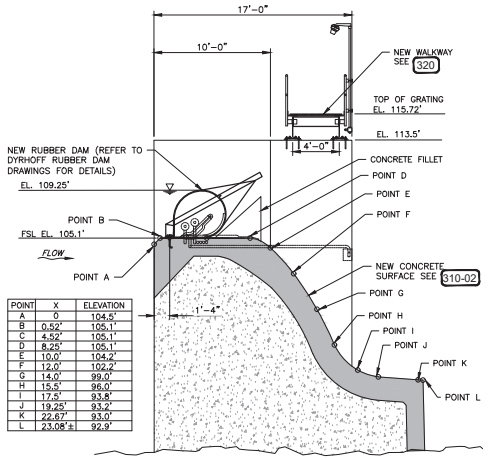
DWG.NO. H096H1163100049 REV. E

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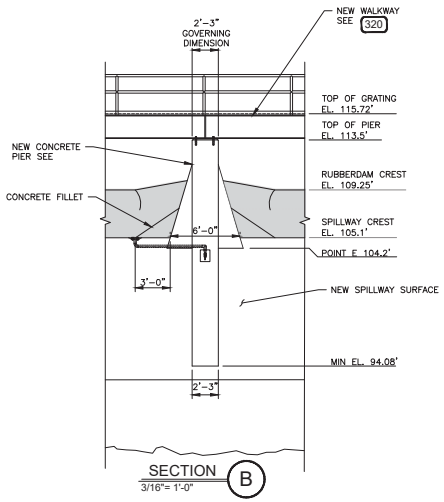
DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 0



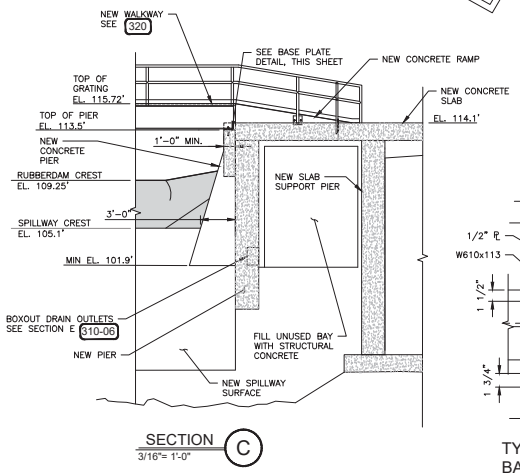
PLAN @ ELEVATION 110.0'
1"= 10'
SCALE IN FEET



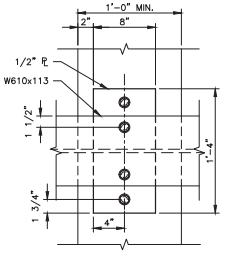
SECTION A
3/16"= 1'-0"
SCALE IN FEET



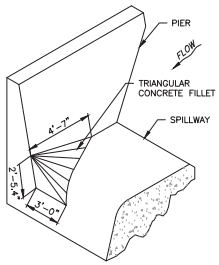
SECTION B
3/16"= 1'-0"



SECTION C
3/16"= 1'-0"



TYPICAL END PIER BASE PLATE DETAIL
1 1/2"= 1'-0"



TRIANGULAR CONCRETE FILLET DETAIL
N.T.S.

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST
BY:	DATE:				

DEPARTMENTAL APPROVALS

CIVIL		E & I	
MECH		CONST	

APPROVED
DATE

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2021-05-27
W.O.	XXXX

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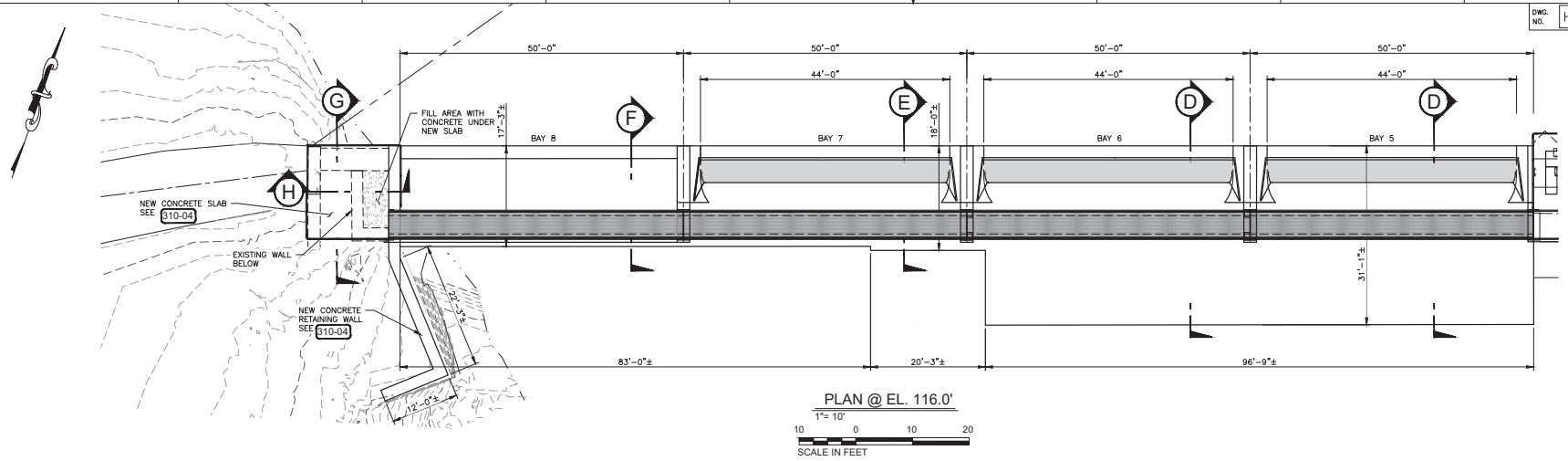
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
EAST SPILLWAY PLAN AND SECTIONS

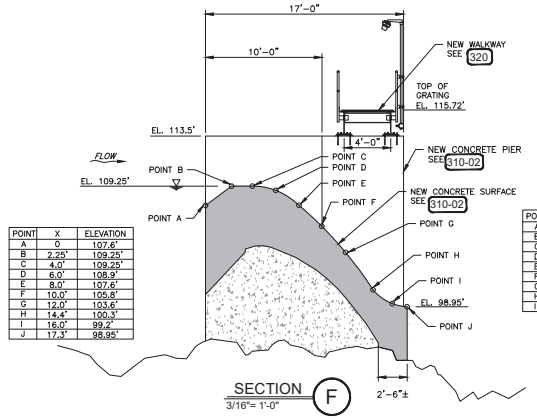
DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 0 REV. E

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DWG. NO. H096H1163100051

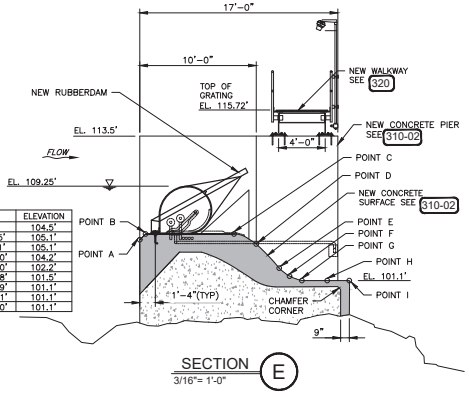


PLAN @ EL. 116.0'
1"= 10'
SCALE IN FEET



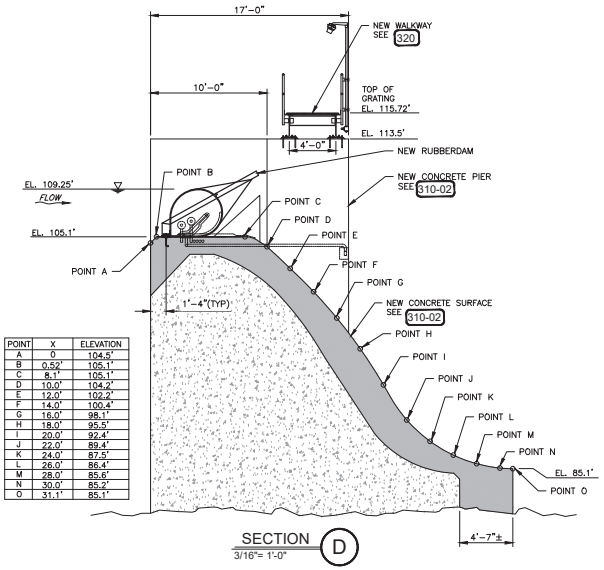
POINT	X	ELEVATION
A	0	107.6'
B	2.25'	109.25'
C	4.0'	109.25'
D	6.0'	108.9'
E	8.0'	107.6'
F	10.0'	105.8'
G	12.0'	103.6'
H	14.4'	100.3'
I	16.0'	99.2'
J	17.3'	98.95'

SECTION F
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.5'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	12.8'	101.5'
G	13.9'	101.1'
H	16.1'	101.1'
I	18.0'	101.1'

SECTION E
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	14.0'	100.4'
G	16.0'	98.1'
H	18.0'	95.5'
I	20.0'	92.4'
J	22.0'	89.4'
K	24.0'	87.5'
L	26.0'	86.4'
M	28.0'	85.6'
N	30.0'	85.2'
O	31.1'	85.1'

SECTION D
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

300-03

Kleinschmidt

J:\18900\018\Drawings\Working Drawings\18900-018 300-02,03,04.dwg
PLOTTED: May. 27, 2021 - 2:12 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED ——
CHECKED ——
DATE 2021-05-27
W.O. XXXX

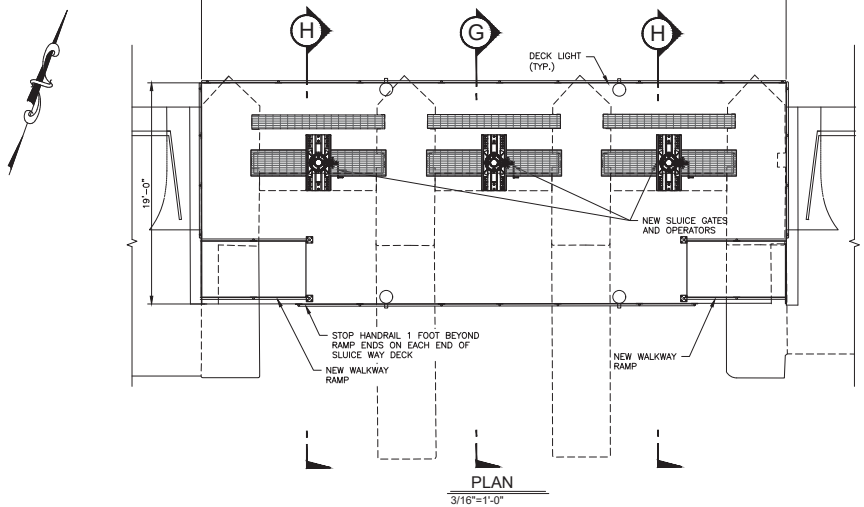
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

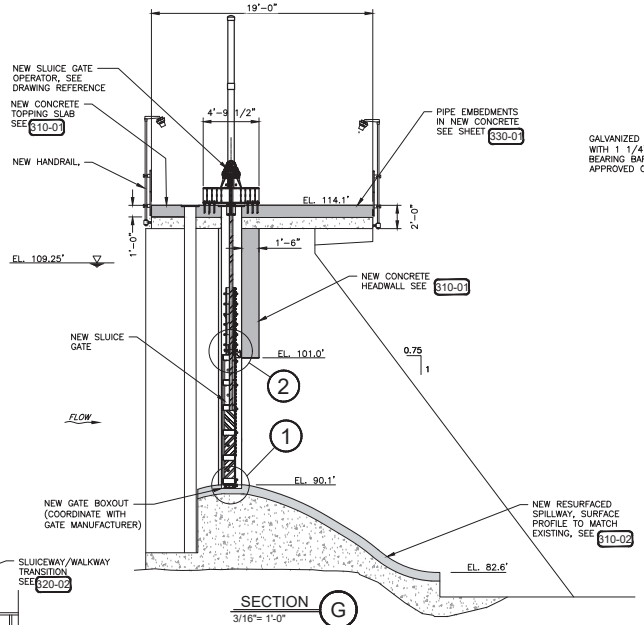
NEW CONDITIONS
WEST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100051 REV. E

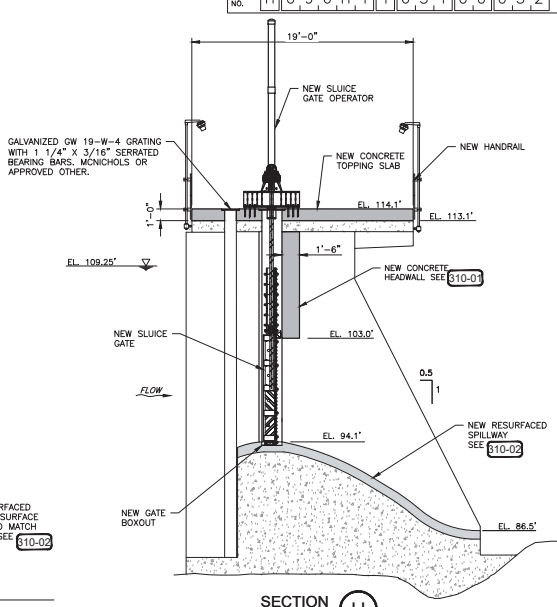
DWG. NO. H096H1163100052



PLAN
3/16"=1'-0"

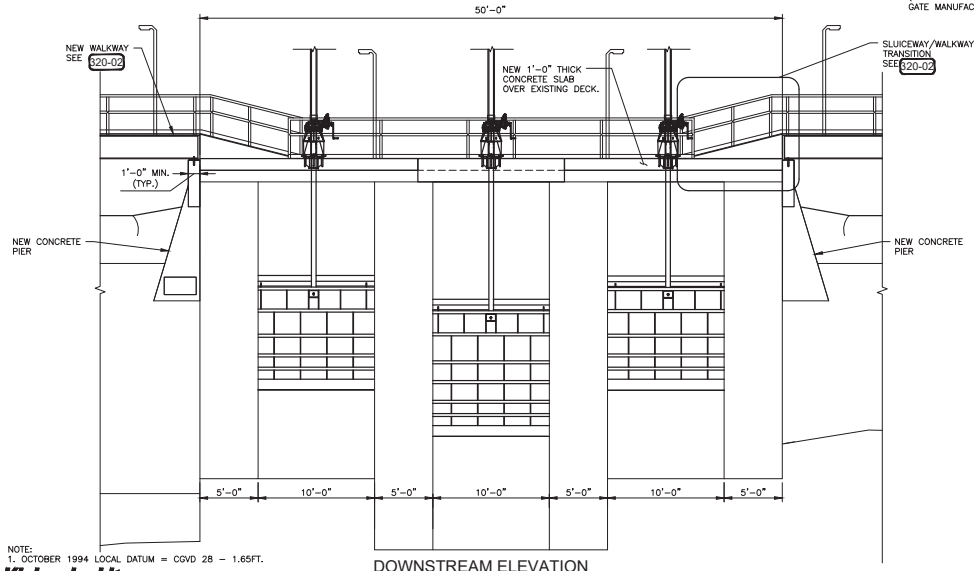


SECTION G
3/16"= 1'-0"



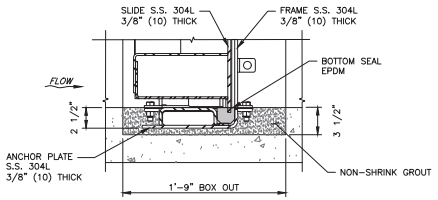
SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



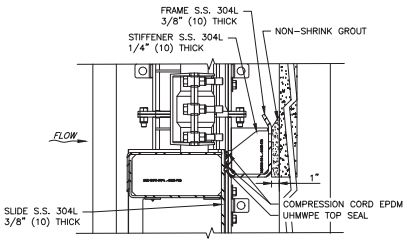
NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

DOWNSTREAM ELEVATION
3/16"=1'-0"



DETAIL 1
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES



DETAIL 2
1 1/2"= 1'-0"

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

300-04

Kleinschmidt

J:\18900\018\Drawings\Working Drawings\18900-018 300-02,03,04.dwg
PRINTED May. 27, 2021 - 2:40 PM

REFERENCE DESCRIPTION	A
STANDARD GUARD SYSTEMS DETAILS	H001H016900001
FONTAINE AQUANOX DWG NO. D15542-01-204P2X120107BFE/CW22	
REFERENCE DRAWINGS	DWG.NO.

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL		E & I	
MECH		CONST	

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2021-05-27
W.O.	XXXX

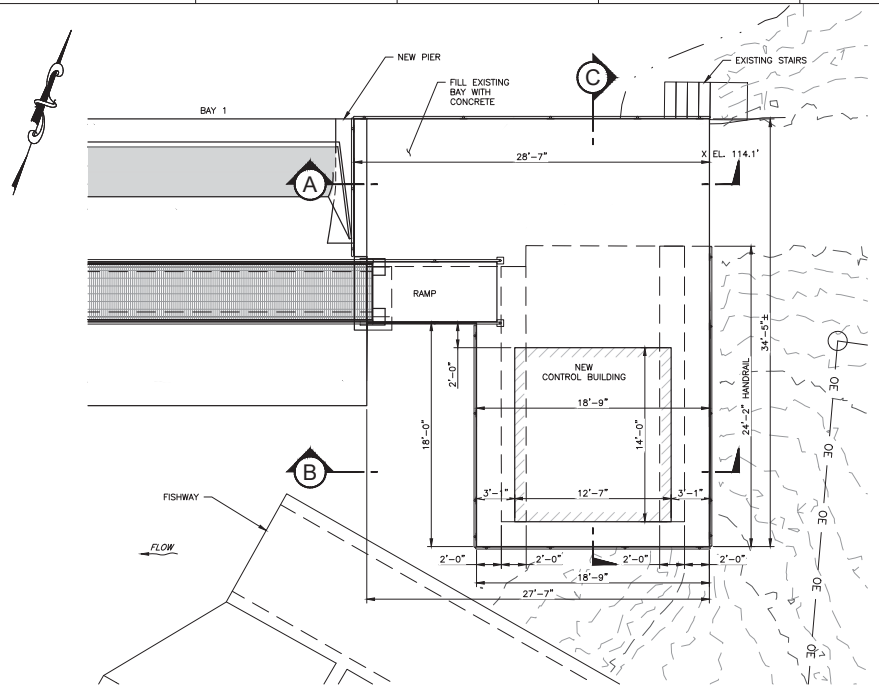
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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
SLUICEWAY PLAN AND DETAILS

DWG.NO. H096H1163100052 REV. E

DWG. NO. H096H116310006 1

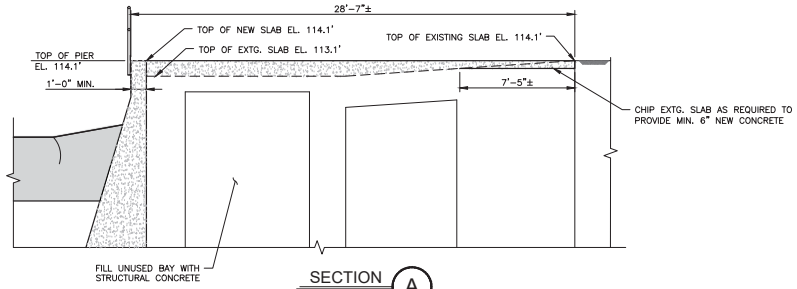


PLAN - EAST ABUTMENT EL. 116.0

1"= 5'

5 0 5 10

SCALE IN FEET

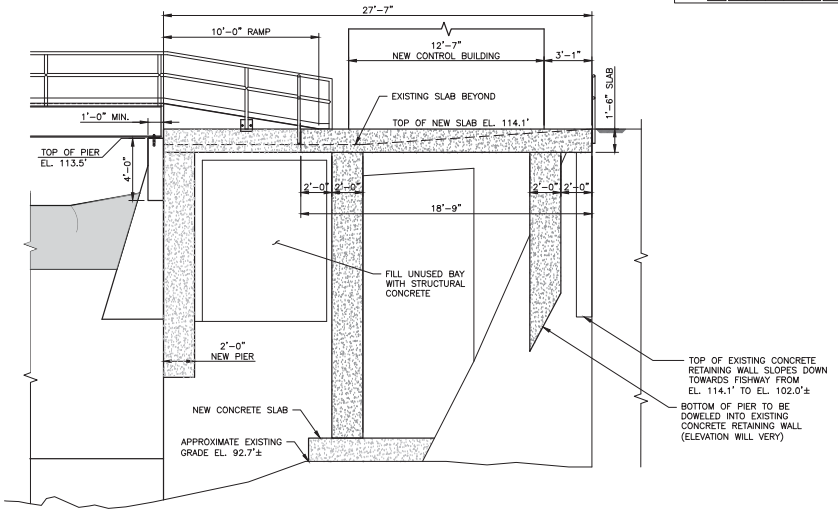


SECTION A

1/4"= 1'-0"

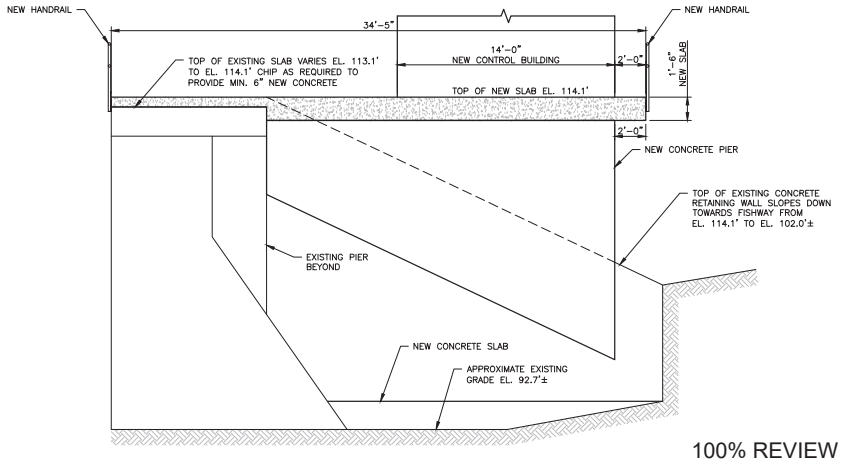
4 0 4 8

SCALE IN FEET



SECTION B

1/4"= 1'-0"



SECTION C

1/4"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

Kleinschmidt

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NOT FOR CONSTRUCTION

300-05

J:\1890\018\Drawings\Working Drawings\1890-018 300-05 Building Slab & Piers.dwg

PRINTED: May. 27, 2021 - 3:44 PM

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REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	JFB
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DATE	2021-05-27
W.O.	XXXX

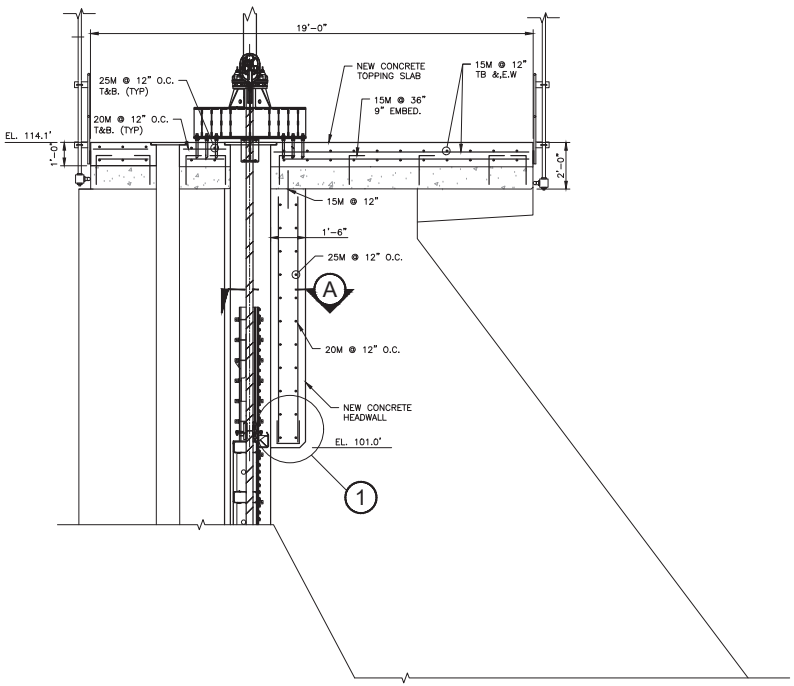
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
EAST ABUTMENT PLAN AND SECTIONS

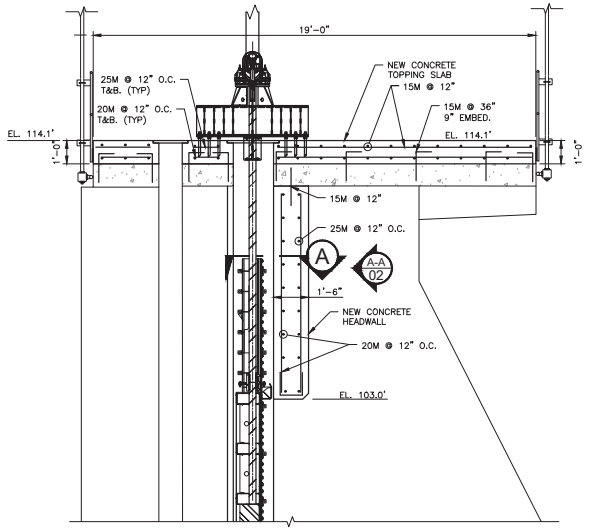
DWG.NO. H096H116310006 REV. B



INNER SLUICEWAY DETAIL

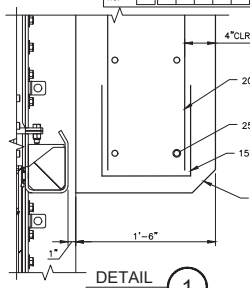
3/8"= 1'-0"

SCALE IN FEET



OUTER SLUICEWAY DETAIL

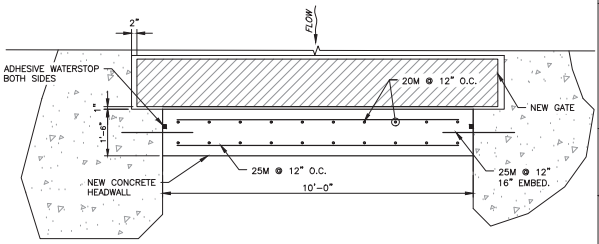
3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

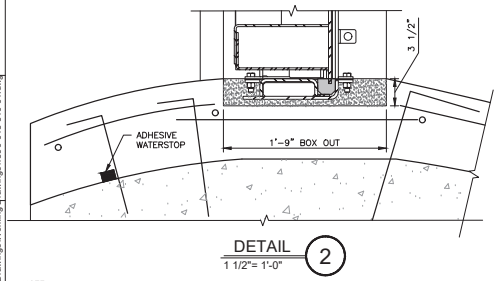
SCALE IN INCHES



SECTION A

1/2"= 1'-0"

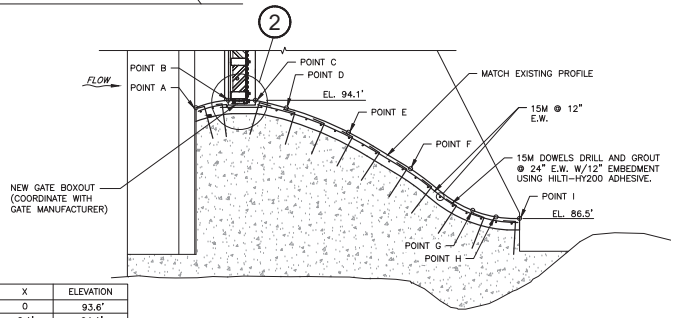
SCALE IN FEET



DETAIL 2

1 1/2"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

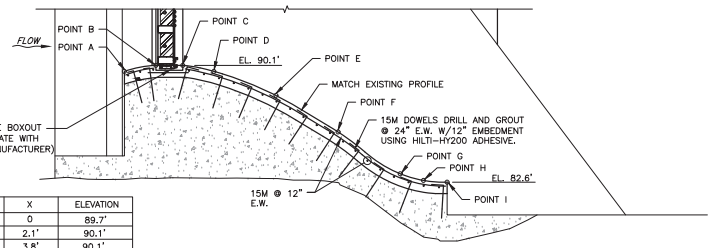


POINT	X	ELEVATION
A	0	93.6'
B	2.1'	94.1'
C	3.8'	94.1'
D	5.8'	93.6'
E	9.8'	92.0'
F	13.8'	89.7'
G	17.8'	87.0'
H	19.3'	86.6'
I	20.8'	86.5'

OUTSIDE SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

SCALE IN FEET



POINT	X	ELEVATION
A	0	89.7'
B	2.1'	90.1'
C	3.8'	90.1'
D	5.8'	89.7'
E	9.8'	88.2'
F	13.8'	85.8'
G	17.8'	83.1'
H	19.3'	82.7'
I	20.8'	82.6'

INNER SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

310-01

Kleinschmidt

J:\1890\018\Drawings\Working Drawings\1890-018 310-01.dwg

PRINTED: May. 27, 2021 - 12:20 PM

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SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2021-05-27

W.O. XXXX

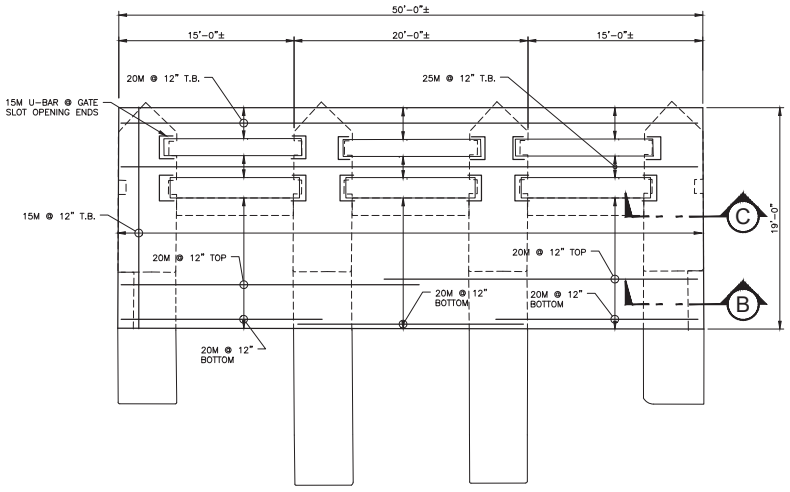
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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

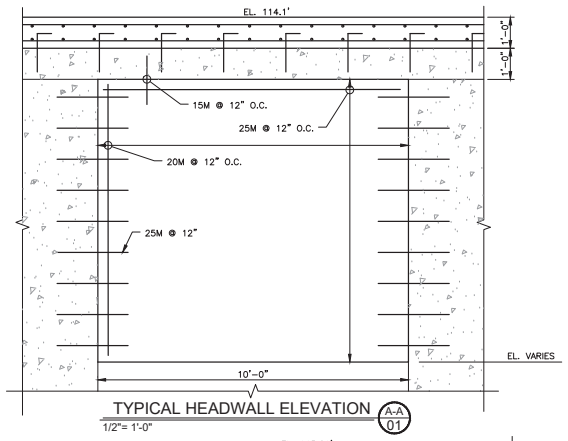
DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 3 REV. E



SLUICEWAY DECK REBAR PLAN

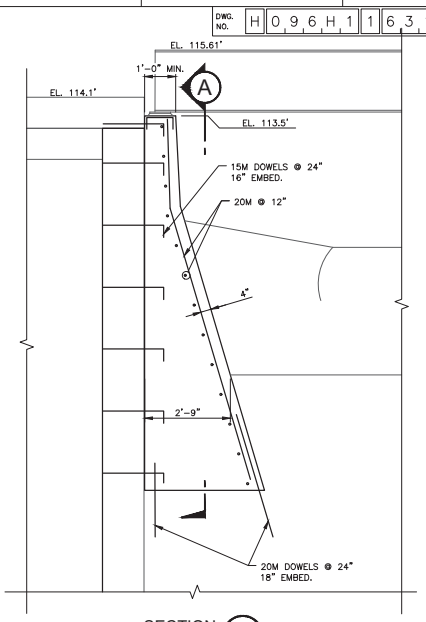
3/16"= 1'-0"

SCALE IN FEET



TYPICAL HEADWALL ELEVATION A-A 01

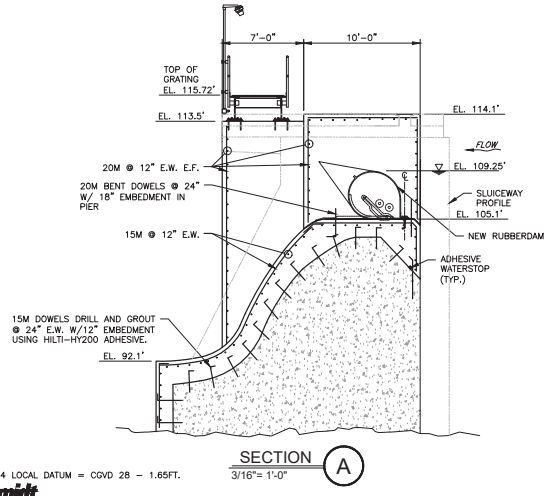
1/2"= 1'-0"



SECTION C

1/2"= 1'-0"

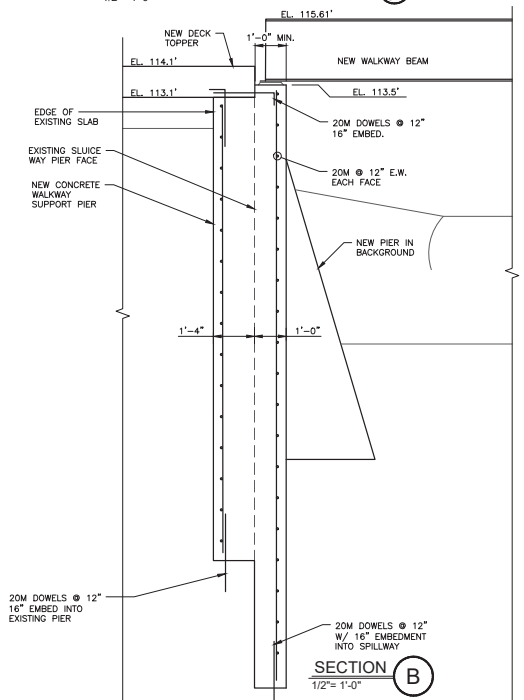
SCALE IN FEET



SECTION A

3/16"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.



SECTION B

1/2"= 1'-0"

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310-02

Kleinschmidt

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SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED ——
CHECKED ——
DATE 2021-05-27
W.O. XXXX

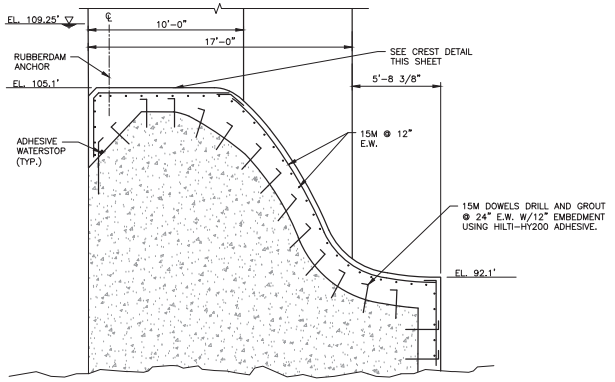
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE
SLUICEWAY HEADWALL AND DECK DETAILS

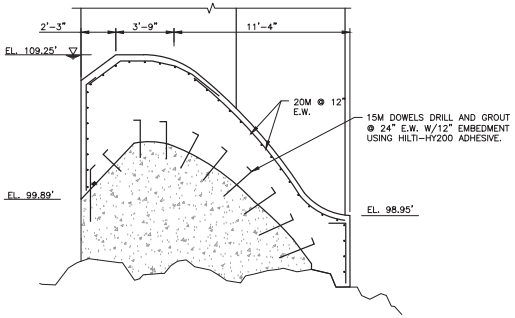
DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 4 REV. E

DWG. NO. H096H1163100055



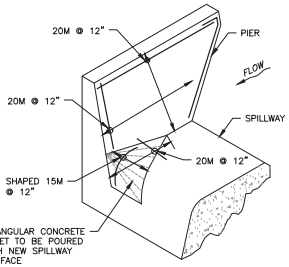
EAST SPILLWAY TYPICAL DETAIL (BAYS 1-4)

1/4"= 1'-0"



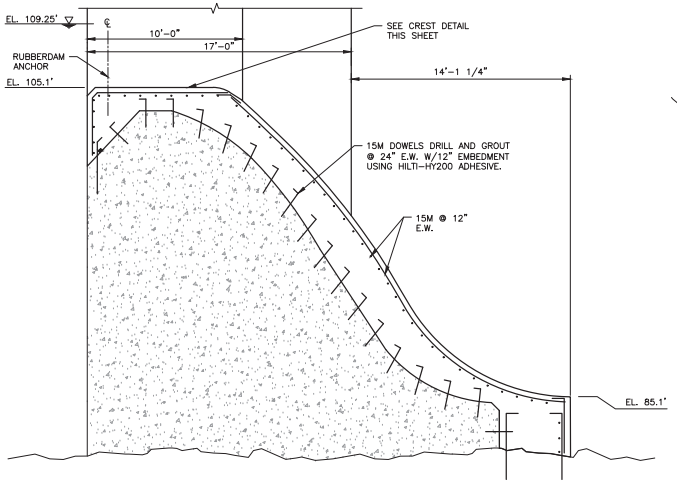
UNCONTROLLED SPILLWAY DETAIL (BAY 8)

1/4"= 1'-0"



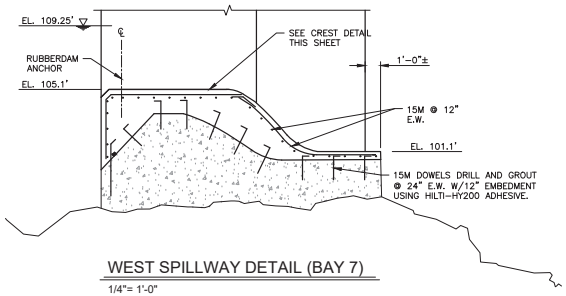
TRIANGULAR CONCRETE FILLET DETAIL

N.T.S.



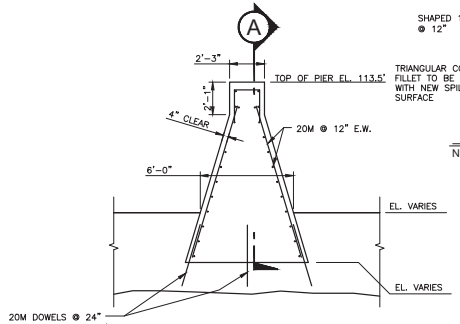
WEST SPILLWAY TYPICAL DETAIL (BAYS 6&5)

1/4"= 1'-0"



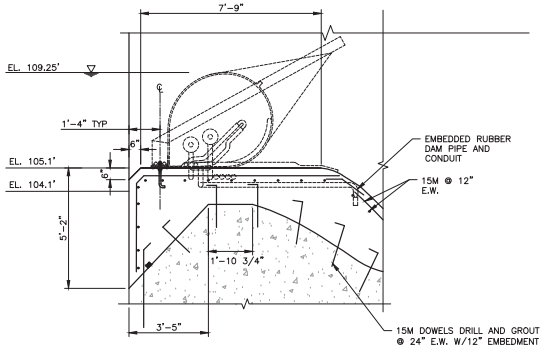
WEST SPILLWAY DETAIL (BAY 7)

1/4"= 1'-0"



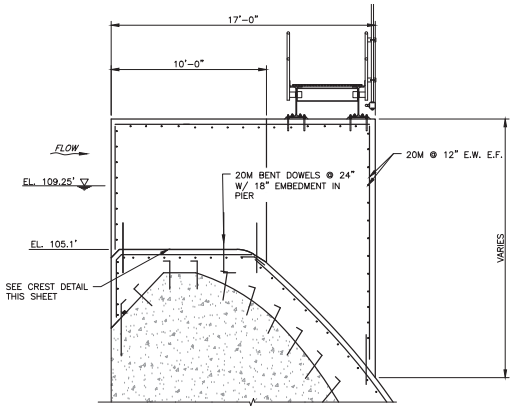
TYPICAL PIER DETAIL

1/4"= 1'-0"



RUBBERDAM CREST TYPICAL

3/8"= 1'-0"



TYPICAL PIER SECTION (A)

1/4"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

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310-03

Kleinschmidt

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PRINTED: May. 27, 2021 - 12:32 PM

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REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED

CHECKED

DATE 2021-05-27

W.O. XXXX

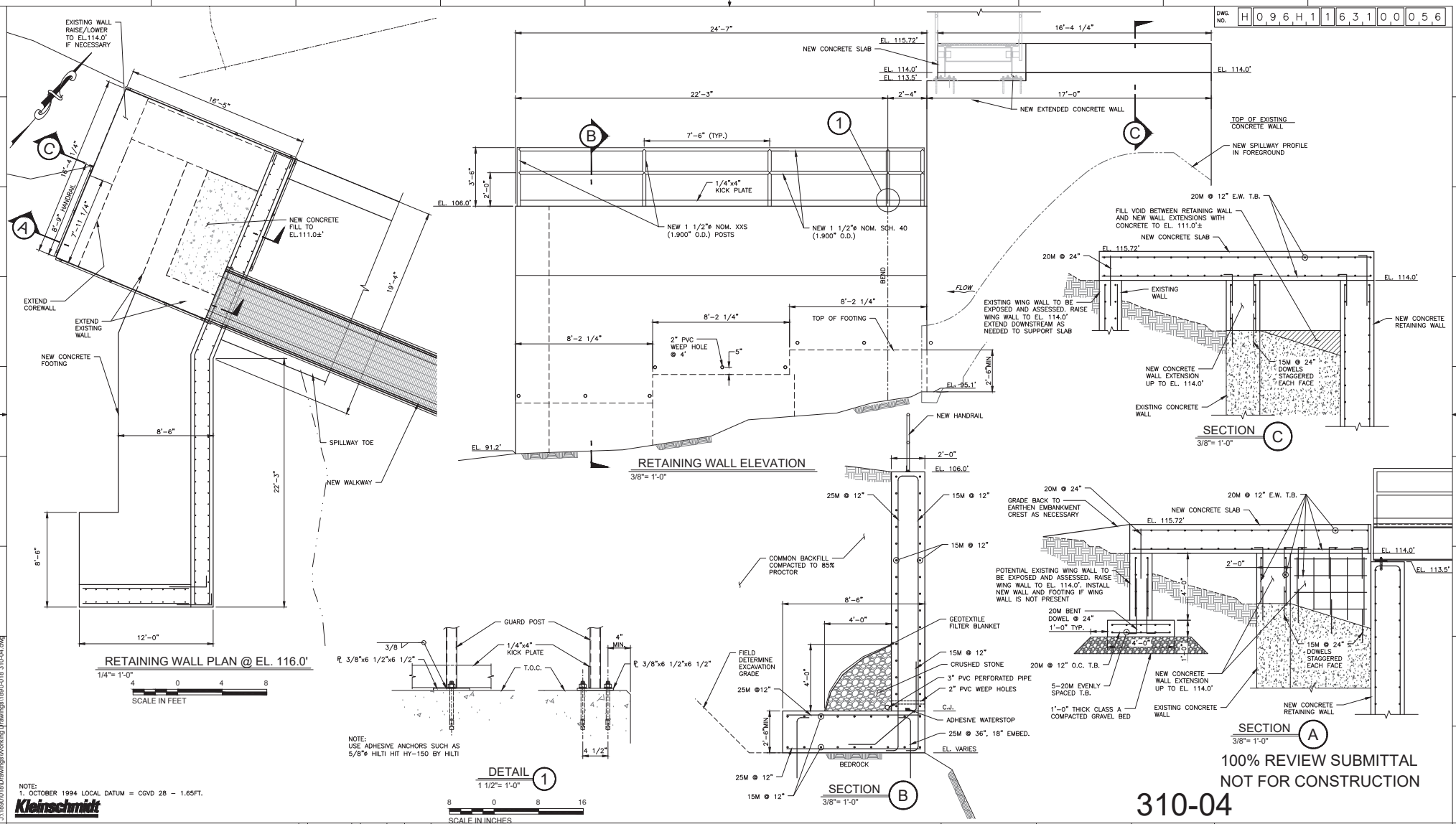
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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SPILLWAY RESURFACING DETAILS

DWG.NO. H096H1163100055 REV. E



NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

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310-04

Kleinschmidt

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
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DESIGNED	CMV
DRAWN	ZJA
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W.O.	XXXX

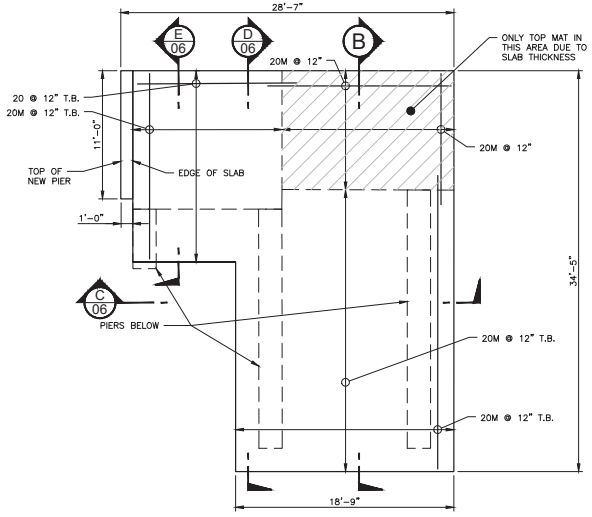
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE RETAINING WALL AND PIER DETAILS

DWG.NO. H096H1163100056 REV. E

PRINTED: May. 27, 2021 - 3:30 PM
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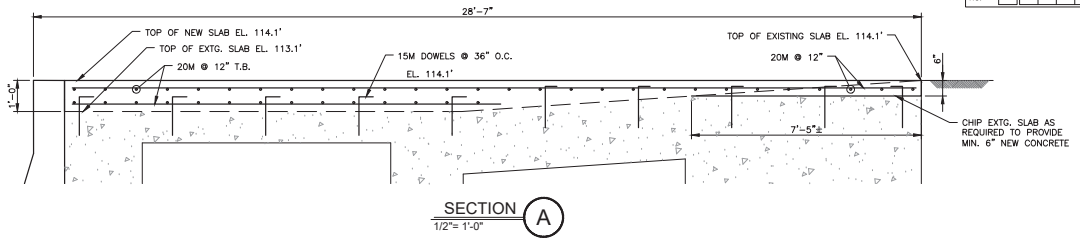


EAST ABUTMENT REBAR PLAN

3/16"= 1'-0"

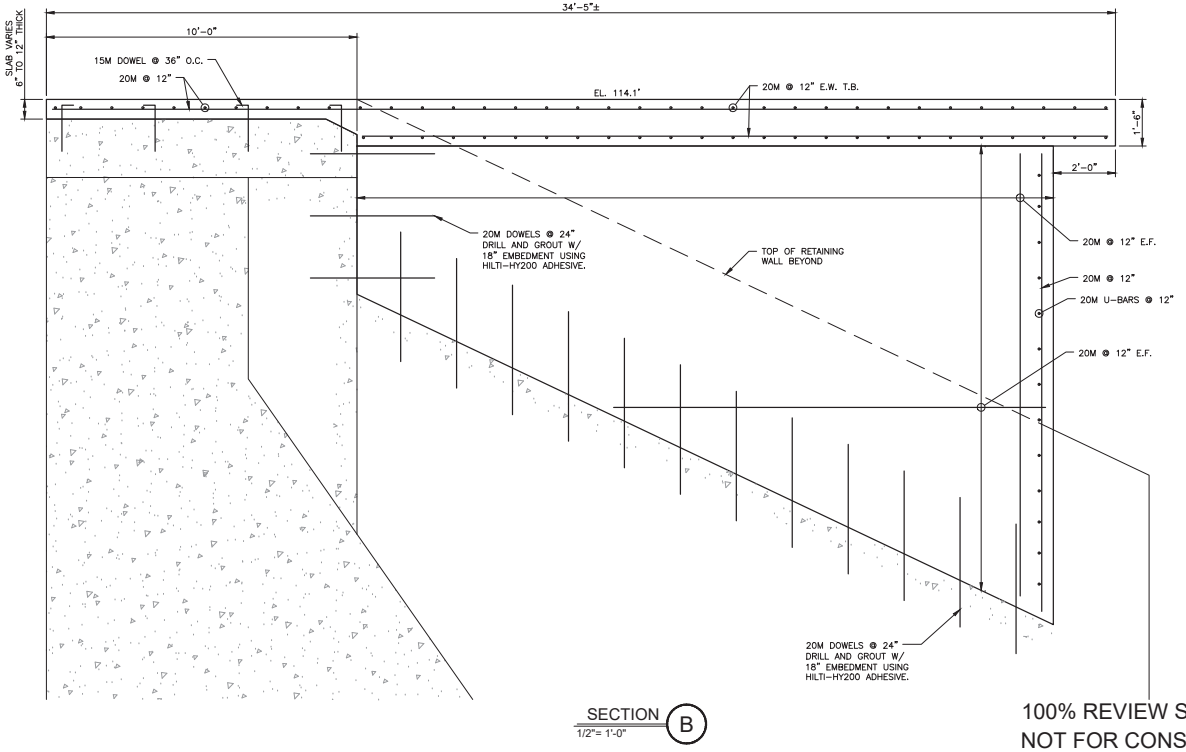
4 0 4 8 12

SCALE IN FEET



SECTION A

1/2"= 1'-0"



SECTION B

1/2"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

100% REVIEW SUBMITTAL
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310-05

Kleinschmidt

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN JFB

CHECKED __

CHECKED __

DATE 2021-05-27

W.O. XXXX

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RUTH FALLS

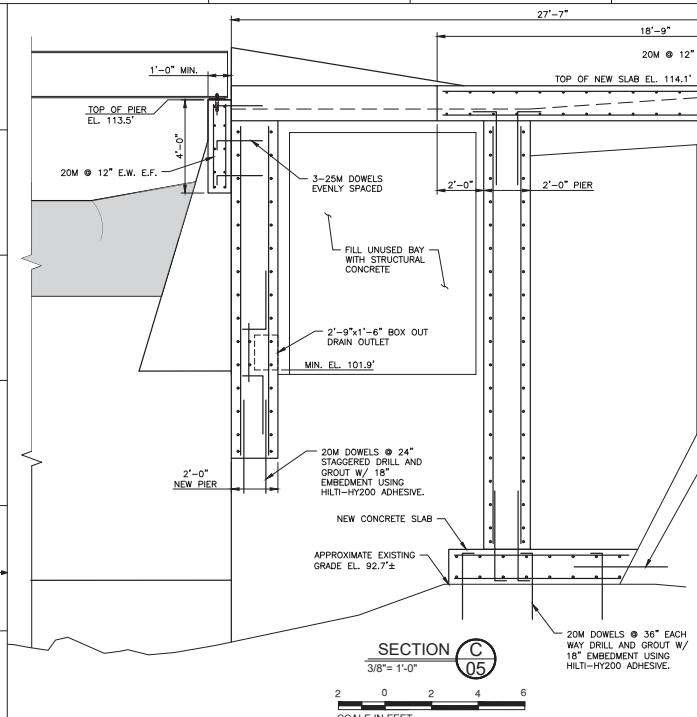
RUTH FALLS REFURBISHMENT PROJECT

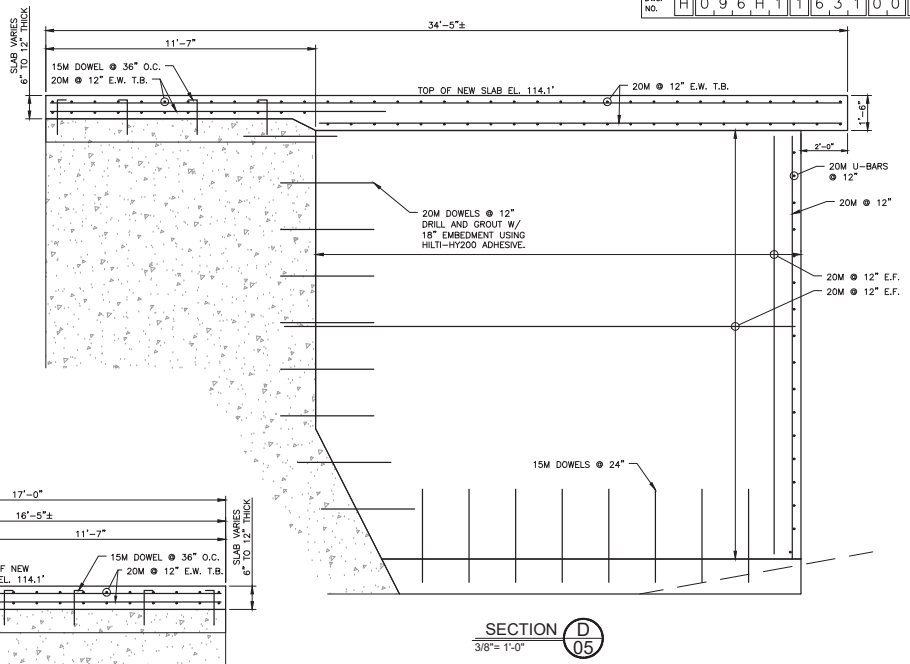
NEW CONCRETE
EAST ABUTMENT PIER & DECK DETAILS

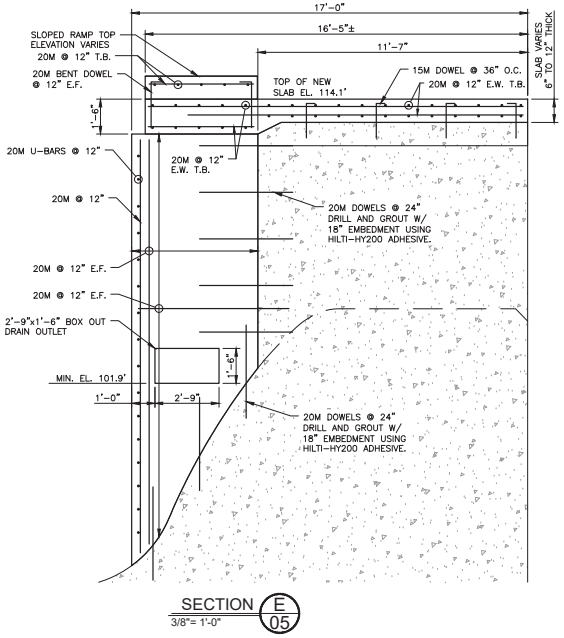
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PRINTED: May. 27, 2021 - 3:55 PM

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NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 - 1.65FT.

Kleinschmidt

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NOT FOR CONSTRUCTION

310-06

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 6 3

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.														

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	-----	E & I	-----
MECH	-----	CONST	-----

APPROVED

DATE . .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	JFB
CHECKED	--
CHECKED	--
DATE	2021-05-27
W.O.	XXXX

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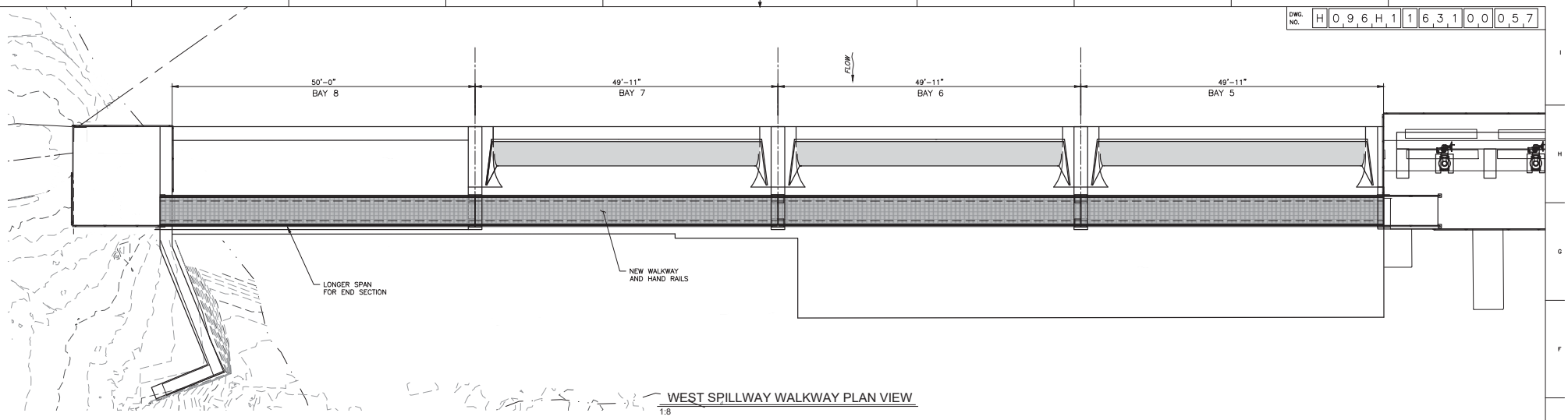
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE
EAST ABUTMENT PIERS & DECK DETAILS

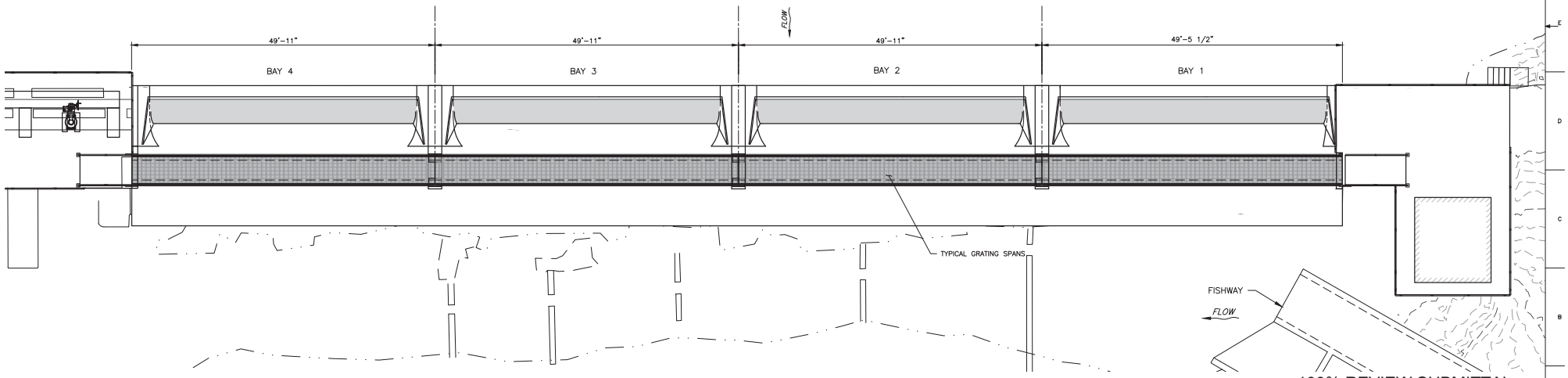
DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 6 3 REV. B

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DWG. NO. H096H116310005 7



WEST SPILLWAY WALKWAY PLAN VIEW
1:8



EAST SPILLWAY WALKWAY PLAN VIEW
1:8

8 0 8 16
SCALE IN FEET

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

Kleinschmidt

320-01

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PRINTED: May. 27, 2021 - 2:18 PM

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REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

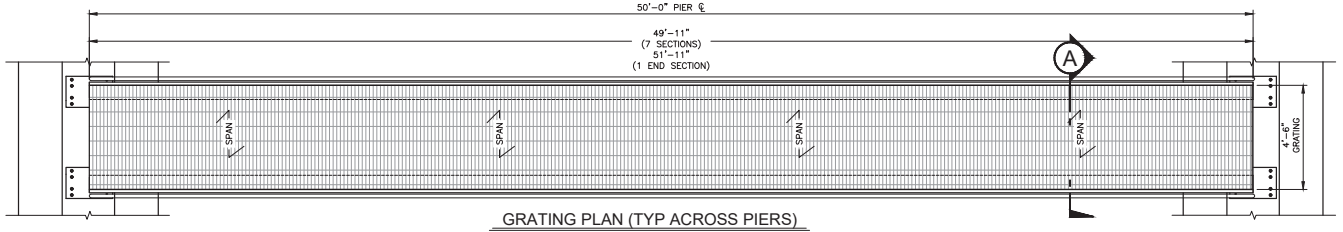
DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED ——
CHECKED ——
DATE 2021-05-27
W.O. XXXX

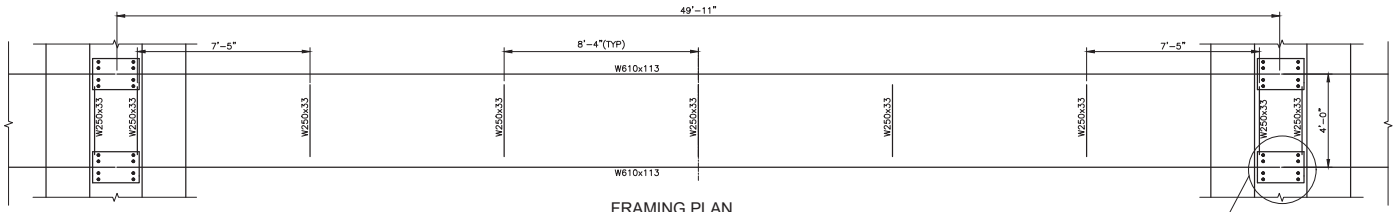
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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW STEEL WALKWAY PLAN VIEW

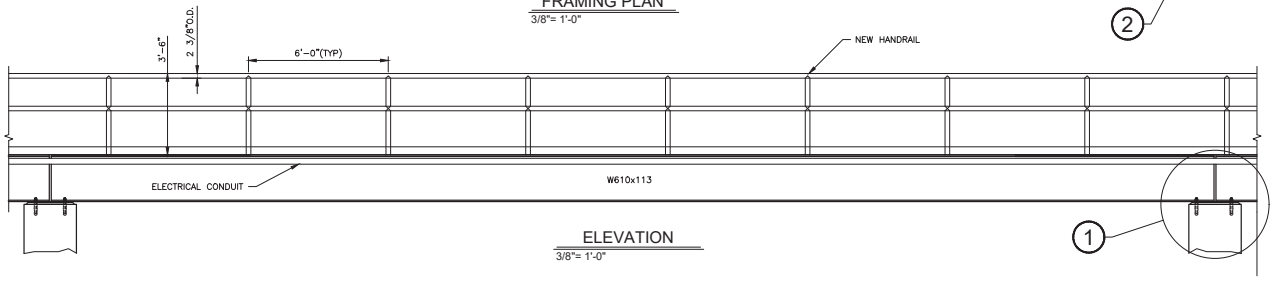
DWG.NO. H096H116310005 REV. E



GRATING PLAN (TYP ACROSS PIERS)
3/8"= 1'-0"

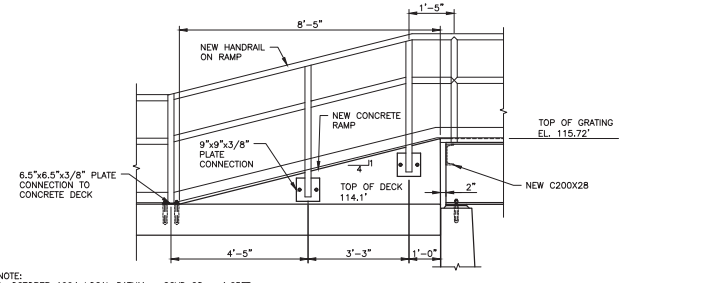


FRAMING PLAN
3/8"= 1'-0"



ELEVATION
3/8"= 1'-0"

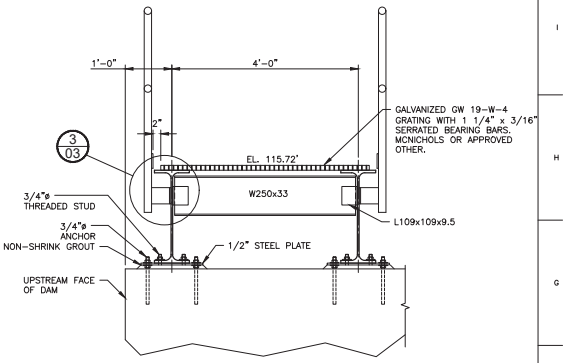
2 0 2 4 6
SCALE IN FEET



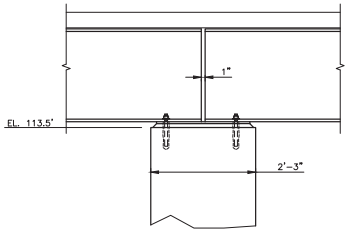
NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 - 1.65FT.

SLUICEWAY/WALKWAY TRANSITION DETAIL
1/2"= 1'-0"

2 0 2 4
SCALE IN FEET

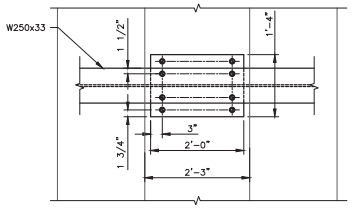


SECTION A
3/4"= 1'-0"



DETAIL 1
3/4"= 1'-0"

1 0 1 2 3
SCALE IN FEET



DETAIL 2
3/4"= 1'-0"

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

320-02

Kleinschmidt

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	0	1
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL ____ E & I ____
MECH ____ CONST ____

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2021-05-27
W.O. XXXX

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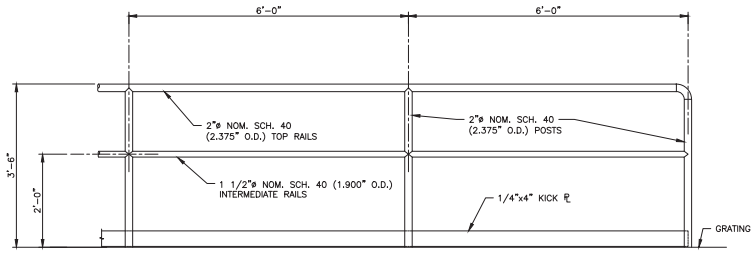
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW STEEL
WALKWAY

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 8 REV. E

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DWG. NO. H096H1163100059

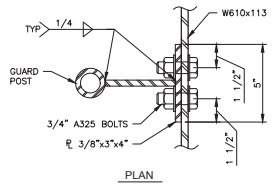


STEEL WALKWAY TYPICAL HANDRAIL DETAIL

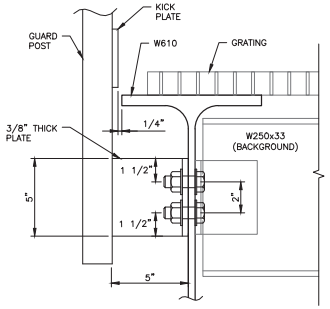
3/4"= 1'-0"

1 0 1 2 3

SCALE IN FEET



PLAN



DETAIL 3/02

3"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

320-03

Kleinschmidt

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REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	1
REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———
MECH ——— CONST ———

APPROVED

DATE , ,

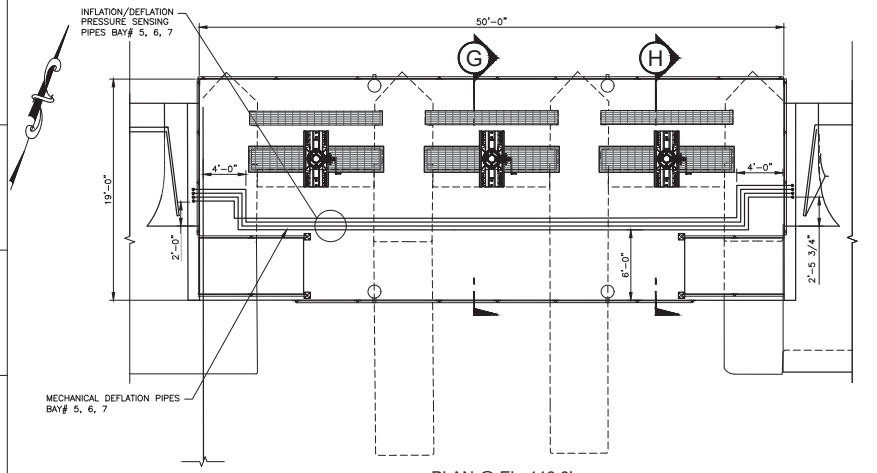
SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2021-05-27
W.O. XXXX

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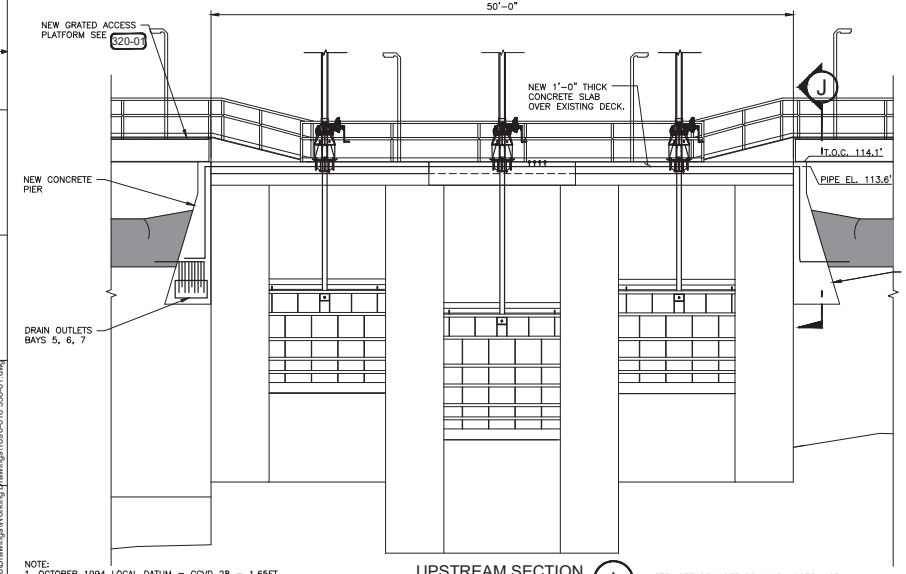
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW STEEL WALKWAY
HANDRAIL DETAILS

DWG.NO. H096H1163100059 REV. E



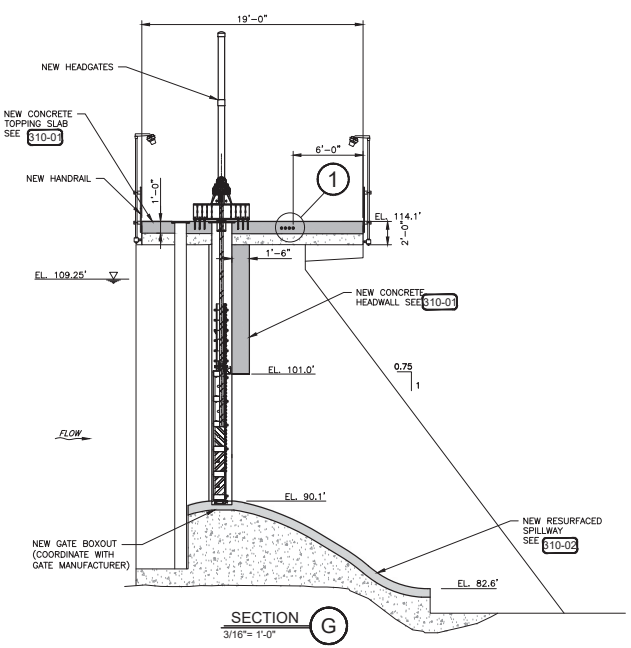
PLAN @ EL. 113.6'
3/16"=1'-0"



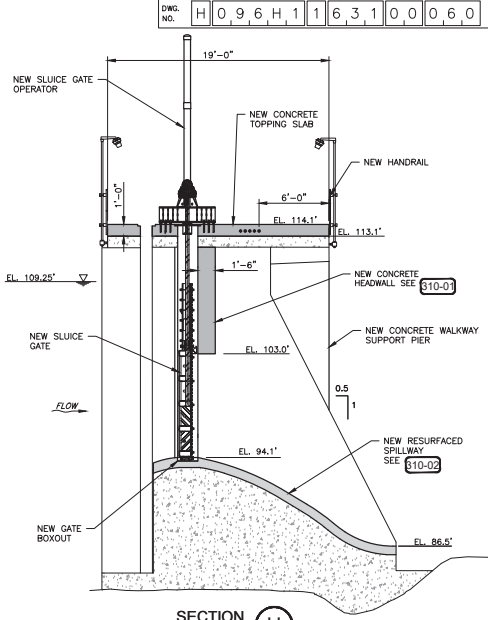
NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

UPSTREAM SECTION I
3/16"= 1'-0"

NOTE: SEE DRYHOFF DRAWING 19038-103

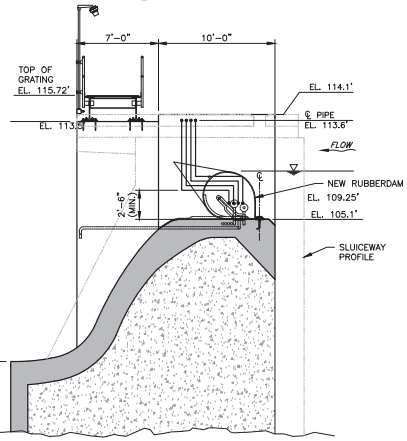


SECTION G
3/16"= 1'-0"

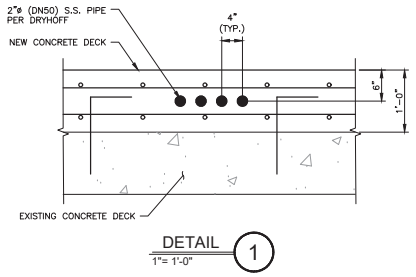


SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION J
3/16"= 1'-0"



DETAIL 1
1"= 1'-0"

100% REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

330-01

Kleinschmidt

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REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
DRYHOFF DRAWINGS 19038 PACKAGE NOV. 2019													
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE , ,

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2021-05-27
W.O. XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

RUBBER DAM PIPING AT SLUICEWAY

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 6 0 REV. E

NOVA SCOTIA

30 Damascus Road, Suite 115
Bedford NS
Canada B4A 0C1

902-424-7773 P
902-424-0597 F
www.novascotia.ca

APPROVAL

Province of Nova Scotia
Environment Act, S.N.S. 1994-95, c.1 s.1

APPROVAL HOLDER: NOVA SCOTIA POWER INCORPORATED

SITE PID: 40221673

APPROVAL NO: 2021-2840307-00

EXPIRY DATE: September 30, 2022

Pursuant to Part V of the *Environment Act*, S.N.S. 1994-95, c.1 s.1 as amended from time to time, approval is granted to the Approval Holder subject to the Terms and Conditions attached to and forming part of this Approval, for the following activity:

Water Approval - Dam



Administrator: Kevin G Garroway

Effective Date: October 22, 2021

The Minister's powers and responsibilities under the Act with respect to this Approval have been delegated to the Administrator named above. Therefore, any information or notifications required to be provided to the Minister under this Approval can be provided to the Administrator unless otherwise advised in writing.

TERMS AND CONDITIONS OF APPROVAL

Nova Scotia Environment

Approval Holder: NOVA SCOTIA POWER INCORPORATED

Project: Ruth Falls Headpond - PID 40221673

Site:

PID	Civic #	Street Name	Street Type	Community	County
40221673	935	HIGHWAY 374	HWY.	SHEET HARBOUR	HALIFAX COUNTY

Approval No: 2021-2840307-00

File No: 95100-30-BED-2021-2840307

Grid Reference: Easting - 539486, Northing - 4978146

Reference Documents

- Application submitted July 27, 2021 and attachments.

1. Definitions

a. Act means Environment Act. 1994-95, c.1, s.1 , and includes, unless the context otherwise requires, the regulations made pursuant to the Act, as amended from time to time.

b. Department means the Nova Scotia Department of Environment and Climate Change, and the contact for the Department for this approval is:
Nova Scotia Department of Environment and Climate Change
Central Region, Bedford Office
30 Damascus Road, Suite 115
Bedford, Nova Scotia B4A 0C1

Phone: (902) 424-7773
Fax: (902) 424-0597

c. Minister means the Minister of Environment and Climate Change and includes any person delegated the authority of the Minister.

d. Site means a place where a designated activity and/or undertaking is occurring or may occur.

e. Surface Watercourse means a watercourse as defined in the Environment Act, excluding groundwater.

2. Scope

a. This Approval (the "Approval") relates to the Approval Holder(s) and their application and all documentation submitted to the Department prior to the issuance of this approval for the Dam situated at or near Ruth Falls Headpond - PID 40221673.

b. The Approval Holder(s) shall ensure the designated activity is carried out in accordance with this Approval and reference documents, including the application and supporting documentation.

3. General

a. The Approval Holder(s) shall conduct the Designated Activity in accordance with the following provisions:

i. The Act, as amended from time to time;

ii. Any standard adopted by the Department, as amended from time to time.

b. Nothing in this Approval relieves the Approval Holder(s) of the responsibility for obtaining and paying for all licenses, permits, approvals or authorizations necessary for carrying out the work authorized to be performed by this Approval which may be required by municipal by-laws, provincial or federal legislation, or other organizations. The Minister does not warrant that such licenses, permits, approvals or other authorizations will be issued.

c. No authority is granted by this Approval to enable the Approval Holder(s) to commence or continue the designated activity on lands which are not in the control or ownership of the Approval Holder(s). It is the responsibility of the Approval Holder(s) to ensure that such a contravention does not occur. The Approval Holder(s) shall provide, to the Department, proof of such control or ownership upon expiry of any relevant lease or agreement. Failure to retain said authorization may result in this Approval being cancelled or suspended.

d. If there is a discrepancy between the reference documents and the terms and conditions of this Approval, the terms and conditions of this Approval shall apply.

e. Any request for renewal or amendment of this Approval is to be made in writing, to the Department, at least ninety (90) days prior to the Approval expiry.

f. If the Minister cancels or suspends this Approval, the Approval Holder(s) remains subject to the penalty provisions of the Act.

g. The Approval Holder(s) shall advise the Department in writing prior to any proposed extensions or modifications to the Activity and/or the Site. An amendment to this Approval may be required before implementing any extension or modification.

h. The Approval Holder(s) shall immediately notify the Department of any incidents of non-compliance with this Approval.

i. The Approval Holder(s) shall bear all expenses incurred in carrying out the environmental monitoring required under the terms and conditions of this Approval.

j. Unless specified otherwise in this Approval, all samples required to be collected by this Approval shall be collected, preserved and analysed, by qualified personnel, in accordance with recognized industry standards and procedures that are all deemed acceptable to the Department.

k. Unless written authorization is received otherwise from the Minister, all samples required by this Approval shall be analyzed by a laboratory that meets the requirements of the Department's "Policy on Acceptable Certification of Laboratories" as amended from time to time.

l. The Approval Holder(s) shall ensure that this Approval, or a copy, is present on Site while personnel are on Site.

m. The Approval Holder(s) shall notify the Department three business days prior to commencing construction of the Activity. The notification must include the Approval Number.

n. All phases of construction shall be overseen by a qualified professional engineer, licensed to practice in Nova Scotia by the Association of Professional Engineers of Nova Scotia (Engineers Nova Scotia), or technologist who works under the supervision of a qualified professional engineer.

o. Written certification by a qualified professional engineer is required, within 6 weeks of project completion, stating that the construction and installation of the facility meets the requirements of the approved drawings and specifications.

p. The certification shall confirm that all as-built drawings and any other relevant documentation have been turned over to the Approval Holder(s) by the engineer.

q. Within 14 days of completion of the work authorized under this Approval, the Approval Holder(s) is required to submit, to the Department, the enclosed form entitled "Completion of the Approved Work".

r. Upon any changes to the Registry of Joint Stock Companies information, the Approval Holder(s) shall provide a copy to the Department within five business days.

4. Covenant Conditions

a. The Approval does not authorize any activity that would:

i. prejudice any riparian rights of any owner or of any person lawfully in possession of or holding any lands abutting the watercourse;

ii. cause any damage or nuisance to adjacent or abutting land; or

iii. discharge surface water onto adjoining lands without the authorization of the affected landowner(s).

b. The Approval Holder(s) is responsible to construct and maintain any culvert, bridge, dam, sluice, flume, conduit, or other approved structure built or used in or on the watercourse so that the structure(s) operates as originally designed and intended, and so that risks related to potential failure of the structure(s) are effectively mitigated.

c. The Approval Holder(s) shall rehabilitate the site to the satisfaction of the Minister and pay all expenses and costs of such rehabilitation in any of the following circumstances:

i. upon the expiry or termination of this Approval; or

ii. if the culvert, bridge, dam, sluice, flume, conduit, or other approved structure built or used in or on the watercourse is not appropriately maintained to mitigate risks related to potential failure of the structure(s).

d. By granting this Approval, the Department is not responsible for any damages as a result of the approved activities, including any water quality or quantity problems that may be encountered by the Approval Holder(s) or other parties.

5. Surface Water

a. The Approval Holder(s) shall ensure the Site is developed and maintained to prevent contaminants from being discharged into a water resource or beyond the property boundary.

b. Monitoring during construction: The Approval Holder(s) shall ensure that the following water quality limits are met in the water resource downstream of construction activities:

i. Total Suspended Solids, Clear Flows (Normal Background Conditions):

(a) Maximum increase of 25 mg/l from background levels for any short term exposure (24 hour or less);

(b) Maximum average increase of 5 mg/l from background levels for longer term exposure (inputs lasting between 24 hours and 30 days);

ii. Total Suspended Solids, High Flow (Spring Freshets and Storm Events)

(a) Maximum increase of 25 mg/l from background levels at any time when background levels are between 25 mg/l and 250 mg/l ;

(b) Maximum increase of 10% over background levels when background is >250 mg/l;

c. Additional surface water monitoring may be required at the request of the Department.

d. The Approval Holder(s) shall develop and implement an Erosion and Sediment Control Plan. A copy of the plan shall be provided for review and deemed acceptable by the Department prior to construction.

e. No authority is granted by this Approval to enable the Approval Holder(s) to discharge surface water onto adjoining lands without the authorization of the affected landowner(s).

f. The Approval Holder(s) shall install and maintain erosion and sediment controls in line with industry best practices (e.g., Nova Scotia Environment Erosion and Sediment Control Handbook for Construction Sites) with the following considerations:

   i. The controls shall be installed prior to the commencement of the construction activities;

   ii. The controls shall remain in place until areas disturbed by construction activities are stabilized so that the risk of release of sediment to a water resource has been mitigated;

   iii. Control features shall be installed as per applicable product specifications or manufacturer's directions; and

   iv. Control materials shall be clean, non-erodible, non-ore-bearing, non-watercourse derived and non-toxic.

g. The Approval Holder(s) shall immediately contact the Department should sulphide bearing material be encountered on the Site.

h. The Approval Holder(s) shall ensure that surface water runoff that may be impacted by petroleum hydrocarbons from the Site is collected and directed for necessary treatment prior to discharge from Site.

i. Erosion and sediment controls shall be inspected daily, at a minimum, and prior to and after precipitation or flow events. These inspections shall confirm the erosion and sediment controls are working as designed and intended. Records outlining results of these inspections and actions taken to correct any deficiencies shall be kept for the duration of the approval and made available to the Department upon request.

j. Work at the site shall only take place when erosion and sediment controls are functional. Contingency erosion and sediment control materials shall be kept on Site in case of failure.

k. Any silted water pumped from work areas shall be directed to vegetated areas, settling ponds, or other treatment devices that mitigate the risk of release of sediment to a water resource.

l. The Approval Holder(s) shall limit the size of the disturbed area and the removal of riparian vegetation to the area of construction activities as outlined in the supporting documentation.

m. The Approval Holder(s) shall ensure that the following activities take place at a distance of a minimum of 30 metres from a surface watercourse or wetland in an area such that a release will not enter a surface watercourse or wetland:

i. Fuel storage, refueling, and/or lubrication of equipment;

ii. Washing of machinery or equipment; and

iii. Storage of equipment, excavated/stockpiled materials, and potential contaminants.

n. Blasting in or near a watercourse is not permitted unless authorized in writing by the Minister.

6. Construction

a. Under authority of this Approval, the watercourse alterations specified herein shall be conducted between June 1st and September 30th (inclusive) of the same calendar year unless otherwise stated in the site specific terms and conditions.

b. All construction activities within or immediately adjacent to the watercourse channel shall be carried out in isolation of the streamflow (i.e., in the dry), unless otherwise stated in the site specific terms and conditions.

c. Disturbed watercourse banks shall be stabilized to mitigate any potential scouring, bank failure, or any other adverse effects as a result of the planned works, where deemed necessary by a qualified professional engineer.

d. The Approval Holder(s) shall ensure any cast-in-place concrete is poured in isolation of the watercourse and cured before it comes in contact with watercourse water.

e. Riprap and other material used in construction shall be clean, non-erodible, non-ore-bearing, non-watercourse derived and consist of non-toxic materials prior to placement within the watercourse to mitigate against the release of substance into a surface watercourse or wetland.

f. Any equipment used for work within a watercourse shall be clean and free of soil and plant material to avoid the release of contaminants and the potential transfer of invasive species.

g. Any equipment used for work within a watercourse or wetland shall be mechanically sound, with no fuel or oil leaks.

h. An emergency spill-kit must be kept on site when vehicles (including machinery) or equipment is used in a watercourse.

i. Upon completion of construction, modification, or maintenance work all debris resulting from the work must be removed from the work site.

7. Site Specific

a. This approval is for the installation of new sluice gates and control building on the Ruth Falls Dam, located on the Sheet Harbour Hydro System in Sheet Harbour, NS. The sluice gate work involves replacing the three existing steplog bays with three screw stem vertical lift gates. The new control building will be

constructed off site and moved into place by crane. All work must be conducted in accordance with the documents submitted by the proponent in the application package submitted to NSECC on July 27, 2021, and the updated work schedule provided on October 6, 2021. Any deviation from the submitted plans will require the proponent to put forward an amendment application to this approval.

b. The Approval Holder shall not commence the watercourse alteration activity until such time that any and all applicable municipal, provincial or federal regulatory approvals have been obtained.

c. The Approval Holder shall conduct on-site pre-construction meetings to ensure all persons involved in watercourse alteration are aware of the terms and conditions of this Approval.

d. Locate all staging areas in an area that will not impact adjacent watercourses or wetlands. Sediment controls are to be employed around this area to ensure that silt will not migrate to adjacent watercourses or wetlands.

e. The construction window for this project is to be between October 19, 2021 and September 30, 2022. Any request for extension outside of this construction window or beyond the expiry date of this approval must be put in writing to NSECC by the Approval Holder.

f. Sediment laden waters from within the work site cannot be discharged into the watercourse or any other watercourse, wetland or water resource. All sediment laden waters must be discharged to a vegetated area or through a filter bag.

g. Cofferdam(s) shall be installed in order to minimize impacts to the surrounding environment, including releases of sediment and other deleterious materials associated with installation/operation/removal of the cofferdam. Material used in construction must be clean and free of fines and other deleterious substances prior to placement within the watercourse. Mitigation measures to prevent the release of debris into the watercourse must be in place prior to construction activities taking place.

h. Erosion and sediment control features shall be inspected at minimum daily and prior to and after any precipitation or flow events to ensure the erosion and sediment control plan is properly in place, and is maintained and/or upgraded as required.

i. A contingency plan shall be in place for significant rainfall events (i.e., greater than or equal to a 1 in 2 year return period storm event).

j. All materials and equipment shall be operated and stored in a manner that prevents any deleterious substances (e.g. petroleum products, silt, etc.) from entering the watercourse.

k. DFO has provided a Letter of Advice (see attached). If you have any questions on the requirements in the Letter of Advice, please contact DFO to discuss the requirements from that agency.

NOVA SCOTIA

File No:95100-30-BED-2021-2840307

COMPLETION OF THE APPROVED WORK

A condition of this Approval requires that the Approval Holder notify Nova Scotia Environment that the work authorized is complete.

Please enter the information on this sheet and return it to Nova Scotia Environment at the following address:

Nova Scotia Environment
Inspection, Enforcement, and Compliance Division
Central Region, Bedford Office
30 Damascus Road, Suite 115
Bedford, NS, B4A 0C1

Phone: 902-424-7773
Fax: 902-424-0597
NSE Contact: Gregory Cummings

APPROVAL NUMBER: 2021-2840307-00

NAME OF APPROVAL HOLDER: NOVA SCOTIA POWER INCORPORATED

WORK AUTHORIZED: Dam

DATE WORK WAS COMPLETED: _____

NAME OF CONTRACTOR: _____

COMMENTS: _____
_____
_____
_____
_____

_____ _____
Signature Date

Fisheries and Oceans Canada | Pêches et Océans Canada

Bedford Institute of Oceanography
1 Challenger Drive
P.O. Box 1006, Station P510
Dartmouth, Nova Scotia, B2Y 4A2

September 28, 2021

Your file Votre référence
2021-2840307

Our file Notre référence
21-HMAR-00478

Greg Cummings
Environment Inspector
Nova Scotia Environment and Climate Change
30 Damascus Road, Suite 115
Bedford, NS B4A 0C1

Subject: Ruth Falls Gates Replacement – Sheet Harbour Hydro System, Halifax County, Nova Scotia - Implementation of Measures to Avoid and Mitigate the Potential for Prohibited Effects to Fish and Fish Habitat

Dear Greg Cummings,

The Fish and Fish Habitat Protection Program (the Program) of Fisheries and Oceans Canada (DFO) received the proposal on July 29, 2021. We understand that the proponent (NS Power) proposes to:

- Install sluice gates on the Ruth Falls Dam, located on the Sheet Harbour Hydro System in Sheet Harbour, NS. This work will involve replacing the three existing deep stoplog bays located in the central portion of the dam with three screw stem vertical lift gates.
- An access road and crane platform will be constructed on land downstream of the dam and fishladder. Both the access road and crane platform will be above the ordinary high water mark (OHWM). The access walkway and platform will be elevated above the water and attached to the downstream side of the dam.
- Work will also include the installation of a new rubber dam control building. Two concrete piers will be constructed to support a slab extension for the control building. The eastern pier will tie into the existing retaining wall while the western pier will be supported with a new concrete footing (new permanent instream footprint of 8 m^2). Temporary sandbag cofferdams will be used to isolate the work area and pumps will be used to work in the dry. The eastern most bay of the dam (which is below where the new control building will sit) is unused and will be filled with concrete.

Canada

- Completing the 2021 portion of the project will not require the reservoir to be lowered beyond the normal operating level required and can be conducted without altering operation of the Ruth Falls fishladder.
- The project and is estimated to take four months and is expected to be completed by late January 2022.
- Erosion and sediment controls will be in place as per Nova Scotia Environment Application for Approval # 2021-2840307.

Our review considered the following information:

- Nova Scotia Environment Application for Approval, Watercourse Alteration file #2021-2840307, and supporting documents, received by the Program on July 29, 2021.
- E-mail correspondence between the Program and the Proponent and yourself on July 30 and 30, 2021 and August 11, 2021.
- Virtual meeting between the Program, the Proponent and yourself on August 12, 2021.

We understand the following aquatic species currently under consideration for listing under the *Species at Risk Act* may use the area in the vicinity of where the proposal is to be located:

- American Eel (*Anguilla rostrata*) designated as Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)

Should the above listed species become listed as threatened or endangered under Schedule 1 of the *Species at Risk Act*, you will be required to obtain the necessary permits prior to continue your workings, undertakings, or activities.

The proposal has been reviewed to determine whether it is likely to result in:

- the death of fish by other means than fishing and the harmful alteration, disruption or destruction of fish habitat which are prohibited under subsections 34.4(1) and 35(1) of the *Fisheries Act*;
- effects to listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*; and
- the introduction of aquatic species into regions or bodies of water frequented by fish where they are not indigenous, which is prohibited under section 10 of the *Aquatic Species Regulations*.

The aforementioned impacts are prohibited unless authorized under their respective legislation and regulations.

21-HMAR-00478

To avoid and mitigate the potential for prohibited effects to fish and fish habitat (as listed above), we recommend the proponent visit the Program's Measures to Protect Fish and Fish Habitat website at: https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html. We also recommend the following avoidance and mitigation measures be implemented:

Standard Mitigation Measures

- All materials and equipment used for the purpose of site preparation and project completion should be operated and stored in a manner that prevents any deleterious substance (*e.g.*, petroleum products, concrete, etc.) from entering the water.
- Vehicle and equipment re-fueling and maintenance should be conducted away from the water.

Site Specific Mitigation Measures

- Isolate the control building worksite from running water by installing non-erodible impermeable barriers/cofferdams capable of withstanding the Q50 flow for the watercourse:
  - Dewater gradually to reduce the potential for stranding fish;
  - Screen intake pipes to prevent entrainment or impingement of fish;
    - Use the code of practice for water intake screens for Americal Eel (https://dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html
  - Conduct a fish salvage using qualified personnel with appropriate licencing and permits to capture, relocate and monitor for fish trapped within isolated, enclosed, or dewatered areas.
- Implement further site-specific sediment and erosion control measures for late season works, including but not limited to:
  - Avoid working during periods which Environment and Climate Change Canada has issued rain or storm warnings for the work area;
  - If exposing soils, cover all exposed soil with rock and/or non-erodible material such as plastic within 30 m of a watercourse; and
  - Additional sediment and erosion control materials should be on site and readily available in the case of sudden and/or heavy precipitation events.
- Monitor the site at least weekly throughout the construction period by conducting visual inspections of water control measures, erosion and sedimentation control measures and for fish passage, and notify DFO immediately (no later than 24 hours) if any issues are observed.

21-HMAR-00478

Provided that the proponent incorporates these measures into their plans, the Program is of the view that the proposal will not require an authorization under the *Fisheries Act*, the *Aquatic Invasive Species Regulations* or the *Species at Risk Act*.

Should the plans change or if the proponent has omitted some information in their proposal, further review by the Program may be required. The proponent should consult our website (http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html) or consult with a qualified environmental consultant to determine if further review may be necessary. It remains the proponent's responsibility to remain in compliance with the *Fisheries Act*, avoid prohibited effects on listed aquatic species at risk, any part of their critical habitat or the residences of their individuals, and prevent the introduction of non-indigenous species.

It is also their *Duty to Notify* DFO if they have caused, or are about to cause, the death of fish by other means than fishing and the harmful alteration, disruption or destruction of fish habitat. Such notifications should be directed to (http://www.dfo-mpo.gc.ca/pnw-ppe/CONTACT-eng.html).

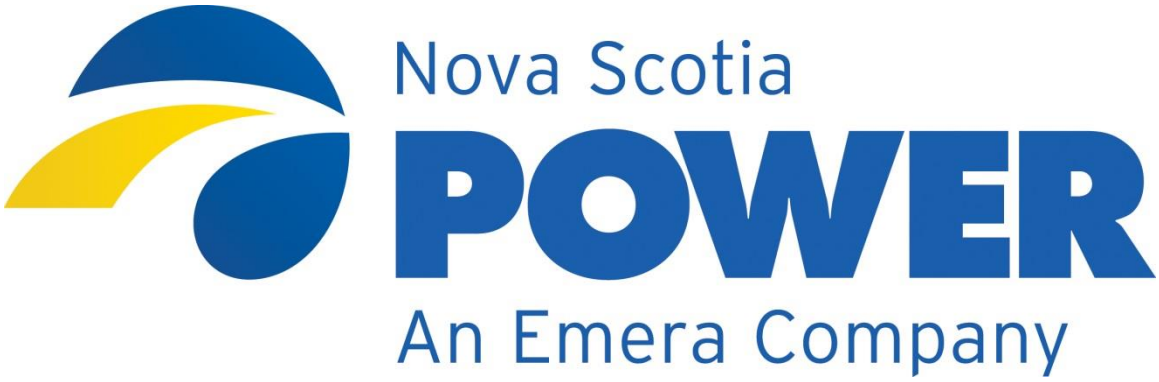
The proponent should notify this office at least 10 days before starting the project. A copy of this letter should be kept on site while the work is in progress. It remains the proponent's responsibility to meet all other federal, territorial, provincial and municipal requirements that apply to their proposal.

If you have any questions with the content of this letter, please contact Kelley Fraser at our Dartmouth office at 902-441-3671 or by email at Kelley.Fraser@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,

Fraser, Kelley
Digitally signed by Fraser, Kelley
Date: 2021.09.28 15:56:11 -03'00'

Kelley Fraser
Hydro and Flows, A/Senior Biologist
Fish and Fish Habitat Protection Program
Ecosystems Management – Regulatory Reviews



Environmental & Project Description for Construction Activities

Addendum

Sheet Harbour Hydro System

Ruth Falls Dam Refurbishment

2022

Nova Scotia POWER
An Emera Company

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PROJECT OVERVIEW

NS Power is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2022. This work is necessary in order to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. The project involves refurbishing the main dam by replacing the existing stop log bays with rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section. Prior to main construction NS Power will be replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates.

Activities proposed for the Project include lowering the Ruth Falls Headpond and canal approximately 18 feet and dewatering the Ruth Falls fish ladder and downstream bypass during construction. Fish will be moved downstream via the sluiceway and/or spillway.

The Project is scheduled to take approximately 9 months to complete starting with the installation of the vertical lift gates in April and main dam construction in mid July 2022.

On April 14, 2021, NS Power submitted an addendum to the watercourse alteration approval application (#2019-2638165-00) to the NS Department of Environment and Climate Change (ECC) for the Ruth Falls Dam Refurbishment Project (the Project); this addendum is to support ECC's letter to NS Power pertaining to NS Power's application dated June 18, 2021, indicating NS Power's application remains incomplete.

The following sections provide additional information pertaining to ECC's information requests outlined in the June 18, 2021 letter. Below is a summary of ECC's information requests with the corresponding section within this addendum addressing the request.

1. Section 4.2 of the April 14, 2021 submission, NSPI states that if a 1:2 year event occurs during the first stage of construction, the construction site will likely be inundated and the cofferdams the length of the whole dam will be overtopped. Section 4.3 Contingency Planning describes a list of options which could be implemented 'with minimal planning time'; however, these options describe the upstream management of water and suggest that there would likely be washout of the downstream access road.

a. Provide rationale for the water management approach shown in Appendix B, including but not limited to: explanation for only one bay proposed for bypass / conveying normal flows during Phase I.
b. Provide additional rationale for why a 1:2 year event cannot or need not be accommodated.
c. Provide rationale for the sizing of the two culverts under the downstream access road.
d. Describe how fish will be prevented from entering the culverts and becoming trapped between the access road and dam.
e. Provide available hydrologic and hydraulic modeling or reporting for the existing

system, e.g. as referenced in the submission, or for the Ruth Falls reservoir specifically.

NS Power has provided a revised Water Management Plan in section 4.1 which addresses NS Power's plan for addressing a 1:2 year storm event as it relates to the NS watercourse Alteration Standard. Section 4.1 also addresses fish becoming trapped between the access road and dam. Section 4.2 – Contingency Planning outlines key details from the Sheet Harbour Flood Study.

2. The water management approach described in the submission refers to two phases of construction. State the duration and seasons/calendar months for Phase I and Phase II of construction.

NS Power has provided a revised construction schedule in Section 2.3. As per the ECC approval (2021-2840307-00), NS Power intends to commence construction of the screw stem vertical lift gates and control building in April 2022. NS Power is requesting main construction start in mid July 2022 to accommodate the upstream alewife migration and fish spawning windows.

3. Provide a site-specific wetland monitoring plan that addresses biodiversity elements at the Ruth Falls site.

NS Power has committed to providing a site-specific wetland monitoring plan to ECC by March 31, 2022.

4. DFO continues to review the Fisheries Act authorization application for the Ruth Falls project. ECC requires the following information with respect to the aquatic environment: Provide comment on if the new toe of spillway has any intended or anticipated changes in performance of the fish ladder.

NS Power does not anticipate changes to the performance of the fish ladder due to the new toe of the spillway. Further details are outlined in section 2.0 - Construction

5. Indicate how the planning and design for the construction at Ruth Falls has mitigated the risk of debris and rock fill washing downstream during the removal of the temporary cofferdam and access path.

NS Power has mitigated risk of debris and rock fill washing during the removal of the downstream access path through planning and design. This is outlined in section 4.3 – Erosion and Sedimentation Control.

6. NSPI has characterized the discharge during drawdown as being in the range of very common (at a 500 cfs) to regularly occurring 6-12 times per year (at 1000 cfs).

a. Based on the information above, provide ECC with modelling results, observations, or other information and experience from discharge events where scour was observed.

NS Power has not observed scour at Ruth falls, details can be found in section 4.3 – Erosion and Sedimentation.

7. ECC is not aware of an existing access road from the right side of the dam (looking downstream, righthand side).
a. Given the bathymetry shown in Appendix B; describe the site access for constructing the right upstream cofferdam.
b. Provide detailed plans for the construction of the right upstream cofferdam. The drawings in Appendix B do not show how the bypass would interact or be stable with respect to the cofferdam (e.g. is a culvert being placed to convey flow through the cofferdam?).

NS Power has provided the proposed water management structures in Appendix C which outline the proposed temporary site access. The downstream access road and bridge will be put in prior to the upstream access roads. Access from the right access road (west) will be accessible once equipment can traverse the downstream access road and bridge.

8. NSPI has noted that changes in the engineering drawings (which include removals, structural and mechanical, and geotechnical) are not anticipated. ECC acknowledges that the drawings in Appendix A do not include water management plans.
a. Provide structural drawings or assessment by a P.Eng. for the construction of the by-pass on the righthand side.

NS Power has provided a Water Management plan in section 4.1. This plan outlines how water will move through the vertical lift sluice bay from the Ruth Falls Head Pond to downstream of the dam.

9. Provide information on whether ice action is anticipated on the temporary causeway.

NS Power has provided details surrounding anticipated ice action in section 4.1 –Water Management

10. The elevation of the crest of the new uncontrolled spillway as shown in Section F (Sheet 300-03, New Conditions, West Spillway) at 109.25 ft is below the minimum operating level for Ruth Falls Headpond of 109.4 ft. The elevation of the new rubberdam crest is also shown at 109.25 ft, which is below the minimum operating level for Ruth Falls. Confirm the maximum dam crest, and that the new uncontrolled spillway will meet operational terms.

NS Power has provided details surrounding datum related discrepancies noted between minimum operating levels of the reservoir (109.4ft and 109.2) as it relates to the new rubberdam crest. in section 2.1 – Existing Project Area

1.0 INTRODUCTION

The Sheet Harbour Hydro system is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The system has a drainage area of 573.9 km^2. Presently there are 6 controlled reservoirs, including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond and Ruth Falls Headpond. Ten Mile Reservoir was previously controlled until the dam was removed in 2012.

Governor Reservoir is located at the head waters of Twelve Mile Stream, which flows through Union Flowage into Marshall Reservoir. Sloane Reservoir is located near the headwaters of Seventeen Mile Stream which passes through Anti Dam Reservoir and into Marshall. Marshall Reservoir comprises the principle reservoir for the Sheet Harbour System. Malay Falls Headpond is directly downstream from Marshall; the Malay Falls power canal conducts water from the Malay Falls Headpond to the generating station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel.

Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power. Mapping of the Sheet Harbour System can be found in Appendix A.

2.0 CONSTRUCTION

Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the embankment and spillway/sluiceway structures. The project involves refurbishing the main dam by replacing the existing 30 stop log bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section. Prior to main construction NS Power will be replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates under a separate approval (2021-2840307-00).

NS Power is anticipating an additional permanent instream footprint of approximately 60 m^2 on the downstream side of the dam to accommodate additional concrete requirements for certain ogee sections. NS Power does not anticipate changes to the fish ladder as a result of the additional concrete. The reservoir will be temporarily drawn down approximately 18 feet, which serves as

the primary method of isolating the existing dam structure for refurbishment activities. Temporary cofferdams will be used to divert water to the centre sluiceway section for water management purposes, and to provide temporary access to the main dam. The fish ladder and fish bypass will be dewatered.

2.1 Existing Project Area

Ruth Falls Headpond is located immediately downstream of the Malay Falls Headpond. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, a 15.2 m long three-bay stoplog-controlled sluiceway section in the centre, and two short concrete gravity bulkhead sections that abut either side of the spillway. Prior to main construction, the three-bay stoplog-controlled sluiceway will be replaced with a set of 3 screw-stem vertical lift gates. The crest elevation of the spillway is 31.7 m and stoplogs can be installed to an elevation of 33.3 m. The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix B for pre-construction site photos.

Flow in the area is controlled by NS Power Hydro Operations. Water levels can fluctuate between the full supply level of 33.7 m (110.5') and the low supply level of 27.5 m (90.1'). A minimum operating level of 33.3 m (109.25') is observed from April 1 - Nov. 30 each year. As per the NSECC Sheet Harbour System Water Approval, a 35 cfs maintenance flow is provided downstream year-round in order to operate the Ruth Falls louvers. This flow is targeting downstream migration of Atlantic salmon smolts and kelts. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers. This flow is set to accommodate downstream migration of all fish species found on the system. The fish ladder at Ruth Falls operates from April 1 - November 1st annually with a flow of 6 cfs. During this time frame a fish trap is operated in the ladder from May 15 – November 1st annually. DFO is contacted if the trap exceeds 50 salmon in order to determine the target release locations. Of note, only 11 salmon have been captured since 2007 with no salmon being captured in 2017 and 2018, two in 2019, and one in 2020.

The site will be surveyed prior to the construction works to ensure that the elevations are accurate with respect to the current configuration and the new design. Discrepancies noted between minimum operating levels of the reservoir (109.4ft and 109.2ft) are datum related, as there have been many datums used over the years, including different coordinate systems and local datums. The minimum operating levels of the reservoir based on engineering drawings and Dam Safety Reviews is noted to be 109.25 ft. This was likely a mistake in the number presented; however, that will not impact the design. The current minimum operating level will remain unchanged with the new dam design.

Atlantic salmon have been the species of interest historically in the system for DFO. However, the low numbers of returns on East River in recent years indicate that there is unlikely a breeding population. Work is ongoing to improve the water quality in the West River and it may be that

higher returns are observed in the East River over time. High concentrations of mercury have been observed in white perch, yellow perch and speckled trout in the system.

The Ruth Falls Headpond was sampled by NS Power in 2017 using gill nets, minnow traps and eel pots. Species found to be present in the headpond include American eel, alewife, brown bullhead, lake chub, golden shiner, speckled trout, white sucker and yellow perch. No aquatic invasive species have been observed in the project area or adjacent habitat. No critical habitat is found in the area.

In July 2021, NS Power staff observed a Barn Swallow nest located in the centre of the dam on top of one of the concrete piers and underneath the deck of the dam. An additional Barn swallow nest was also observed on the bridge across the upstream side of the canal. The NS Department of Lands and Forestry (DLF) have granted NS Power a Species at Risk (SAR) permit which grants permission to remove the nests before March 31, 2022, the use of deterrents to temporarily prevent nesting during construction and requires the installation of an alternative nesting structure fitted with nesting cups at a 3:1 ratio.

2.2 Proposed Refurbishment Activities

The proposed refurbishment activities are broken up into two phases below, Phase 1 - the installation of the sluiceway gates (already approved under Approval 2021-2840307-00) and Phase 2 – the dam construction:

Phase 1 – Sluice gate installation:

- Installation of a bulkhead, exact method to be determined, to isolate the existing sluiceway section.
- Refurbishment of the original control building, and existing low level sluiceway section with the removal of the stoplogs and replacing the stoplogs with three (3) low level sluice gates. The existing piers will remain in-place.
- Removal of bulkhead.

Phase 2 – Dam construction:

- Lowering of Ruth Falls Headpond approximately 18 ft.
- Dewatering of the Ruth Falls fishladder and canal during the construction activities.
- Installation of temporary access for machinery on both the upstream and downstream sides of the dam, see below for more information on the access roads.
- Removal of the existing stoplog bays, piers, stoplog lifter and walkway.
- Reface the concrete on the crest and downstream slope of the spillway ogee sections.
- Installation of new rubber dam bladders on the crest of the ogee spillway sections.
- Construction of a free overflow spillway section at the right end of the dam.
- Installation of a new steel walkway for access across the dam.
- Removal of the temporary access road material.
- Watering up of the headpond to within normal operating levels.

2.3 Construction Schedule

The Project is expected to take nine months starting in April 2022 with the installation of the vertical lift gates, main dam construction in mid-July 2022, and finishing in late March 2023. This includes both the lowering and subsequent recharging of water in the headpond.

3.0 REGULATORY PERMITS/APPROVALS

In addition to the Watercourse Alteration Approval required in accordance with Section 5(A)(1)(c) of the Activities Designation Regulations of the *Environment Act*, an authorization under Section 35(2)(b) of the *Fisheries Act* is required for the revised scope of work.

A variance to the Sheet Harbour Hydro System Water Approval (#2008-062826-01) for water withdrawal/storage will also be required in order to carry out the proposed scope of work. This includes the following:

- operation of the Ruth Falls fishladder and salmon trap, which will be non-operational throughout construction
- minimum water elevations for the period of April 1-November 30th for Ruth Falls Headpond.
- Supplementary flow release requirements for Atlantic salmon, which are unable to be adhered to during construction due to lowered water levels. As part of NS Power's water management plan water will be free flowing through the deep sloplog/sluiceway bay, providing continuous downstream flow, however standard supplementary releases for specific time periods will not be provided.

A Species At Risk permit has been obtained by NSDNRR as per Section 50(1), 51(a) of the *Wildlife Act*, and Section 14(1) of the *Endangered Species Act*.

An authorization in accordance with Transport Canada's Navigation Protection Program is also required for construction activities for the Project.

4.0 ENVIRONMENTAL PROTECTION

4.1 Water Management

Once the desired construction elevation of 91.0 ft is reached, work will begin on the temporary upstream access paths. NS Power had originally requested a drawdown level of 98'; however, upon careful review of the bathymetric study, the bathymetry modelling does not demonstrate a considerable difference between a reservoir level lowered to 98 ft or to 91 ft. In an effort to provide the safest and most reliable construction execution, lowering the reservoir to elevation 91 ft is preferable. To execute the most reliable construction schedule, this allowance of a reservoir level at 91 ft confidently allows the Contractor to safely execute all project works within one drawdown period. In order to expose the portions of the concrete dam to be refurbished,

the Ruth Falls Headpond will be lowered approximately 18 ft from the 109.25 ft minimum operating level, maintained from April 1st to November 30th annually. The canal, fishladder, and fish bypass will be dewatered. A 35 cfs flow will also be maintained downstream of the dam. Supplemental flow required as part of the operating approval will not be provided during construction and the fish trap will not be operated.

Prior to the new sluice gate installation, the Ruth Falls Dam would have an overflow spill of approximately 350 cfs while at full supply elevation of 110.5 ft. The overflow spill would spill over the stoplog along the full length of the dam. From May to August 2021, overflow spill was approximately 350 cfs, this was due to a lack of generation a result of Ruth Falls switch gear refurbishment project.

The Ruth Falls Headpond has a storage volume of 2.3M cubic meters (1888 acre-ft) when at full supply level at elevation of 109.25 ft. As noted previously, the headpond will be lowered to elevation of 91 feet for construction. At 91 ft, the headpond will have a volume of .005M cubic meters (4 acre-ft).

During normal operation, inflows in the reservoir are controlled by NS Power Hydro Operations. Water levels fluctuate between the full supply level of 33.7 m (110.5 ft), minimum supply level of 33.3 m (109.25 ft), and the low supply level of 27.5 m (90.1 ft). In order to complete work in dry conditions, the Project will include temporarily lowering the headpond and canal approximately 18 ft below the minimum operating level of 33.3 m (109.25') observed from April 1 – Nov 30 each year. Dewatering activities will begin no earlier than July 10th, 2022. To commence the drawdown, NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 33.7 m (110.5 ft) to the minimum operating level of 33.3 m (109.25 ft). Once the headpond reaches an elevation of 33.3 m (109.25 ft), the drawdown will be controlled using the centre vertical lift gate/deep sluice bay until the desired elevation of 27.7 m (91 ft) is achieved. The drawdown flow will be directed through areas that are part of the normal flowage channels. At least one gate will remain in full open throughout construction to maintain lowered water elevations and provide a method of fish passage.

During the drawdown, water will pass through the gates and reduce the headpond level from 109.25 ft to 91 ft. Table 1 displays the decrease in flow velocities as the headpond elevation lowers over the course of the 4-day drawdown period.

Table 1: Estimated Flow Velocities Table

Time (day)	Beginning Elevation (ft)	Middle Sluice Opening (ft)	Discharge (cfs)	Velocity through gate(fps)	Downstream Velocity (fps)
0	109.2	1	211	21	2.4
0.5	108.8	1	209	21	2.4
1	108.0	1	204	20	2.4
1.5	107.2	1.5	300	20	2.8
2	106.0	1.5	289	19	2.8
2.5	104.9	1.5	279	18	2.7
3	103.0	1.5	260	17	2.6
3.5	101.0	2	319	16	2.9
4	96.0	2	236	12	2.5
4.5	91.0	2	33	5	1.3

The flow downstream will be controlled in order to avoid scour and sedimentation. The 35 cfs maintenance flow and downstream fish passage will be provided through the sluiceway. Fish will have the ability to move downstream and upstream through the vertical lift sluice bay during the drawdown period. The passive opening under the bridge will allow fish to move freely downstream. Once the headpond is lowered to 91ft, temporary access upstream and downstream of the dam will be installed in the dry.

Qualified NS Power personnel will be on site during the drawdown to monitor water quality (visual silt) and conduct a fish rescue for any isolated fish in the headpond and canal. The headpond will be subsequently recharged at a controlled rate and monitored for silt and fish issues.

Two access roads will be installed on the upstream side of the dam; one extending from the left abutment to the left end of the sluiceway, and one extending from the right abutment to the right end of the sluiceway. The access roads will be constructed to elevation 100.0 ft (30.5 m) with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes using clean rock material that is free of fines. The left upstream access road will be 209 ft (64 m) long while the right upstream access road will be 343 ft (104.5 m) long. The estimated temporary instream footprint of the left access road is 576 ft^2 (535 m^2) while the right access road is 747 ft^2 (694 m^2). Using available bathymetry, approximately 74% of the upstream access road will be placed in the dry at an elevation of 91.0 ft.

The upstream cofferdams will serve primarily to provide access for machinery to complete refurbishment activities but also to divert water to the centre deep sluiceway section of the dam. While cofferdams are required to maintain dry work areas to some extent (namely to ensure

water levels remain below the spillway section of the existing dam), all construction activities will be taking place on the existing dam structure. NS Power is not anticipating concerns related to the inability to maintain dry work areas similar to what has been observed on the Tusket main dam refurbishment project for these reasons.

Temporary access will also be constructed on the downstream side of the dam to access the right side of the dam. The rockfill access road will be equipped with a bridge that will be located over the discharge channel -see Appendix C- Proposed Water Management Structures. Ice build up is not anticipated on the temporary access road as the water will be constantly flowing downstream. Excavators will be using the access roads on a continual basis during construction which will break up any ice that could accumulate. If significant ice accumulation was to occur, the ice could be removed physically by the contractor.

It is expected that elevations in the headpond will fluctuate throughout construction due to inflows from Malay Falls as well as uncontrolled inflows from Grant River watershed. The use of these access roads will allow the headpond to rise to approximately elevation 99 ft before additional water control measures would be required, see Section 3.4 for a discussion on contingency planning should the elevation exceed 99 ft.

It is expected that at a minimum, natural inflows from Grant River Watershed, which is uncontrolled by NS Power, as well as required maintenance flows and spill over the Malay Falls rubber dams would be managed through the construction site. NS Power may generate at Malay Falls to continue to pass water through the system and maintain required water levels in the upper reservoirs. This will only be completed to a level that is manageable at the construction work area and with oversight from the NS Power's Construction Project Management and Hydro System Superintendent.

To maintain water passage through the dam during construction, the water will be passed through the middle vertical lift gate deep sluice bay, which will be adjusted as required. The sill elevation of the middle sluice gate is 90.1 ft, whereas the sill elevation of the outer two gates is 94.1 ft. Therefore, at a headpond level lower than 94.1 ft, only the middle vertical lift gate deep sluice bay will be available to discharge flows.

The vertical lift gates will be installed prior to main construction providing improved water management during the project. If all three vertical lift gates were not able to be installed prior to the July 15th start date for the main construction project, it is anticipated that the two outer gates will be constructed first and will be able to manage the discharge from the headpond through the centre sluiceway bay. This option would not impact the discharge flows as there would be no change to how the water flows through the center sluice bay. In this situation, once the two outer gates are completed, the reservoir will be raised to an elevation of 95 ft and the centre gate will be isolated and constructed. Once the middle gate is constructed the elevation will be brought back down to 91 ft. It should be noted that in all scenarios, the minimum 35 cfs discharge requirement will continue to be maintained and there will be no negative impacts the passage of the water should this situation occur.

The estimated maximum discharge flows through the gates are shown in Table 2:

Table 2 : Estimated Discharge Flow for the New Vertical Lift Gates

Reservoir El.	91 ft	93 ft	95 ft	97 ft	99 ft
Outer Gate 1	N/A	N/A	171 cfs	990 cfs	2,175 cfs
Outer Gate 2	N/A	N/A	171 cfs	990 cfs	2,175 cfs
Middle Gate	171 cfs	990 cfs	2,175 cfs	3,635 cfs	5,324 cfs
Totals	171 cfs	990 cfs	2,517 cfs	5,615 cfs	9,674 cfs

The two outer gates are identical in their dimensions; therefore, yield the same outflows. All gates were considered to be fully open for the purpose of these calculations. N/A – Sill elevation is above the headpond level.

The existing area just downstream of the dam consists of exposed bedrock and boulders. The water will flow downstream through the sluiceway bay and under the temporary bridge. Expected flows through the vertical lift sluice bay is expected to be much lower during construction, see Section 3.4 for contingency planning for higher inflows. Following the drawdown of headpond, the remaining section of the downstream access for the site will be completed. To cross the existing spillway channel, clean rock material that is free of fines will be placed across the spillway to construct an access path, which will span the entire discharge channel. Based on the NS Watercourse Alteration sizing criteria, calculations were conducted in order to determine an appropriate bridge size capable of passing 1:2 year return storm conditions on the downstream side. To reduce the need for a large structure required to satisfy the NS watercourse Alteration Standard (requiring a bridge to have a width of 126 ft or 38.5 m), the contractor is proposing to make use of the storage capacity of the reservoir once drawn down, and install a bridge that is approximately 6 ft tall and 42 ft wide. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. If a heavy influx of water is expected, NS Power will notify the contractor and the bridge will be removed promptly to allow for excessive flow conditions that would be expected for a 1:2 year return storm event. An excavator or crane will be available on-site during construction to remove the bridge promptly. As an additional measure, NS Power has the option to close the vertical lift sluice bay to hold back water from moving downstream. During the drawdown, the headpond will be lowered to an elevation of 91 ft, which allows for a 9 ft elevation increase should storm conditions arise. Equipment used during construction will be clean and fee of debris and all material will be removed in a responsible manner. Clean rock fill will be used, and geotextile / poly liner will be available to use should the need arise.

4.2 Contingency Planning

The hydrological information provided in the application submission references the Sheet Harbour system flood study, which was completed as part of NS Power's dam safety program in addition to the system dam safety reviews. Key details from this study which are relevant to the water management plan for the ruth falls dam refurbishment are provided below. NS Power does not typically provide flood study reports as part of watercourse alteration applications pertaining to hydro capital projects as these studies contain confidential information pertaining to NS Power's hydro dam safety program

The statistical flood peaks for the Ruth Falls headpond, taken from the 2008 Sheet Harbour Hydro System Flood Study, are presented in Table 3 below:

Table 3: Instantaneous Flood Peaks for the East River

Return period (years)	Instantaneous Flow Peaks (cfs)
2	5,850
5	8,340
10	10,130
20	11,940
50	14,430
100	16,420
1000	24,220

The instantaneous flood peaks outlined in Table 4 take into consideration inflows from the Grant River, which was included in the 2008 flood study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

The primary means of water management for the Project is the lowering of Ruth Falls Headpond to elevation 91.0 ft. Prior to main construction, the vertical lift gates will be installed. Temporary upstream access roads will be installed to withstand a rise in the headpond to elevation 100 ft; however, it is unknown how much instantaneous inflow would result in a rise in the headpond elevation from 91.0 ft to over 100 ft as there is no storage curve for Ruth Falls Headpond, due to lack of storage. Should unexpected inflows be received, NS Power will implement contingencies to safely pass water. In the situation where water is rising, NS Power has the ability to open the two additional gates to pass water and maintain lower elevations. If extreme heavy rain or significant sustained flows are forecasted, which could exceed the 100 ft elevation, NS Power has the ability to stabilize the cofferdams to withstand the additional water and / or had height to prevent breaching.

The new vertical lift gates will be used to pass water and have been designed to meet all applicable standards. As outlined in Section 3.5, To reduce the need for a large structure required to satisfy the NS watercourse Alteration Standard (requiring a bridge to have a width of 126 ft or 38.5 m), a bridge that is approximately 6 ft tall and 42 ft wide will be installed. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. If a heavy influx of

water is expected, NS Power will notify the contractor and the bridge will be removed promptly to allow for excessive flow conditions that would be expected for a 1:2 year return storm event. An excavator or crane will be available on-site during construction to remove the bridge promptly. As an additional measure, NS Power has the option to close the vertical lift sluice bay to hold back water from moving downstream. During the drawdown, the headpond will be lowered to an elevation of 91 ft, which allows for a 9 ft elevation increase should storm conditions arise. Should more significant sustained inflows or a higher return period flood event be forecasted, NS Power will develop a plan for additional contingency measures. Upstream access roads will consist of clean rockfill material; if in the event migration measures are required, the associated risk of sedimentation is extremely low.

If significant discharge is anticipated downstream of the dam, NS Power may make adjustments to the downstream temporary access road to accommodate the additional flows. This may involve the removal of access road material and prepping sections of the access road to allow water to pass safely beyond it. The downstream access road / bridge will comprise clean rockfill material and clean preformed concrete blocks. If in the event migration of material is observed, the associated risk of sedimentation is extremely low. NS Power will assess the access road material migration once water levels have receded. Since the headpond will be drawn down to 91.0 ft, NS Power has the ability to attenuate water in order to implement contingency measures, if necessary.

4.3 Erosion and Sedimentation Control

Erosion and sedimentation control materials such as hay, silt fencing, etc., will be used to control sediment laden water from entering the headpond while it is dewatered. Any silt-laden water in the work area will be recovered and pumped away from the headpond to areas with sufficient vegetation to facilitate filtration. The headpond will be recharged at a controlled rate with NS Power personnel monitoring for any visible water quality issues. NS Power is not anticipating any issues with erosion or scour when passing the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. Hydro Operations has confirmed that spill in excess of 500 cfs is very common, and a spill in excess of 1,000 cfs (equivalent to both generating units running) is common with 6-12 occurrences annually. Bi-annual inspections and weekly checks are conducted downstream of the Ruth Falls Dam. Observations during the inspections and checks indicate that scour is not of concern when spilling in excess of 500 cfs.

NS Power Project personnel will remain in regular contact with Hydro Operations personnel throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

All access road material will be clean, appropriately sourced rock material that is free of fines, to significantly reduce potential sedimentation of the upstream and downstream work areas. Rockfill cofferdams have been used by NS Power on other hydro refurbishment projects and have

proven to have little effect on sedimentation of the surrounding watercourse, even during periods of high inflows/discharge. Pumps will be used, as required, to assist with removing any silt laden water, which will be pumped to a designated area.

The proposed scope of work for the Project involves minimal excavation of soil material, as the focus of construction is the refurbishment of the existing concrete dam structure. The primary method of erosion and sedimentation control is the water management strategy outlined in section 4.1.

There will be some excavation of the right (west) abutment retaining wall that is scheduled for removal and replacement. During construction activities for the retaining wall, silt fencing will be used along the boundary of the spillway bank to protect the adjacent spillway channel. The excavation for the retaining wall is anticipated to be small and as such, soil material will not be exposed for a significant length of time. Pumps will be used to keep the retaining wall work area dry and silt laden water will be pumped to the west of the dam in an area designated as acceptable to filter water prior to re-entry into a watercourse. Hay will be used to cover any temporarily exposed work areas, as required. Based on initial scoping of surrounding lands, NS Power has identified two potential areas to be used for water filtration areas or installation of sediment traps. One area is immediately west of the dam and the other is located north east of the dam, see Figure 1 below. Both areas are on NS Power property and have been evaluated for possible wetland/rare species habitat. Both areas are forested and provide suitable vegetation to aid in water filtration. Additional field scoping will be completed to confirm areas to be used and method of water filtration.

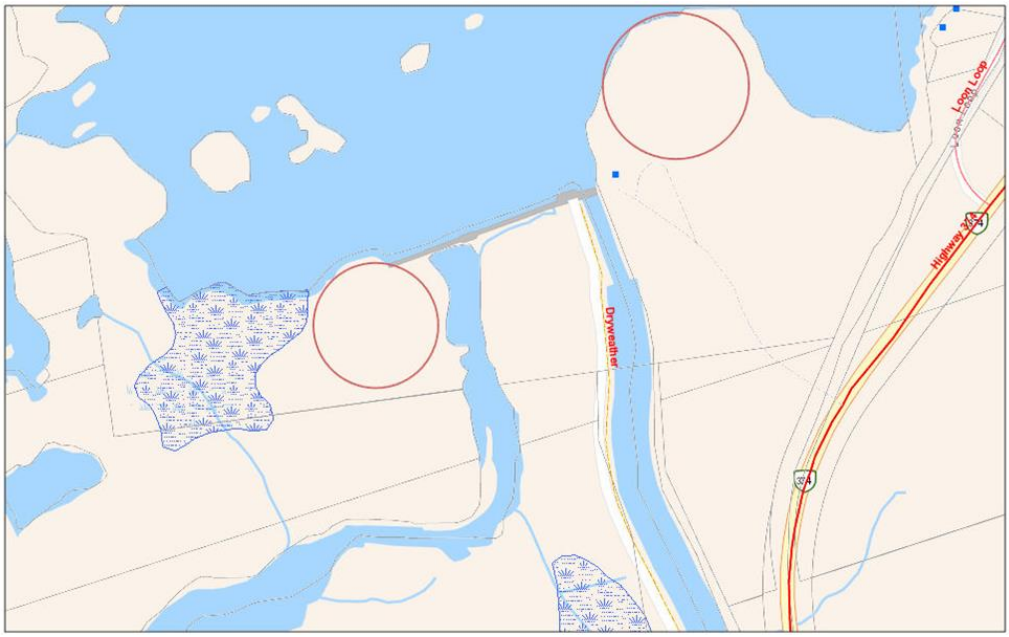


Figure 1: Potential locations for water filtration to support pumping activities. Areas to be field verified in spring 2022.

The removal of cofferdam material will take place with Ruth Falls Headpond at elevation 91 ft, which will allow for visual observation of the majority of material being removed. Washed rock will be used to ensure no silt or fines interacts with the watercourse. Siltation monitoring will take place as debris from the access road is removed. Monitoring will be carried out by NS Power downstream during the removal to ensure siltation is not occurring.

The selected contractor for the Project will be required to submit a site-specific erosion and sedimentation control plan designed for the planned scope of work. This will include identification of any additional site-specific controls required and location of water filtration operations or requirements for sediment traps for pumping activities. NS Power would request that, if required, a condition be incorporated into the Approval, if issued, for NS Power to provide a site-specific plan to confirm the above outlined measures prior to construction activities starting. Additional impacts as a result of sedimentation beyond the in-water work window (June 1 – September 30) are unlikely. In addition to the mitigation measures discussed above, NS Power will monitor weather closely to ensure appropriate planning/mitigation is in place prior to a heavy rain event. This may include temporary closure/stabilization of site, temporary work stoppage, or removal of access road sections to allow for increased passage of water. Site inspections will be completed immediately after heavy rain events to monitor for erosion or sedimentation issues.

NS Power will also require the general civil contractor to implement daily site inspections and completes overarching environmental inspections on a weekly basis during construction. This will allow NS Power to ensure compliance to regulatory requirements and best practices, while ensuring deficiencies are assigned an appropriate corrective action to be addressed in a timely manner.

4.4 Water Quality

NS Power conducts water quality surveys as part of the hydro relicensing program, the process by which the water approvals for storage/withdrawal are renewed for each hydro system. Relicensing studies for the Sheet Harbour Hydro System were completed in 2017 in preparation for the relicensing of this system. The water quality surveys completed for the headpond show acidic conditions with an in-situ pH range of 4.43-4.52, presence of phosphorus and chlorophyll and good conductivity. Based on these results, the headpond is classified as meso-eutrophic or eutrophic. A small thermocline was observed at 3.2 ft (1 m) depth; however, dissolved oxygen remained consistent to sample depth 19.7 ft (6 m).

Using available bathymetry for the headpond (see Appendix A), approximately 0.5 miles square (1.15 km^2) of total shoreline will be exposed as a result of a drawdown to 91.0 ft from FSL. The majority of shoreline to be exposed is very shallow under normal FSL of 109.25 ft, with depths of less than 9.8 ft (3 m). At an elevation of 91.0 ft, the headpond will look similar to pre-inundation conditions of the East and Grant Rivers. It is unknown how the drawdown of approximately 18 ft for a period of 9 months will influence water quality; however, it is expected that inflows from Grant River, and small inflows from Malay Falls will provide continuous oxygenated water to Ruth Falls Headpond throughout the drawdown. It is unknown how much inflow is contributed by the

Grant River Watershed; although, inflows from this watershed were included in the 2008 Flood Study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

NS Power proposes to complete monthly water quality sampling from a deeper area of the headpond, to compare various water quality parameters with those observed under normal operation. NS Power will use the location of the water quality sample site used during the 2017 relicensing of the Sheet Harbour Hydro System for direct comparison to normal operating conditions. Water quality sampling will be completed from July to November for temperature, dissolved oxygen, total suspended solids and turbidity.

The monitoring site for monthly sampling will be established at the deepest part of the headpond, using available bathymetry or manual soundings if bathymetry is not available.

Monthly monitoring will be conducted from July to November and will include the following parameters:

- Secchi depth
- Temperature
- Dissolved oxygen
- Nutrient content (lab analysis)

In addition, NS Power will install a temperature logger for continuous temperature monitoring, providing readings every hour. NS Power will use 23 degrees Celsius in the main body of each lake as an indicator of normal temperatures expected in the headpond for July-November.

4.5 Wetland and Rare Plants

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. Twenty-one (21) wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was not identified during the 2007 survey. For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond.

Table 4 shows the type of each wetland mapped in 2007; 6 of the 21 wetlands identified at the time of the survey where characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered.

Wetland ID Number	Wetland Type	Wetland Description
1	Coniferous treed shore bog	No
2	Coniferous treed shore bog	No
3	Coniferous treed shore bog (two subtypes)	Yes
4	Shore bog	Yes
5	Shore bog	No
6	Wetland complex composed of coniferous treed shore bog and floating bog (two subtypes)	Yes
7	Shore bog	Yes
8	Shore bog	No
9	Shore bog	No
10	Shore bog	No
11	Shore bog	Yes
12	Shore bog	No
13	Shore bog	No
14	Shore bog	No
15	Wetland complex composed of coniferous treed shore bog and coniferous treed shore swamp	Yes
16	Coniferous treed shore bog	No
17	Shore bog	No
18	Coniferous treed shore bog	No
19	Shore bog	No
20	Shore bog	No
21	Shore bog	No

Table 4: Wetlands Found Within the Littoral Zone of Ruth Falls Headpond.

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. In examining the ACCDC search completed in 2017 for the previous relicensing of the Sheet Harbour Hydro System, 4 records of potentially rare or endangered species are found in close proximity to Ruth Falls Headpond, see Figure 3. There are two records of Salted shell lichen (Coccocarpia palmicola) located in a wetland on the northwest portion of the headpond, which appears to be hydraulically connected by a small stream. Salted shell lichen is listed as secure within the NS General Status Rank. There are also two records of Ruby-crowned Kinglet (Regulus calendula) on the east side of the headpond along the Lochaber Mines Road. Ruby-crowned Kinglet is listed as Sensitive within the NS General Status Rank. Neither of these species are anticipated to be impacted by the drawdown of Ruth Falls Headpond.

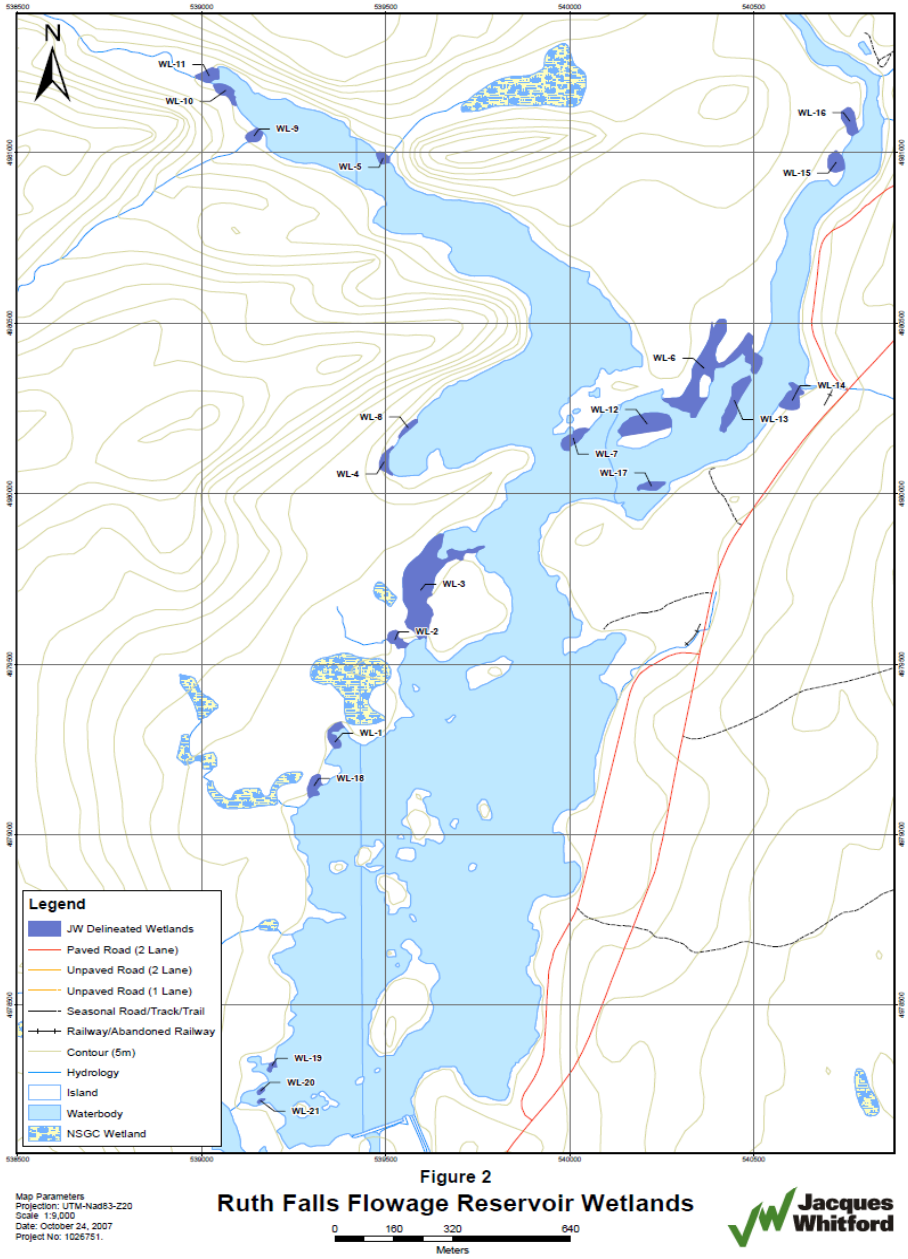


Figure 2: Mapped wetlands on Ruth Falls Headpond (2007).

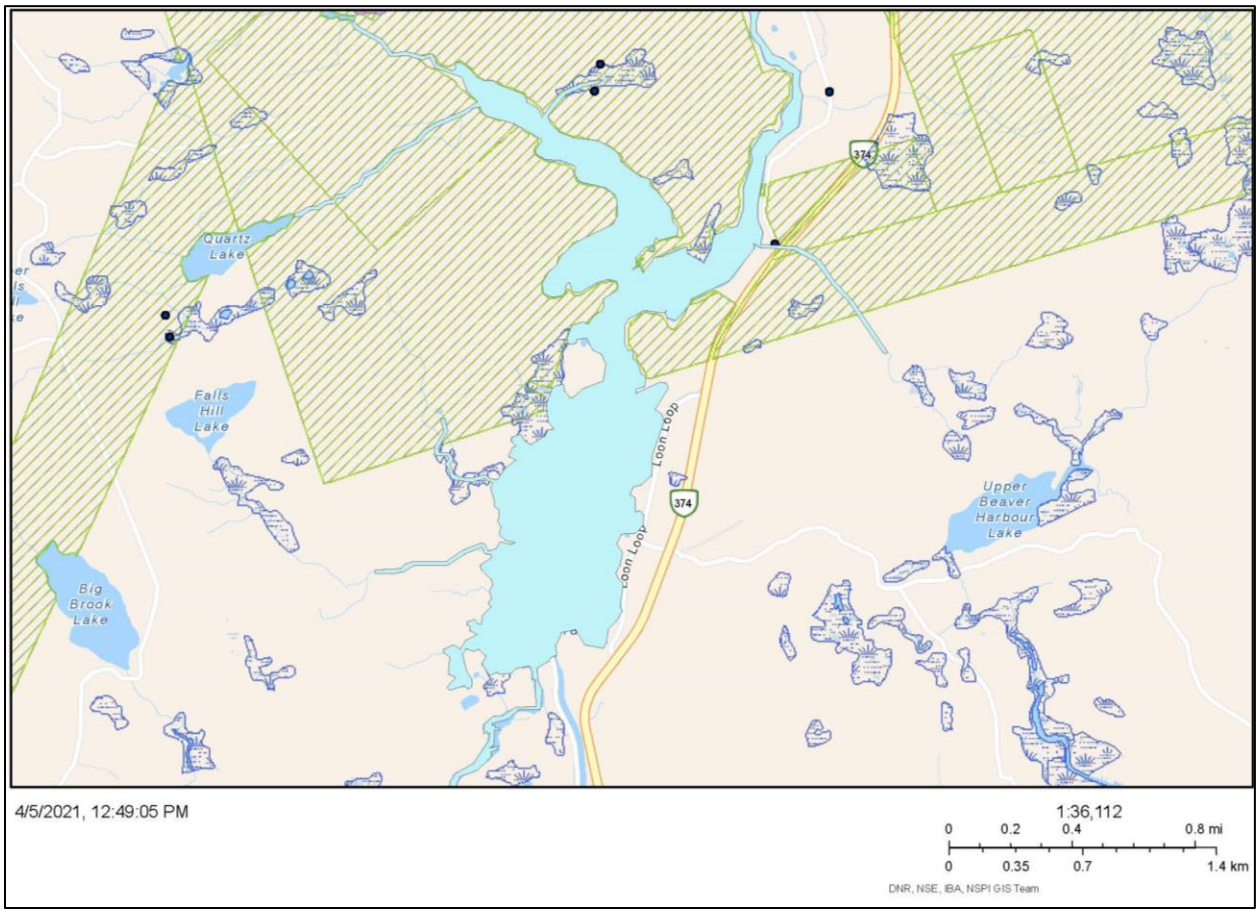


Figure 3: NS Department of Lands and Forestry Wetland Inventory Mapping and ACCDC Search Points

Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown (9 months), NS Power is not anticipating long term impact to species composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of the Ruth Falls Headpond for a 9 month period is unknown. NS Power proposes to contract a third-party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels, water levels, and impacts to fish and fish habitat throughout the duration of the Project. NS Power will submit a wetland monitoring plan to ECC prior to March 31st, 2022.

4.6 Construction Material and Debris

Measures will be taken to prevent any materials used in the various work activities from entering the watercourse. All such materials will be applied in a controlled manner and any excess material will be contained during application. All construction debris will be stored on NS Power property

or disposed to an approved landfill. Any debris that requires disposal will be done so in accordance with NSECC Construction and Demolition Debris Disposal Site Guidelines.

4.7 Equipment and Machinery

All equipment and machinery required to be operated on or near a body of water will be mechanically sound with no leaking fuel tanks or hydraulic connections. Refuelling and lubrication shall be in designated areas not within 30 m of any wetland or water body. Storage of petroleum products will be at least 100 m from a water body. Machinery and equipment will be stored above flood water levels. Oil spill contingency plans will be followed, and spill kits maintained on-site, in the event a petroleum product spill occurs.

4.9 Rehabilitation

Following any excavation and placement activities, areas disturbed by machinery or equipment will be returned to pre-construction condition. Any exposed soil areas will be stabilized to prevent erosion. In the event that long-term erosion problems, resulting from the clearing of the area, cannot be dealt with at the time construction is complete, temporary measures shall be taken.

5.0 ARCHAEOLOGICAL CONSIDERATIONS

An Archaeological Screening and Reconnaissance (ARIA) for the Ruth Falls Headpond was completed in 2017. The purpose of the ARIA was to assess the potential for archaeological resources in the project area, which included approximately 5 hectares surrounding the dam and earthen embankment primarily on the downstream side. The ARIA included a background study and visual assessment of the study area. The assessment identified three areas considered to exhibit high potential for encountering Precontact and/or early historic Native archaeological resources and/or historic Euro-Canadian archaeological resources. It was recommended that if these areas could not be avoided, shovel testing be conducted.

Shovel testing in 2 of the identified areas was conducted in 2018 and included 64 shovel tests. No archaeological resources were encountered and no evidence of historically significant cultural modification was identified during the course of the shovel testing. Based on the results of the 2018 shovel testing, the potential for encountering significant, intact archaeological resources within the two areas is considered to be low. It was recommended that the two shovel tested areas be cleared of any requirement for further archaeological investigation and that development within these areas may proceed as planned.

During the drawdown, archaeological reconnaissance will take place within the Ruth Falls Headpond by a qualified Archaeologist. The objective of the reconnaissance is to inspect the exposed shoreline for evidence of any previously unrecorded archaeological resources within the

dewatered reservoir. In the event that archaeological resources are identified during the archaeological reconnaissance, it is proposed that two separate rounds of documentation and mitigative artifact collection will be conducted during the course of the drawdown.

6.0 ABORIGINAL ENGAGEMENT

NS Power initiated engagement regarding the Ruth Falls Main Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant project information with the KMKNO throughout 2018 providing six project updates, the project was deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018 at the One Window Meeting with KMKNO. NS Power continued to provide monthly Project updates and share relevant project information throughout 2019, working towards a preferred design option and planning for the Project to be completed in 2020. NS Power further presented the Project and design option with the KMKNO during the One Window meeting to discuss 2020 hydro capital projects.

In January 2020, NS Power initiated engagement with the Mi'kmaw Conservation Group to collaborate on an offsetting project. NS Power, in February and March 2020, continued engagement with the Mi'kmaw Conservation Group, continuing discussions to identify an offsetting project with the group and the Millbrook Mi'kmaw community. NS Power continued to engage with Millbrook throughout 2020 but was not able to share any new information on the Project due the Project deferral to 2021. During this time, NS Power has been working with the Mi'kmaw Conservation Group (MCG) of the Confederacy of Mainland Mi'kmaq (CMM) to collaborate with Millbrook First Nation on an offsetting plan for potential impacts to fish and fish habitat that are anticipated as a result of the Project. This offsetting Project will be included with NS Power's Application for Authorization to DFO. In 2021, NS Power re-initiated engagement with Millbrook First Nation and attended a Chief and Council meeting on April 20th, to share updated information on the Project.

NS Power will continue engagement regarding the project with monthly project updates to the KMKNO and notifications regarding the permitting schedule for the submission of an NSECC Watercourse Alteration application. Weekly project manager communications will be provided to the KMKNO, as construction begins, currently scheduled for July 2022 – March 2023.

APPENDIX A – HYDRO SYSTEM OVERVIEW

1. Sheet Harbour Hydro System Map
2. Ruth Falls Plan View
3. Ruth Falls Reservoir Bathymetry

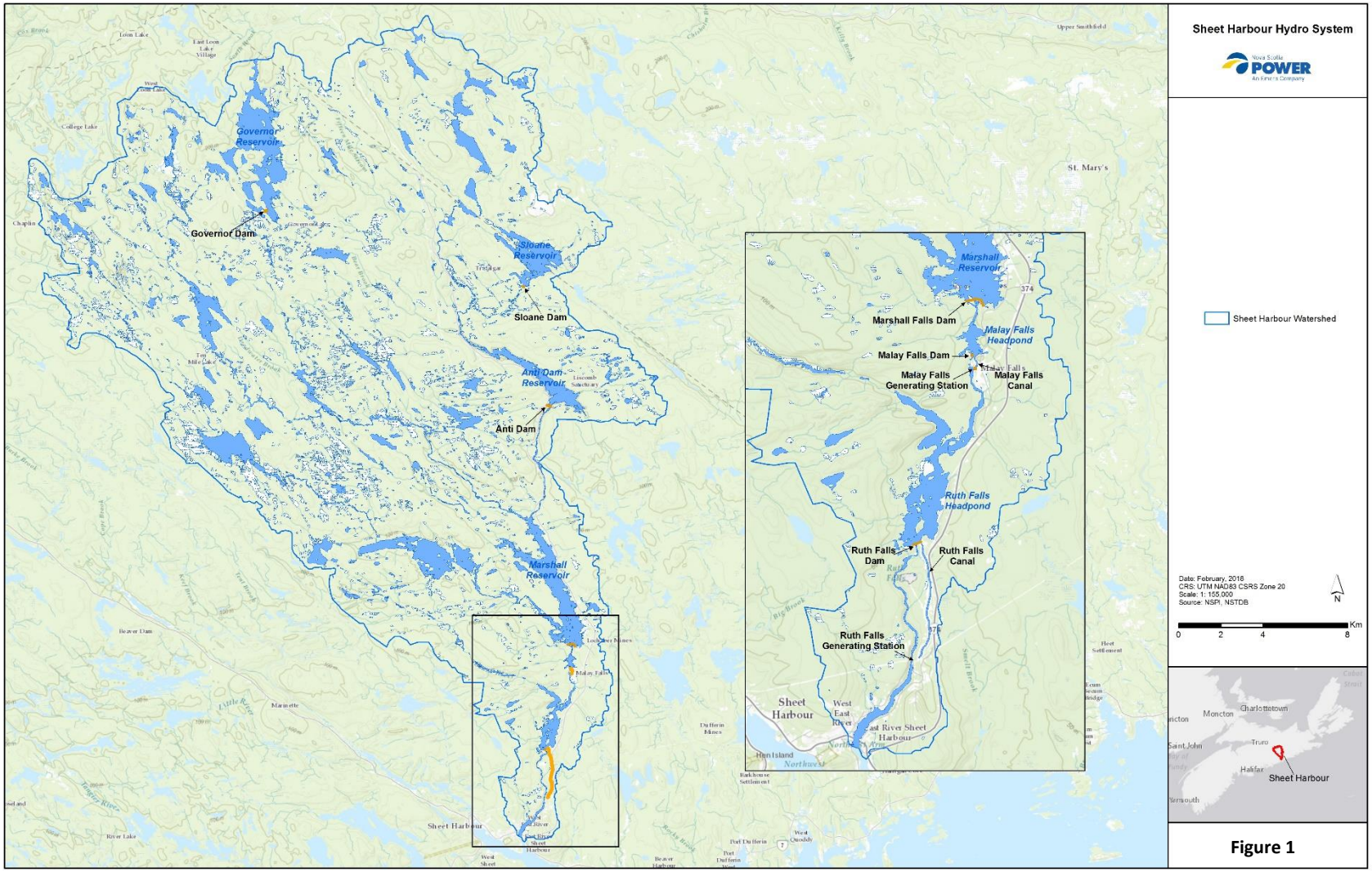

Governor Reservoir
Governor Dam
Sloane Reservoir
Sloane Dam
Anti Dam Reservoir
Anti Dam
Marshall Reservoir
Marshall Falls Dam
Malay Falls Headpond
Malay Falls Dam
Malay Falls Generating Station
Malay Falls Canal
Ruth Falls Headpond
Ruth Falls Dam
Ruth Falls Canal
Ruth Falls Generating Station
Sheet Harbour
West East River
East River Sheet Harbour
Sheet Harbour Hydro System
Sheet Harbour Watershed
Date: February, 2016
CRS: UTM NAD83 CSRS Zone 20
Scale: 1: 155,000
Source: NSPI, NSTDB
Km
0
2
4
8
Moncton
Charlottetown
Saint John
Truro
Halifax
Sheet Harbour

Figure 1

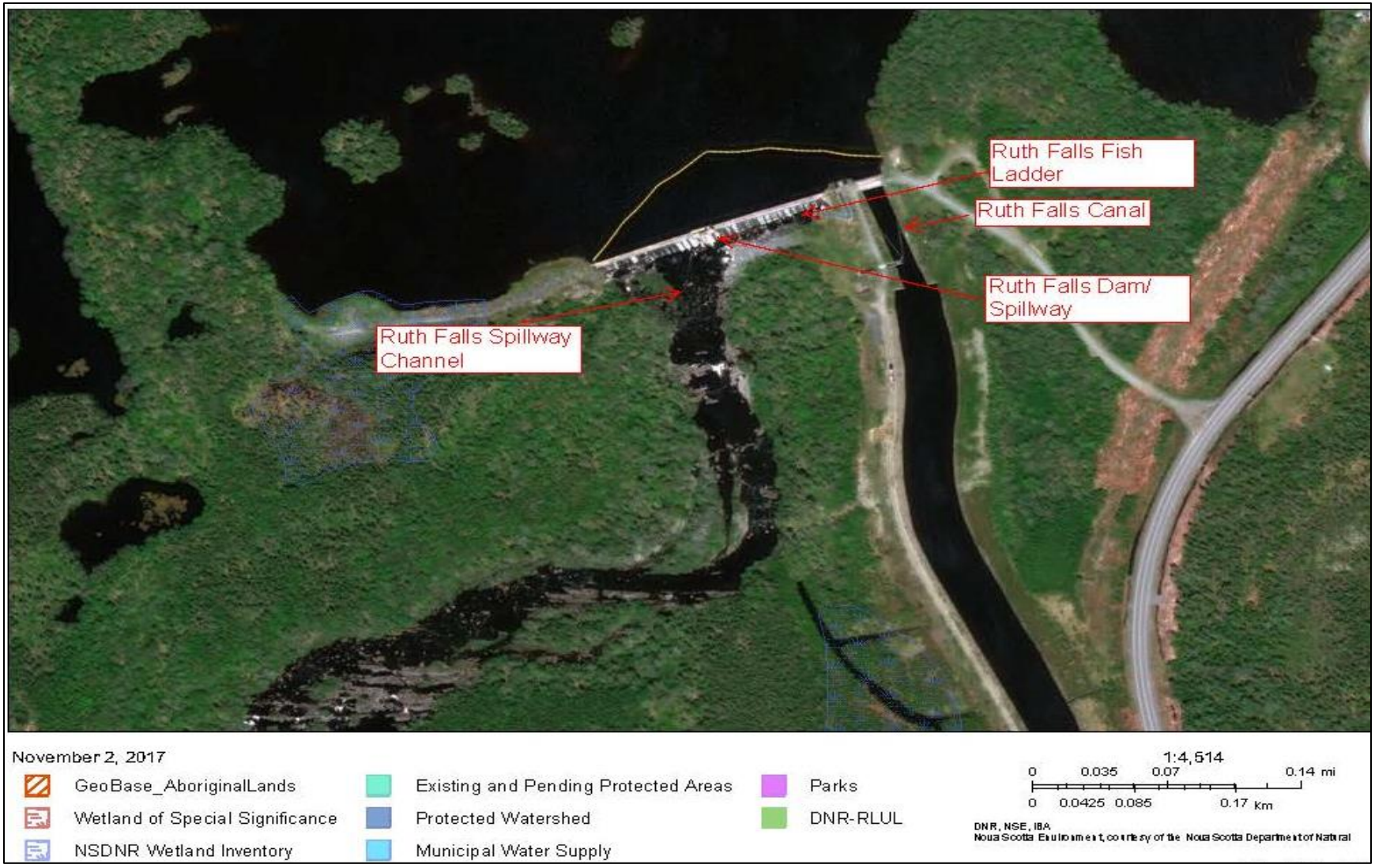


Figure 3. Ruth Falls Plan View

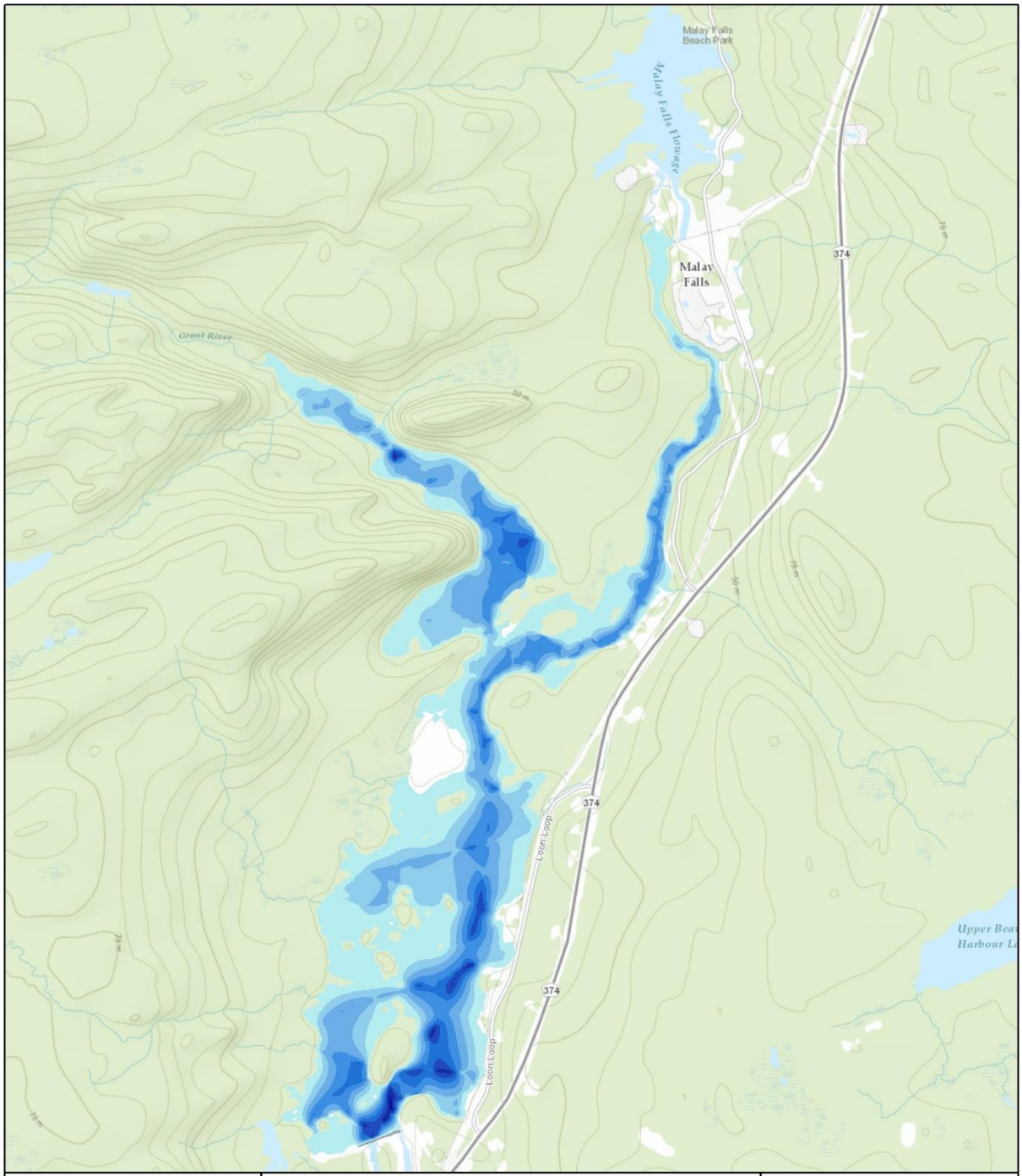

Malay Falls Beach Park
Malay Falls Flowage
Malay Falls
374
Grant River
50 m
75 m
Loon Loop
Upper Beaver Harbour Lake
Ruth Falls Headpond Bathymetry
Nova Scotia POWER An Emera Company
Depth in meters
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1:20,000
Source: NSPI
N
Km
0
0.225
0.45
0.9

Figure 2

APPENDIX B – SITE PHOTOS



Photo 1: View of Ruth Falls Dam, facing north



Photo 2: View of Ruth Falls Dam, facing west



Photo 3: Ruth Falls fishladder and bypass pipe



Photo 4: Downstream of Ruth Falls Dam



Photo 5. Upstream of Ruth Falls Dam

Nova Scotia POWER
An Emera Company

APPENDIX C – PROPOSED WATER MANAGEMENT STRUCTURES

APPENDIX D – ENGINEERING DRAWINGS

APPENDIX E – NS WATERCOURSE ALTERNATION SIZING CALCULATIONS

February 4, 2022

Ms. Kailey Osborne
Nova Scotia Power Inc.
1223 Lower Water St.
Halifax, NS B3J 3S8

Dear Ms. Osborne,

Re: Wetland and Wetland Fish Habitat Monitoring Plan
Ruth Falls Reservoir, Sheet Harbour, NS

INTRODUCTION

Nova Scotia Power Inc. (NSPI) is planning to temporarily lower the headpond at the Ruth Falls Reservoir within the Sheet Harbour Hydroelectric System to accommodate refurbishments at the Ruth Falls Reservoir (the Project). Strum Consulting was retained by NSPI to develop a Wetland and Wetland Fish Habitat Monitoring Plan (the Plan) for the Project.

The objective of the Plan is to determine whether the function of wetlands located along the shore that are contiguous with the headpond are impacted as a result of the lowered water levels. Additionally, the Plan will assess the impact on potential fish habitat provided by these wetlands.

The Plan will outline the general principles and methodology by which the wetlands and fish habitat around the Ruth Falls headpond will be monitored, before and after the water level is altered.

PROJECT DETAILS

In order to accommodate refurbishments at the Ruth Falls Reservoir, the water level in the headpond will be dropped from a full supply level of 109.25 ft down to 91 ft. The headpond will remain lowered for a period of approximately 9 months while work is completed on the Reservoir.

Wetlands

Wetland delineation was completed along the shores of the Ruth Falls Reservoir during the *Vegetation Surveys at the Sheet Harbour Hydroelectric System* completed by Jacques Whitford (JW) in 2007 (JW, 2007). As a result of this delineation, 21 wetlands were identified that are contiguous with the headpond (Table 1; see attached figure).

Table 1. Wetlands identified at the Ruth Falls Reservoir (Jacques Whitford, 2007)

Wetland ID	Wetland Type
1	Treed shore bog
2	Treed shore bog
3	Treed shore bog
4	Shore bog
5	Shore bog
6	Treed shore bog/ floating bog
7	Shore bog
8	Shore bog
9	Shore bog
10	Shore bog
11	Shore bog
12	Shore bog
13	Shore bog
14	Shore bog
15	Treed shore bog/ treed shore swamp
16	Treed shore bog
17	Shore bog
18	Treed shore bog
19	Shore bog
20	Shore bog
21	Shore bog

Fish Sampling

Fish species data collected within the Sheet Harbour hydroelectric system will be provided to Strum by NSPI; historical data will be used to establish baseline conditions and inform fish habitat post-construction monitoring assessments.

WETLAND MONITORING

The wetlands, as identified by Jacques Whitford (2007), will provide the initial wetland assessment information; Strum will rely on this previously collected data to select and complete their assessment on six of these identified wetlands.

Wetland monitoring activities will consist of one pre-construction assessment and 5 years of post-construction monitoring. Pre-construction monitoring will be completed prior to the headpond being lowered to establish baseline conditions. Post-construction monitoring will begin after refurbishments are concluded and the Ruth Falls Reservoir water level has been returned to its pre-construction full supply level. The findings of the monitoring program will allow for an evaluation of the extent of any changes in wetland characteristics and function as a result of the lowered water levels within the headpond.

Wetland monitoring activities will be completed within six of the previously identified wetlands. The six wetlands to be monitored will be selected to provide a representative sample of the wetland types located around the headpond.

Methodology

Wetland monitoring will include detailed vegetative, hydrological, and soil monitoring within the six selected wetlands. Each wetland to be monitored will be delineated prior to the commencement of monitoring activities to ensure that wetland boundaries are accurate and up-to-date.

Vegetative monitoring will entail the assessment of vegetative composition and cover within quadrats along a transect. The linear transect will consist of a series of four 1 m x 1 m quadrats placed 5-10 m apart along the transect route. Percent cover of the herbaceous, shrub/sapling, and tree species within each quadrat will be assessed. The top right corner of each quadrat will be staked to ensure that the selected areas can be replicated for future monitoring events. Additionally, dominant plant species throughout the wetland, as identified along the transect, will be determined for each stratum based on the percentage of aerial cover. A general assessment will be made to determine overall plant health and note any species that appear to be unhealthy or dying.

Monitoring wells will also be installed manually within each of the six selected wetlands using a hand auger/shovel. A minimum of one monitoring well will be included per wetland. Water level measurements will be documented within each well.

Soil test pits will also be incorporated via manual installation (auger, shovel). Indicators of wetland hydrology will be noted, including soil saturation, water table level, and standing water. Soil type(s) within each test pit will also be identified and recorded.

Photographs will be taken of the wetland from a fixed location (identified via GPS) for comparison with future events. All monitoring methodology will be completed during pre-construction and post-construction monitoring events. Monitoring events will be conducted by a trained biologist and will take place within the growing season (June 1 – September 30) to capture the prime growth period for plants and assess dry season conditions. Subsequent monitoring events will be timed to coincide with previous years' assessment dates to allow data comparisons to be made with previous and future monitoring events.

A description of the monitoring parameters and assessment methodology for wetlands is provided in Table 2, below. All data gathering techniques will be replicated for each subsequent monitoring event.

Table 2. Wetland Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Methods of Assessment
Hydrology	Depth to groundwater will be measured in monitoring wells.
	Standing water depth measurements will be noted within the existing wetland (if applicable).
	Evidence of other positive indicators of hydrology (*e.g.*, drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen sulphide odour in soils, water marks etc.) will be noted.
	An assessment of the general hydrologic condition will be made.
Vegetation	Herbaceous vegetation assessments (as % cover) will be completed within plots along a vegetative transect throughout the wetland. Assessment of the potential changes in composition, species, and health will be evaluated. Photographs will be taken of each individual vegetation plot for comparison with future monitoring events. Any presence of non-native/exotic species will be noted during all surveys, and are addressed specifically in the WESP-AC assessment.
	General assessment of the above variables throughout the wetland will be completed.
	Dominant plant species throughout the wetland will be determined for each stratum based on the percentage of aerial cover.
	Photographs will be taken of the wetland from a fixed location for comparison with future monitoring events.
Soils	Soil type within test pits will be noted and recorded.
	Assessment of potential changes in soil conditions throughout the wetland habitat will be evaluated, including evidence of sedimentation and siltation.

Wetland Functional Assessments (WESP-AC)

WESP-AC will be completed during the pre-construction surveys and again during the Year 5 post-construction monitoring event to assess whether the function and values of the wetlands were changed as a result of the Project.

WETLAND FISH HABITAT MONITORING

Review of Fish Sampling Results

A review of all fish sampling conducted by NSPI will be completed for all data available prior to the commencement of monitoring. The review will involve data compilation of fish species and abundance, information related to migratory periods (including applicable date ranges and species types observed), and identified species' habitat requirements.

Desktop Fish Habitat Suitability Review

Prior to the commencement of monitoring, a desktop fish habitat suitability review will be completed to assess the quality of fish habitat provided by both the Ruth Falls Reservoir and the wetlands contiguous with the Reservoir's shoreline. This review will identify the wetlands that provide valuable fish habitat and inform the selection of wetlands for both wetland monitoring and wetland fish habitat monitoring, and may include the following:

- Accessibility to fish
- Provision of fish cover
- Provision of water quality control features
- Potential sources of food and nutrition
- Bathymetry and water depth of the reservoir
- Review of fish sampling results (see above)

Based on this assessment, the six wetlands that are most likely to provide suitable fish habitat will be selected for wetland and wetland fish habitat monitoring.

Assumptions for Fish Habitat Assessments

Fish habitat field surveys are to be modelled after the Ontario Ministry of Natural Resources Procedure (1991) for the Bay of Quinte. Given that the habitat assessments are taking place along the shoreline of a body of (relatively) still water, rather than along a watercourse, the application of flow assessments and fish habitat in streams is less transferable and resources such as the Nova Scotia Fish Habitat Suitability Assessment (NS Adopt-a-stream, 2018), are not as applicable.

Given NSPI's ongoing fish monitoring at the Ruth Falls fish ladder, it is our assumption that fish are present in the Reservoir, and that there are fish that use the habitats to be surveyed. Therefore, minimizing damage and disruption to fish in sensitive situations, such as breeding, will take priority over the collection of any single data point. If fish breeding evidence is encountered during surveys, those effected data points may be omitted. NSPI may also want to consider structuring their work schedule around the known breeding periods of any species of conservation interest, including Atlantic salmon (*Salmo salar*).

Methodology for Fish Habitat Field Assessments

The requirements for the baseline and subsequent fish habitat monitoring are described below in detail, including the timing of each of the field and desktop components.

The initial baseline surveys for fish habitat identification and classification will be conducted by a trained biologist and will take place within the growing season (June 1 – September 30). The baseline surveys will be conducted at six different wetlands surrounding the Ruth Falls Reservoir, shortly before drawdown is to begin. The wetlands to be surveyed for fish habitat will be the same as the wetlands chosen for Wetland Monitoring; this will be done for both logistical purposes and to incorporate the consideration of fish habitat and details associated with water quality which will be collected during the WESP-AC assessments. The monitoring schedule will proceed as outlined in the Proposed Schedule and Reporting section of this Plan.

Following the procedure outlined in the Ontario Ministry of Natural Resources (1991) document, transects will be walked from the Open Lake inland, through the Lakeshore and into the backshore. General observations will be made, and specific parameters will be assessed for their likelihood to support fish habitat, as seen in Table 3, below.

Along the specific transects, the portions of each transect to be assessed will be defined as follows:

Open Lake (OL): Open Lake is the area that is completely inundated with water, and can be definitively considered fish habitat. There may be any combination of emergent, floating and submerged vegetation, though the water depth should be no more than 50 cm. The Open Lake area must also be connected to the main water body of the Reservoir so as to allow fish passage.

Lakeshore (LS): The Lakeshore (also known as the Foreshore) is the area that is generally above the current water level of the lake (Reservoir), but below the highwater line on an annual basis. This area might be considered fish habitat, though fish habitat should not be considered a requirement. There is wetland vegetation, with the potential for some aquatic vegetation, especially when in proximity to the Open Lake area. The point for the LS assessment should be where there is a transition from standing water to no standing water.

Backshore (BS): The Backshore is the area at least 30 m perpendicular inland to the shore's highwater line and it should not be saturated in water, though it can be wetland or upland. It is not considered fish habitat and should not be accessible to fish.

The parameters to be monitored at each portion of the transect (i.e., OL, LS and BS) are described in Table 3.

Table 3: Wetland Fish Habitat Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Transect Portion to be assessed	Methods of Assessment
Photos	OL, LS, BS	Photos will be taken of the substrate (where applicable), vegetation, surrounding habitat, and any other observations of note.
GPS	OL, LS, BS	GPS waypoints will be taken in order to accurately map results and track the movement of OL and LS waypoints based on de-watering activities.
Vegetation	OL, LS, BS	Any vegetation species within a 5 m radius will be recorded, and the relative abundance as a percent cover within each stratum within a 30 m radius will be estimated.
Aquatic vegetation	OL, LS	Any water-bound vegetation species will be noted within a 5 m radius and the relative abundance as a percent cover within a 30 m radius will be estimated.
Water Quality	OL, LS	Standard parameters including pH, conductivity, temperature, and dissolved oxygen will be measured using a YSI Multiparameter meter where open water is present and can be accessed safely. At the Lake Shore area, this may not be possible given differing water levels and vegetation constraints.
Substrate	OL, LS, BS	Substrate types and relative abundance will be noted, including bedrock, boulders, rubble, cobble, gravel, sand, detritus, and fines/muck/silt.

Monitoring Parameter	Transect Portion to be assessed	Methods of Assessment
Water Level/Depth	OL, LS	The depth or level of water compared to the substrate should be measured using a measuring device. The use of a piezometer for continuous measurement may be required in conjunction with, or as a replacement to, any monitoring wells installed within the wetlands to be monitored.

Given that the water level will significantly change during the drawdown, the transects where the assessment points are taken will remain the same, however, new assessment points will be added at each of the monitoring sites to reflect the changing OL and LS locations. The transect lines will still inform the placement of those points of assessment, however, if safety challenges prevent access to a specific location, the point will be moved to a nearby and comparable safe location, or omitted entirely if accessible and representative habitat is not present. Upon water levels rising to pre-construction levels (or as close as can be expected in post-construction conditions), the original assessment points will be resumed for all post-construction monitoring.

In all cases, the assessment points and transects will be chosen in order to best represent the surrounding habitats.

PROPOSED SCHEDULE AND REPORTING

Annual post-construction monitoring reports will be submitted to Nova Scotia Environment and Climate Change (NSECC) for the five years of post-construction monitoring. Vegetation results shall be provided in a cumulative table to allow for inter-annual comparison of data. Table 4 outlines the monitoring and reporting schedule for the Wetland Monitoring Program, while Table 5 outlines the monitoring and reporting schedule for the Wetland Fish Habitat Monitoring Program.

Table 4. Monitoring and Reporting Schedule for Wetland Monitoring

Monitoring Event		Wetland Monitoring	WESP-AC	Reporting Submission to NSECC
Pre-construction	Baseline	✓	✓	
Post-construction	Year 1	✓		✓
	Year 2	✓		✓
	Year 3	✓		✓
	Year 4	✓		✓
	Year 5	✓	✓	✓

Information collected from post-construction monitoring events will be compared with the baseline data collected during the pre-construction monitoring events and previous years' monitoring events to evaluate post-construction vegetation (e.g., wetland and vegetation present, invasion of exotic species, success of any re-vegetation, etc.), hydrology, and soils. After Year 5, potential long-term impacts to the wetlands will be assessed and required consultation with NSECC will take place.

Table 5. Monitoring and Reporting Schedule for Wetland Fish Habitat Monitoring

Monitoring Event		Fish Habitat Transect Monitoring	Desktop Review of Fish Data	Reporting Submission to NSECC & DFO
Pre-construction	Baseline	✓	✓	✓
During Construction*	1 week after drawdown	✓	✓	✓
	End of growing season during drawdown/construction	✓	✓	✓
Post Construction*	1 week after water level is restored	✓	✓	✓
	Year 1	✓	✓	✓
	Year 2	✓	✓	✓
	Year 3	✓	✓	✓
	Year 4	✓	✓	✓
	Year 5	✓	✓	✓

*Monitoring may be limited depending on the time of year when construction is to be completed, *i.e.,* if construction is completed in January, the first post-construction survey will not be completed before the growing season begins in June.

Information during post-construction monitoring will be used to inform reports submitted to NSECC and Fisheries and Oceans Canada (DFO) on an annual basis, while further consultation with each respective governing body may be required after the post-construction monitoring is completed.

If you have any questions, please contact us.

Thank you,

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REFERENCES

Jacques Whitford. 2007. *Report – Vegetation Surveys at the Sheet Harbour Hydroelectric System*. Project No. 1026751.

NSLC Adopt a Stream and Nova Scotia Salmon Association. 2018. *The Nova Scotia Fish Habitat Suitability Assessment – A Field Methods Manual Version 2.1.* pp. 1-46.

Ontario Ministry of Natural Resources. 1991. *Procedures Manual for Mapping Fish Habitat along the Nearshore Zone of the Bay of Quinte.* pp. 1-61.

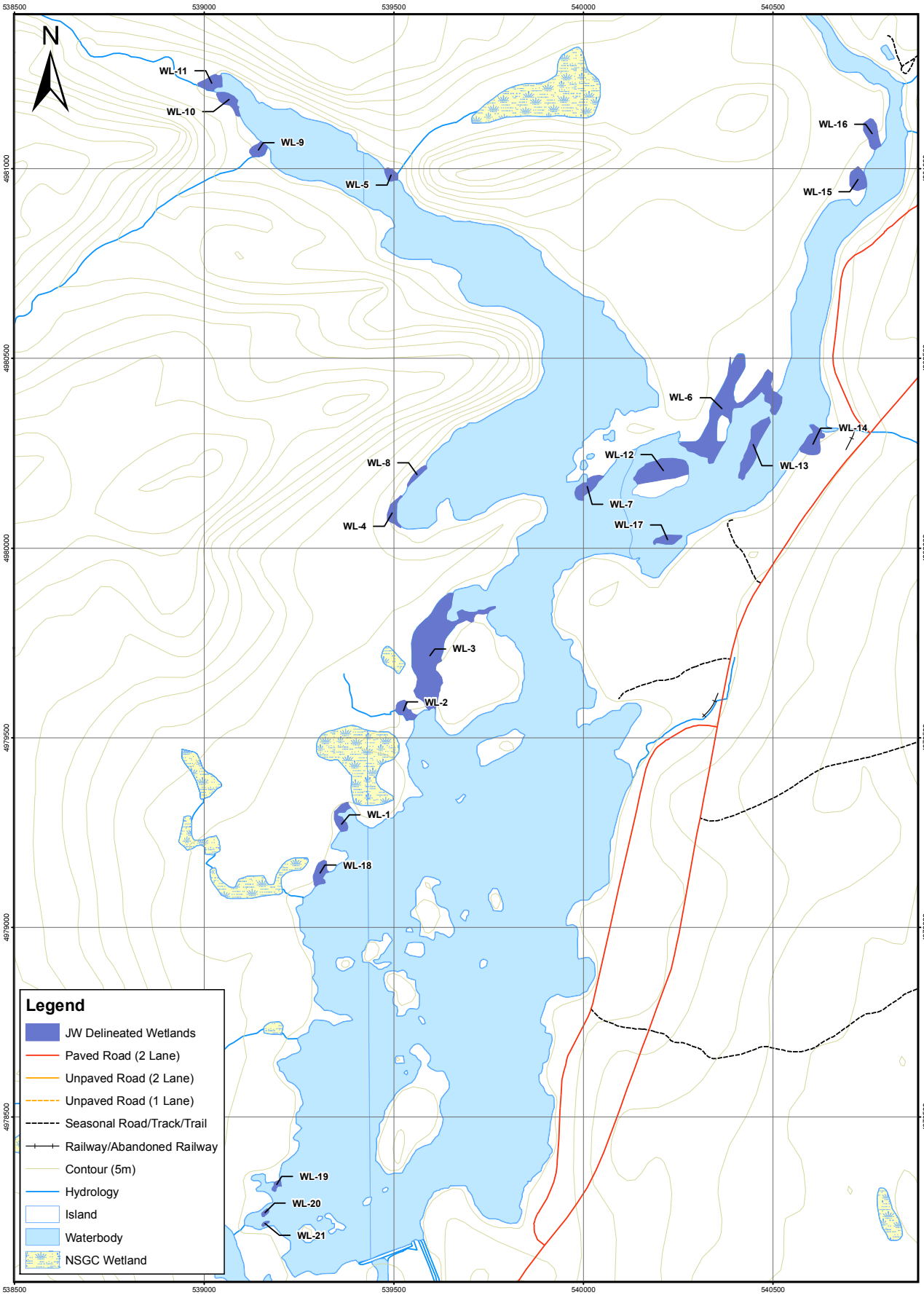


Figure 2

Ruth Falls Flowage Reservoir Wetlands

Map Parameters
Projection: UTM-Nad83-Z20
Scale 1:9,000
Date: October 24, 2007
Project No: 1026751.

0 160 320 640
Meters

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April 1, 2022

NOVA SCOTIA POWER INCORPORATED
PO BOX 910, 25 LAKESIDE PARK DR
HALIFAX, NS
B3J 2W5

Dear NOVA SCOTIA POWER INCORPORATED

RE: Application # 2019-2638165-00 Sheet Harbour Hydro System – Ruth Falls Dam Refurbishment (Watercourse Alteration)

With reference to your application please be advised that as a result of a fifth review prompted by Nova Scotia Power's (NSPI) submission on February 17, 2022, your application has been deemed incomplete. As a result, Nova Scotia Department of Environment and Climate Change (ECC) is requesting the following information to process your application:

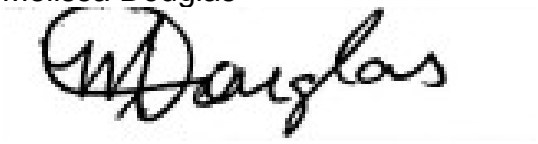
1.) Provide the following clarifications for the downstream cofferdams/access road:
   - The bridge opening will be located at a skew to the water flowing coming from the gates. How will this effect the bridge capacity?
   - Will the position of the bridge opening increase the risk of the Downstream Access Road/Cofferdam overtopping?
   - Discuss how the cofferdams, held in place over winter seasons, are expected to follow industry standards and be proportionate to duration and season of construction, and risk to the project and environment?
2.) Quantify the ability for the water to move through the construction zone. Based on the information present in Table 2 (Estimated Discharge Flow for the New Vertical Lift Gates) and Table 3 (Instantaneous Flood Peaks for the East River), confirm that the sluiceways and cofferdams should be able to convey more extreme events, approaching a 1:10 return period.
3.) Provide additional details related to the Construction Schedule. Will the Phase 1 work (deep stoplog bay replacement with screw stem vertical lift gates), under Approval **#2021-2840307-00,** overlap with these proposed project components? Will the main sluiceway be operational prior to any obstruction of the left and right spillways via cofferdam/road access construction?
4.) Provide additional details for the wetland hydrological monitoring. Will the monitoring be conducted using continuous measurements (via data loggers) or by an instantaneous measurement conducted during the annual monitoring event?

- If an instantaneous measurement method is proposed, provide justification for only having one pre-construction monitoring event to establish baseline conditions.

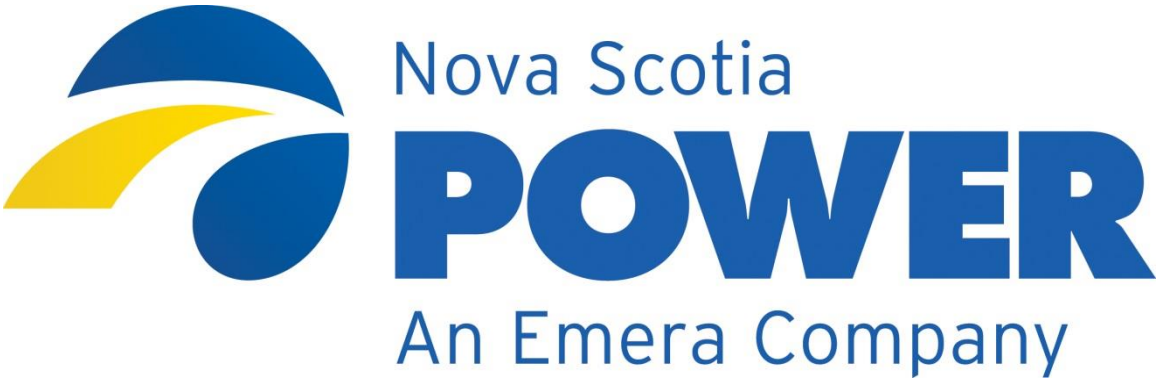
5.) Provide a map showing the proposed wetland monitoring locations.
6.) Provide an updated 'Figure 1 – Site Plan Showing Upstream Access Roads and Downstream Access Roads'.
    - Confirm whether the bypass, located along the upstream Right Access Road, is part of the project;
    - Confirm that the blue lines that intersect with the Downstream Access Road represent the modular bridge as described in the Addendum.
7.) Provide the rationale for using 23°C in the main body of each lake as an indicator of normal temperatures expected in the headpond for July-November. What is the purpose of the continuous water temperature monitoring?
8.) Provide a communications plan to inform property owners, who reside around the headpond, of the drawdown activities.

ECC is requesting this information be submitted by July 1, 2022. Please note that in accordance with *Section 7 of the Approval and Notification Procedure Regulations,* if information is not supplied by an applicant within 3 months of a request, the Minister may reject your application. Should your application be rejected, you will be informed of that decision in writing.

Yours truly,
Melissa Douglas



cc:



Environmental & Project Description for Construction Activities

Addendum

Sheet Harbour Hydro System

Ruth Falls Dam Refurbishment

2022

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PROJECT OVERVIEW

NS Power is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2022. This work is necessary in order to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. The project involves refurbishing the main dam by replacing the existing stop log bays with rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section. NS Power will also be replacing the existing deep stoplog bays located in the central portion of the dam with screw stem vertical lift gates.

Activities proposed for the Project include lowering the Ruth Falls Headpond and canal approximately 18 feet and dewatering the Ruth Falls fish ladder and downstream bypass during construction. Fish will be moved downstream via the sluiceway and/or spillway.

The Project is scheduled to take approximately 9 months to complete starting with the refurbishment of the original control building in May and main dam construction (including the installation of the vertical lift gates) in mid July 2022.

On February 14, 2022 NS Power submitted an addendum to the watercourse alteration approval application (#2019-2638165-00) to the NS Department of Environment and Climate Change (ECC) for the Ruth Falls Dam Refurbishment Project (the Project); this addendum is to support ECC's letter to NS Power pertaining to NS Power's application dated April 1, 2022, indicating NS Power's application remains incomplete.

The following sections provide additional information pertaining to ECC's information requests outlined in the April 1, 2022 letter. Below is a summary of ECC's information requests with the corresponding section within this addendum addressing the request.

1. Provide the following clarifications for the downstream cofferdams/access road:

a. The bridge opening will be located at a skew to the water flowing coming from the gates. How will this effect the bridge capacity?

NS Power has provided updated Appendix C - Proposed Water Management Structures drawings to show that the bridge opening will not be skewed as displayed in previous drawings. NS Power does not anticipate an impact to bridge capacity with the bridge being situated directly downstream of the sluice bay opening.

b. Will the position of the bridge opening increase the risk of the Downstream Access Road/Cofferdam overtopping?

As indicated NS Power's answer to question 1 a, the position of the bridge has been corrected within Appendix C – Proposed Water Management Structures to show that the bridge position will not be skewed to the sluice bay opening. The straight position will allow the water to flow

naturally from the sluice bay opening downstream and under the bridge. This angle decreases the risk of the adjacent access roads overtopping.

c. Discuss how the cofferdams, held in place over winter seasons, are expected to follow industry standards and be proportionate to duration and season construction, and risk to the project and environment.

NS Power will use access roads built to industry standards to provide access to the construction site on the upstream and downstream side of the dam. Further clarification can be found in Section 4.1 – Water Management.

2. Quantify the ability for the water to move through the construction zone. Based on the information present in table 2 (Estimated Discharge Flow for the New Vertical Lift Gates) and Table 3 (Instantaneous Flood Peaks for the East River), confirm that the sluiceways and cofferdams should be able to convey more extreme events, approaching a 1:10 return event

NS Power is utilizing Tables 2 and 3 as references to quantify the discharge through the construction zone. Further information regarding more extreme events is described in section 4.1 – Water Management.

3. Provide additional details related to the Construction Schedule. Will the Phase I work (deep stoplog bay replacement with screw stem vertical lift gated), under Approval #2021-2840307-00, overlap with these proposed project components? Will the main sluiceway be operational prior to any obstruction of the left and right spillways via cofferdam/road access construction?

NS Power has provided additional schedule details in Section 2.3 Construction Schedule.

4. Provide additional details for the wetland hydrological monitoring. Will the monitoring be conducted using continuous measurements (via data loggers) or by an instantaneous measurement conducted during the annual monitoring event? If an instantaneous measurement method is proposed, provide justification for only having one pre-construction monitoring event to establish baseline conditions.

Monitoring wells will be installed manually within each of the six selected wetlands using a hand auger/shovel, with a minimum of one monitoring well included per wetland. Upon further review, it was determined that an additional monitoring event is warranted to capture baseline water levels via the instantaneous measurement method. Further information pertaining to wetland hydrological monitoring and pre-construction wetland monitoring is provided in Section 4.5 – Wetland and Rare Plants.

5. Provide a map showing the proposed wetland monitoring locations.

NS Power has provided a map showing the proposed wetland monitoring locations in Section 4.5 – Wetlands and Rare Plants.

6. Provide an updated 'Figure 1 – Site Plan Showing Upstream Access Roads and Downstream Access Roads'.

a. Confirm whether the bypass, located along the upstream Right Access road, is part of the project;

NS Power has provided updated version of Appendix C- Proposed Water Management Structures. As per the drawing, the bypass located along the upstream Right Access road is not included as part of the project.

b. Confirm that the blue lines that intersect with the Downstream Access Road represent the modular bridge as described in the Addendum.

NS Power has provided an updated version of Appendix C- Proposed Water Management Structures. The updated drawing displays the bridge position relative to the sluice bay as described in the Addendum.

7. Provide the rationale for using the 23°C in the main body of each lake as an indicator of normal temperatures expected in the headpond for July-November. What is the purpose of the continuous water temperature monitoring?

NS Power has provided additional details regarding the use of 23°C in the main body of each lake as an indicator of normal temperatures expected in the headpond in Section 4.4 - Water Quality. The purpose of continuous water temperature monitoring was on request from DFO to monitor fish habitat.

8. Provide a communications plan to inform property owners, who reside around the headpond, of the drawdown activities.

NS Power is committed to inform property owners, who reside around the Ruth Falls Headpond of the drawdown activities planned for mid-July 2022. Further details around the plan are described in section 7.0 – Other Stakeholder Engagement. A detailed communication plan is currently being reviewed internally and will be provided to NSECC once it is available.

1.0 INTRODUCTION

The Sheet Harbour Hydro system is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The system has a drainage area of 573.9 km^2. Presently there are 6 controlled reservoirs, including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond and Ruth Falls Headpond. Ten Mile Reservoir was previously controlled until the dam was removed in 2012.

Governor Reservoir is located at the head waters of Twelve Mile Stream, which flows through Union Flowage into Marshall Reservoir. Sloane Reservoir is located near the headwaters of Seventeen Mile Stream which passes through Anti Dam Reservoir and into Marshall. Marshall Reservoir comprises the principle reservoir for the Sheet Harbour System. Malay Falls Headpond is directly downstream from Marshall; the Malay Falls power canal conducts water from the Malay Falls Headpond to the generating station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel.

Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power. Mapping of the Sheet Harbour System can be found in Appendix A.

2.0 CONSTRUCTION

Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the embankment and spillway/sluiceway structures. The project involves refurbishing the main dam by replacing the existing 30 stop log bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section.

NS Power is anticipating an additional permanent instream footprint of approximately 60 m^2 on the downstream side of the dam to accommodate additional concrete requirements for certain ogee sections. NS Power does not anticipate changes to the fish ladder as a result of the additional concrete. The reservoir will be temporarily drawn down approximately 18 feet, which serves as the primary method of isolating the existing dam structure for refurbishment activities.

2.1 Existing Project Area

Ruth Falls Headpond is located immediately downstream of the Malay Falls Headpond. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, a 15.2 m long three-bay stoplog-controlled sluiceway section in the center, and two short

concrete gravity bulkhead sections that abut either side of the spillway. Prior to main construction, the three-bay stoplog-controlled sluiceway will be replaced with a set of 3 screw-stem vertical lift gates. The crest elevation of the spillway is 31.7 m and stoplogs can be installed to an elevation of 33.3 m. The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix B for pre-construction site photos.

Flow in the area is controlled by NS Power Hydro Operations. Water levels can fluctuate between the full supply level of 33.7 m (110.5') and the low supply level of 27.5 m (90.1'). A minimum operating level of 33.3 m (109.25') is observed from April 1 - Nov. 30 each year. As per the NSECC Sheet Harbour System Water Approval, a 35 cfs maintenance flow is provided downstream year- round in order to operate the Ruth Falls louvers. This flow is targeting downstream migration of Atlantic salmon smolts and kelts. From April 1 - November 30th each year, 6 cfs of the 35 cfs maintenance flow is provided to the fish ladder while 29 cfs is provided to operate the louvers. This flow is set to accommodate downstream migration of all fish species found on the system. The fish ladder at Ruth Falls operates from April 1 - November 1st annually with a flow of 6 cfs. During this time frame a fish trap is operated in the ladder from May 15 – November 1st annually. DFO is contacted if the trap exceeds 50 salmon in order to determine the target release locations. Of note, only 11 salmon have been captured since 2007 with no salmon being captured in 2017 and 2018, two in 2019, and one in 2020.

The site will be surveyed prior to the construction works to ensure that the elevations are accurate with respect to the current configuration and the new design. Discrepancies noted between minimum operating levels of the reservoir (109.4ft and 109.2ft) are datum related, as there have been many datums used over the years, including different coordinate systems and local datums. The minimum operating levels of the reservoir based on engineering drawings and Dam Safety Reviews is noted to be 109.25 ft. This was likely a mistake in the number presented; however, that will not impact the design. The current minimum operating level will remain unchanged with the new dam design.

Atlantic salmon have been the species of interest historically in the system for DFO. However, the low numbers of returns on East River in recent years indicate that there is unlikely a breeding population. Work is ongoing to improve the water quality in the West River and it may be that higher returns are observed in the East River over time. High concentrations of mercury have been observed in white perch, yellow perch and speckled trout in the system.

The Ruth Falls Headpond was sampled by NS Power in 2017 using gill nets, minnow traps and eel pots. Species found to be present in the headpond include American eel, alewife, brown bullhead, lake chub, golden shiner, speckled trout, white sucker and yellow perch. No aquatic invasive species have been observed in the project area or adjacent habitat. No critical habitat is found in the area.

In July 2021, NS Power staff observed a Barn Swallow nest located in the centre of the dam on top of one of the concrete piers and underneath the deck of the dam. An additional Barn swallow nest was also observed on the bridge across the upstream side of the canal. The NS Department of Lands and Forestry (DLF) have granted NS Power a Species at Risk (SAR) permit which grants permission to remove the nests before March 31, 2022, the use of deterrents to temporarily prevent nesting during construction and requires the installation of an alternative nesting structure fitted with nesting cups at a 3:1 ratio.

2.2 Proposed Refurbishment Activities

The proposed refurbishment activities are broken up into two phases below, Phase 1 - the installation of the sluiceway gates (already approved under Approval 2021-2840307-00) and Phase 2 – the dam construction:

Phase 1 – Sluice gate installation:

- Refurbishment of the original control building

Phase 2 – Dam construction:

- Installation of downstream access road and bridge (to start prior to drawdown activities)
- Lowering of Ruth Falls Headpond approximately 18 ft.
- Dewatering of the Ruth Falls fishladder and canal during the construction activities.
- Installation of temporary access for machinery on the upstream side of the dam.
- Removal of stoplogs from existing sluiceway bays, prepping of bays, and installation of vertical lift gates.
- Removal of the existing stoplog bays, piers, stoplog lifter and walkway.
- Reface the concrete on the crest and downstream slope of the spillway ogee sections.
- Installation of new rubber dam bladders on the crest of the ogee spillway sections.
- Construction of a free overflow spillway section at the right end of the dam.
- Installation of a new steel walkway for access across the dam.
- Removal of the temporary access road material.
- Watering up of the headpond to within normal operating levels.

2.3 Construction Schedule

The construction schedule is as follows:

- Phase 1, completion of new control building under approval 2021-2840307-00, will commence mid-May 2022. This work will start prior to Phase II, the lowering of Ruth Falls

Headpond and Main Dam construction (see below), but will overlap with Phase II construction scope.

- Phase II will commence in early July with the construction of the downstream access road and installation of the bridge. This work is intended to be completed prior to the drawdown in preparation for main dam construction work to take place in mid-July after the lowering of Ruth Falls Headpond.

- Construction activities associated with the sluiceway and main dam refurbishment will commence in mid-July with the lowering of Ruth falls headpond. The lowering is scheduled to commence on July 10th and extend to July 15th. Construction activities will then begin with the installation of the upstream access roads. Work on the main dam refurbishment and sluiceway bays will continue simultaneously as construction progresses however NS Power will aim to complete the new sluice gates first in the low flow window of July-September. It is anticipated that each gate bay will take approximately 3-4 weeks to complete, and a total of 9-12 weeks to complete the entire sluice structure. This may be affected by weather should heavy inflows be required to be passed for a significant period of time.

- All construction activities, including the recharging of Ruth Falls to normal operating levels, will be completed by March 31st, 2023.

3.0 REGULATORY PERMITS/APPROVALS

In addition to the Watercourse Alteration Approval required in accordance with Section 5(A)(1)(c) of the Activities Designation Regulations of the *Environment Act*, an authorization under Section 35(2)(b) of the *Fisheries Act* is required for the revised scope of work.

A variance to the Sheet Harbour Hydro System Water Approval (#2008-062826-01) for water withdrawal/storage will also be required in order to carry out the proposed scope of work. This includes the following:

- operation of the Ruth Falls fishladder and salmon trap, which will be non-operational throughout construction
- minimum water elevations for the period of April 1-November 30th for Ruth Falls Headpond.
- Supplementary flow release requirements for Atlantic salmon, which are unable to be adhered to during construction due to lowered water levels. As part of NS Power's water management plan water will be free flowing through the deep sloplog/sluiceway bay, providing continuous downstream flow, however standard supplementary releases for specific time periods will not be provided.

A Species At Risk permit has been obtained by NSDNRR as per Section 50(1), 51(a) of the *Wildlife Act*, and Section 14(1) of the *Endangered Species Act*.

An authorization in accordance with Transport Canada's Navigation Protection Program is also required for construction activities for the Project.

4.0 ENVIRONMENTAL PROTECTION

4.1 Water Management

Once the desired construction elevation of 91.0 ft is reached, work will begin on the temporary upstream access paths. NS Power had originally requested a drawdown level of 98'; however, upon careful review of the bathymetric study, the bathymetry modelling does not demonstrate a considerable difference between a reservoir level lowered to 98 ft or to 91 ft. In an effort to provide the safest and most reliable construction execution, lowering the reservoir to elevation 91 ft is preferable. To execute the most reliable construction schedule, this allowance of a reservoir level at 91 ft confidently allows the Contractor to safely execute all project works within one drawdown period. In order to expose the portions of the concrete dam to be refurbished, the Ruth Falls Headpond will be lowered approximately 18 ft from the 109.25 ft minimum operating level, maintained from April 1st to November 30th annually. The canal, fishladder, and fish bypass will be dewatered. A 35 cfs flow will also be maintained downstream of the dam. Supplemental flow required as part of the operating approval will not be provided during construction and the fish trap will not be operated.

Prior to the new sluice gate installation, the Ruth Falls Dam would have an overflow spill of approximately 350 cfs while at full supply elevation of 110.5 ft. The overflow spill would spill over the stoplog along the full length of the dam. From May to August 2021, overflow spill was approximately 350 cfs, this was due to a lack of generation a result of Ruth Falls switch gear refurbishment project.

The Ruth Falls Headpond has a storage volume of 2.3M cubic meters (1888 acre-ft) when at full supply level at elevation of 109.25 ft. As noted previously, the headpond will be lowered to elevation of 91 feet for construction. At 91 ft, the headpond will have a volume of .005M cubic meters (4 acre-ft).

During normal operation, inflows in the reservoir are controlled by NS Power Hydro Operations. Water levels fluctuate between the full supply level of 33.7 m (110.5 ft), minimum supply level of 33.3 m (109.25 ft), and the low supply level of 27.5 m (90.1 ft). In order to complete work in dry conditions, the Project will include temporarily lowering the headpond and canal approximately 18 ft below the minimum operating level of 33.3 m (109.25') observed from April 1 – Nov 30 each year. Dewatering activities will begin no earlier than July 10th, 2022. To commence the drawdown, NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 33.7 m (110.5 ft) to the minimum operating level of 33.3 m (109.25 ft). Once the headpond reaches an elevation of 33.3 m (109.25 ft), the drawdown will be controlled using the centre vertical lift gate/deep sluice bay until the desired elevation of 27.7 m (91 ft) is achieved.

The drawdown flow will be directed through areas that are part of the normal flowage channels. At least one gate will remain in full open throughout construction to maintain lowered water elevations and provide a method of fish passage.

During the drawdown, water will pass through the sluice bay openings and reduce the headpond level from 109.25 ft to 91 ft. Table 1 displays the decrease in flow velocities as the headpond elevation lowers over the course of the 4-day drawdown period.

Table 3: Estimated Flow Velocities Table

Time (day)	Beginning Elevation (ft)	Middle Sluice Opening (ft)	Discharge (cfs)	Velocity through gate(fps)	Downstream Velocity (fps)
0	109.2	1	211	21	2.4
0.5	108.8	1	209	21	2.4
1	108.0	1	204	20	2.4
1.5	107.2	1.5	300	20	2.8
2	106.0	1.5	289	19	2.8
2.5	104.9	1.5	279	18	2.7
3	103.0	1.5	260	17	2.6
3.5	101.0	2	319	16	2.9
4	96.0	2	236	12	2.5
4.5	91.0	2	33	5	1.3

The flow downstream will be controlled in order to avoid scour and sedimentation. The 35 cfs maintenance flow and downstream fish passage will be provided through the sluiceway. Qualified NS Power personnel will be on site during the drawdown to monitor water quality (visual silt) and conduct a fish rescue for any isolated fish in the headpond and canal. The headpond will be subsequently recharged at a controlled rate and monitored for silt and fish issues.

Prior to the drawdown taking place, the temporary downstream access roads and bridge will be installed. The rockfill access road will be equipped with a bridge that will be located over the discharge channel -see Appendix C- Proposed Water Management Structures. Ice build-up is not anticipated on the temporary access road as the water will be constantly flowing downstream. Excavators will be using the access roads on a continual basis during construction which will break up any ice that could accumulate. If significant ice accumulation was to occur, the ice could be removed physically by the contractor.

Once the drawdown is completed, two access roads will be installed on the upstream side of the dam; one extending from the left abutment to the left end of the sluiceway, and one extending from the right abutment to the right end of the sluiceway. The access roads will be constructed to elevation 100.0 ft (30.5 m) with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes using clean rock material that is free of fines. The left upstream access road will be 209 ft (64 m) long while the right upstream access road will be 343 ft (104.5 m) long. The estimated temporary instream footprint of the left access road is 576 ft^2 (535 m^2) while the right access road is 747 ft^2 (694 m^2). Using available bathymetry, approximately 74% of the upstream access road will be placed in the dry at an elevation of 91.0 ft.

The upstream access roads will serve primarily to provide access for machinery to complete refurbishment activities. It should be noted, there are no cofferdams being constructed on the construction site that would hold back water; temporary access roads are being constructed of clean rockfill, which won't be impacted should the water rise to higher levels. Water would easily flow through the rockfill as there will be no low permeability in the rockfill material.

All access roads will be developed to and meet industry standards. This includes adhering to required crest width and height to accommodate machinery. The access roads will be built using clean rock material that is free of fines. The access roads are built to be held in place until removed; therefore, capable of withstanding all four seasons changing weather and precipitation conditions. The access roads pose very low risk to the project and the environment.

The existing area just downstream of the dam consists of exposed bedrock and boulders. To cross the existing spillway channel, a temporary bridge will be installed in the downstream access road. Based on the NS Watercourse Alteration sizing criteria, calculations were conducted in order to determine an appropriate bridge size capable of passing 1:2 year return storm conditions on the downstream side. To reduce the need for a large structure required to satisfy the NS watercourse Alteration Standard (requiring a bridge to have a width of 126 ft or 38.5 m), the contractor is proposing to make use of the storage capacity of the reservoir once drawn down, and install a bridge that is approximately 6 ft tall and 42 ft wide. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. If a heavy influx of water is expected, NS Power will notify the contractor and the bridge will be removed promptly to allow for excessive flow conditions that would be expected for a 1:2 year return storm event. An excavator or crane will be available on-site during construction to remove the bridge promptly. Further details on contingency planning are provided in Section 4.2.

It is expected that at a minimum, natural inflows from Grant River Watershed, which is uncontrolled by NS Power, as well as required maintenance flows and spill over the Malay Falls rubber dams would be managed through the construction site which will result in water level

fluctuations in Ruth Falls Headpond throughout construction . NS Power may generate at Malay Falls to continue to pass water through the system and maintain required water levels in the upper reservoirs. This will only be completed to a level that is manageable at the construction work area and with oversight from the NS Power's Construction Project Management and Hydro System Superintendent.

To maintain water passage through the dam during construction, the water will be passed through the middle deep sluice bay. The sill elevation of the middle sluice gate is 90.1 ft, whereas the sill elevation of the outer two gates is 94.1 ft. Therefore, at a headpond level lower than 94.1 ft, only the middle vertical lift gate deep sluice bay will be available to discharge flows. It is anticipated that the two outer gates will be constructed first and discharge from the headpond will be managed through the centre sluiceway bay. Once the two outer gates are completed, the centre gate will then be isolated and constructed. Given that the outer gates have a sill elevation of 94.1 ft., inflows may raise water levels in the headpond to above this elevation, since the centre bay will not be available to pass water.

The estimated maximum discharge flows through the sluice bays are shown in Table 2 (note: discharges in Table 2 are based on Ruth Falls Headpond being at full supply level, not at 91 ft):

Table 2 : Estimated Discharge Flow for the New Vertical Lift Gates

Reservoir El.	91 ft	93 ft	95 ft	97 ft	99 ft
Outer Gate 1	N/A	N/A	171 cfs	990 cfs	2,175 cfs
Outer Gate 2	N/A	N/A	171 cfs	990 cfs	2,175 cfs
Middle Gate	171 cfs	990 cfs	2,175 cfs	3,635 cfs	5,324 cfs
Totals	171 cfs	990 cfs	2,517 cfs	5,615 cfs	9,674 cfs

The two outer gates are identical in their dimensions; therefore, yield the same outflows. All gates were considered to be fully open for the purpose of these calculations. N/A – Sill elevation is above the headpond level.

It is expected that average inflows throughout construction can be managed through the centre sluiceway bay, and outer sluiceway bays when the centre bay is under construction, with minor headpond fluctuations. Temporary upstream access roads will be designed to an elevation of 100 ft, which allows for 9 ft of water level fluctuation within the headpond during construction. At elevation 91 ft, the centre sluice bay can pass 171 cfs without any water level fluctuation, and up to 5,324 cfs should inflows result in an increase in water elevation to 99 ft. During construction of the centre gate, should inflows result in water levels to increase, the outer sluice bays will be operational once elevations reach 94.1 ft. At elevation 95 ft, the outer sluice bays can pass a total of 342 cfs, and up to 4,350 cfs if water levels were to raise to 99 ft.

Fish will have the ability to move downstream and upstream through the sluice bay during construction, with the exception of when the centre sluice bay gate is under construction. The passive opening under the bridge will allow fish to move freely downstream.

It should be noted that in all scenarios, the minimum 35 cfs discharge requirement will be maintained throughout construction. There would be no negative impacts to the passage of water during all scenarios.

4.2 Contingency Planning

The hydrological information provided in the application submission references the Sheet Harbour system flood study, which was completed as part of NS Power's dam safety program in addition to the system dam safety reviews. Key details from this study which are relevant to the water management plan for the ruth falls dam refurbishment are provided below. NS Power does not typically provide flood study reports as part of watercourse alteration applications pertaining to hydro capital projects as these studies contain confidential information pertaining to NS Power's hydro dam safety program

The statistical flood peaks for the Ruth Falls headpond, taken from the 2008 Sheet Harbour Hydro System Flood Study, are presented in Table 3 below:

Table 3: Instantaneous Flood Peaks for the East River

Return period (years)	Instantaneous Flow Peaks (cfs)
2	5,850
5	8,340
10	10,130
20	11,940
50	14,430
100	16,420
1000	24,220

The instantaneous flood peaks outlined in Table 3 take into consideration inflows from the Grant River, which was included in the 2008 flood study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

The primary means of water management for the Project is the lowering of Ruth Falls Headpond to elevation 91.0 ft. The new steel vertical gates will have greater discharge capacity then the original stoplog structure given that the discharge will be from the bottom of the gate, not overtopping the stoplog. Once construction commences, the stoplogs will be removed from the

sluiceway bays, as required for the sequencing of the sluiceway work, which would allow discharge through these bays throughout the construction activities, if needed, from elevation 91 ft to elevation 99 ft. NS Power operations and the contractor will be monitoring the water inflows and discharges throughout the construction activities and will be able to adjust to the changing conditions, as required, to ensure that the headpond levels are managed accordingly.Temporary upstream access roads will be installed to withstand a rise in the headpond to elevation 100 ft; however, it is unknown how much instantaneous inflow would result in a rise in the headpond elevation from 91.0 ft to over 100 ft as there is no storage curve for Ruth Falls Headpond, due to lack of storage.

Should high return period rain events (i.e. 1:10 year return period) be received during construction activities, the Ruth Falls Headpond can withstand an increase in water elevation to 99 ft., based on the discharge capacity of the sluice bays and expected inflows during a 1:10 return period event (Table 3 – approximately 10,130 cfs). With all three sluice bays available, approximately 9,674 cfs can be passed at an elevation of 99 ft, noting that the peak inflow wouldn't be sustained over a long period of time and discharge would be occurring over the entire timeline of the storm event. During such an event , NS Power and the contractor would plan to shut down all construction activities. Keeping in mind that the reservoir would already be drawn down, inflows would be able to attenuate in the reservoir, essentially raising the level of the reservoir over time. During this event, discharge would be managed through the sluice bays.

Should unexpected inflows be received, NS Power will implement contingencies to safely pass water. In the situation where water is rising, NS Power has the ability to open the two additional gates to pass water and maintain lower elevations. If extreme heavy rain or significant sustained flows are forecasted, which could result in water levels to exceed the 100 ft elevation, the construction infrastructure that can be quickly removed to meet the sluiceway width capacity are:

- the temporary work platforms and construction materials supporting gate installation
- the installed vertical gates if they are not fully operational at the time of the event
- the removal of temporary bridge
- the removal of clean rock from the access road to allow for additional water flow in the sluiceway channel

The upstream access roads will be constructed in a manner as to not impact the discharge capacity of the sluiceway. If in the event migration of material is observed, the associated risk of sedimentation is extremely low. NS Power will assess the access road material migration once water levels have receded.

4.3 Erosion and Sedimentation Control

Erosion and sedimentation control materials such as hay, silt fencing, etc., will be used to control sediment laden water from entering the headpond while it is dewatered. Any silt-laden water in the work area will be recovered and pumped away from the headpond to areas with sufficient vegetation to facilitate filtration. The headpond will be recharged at a controlled rate with NS Power personnel monitoring for any visible water quality issues. NS Power is not anticipating any issues with erosion or scour when passing the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. Hydro Operations has confirmed that spill in excess of 500 cfs is very common, and a spill in excess of 1,000 cfs (equivalent to both generating units running) is common with 6-12 occurrences annually. Bi-annual inspections and weekly checks are conducted downstream of the Ruth Falls Dam. Observations during the inspections and checks indicate that scour is not of concern when spilling in excess of 500 cfs.

NS Power Project personnel will remain in regular contact with Hydro Operations personnel throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

All access road material will be clean, appropriately sourced rock material that is free of fines, to significantly reduce potential sedimentation of the upstream and downstream work areas. Rockfill cofferdams have been used by NS Power on other hydro refurbishment projects and have proven to have little effect on sedimentation of the surrounding watercourse, even during periods of high inflows/discharge. Pumps will be used, as required, to assist with removing any silt laden water, which will be pumped to a designated area.

The proposed scope of work for the Project involves minimal excavation of soil material, as the focus of construction is the refurbishment of the existing concrete dam structure. The primary method of erosion and sedimentation control is the water management strategy outlined in section 4.1.

There will be some excavation of the right (west) abutment retaining wall that is scheduled for removal and replacement. During construction activities for the retaining wall, silt fencing will be used along the boundary of the spillway bank to protect the adjacent spillway channel. The excavation for the retaining wall is anticipated to be small and as such, soil material will not be exposed for a significant length of time. Pumps will be used to keep the retaining wall work area dry and silt laden water will be pumped to the west of the dam in an area designated as acceptable to filter water prior to re-entry into a watercourse. Hay will be used to cover any temporarily exposed work areas, as required. Based on initial scoping of surrounding lands, NS Power has identified two potential areas to be used for water filtration areas or installation of sediment traps. One area is immediately west of the dam and the other is located north east of the dam, see Figure 1 below. Both areas are on NS Power property and have been evaluated for possible wetland/rare species habitat. Both areas are forested and provide suitable vegetation to aid in water filtration. Additional field scoping will be completed to confirm areas to be used and method of water filtration.

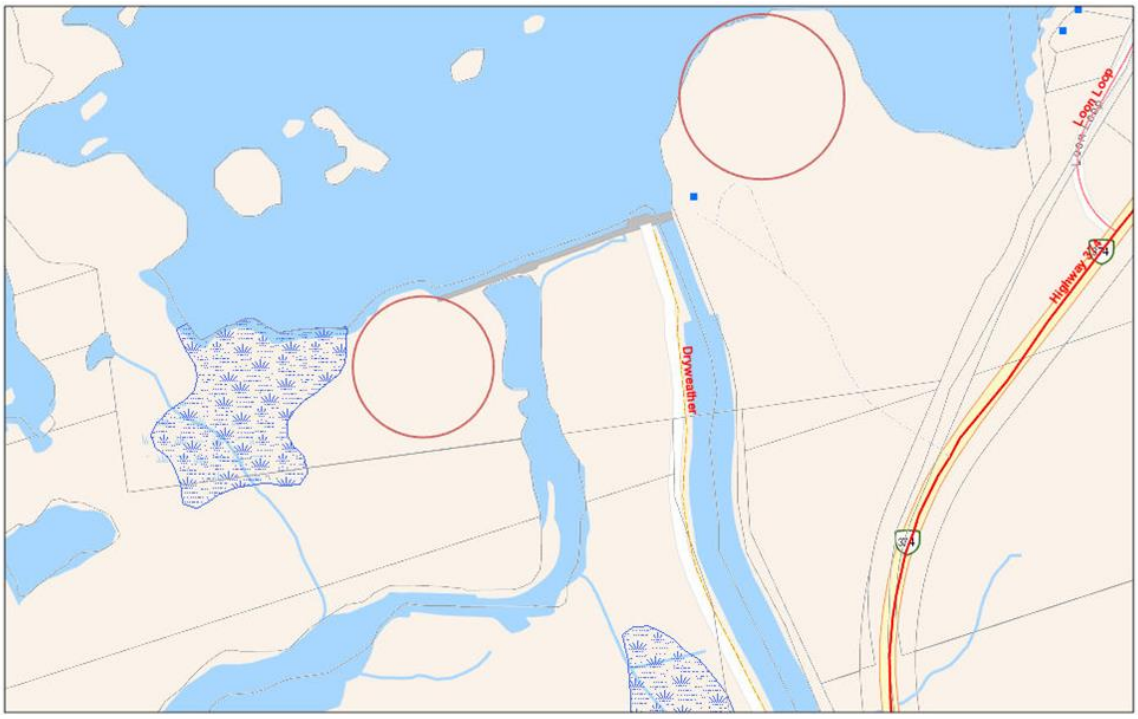


Figure 1: Potential locations for water filtration to support pumping activities. Areas to be field verified in spring 2022.

The removal of access road material will take place with Ruth Falls Headpond at elevation 91 ft, which will allow for visual observation of the majority of material being removed. Washed rock will be used to ensure no silt or fines interacts with the watercourse. Siltation monitoring will take place as debris from the access road is removed. Monitoring will be carried out by NS Power downstream during the removal to ensure siltation is not occurring.

The selected contractor for the Project will be required to submit a site-specific erosion and sedimentation control plan designed for the planned scope of work. This will include identification of any additional site-specific controls required and location of water filtration operations or requirements for sediment traps for pumping activities. NS Power would request that, if required, a condition be incorporated into the Approval, if issued, for NS Power to provide a site-specific plan to confirm the above outlined measures prior to construction activities starting. Additional impacts as a result of sedimentation beyond the in-water work window (June 1 – September 30) are unlikely. In addition to the mitigation measures discussed above, NS Power will monitor weather closely to ensure appropriate planning/mitigation is in place prior to a heavy rain event. This may include temporary closure/stabilization of site, temporary work stoppage, or removal of access road sections to allow for increased passage of water. Site inspections will be completed immediately after heavy rain events to monitor for erosion or sedimentation issues.

NS Power will also require the general civil contractor to implement daily site inspections and completes overarching environmental inspections on a weekly basis during construction. This will allow NS Power to ensure compliance to regulatory requirements and best practices, while ensuring deficiencies are assigned an appropriate corrective action to be addressed in a timely manner.

4.4 Water Quality

NS Power conducts water quality surveys as part of the hydro relicensing program, the process by which the water approvals for storage/withdrawal are renewed for each hydro system. Relicensing studies for the Sheet Harbour Hydro System were completed in 2017 in preparation for the relicensing of this system. The water quality surveys completed for the headpond show acidic conditions with an in-situ pH range of 4.43-4.52, presence of phosphorus and chlorophyll and good conductivity. Based on these results, the headpond is classified as meso-eutrophic or eutrophic. A small thermocline was observed at 3.2 ft (1 m) depth; however, dissolved oxygen remained consistent to sample depth 19.7 ft (6 m).

Using available bathymetry for the headpond (see Appendix A), approximately 0.5 miles square (1.15 km^2) of total shoreline will be exposed as a result of a drawdown to 91.0 ft from FSL. The majority of shoreline to be exposed is very shallow under normal FSL of 109.25 ft, with depths of less than 9.8 ft (3 m). At an elevation of 91.0 ft, the headpond will look similar to pre-inundation conditions of the East and Grant Rivers. It is unknown how the drawdown of approximately 18 ft for a period of 9 months will influence water quality; however, it is expected that inflows from Grant River, and small inflows from Malay Falls will provide continuous oxygenated water to Ruth Falls Headpond throughout the drawdown. It is unknown how much inflow is contributed by the Grant River Watershed; although, inflows from this watershed were included in the 2008 Flood Study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

NS Power proposes to complete monthly water quality sampling from a deeper area of the headpond, to compare various water quality parameters with those observed under normal operation. NS Power will use the location of the water quality sample site used during the 2017 relicensing of the Sheet Harbour Hydro System for direct comparison to normal operating conditions. Water quality sampling will be completed from July to November for temperature, dissolved oxygen, total suspended solids and turbidity.

The monitoring site for monthly sampling will be established at the deepest part of the headpond, using available bathymetry or manual soundings if bathymetry is not available.

Monthly monitoring will be conducted from July to November and will include the following parameters:

- Secchi depth
- Temperature
- Dissolved oxygen
- Nutrient content (lab analysis)

In addition, NS Power will install a temperature logger for continuous temperature monitoring, providing readings every hour. NS Power will use 23 degrees Celsius in the main body of each lake as an indicator of normal temperatures expected in the headpond for July-November. This number was used based on temperature measurements taken during hydro relicensing for Ruth Falls Headpond. This number provides a baseline for typical water quality for fish habitat.

4.5 Wetland and Rare Plants

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. Twenty-one (21) wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was not identified during the 2007 survey. For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond.

Table 4 shows the type of each wetland mapped in 2007; 6 of the 21 wetlands identified at the time of the survey where characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered.

Table 4: Wetlands Found Within the Littoral Zone of Ruth Falls Headpond. Wetlands 3,5,6,15,17,19 are highlighted as they have been selected for Wetland Monitoring as described below.

Wetland ID Number	Wetland Type	Wetland Description
1	Coniferous treed shore bog	No
2	Coniferous treed shore bog	No
3	Coniferous treed shore bog (two subtypes)	Yes
4	Shore bog	Yes
5	Shore bog	No
6	Wetland complex composed of coniferous treed shore bog and floating bog (two subtypes)	Yes
7	Shore bog	Yes
8	Shore bog	No
9	Shore bog	No
10	Shore bog	No
11	Shore bog	Yes
12	Shore bog	No
13	Shore bog	No
14	Shore bog	No
15	Wetland complex composed of coniferous treed shore bog and coniferous treed shore swamp	Yes
16	Coniferous treed shore bog	No
17	Shore bog	No
18	Coniferous treed shore bog	No
19	Shore bog	No
20	Shore bog	No
21	Shore bog	No

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. In examining the ACCDC search completed in 2017 for the previous relicensing of the Sheet Harbour Hydro System, 4 records of potentially rare or endangered species are found in close proximity to Ruth Falls Headpond, see Figure 3. There are two records of Salted shell lichen (Coccocarpia palmicola) located in a wetland on the northwest portion of the headpond, which appears to be hydraulically connected by a small stream. Salted shell lichen is listed as secure within the NS General Status Rank. There are also two records of Ruby-crowned Kinglet (Regulus calendula) on the east side of the headpond along the Lochaber Mines Road. Ruby-crowned Kinglet is listed as Sensitive within the NS General Status Rank. Neither of these species are anticipated to be impacted by the drawdown of Ruth Falls Headpond.

Figure 2: Mapped wetlands on Ruth Falls Headpond (2007). Proposed Wetland Monitoring locations are highlighted in red (6 locations)

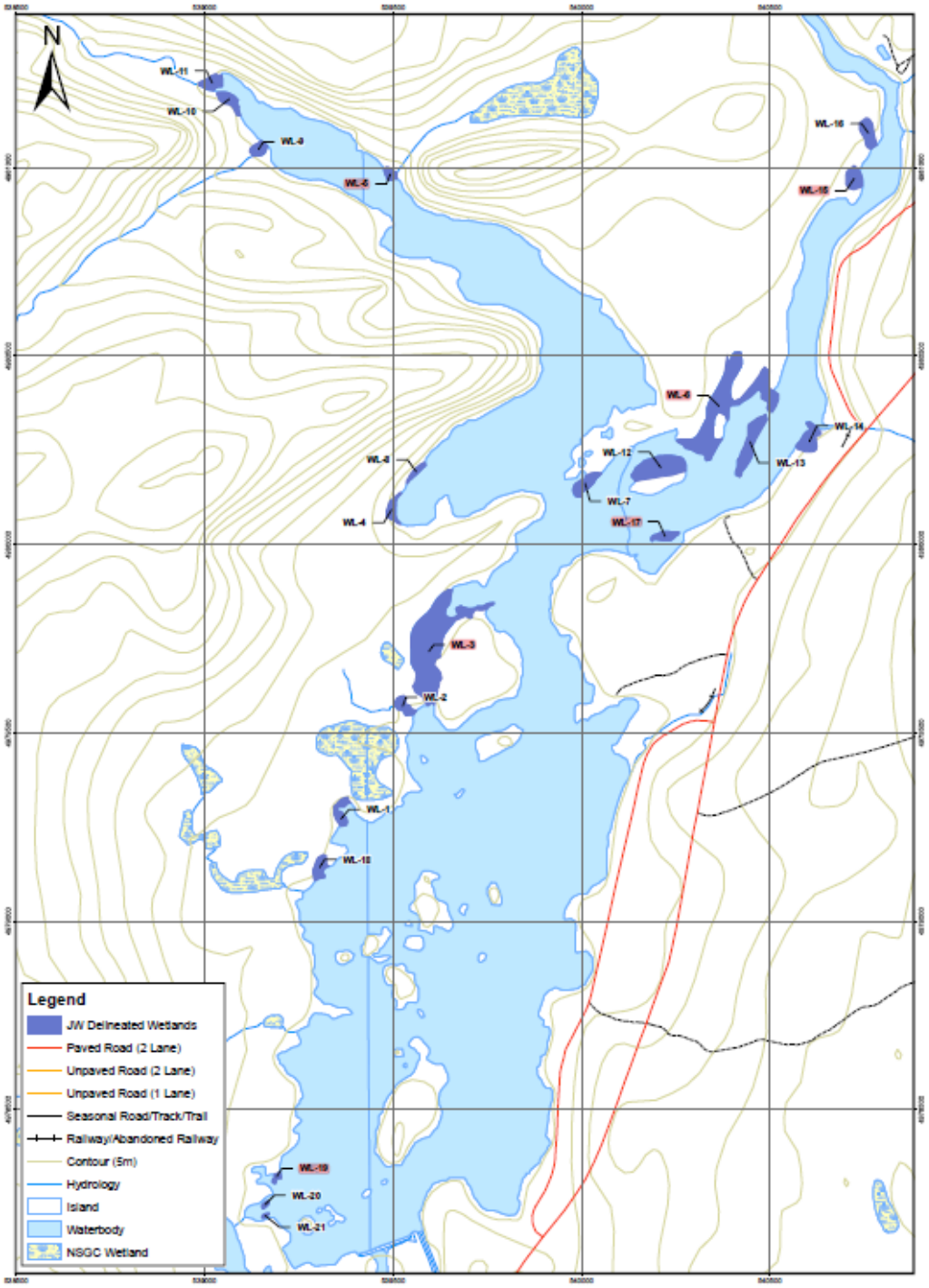
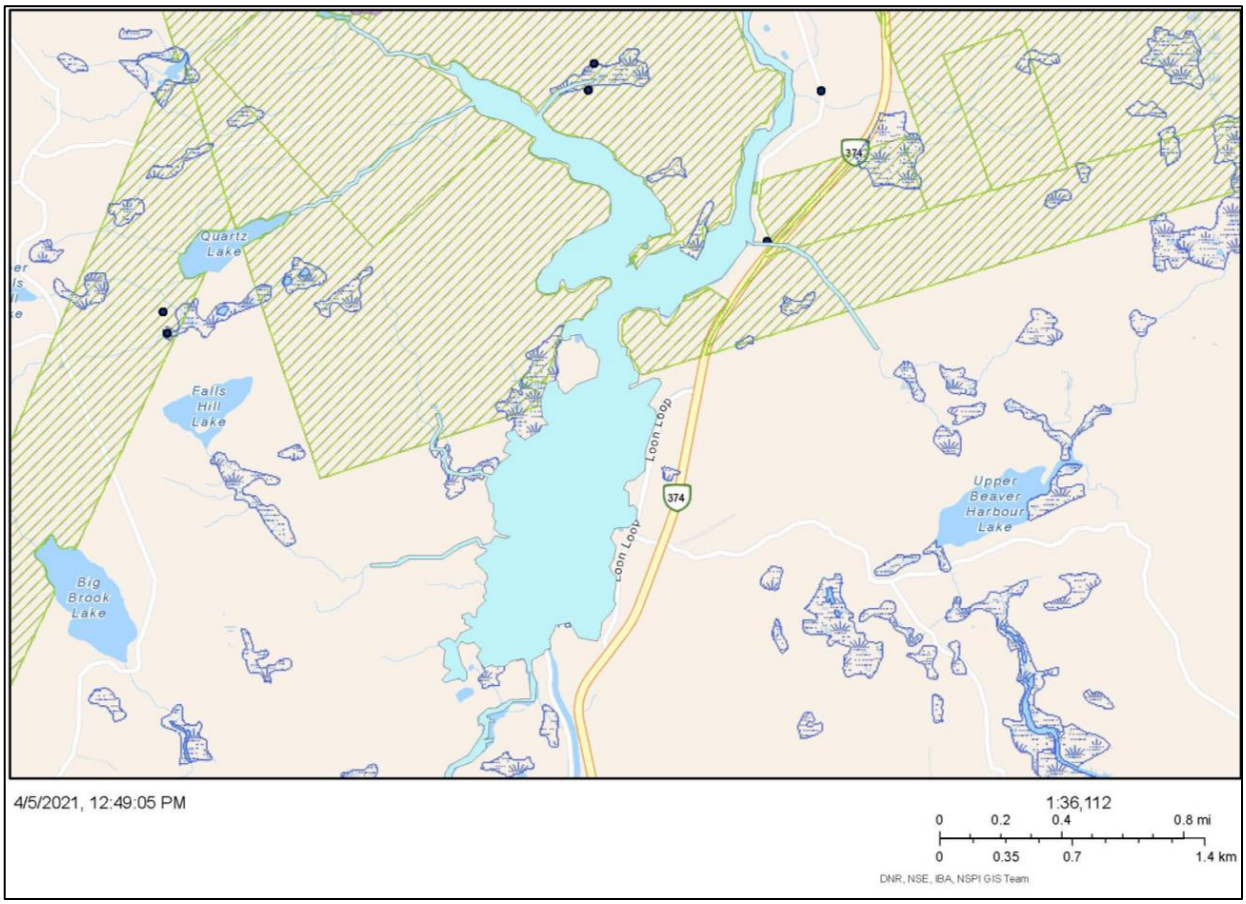


Figure 3: NS Department of Lands and Forestry Wetland Inventory Mapping and ACCDC Search Points



Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown (9 months), NS Power is not anticipating long term impact to species composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of the Ruth Falls Headpond for a 9 month period is unknown. NS Power has contracted a third-party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels, water levels, and impacts to fish and fish habitat throughout the duration of the Project. NS Power has submitted the Wetland Monitoring Plan to ECC for review.

As per the Wetland Monitoring Plan, in advance to the drawdown period, a single baseline wetland monitoring will occur using a hand auger/shovel. Upon further review it was determined that an additional monitoring event is warranted to capture baseline water levels via the instantaneous measurement method. The first water level measurement will be collected in early June when monitoring wells are installed. The second water level measurement will be completed in late June, in tandem with wetland and fish habitat assessments. Having two monitoring events will better characterize baseline water levels within each wetland environment and provide insight on any potential variation of water levels over time and/or in association with precipitation events.

Six wetlands have been selected for monitoring. Figure 2 displays the mapped wetland on the Ruth Falls Headpond, with the six wetlands to be monitored highlighted in red. Wetland locations to be monitored include wetlands WL3, WL5, WL6, WL15, WL17 and WL19 which are described in Table 4.

Wetlands selected for monitoring were chosen based on the following considerations:

- representative of various wetland types identified (as per the results of the previously completed assessment);
- capture the geographic spread of the Reservoir;
- represent the varying wetland sizes observed;
- capture some of the most species-diverse wetlands (as per the results of the previously completed species assessment);
- representative of variations in fish habitat; and
- consideration of landowner proximity and/or access considerations/limitations.

4.6 Construction Material and Debris

Measures will be taken to prevent any materials used in the various work activities from entering the watercourse. All such materials will be applied in a controlled manner and any excess material will be contained during application. All construction debris will be stored on NS Power property or disposed to an approved landfill. Any debris that requires disposal will be done so in accordance with NSECC Construction and Demolition Debris Disposal Site Guidelines.

4.7 Equipment and Machinery

All equipment and machinery required to be operated on or near a body of water will be mechanically sound with no leaking fuel tanks or hydraulic connections. Refueling and lubrication shall be in designated areas not within 30 m of any wetland or water body. Storage of petroleum products will be at least 100 m from a water body. Machinery and equipment will be stored above flood water levels. Oil spill contingency plans will be followed, and spill kits maintained on-site, in the event a petroleum product spill occurs.

4.8 Rehabilitation

Following any excavation and placement activities, areas disturbed by machinery or equipment will be returned to pre-construction condition. Any exposed soil areas will be stabilized to prevent erosion. In the event that long-term erosion problems, resulting from the clearing of the area, cannot be dealt with at the time construction is complete, temporary measures shall be taken.

5.0 ARCHAEOLOGICAL CONSIDERATIONS

An Archaeological Screening and Reconnaissance (ARIA) for the Ruth Falls Headpond was completed in 2017. The purpose of the ARIA was to assess the potential for archaeological resources in the project area, which included approximately 5 hectares surrounding the dam and earthen embankment primarily on the downstream side. The ARIA included a background study and visual assessment of the study area. The assessment identified three areas considered to exhibit high potential for encountering Precontact and/or early historic Native archaeological resources and/or historic Euro-Canadian archaeological resources. It was recommended that if these areas could not be avoided, shovel testing be conducted.

Shovel testing in 2 of the identified areas was conducted in 2018 and included 64 shovel tests. No archaeological resources were encountered and no evidence of historically significant cultural modification was identified during the course of the shovel testing. Based on the results of the 2018 shovel testing, the potential for encountering significant, intact archaeological resources within the two areas is considered to be low. It was recommended that the two shovel tested areas be cleared of any requirement for further archaeological investigation and that development within these areas may proceed as planned.

During the drawdown, archaeological reconnaissance will take place within the Ruth Falls Headpond by a qualified Archaeologist. The objective of the reconnaissance is to inspect the exposed shoreline for evidence of any previously unrecorded archaeological resources within the dewatered reservoir. In the event that archaeological resources are identified during the archaeological reconnaissance, it is proposed that two separate rounds of documentation and mitigative artifact collection will be conducted during the course of the drawdown.

6.0 ABORIGINAL ENGAGEMENT

NS Power initiated engagement regarding the Ruth Falls Main Dam project with the KMKNO in December 2017 during the One Window meeting to discuss 2018 hydro capital projects. NS Power continued to share relevant project information with the KMKNO throughout 2018 providing six project updates, the project was deferred to 2019 as NS Power continued to review design options. NS Power provided an update on the project and 2019 scope of work in December 2018

at the One Window Meeting with KMKNO. NS Power continued to provide monthly Project updates and share relevant project information throughout 2019, working towards a preferred design option and planning for the Project to be completed in 2020. NS Power further presented the Project and design option with the KMKNO during the One Window meeting to discuss 2020 hydro capital projects.

In January 2020, NS Power initiated engagement with the Mi'kmaw Conservation Group to collaborate on an offsetting project. NS Power, in February and March 2020, continued engagement with the Mi'kmaw Conservation Group, continuing discussions to identify anoffsetting project with the group and the Millbrook Mi'kmaw community. NS Power continued to engage with Millbrook throughout 2020 but was not able to share any new information on the Project due the Project deferral to 2021. During this time, NS Power has been working with the Mi'kmaw Conservation Group (MCG) of the Confederacy of Mainland Mi'kmaq (CMM) to collaborate with Millbrook First Nation on an offsetting plan for potential impacts to fish and fish habitat that are anticipated as a result of the Project. This offsetting Project will be included with NS Power's Application for Authorization to DFO. In 2021, NS Power re-initiated engagement with Millbrook First Nation and attended a Chief and Council meeting on April 20th, to share updated information on the Project.

NS Power will continue engagement regarding the project with monthly project updates to the KMKNO and notifications regarding the permitting schedule for the submission of an NSECC Watercourse Alteration application. Weekly project manager communications will be provided to the KMKNO, as construction begins, currently scheduled for July 2022 – March 2023.

7.0 OTHER STAKEHOLDER ENGAGEMENT

NS Power is committed to proactively communicating and engaging with community stakeholders, the Mi'kmaq, regulators and the public on the Ruth Falls Dam Refurbishment Project. As part of this commitment, NS Power has developed a communication plan which outlines NS Power's detailed execution plan for engagement and communication on the Project. The Communication Plan is currently being reviewed internally and will be provided to NSECC once available.

APPENDIX A – HYDRO SYSTEM OVERVIEW

1. Sheet Harbour Hydro System Map
2. Ruth Falls Plan View
3. Ruth Falls Reservoir Bathymetry

Sheet Harbour Hydro System
Ruth Falls Dam Sluice Gate Installation
Project and Environmental Description

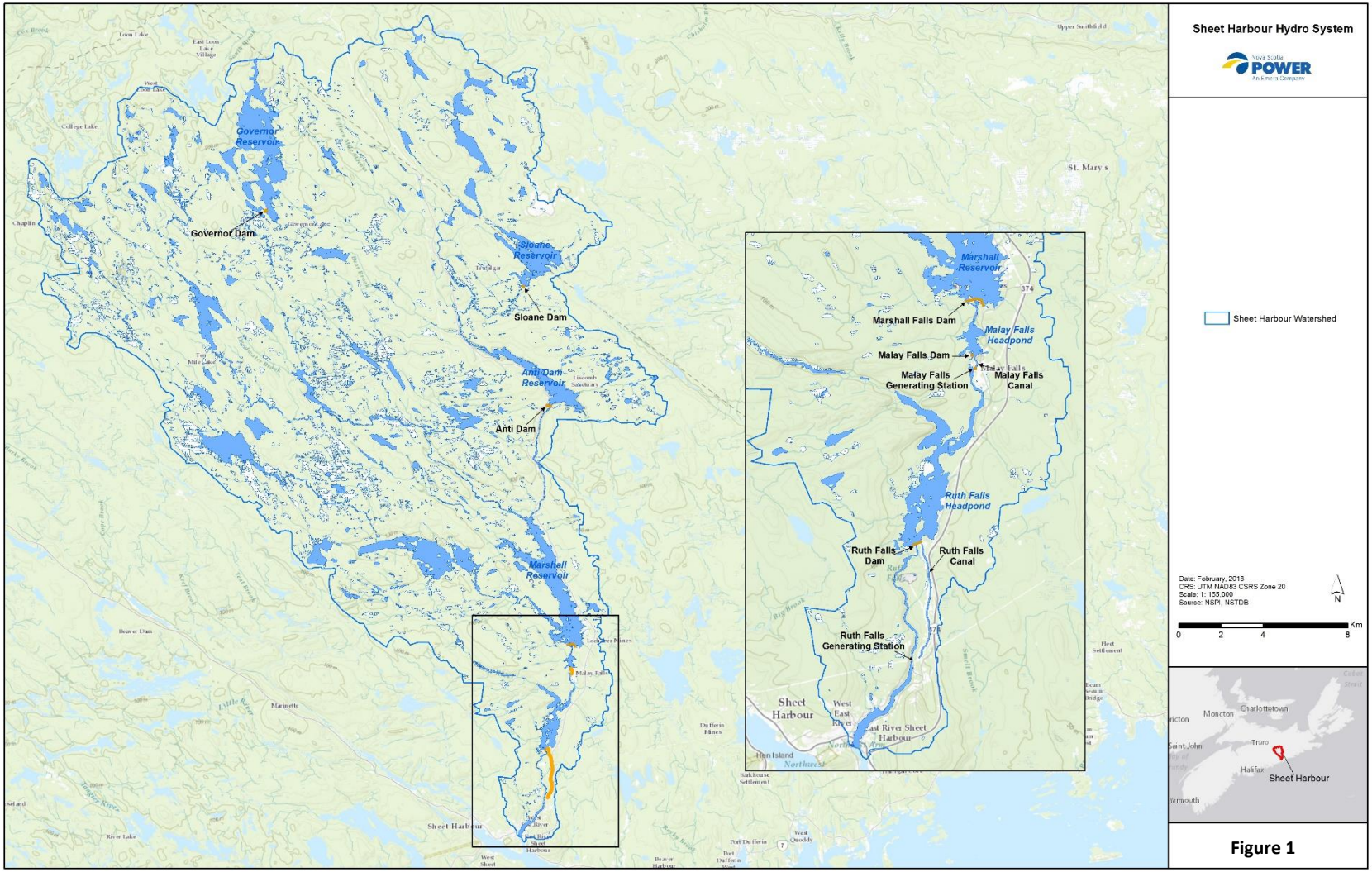


Figure 1



Figure 3. Ruth Falls Plan View

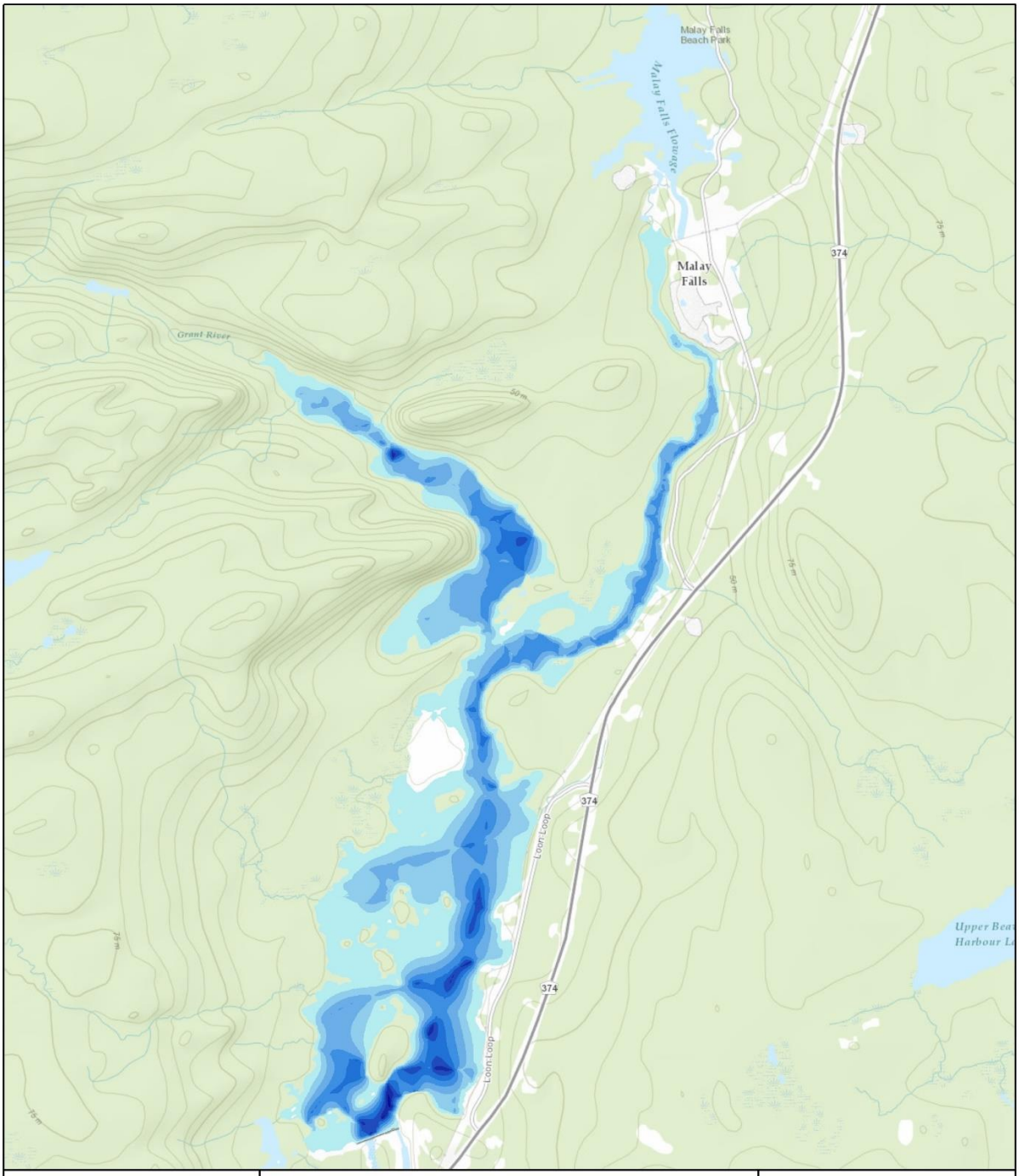

Malay Falls Beach Park
Malay Falls Flowage
Malay Falls
374
Grant River
50 m
75 m
Loon Loop
Upper Beaver Harbour Lake
Ruth Falls Headpond Bathymetry
Depth in meters
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1:20,000
Source: NSPI
N
Km
0
0.225
0.45
0.9

Figure 2

APPENDIX B – SITE PHOTOS



Photo 1: View of Ruth Falls Dam, facing north



Photo 2: View of Ruth Falls Dam, facing west



Photo 3: Ruth Falls fishladder and bypass pipe



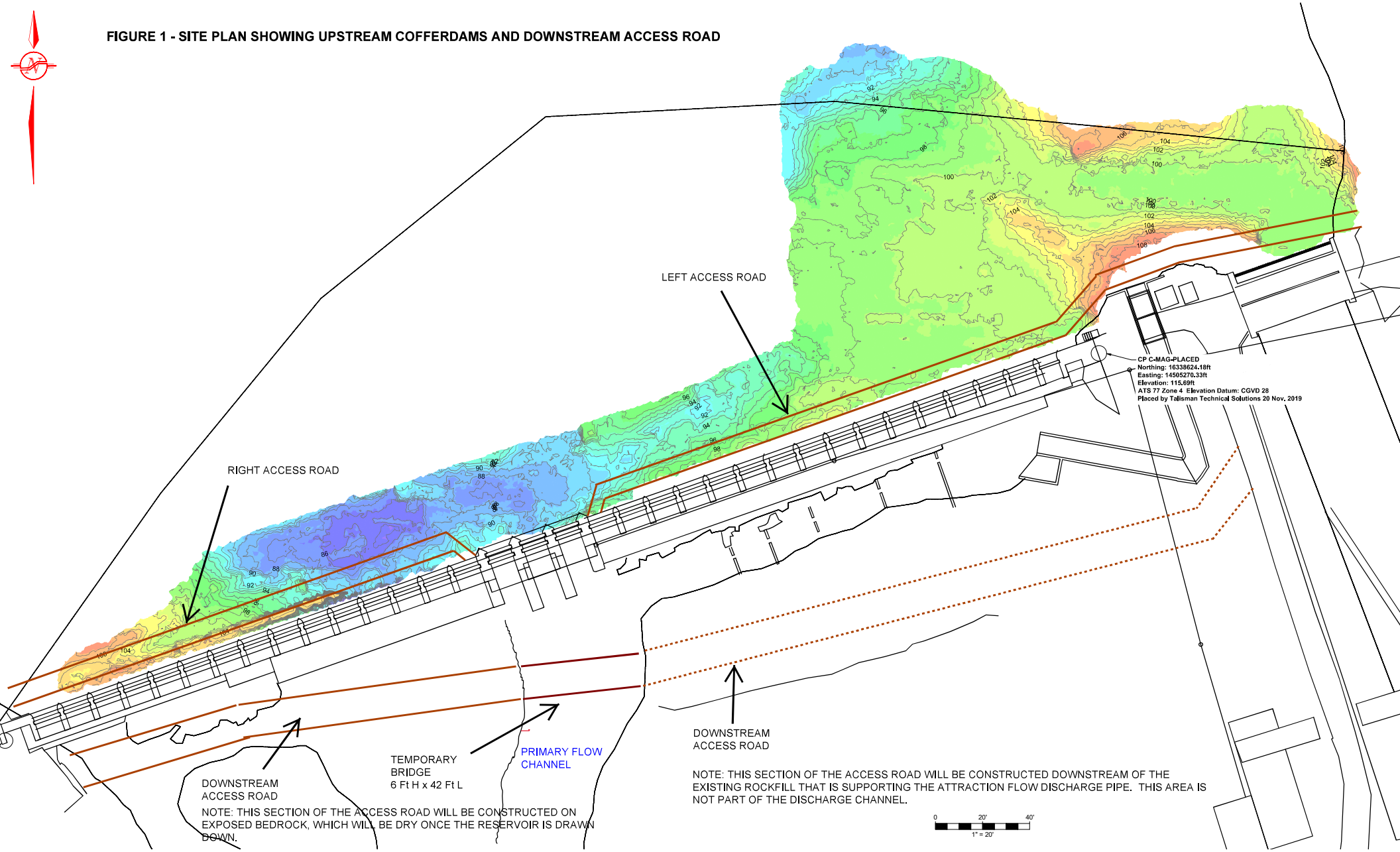
Photo 4: Downstream of Ruth Falls Dam



Photo 5. Upstream of Ruth Falls Dam

APPENDIX C – PROPOSED WATER MANAGEMENT STRUCTURES

FIGURE 1 - SITE PLAN SHOWING UPSTREAM COFFERDAMS AND DOWNSTREAM ACCESS ROAD



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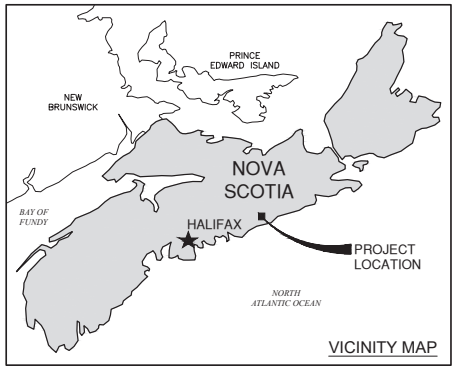
APPENDIX D – ENGINEERING DRAWINGS

DWG. NO. H096H1163100040

NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP





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DATE 2020-12-11
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

COVER SHEET

DWG.NO. H096H1163100040 REV. C

DWG. NO. H096H1163100041

DRAWING LIST

SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS	NSPI DRAWING No.
100-01	DRAWING LIST	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-041
100-02	GENERAL NOTES	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-042
200-01	EXISTING CONDITIONS OVERALL SITE PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-043
200-02	EXISTING CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-044
200-03	EXISTING CONDITIONS WEST SPILLWAY DAM PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-045
210-01	TEMPORARY CONDITIONS/DEMO PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-046
210-02	TEMPORARY CONDITIONS/DEMO EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-047
210-03	TEMPORARY CONDITIONS/DEMO WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-048
300-01	NEW CONDITIONS DAM PLAN AND ELEVATION	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-049
300-02	NEW CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-050
300-03	NEW CONDITIONS WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-051
300-04	NEW CONDITIONS SLUICEWAY PLAN AND DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-052
310-01	NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-053
310-02	NEW CONCRETE SLUICEWAY HEADWALL DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-054
310-03	NEW CONCRETE SPILLWAY RESURFACING DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-055
310-04	NEW CONCRETE RETAINING WALL AND PIER DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-056
320-01	NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-057
320-02	NEW STEEL GRATED ACCESS PLATFORM	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-058
320-03	NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-059
330-01	RUBBER DAM PIPING AT SLUICEWAY	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-060

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

DRAWING LIST

DWG.NO. H096H1163100041 REV. C

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

DWG. NO. H096H1163100042

GENERAL NOTES

1. GENERAL:
   - A. CONTRACTOR SHALL DETERMINE LOCATIONS, EXISTING CONDITIONS, AND DIMENSIONS BY THEIR OWN INVESTIGATION.
   - B. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON LIMITED FIELD MEASUREMENTS, REFERENCE DRAWINGS AND SURVEY. FIELD VERIFY ALL DIMENSIONS, AND NOTIFY THE OWNER AND ENGINEER OF DISCREPANCIES.
   - C. CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION, AND WILL NOTIFY THE OWNER FOR AN APPROVAL, IF REQUIRED.
2. SURVEY:
   - A. GEOMETRY OF THE EXISTING DAM STRUCTURE SURVEYED BY TALISMAN TECHNICAL SOLUTIONS, LANTZ, NS, IN 2017.
   - B. ELEVATIONS ARE BASED ON OCTOBER 1994 GEODETIC DATUM. ELEVATIONS AND DIMENSIONS ARE NOMINAL. ACTUAL ELEVATIONS VARY THROUGHOUT EXISTING STRUCTURES.
   - C. UTILITIES LOCATED BY SURVEY OR SHOWN ON DRAWINGS ARE APPROXIMATE AND SHALL BE CONFIRMED IN FIELD.
   - D. CONTRACTOR SHALL COORDINATE WITH NSPI FOR TEMPORARY RELOCATION OR PERMANENT RELOCATION OF POWER LINES AND POLES IF REQUIRED.
   - E. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65 FT
3. DESIGN LOADS:
   - A. NORMAL HEADPOND: EL. 109.25 FT
   - B. INFLOW DESIGN FLOOD HEADPOND: EL. 114.0 FT AT PEAK FLOW OF 29,183 CFS
   - C. SEISMIC COEFFICIENT: 0.1g
   - D. ICE LOAD AT NORMAL POND ELEVATION: 5,000 LB/FT
4. JOB CONDITIONS:
   - A. SITE INFORMATION:
     - I. ANY SUBSURFACE CONDITIONS SHOWN ON THE DRAWINGS ARE BASED ON INTERPRETATIONS/INTERPOLATIONS OF DATA OBTAINED FROM BACKGROUND DOCUMENTS AND WIDELY SPACED EXPLORATIONS BY OTHERS. VARIATIONS MAY EXIST AND SHOULD BE EXPECTED.
   - B. EXISTING UTILITIES:
     - I. THE CONTRACTOR SHALL LOCATE EXISTING UNDERGROUND AND OVERHEAD UTILITIES IN THE AREAS OF WORK. IF UTILITIES ARE TO REMAIN IN PLACE, PROVIDE ADEQUATE MEANS OF PROTECTION DURING EARTHWORK OPERATIONS.
     - II. NOTE THAT THERE ARE EXISTING OVERHEAD POWERLINES AND ASSOCIATED POLES ALONG AND ADJACENT TO THE EMBANKMENT DAM. THE CONTRACTOR SHALL COORDINATE WITH OWNER FOR TEMPORARY OR PERMANENT RELOCATION OF POWERLINES AND POLES; AS REQUIRED.
     - III. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATION, CONSULT THE OWNER AND UTILITY OWNER/OPERATOR IMMEDIATELY FOR DIRECTIONS.
     - IV. THE CONTRACTOR SHALL REPAIR DAMAGED UTILITIES TO SATISFACTION OF THE OWNER AND UTILITY OWNER/OPERATOR.
5. QUALITY ASSURANCE:
   - A. HORIZONTAL AND VERTICAL CONTROL:
     - I. THE CONTRACTOR IS RESPONSIBLE FOR AND SHALL PROVIDE ALL CONSTRUCTION LAYOUT.
     - II. SURVEYS FOR CONSTRUCTION ELEVATIONS AND LOCATIONS OF THE WORK SHALL BE PERFORMED BY OR UNDER THE SUPERVISION OF A QUALIFIED SURVEYOR.
   - B. OWNER'S REPRESENTATIVE:
     - I. THE OWNER'S REPRESENTATIVE WILL PROVIDE PERIODIC TO REGULAR REVIEW OF THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR REGULAR COMMUNICATION OF THE CONSTRUCTION SCHEDULE AND FOR PROVIDING AMPLE NOTICE TO THE OWNER'S REPRESENTATIVE FOR CRITICAL REVIEWS SPECIFIED HEREIN.
     - II. THE OWNER'S REPRESENTATIVE MUST REVIEW ALL EXPOSED SUBGRADES PRIOR TO PLACEMENT OF FILL MATERIALS.
     - III. THE CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY (QCTL) SHALL PERFORM QUALITY CONTROL TESTING DURING CONSTRUCTION, AS SPECIFIED HEREIN. THE CONTRACTOR'S QCTL SHALL SHARE TEST RESULTS ON–SITE WITH THE OWNER'S REPRESENTATIVE UPON REQUEST.
     - IV. THE OWNER MAY CHOOSE TO EMPLOY AN INDEPENDENT THIRD PARTY TESTING AGENCY TO PERFORM QUALITY ASSURANCE (QA) TESTING.
6. EROSION & SEDIMENT CONTROL:
   - A. EROSION PREVENTION AND SEDIMENT CONTROL SHALL BE IN ACCORDANCE WITH LOCAL AND PROVINCE STANDARDS AND OWNER'S STANDARDS. ALL MEASURES SHALL BE CONSISTENT WITH THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT EROSION AND SEDIMENTATION CONTROL HANDBOOK FOR CONSTRUCTION SITES, AT A MINIMUM.
   - B. SUBMIT PLAN AND DETAILS TO OWNER FOR REVIEW AND APPROVAL.
   - C. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE OWNER.
7. DEMOLITION:
   - A. DEMOLISH PORTIONS OF THE EXISTING CONCRETE DAM AS SHOWN IN THE PLANS.
   - B. CONTRACTOR SHALL DEWATER WORK AREAS AS NEEDED TO PERFORM DEMOLITION AND EXCAVATION AND TO ACCOMMODATE NEW CONSTRUCTION.
   - C. CONTRACTOR SHALL CONFORM TO ALL OWNER SAFETY PROCEDURES.
   - D. CONTRACTOR SHALL NOT BEGIN ANY DEMOLITION OR EXCAVATION UNTIL AFTER RECEIVING WRITTEN AUTHORIZATION TO BEGIN DEMOLITION FROM OWNER'S PROJECT MANAGER.
   - E. CONTRACTOR IS RESPONSIBLE FOR CARE OF ANY LEAKAGE INTO THE WORK AREAS DURING CONSTRUCTION.
   - F. CONTRACTOR SHALL DISPOSE ALL DEMOLITION MATERIAL AT A LOCATION THAT HAS BEEN APPROVED BY OWNER.
8. MATERIALS:
   - A. STEEL:
     - I. BOLTS ASTM A325 (THREAD EXCLUDED FROM SHEAR PLANE) COMPLETE WITH A563 HEX NUT AND HELICAL SPRING WASHER ANSI B 18.21.1 UNLESS OTHERWISE SPECIFIED. ALL HARDWARE SHALL BE GALVANIZED AS PER ASTM A153.
     - II. STRUCTURAL W SHAPES: ASTM A992, OR CSA G40.21–350W.
     - III. STEEL PLATE: ASTM A–36, OR CSA G40.21–300W.
     - IV. ANCHOR RODS: ASTM A 36, A 307, OR F1554. HOT DIPPED GALVANIZED PER ASTM A 153, AS INDICATED ON DRAWINGS.
   - B. CONCRETE:

     SUBMIT MIX DESIGN AND REINFORCEMENT SHOP DRAWINGS FOR APPROVAL BY OWNER.

     SURFACE PREP:
     - I. REMOVED DETERIORATED SURFACE MATERIAL IN DESIGNATED AREAS DOWN TO SOUND CONCRETE. SOUND CONCRETE IS DEFINED AS WHEN THE SURFACE IS STRUCK WITH A GEOLOGIST'S HAMMER, THE AGGREGATE OF THE CONCRETE FRACTURES BEFORE THE CEMENT PASTE BOND IS BROKEN.
     - II. PERFORM REMOVAL WITH POINTED TOOLS THAT DO NOT DAMAGE OR FRACTURE THE UNDERLYING SOUND CONCRETE, OR BY PRESSURE WASHING OR AIR BLASTING.
     - III. ROUGHEN ALL SURFACES TO GREATER THAN 1/4" AMPLITUDE. CLEAN SURFACE TO REMOVE ALL DELETERIOUS MATERIAL, INCLUDING DIRT, GREASE, ETC. WASH WITH HIGH PRESSURE WASH AT LEAST 6,000 PSI.
     - IV. CONCRETE SURFACE SHALL BE SATURATED AT TIME OF CONCRETE PLACEMENT, BUT NO STANDING WATER.
     - V. DO NOT PLACE CONCRETE AGAINST ACTIVE LEAKS OR SEAMS WITH FLOWING WATER. STOP FLOW OR INSTALL DRAINAGE TO DIVERT FLOW AWAY FROM FRESH CONCRETE.

     SPECIFICATIONS:
     - I. MINIMUM F'c = 30 MPa AT 28 DAYS (4,000 PSI),
     - II. MAX W/C RATIO 0.45
     - III. FLYASH: ALL FLY ASH SHALL BE CLASSIFIED "FLY ASH CLASS CI OR F", CONFORMING TO CSA A3000 AND AS FURTHER DESCRIBED IN CLAUSE 2.2.1, CONCRETE MIXES. THE TOTAL ALKALI CONTENT OF THE FLY ASH SHALL BE LIMITED TO 4.5% MAXIMUM. THE FLY ASH SHALL BE OBTAINED FROM THE TRENTON GENERATING STATION UNIT 6 AS MARKETED BY SHAW RESOURCES.
     - IV. AIR ENTRAINMENT 6–8%
     - V. SLUMP AT PLACEMENT SHALL BE 100mm +/– 25mm (4" +/– 1")
     - VI. MAX AGGREGATE SIZE SHALL BE 25mm (1")
     - VII. CONCRETE PLACEMENT AND CURING SHALL BE IN ACCORDANCE WITH CSA 23.1, EXPOSURE CLASS F–1, "SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS".
     - VIII. CONCRETE WORK SHALL CONFORM TO CSA 23.1. CONCRETE STRENGTH SHALL BE VERIFIED BY STANDARD 28 DAY TESTS.
     - IX. REINFORCEMENT = CSA G30.18, GRADE 400W DEFORMED. STANDARD HOOKS PER CSA A23.3.
     - X. NON SHRINK CEMENT GROUT: MINIMUM F'C = 35MPA AT 7 DAYS.
     - XI. ADHESIVE ANCHORS SUITABLE FOR USE IN DAMP OR WET ENVIRONMENT: HILTI–HIT HY 200 ADHESIVE OR APPROVED EQUAL. ANCHORS ASTM F1554 GRADE 55, MINIMUM Fy=380MPA; Fu=520MPA.
   - C. NON–SHRINK GROUT: CRD–C 621, FACTORY PREMIXED GROUT
     - I. EARLY VOLUME CHANGE: ASTM C–827: 0.00% SHRINKAGE
     - II. HARDENED VOLUME CHANGE: 0.00% SHRINKAGE AND EXPANSION AFTER SET.
     - III. COMPRESSIVE STRENGTH: ASTM C–109 MIN. = 35 MPA AT 7 DAYS
     - IV. ACCEPTABLE SUPPLIERS: "FIVE STAR GROUT" BY US GROUT CORP, OR APPROVED EQUIVALENT.
9. SUBMITTALS:
   - A. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO OWNER FOR APPROVAL PRIOR TO FABRICATION.
   - B. EXCAVATION AND FILL PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE A WRITTEN EXCAVATION AND FILL PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL DETAIL THE FOLLOWING ITEMS, AT A MINIMUM:
       - SCHEDULE AND SEQUENCE OF WORK IN EACH AREA.
       - ACCESS TO EACH AREA.
       - LOCATION OF MATERIAL STOCKPILES IN EACH AREA.
       - EQUIPMENT TO BE USED IN EACH AREA.
       - MONITORING AND QUALITY CONTROL PROCEDURES.
       - MEANS/METHODS AND MATERIALS TO PROTECT EXISTING FEATURES DESIGNATED TO REMAIN.
   - C. DEWATERING PLAN:
     - I. DEWATERING WILL BE DONE IN CONJUNCTION WITH NSPI HYDRO SYSTEM PERSONNEL AND THE NSPI PROJECT MANAGER/ENGINEERS. THE CONTRACTOR SHALL PROVIDE A DETAILED DEWATERING PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING ITEMS, AT A MINIMUM:
       - MEANS/METHODS OF TEMPORARY EXCAVATION DEWATERING.
       - EQUIPMENT TO BE USED.
       - SETTLEMENT BASINS, IF REQUIRED, FILTER BAG LOCATIONS AND POINTS OF DISCHARGE.
       - SEQUENCING OF DEWATERING, EXCAVATION, AND FILL PLACEMENT.
   - D. EMERGENCY SEEPAGE PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE AN EMERGENCY SEEPAGE PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING, AT A MINIMUM:
       - TYPE, QUANTITY, AND LOCATION OF EMERGENCY FILTER/BALLAST STOCKPILES.
       - OTHER MATERIALS TO BE USED, (E.G., SANDBAGS, NON–WOVEN GEOTEXTILE, FILTER STONE, SMALL RIPRAP, ETC.).
   - E. WINTERIZATION PLAN:
     - I. AT LEAST TWO (2) WEEKS PRIOR TO ANY WINTER SHUTDOWN, THE CONTRACTOR SHALL SUBMIT A PLAN FOR PROTECTING/WINTERIZING THE COMPLETED WORK.
   - F. CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY:
     - I. THE CONTRACTOR SHALL SUBMIT THE NAME AND QUALIFICATIONS OF AN INDEPENDENT THIRD PARTY COMMERCIAL TESTING LABORATORY TO BE USED FOR BORROW SOURCE TESTING OF SOILS/CONSTRUCTION MATERIALS TESTING.
       - THE TESTING AGENCY SHALL BE A RECOGNIZED COMMERCIAL LABORATORY WITH NOT LESS THAN 5 YEARS OF EXPERIENCE IN CONDUCTING RELEVANT FIELD AND LABORATORY QUALITY CONTROL TESTING.
       - THE TESTING AGENCY SHALL MEET THE REQUIREMENTS OF ASTM D–3740.
   - G. BORROW SOURCE(S):
     - I. AT LEAST TWO (2) WEEKS PRIOR TO INITIATION OF APPLICABLE WORK, THE CONTRACTOR SHALL PROVIDE THE PROPOSED SOURCE(S) OF BORROW MATERIALS AND SUPPORTING DATA/RESULTS OF THE SPECIFIED BORROW SOURCE TESTING.
       - TESTING DATA/RESULTS SHALL BE FROM CURRENT TESTING OF SAMPLES OBTAINED FROM THE ACTUAL PROPOSED SOURCE/STOCKPILE AND NOT PRIOR/FILE RESULTS FROM THE SUPPLIER.
   - H. QUALITY CONTROL TESTING REPORTS:
     - I. SUBMIT TWO (2) COPIES OF THE FOLLOWING REPORTS AS SOON AS POSSIBLE, BUT NOT MORE THAN TWO (2) BUSINESS DAYS FOLLOWING COMPLETION OF ASSOCIATED QUALITY CONTROL TESTING.
       - LABORATORY TEST REPORTS FOR PROPOSED BORROW SOURCE MATERIALS. ACCEPTANCE OR REJECTION OR FILL MATERIALS WILL BE BASED ON THE RESULTS OF CURRENT LABORATORY TESTING.
       - FIELD IN–PLACE DENSITY/COMPACTION TEST REPORTS.
10. EARTHWORK:
    - A. SEE SHEET 310–04 FOR EARTHWORK.

90% REV. 1 REVIEW SUBMITTAL
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100-02 Kleinschmidt

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____–__–__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———
MECH ——— CONST ———

APPROVED

DATE . . . . . .

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED CMV
CHECKED __
DATE 2020–12–11
W.O. XXXX

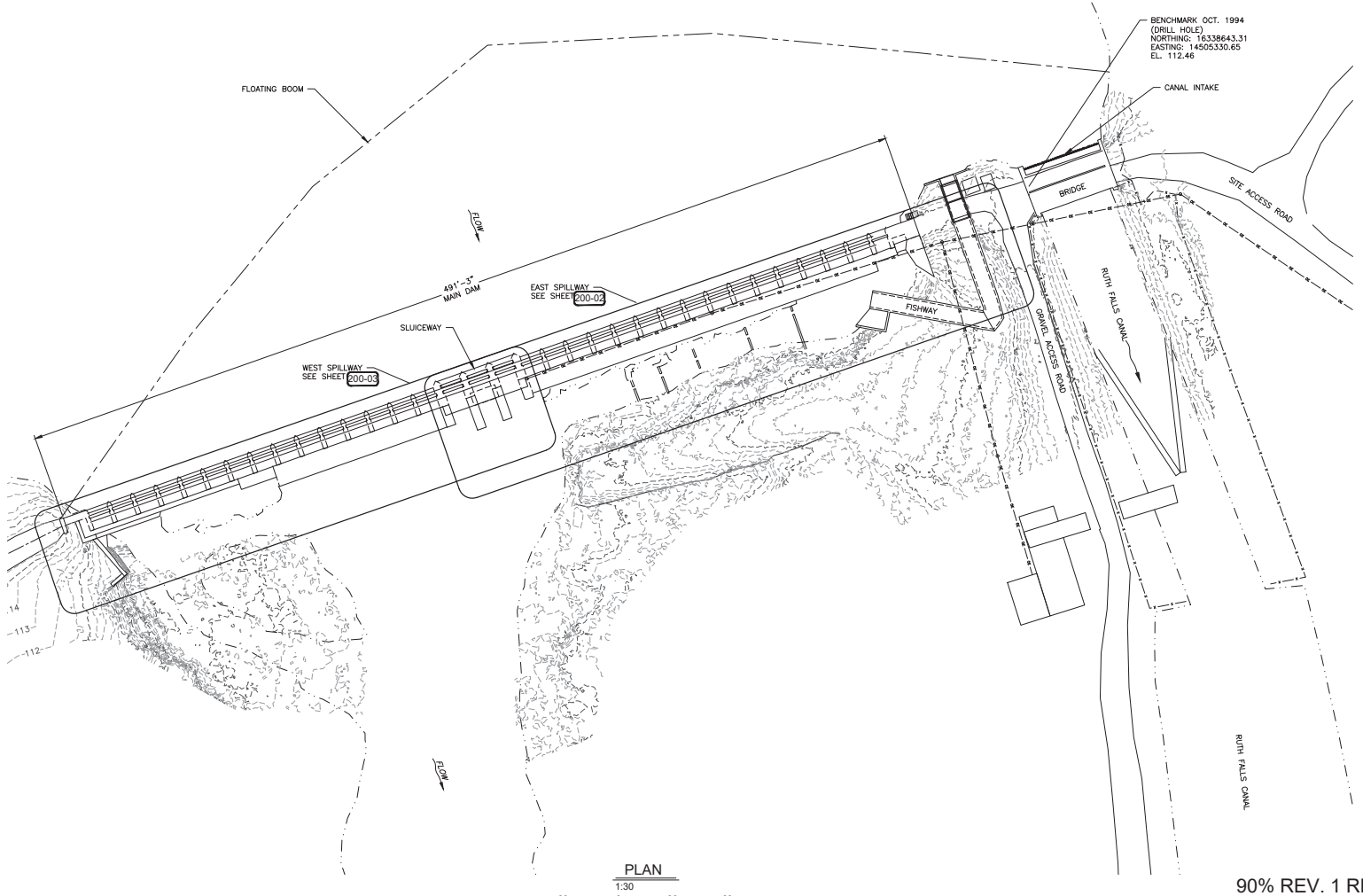
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

GENERAL NOTES

DWG.NO. H096H1163100042 REV. C

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 3



PLAN
1:30
30 0 30 60
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

200-01

Kleinschmidt

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PRINTED: Dec. 9, 2020 - 2:53 PM

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

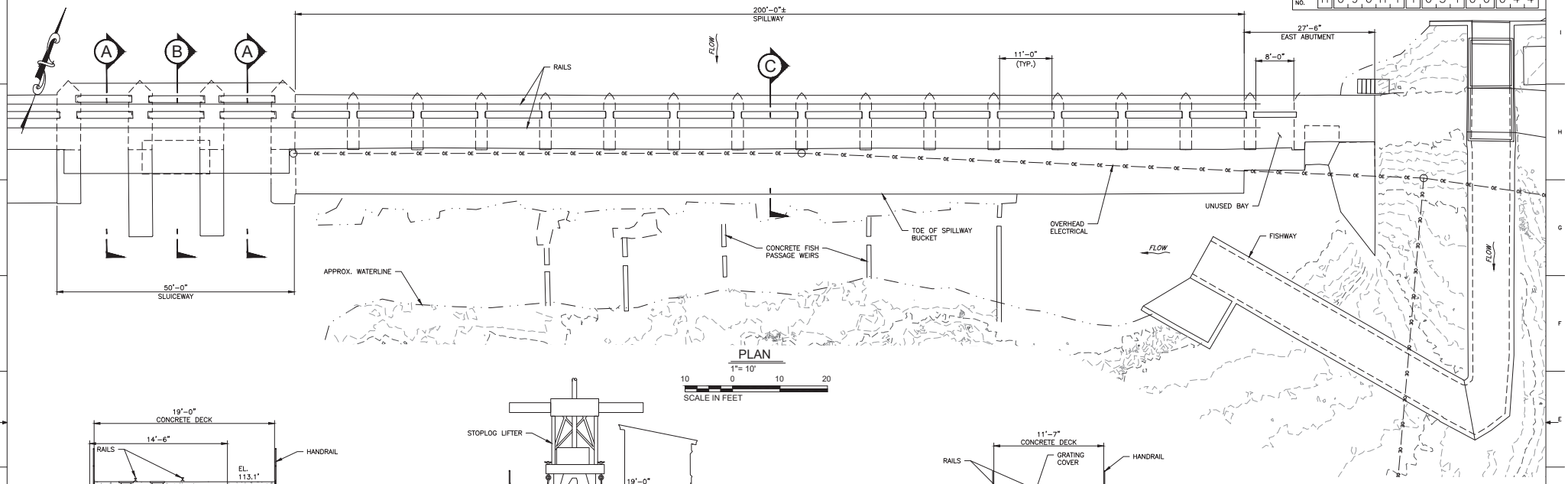
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An Emera Company
energy everywhere.

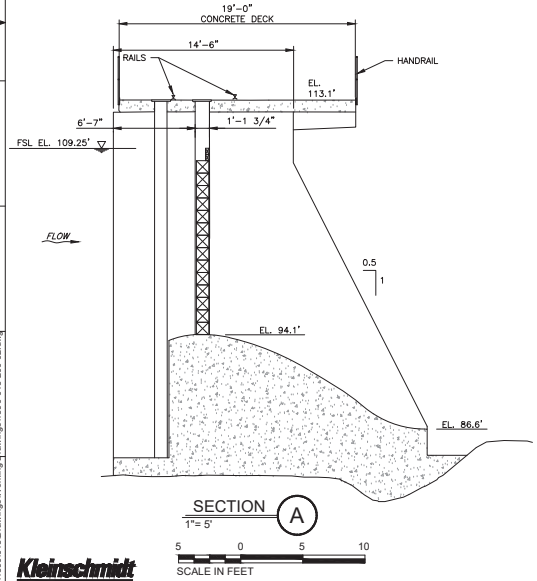
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

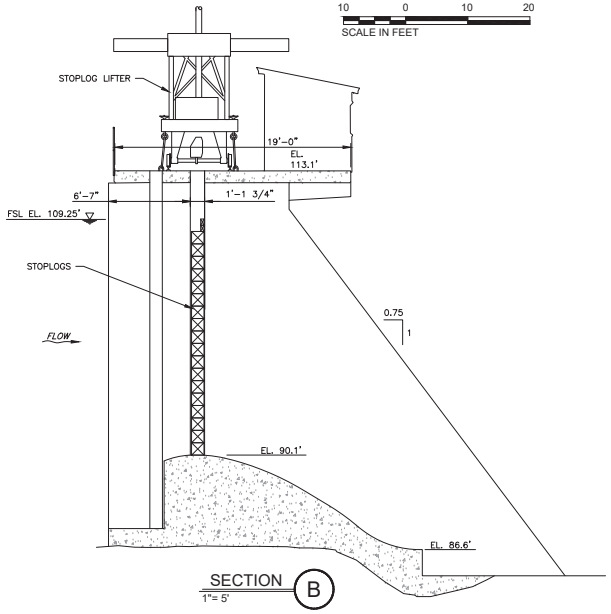
EXISTING CONDITIONS
OVERALL SITE PLAN

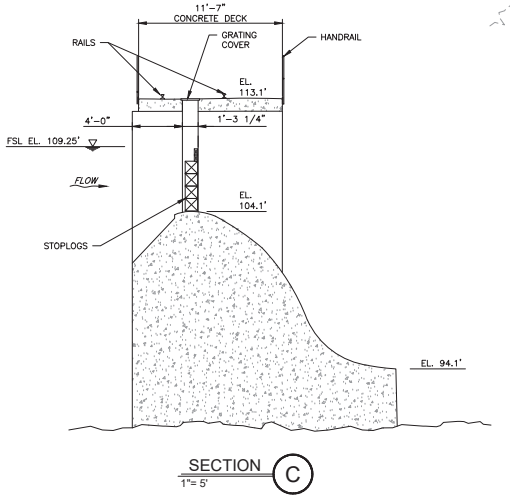
H 0 9 6 H 1 1 6 3 1 0 0 0 4 3 REV. C
DWG.NO.

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 4









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200-02

Kleinschmidt

REFERENCE DESCRIPTION	A X X X X X X X X X X X X X X
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H 0 9 5 H 1 1 6 7 0 0 0 3 2
REFERENCE DRAWINGS	DWG.NO.

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———
MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

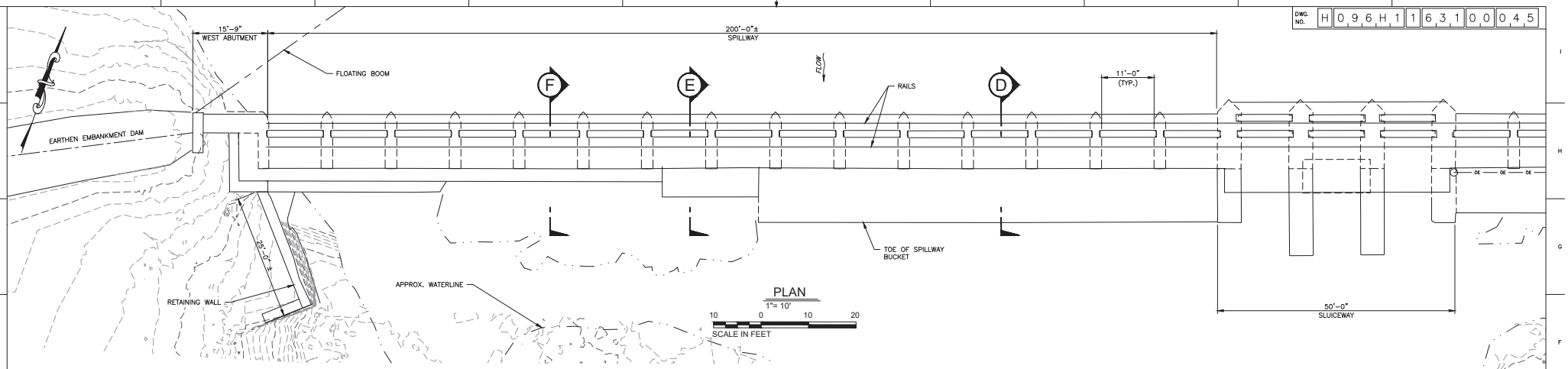
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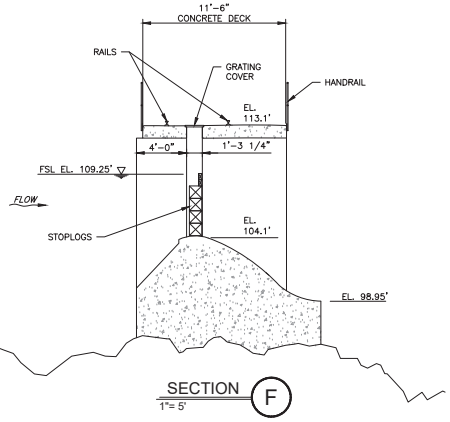
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

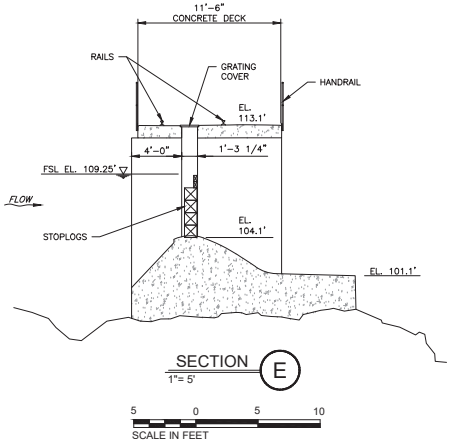
EXISTING CONDITIONS EAST SPILLWAY
PLAN AND SECTION

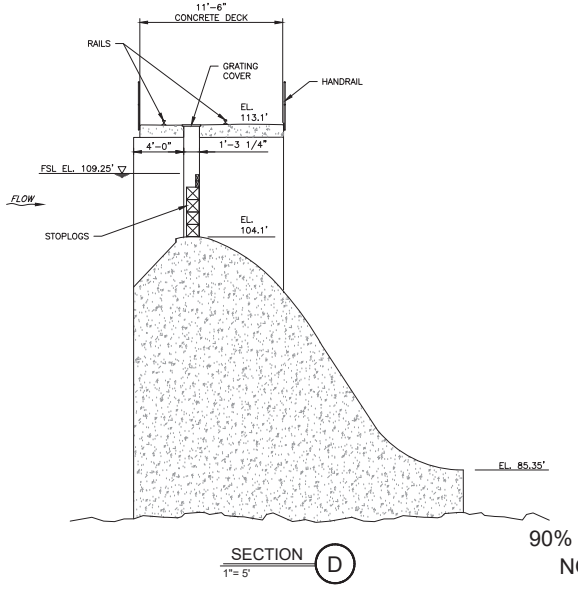
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DWG.NO.

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200-03

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 5

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REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

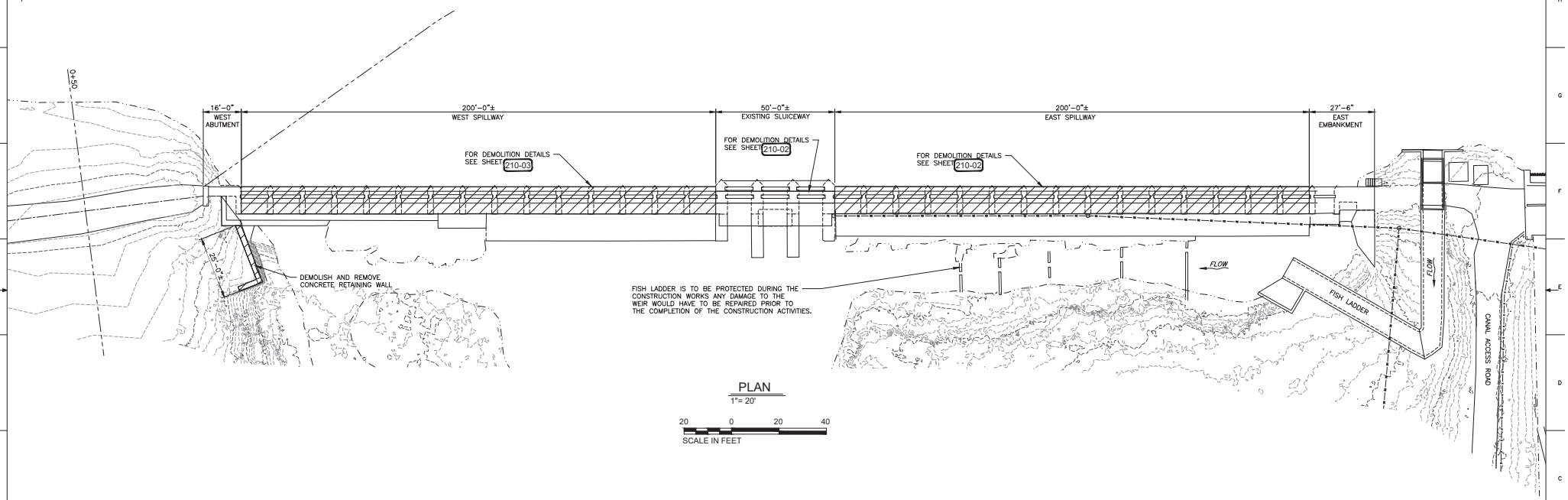
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

EXISTING CONDITIONS WEST SPILLWAY
DAM PLAN AND SECTIONS

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 5 REV. C

DWG. NO. H096H1163100046



PLAN
1"= 20'

20 0 20 40
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
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Kleinschmidt

210-01

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PRINTED: Dec. 9, 2020 - 2:55 PM

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REFERENCE DRAWINGS					DWG.NO.								

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

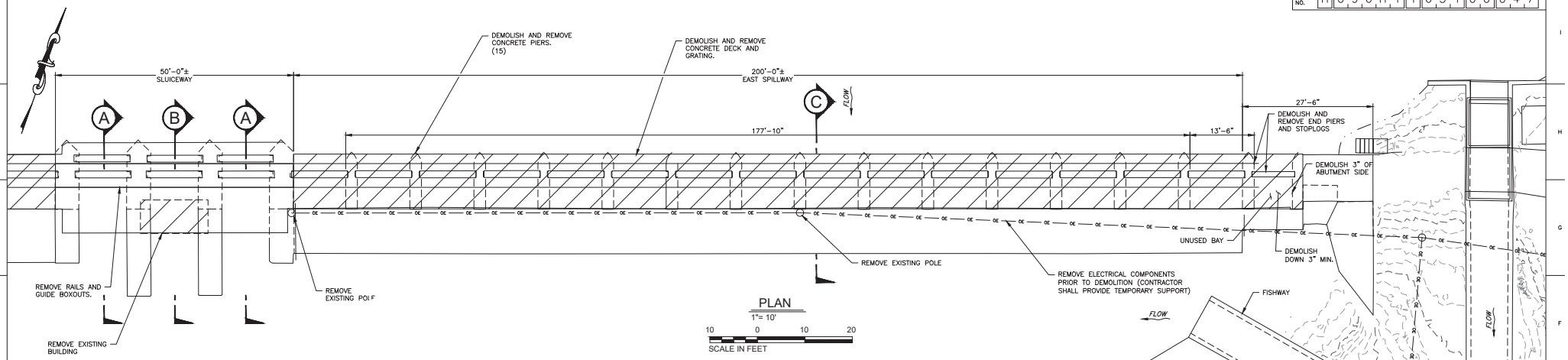
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

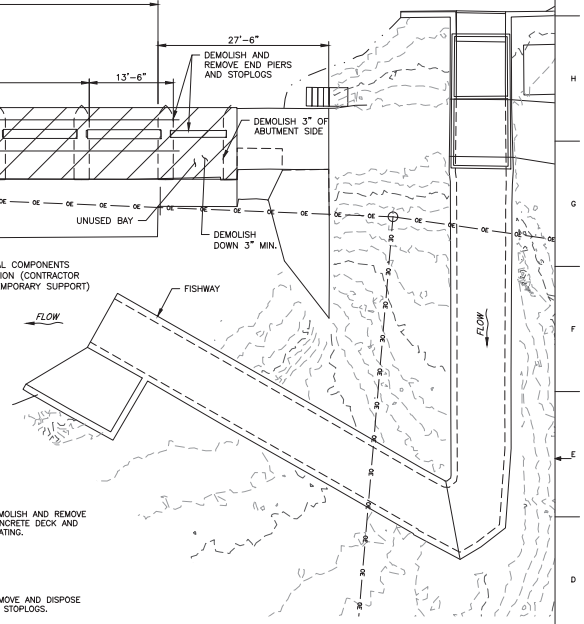
TEMPORARY CONDITIONS/DEMO PLAN

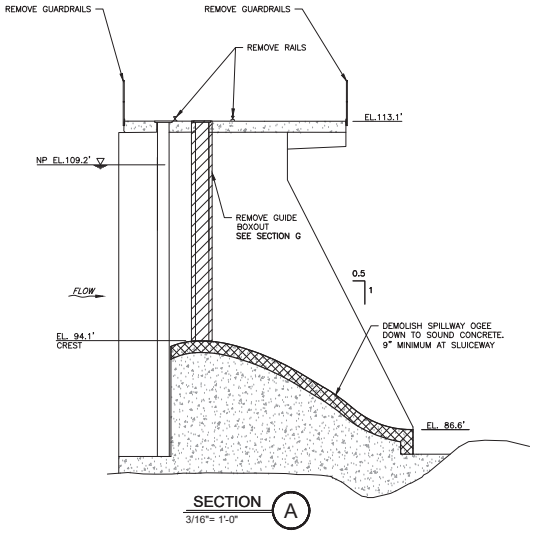
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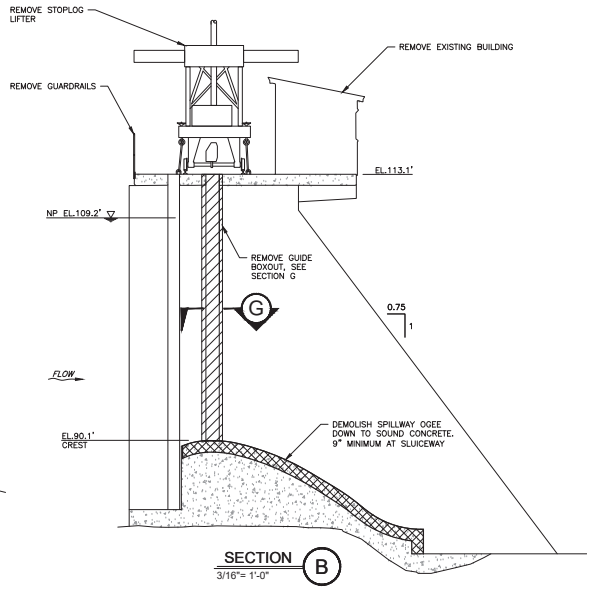


PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

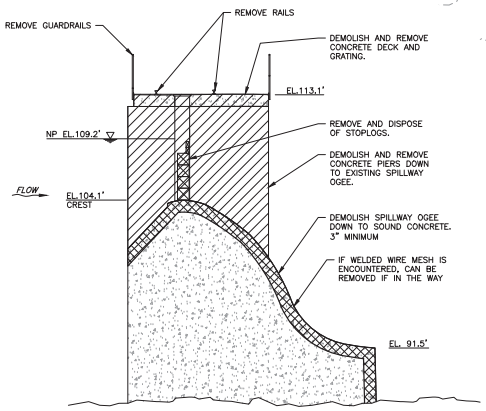




SECTION A
3/16"= 1'-0"

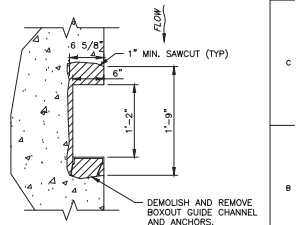


SECTION B
3/16"= 1'-0"



SECTION (TYP EAST SPILLWAY) C
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION (TYP) G
1"= 1'-0"

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210-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H	0	9	5	H	1	1	6	7	0	0	0	3	2
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL		E & I	
MECH		CONST	

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	--
CHECKED	--
DATE	2020-12-11
W.O.	XXXX

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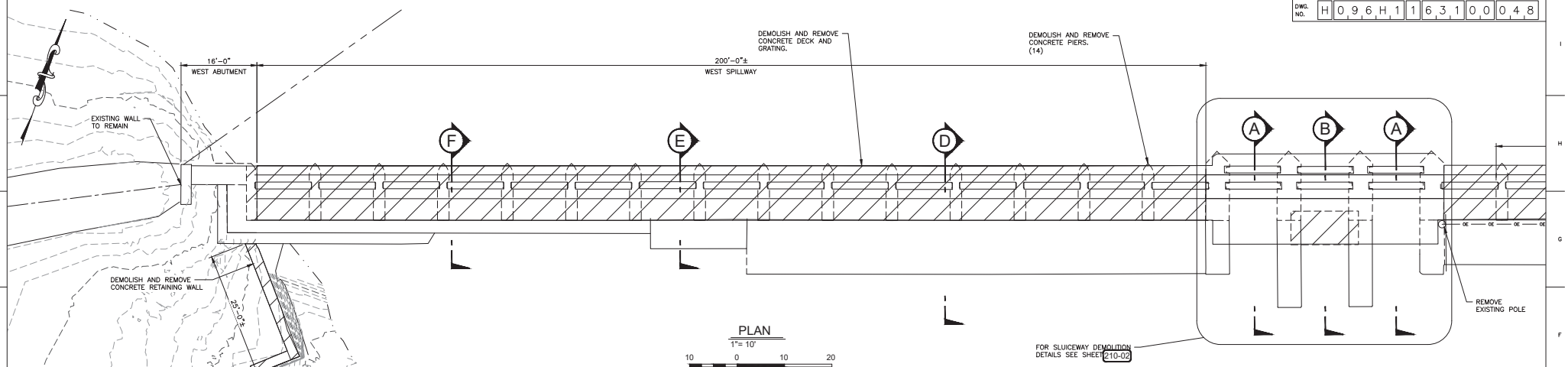
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
EAST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100047 REV. C

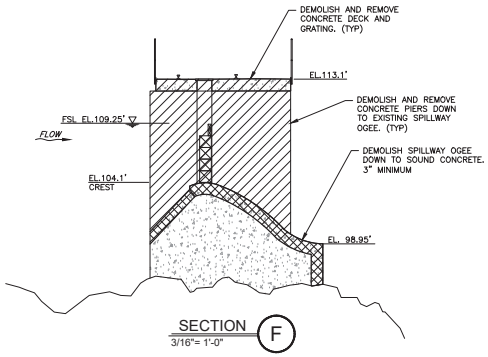
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DWG. NO. H096H1163100048



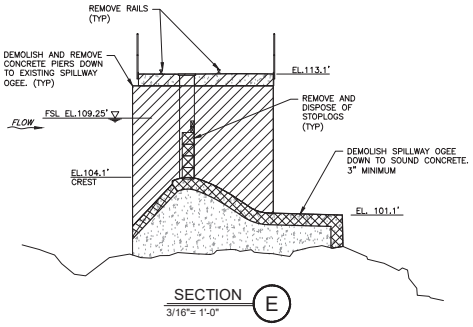
PLAN
1"= 10'

10 0 10 20
SCALE IN FEET

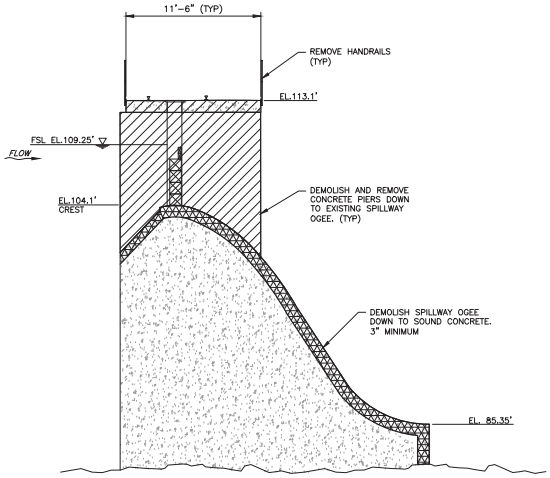


SECTION F
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION E
3/16"= 1'-0"



SECTION D
3/16"= 1'-0"

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210-03

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REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2020-12-11
W.O.	XXXX

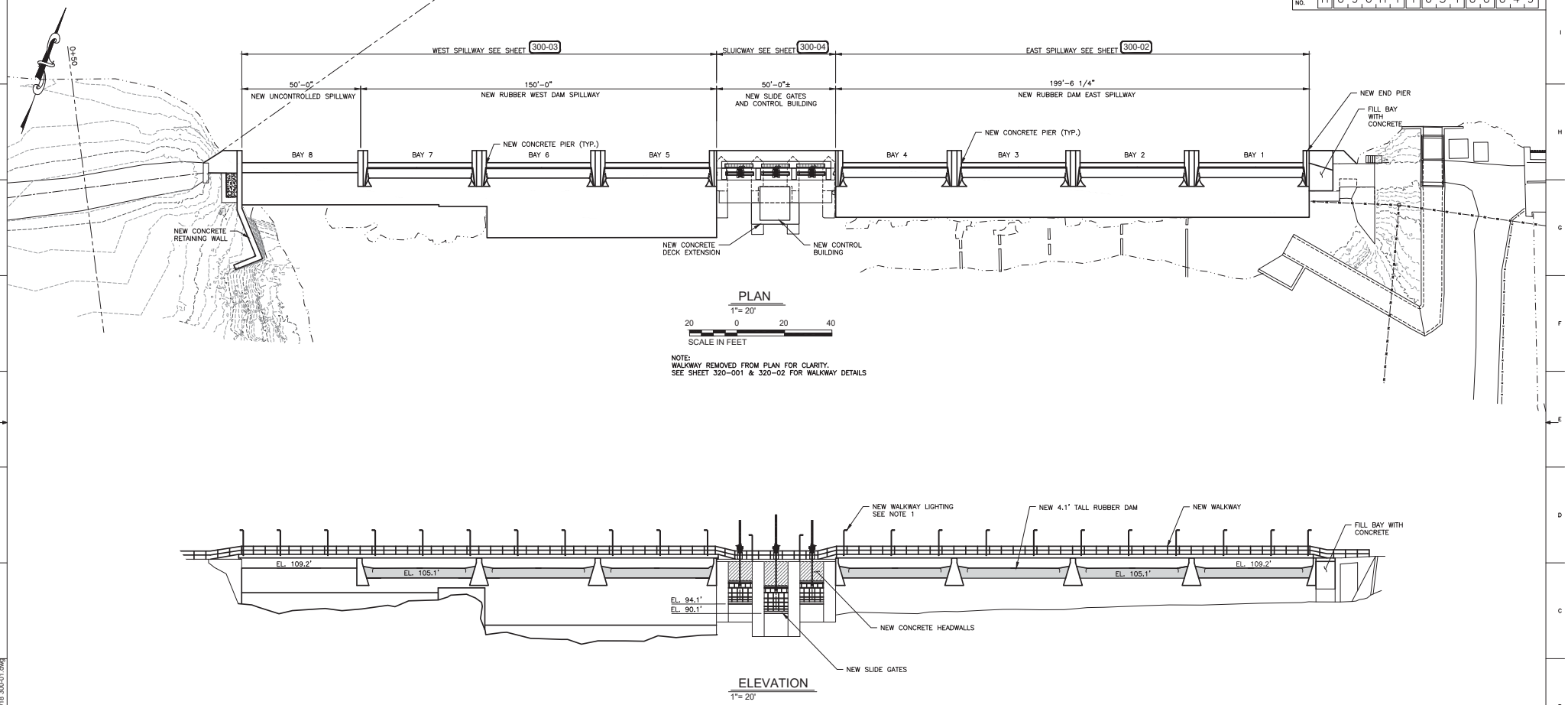
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RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
WEST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100048 REV. C

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 9



NOTE:
1. LED LUMINAIRE MOUNTED TO A SWIVEL POLE– 5,300 LUMENS, TYPE 1 OPTIC, MULTIVOLT DRIVER, WARM (3000K) COLOR TEMP. LIGHT TO BE MOUNTED 10' ABOVE WALKWAY AND SPACED AT 20'. WIRING AND CONDUIT RESPONSIBILITY OF CONTRACTOR.

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300-01

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PRINTED: Dec. 9, 2020 - 3:37 PM

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REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST
BY:	DATE:				

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED
DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

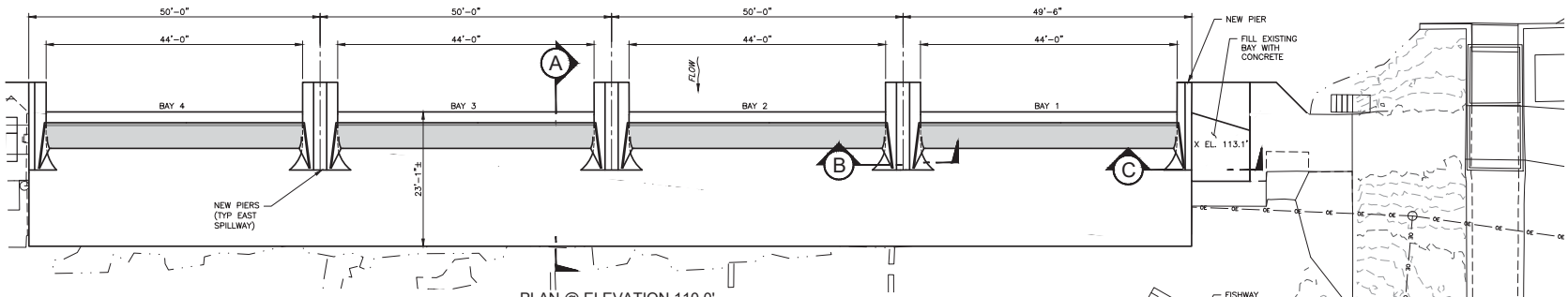
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

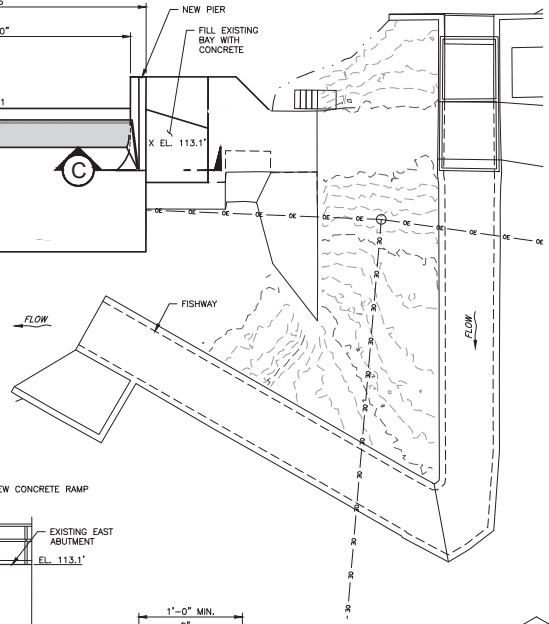
NEW CONDITIONS
DAM PLAN AND ELEVATION

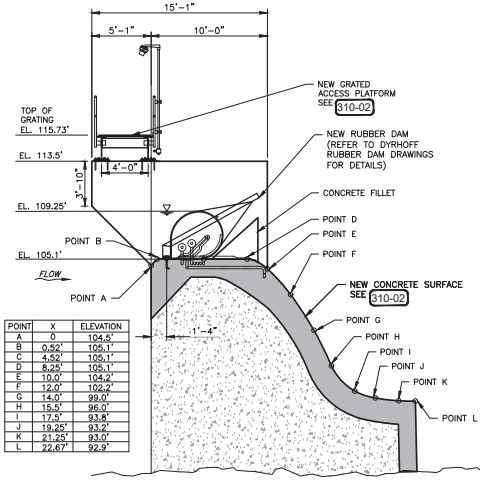
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DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 0



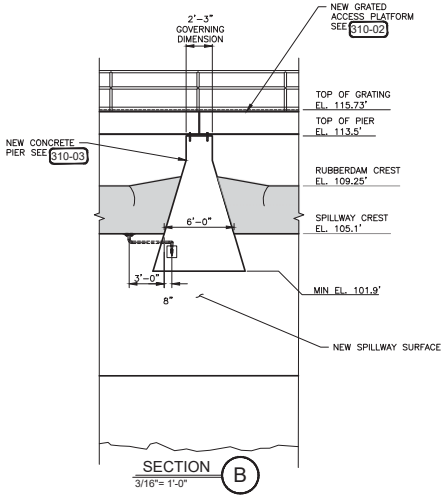
PLAN @ ELEVATION 110.0'
1"= 10'
10 0 10 20
SCALE IN FEET



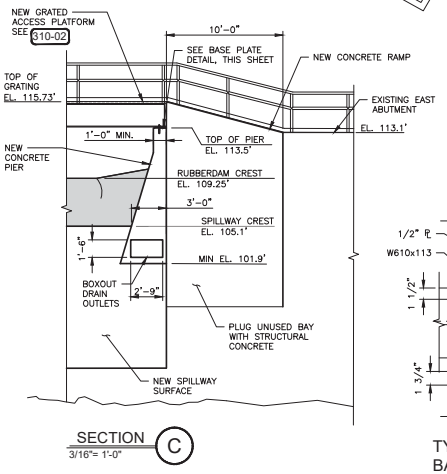


POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	4.52'	105.1'
D	8.25'	105.1'
E	10.0'	104.2'
F	12.0'	102.2'
G	14.0'	99.0'
H	15.5'	96.0'
I	17.5'	93.8'
J	19.25'	93.2'
K	21.25'	93.0'
L	22.67'	92.9'

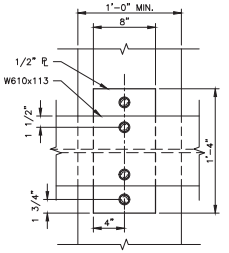
SECTION A
3/16"= 1'-0"
4 0 4 8 12
SCALE IN FEET



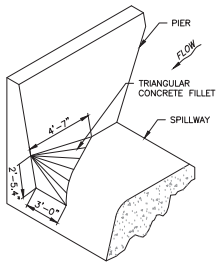
SECTION B
3/16"= 1'-0"



SECTION C
3/16"= 1'-0"



TYPICAL END PIER
BASE PLATE DETAIL
1 1/2"= 1'-0"



TRIANGULAR CONCRETE FILLET DETAIL
N.T.S.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST
BY: _____ DATE: ____-__-__					

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———
MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED ——
CHECKED ——
DATE 2020-12-11
W.O. XXXX

Nova Scotia POWER An Emera Company energy everywhere.

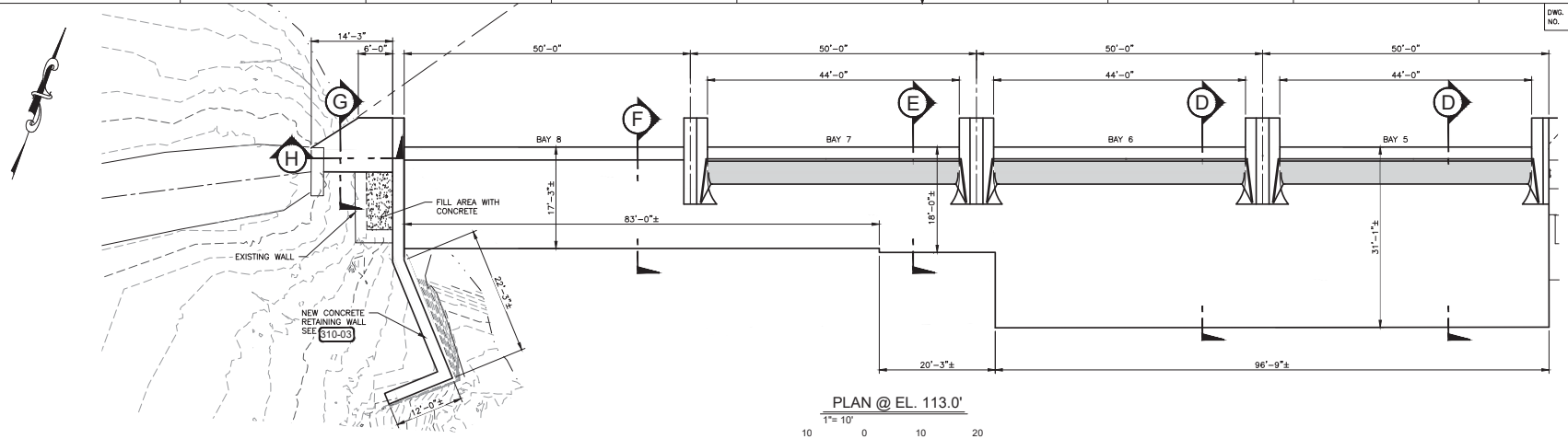
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
EAST SPILLWAY PLAN AND SECTIONS

H 0 9 6 H 1 1 6 3 1 0 0 0 5 0 REV. C
DWG.NO.

PRINTED: Dec. 9, 2020 - 2:13 PM
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DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 1

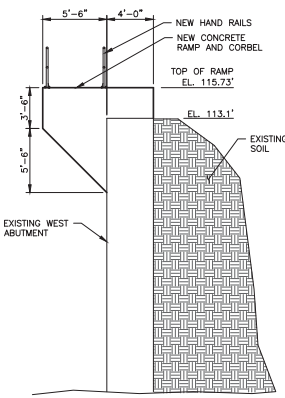


PLAN @ EL. 113.0'

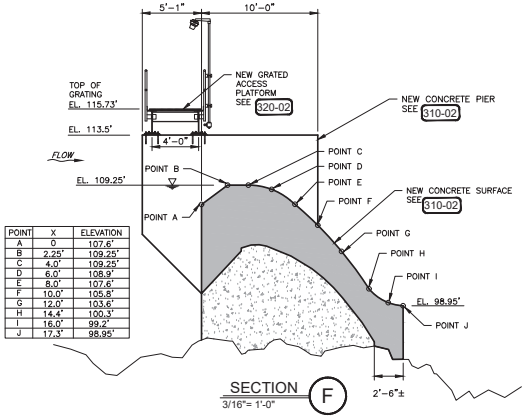
1"= 10'

SCALE IN FEET

NOTE:
WALKWAY REMOVED FROM PLAN FOR CLARITY.
SEE SHEET 320-001 & 320-02 FOR WALKWAY DETAILS

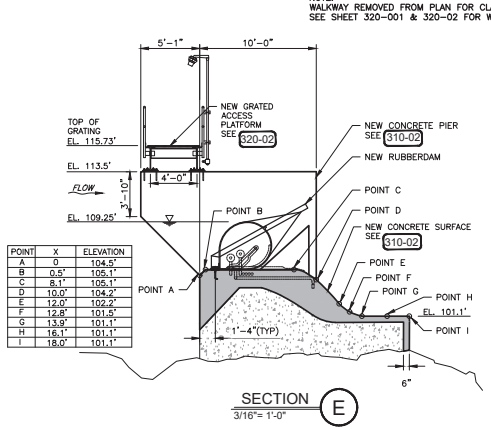


SECTION G
3/16"= 1'-0"



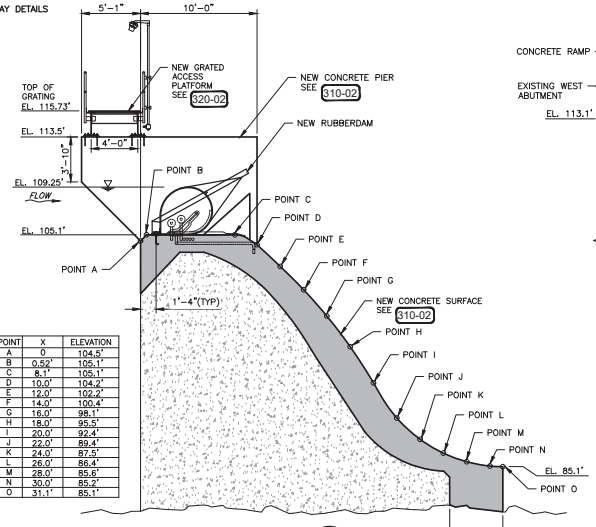
POINT	X	ELEVATION
A	0	107.6'
B	2.25'	109.25'
C	4.0'	109.25'
D	6.0'	108.9'
E	8.0'	107.6'
F	10.0'	105.8'
G	12.0'	103.6'
H	14.4'	100.3'
I	16.0'	99.2'
J	17.3'	98.95'

SECTION F
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.5'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	12.8'	101.5'
G	13.9'	101.1'
H	16.1'	101.1'
I	18.0'	101.1'

SECTION E
3/16"= 1'-0"

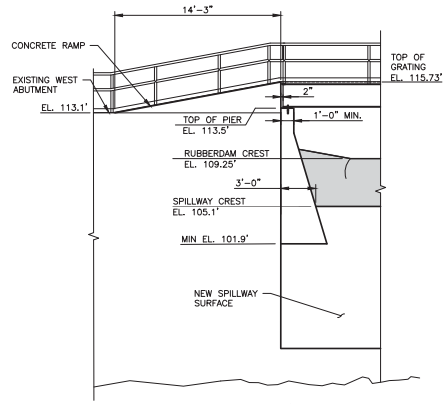


POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	14.0'	100.4'
G	16.0'	98.1'
H	18.0'	95.5'
I	20.0'	92.4'
J	22.0'	89.4'
K	24.0'	87.5'
L	26.0'	86.4'
M	28.0'	85.6'
N	30.0'	85.2'
O	31.1'	85.1'

SECTION D
3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET



SECTION H
3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2020-12-11
W.O.	XXXX

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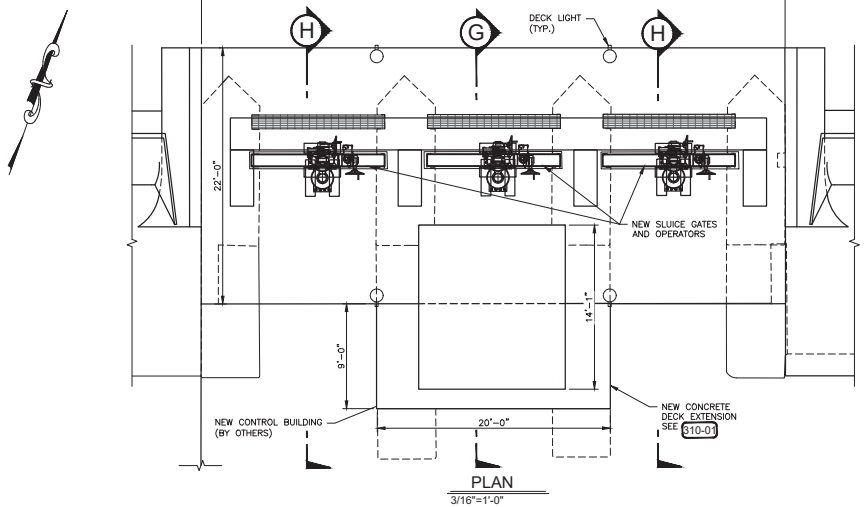
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
WEST SPILLWAY PLAN AND SECTIONS

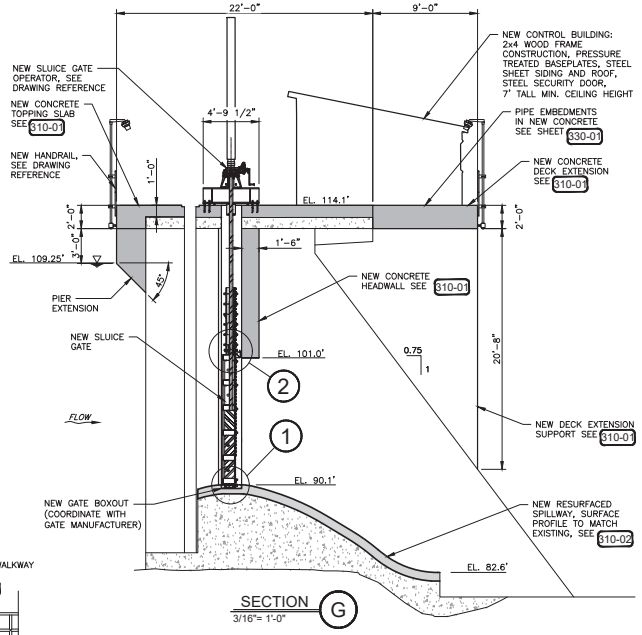
DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 1 REV. C

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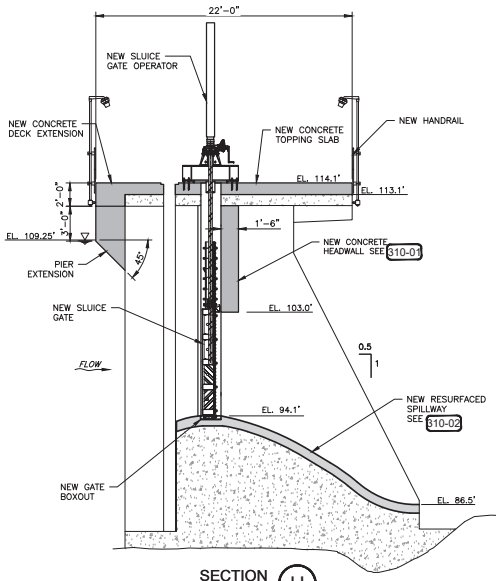
DWG. NO. H096H1163100052



PLAN
3/16"=1'-0"

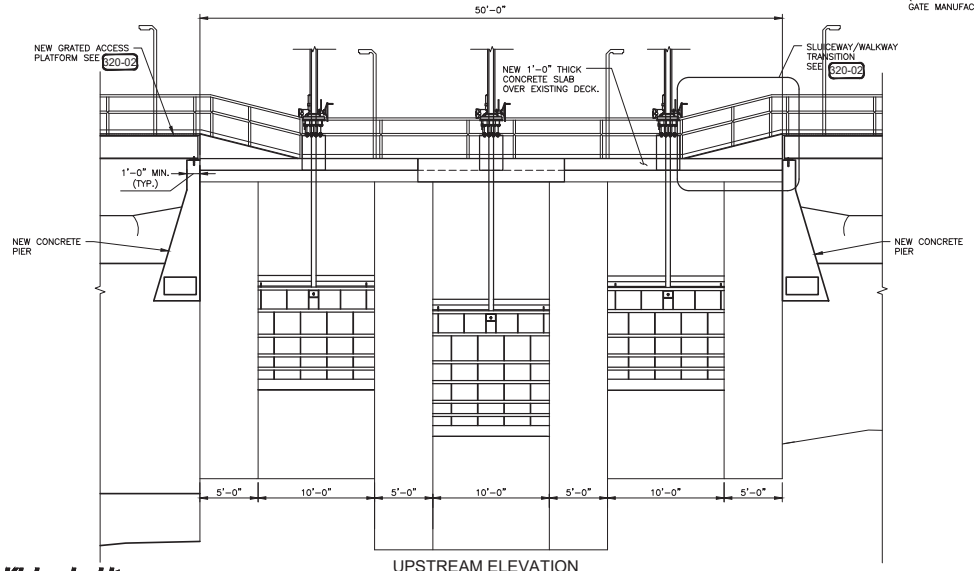


SECTION G
3/16"= 1'-0"

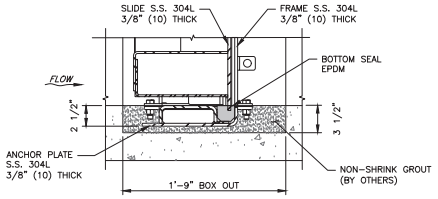


SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

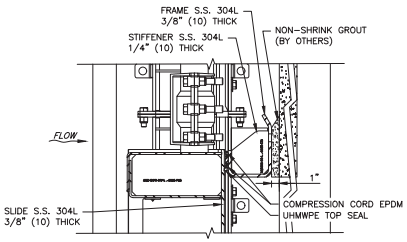


UPSTREAM ELEVATION
3/16"=1'-0"



DETAIL 1
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES



DETAIL 2
1 1/2"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-04

J:\1890\018\Drawings\Working Drawings\1890-018 300-02,03,04.dwg
PRINTED: Dec. 9, 2020 - 3:43 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	0	1
FONTAINE AQUANOX DWG NO. D15542-01-204P2X120107BFE/CW22														
REFERENCE DRAWINGS					DWG.NO.									

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL		E & I	
MECH		CONST	

APPROVED

DATE , ,

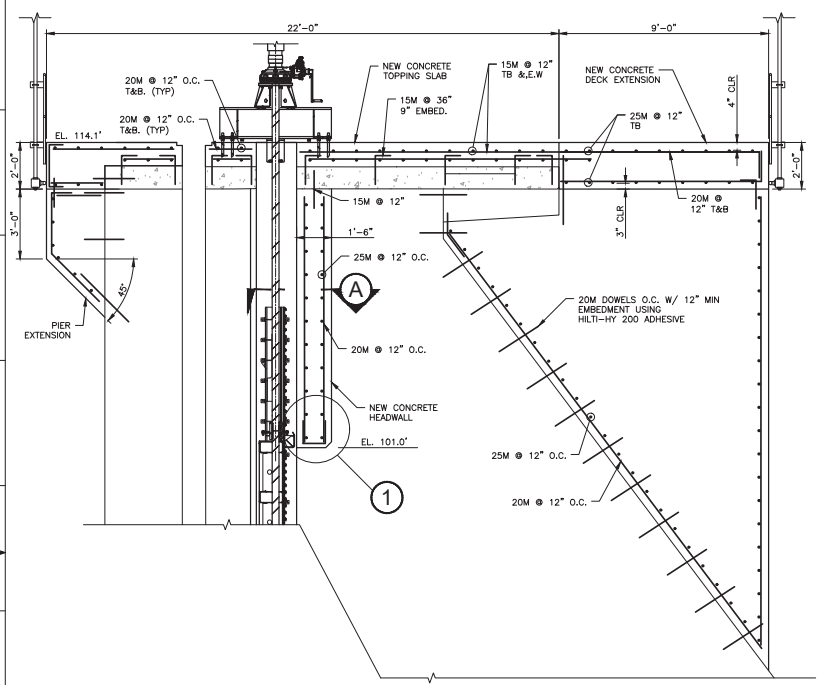
SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
SLUICEWAY PLAN AND DETAILS

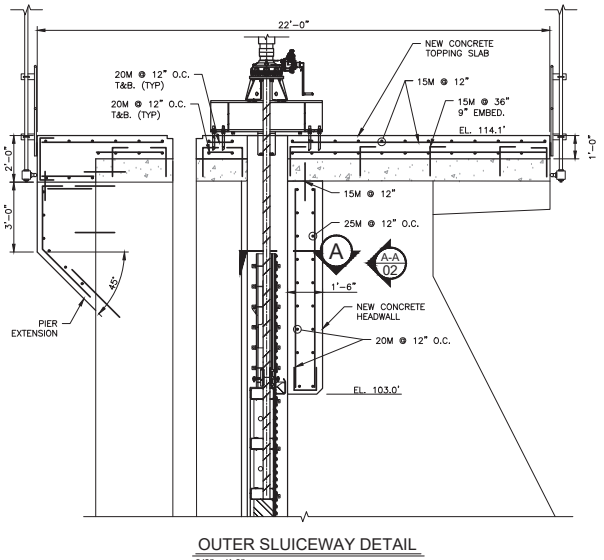
DWG.NO. H096H1163100052 REV. C



INNER SLUICEWAY DETAIL

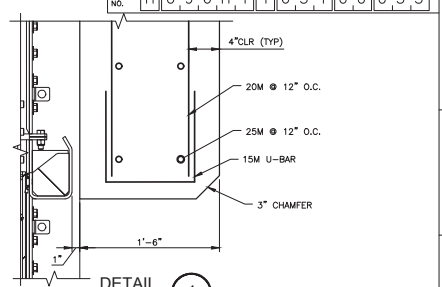
3/8"= 1'-0"

SCALE IN FEET



OUTER SLUICEWAY DETAIL

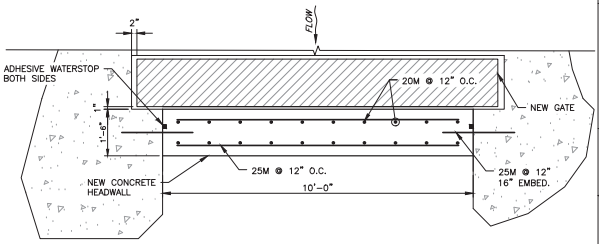
3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

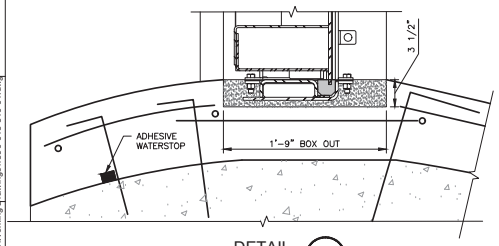
SCALE IN INCHES



SECTION A

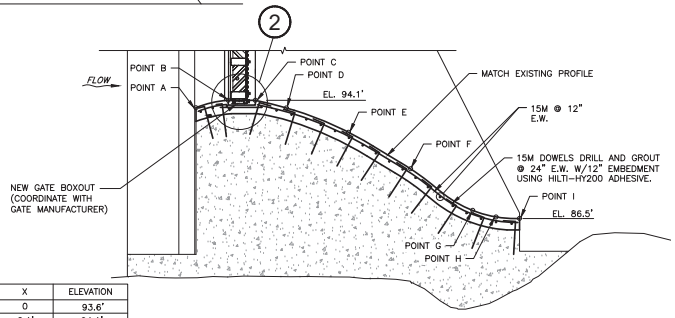
1/2"= 1'-0"

SCALE IN FEET



DETAIL 2

1 1/2"= 1'-0"

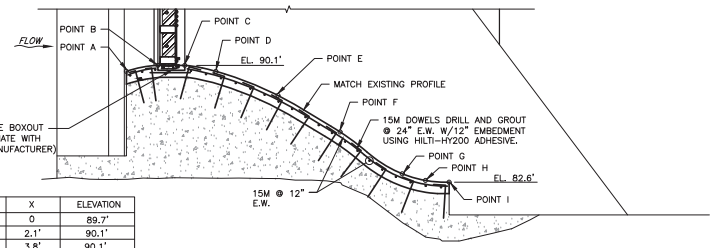


POINT	X	ELEVATION
A	0	93.6'
B	2.1'	94.1'
C	3.8'	94.1'
D	5.8'	93.6'
E	9.8'	92.0'
F	13.8'	89.7'
G	17.8'	87.0'
H	19.3'	86.6'
I	20.8'	86.5'

OUTSIDE SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

SCALE IN FEET



POINT	X	ELEVATION
A	0	89.7'
B	2.1'	90.1'
C	3.8'	90.1'
D	5.8'	89.7'
E	9.8'	88.2'
F	13.8'	85.8'
G	17.8'	83.1'
H	19.3'	82.7'
I	20.8'	82.6'

INNER SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-01

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
FONTAINE AQUANOX DWG NO. D15542-01-204P2X120107BFE/CW22														
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS			
CIVIL	———	E & I	———
MECH	———	CONST	———
APPROVED			
DATE			

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2020-12-18
W.O.	XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

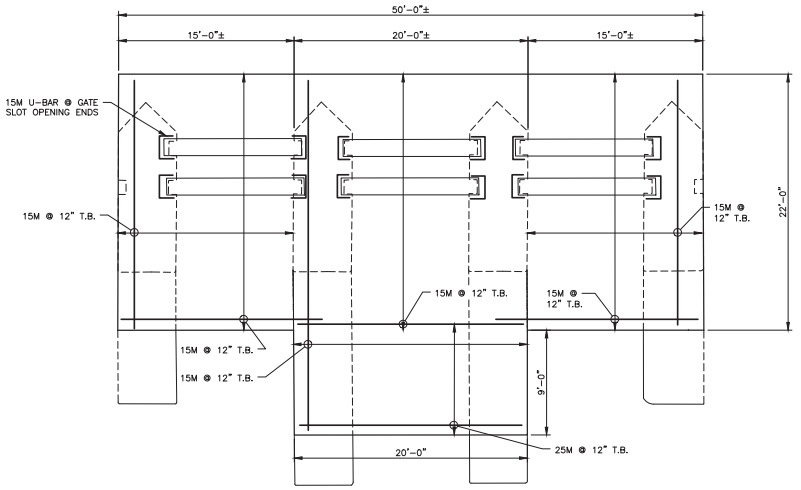
NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

DWG.NO. H096H1163100053 REV. C

PRINTED: Dec. 18, 2020 - 8:42 AM

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DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 4

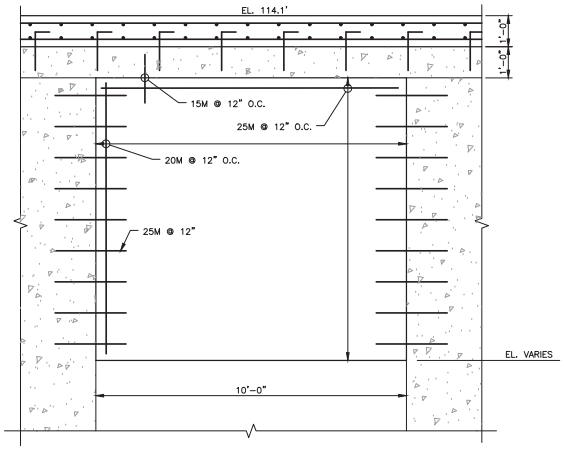


SLUICEWAY DECK REBAR PLAN

3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET

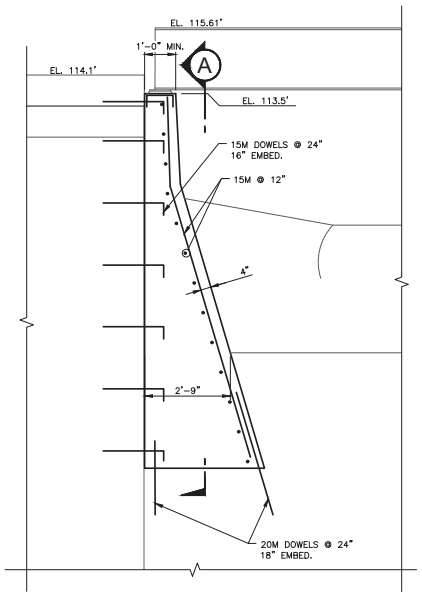


TYPICAL HEADWALL ELEVATION A-A 01

1/2"= 1'-0"

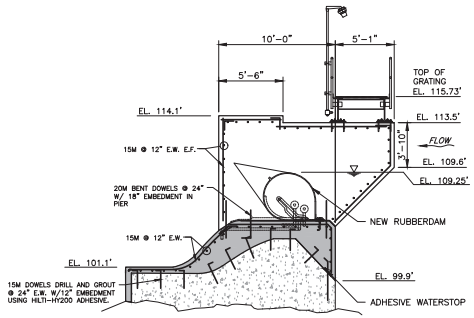
2 0 2 4

SCALE IN FEET



PIER TO SLUICEWAY REBAR DETAIL

1/2"= 1'-0"



SECTION A

3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.														

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL _____ E & I _____

MECH _____ CONST _____

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-18

W.O. XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

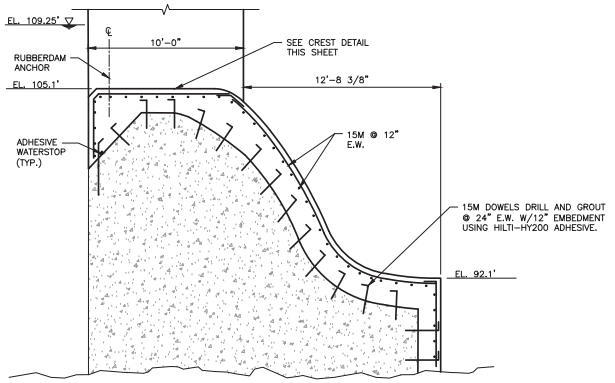
H 0 9 6 H 1 1 6 3 1 0 0 0 5 4 REV. C

DWG.NO.

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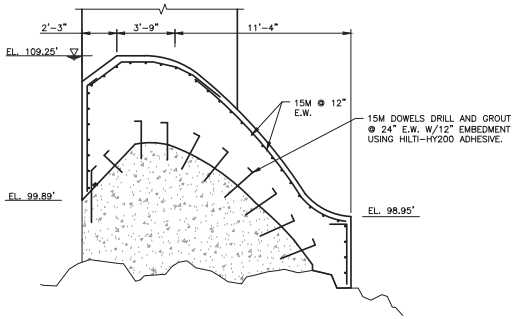
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DWG. NO. H096H1163100055



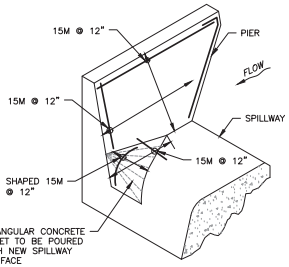
EAST SPILLWAY TYPICAL DETAIL (BAYS 1-4)

1/4"= 1'-0"



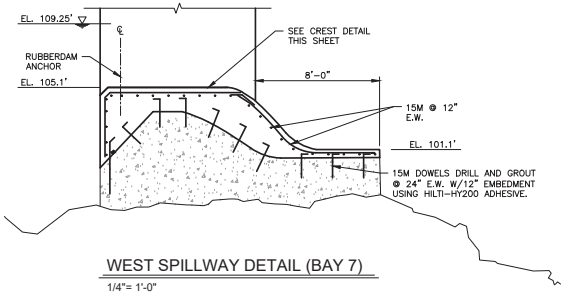
UNCONTROLLED SPILLWAY DETAIL (BAY 8)

1/4"= 1'-0"



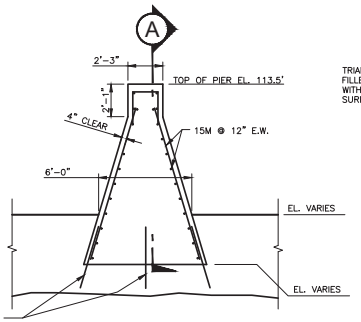
TRIANGULAR CONCRETE FILLET DETAIL

N.T.S.



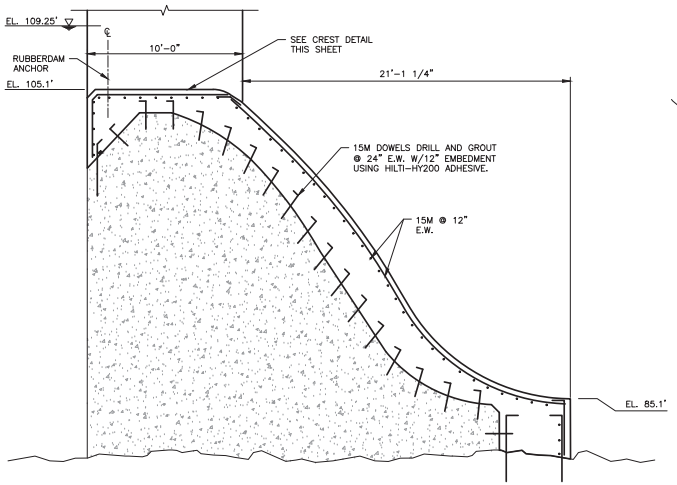
WEST SPILLWAY DETAIL (BAY 7)

1/4"= 1'-0"



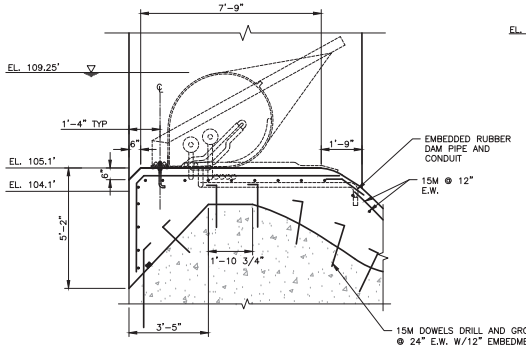
TYPICAL PIER DETAIL

1/4"= 1'-0"



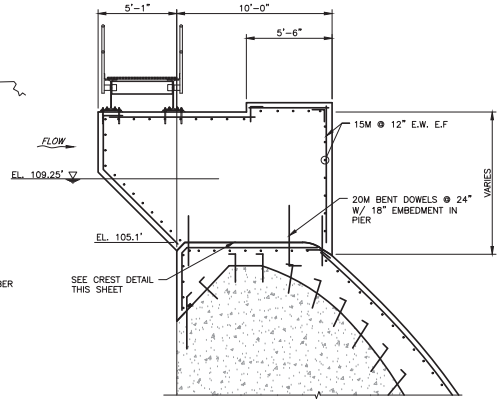
WEST SPILLWAY TYPICAL DETAIL (BAYS 6&5)

1/4"= 1'-0"



RUBBERDAM CREST TYPICAL

3/8"= 1'-0"



TYPICAL PIER SECTION

1/4"= 1'-0"

A 90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

310-03

Kleinschmidt

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PRINTED: Dec. 18, 2020 - 8:42 AM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-18

W.O. XXXX

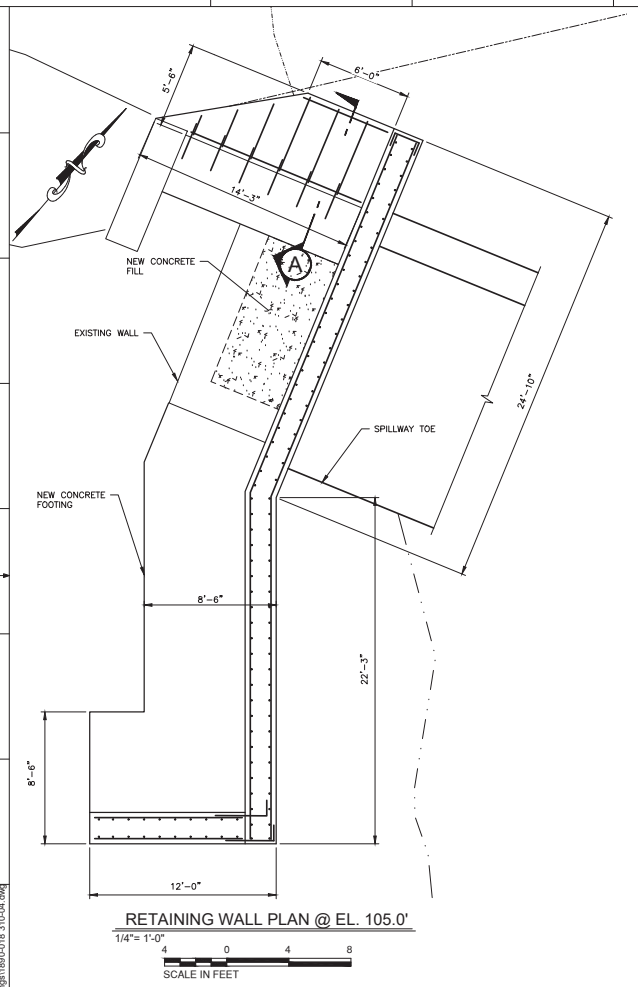
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SPILLWAY RESURFACING DETAILS

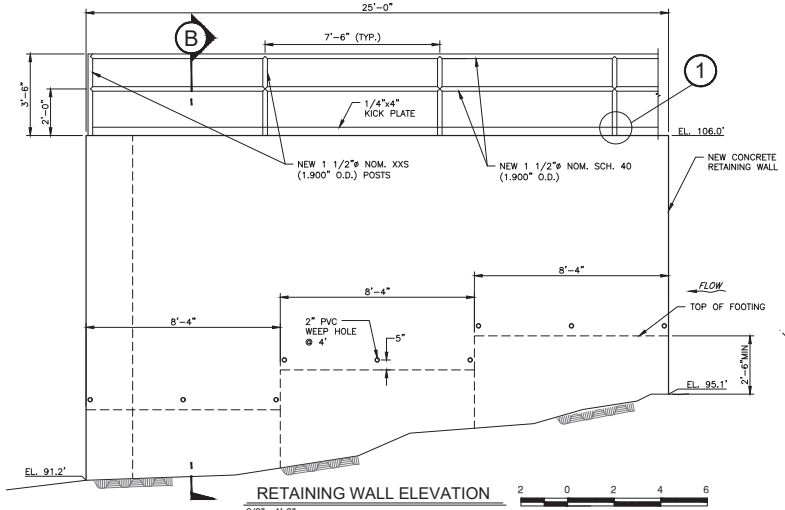
DWG.NO. H096H1163100055 REV. C



RETAINING WALL PLAN @ EL. 105.0'

1/4"= 1'-0"

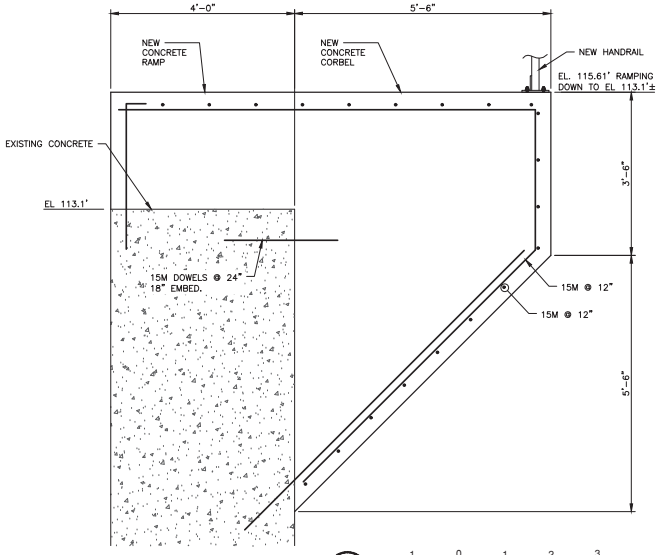
SCALE IN FEET



RETAINING WALL ELEVATION

3/8"= 1'-0"

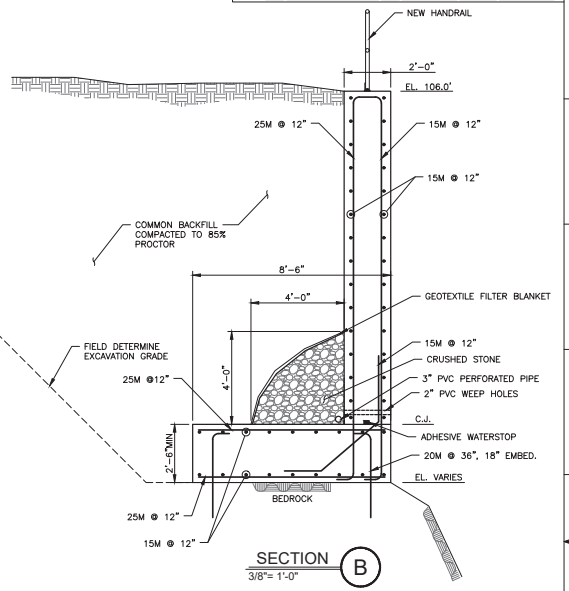
SCALE IN FEET



SECTION A

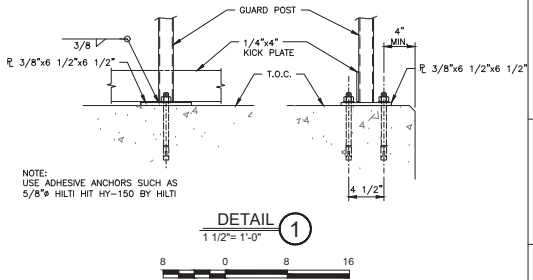
3/4"= 1'-0"

SCALE IN FEET



SECTION B

3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

8 0 8 16

SCALE IN INCHES

90% REV. 1 REVIEW SUBMITTAL

NOT FOR CONSTRUCTION

310-04

Kleinschmidt

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PRINTED: Dec. 18, 2020 - 8:41 AM

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REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED ——

CHECKED ——

DATE 2020-12-18

W.O. XXXX

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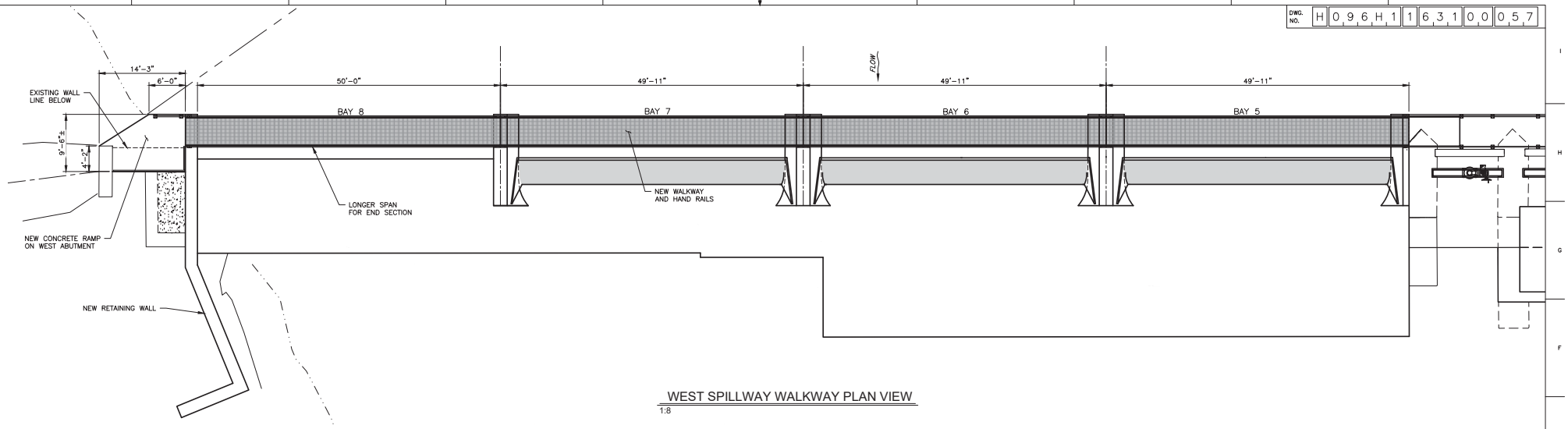
RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

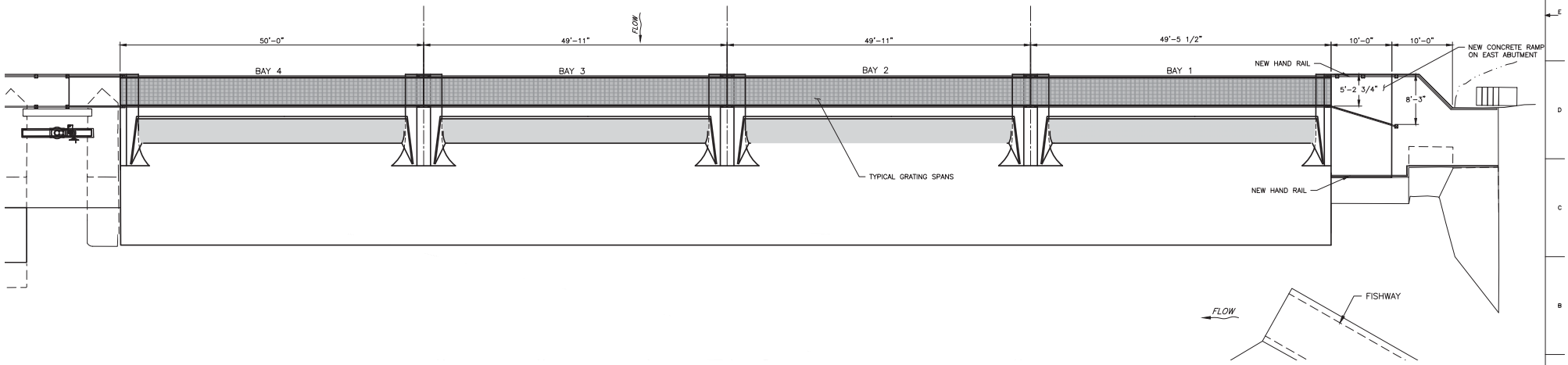
NEW CONCRETE RETAINING WALL AND PIER DETAILS

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 6 REV. C

DWG. NO. H096H1163100057



WEST SPILLWAY WALKWAY PLAN VIEW
1:8



EAST SPILLWAY WALKWAY PLAN VIEW
1:8

8 0 8 16
SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

320-01

PRINTED: Dec. 11, 2020 - 9:51 AM
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REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST
BY:		DATE:			

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

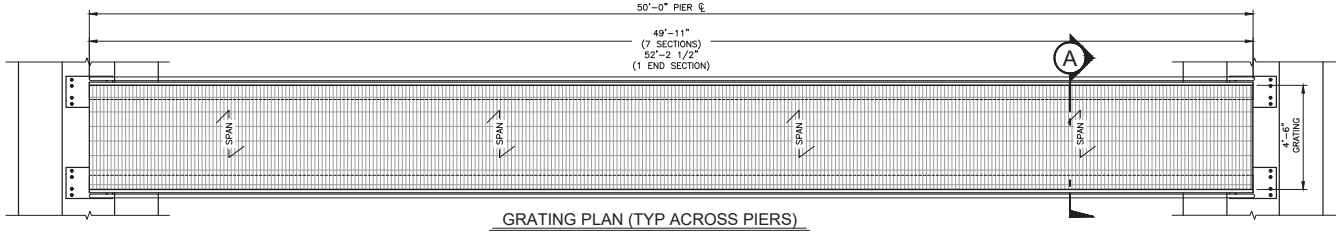
DATE

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2020-12-11
W.O.	XXXX

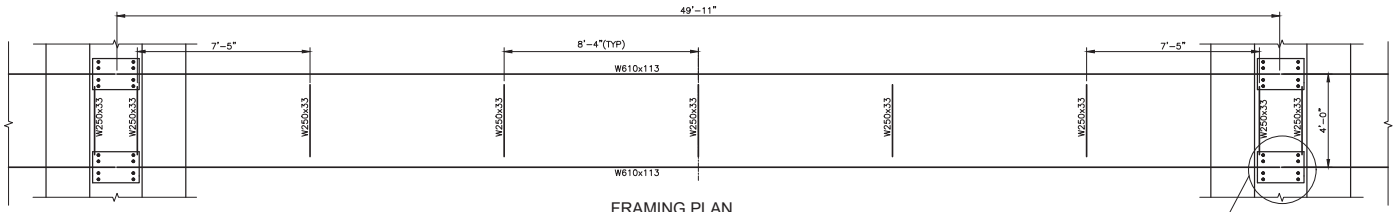
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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW

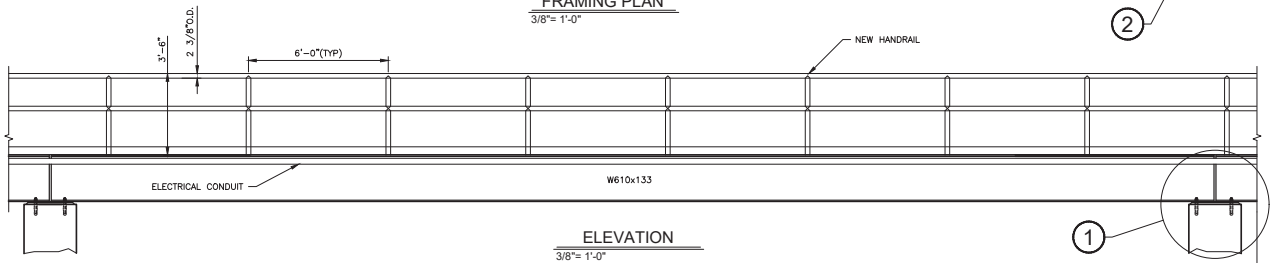
DWG.NO. H096H1163100057 REV. C



GRATING PLAN (TYP ACROSS PIERS)
3/8"= 1'-0"

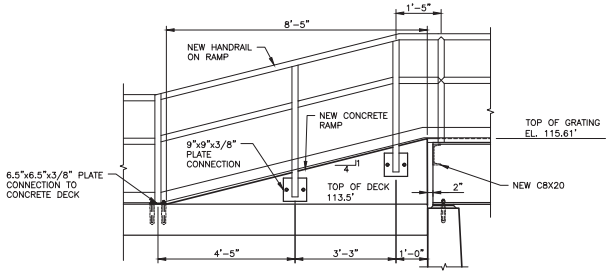


FRAMING PLAN
3/8"= 1'-0"

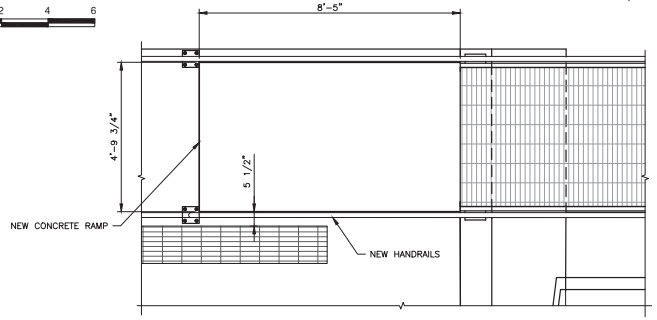


ELEVATION
3/8"= 1'-0"

2 0 2 4 6
SCALE IN FEET

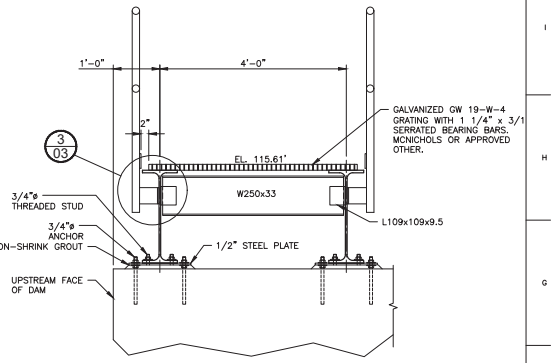


SLUICEWAY/WALKWAY TRANSITION DETAIL
1/2"= 1'-0"

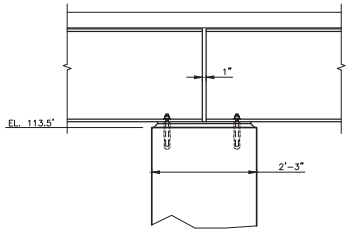


2 0 2 4
SCALE IN FEET

SLUICEWAY/WALKWAY TRANSITION PLAN
1/2"= 1'-0"

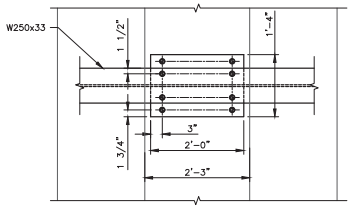


SECTION A
3/4"= 1'-0"



DETAIL 1
3/4"= 1'-0"

1 0 1 2 3
SCALE IN FEET



DETAIL 2
3/4"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

320-02

Kleinschmidt

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PRINTED: Dec. 9, 2020 - 2:43 PM

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STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	0	1
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED --
CHECKED --
DATE 2020-12-11
W.O. XXXX

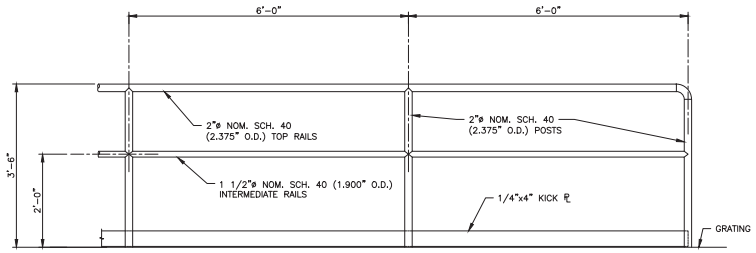
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW STEEL
GRATED ACCESS PLATFORM

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 8 REV. C

DWG. NO. H096H1163100059

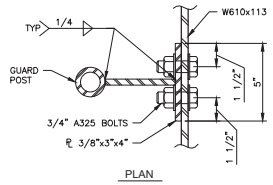


STEEL ACCESS PLATFORM TYPICAL HANDRAIL DETAIL

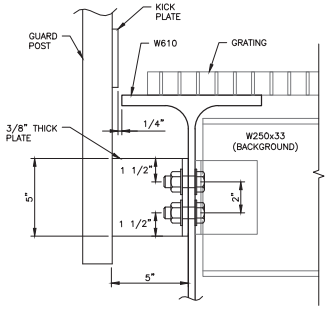
3/4"= 1'-0"

1 0 1 2 3

SCALE IN FEET



PLAN



DETAIL 3/02

3"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

320-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
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REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-11

W.O. XXXX

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RUTH FALLS

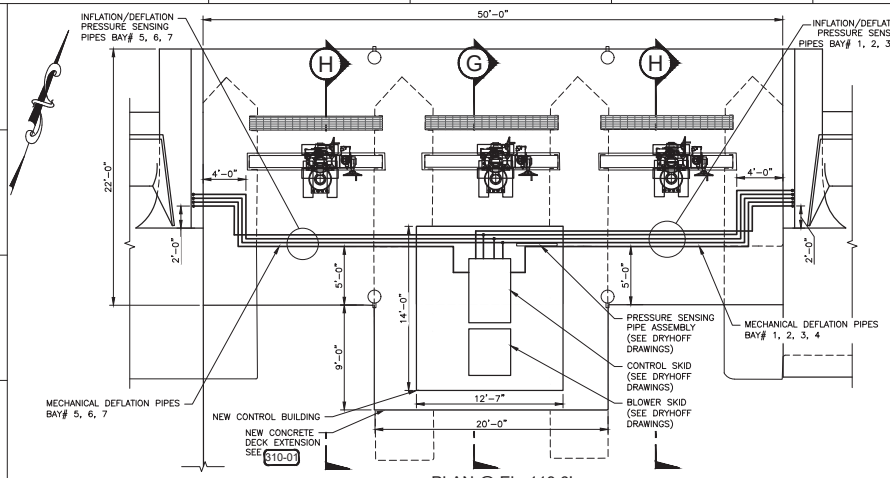
RUTH FALLS REFURBISHMENT PRJECT

NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS

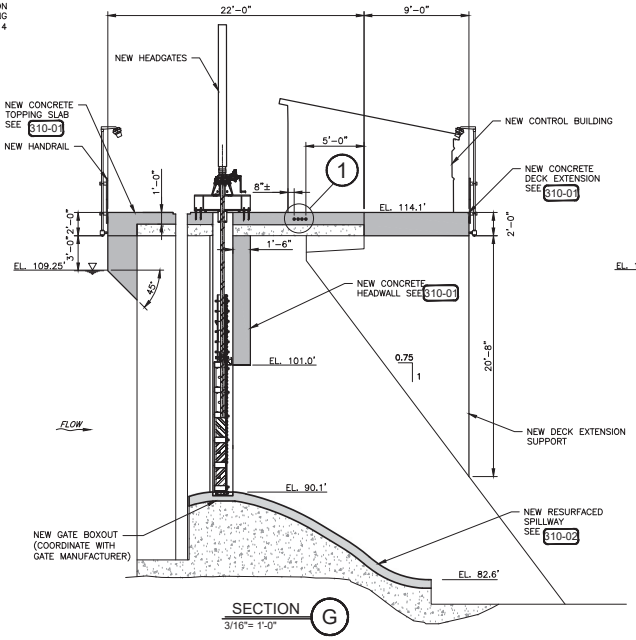
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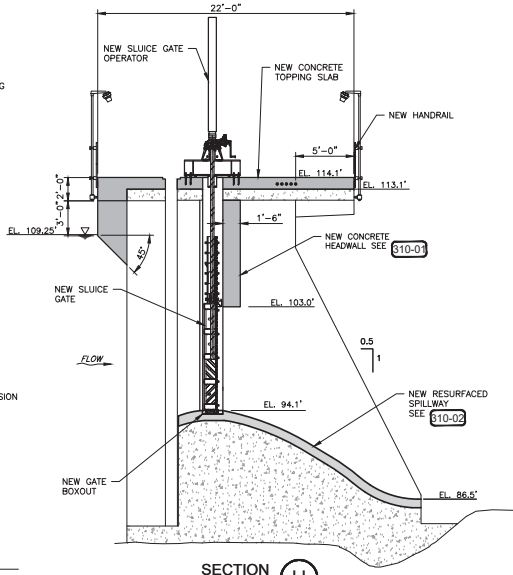
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PLAN @ EL. 113.6'
3/16"=1'-0"

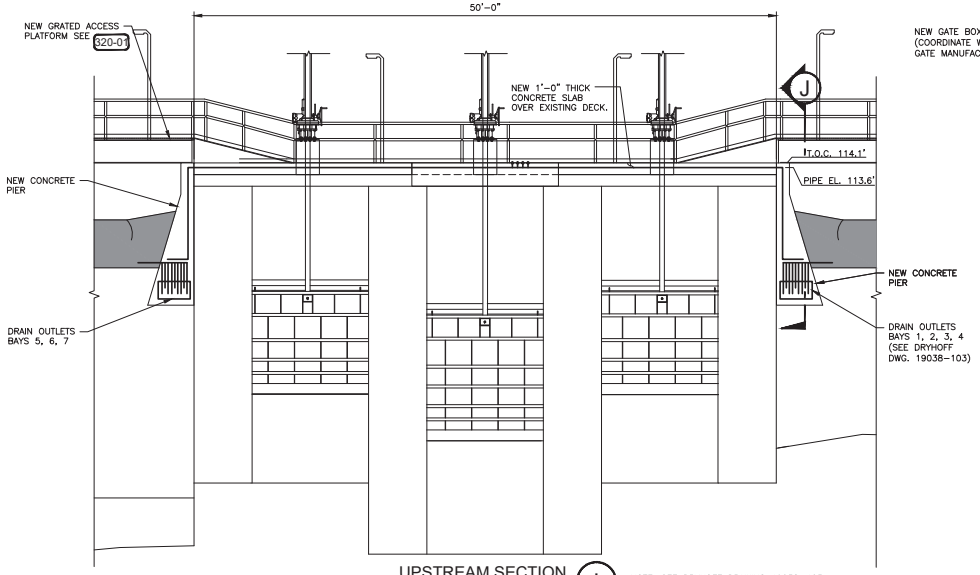


SECTION G
3/16"= 1'-0"



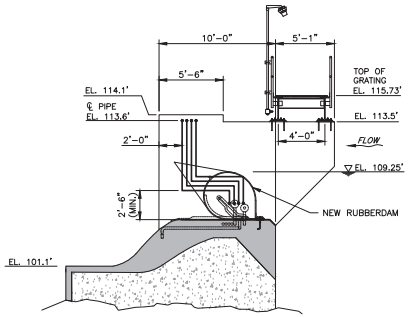
SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

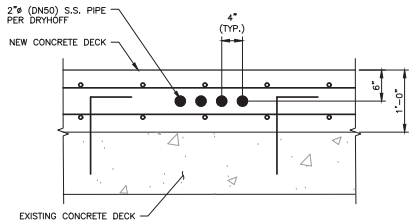


UPSTREAM SECTION
3/16"= 1'-0"

NOTE: SEE DRYHOFF DRAWING 19038-103



SECTION J
3/16"= 1'-0"



DETAIL 1
1"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

330-01

Kleinschmidt

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PRINTED: Dec. 9, 2020 - 4:06 P.M.

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DRYHOFF DRAWINGS 19038 PACKAGE NOV. 2019													
REFERENCE DRAWINGS	DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED __
CHECKED __
DATE 2020-12-11
W.O. XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

RUBBER DAM PIPING AT SLUICEWAY

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 6 0 REV. C

Nova Scotia POWER
An Emera Company

APPENDIX E – NS WATERCOURSE ALTERNATION SIZING CALCULATIONS

1/5/2022

Trevor MacDonald, P.Eng – Watercourse Sizer No. 1500222-S
Skye 7 Consulting Limited
Fall River, NS

Suzanne MacDonald, P.Eng, PMP
Nova Scotia Power

Ruth Falls Drainage Area and Bridge Sizing

Skye 7 Consulting Limited (S7) was engaged by Elliot Excavators (EE) to provide a sizing calculation based on Nova Scotia Environment (NSE) sizing criteria. Below is a summary of calculations for the proposed crossing in Ruth Falls. This calculation does not consider the ability to lower or divert the upstream water levels to manage flows at the proposed crossing. This is simply an exercise to gage a worst case scenario without using any existing infrastructure.

Drainage area = 463km^2

Design Flow (1:2 Storm Event for Construction Sites) = 278 m^3/s

Max Velocity for Bridges ≤ 1.8m/s

Water Opening - 38.5m x 4m = 154m^2 ;

Water Velocity Check < 1.8m/s → 278m^3/s / 154m^2 = 1.8m/s ✓

Therefore, a bridge in this situation would have to span 38.5m (+) and allow for at least 4m of water depth below the lowest part of the bridge.

To reduce the need for a large structure needed for the above calculations, EE is proposing to utilize the upstream reservoirs and install a smaller bridge that will be designed to be removed at an agreed to reservoir capacity to allow the water to flow until it subsides to manageable water levels again.

Trevor MacDonald, P.Eng – Watercourse Sizer No. 1500222-S
Principal
Skye 7 Consulting Limited

Skye 7 Consulting Limited

APPLICATION FOR APPROVAL

OFFICE USE ONLY	
Date Received: (yyyy/mm/dd)	Application #

PLEASE PRINT OR TYPE. Complete Sections 1, 2, 3, 4 and 7 for ALL Applications. Complete areas of Sections 5 and 6 that are applicable to the specific activities of this application only.

Type of Application:

◯ New Application ◯ Renewal ◉ Amendment ◯ Transfer

If applicable, provide the previous Approval #

SECTION 1 – APPLICANT

If there is more than one applicant, click Add Applicant or attach a complete list of applicants with the information below. The first applicant listed will be considered the primary applicant for this project.

Nova Scotia Power Inc.
Company/Organization/Municipality

Business Number (BN) if applicable

Kailey | J | Osborne
First Name | Middle Initial | Last Name

902-266-2451 | | | | |
Primary Phone Number | Ext. | Secondary Phone Number | Ext. | Fax

kailey.osborne@nspower.ca
E-mail

1223 Lower Water Street
Street Address PO

N/A
Mailing Address (if different than Civic)

Halifax | Halifax
County | Community

Nova Scotia | B3J 2V7 | Canada
Province | Postal Code | Country

Return Correspondence? ◉ Yes ◯ No
Preferred Method of Contact? ◉ Email ◯ Letter
Note: Following application decision, all correspondence will go to the applicant

Certification Number

Applicant Type (if applicable)

◯ Installer ◯ Sizer ◯ Hydrogeologist ◯ Professional Engineer

Applicant 1 of 1

SECTION 2 - APPLICATION CONTACT

Is the Application Contact the same as Section 1 – Applicant? ◉ **Yes** ○ **No** **If yes, please skip to Section 3.**

If there is more than one contact, click Add Contact or attach a complete list of contacts with the information below.

Company/Organization/Municipality

Business Number (BN) if applicable

First Name | Middle Initial | Last Name

Primary Phone Number | Ext. | Secondary Phone Number | Ext. | Fax

E-mail

Civic/Street Address

Mailing Address (if different than Civic)

County | Community

Province | Postal Code | Country

Return Correspondence? ○ Yes ○ No

Preferred Method of Contact? ○ Email ○ Letter

Note: Following application decision, all correspondence will go to the applicant

Certification Number

Contact Type

○ Installer ○ Sizer ○ Professional Engineer ○ Hydrogeologist

Contact 1 of 1

SECTION 3 - SITE/LOCATION OF PROPOSED ACTIVITIES

Property Identification numbers (PID) are available at the Nova Scotia Land Registry.
1:50,000 Topo Maps (identifying Easting and Northing) are available at Nova Scotia Environment offices.

If more than one Site, click Add Site or Copy this section and attach for each Site.

Ruth Falls Headpond
Watercourse Name

East River
Tributary To

East River
Watershed Name (if applicable)

If Applying for a Wetland Alteration, please specify the Site Type ◯ Alteration ◯ Compensation

Site Name

Is Watercourse a Fish Habitat? ◉ Yes ◯ No

Is this location within a municipal drinking water watershed? ◯ Yes ◉ No

If there is more than one activity per property, click Add Property or Copy this section and attach for each activity.

Property 1 of 1

935 Highway 374
Civic/Street Address

Halifax | Sheet Harbour
County | Community

40221673 | 11D16
Property Identification # (PID) | Topographical Map Number

If there is more than one location per activity, click Add Activity Location or Copy this section and attach for each Easting/Northing coordinates.

Coordinates 1 of 1

539486 E	4978146	20T
Easting (6)	Northing (7)	Zone

Please use NAD83 or WGS84

Access via NSPI gated road off Highway 374. Coming from Sheet Harbour, NSPI road is approximately 2 km beyond East River Road on right side. Gate is closed.
Additional Directions to Site (if applicable)

Site 1 of 1

SECTION 4 - ACTIVITY

Proposed Activity - Please check (✓) all that apply.

Activity	Complete Sections	Activity	Complete Sections
Boat Launch	◯ 4, 5A, 6A ,7	Bridge/Open Bottom Structure	◯ 4, 5A, 5C, 6A, 7
Culvert/Closed Bottom Structure	◯ 4, 5A, 5B, 6A, 7	Dam	◉ 4, 5A, 6A, 6B, 7
Dredging	◯ 4, 5A, 6A, 7	Erosion Protection	◯ 4, 5A, 6A ,7
Instream Structure	◯ 4, 5A, 6A, 7	Pipeline or Other Utility	◯ 4, 5A, 6A, 7
Removal of Beaverdam	◯ 4, 5A, 6A, 7	Removal of Material	◯ 4, 5A, 6A, 7
Storage of Water	◯ 4, 5D, 6A, 6B, 7	Water Intake/Dry Hydrant	◯ 4, 5A, 6A, 7
Water Withdrawal	◯ 4, 5E, 6A, 6B, 7	Watercourse Diversion	◯ 4, 5A, 5E, 6A, 6B, 7
Wetland Alteration	◯ 4, 5G, 6A, 6C, 7	Wharf	◯ 4, 5A, 6A, 7
Work to Improve Fish Habitat	◯ 4, 5A, 5F, 6A, 7	Other Alteration	◯ 4, 5A, 5F, 6A, 7

Is this a Pilot Activity? ◯ Yes ◉ No

Variance Requested? ◯ Yes* ◉ No

*If yes, please fill out a request for variance form

Proposed Project Dates, if applicable (yyyy/mm/dd)

Start Date of Construction	Start Date of Operations	End Date of Activities
2022/06/01		2022/09/31

SECTION 5 - ACTIVITY DETAILS

Complete Section 5 to the best of your knowledge. Please provide measurements in the metric units indicated.
5A – Complete for all applicable Watercourse Alteration Applications.

Type of Alteration

◯ New Construction ◯ Removal ◉ Replacement ◯ Expansion

rock, silt

Description of Channel Bottom

Install small extension and control building on east end of dam

Description of Alteration

Approximately 20 m

Length of Alteration (m)

5B - Complete only for Culvert or Closed Bottom Structure
Information about the Watercourse

Upstream watershed area (km²) | Watercourse Slope (%) | Watercourse Velocity (m/s)

Watercourse Channel Width (m) | Watercourse Channel Depth (m)

Crossing Type ◯ Culvert with fish passage ◯ Culvert without fish passage

If Culvert without fish passage, was a fish passage assessment completed? ◯ Yes ◯ No

Length of culvert (m) | Diameter of culvert (mm) | Length of dissipation pool (m)

Width of dissipation pool (m) | Date of installation (yyyy/mm/dd)

5C - Complete only for Bridge or other open bottomed structure
Information about the Watercourse

Up-stream Drainage Area (km2) | Watercourse Slope (%) | Watercourse Velocity (m/s)

Watercourse Channel Width (m) | Watercourse Channel Depth (m)

Crossing Type ◯ Bridge/concrete span ◯ Pipe arch/open bottom structure

Width of Span/Bridge (m) | Width of Structure/Arch (mm) | Length of Structure (m)

Bridge Piles? ◯ Yes ◯ No

5D - Complete only for Storage of Water

Total Volume (m^3)

Method of Storage ◯ Dam ◯ Reservoir ◯ Offline Pond ◯ Tank ◯ Other If Other, please specify

Source of Withdraw ◯ Groundwater ◯ Surface Water

5E - Complete only for Water Withdrawal/Diversion

Source of Withdraw ◯ groundwater ◯ surface water

Well Log #

Average Withdrawal Rate (litres/day) Maximum Withdraw Rate (litres/day)

Usage ◯ Agriculture ◯ Industry ◯ Aquaculture ◯ Municipal Domestic ◯ Bottled Water ◯ Hydroelectric

◯ Public Drinking Water Supply(excluding municipal) ◯ Recreational ◯ Other If Other, please specify

Description of Channel Bottom (Only Applicable for Water Diversion)

5F - Complete for Other Alteration and Work to Improve Fish Habitat

Description of Alteration

Length of Alteration (m)

5G - Wetland

Wetland Type - Alteration

Salt Marsh ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Freshwater Marsh – Shallow ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Freshwater Marsh - Deep ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Freshwater Marsh – Shoreline ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Fen - Open ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Fen - Shrub ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Fen – Treed ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Bog – Open ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Bog – Shrub ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Bog – Treed ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Swamp – Shrub ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Swamp - Treed ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Vernal Pool ◯	Size of Wetland (ha)	Size of Alteration(ha)	
Unknown ◯	Size of Wetland (ha)	Size of Alteration(ha)	

Wetland Type - Compensation (check all that apply)

Type	Compensation Area (ha)	Type	Compensation Area (ha)
◯ Salt Marsh		◯ Freshwater Marsh - Shallow	
◯ Freshwater Marsh - Deep		◯ Freshwater Marsh – Shoreline	
◯ Fen – Open		◯ Fen – Shrub	
◯ Fen – Treed		◯ Bog – Open	
◯ Bog - Shrub		◯ Bog – Treed	
◯ Swamp – Shrub		◯ Swamp – Treed	
◯ Vernal Pool		◯ Unknown	

Compensation Type

◯ Restoration	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Enhancement	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Creation	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Expansion	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started
◯ Research	Compensation Status	◯ Approved	◯ In Progress	◯ Not Started

Compensation Value($)

◯ Study Area (ha) _____ Compensation Status ◯ Approved ◯ In Progress ◯ Not Started

Compensation Value($)

◯ Education Area (ha) _____ Compensation Status ◯ Approved ◯ In Progress ◯ Not Started

Compensation Value($)

◯ Other Area (ha) _____ Compensation Status ◯ Approved ◯ In Progress ◯ Not Started

If Other, please specify _____

SECTION 6 - SUPPORTING DOCUMENTATION

All supporting documentation is to be submitted in accordance with the "Approvals Procedures Regulations." If applicable, the following documents must be submitted with this Application. However, additional information may be requested.

Note: A legend must be supplied for all mapping describing symbols used, scale and north orientation.

Description	Submitted	Waiver requested	Reason for Waiver
6A - Attach for all applicable Water Applications			
Proof of Ownership/Agreement/Legal right to conduct Activity	◉	○	
Site Plan or Survey	◉	○	
Detailed Plans/Specifications	◉	○	
Substance Descriptions and Controls	◉	○	
Description of Adverse Effect	◉	○	
Info Required under Checklists/Guidelines/Standards/Policies	◉	○	
6B - Attach only for Storage of Water/Dam, and Water Withdrawal/Diversion			
Environmental Assessment Study	◉	○	
Rehabilitation Plan	◉	○	
Description Contingency Plan	◉	○	
Explanation of Substances Released	◉	○	
Details of Site Suitability and Sensitivity	◉	○	
Detailed Description of Activity	◉	○	
Public Consultation Description	◉	○	
6C – Attach only for Wetland			
Details of Site Suitability and Sensitivity	○	○	
Detailed Description of Activity	○	○	
Public Consultation Description	○	○	

If information submitted is incomplete, or if supporting documentation is of poor quality (plans, maps, etc.), the application may be delayed, returned or rejected.

SECTION 7 – DECLARATION

Information in this application package which the applicant considers to be confidential business information should be clearly identified.

Are you making this request? ◯ Yes ◉ No

If yes, please indicate which information in the Supporting Documentation is considered confidential.

◉ I acknowledge it is an offense under Section 158 of the *Environment Act* to provide false or misleading information, and confirm to the best of my knowledge and belief the information provided in this form and supporting documentation is true and accurate and complies with the relevant provisions of the *Environment Act* and Regulations.

Applicant's Signature:  Date: (yyyy/mm/dd) 2022/07/07

Name (Please print or type): Kailey Osborne

OR

I certify that I am acting with the applicant's full consent.

Signature: _____ Date: (yyyy/mm/dd) _____

Name (Please print or type): _____

Nova Scotia POWER
An Emera Company

PO Box 910 ● Halifax, Nova Scotia ● Canada ● B3J 2W5

July 7, 2022

Melissa Douglas
Environmental Inspector
Nova Scotia Environment and Climate Change
30 Damascus Road
Bedford, Nova Scotia, B4A 0C1

Re: Ruth Falls Approval 2021-2840307-00 (Phase 1) Amendment Request– Project Overview Description

Dear Melissa Douglas,

Please accept this letter as a formal amendment request to NS Power's Watercourse Alteration Approval 2021-2840307-00 for Phase 1 of the Ruth Falls Main Dam Refurbishment Project. This request is being submitted as per direction from NSECC made on June 24, 2022 to provide an amendment application outlining updates to Phase 1 timeline and scope as per Term and Condition 7.a within the existing approval. In addition, NS Power would like to request an extension to the existing approval expiry date of September 30, 2022 to October 31, 2022 to account for unexpected delays in construction that occurred in the spring of 2022.

The section below outlines updates to the Phase 1 scope including refurbishment activities, construction scheduling, water management, erosion and sedimentation controls, and Mi'kmaq / stakeholder engagement.

If you have any questions or require clarification or additional information, please do not hesitate to contact the undersigned at (902) 266-2451.

Sincerely,



Kailey Osborne
Environmental Scientist
Nova Scotia Power Incorporated

July 8, 2022

PROJECT OVERVIEW

NS Power is installing a new control building at the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2022. This work is necessary in order to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines and improve the operability of the Ruth Falls Dam. The scope of work to be completed in 2022 (Phase 1) is approved under approval 2021-2840307-00. Amendments to the original schedule including the postponement of the vertical lift gate installation to Phase 2 are outlined within this document. In addition, NS Power is requesting a one month extension for the permit expiration to accommodate for delays associated with the starting of construction in 2022.

Work in 2022 (Phase 1) involves the installation of a new control building on the east side of the dam. The sluice gate installation was initially part of approval 2021-2840307-00, however, in order to provide the safest work environment for construction crews, the installation of the vertical lift gates are now proposed as part of Phase 2 which includes the drawdown of the Ruth falls headpond. Phase 2 of the Ruth Falls Dam Refurbishment Project is proposed under application #2019-2638165-00, which is currently under review with NSECC. Due to delays in the regulatory review process, NS Power has deferred Phase 2 to 2023. NS Power has provided a description of the revised Phase 1 and Phase 2 scope including updated scheduling in the most recent #2019-2638165-00 application. An additional revised application package for Phase 2 (2019-2638165-00) to support the deferred construction schedule of the Ruth Falls Dam Refurbishment Project will be submitted 2022.

NS Power has started the construction of the of the control building which began in June 2022 under the current permit. The expected completion time for this work is now set for end of October 2022. This date is weather permitting and pending contractor availability. As noted in the Phase 2 application 2019-2638165-00, Phase 1 work was planned to commence in May and end by the end of September. Due to scheduling constraints with the contractor, NS Power was unable to start the work until June resulting in a one-month postponement. As a result of this constraint, NS Power is requesting the extension of the current permit expiration date to be updated from September 30, 2022 to October 31, 2022 to accommodate for this delay.

CONSTRUCTION

The scope of work to be completed in 2022 is approved under approval 2021-2840307-00. Amendments to the schedule and scope including the postponement of the installation of the vertical lift gates from Phase 1 to Phase 2 are described within this amendment. Phase 1 work includes the installation of a control building and an associated elevated concrete slab to support the building (under approval 2021-2840307-00).

July 8, 2022

REFURBISHMENT ACTIVITIES

The proposed refurbishment activities are broken up into two phases below, Phase 1 - the installation of the control building (approved under Approval 2021-2840307-00 and related to this amendment) and Phase 2 – main dam construction (under Application 2019-2638165-00). Phase 1 and 2 are described below to provide clarification regarding the overall project scope.

Phase 1 – Control building installation:

- Refurbishment of the original control building

Phase 2 – Main dam construction:

- Installation of downstream access road and bridge (to start prior to drawdown activities)
- Lowering of Ruth Falls Headpond approximately 18 ft.
- Dewatering of the Ruth Falls fishladder and canal during the construction activities.
- Installation of temporary access for machinery on the upstream side of the dam.
- Removal of stoplogs from existing sluiceway bays, prepping of bays, and installation of vertical lift gates.
- Removal of the existing stoplog bays, piers, stoplog lifter and walkway.
- Reface the concrete on the crest and downstream slope of the spillway ogee sections.
- Installation of new rubber dam bladders on the crest of the ogee spillway sections.
- Construction of a free overflow spillway section at the right end of the dam.
- Installation of a new steel walkway for access across the dam.
- Removal of the temporary access road material.
- Watering up of the headpond to within normal operating levels.

PHASE 1 : CONTROL BUILDING

The rubber dam controls will be housed in a new control building, which is being installed on the eastern end of the dam on the downstream side, see Figure 1 for location. The rubber dam control building will be fabricated offsite and will be lifted in place with a crane. The deck of the dam needs to be extended as shown on drawings 300-02 and 300-05 of the drawing package (Appendix C) to accommodate the rubber dam control building. Additionally, the eastern most bay of the dam (which is below where the new control building will sit) is unused and will be filled in with concrete. The follow steps outline the modifications required to the eastern end of the dam to accommodate the new control building and the installation of the control building:

- The eastern most bay will be filled in with concrete as per drawings 300-02 and 300-05 of the drawing package.
- Two concrete piers are being constructed to support the slab extension. The eastern most pier will tie into the existing retaining wall while the western pier will be supported with a new 5’ x 18’ concrete footing (new instream footprint of 8.25 m2). The footing are being constructed on grade in a location that typically contains back

July 8, 2022

water when the dam is spilling. Sandbags will be used to isolate the work area and pumps used to keep this area dry. Any water that is pumped from the isolated area will be pumped into a silt bag which sits behind a silt fence in a highly vegetated area to the south of the isolated area. An Erosion and Sedimentation Control Plan has been submitted and accepted by NSECC for this scope of work.

- Once the piers are poured, the deck extension will be poured, and a crane will be used to install the control building.
- It is estimated that the above work will take 4-5 months but will depend upon construction crew availability and weather.

Note: all mobilization activities will be conducted above the ordinary high water mark (OHWM) Please reference Figure 1 for a layout of site access.

Demobilization:

Upon completion of the above Phase 1 scope of work, most large equipment will be demobilized until construction resumes in 2023 pending all outstanding regulatory approvals.

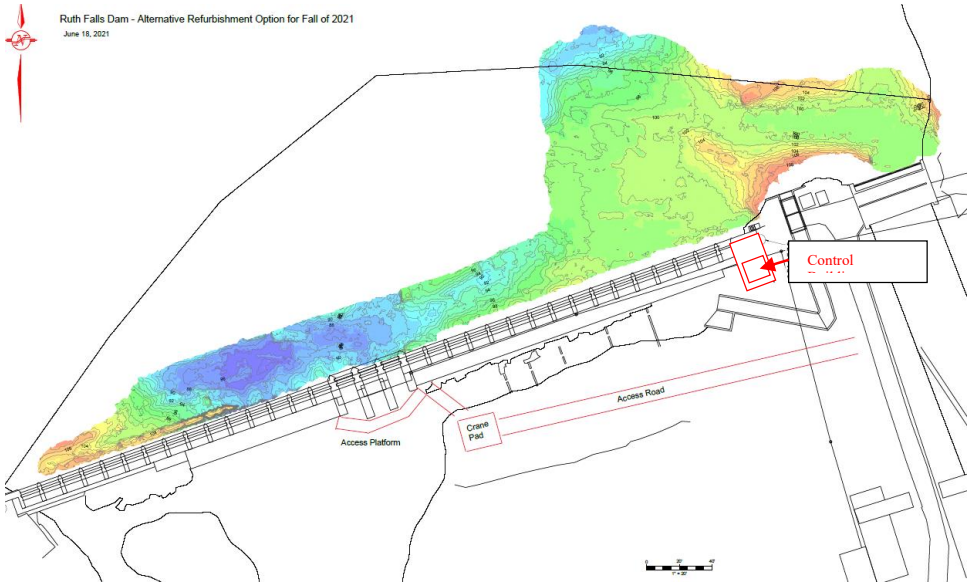


Figure 1: Location New Control Building to be installed during Phase 1

July 8, 2022

CONSTRCUTION SCHEDULE

The construction schedule is as follows:

Phase 1, completion of new control building under approval 2021-2840307-00, commenced in June 2022 and extend to October 31, 2022.

WATER MANAGEMNT

Work associated with the construction of the new control building can be completed without lowering the water level in the reservoir. The work area beneath the base of the control building has been isolated using sandbags and liner to provide a dry work area for construction. Any accumulated water from rainfall or leakage from the dam can be pumped to a heavily vegetated area to the south of the work area.

Water elevations in the reservoir will be maintained at 109.4' until November 30th as required by water approval 2008-062826-01. All downstream flows required by approval 2008-062826-01 will be maintained as well as operation of the fishladder and salmon trap. Work associated with the construction and installation of the control build will not interfere with the entrance conditions / operation of the fishladder. All other work will be conducted above the OHWM.

Managing for high precipitation events, natural inflows from the Grant River Watershed, and inflows from Malay Falls will be overseen by NS Power hydro operating personnel in consultation with Project personnel as per regular operating procedures.

EROSION AND SEDIMENTATION CONTROL

The contractor has developed an Erosion and Sedimentation Control (ESC) Plan which has been submitted and accepted by NSECC. The ESC plan outlines the site-specific erosion and sedimentation controls for Phase 1 including a site diagram describing the placement of said controls.

ABORIGINAL ENGAGEMENT

NS Power continues to engage the Mi'kmaq regarding the project with monthly project updates to the KMKNO and notifications regarding the work taking place under the NSECC Watercourse Alteration approval 2021-2840307-00 (Phase 1) and application 2019-2638165-00 (Phase 2). Weekly project manager communications are provided to the KMKNO regarding construction taking place for Phase 1 and planned construction for Phase 2 expected to take place starting in July 2023.

July 8, 2022

OTHER STAKEHOLDER ENGAGEMENT

NS Power is committed to proactively communicating and engaging with community stakeholders, the Mi'kmaq, regulators and the public on the Ruth Falls Dam Refurbishment Project. As part of this commitment, NS Power has developed a communication plan which outlines NS Power's detailed execution plan for engagement and communication on the Project. The Communication Plan has been provided to NSECC. Communication to local homeowners and community stakeholders is focused on Phase 2 of the project as it includes the drawdown of Ruth Falls Head Pond which could impact local homeowners and location community members. Local homeowners and community stakeholders have been notified that Phase 2 work has been deferred to 2023. Work associated with Phase 1 will not have an impact on local homeowners and community stakeholders as the work is being completed while maintaining normal operations This also includes normal water operating levels required at this time of year as per water approval 2008-062826-01.

NOVA SCOTIA

30 Damascus Road, Suite 115
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Canada B4A 0C1

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APPROVAL

Province of Nova Scotia
Environment Act, S.N.S. 1994-95, c.1 s.1

APPROVAL HOLDER: NOVA SCOTIA POWER INCORPORATED

SITE PID: 40221673

APPROVAL NO: 2021-2840307-01

EXPIRY DATE: October 31, 2022

Pursuant to Part V of the Environment Act, S.N.S. 1994-95, c.1 s.1 as amended from time to time, approval is granted to the Approval Holder subject to the Terms and Conditions attached to and forming part of this Approval, for the following activity:

Water Approval - Dam



Administrator: Kevin G Garroway

Effective Date: September 5, 2022

The Minister's powers and responsibilities under the Act with respect to this Approval have been delegated to the Administrator named above. Therefore, any information or notifications required to be provided to the Minister under this Approval can be provided to the Administrator unless otherwise advised in writing.

TERMS AND CONDITIONS OF APPROVAL

Nova Scotia Department of Environment and Climate Change

Approval Holder: NOVA SCOTIA POWER INCORPORATED

Project: Ruth Falls Headpond - PID 40221673

Site:

PID	Civic #	Street Name	Street Type	Community	County
40221673	935	HIGHWAY 374	HWY.	SHEET HARBOUR	HALIFAX COUNTY

Approval No: 2021-2840307-01

File No: 95100-30-BED-2021-2840307

Grid Reference: Easting - 539486, Northing - 4978146

Reference Documents

- Application submitted July 13, 2022 and attachments.

1. Definitions

a. Act means Environment Act. 1994-95, c.1, s.1 , and includes, unless the context otherwise requires, the regulations made pursuant to the Act, as amended from time to time.

b. Department means the Nova Scotia Department of Environment and Climate Change, and the contact for the Department for this approval is:
Nova Scotia Department of Environment and Climate Change
Central Region, Bedford Office
30 Damascus Road, Suite 115
Bedford, Nova Scotia B4A 0C1

Phone: (902) 424-7773
Fax: (902) 424-0597

c. Minister means the Minister of Environment and Climate Change and includes any person delegated the authority of the Minister.

d. Site means a place where a designated activity and/or undertaking is occurring or may occur.

e. Surface Watercourse means a watercourse as defined in the Environment Act, excluding groundwater.

2. Scope

a. This Approval (the "Approval") relates to the Approval Holder(s) and their application and all documentation submitted to the Department prior to the issuance of this approval for the Dam situated at or near Ruth Falls Headpond - PID 40221673.

b. The Approval Holder(s) shall ensure the designated activity is carried out in accordance with this Approval and reference documents, including the application and supporting documentation.

3. General

a. The Approval Holder(s) shall conduct the Designated Activity in accordance with the following provisions:

i. The Act, as amended from time to time;

ii. Any standard adopted by the Department, as amended from time to time.

b. Nothing in this Approval relieves the Approval Holder(s) of the responsibility for obtaining and paying for all licenses, permits, approvals or authorizations necessary for carrying out the work authorized to be performed by this Approval which may be required by municipal by-laws, provincial or federal legislation, or other organizations. The Minister does not warrant that such licenses, permits, approvals or other authorizations will be issued.

c. No authority is granted by this Approval to enable the Approval Holder(s) to commence or continue the designated activity on lands which are not in the control or ownership of the Approval Holder(s). It is the responsibility of the Approval Holder(s) to ensure that such a contravention does not occur. The Approval Holder(s) shall provide, to the Department, proof of such control or ownership upon expiry of any relevant lease or agreement. Failure to retain said authorization may result in this Approval being cancelled or suspended.

d. If there is a discrepancy between the reference documents and the terms and conditions of this Approval, the terms and conditions of this Approval shall apply.

e. Any request for renewal or amendment of this Approval is to be made in writing, to the Department, at least ninety (90) days prior to the Approval expiry.

f. If the Minister cancels or suspends this Approval, the Approval Holder(s) remains subject to the penalty provisions of the Act.

g. The Approval Holder(s) shall advise the Department in writing prior to any proposed extensions or modifications to the Activity and/or the Site. An amendment to this Approval may be required before implementing any extension or modification.

h. The Approval Holder(s) shall immediately notify the Department of any incidents of non-compliance with this Approval.

i. The Approval Holder(s) shall bear all expenses incurred in carrying out the environmental monitoring required under the terms and conditions of this Approval.

j. Unless specified otherwise in this Approval, all samples required to be collected by this Approval shall be collected, preserved and analysed, by qualified personnel, in accordance with recognized industry standards and procedures that are all deemed acceptable to the Department.

k. Unless written authorization is received otherwise from the Minister, all samples required by this Approval shall be analyzed by a laboratory that meets the requirements of the Department's "Policy on Acceptable Certification of Laboratories" as amended from time to time.

l. The Approval Holder(s) shall ensure that this Approval, or a copy, is present on Site while personnel are on Site.

m. The Approval Holder(s) shall notify the Department three business days prior to commencing construction of the Activity. The notification must include the Approval Number.

n. All phases of construction shall be overseen by a qualified professional engineer, licensed to practice in Nova Scotia by the Association of Professional Engineers of Nova Scotia (Engineers Nova Scotia), or technologist who works under the supervision of a qualified professional engineer.

o. Written certification by a qualified professional engineer is required, within 6 weeks of project completion, stating that the construction and installation of the facility meets the requirements of the approved drawings and specifications.

p. The certification shall confirm that all as-built drawings and any other relevant documentation have been turned over to the Approval Holder(s) by the engineer.

q. Within 14 days of completion of the work authorized under this Approval, the Approval Holder(s) is required to submit, to the Department, the enclosed form entitled "Completion of the Approved Work".

r. Upon any changes to the Registry of Joint Stock Companies information, the Approval Holder(s) shall provide a copy to the Department within five business days.

4. Covenant Conditions

a. The Approval does not authorize any activity that would:

i. prejudice any riparian rights of any owner or of any person lawfully in possession of or holding any lands abutting the watercourse;

ii. cause any damage or nuisance to adjacent or abutting land; or

iii. discharge surface water onto adjoining lands without the authorization of the affected landowner(s).

b. The Approval Holder(s) is responsible to construct and maintain any culvert, bridge, dam, sluice, flume, conduit, or other approved structure built or used in or on the watercourse so that the structure(s) operates as originally designed and intended, and so that risks related to potential failure of the structure(s) are effectively mitigated.

c. The Approval Holder(s) shall rehabilitate the site to the satisfaction of the Minister and pay all expenses and costs of such rehabilitation in any of the following circumstances:

i. upon the expiry or termination of this Approval; or

ii. if the culvert, bridge, dam, sluice, flume, conduit, or other approved structure built or used in or on the watercourse is not appropriately maintained to mitigate risks related to potential failure of the structure(s).

d. By granting this Approval, the Department is not responsible for any damages as a result of the approved activities, including any water quality or quantity problems that may be encountered by the Approval Holder(s) or other parties.

5. Surface Water

a. The Approval Holder(s) shall ensure the Site is developed and maintained to prevent contaminants from being discharged into a water resource or beyond the property boundary.

b. Monitoring during construction: The Approval Holder(s) shall ensure that the following water quality limits are met in the water resource downstream of construction activities:

i. Total Suspended Solids, Clear Flows (Normal Background Conditions):

(a) Maximum increase of 25 mg/l from background levels for any short term exposure (24 hour or less);

(b) Maximum average increase of 5 mg/l from background levels for longer term exposure (inputs lasting between 24 hours and 30 days);

ii. Total Suspended Solids, High Flow (Spring Freshets and Storm Events)

(a) Maximum increase of 25 mg/l from background levels at any time when background levels are between 25 mg/l and 250 mg/l ;

(b) Maximum increase of 10% over background levels when background is >250 mg/l;

c. Additional surface water monitoring may be required at the request of the Department.

d. The Approval Holder(s) shall develop and implement an Erosion and Sediment Control Plan. A copy of the plan shall be provided for review and deemed acceptable by the Department prior to construction.

e. No authority is granted by this Approval to enable the Approval Holder(s) to discharge surface water onto adjoining lands without the authorization of the affected landowner(s).

f. The Approval Holder(s) shall install and maintain erosion and sediment controls in line with industry best practices (e.g., Nova Scotia Environment Erosion and Sediment Control Handbook for Construction Sites) with the following considerations:

   i. The controls shall be installed prior to the commencement of the construction activities;

   ii. The controls shall remain in place until areas disturbed by construction activities are stabilized so that the risk of release of sediment to a water resource has been mitigated;

   iii. Control features shall be installed as per applicable product specifications or manufacturer's directions; and

   iv. Control materials shall be clean, non-erodible, non-ore-bearing, non-watercourse derived and non-toxic.

g. The Approval Holder(s) shall immediately contact the Department should sulphide bearing material be encountered on the Site.

h. The Approval Holder(s) shall ensure that surface water runoff that may be impacted by petroleum hydrocarbons from the Site is collected and directed for necessary treatment prior to discharge from Site.

i. Erosion and sediment controls shall be inspected daily, at a minimum, and prior to and after precipitation or flow events. These inspections shall confirm the erosion and sediment controls are working as designed and intended. Records outlining results of these inspections and actions taken to correct any deficiencies shall be kept for the duration of the approval and made available to the Department upon request.

j. Work at the site shall only take place when erosion and sediment controls are functional. Contingency erosion and sediment control materials shall be kept on Site in case of failure.

k. Any silted water pumped from work areas shall be directed to vegetated areas, settling ponds, or other treatment devices that mitigate the risk of release of sediment to a water resource.

l. The Approval Holder(s) shall limit the size of the disturbed area and the removal of riparian vegetation to the area of construction activities as outlined in the supporting documentation.

m. The Approval Holder(s) shall ensure that the following activities take place at a distance of a minimum of 30 metres from a surface watercourse or wetland in an area such that a release will not enter a surface watercourse or wetland:

i. Fuel storage, refueling, and/or lubrication of equipment;

ii. Washing of machinery or equipment; and

iii. Storage of equipment, excavated/stockpiled materials, and potential contaminants.

n. Blasting in or near a watercourse is not permitted unless authorized in writing by the Minister.

6. Construction

a. Under authority of this Approval, the watercourse alterations specified herein shall be conducted between June 1st and September 30th (inclusive) of the same calendar year unless otherwise stated in the site specific terms and conditions.

b. All construction activities within or immediately adjacent to the watercourse channel shall be carried out in isolation of the streamflow (i.e., in the dry), unless otherwise stated in the site specific terms and conditions.

c. Disturbed watercourse banks shall be stabilized to mitigate any potential scouring, bank failure, or any other adverse effects as a result of the planned works, where deemed necessary by a qualified professional engineer.

d. The Approval Holder(s) shall ensure any cast-in-place concrete is poured in isolation of the watercourse and cured before it comes in contact with watercourse water.

e. Riprap and other material used in construction shall be clean, non-erodible, non-ore-bearing, non-watercourse derived and consist of non-toxic materials prior to placement within the watercourse to mitigate against the release of substance into a surface watercourse or wetland.

f. Any equipment used for work within a watercourse shall be clean and free of soil and plant material to avoid the release of contaminants and the potential transfer of invasive species.

g. Any equipment used for work within a watercourse or wetland shall be mechanically sound, with no fuel or oil leaks.

h. An emergency spill-kit must be kept on site when vehicles (including machinery) or equipment is used in a watercourse.

i. Upon completion of construction, modification, or maintenance work all debris resulting from the work must be removed from the work site.

7. Site Specific

a. This approval is for Phase 1 project components, including the installation of the control building on the Ruth Falls Dam, located on the Sheet Harbour Hydro System in Sheet Harbour, NS. The new control building will be constructed as described in the letter and supporting documentation titled "Ruth Falls Approval

2021-2840307-00 (Phase 1) Amendment Request - Project Overview Description", dated July 7, 2022. Any deviation from the submitted plans will require the proponent to put forward an amendment application to this approval.

b. The Approval Holder shall not commence the watercourse alteration activity until such time that any and all applicable municipal, provincial or federal regulatory approvals have been obtained.

c. The Approval Holder shall conduct on-site pre-construction meetings to ensure all persons involved in watercourse alteration are aware of the terms and conditions of this Approval.

d. Locate all staging areas in an area that will not impact adjacent watercourses or wetlands. Sediment controls are to be employed around this area to ensure that silt will not migrate to adjacent watercourses or wetlands.

e. The construction window for this project is to be between June 01, 2022 and October 31, 2022. Any request for extension outside of this construction window or beyond the expiry date of this approval must be put in writing to NSECC by the Approval Holder.

f. Sediment laden waters from within the work site cannot be discharged into the watercourse or any other watercourse, wetland or water resource. All sediment laden waters must be discharged to a vegetated area or through a filter bag.

g. Cofferdam(s) shall be installed in order to minimize impacts to the surrounding environment, including releases of sediment and other deleterious materials associated with installation/operation/removal of the cofferdam. Material used in construction must be clean and free of fines and other deleterious substances prior to placement within the watercourse. Mitigation measures to prevent the release of debris into the watercourse must be in place prior to construction activities taking place.

h. Erosion and sediment control features shall be inspected at minimum daily and prior to and after any precipitation or flow events to ensure the erosion and sediment control plan is properly in place, and is maintained and/or upgraded as required.

i. A contingency plan shall be in place for significant rainfall events (i.e., greater than or equal to a 1 in 2 year return period storm event).

j. All materials and equipment shall be operated and stored in a manner that prevents any deleterious substances (e.g. petroleum products, silt, etc.) from entering the watercourse.

NOVA SCOTIA

File No:95100-30-BED-2021-2840307

COMPLETION OF THE APPROVED WORK

A condition of this Approval requires that the Approval Holder notify Nova Scotia Department of Environment and Climate Change that the work authorized is complete.

Please enter the information on this sheet and return it to Nova Scotia Department of Environment and Climate Change at the following address:

Nova Scotia Department of Environment and Climate Change
Inspection, Enforcement, and Compliance Division
Central Region, Bedford Office
30 Damascus Road, Suite 115
Bedford, NS, B4A 0C1

Phone: 902-424-7773
Fax: 902-424-0597
ECC Contact: Melissa Douglas

APPROVAL NUMBER: 2021-2840307-01

NAME OF APPROVAL HOLDER: NOVA SCOTIA POWER INCORPORATED

WORK AUTHORIZED: Dam

DATE WORK WAS COMPLETED: _____

NAME OF CONTRACTOR: _____

COMMENTS: _____
_____
_____
_____
_____

_____ _____
Signature Date

NOVA SCOTIA

File No:95100-30-BED-2021-2840307

COMPLETION OF THE APPROVED WORK

A condition of this Approval requires that the Approval Holder notify Nova Scotia Department of Environment and Climate Change that the work authorized is complete.

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Phone: 902-424-7773
Fax: 902-424-0597
ECC Contact: Melissa Douglas

APPROVAL NUMBER: 2021-2840307-01

NAME OF APPROVAL HOLDER: NOVA SCOTIA POWER INCORPORATED

WORK AUTHORIZED: Dam

DATE WORK WAS COMPLETED: September 16, 2022

NAME OF CONTRACTOR: Elliot Excavators Ltd.

COMMENTS: Completion of Phase I - Control Building Installation



Signature

September 20, 2022
Date

NOVA SCOTIA

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Our File Number: 95100-30-BED-2019-2638165

December 9, 2022

NOVA SCOTIA POWER INCORPORATED
PO BOX 910, 25 LAKESIDE PARK DR
HALIFAX, NS
B3J 2W5

Dear NOVA SCOTIA POWER INCORPORATED

RE: Application # 2019-2638165-00

With reference to your application please be advised that your application has been deemed incomplete. As a result, Nova Scotia Department of Environment and Climate Change (ECC) is requesting the following information to process your application:

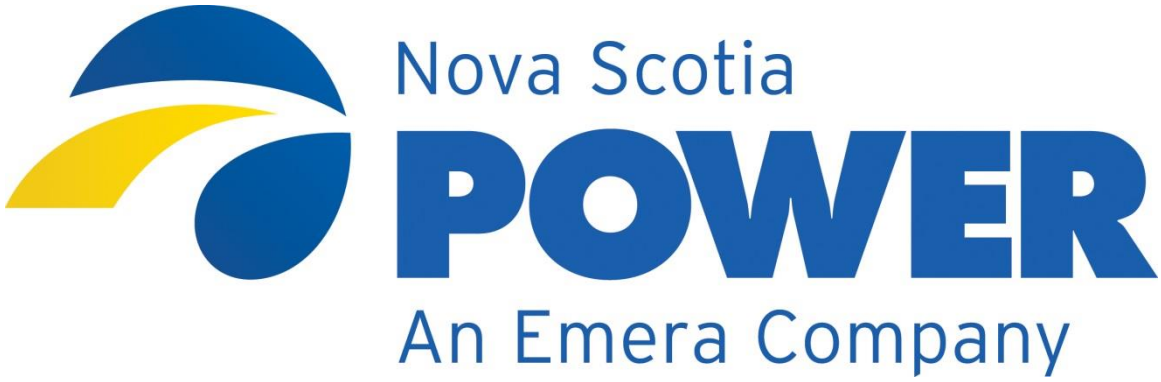
- As discussed in June 2022, NSPI stated that the Ruth Falls Phase 2 schedule had change, and construction is anticipated to commence in July 2023. Additional hydraulic modelling has started and is proposed to be completed in Fall 2022. Please submit an addendum with updates to the construction schedule and sequence and studies including, but not limited to, hydraulic modelling.

ECC is requesting this information be submitted by February 9, 2023. Please note that in accordance with *Section 7 of the Approval and Notification Procedure Regulations,* if information is not supplied by an applicant within 3 months of a request, the Minister may reject your application. Should your application be rejected, you will be informed of that decision in writing.

Yours truly,
Melissa Douglas



cc:



Environmental & Project Description for Construction Activities

Sheet Harbour Hydro System

Ruth Falls Dam Refurbishment

2024

Nova Scotia POWER
An Emera Company

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PROJECT OVERVIEW

NS Power is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2024. This work is necessary in order to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the embankment and spillway/sluiceway structures. The project involves refurbishing the main dam by replacing the existing 30 stop log bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section, and replacing the sluiceway bays with vertical lift gates. In conjunction with main dam refurbishments, improvements will be made to the upstream fishway, and downstream louvre system to make it more suitable for all fish species migrating around the dam to complete their lifecycle. The addition of an upstream eel pass will also be installed to support specific upstream passage for eels.

Activities proposed for the Project include lowering the Ruth Falls Headpond and canal approximately 18 feet while also dewatering the Ruth Falls fish ladder and downstream bypass during construction. During construction fish will be moved downstream via the sluiceway bay and/or spillway.

The Project is scheduled to take approximately 9 months to complete starting with the installation of the downstream access roads and temporary bridge in early July 2024. After the water is drawn down, the installation of upstream access roads will take place and main dam construction will commence in mid-July 2024.

NS Power has provided several iterations of the Ruth Falls Dam Refurbishment Project Watercourse Alteration Application (2019-2638165-00) to NSECC since the first application in December 2019. The scope and timeline of the project has been adjusted several times with a separate approval received for the refurbishment of the sluiceway/installation of the vertical lift gates and control building in advance of the main dam refurbishment under approval 2021-2840307-00 in October of 2021. In 2022, NS Power made the decision to proceed with aspects of approval 2021-2840307-00 in June 2022, but not the sluiceway refurbishment. An amended approval was received in September 2022 (2021-2840307-01) excluding the sluiceway refurbishment/vertical lift gate scope, to complete the scope associated with the new control building. NS Power notified NSECC at this time that the sluiceway refurbishment/vertical lift gate installation is planned to take place under the main dam refurbishment scope (application 2019-2638165-00) NS Power has provided a timeline of the regulatory process below:

Main Dam Refurbishment Application 2019-2638165-00
NS Power Initial Application Submission December 20, 2019
NSECC Incomplete Letter Received January 7, 2020
NS Power Updated Submission February 27, 2020
NSECC Incomplete Letter Received March 25, 2020

NS Power Updated Submission June 22, 2020
NSECC Incomplete Letter Received March 31, 2021
NS Power Updated Submission April 14, 2021
NSECC Incomplete Letter Received June 18, 2021
NS Power Updated Submission February 14, 2022
NSECC Incomplete Letter Received April 1, 2022
NS Power Updated Submission May 6, 2022
NSECC Incomplete Letter Received December 9, 2023

Vertical Lift Gate / Control Building Approval 2021-2840307-00
NS Power Initial Submission July 12, 2021
NSECC Approval Received October 22, 2021
NS Power Amendment Submission July 11, 2022
NSECC Amended Approval Received September 5, 2022

Previous applications as noted above reference construction taking place in a phased approach, with phase I including new control building with Ruth Headpond at normal operating levels, and phase II including a drawdown of Ruth Headpond and refurbishment of the remaining dam structure. Phasing of construction is no longer required for the purposes of this application (2019-2638165-00). Work related to the control building was completed in 2022 under approval Approval 2021-2840307-00), which has been closed.

This document provides an updated project and environmental description to support NS Power's application for watercourse alteration approval 2019-2638165-00 for the Project and supersedes previous iterations submitted to NSECC. The information in this document is intended to address NSECC's most recent incomplete letter, issued to NS Power on December 9, 2022 which says:

> *As discussed in June 2022, NSPI stated that the Ruth Falls Phase 2 schedule had changed, and construction is anticipate to commence in July 2023. Additional hydraulic modelling has started and is proposed to be completed in Fall 2022. Please submit an addendum with updates to the construction schedule and sequence and studies, including, but not limited to, hydraulic modelling.*

This project and environmental description is also intended to address all questions and information requests previously directed to NS Power in incomplete letters issued by NSECC for application 2019-2638165-00 as outlined above. Therefore, NS Power assumes that all previous incomplete letters are no longer relevant, and any remaining questions or information requests directed to NS Power through a new incomplete letter, if required.

Further, NS Power assumes that, given the information in this document has been provided to NSECC several times and NSECC has had adequate time to review and request additional information (as demonstrated through the 6 incomplete letters for this application), that any further information requests will be pertaining only to new information that has not been previously reviewed by NSECC.

1.0 INTRODUCTION

The Sheet Harbour Hydro system is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The system has a drainage area of 573.9 km^2. Presently there are 6 controlled reservoirs, including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond and Ruth Falls Headpond. Ten Mile Reservoir was previously controlled until the dam was removed in 2012.

Governor Reservoir is located at the head waters of Twelve Mile Stream, which flows through Union Flowage into Marshall Reservoir. Sloane Reservoir is located near the headwaters of Seventeen Mile Stream which passes through Anti Dam Reservoir and into Marshall. Marshall Reservoir comprises the principle reservoir for the Sheet Harbour System. Malay Falls Headpond is directly downstream from Marshall; the Malay Falls power canal conducts water from the Malay Falls Headpond to the generating station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel. Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power. Mapping of the Sheet Harbour System can be found in Appendix A.

The Ruth Falls dam has structures to support upstream and downstream fish passage. The upstream fishway consists of a technical (concrete) ladder section on the upper section which connects to a non-technical channel fishway that runs along the toe of the dam. Downstream passage is facilitated by a louvre system which is situated at the entrance of the powerhouse canal. The louvre redirects fish through a bypass downstream of the dam.

2.0 CONSTRUCTION

2.1 Existing Project Area

Ruth Falls Headpond is located immediately downstream of the Malay Falls Headpond. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, a 15.2 m long three-bay stoplog-controlled sluiceway section in the center, and two short concrete gravity bulkhead sections that abut either side of the spillway. The crest elevation of the spillway is 31.7 m (104.00') and stoplogs can be installed to an elevation of 33.3 m (109.25'). The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix B for pre-construction site photos.

Water levels in Ruth Headpond can fluctuate between the full supply level of 33.7 m (110.5') and the low supply level of 27.5 m (90.1'). A minimum operating level of 33.3 m (109.25') is observed from April 1 - November 30 each year. The Ruth Falls Headpond has a storage volume of 2.3M cubic meters (1888 acre-ft) when at the minimum operating level of 109.25 ft.

The site will be surveyed prior to the construction works to ensure that the elevations are accurate with respect to the current configuration and the new design. As noted by NSECC, the Sheet Harbour Hydro System Water Approval shows the minimum operating level of Ruth Headpond between April 1-November 30 as 109.4 ft. The engineering drawings associated with the Project, show the crest of the refurbished dam structure to be below this minimum level, at 109.25 ft. Discrepancies noted between minimum operating levels of the reservoir (109.4ft and 109.25ft) are datum related, as there have been many datums used over the years, including different coordinate systems and local datums. The minimum operating levels of the reservoir based on engineering drawings and Dam Safety Reviews is noted to be 109.25 ft. The current minimum operating level will remain unchanged with the new dam design.

As per the NSECC Sheet Harbour System Water Approval, the following ecological maintenance flows are provided at Ruth Falls:

- Year round – 35 cfs downstream of the Ruth Falls Dam
- April 1- November 30th – 6 cfs provided to fish ladder, 29 cfs provided to operate the louvers and downstream bypass
- May 15 – November 1 – salmon trap in the fish ladder in operation. DFO is contacted if the trap exceeds 50 salmon in order to determine the target release locations.

Water elevations in Ruth Falls are mostly controlled to operate the fish ladder, louver and bypass system and to generate electricity at Ruth Falls generating station. Excess water is spilled through the dam by manually removing spillplanks or stoplogs from the spillway and/or sluiceway bays. The Ruth Falls Dam has an overflow spill capacity of approximately 350 cfs while at full supply elevation of 110.5 ft. The overflow spill is provided over the stoplogs along the full length of the dam. From May to August 2021, overflow spill was approximately 350 cfs, this was due to a lack of generation a result of Ruth Falls switch gear refurbishment project.

Atlantic salmon have been the species of interest historically in the system for DFO. However, the low numbers of returns on East River in recent years indicate that there is unlikely a breeding population. Work is ongoing to improve the water quality in the West River and it may be that higher returns are observed in the East River over time. Of note, only 11 salmon have been captured in the Ruth Falls fish ladder salmon trap since 2007 with no salmon being captured in 2017 and 2018, two in 2019, and one in 2020. There were no salmon captured in 2021 and 2022.

Alewife and American eel are species of interest that have been observed in Ruth Falls headpond and below the Ruth falls dam and are known to ascend the Ruth falls fish ladder.

The Ruth Falls Headpond was sampled by NS Power in 2017 during the relicensing of the Sheet Harbour Hydro System using gill nets, minnow traps and eel pots. Species found to be present in the headpond include American eel, alewife, brown bullhead, lake chub, golden shiner, speckled trout, white sucker and yellow perch. High concentrations of mercury have been observed in white perch, yellow perch and speckled trout in the system. No aquatic invasive species have been observed in the project area or adjacent habitat. No critical habitat for aquatic species at risk is found in the area.

In July 2021, NS Power staff observed a Barn Swallow nest located in the centre of the dam on top of one of the concrete piers and underneath the deck of the dam. An additional Barn swallow nest was also observed on the bridge across the upstream side of the canal. The NS Department of LNatural Resources and Renewables (DNRR) issued NS Power a Species at Risk (SAR) permit which granted permission to remove the nests, the use of deterrents to temporarily prevent nesting during construction activities and the installation of an alternative nesting structure fitted with nesting cups at a 3:1 ratio. The nesting structure was installed and a deterrent program was put in place during Phase I construction which took place in 2022. This permit expires March 31, 2023. A new SAR permit will be obtained for the 2024 construction season to deter birds from nesting within the construction area.

Twenty-one (21) wetlands that are contiguous to the Ruth Falls headpond edge have been identified through previous assessment conducted in 2007. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was not identified during the 2007 survey. For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond. 6 of the 21 wetlands identified at the time of the survey were characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered. Refer to Section 5.5 - Wetlands and Rare Species for more detail.

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. In examining the ACCDC search completed in 2017 for the previous relicensing of the Sheet Harbour Hydro System, 4 records of potentially rare or endangered species are found in close proximity to Ruth Falls Headpond. These species are not anticipated to be impacted by the drawdown of Ruth Falls Headpond. Refer to Section 5.5 - Wetlands and Rare Species for more detail.

2.2 Proposed Refurbishment Activities

The proposed refurbishment activities are listed below. Please note that the installation of the control building (under separate Approval 2021-2840307-00) is complete and is not included in the scope of work below:

- Installation of downstream access road and temporary bridge (to start prior to drawdown activities). Downstream access roads will need to be in place in order to access the right side of the dam
- Lowering of Ruth Falls Headpond approximately 18 ft.
- Dewatering of the Ruth Falls fishladder and canal and fish rescue
- Installation of temporary access for machinery on the upstream side of the dam – access from the right side and the left side. The area in front of the sluiceway bays will remain open to allow water to pass through.
- Removal of stoplogs from existing sluiceway bays, prepping of bays, and installation of vertical lift gates.
- Removal of the existing stoplogs from stoplog bays, piers, stoplog lifter and walkway.
- Reface the concrete on the crest and downstream slope of the spillway ogee sections.
- Installation of new rubber dam bladders on the crest of the ogee spillway sections.
- Construction of a free overflow spillway section at the right end of the dam.
- Installation of a new steel walkway for access across the dam.
- Improvements to the upstream fishway.
- Improvements to the existing downstream louvre system.
- Installation of an upstream eel ramp.
- Removal of the temporary access road material.
- Watering up of the headpond to within normal operating levels, return of fish ladder and louvre system to normal operation.
- Contractor Demobilization from site.

2.3 Construction Schedule

The construction schedule is as follows:

- Installation of the downstream access roads and temporary bridge will commence in early July 2024. This work is intended to be completed prior to the drawdown in preparation for main dam construction work to take place in mid-July after the lowering of Ruth Falls Headpond. Access to the right side of the dam will be provided by the downstream access roads connected by the temporary bridge.

- Construction activities associated with the sluiceway, main dam refurbishment, and improvements to fish passage will commence in mid-July with the lowering of Ruth falls headpond. The lowering of the Ruth Falls Headpond will commence no earlier than July 10th 2024 and will take place over the course of 8 days.

- After the water is at an elevation of 91 ft, construction activities will then begin with the installation of the upstream access roads. Work on the main dam refurbishment, sluiceway bays, and improvements to fish passage will continue simultaneously as construction progresses, however NS Power will aim to complete the new sluice gates first in the low flow window of July-September. It is anticipated that each gate bay will take approximately 3-4 weeks to complete, and a total of 9-12 weeks to complete the entire sluice structure. This may be affected by weather should heavy inflows be required to be passed for a significant period of time.

- Remaining dam refurbishment and upgrades to existing fish passage structures will then continue with all temporary control structures and access paths removed and Ruth Falls Headpond returned to normal operation April 1st 2025. The focus will be on completing dam refurbishments and upgrades to the louvre system (while the canal is dewatered) to ensure the dam and fish passage structures are operational by April 1st. In the event that there is not enough time to complete the improvements to the upstream fishway during the drawdown, NS Power commits to completing the work during the next construction season (avoiding upstream migration timing) in 2025. This would not require the headpond to be drawdown – cofferdams would be used to isolate the fishway while the work takes place.

To accomplish this scope and construction schedule, NS Power is requesting an approval expiry date of December 31, 2025.

3.0 REGULATORY PERMITS/APPROVALS

In addition to the Watercourse Alteration Approval required in accordance with Section 5(A)(1)(c) of the Activities Designation Regulations of the *Environment Act*, an authorization under Section 35(2)(b) of the *Fisheries Act* is required for this scope of work.

A variance to the Sheet Harbour Hydro System Water Approval (#2008-062826-01) for water withdrawal/storage will also be required in order to carry out the proposed scope of work. This includes the following:

- operation of the Ruth Falls fishladder, louvre system and salmon trap, which will be non-operational throughout construction
- 35 cfs maintenance flow, during the refurbishment of the middle sluiceway bay and installation of vertical lift gate (approximately 4 weeks).
- minimum water elevations for the period of April 1-November 30th for Ruth Falls Headpond.
- Supplementary flow release requirements for Atlantic salmon, which are unable to be adhered to during construction due to lowered water levels. As part of NS Power's water

management plan water will be free flowing through the deep sloplog/sluiceway bay, providing continuous downstream flow, however standard supplementary releases for specific time periods will not be provided.

A Species at Risk permit will be obtained by NSDNRR as per Section 50(1), 51(a) of the *Wildlife Act*, and Section 14(1) of the *Endangered Species Act*.

An authorization in accordance with Transport Canada's Navigation Protection Program is also required for construction activities for the Project.

4.0 WATER MANAGEMENT DURING CONSTRUCTION

4.1 Drawdown of Ruth Heapdond

In an effort to provide the safest and most reliable construction execution during one drawdown period, lowering the reservoir to elevation 91 ft is required. A construction elevation of 91 ft (approximately 18 ft below minimum operating level of 109.25 ft) allows for the portions of the concrete dam to be refurbished to be fully exposed. The canal, fishladder, and downstream bypass will be dewatered and a fish rescue completed by qualified staff. The drawdown to 91 ft represents a difference in storage of approximately 2.295M cubic meters or 1884-acre-ft from full supply (2.3M m3 and 1888 acre-ft, respectively).

To complete the drawdown, NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 33.7 m (110.5 ft) (if required) to the minimum operating level of 33.3 m (109.25 ft). Once the headpond reaches an elevation of 33.3 m (109.25 ft) – the top of the spillway stoplogs - the drawdown will be controlled by removing the spillway stoplogs until an elevation of 31.7 m (104.1 ft) - the concrete spillway crest - is reached. After this point, the sluiceway bay stop logs will removed be until the desired elevation of 27.7 m (91 ft) is achieved. The drawdown flow will be directed through areas that are part of the normal flowage channels. At least one gate will remain in full open throughout construction to maintain lowered water elevations and provide a method of fish passage.

Table 1 displays the decrease in flow velocities as the headpond elevation lowers over the course of the 8-day drawdown period.

Table 1: Estimated Flow and Velocities for an 8-day drawdown of Ruth Falls Heapond

Time (day)	Beginning Elevation (ft)	Bays 1-15	Bays 16-30	Outer Sluice	Middle Sluice Opening (ft)	Total Discharge (cfs)	Velocity through each bay (fps)	Downstream Velocity (fps)
0	109.2	1	0	0	0	159	2.1	6.6
0.5	109.1	1	1	1	1	281	2.0	8.5
1	108.1	2	1	1	1	102	1.8	5.7
1.5	107.6	2	2	2	2	93	1.4	5.4
2	107.4	3	2	2	2	189	2.2	8.6
2.5	106.6	3	3	3	3	91	1.4	5.4
3	106.4	4	3	3	3	190	2.3	8.6
3.5	105.6	4	4	4	4	91	1.4	5.4
4	105.4	5	4	4	4	190	2.3	8.6
4.5	104.6	5	5	5	5	91	1.4	5.4
5	104.5	5	5	7	7	99	3.1	5.7
5.5	103.7	5	5	9	9	187	3.8	8.6
6	102.2	5	5	11	11	244	4.2	8.1
6.5	100.3	5	5	13	13	258	4.3	8.3
7	96.2	5	5	15	15	90	3.0	5.4
7.5	94.2	5	5	15	17	30	1.0	3.4
8	93.1	5	5	15	19	51	3.6	4.2
8.5	91.0	5	5	15	19			

The flow downstream will be controlled in order to avoid scour and sedimentation. The 35 cfs maintenance flow and downstream fish passage will be provided through the open sluiceway bays with the exception of when the centre bay is being worked on. During this time, water will be pumped around the centre bay down through the other bays which sit at a higher elevation to maintain flow. NS Power may not be able to provide the entire 35 cfs by pumping activities, but will provide as much flow as possible using multiple pumpsQualified NS Power personnel will be on site during the drawdown to monitor water quality (visual observations) and conduct a fish rescue for any isolated fish in the headpond and canal. Once the headpond level reaches 91 ft most of the canal will be dewatered. NS Power will drain the remaining water using the drain valve at the powerhouse.

Following the completion of refurbishment activities, the headpond will be subsequently recharged at a controlled rate.

4.2 Temporary Structures

Prior to the drawdown taking place, a temporary rockfill downstream access road will be constructed using clean rock that is free of fines with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes. The downstream access road will be equipped with a temporary bridge that will be located over the spillway discharge channel (refer to Appendix C - Proposed Water Management Structures). The temporary bridge will be approximately 4 ft tall and 42 ft wide and will be constructed to pass upwards of 3200 cfs (refer to Table 2 for details). The bridge will be constructed using steel beams that are removable using an excavator should additional if required if a large rain event is anticipated (refer to section 4.4).

Ice build-up is not anticipated on the temporary access road as the water will be constantly flowing downstream. Excavators will be using the access roads on a continual basis during construction which will break up any ice that could accumulate. If significant ice accumulation was to occur, the ice could be removed physically by the contractor.

Following the completion of the drawdown to elevation 91 ft, two rockfill access roads will be constructed on the upstream side of the dam; one extending from the left abutment to the left end of the sluiceway, and one extending from the right abutment to the right end of the sluiceway. The access roads will be constructed to elevation 100.0 ft (30.5 m) with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes using clean rock material that is free of fines. The left upstream access road will be 209 ft (64 m) long while the right upstream access road will be 343 ft (104.5 m) long. The estimated temporary instream footprint of the left access road is 576 ft^2 (535 m^2) while the right access road is 747 ft^2 (694 m^2). Using available bathymetry, approximately 74% of the upstream access road will be placed in the dry at an elevation of 91.0 ft.

The upstream access roads will serve primarily to provide access for machinery to complete refurbishment activities. It should be noted that there are no cofferdams being constructed on the construction site that are required to hold back water; there is no requirement for construction to take place behind cofferdams, or to isolate work areas. Temporary access roads are being constructed of clean rockfill, and water will be allowed to equalize between the dam structure and roads. The drawdown to the desired 91 ft is the primary means of water control for the Project.

All access roads will be developed to and meet industry standards. This includes adhering to required crest width and height to accommodate machinery. The access roads are built to be held in place until removed and therefore, are capable of withstanding all four seasons changing

weather and precipitation conditions. The access roads pose very low risk to the project and the environment.

4.3 Water Management Planning

Once the drawdown is complete, all stoplogs from the ogee spillway sections and sluiceway section will be fully removed to prepare for refurbishment activities. As shown in drawing 210-03 and 300-03 of the project design package, concrete will be demolished in bay 8 to prepare for the construction of the new uncontrolled spillway. This bay will be demolished to an elevation of 98 ft, which is approximately the elevation of the toe of the ogee for the new uncontrolled spillway section. The concrete in bay 8, where the uncontrolled spillway section is being constructed, will need to be brought down to beyond the minimum 3 inches to 98 ft

To maintain desired construction elevations and to manage periodic fluctuations in Ruth Headpond, the open sluiceway bays will be used for passage of water through the dam during construction, with the deepest bay in the centre of the structure constructed first during the expected low flow period. (July and August). During this time, work will also begin on one of the outer bays simultaneously, with one bay always open to pass water. The sill elevation of the middle sluice gate is 90.1 ft, whereas the sill elevation of the outer two gates is 94.1 ft. Therefore, at a headpond level lower than 94.1 ft, only the middle vertical lift gate deep sluice bay will be available to discharge flows. To keep the centre bay as dry as possible during the four-week period needed to complete the work, a steel barrier will be placed in the notches of the sluiceway bay to divert water (which will then be pumped through the other sluiceway bays via pumps). During construction of the centre bay/gate, upstream fish passage may be temporarily affected as passage is not possible through the higher outer bays unless the headpond elevation was to rise to 94.1ft.

Once the centre sluice bay/gate is completed, this bay will be used as the primary method of managing water through the construction site while the remaining outer bays are constructed. Once the entire sluiceway is operational, all three bays will be used to manage water.

The sluiceway is intended to manage the majority of water fluctuation in the headpond while construction is ongoing. To manage a wider range of fluctuation caused by heavier precipitation which could occur during the drawdown, water will be passed through the open bay 8, where the new uncontrolled spillway is to be constructed. Existing concrete in bay 8 will be demolished to elevation 98 ft, and will be left open until the new uncontrolled spillway will be constructed toward the end of the construction window. As shown in drawing 300-03, bay 8 is 50 ft wide.

Armour stone will be placed on the upstream side of the right downstream access road to reinforce the road from the impact of spill from bay 8, should water levels rise to above 98 ft. It is important to note that the headpond would need to rise by 7 ft (91 ft-98 ft) before the spillway would be available for passing water. Refer to Table 2 Section 4.4 more details.

As shown in Table 2, the bridge opening can tolerate discharge associated with a rise in elevation to 101 ft, at which point the bridge would then be removed to pass additional water. This is further discussed in Section 4.4.

The estimated discharge flows through the open sluice bays, bay 8 uncontrolled spillway opening, and the bridge opening re shown in Table 2.

Table 2 : Estimated Discharge for the New Vertical Lift Gates

Reservoir El.	91 ft	93 ft	95 ft	97 ft	99 ft	100 ft	101 ft	103 ft	104 ft
Outer Gate 1	N/A	N/A	30 cfs	180 cfs	390 cfs	510 cfs	650 cfs	940 cfs	1270 cfs
Outer Gate 2	N/A	N/A	30 cfs	180 cfs	390 cfs	510 cfs	650 cfs	940 cfs	1270 cfs
Middle Gate	35 cfs	180 cfs	390 cfs	650 cfs	940 cfs	1100 cfs	1270 cfs	1630 cfs	2025 cfs
Total Gate Discharge	**35 cfs**	**180 cfs**	**460 cfs**	**1010 cfs**	**1720 cfs**	**2120 cfs**	**2570 cfs**	**3510 cfs**	**4565 cfs**
Spillway (Crest – El 98ft)	**N/A**	**N/A**	**N/A**	**N/A**	**125 cfs**	**355 cfs**	**650 cfs**	**1400 cfs**	**840 cfs**
Total Discharge	**35 cfs**	**180 cfs**	**460 cfs**	**1010 cfs**	**1845 cfs**	**2475 cfs**	**3220 cfs**	**4910 cfs**	**6405 cfs**
Depth Under Bridge	0.2 ft	0.6 ft	1.1 ft	1.8 ft	2.5 ft	31. ft	**3.7 ft**	4.8 ft	4.6 ft

The two outer gates are identical in their dimensions; therefore, yield the same outflows. All gates were considered to be fully open for the purpose of these calculations. The spillway crest sits at 98ft, therefore will act as a contingency for passing additional flows.

It is expected that at a minimum, natural inflows from Grant River Watershed, which is uncontrolled by NS Power, water from intermittent precipitation events as well as required maintenance flows and spill over the Malay Falls rubber dams would be managed through the construction site which will result in water level fluctuations in Ruth Falls Headpond throughout construction. Temporary upstream access roads on the upstream side of the dam will be designed to an elevation of 100 ft. This allows for approximately 9 ft of water level fluctuation within the headpond during construction before the access roads would be submerged. The access roads will be constructed using clean rock free of fines. The roads are not intended to hold back water

and it is expected that in the event of increased water elevations, work will be able to continue until the top of the access roads is reached (100 ft).

NS Power believes that by having 9 ft of headpond capacity available that work crews will have sufficient time to plan and remove any necessary equipment should the forecast warrant such planning. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. Refer to section 4.4 - Contingency planning for more details.

It is also important to note that even with the new sluiceway and vertical lift gates under construction, NS Power still has the ability to use the open gate bays to pass water if an extreme precipitation event is forecasted. The scope of the sluiceway refurbishment includes only pepping the concrete bays for installation of the new vertical lift gates. Work on the sluiceway can be halted quickly and the bays stabilized to prepare for passage of water as required. NS Power may generate at Malay Falls to continue to pass water through the system and maintain required water levels in the upper reservoirs. This will only be completed to a level that is manageable at the construction work area and with oversight from the NS Power's Construction Project Management and Hydro System Superintendent.

Fish will have the ability to move downstream and upstream through the sluice bay during construction, with the exception of when the centre sluice bay gate is under construction. The passive opening under the bridge will allow fish to move freely downstream. It should be noted that in all scenarios, the minimum 35 cfs discharge requirement will be maintained throughout construction with the exception of the approximately 4 week window where the centre sluicebay is under construction, during which time water will be pumped around the centre bay construction area (through the outer sluiceway). A six inch pump will be used to discharge the flow through one of the other sluiceway bays. During construction of the centre gate, should inflows result in water levels to increase, the outer sluice bays will be operational once elevations reach 94.1 ft. At elevation 95 ft, the outer sluice bays can pass a total of 70 cfs, and up to 780 cfs if water levels were to raise to 99 ft. There would be no negative impacts to the passage of water during all scenarios.

4.4 Contingency Planning

The hydrological information provided below references the Sheet Harbour system flood study, which was completed as part of NS Power's dam safety program in addition to the system dam safety reviews. NS Power does not typically provide flood study reports as part of watercourse alteration applications pertaining to hydro capital projects as these studies contain confidential information pertaining to NS Power's hydro dam safety program.

The maximum mean annual flows for the Ruth Falls headpond was calculated using the 2008 Sheet Harbour Hydro System Flood Study. The values were calculated using the 6-hour sub basin unit hydrograph for the sheet harbour hydro system and the 6-hour duration rainfall from 6-hour duration rainfall from Atmospheric Environmental Service, Rainfall Intensity-Duration Frequency Values for Shearwater Airport. Figures are presented in Table 3 below.

Table 3: Mean Annual Flood for the East River

Return period (years)	Maximum Mean Flow (cfs)
2	3,427
5	4,468
10	5,183
50	6,613
100	7,149

The maximum mean flows outlined in Table 3 take into consideration inflows from the Grant River, which was included in the 2008 flood study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond. The water management plan for the Project has considered the ability to pass discharge associated with the mean annual floods for the East River associated with a 1:10 return period (equivalent to approximately 5,183 cfs). It is important to note that the gates and spillway are capable of passing approximately 6405 cfs if the headpond was to reach an elevation of 104 ft, this is just below the threshold a 1:50 return event. Contingency measures have been considered below for precipitation events that may occur resulting in higher discharge associated with a 1:10 return period event.

The following list outlines the sequence of events associated with increasing headpond elevations:

- At elevation 91 ft, the centre sluice bay can pass 35 cfs without any water level fluctuation. If water was to rise to an elevation of 94.1 the outside sluiceways would come into operation and the three bays would be capable of passing approximately 320 cfs.
- Between 94 ft and 97 ft, water would continue to pass through all three gates - discharging approximately 1010 cfs once 97 ft is reached.
- Once an elevation of 98 ft is reached, the concrete spillway (which will be prepped for construction of the new uncontrolled spillway section during the last phase of construction) will be available for passing additional water in addition to the three gates. At 99 ft, the gates and the spillway will be capable of discharging approximately 1845 cfs.

The right downstream access road will be reinforced on the upstream side using large riprap to withstand any incoming spill from the spillway should this occur.

- At a headpond elevation of 100 ft, the top of the upstream access roads will begin to become submerged. Any machinery will need to be moved in advance of this; however, the access roads will be built to tolerate submersion. At this point, approximately 2475 cfs will be passing through the gates and the spillway. At 101 ft, it is anticipated that the water will be approaching the underside of the downstream bridge (water coming up to approximately 3.7 ft under a 4 ft bridge). At this point, the bridge will be removed using an excavator on site. This type of removal is expected to take approximately 4 hours.
- Once an elevation of 104 ft is reached, the gates and spillway will be discharging approximately 6405 cfs combined. The crest of the ogee section of the dam is situated at 104 ft. This discharge exceeds a 1:10 year return period for mean annual flows. Refer to Table 2 for more details.

NS Power operations and the contractor will be monitoring the water inflows and discharges throughout the construction activities and will be able to adjust to the changing conditions, as required, to ensure that the headpond levels are managed accordingly. Temporary upstream access roads will be installed to withstand a rise in the headpond to elevation 100 ft. The access rocks will be constructed using large rock free of fines making it permeable and able to pass water through without becoming compromised. At 101 ft the temporary bridge would need to be removed. Once elevations hit 104 ft, the water would begin to overtop the ogee section of the spillway causing work to halt until water levels recede. This is not anticipated to occur during the construction period as this would be approaching a 1:50 return period event.

Should high return period rain events (i.e. 1:10 year return period) be received during construction activities, the Ruth Falls Headpond can withstand an increase in water elevation to 104 ft, based on the discharge capacity of the sluice bays, spillway opening, and expected inflows during a 1:10 return period event (Table 3 – approximately 4,468 cfs). With all three sluice bays available and the spillway also passing water, approximately 6405 cfs can be passed at an elevation of 104 ft, (Table 2) During such an event, NS Power and the contractor would plan to shut down all construction activities. Keeping in mind that the reservoir would already be drawn down, inflows would be able to attenuate in the reservoir, essentially raising the level of the reservoir over time from 91 ft to 104 ft (13 ft differential). If extreme heavy rain or significant sustained flows are forecasted, which could result in water levels to exceed the 100 ft elevation, the construction infrastructure that can be quickly removed to meet the sluiceway width capacity are:

- The temporary work platforms and construction materials supporting gate installation
- The installed vertical gates if they are not fully operational at the time of the event
- The removal of temporary bridge

- Removal of any temporary formwork supporting the construction of the uncontrolled spillway section.

During the construction of bay 8, the uncontrolled spillway section, water management will be achieved using the operational sluiceway. If a high return period event is forecasted while the spillway is under construction, which would cause headpond elevations to rise above 98 ft work associated with the installation of the new spillway section would be paused until water levels recede. Concrete pouring will only proceed if no significant rainfall is forecasted.

The upstream access roads will be constructed in a manner as to not impact the discharge capacity of the sluiceway. Both upstream and downstream temporary access roads will be constructed with large rock material properly sloped, to safely flood and overtop if a return period event of high water levels are received. The temporary access roads will be constructed with clean rockfill material and no easily erodible material (such as clay, sandbags, filter fabric, plastic liner) will be used because there is no need for the access paths to hold back water (access roads are not cofferdams) If in the event migration of material is observed, the associated risk of sedimentation or debris being deposited downstream is extremely low. NS Power will assess the access road material migration once water levels have receded and develop plans for material removal in coordination with NSECC and DFO, if required.

5. ENVIRONMENTAL PROTECTION AND MITIGATION

5.1 Hydraulic Modeling

NS Power engaged CBCL Ltd. to complete 3D hydraulic modeling to assess post-refurbishment hydraulic conditions. The objective of the modeling was to evaluate whether the refurbishment and subsequent operation of the new dam would result in negative impacts to fish and fish habitat downstream of the dam, namely impacts to upstream and downstream fish passage.

The following was completed as part of the 3D hydraulic modelling:

- Modelling of historical spill data to assess potential impacts to fish passage during various expected flow conditions (i.e. base flows – high flow spill conditions), as a result of the proposed refurbishment dam design operation.
- Modelling of existing ecological maintenance flows (as required in accordance with the Sheet Harbour Hydro System) and current estimated leakage rates (i.e. base flows) to

evaluate whether ecological flows are sufficient for optimal fish passage, and modelling of different gate configurations to provide the ecological flows (i.e. gate openings).

- Modelling of passage conditions in the existing fish ladder and downstream bypass, and testing of a range of configurations to optimize upstream and downstream passage. Modelling results can be found in Appendix F.

The hydraulic modeling provides insight as to how the post-refurbishment design would impact the entrance conditions to the fishway and support fish as they migrate towards the dam. Specific considerations have been made to design and operations plans to allow for improved conditions below and at the fishway entrance. This includes designing for appropriate velocities which will allow for prolonged swimming and burst swimming for species looking to migrate upstream.

The following will be implemented to mitigate or avoid negative impacts to fish passage and optimize upstream and downstream passage, as supported by the 3D modelling exercise:

- The current downstream base flow condition, which is a combination of the required ecological flow of 35 cfs plus standard leakage rates through the dam (approximately 100 cfs), will be maintained as the minimum ecological flow for optimal fish passage between April 1-November 30th.
- The current ecological flow for the upper technical (concrete) fish ladder and louver (downstream bypass) system (6 cfs and 29 cfs, respectively), will be maintained.
- Adjustments to attraction flow within the lower (non-technical) section of the fish ladder will be made (refer to section 5.2).
- Modifications to the lower (non-technical) section of the fish ladder will be made to improve upstream passage for all species (refer to Section 5.2).
- Modifications to the louver/downstream bypass system will be made to improve downstream passage for all species (refer to Section 5.2).
- The remaining base ecological flow (approximately 65 cfs) will be provided using the new vertical lift gates, with the use of the most easterly gate reduced or avoided to avoid sub-optimal flow conditions for upstream passage. Once the dam is constructed, the gate flow will be optimized to provide the best flow conditions for fish (avoiding back eddies) using a combination of all three gates, two gates, or just one gate to provide the maintenance flow. refer to Appendix F – Hydraulic Modeling Results for more information.
- Excessive spill will be avoided between May 1 - June 30th where possible. While infrequent as shown in the modelling, when required it is expected that the duration will be short (1-2 days) and therefore will not negatively affect upstream passage.
- Supplemental flows (50 cfs) of 10 or more occurrences will be provided through the gates between the dates of June 15 to July 15 and September 26 to November 30 as per the Sheet Harbour Water Approval.

For full hydraulic modeling results and interpretation by Thaumus Environmental, please see Appendix F.

5.2 Fish Passage Improvements

In addition to 3D hydraulic modelling, NS Power contracted Wood and Thaumas Environmental consulting firms to complete an evaluation of existing upstream and downstream passage and recommend operational or structural modifications to improve fish passage, as required. Refer to Appendix G – Fish Passage Assessment for more details. Figure 1 shows a site overview of refurbishments associated with improvements to fish passage as described below.



Figure 1: Site diagram outlining refurbishments associated with upstream and downstream fish passage.

Downstream Louver System

The assessment of downstream passage included looking at the existing infrastructure to evaluate the effectiveness of a louvre system at facilitating downstream passage for species that would be required to move downstream of the dam in order to complete their life cycle, and to assess the need for upgrades and general repairs. This included assessing whether the louvres system meets the US Fish and Wildlife Association (USFWA) Fish Passage Engineering Design Criteria. A

conceptual design for proposed improvements were provided to address improvements identified within the assessment (refer to Appendix H – Louvre Assessment for more details). Recommendations for improvement for downstream passage were made and proposed changes to the louver system are as follows:

- Repairs to the existing louvre slats may be required to ensure a complete system. These repairs will be identified when the water is drawdown and canal dewatered in July 2024. Anticipated repairs include replacing partially broken / damaged slats.
- Installation of a trap funnel to prevent upstream movement once fish have moved through the entrance of the bypass. Bottom orifices will also be installed in the stoplogs to support downstream migration.
- A ramp is recommended to facilitate movement from the bottom of the water column towards the bypass pipe at the top of the water column. This would benefit those bottom dwelling species such as American eel, Brown bullhead, White suckers etc. by guiding the fish from the bottom to the convergence of the slates in order to find the bypass pipe. Refer to Appendix H for concept sketches of the new ramp.
- Realignment of the bypass outfall into the top of the non-technical lower fishway section. The plunge pool water depth will be designed to meet or exceed the USFW criteria for drops of all species and age classes at the site. See Figure 1 to view the placement of the new bypass pipe.

Upstream Fish Passage

Results of the 3D hydraulic modeling determined that improvement to the lower non-technical section of the existing fishway should be made to improve passage for species migrating upstream to complete their lifecycle. The current fishway was originally designed for salmon; the proposed improvements will look to improve velocity and flow conditions to support other species such as gaspereau, which will in turn improve conditions for all species as the swimming capability of gaspereau is the limiting criteria for the fishway. The following improvements are proposed:

- Replace the existing lower non-technical fishway weirs with 11 new concrete weirs, including an additional weir immediately below the upper technical (concrete) fish ladder. The weir at the entrance to the fishway will be placed on a diagonal pointing south-west to provide improved entrance conditions. Refer to Appendix G – Fish Passage Assessment for concept sketches.
- Relocate the louvre bypass outflow pipe to connect into the fishway to provide additional attraction flow through the fishway. The fishway currently provides a minimum of 6 cfs and the bypass pipe provided a minimum of 29 cfs making the new total coming down

through the fishway 35 cfs. Refer to Appendix G – Fish Passage Assessment for concept sketches.

Upstream Eel Passage

An eel ramp is proposed to facilitate upstream eel passage as it was determined through the evaluation that a separate stand-alone structure was required for effective upstream eel passage, beyond the existing fishway. The design consists of a metal enclosed box lined with a climbing substrate and equipped with pumped water to facilitate eel movement up the ramp. The placement of the eel ramp will sit on the outside of the upper technical (concrete) fishway – following the general outline of the fishway up to the headpond (refer to Appendix I – Upstream Eel Passage for more details). The hydraulic modeling results were used to confirm the placement of the eel ramp including entrance conditions (Appendix F).

5.3 Erosion and Sedimentation Control

Erosion and sedimentation control materials such as hay, silt fencing, etc., will be used to control sediment laden water from entering the headpond while it is dewatered. Any silt-laden water in the work area will be recovered and pumped away from the headpond to areas with sufficient vegetation to facilitate filtration. The headpond will be recharged at a controlled rate with NS Power personnel monitoring for any visible water quality issues. NS Power is not anticipating any issues with erosion or scour when passing the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. Bi-annual inspections and weekly checks are conducted downstream of the Ruth Falls Dam. Observations during the inspections and checks indicate that scour is not of concern when spilling in excess of 500 cfs.

NS Power Project personnel will remain in regular contact with Hydro Operations personnel throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

All access road material will be clean, appropriately sourced rock material that is free of fines, to significantly reduce potential sedimentation of the upstream and downstream work areas. Rockfill cofferdams have been used by NS Power on other hydro refurbishment projects and have proven to have little effect on sedimentation of the surrounding watercourse, even during periods of high inflows/discharge. Pumps will be used, as required, to assist with removing any silt laden water, which will be pumped to a designated area.

The proposed scope of work for the Project involves minimal excavation of soil material, as the focus of construction is the refurbishment of the existing concrete dam structure. The primary method of erosion and sedimentation control is the water management strategy outlined in Section 4.

There will be some excavation of the right (west) abutment retaining wall that is scheduled for removal and replacement. During construction activities for the retaining wall, silt fencing will be used along the boundary of the spillway bank to protect the adjacent spillway channel. The excavation for the retaining wall is anticipated to be small and as such, soil material will not be exposed for a significant length of time. Pumps will be used to keep the retaining wall work area dry and silt laden water will be pumped to the west of the dam in an area designated as acceptable to filter water prior to re-entry into a watercourse. Hay will be used to cover any temporarily exposed work areas, as required. Based on initial scoping of surrounding lands, NS Power has identified two potential areas to be used for water filtration areas or installation of sediment traps. One area is immediately west of the dam and the other is located north east of the dam, see Figure 1 below. Both areas are on NS Power property and have been evaluated for possible wetland/rare species habitat. Both areas are forested and provide suitable vegetation to aid in water filtration. Additional field scoping will be completed to confirm areas to be used and method of water filtration.

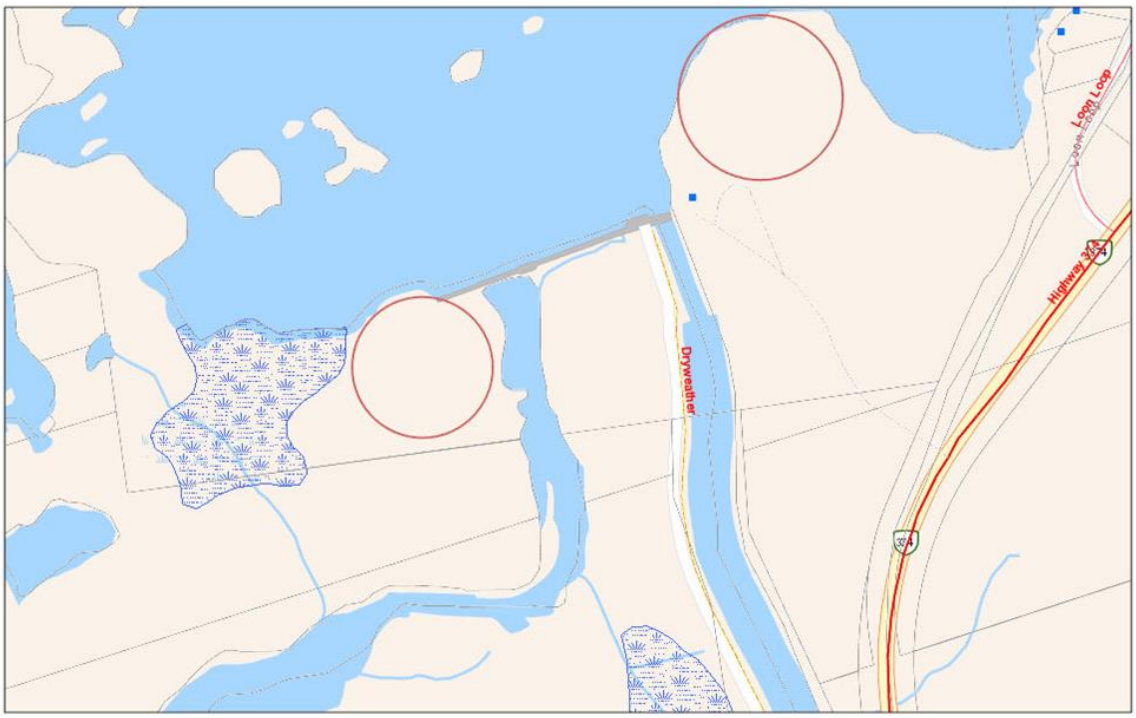


Figure 2: Potential locations for water filtration to support pumping activities. Areas to be field verified in spring 2023.

The removal of access road material will take place with Ruth Falls Headpond at elevation 91 ft, which will allow for visual observation of the majority of material being removed. Washed rock will be used to ensure no silt or fines interacts with the watercourse. Siltation monitoring will take place as debris from the access road is removed. Monitoring will be carried out by NS Power downstream during the removal to ensure siltation is not occurring.

The selected contractor for the Project will be required to submit a site-specific erosion and sedimentation control plan designed for the planned scope of work. This will include identification of any additional site-specific controls required and location of water filtration operations or requirements for sediment traps for pumping activities. NS Power would request that, if required, a condition be incorporated into the Approval, if issued, for NS Power to provide a site-specific plan to confirm the above outlined measures prior to construction activities starting. Additional impacts as a result of sedimentation beyond the in-water work window (June 1 – September 30) are unlikely. In addition to the mitigation measures discussed above, NS Power will monitor weather closely to ensure appropriate planning/mitigation is in place prior to a heavy rain event. This may include temporary closure/stabilization of site, temporary work stoppage, or removal of access road sections to allow for increased passage of water. Site inspections will be completed immediately after heavy rain events to monitor for erosion or sedimentation issues.

NS Power will also require the general civil contractor to implement daily site inspections and completes overarching environmental inspections on a weekly basis during construction. This will allow NS Power to ensure compliance to regulatory requirements and best practices, while ensuring deficiencies are assigned an appropriate corrective action to be addressed in a timely manner.

5.4 Water Quality

NS Power conducts water quality surveys as part of the hydro relicensing program, the process by which the water approvals for storage/withdrawal are renewed for each hydro system. Relicensing studies for the Sheet Harbour Hydro System were completed in 2017 in preparation for the relicensing of this system. The water quality surveys completed for the headpond show acidic conditions with an in-situ pH range of 4.43-4.52, presence of phosphorus and chlorophyll and good conductivity. Based on these results, the headpond is classified as meso-eutrophic or eutrophic. A small thermocline was observed at 3.2 ft (1 m) depth; however, dissolved oxygen remained consistent to sample depth 19.7 ft (6 m).

Using available bathymetry for the headpond (see Appendix A), approximately 0.5 miles square (1.15 km^2) of total shoreline will be exposed as a result of a drawdown to 91.0 ft from FSL. The majority of shoreline to be exposed is very shallow under normal FSL of 109.25 ft, with depths of

less than 9.8 ft (3 m). At an elevation of 91.0 ft, the headpond will look similar to pre-inundation conditions of the East and Grant Rivers. It is unknown how the drawdown of approximately 18 ft for a period of 9 months will influence water quality; however, it is expected that inflows from Grant River, and small inflows from Malay Falls will provide continuous oxygenated water to Ruth Falls Headpond throughout the drawdown. It is unknown how much inflow is contributed by the Grant River Watershed; although, inflows from this watershed were included in the 2008 Flood Study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

NS Power proposes to complete monthly water quality sampling from a deeper area of the headpond, to compare various water quality parameters with those observed under normal operation. NS Power will use the location of the water quality sample site used during the 2017 relicensing of the Sheet Harbour Hydro System for direct comparison to normal operating conditions. Water quality sampling will be completed from July to November for temperature, dissolved oxygen, total suspended solids and turbidity.

The monitoring site for monthly sampling will be established at the deepest part of the headpond, using available bathymetry or manual soundings if bathymetry is not available.

Monthly monitoring will be conducted from July to November and will include the following parameters:

- Secchi depth
- Temperature
- Dissolved oxygen
- Nutrient content (lab analysis)

5.5 Wetland and Rare Species

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. Twenty-one (21) wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was not identified during the 2007 survey. For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond.

Table 4 shows the type of each wetland mapped in 2007; 6 of the 21 wetlands identified at the time of the survey where characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered.

Table 4: Wetlands Found Within the Littoral Zone of Ruth Falls Headpond. Wetlands 3,5,6,15,17,19 are highlighted as they have been selected for Wetland Monitoring as described below.

Wetland ID Number	Wetland Type	Wetland Description
1	Coniferous treed shore bog	No
2	Coniferous treed shore bog	No
3	Coniferous treed shore bog (two subtypes)	Yes
4	Shore bog	Yes
5	Shore bog	No
6	Wetland complex composed of coniferous treed shore bog and floating bog (two subtypes)	Yes
7	Shore bog	Yes
8	Shore bog	No
9	Shore bog	No
10	Shore bog	No
11	Shore bog	Yes
12	Shore bog	No
13	Shore bog	No
14	Shore bog	No
15	Wetland complex composed of coniferous treed shore bog and coniferous treed shore swamp	Yes
16	Coniferous treed shore bog	No
17	Shore bog	No
18	Coniferous treed shore bog	No
19	Shore bog	No
20	Shore bog	No
21	Shore bog	No

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. In examining the ACCDC search completed in 2017 for the previous relicensing of the Sheet Harbour Hydro System, 4 records of potentially rare or endangered species are found in close proximity to Ruth Falls Headpond, see Figure 3. There are two records of Salted shell lichen (*Coccocarpia palmicola*) located in a wetland on the northwest portion of the headpond, which appears to be hydraulically connected by a small stream. Salted shell lichen is listed as secure within the NS General Status Rank. There are also two records of Ruby-crowned Kinglet (Regulus calendula) on the east side of the headpond along the Lochaber Mines Road. Ruby-crowned Kinglet is listed as Sensitive within the NS General Status Rank. Neither of these species are anticipated to be impacted by the drawdown of Ruth Falls Headpond.

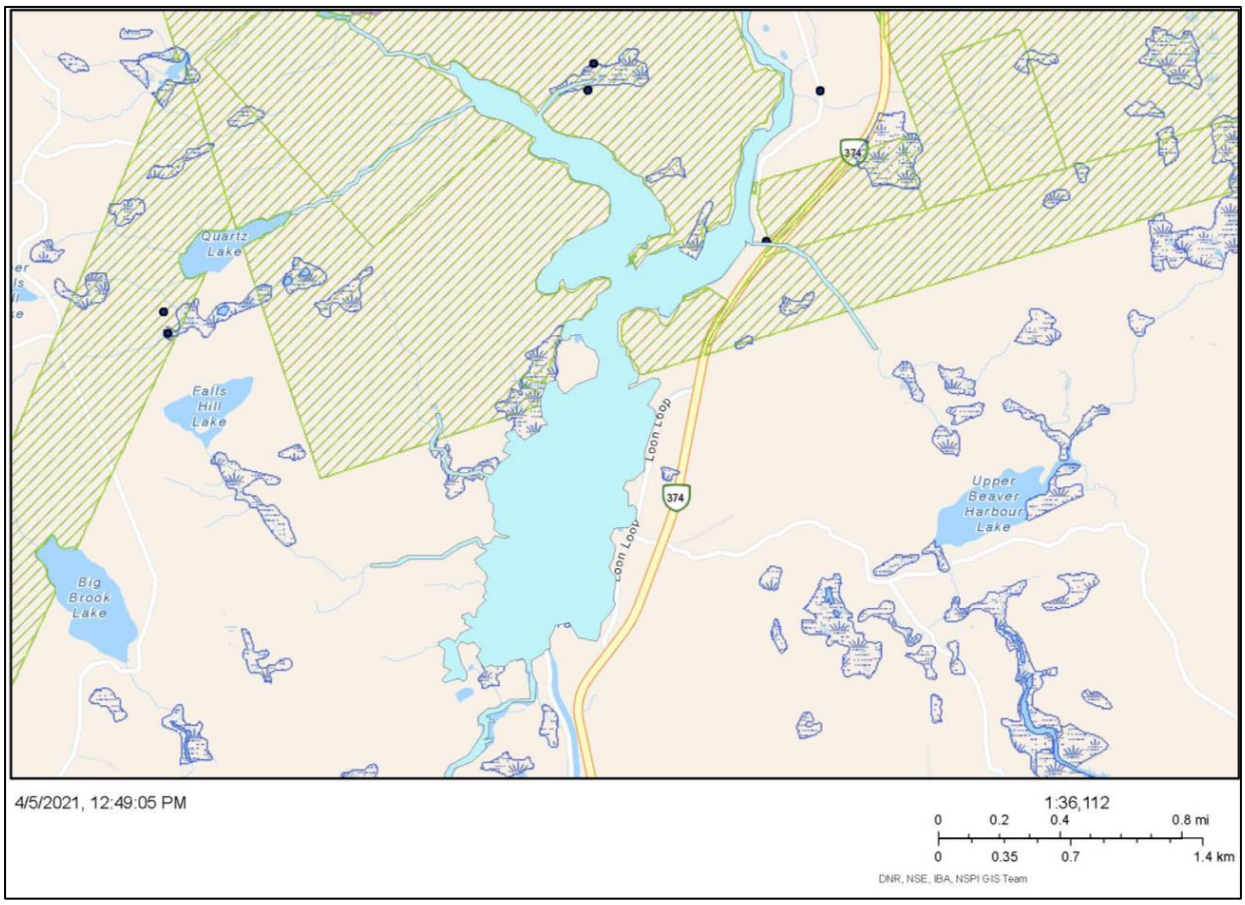


Figure 3: NS Department of Lands and Forestry Wetland Inventory Mapping and ACCDC Search Points (2017)

Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown (9 months), NS Power is not anticipating long term impact to species composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of the Ruth Falls Headpond for a 9 month period is unknown. NS Power has contracted a third-party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels, water levels, and impacts to fish and fish habitat throughout the duration of the Project. Full details can be found in Appendix E - Wetland Monitoring Plan.

Six wetlands have been selected for monitoring. Figure 4 displays the mapped wetland on the Ruth Falls Headpond, with the six wetlands to be monitored highlighted in red. Wetland locations to be monitored include wetlands WL3, WL5, WL6, WL15, WL17 and WL19 which are described in Table 4.

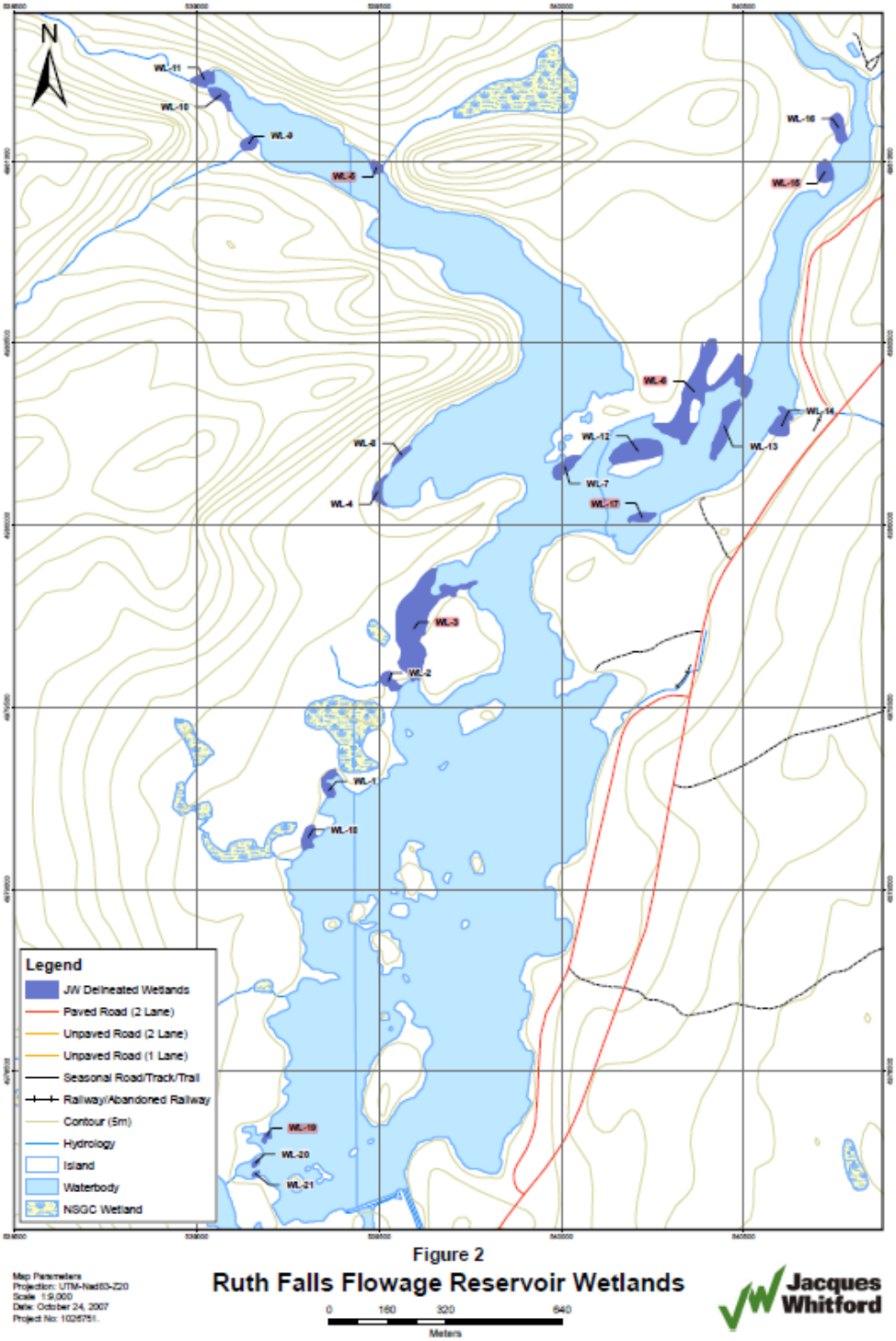


Figure 4: Mapped wetlands on Ruth Falls Headpond (2007). Proposed Wetland Monitoring locations are highlighted in red (6 locations)

Wetlands selected for monitoring were chosen based on the following considerations:

- representative of various wetland types identified (as per the results of the previously completed assessment).
- capture the geographic spread of the Headpond.
- represent the varying wetland sizes observed.
- capture some of the most species-diverse wetlands (as per the results of the previously completed species assessment).
- representative of variations in fish habitat.
- consideration of landowner proximity and/or access considerations/limitations.

Wetland monitoring will include detailed vegetative, hydrological, and soil monitoring within the six selected wetlands. Each wetland to be monitored was delineated prior to the commencement of monitoring activities to ensure that wetland boundaries are accurate and up to date, and to establish the current biodiversity of the existing habitat. Baseline wetland monitoring took place in July 2022. Preliminary monitoring results of the 2022 baseline assessment are provided within the updated wetland monitoring plan (Appendix E).

5.6 Construction Material and Debris

Measures will be taken to prevent any materials used in the various work activities from entering the watercourse. All such materials will be applied in a controlled manner and any excess material will be contained during application. All construction debris will be stored on NS Power property or disposed to an approved landfill. Any debris that requires disposal will be done so in accordance with NSECC Construction and Demolition Debris Disposal Site Guidelines.

5.7 Equipment and Machinery

All equipment and machinery required to be operated on or near a body of water will be mechanically sound with no leaking fuel tanks or hydraulic connections. Refueling and lubrication shall be in designated areas not within 30 m of any wetland or water body. Storage of petroleum products will be at least 100 m from a water body. Machinery and equipment will be stored above flood water levels. Oil spill contingency plans will be followed, and spill kits maintained on-site, in the event a petroleum product spill occurs.

5.8 Rehabilitation

Following any excavation and placement activities, areas disturbed by machinery or equipment will be returned to pre-construction condition. Any exposed soil areas will be stabilized to prevent erosion. In the event that long-term erosion problems, resulting from the clearing of the area, cannot be dealt with at the time construction is complete, temporary measures shall be taken.

6.0 ARCHAEOLOGICAL CONSIDERATIONS

An Archaeological Screening and Reconnaissance (ARIA) for the Ruth Falls Headpond was completed in 2017. The purpose of the ARIA was to assess the potential for archaeological resources in the project area, which included approximately 5 hectares surrounding the dam and earthen embankment primarily on the downstream side. The ARIA included a background study and visual assessment of the study area. The assessment identified three areas considered to exhibit high potential for encountering Precontact and/or early historic Native archaeological resources and/or historic Euro-Canadian archaeological resources. It was recommended that if these areas could not be avoided, shovel testing be conducted.

Shovel testing in 2 of the identified areas was conducted in 2018 and included 64 shovel tests. No archaeological resources were encountered and no evidence of historically significant cultural modification was identified during the course of the shovel testing. Based on the results of the 2018 shovel testing, the potential for encountering significant, intact archaeological resources within the two areas is considered to be low. It was recommended that the two shovel tested areas be cleared of any requirement for further archaeological investigation and that development within these areas may proceed as planned.

During the drawdown, archaeological reconnaissance will take place within the Ruth Falls Headpond by a qualified Archaeologist. The objective of the reconnaissance is to inspect the exposed shoreline for evidence of any previously unrecorded archaeological resources within the dewatered reservoir. In the event that archaeological resources are identified during the archaeological reconnaissance, it is proposed that two separate rounds of documentation and mitigative artifact collection will be conducted during the course of the drawdown.

7.0 ABORIGINAL ENGAGEMENT

NS Power initiated engagement with the Millbrook First Nation in January 2020 to provide an overview of the project and discuss next steps and approach to engagement for the project. In 2021 attended a Chief and Council meeting on April 20th, to share updated information on the

Project. Chief and Council requested a site visit during this meeting. In Sept 2021 NS Power organized a site visit with Millbrook First Nation – participants included Millbrook Consultation Lead and Communications Officer. In January 2022 NS Power held meeting with Millbrook Consultation Lead and Millbrook Director of Fisheries to discuss fish passage and monitoring at Ruth Falls. As requested by Millbrook, NSP followed up with information about eel passage from the previous Relicensing studies. In January of 2023 NS Power met with Consultation Lead from Millbrook First Nation to discuss project updates and timeline. Millbrook requested additional discussion about community involvement in the archaeological reconnaissance and fish monitoring when the reservoir drawdown and construction begins.

NS Power has also been working with the Mi'kmaw Conservation Group (MCG) of the Confederacy of Mainland Mi'kmaq (CMM) to collaborate with Millbrook First Nation on an offsetting plan for potential impacts to fish and fish habitat that are anticipated as a result of the Project. This offsetting Project will be included with NS Power's Application for Authorization to DFO.

In August 2022 NS Power met with Maritime Aboriginal Peoples Council (MAPC) to discuss the Ruth Falls Refurbishment Project. MAPC requested additional information about archaeological reconnaissance during the planned drawdown, and information about the fish rescue process and offsetting and monitoring plans for the project. NS Power followed up with additional information regarding this discussion in November 2022.

NS Power will continue engagement regarding the project with monthly project updates to the KMKNO and regular updates and meetings with Millbrook Frist Nation. NS Power will send notifications regarding the permitting schedule for the submission of permits and authorizations such as the NSECC Watercourse Alteration application and DFO Fisheries Authorization. During construction, regular project manager communications will be provided to Millbrook and KMKNO.

7.0 OTHER STAKEHOLDER ENGAGEMENT

NS Power is committed to proactively communicating and engaging with community stakeholders, the Mi'kmaq, regulators and the public on the Ruth Falls Dam Refurbishment Project. As part of this commitment, NS Power has developed a communication plan which outlines NS Power's detailed execution plan for engagement and communication on the Project. Refer to Appendix J – Communication plan for further details.

APPENDIX A – HYDRO SYSTEM OVERVIEW

1. Sheet Harbour Hydro System Map
2. Ruth Falls Plan View
3. Ruth Falls Reservoir Bathymetry

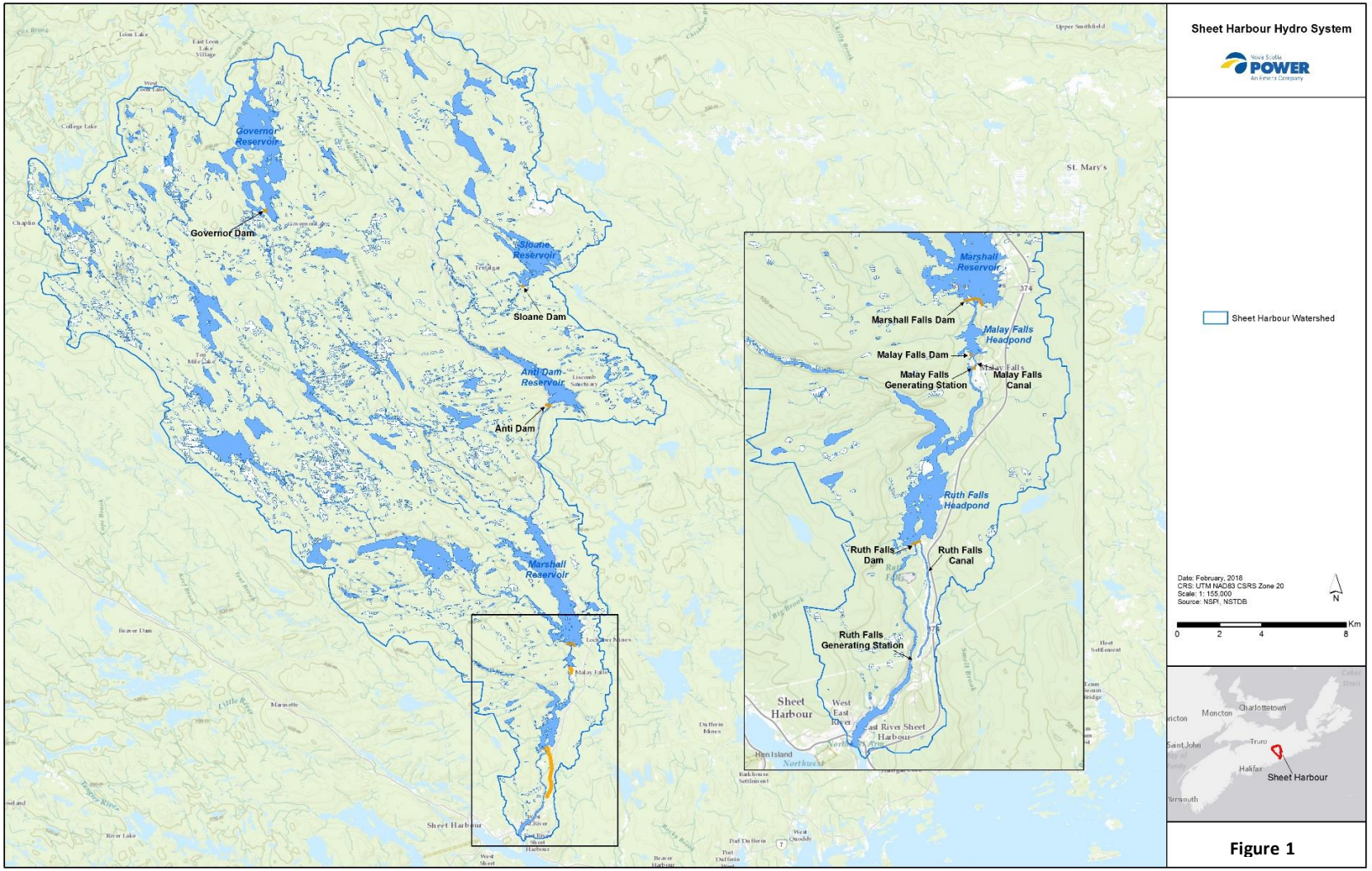

Governor Reservoir
Governor Dam
Sloane Reservoir
Sloane Dam
Anti Dam Reservoir
Anti Dam
Marshall Reservoir
Marshall Falls Dam
Malay Falls Headpond
Malay Falls Dam
Malay Falls Generating Station
Malay Falls Canal
Ruth Falls Headpond
Ruth Falls Dam
Ruth Falls Canal
Ruth Falls Generating Station
Sheet Harbour
Sheet Harbour Hydro System
Sheet Harbour Watershed
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1: 155,000
Source: NSPI, NSTDB
N
0 2 4 8 Km
Moncton
Charlottetown
Saint John
Truro
Halifax
Sheet Harbour

Figure 1

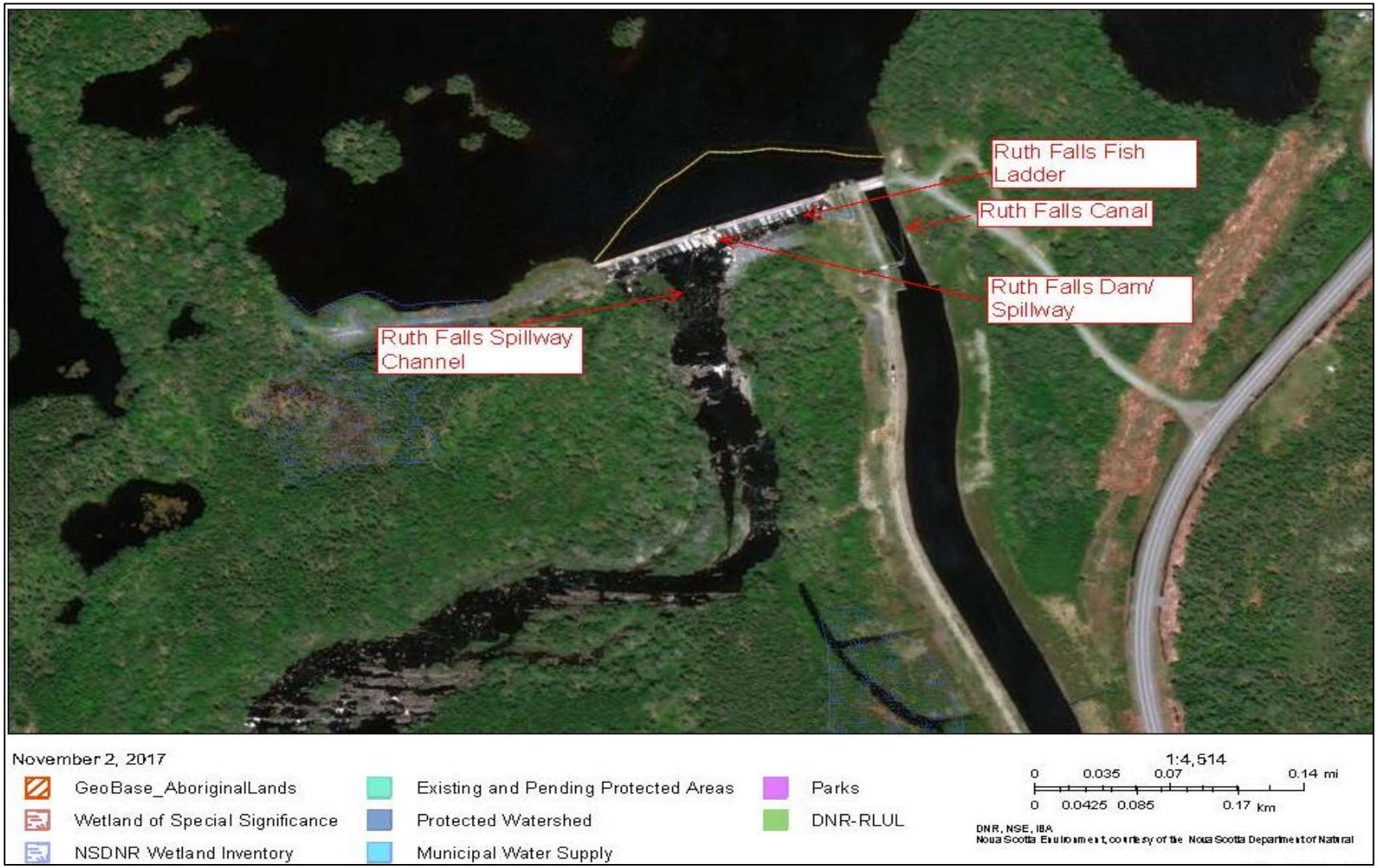


Figure 3. Ruth Falls Plan View

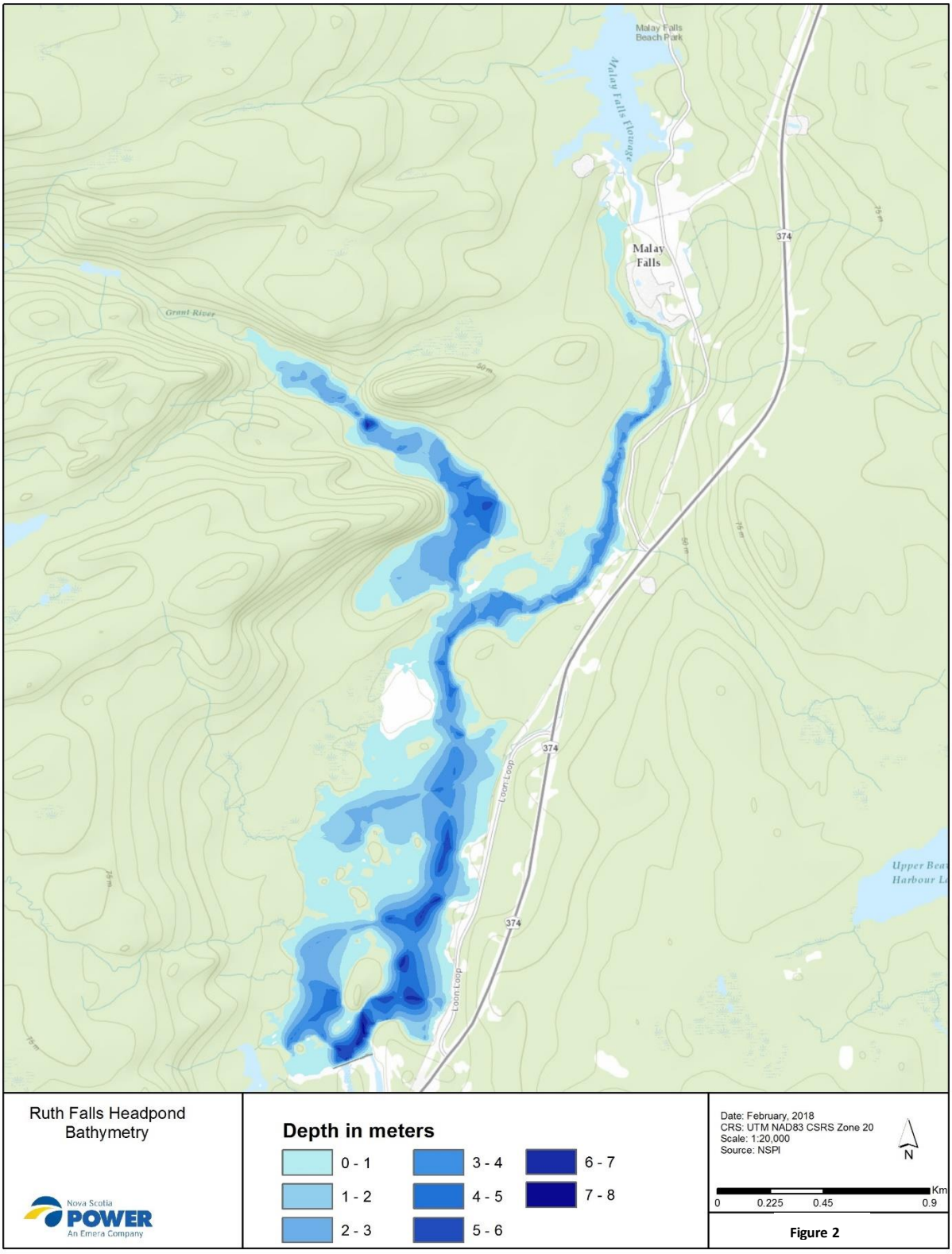

Malay Falls Beach Park
Malay Falls Flowage
Malay Falls
374
Grant River
50 m
75 m
Loon Loop
Upper Bea
Harbour L
Ruth Falls Headpond Bathymetry
Depth in meters
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1:20,000
Source: NSPI
N
Km
0
0.225
0.45
0.9

Figure 2

APPENDIX B – SITE PHOTOS



Photo 1: View of Ruth Falls Dam, facing north



Photo 2: View of Ruth Falls Dam, facing west



Photo 3: Ruth Falls fishladder and bypass pipe facing east



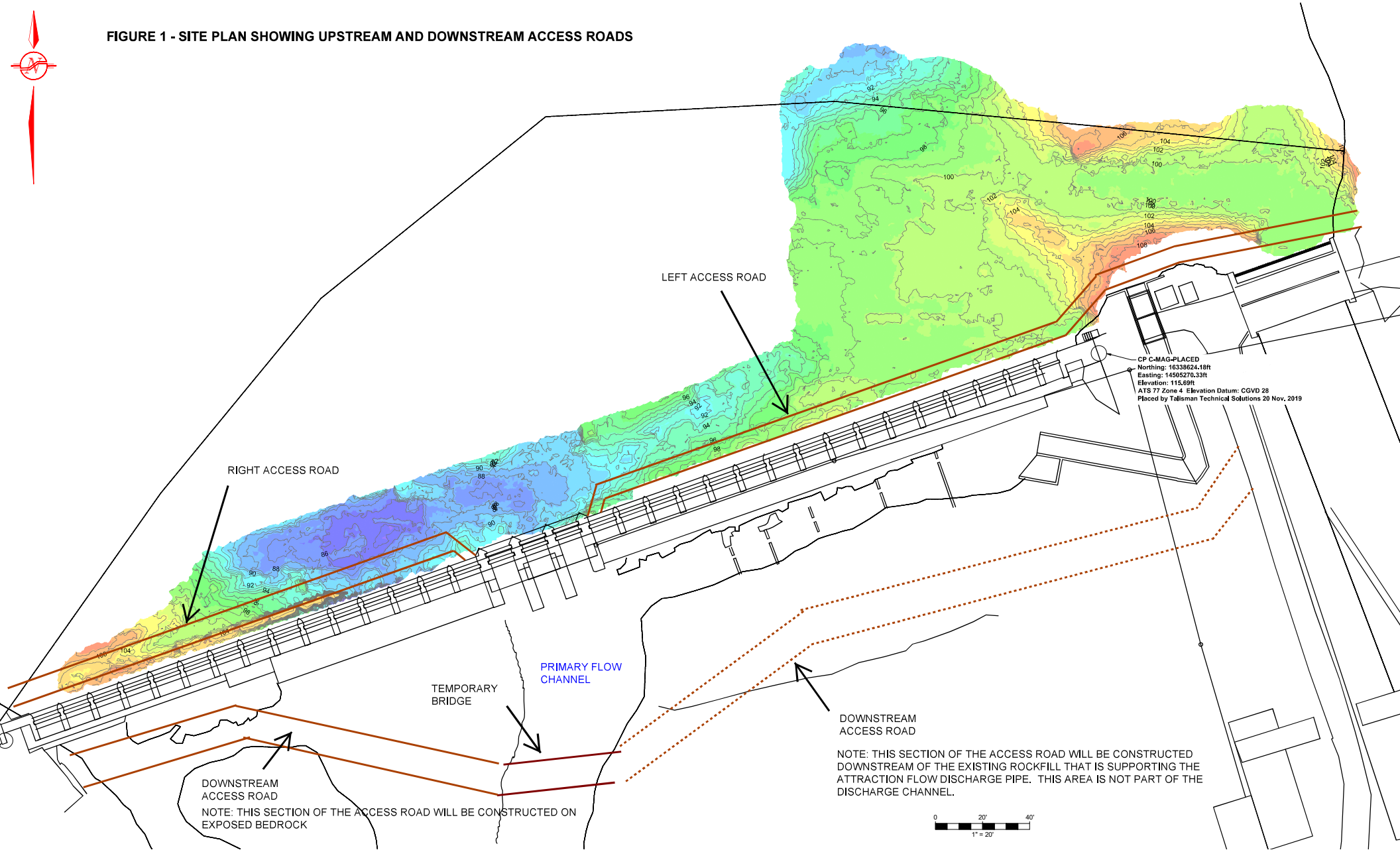
Photo 4: Downstream of Ruth Falls Dam facing south



Photo 5. Upstream of Ruth Falls Dam facing northeast

APPENDIX C – PROPOSED WATER MANAGEMENT STRUCTURES

FIGURE 1 - SITE PLAN SHOWING UPSTREAM AND DOWNSTREAM ACCESS ROADS



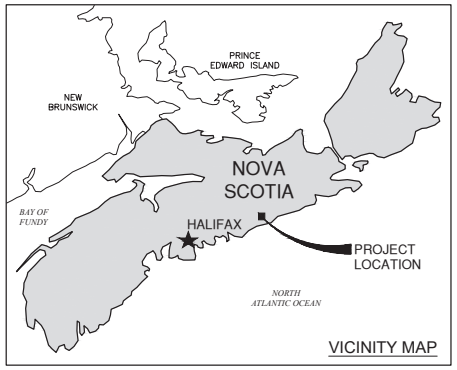
APPENDIX D – ENGINEERING DRAWINGS

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NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP





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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

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DRAWING LIST

SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS	NSPI DRAWING No.
100-01	DRAWING LIST	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-041
100-02	GENERAL NOTES	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-042
200-01	EXISTING CONDITIONS OVERALL SITE PLAN	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-043
200-02	EXISTING CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-044
200-03	EXISTING CONDITIONS WEST SPILLWAY DAM PLAN AND SECTIONS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-045
210-01	TEMPORARY CONDITIONS/DEMO PLAN	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-046
210-02	TEMPORARY CONDITIONS/DEMO EAST SPILLWAY PLAN AND SECTIONS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-047
210-03	TEMPORARY CONDITIONS/DEMO WEST SPILLWAY PLAN AND SECTIONS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-048
300-01	NEW CONDITIONS DAM PLAN AND ELEVATION	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-049
300-02	NEW CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-050
300-03	NEW CONDITIONS WEST SPILLWAY PLAN AND SECTIONS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-051
300-04	NEW CONDITIONS SLUICEWAY PLAN AND DETAILS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-052
300-05	NEW CONDITIONS EAST ABUTMENT PLAN AND SECTIONS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-061
310-01	NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-053
310-02	NEW CONCRETE SLUICEWAY HEADWALL DETAILS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-054
310-03	NEW CONCRETE SPILLWAY RESURFACING DETAILS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-055
310-04	NEW CONCRETE RETAINING WALL AND PIER DETAILS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-056
310-05	NEW CONCRETE EAST ABUTMENT PIER & DECK DETAILS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-062
310-06	NEW CONCRETE EAST ABUTMENT PIER & DECK DETAILS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-063
320-01	NEW STEEL WALKWAY PLAN VIEW	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-057
320-02	NEW STEEL WALKWAY	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-058
320-03	NEW STEEL WALKWAY HANDRAIL DETAILS	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-059
330-01	RUBBER DAM PIPING AT SLUICEWAY	2021-06-01	0	ISSUED FOR CONSTRUCTION	H-096H1-1--631-00-060

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RUTH FALLS REFURBISHMENT PRJECT

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GENERAL NOTES

1. GENERAL:
   - A. CONTRACTOR SHALL DETERMINE LOCATIONS, EXISTING CONDITIONS, AND DIMENSIONS BY THEIR OWN INVESTIGATION.
   - B. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON LIMITED FIELD MEASUREMENTS, REFERENCE DRAWINGS AND SURVEY. FIELD VERIFY ALL DIMENSIONS, AND NOTIFY THE OWNER AND ENGINEER OF DISCREPANCIES.
   - C. CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION, AND WILL NOTIFY THE OWNER FOR AN APPROVAL, IF REQUIRED.
2. SURVEY:
   - A. GEOMETRY OF THE EXISTING DAM STRUCTURE SURVEYED BY TALISMAN TECHNICAL SOLUTIONS, LANTZ, NS, IN 2017.
   - B. ELEVATIONS ARE BASED ON OCTOBER 1994 GEODETIC DATUM. ELEVATIONS AND DIMENSIONS ARE NOMINAL. ACTUAL ELEVATIONS VARY THROUGHOUT EXISTING STRUCTURES.
   - C. UTILITIES LOCATED BY SURVEY OR SHOWN ON DRAWINGS ARE APPROXIMATE AND SHALL BE CONFIRMED IN FIELD.
   - D. CONTRACTOR SHALL COORDINATE WITH NSPI FOR TEMPORARY RELOCATION OR PERMANENT RELOCATION OF POWER LINES AND POLES IF REQUIRED.
   - E. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65 FT
3. DESIGN LOADS:
   - A. NORMAL HEADPOND: EL. 109.25 FT
   - B. INFLOW DESIGN FLOOD HEADPOND: EL. 114.0 FT AT PEAK FLOW OF 29,183 CFS
   - C. SEISMIC COEFFICIENT: 0.1g
   - D. ICE LOAD AT NORMAL POND ELEVATION: 5,000 LB/FT
4. JOB CONDITIONS:
   - A. SITE INFORMATION:
     - I. ANY SUBSURFACE CONDITIONS SHOWN ON THE DRAWINGS ARE BASED ON INTERPRETATIONS/INTERPOLATIONS OF DATA OBTAINED FROM BACKGROUND DOCUMENTS AND WIDELY SPACED EXPLORATIONS BY OTHERS. VARIATIONS MAY EXIST AND SHOULD BE EXPECTED.
   - B. EXISTING UTILITIES:
     - I. THE CONTRACTOR SHALL LOCATE EXISTING UNDERGROUND AND OVERHEAD UTILITIES IN THE AREAS OF WORK. IF UTILITIES ARE TO REMAIN IN PLACE, PROVIDE ADEQUATE MEANS OF PROTECTION DURING EARTHWORK OPERATIONS.
     - II. NOTE THAT THERE ARE EXISTING OVERHEAD POWERLINES AND ASSOCIATED POLES ALONG AND ADJACENT TO THE EMBANKMENT DAM. THE CONTRACTOR SHALL COORDINATE WITH OWNER FOR TEMPORARY OR PERMANENT RELOCATION OF POWERLINES AND POLES; AS REQUIRED.
     - III. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATION, CONSULT THE OWNER AND UTILITY OWNER/OPERATOR IMMEDIATELY FOR DIRECTIONS.
     - IV. THE CONTRACTOR SHALL REPAIR DAMAGED UTILITIES TO SATISFACTION OF THE OWNER AND UTILITY OWNER/OPERATOR.
5. QUALITY ASSURANCE:
   - A. HORIZONTAL AND VERTICAL CONTROL:
     - I. THE CONTRACTOR IS RESPONSIBLE FOR AND SHALL PROVIDE ALL CONSTRUCTION LAYOUT.
     - II. SURVEYS FOR CONSTRUCTION ELEVATIONS AND LOCATIONS OF THE WORK SHALL BE PERFORMED BY OR UNDER THE SUPERVISION OF A QUALIFIED SURVEYOR.
   - B. OWNER'S REPRESENTATIVE:
     - I. THE OWNER'S REPRESENTATIVE WILL PROVIDE PERIODIC TO REGULAR REVIEW OF THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR REGULAR COMMUNICATION OF THE CONSTRUCTION SCHEDULE AND FOR PROVIDING AMPLE NOTICE TO THE OWNER'S REPRESENTATIVE FOR CRITICAL REVIEWS SPECIFIED HEREIN.
     - II. THE OWNER'S REPRESENTATIVE MUST REVIEW ALL EXPOSED SUBGRADES PRIOR TO PLACEMENT OF FILL MATERIALS.
     - III. THE CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY (QCTL) SHALL PERFORM QUALITY CONTROL TESTING DURING CONSTRUCTION, AS SPECIFIED HEREIN. THE CONTRACTOR'S QCTL SHALL SHARE TEST RESULTS ON–SITE WITH THE OWNER'S REPRESENTATIVE UPON REQUEST.
     - IV. THE OWNER MAY CHOOSE TO EMPLOY AN INDEPENDENT THIRD PARTY TESTING AGENCY TO PERFORM QUALITY ASSURANCE (QA) TESTING.
6. EROSION & SEDIMENT CONTROL:
   - A. EROSION PREVENTION AND SEDIMENT CONTROL SHALL BE IN ACCORDANCE WITH LOCAL AND PROVINCE STANDARDS AND OWNER'S STANDARDS. ALL MEASURES SHALL BE CONSISTENT WITH THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT EROSION AND SEDIMENTATION CONTROL HANDBOOK FOR CONSTRUCTION SITES, AT A MINIMUM.
   - B. SUBMIT PLAN AND DETAILS TO OWNER FOR REVIEW AND APPROVAL.
   - C. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE OWNER.
7. DEMOLITION:
   - A. DEMOLISH PORTIONS OF THE EXISTING CONCRETE DAM AS SHOWN IN THE PLANS.
   - B. CONTRACTOR SHALL DEWATER WORK AREAS AS NEEDED TO PERFORM DEMOLITION AND EXCAVATION AND TO ACCOMMODATE NEW CONSTRUCTION.
   - C. CONTRACTOR SHALL CONFORM TO ALL OWNER SAFETY PROCEDURES.
   - D. CONTRACTOR SHALL NOT BEGIN ANY DEMOLITION OR EXCAVATION UNTIL AFTER RECEIVING WRITTEN AUTHORIZATION TO BEGIN DEMOLITION FROM OWNER'S PROJECT MANAGER.
   - E. CONTRACTOR IS RESPONSIBLE FOR CARE OF ANY LEAKAGE INTO THE WORK AREAS DURING CONSTRUCTION.
   - F. CONTRACTOR SHALL DISPOSE ALL DEMOLITION MATERIAL AT A LOCATION THAT HAS BEEN APPROVED BY OWNER.
8. MATERIALS:
   - A. STEEL:
     - I. BOLTS ASTM A325 (THREAD EXCLUDED FROM SHEAR PLANE) COMPLETE WITH A563 HEX NUT AND HELICAL SPRING WASHER ANSI B 18.21.1 UNLESS OTHERWISE SPECIFIED. ALL HARDWARE SHALL BE GALVANIZED AS PER ASTM A153.
     - II. STRUCTURAL W SHAPES: ASTM A992, OR CSA G40.21–350W.
     - III. STEEL PLATE: ASTM A–36, OR CSA G40.21–300W.
     - IV. ANCHOR RODS: ASTM A 36, A 307, OR F1554. HOT DIPPED GALVANIZED PER ASTM A 153, AS INDICATED ON DRAWINGS.
   - B. CONCRETE:

     SUBMIT MIX DESIGN AND REINFORCEMENT SHOP DRAWINGS FOR APPROVAL BY OWNER.

     SURFACE PREP:
     - I. REMOVED DETERIORATED SURFACE MATERIAL IN DESIGNATED AREAS DOWN TO SOUND CONCRETE. SOUND CONCRETE IS DEFINED AS WHEN THE SURFACE IS STRUCK WITH A GEOLOGIST'S HAMMER, THE AGGREGATE OF THE CONCRETE FRACTURES BEFORE THE CEMENT PASTE BOND IS BROKEN.
     - II. PERFORM REMOVAL WITH POINTED TOOLS THAT DO NOT DAMAGE OR FRACTURE THE UNDERLYING SOUND CONCRETE, OR BY PRESSURE WASHING OR AIR BLASTING.
     - III. ROUGHEN ALL SURFACES TO GREATER THAN 1/4" AMPLITUDE. CLEAN SURFACE TO REMOVE ALL DELETERIOUS MATERIAL, INCLUDING DIRT, GREASE, ETC. WASH WITH HIGH PRESSURE WASH AT LEAST 6,000 PSI.
     - IV. CONCRETE SURFACE SHALL BE SATURATED AT TIME OF CONCRETE PLACEMENT, BUT NO STANDING WATER.
     - V. DO NOT PLACE CONCRETE AGAINST ACTIVE LEAKS OR SEAMS WITH FLOWING WATER. STOP FLOW OR INSTALL DRAINAGE TO DIVERT FLOW AWAY FROM FRESH CONCRETE.

     SPECIFICATIONS:
     - I. MINIMUM F'c = 30 MPa AT 28 DAYS (4,000 PSI),
     - II. MAX W/C RATIO 0.45
     - III. FLYASH: ALL FLY ASH SHALL BE CLASSIFIED "FLY ASH CLASS CI OR F", CONFORMING TO CSA A3000 AND AS FURTHER DESCRIBED IN CLAUSE 2.2.1, CONCRETE MIXES. THE TOTAL ALKALI CONTENT OF THE FLY ASH SHALL BE LIMITED TO 4.5% MAXIMUM. THE FLY ASH SHALL BE OBTAINED FROM THE TRENTON GENERATING STATION UNIT 6 AS MARKETED BY SHAW RESOURCES.
     - IV. AIR ENTRAINMENT 6–8%
     - V. SLUMP AT PLACEMENT SHALL BE 100mm +/– 25mm (4" +/– 1")
     - VI. MAX AGGREGATE SIZE SHALL BE 25mm (1")
     - VII. CONCRETE PLACEMENT AND CURING SHALL BE IN ACCORDANCE WITH CSA 23.1, EXPOSURE CLASS F–1, "SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS".
     - VIII. CONCRETE WORK SHALL CONFORM TO CSA 23.1. CONCRETE STRENGTH SHALL BE VERIFIED BY STANDARD 28 DAY TESTS.
     - IX. REINFORCEMENT = CSA G30.18, GRADE 400W DEFORMED. STANDARD HOOKS PER CSA A23.3.
     - X. NON SHRINK CEMENT GROUT: MINIMUM F'C = 35MPA AT 7 DAYS.
     - XI. ADHESIVE ANCHORS SUITABLE FOR USE IN DAMP OR WET ENVIRONMENT: HILTI–HIT HY 200 ADHESIVE OR APPROVED EQUAL. ANCHORS ASTM F1554 GRADE 55, MINIMUM Fy=380MPA; Fu=520MPA.
   - C. NON–SHRINK GROUT: CRD–C 621, FACTORY PREMIXED GROUT
     - I. EARLY VOLUME CHANGE: ASTM C–827: 0.00% SHRINKAGE
     - II. HARDENED VOLUME CHANGE: 0.00% SHRINKAGE AND EXPANSION AFTER SET.
     - III. COMPRESSIVE STRENGTH: ASTM C–109 MIN. = 35 MPA AT 7 DAYS
     - IV. ACCEPTABLE SUPPLIERS: "FIVE STAR GROUT" BY US GROUT CORP, OR APPROVED EQUIVALENT.
9. SUBMITTALS:
   - A. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO OWNER FOR APPROVAL PRIOR TO FABRICATION.
   - B. EXCAVATION AND FILL PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE A WRITTEN EXCAVATION AND FILL PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL DETAIL THE FOLLOWING ITEMS, AT A MINIMUM:
       - SCHEDULE AND SEQUENCE OF WORK IN EACH AREA.
       - ACCESS TO EACH AREA.
       - LOCATION OF MATERIAL STOCKPILES IN EACH AREA.
       - EQUIPMENT TO BE USED IN EACH AREA.
       - MONITORING AND QUALITY CONTROL PROCEDURES.
       - MEANS/METHODS AND MATERIALS TO PROTECT EXISTING FEATURES DESIGNATED TO REMAIN.
   - C. DEWATERING PLAN:
     - I. DEWATERING WILL BE DONE IN CONJUNCTION WITH NSPI HYDRO SYSTEM PERSONNEL AND THE NSPI PROJECT MANAGER/ENGINEERS. THE CONTRACTOR SHALL PROVIDE A DETAILED DEWATERING PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING ITEMS, AT A MINIMUM:
       - MEANS/METHODS OF TEMPORARY EXCAVATION DEWATERING.
       - EQUIPMENT TO BE USED.
       - SETTLEMENT BASINS, IF REQUIRED, FILTER BAG LOCATIONS AND POINTS OF DISCHARGE.
       - SEQUENCING OF DEWATERING, EXCAVATION, AND FILL PLACEMENT.
   - D. EMERGENCY SEEPAGE PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE AN EMERGENCY SEEPAGE PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING, AT A MINIMUM:
       - TYPE, QUANTITY, AND LOCATION OF EMERGENCY FILTER/BALLAST STOCKPILES.
       - OTHER MATERIALS TO BE USED, (E.G., SANDBAGS, NON–WOVEN GEOTEXTILE, FILTER STONE, SMALL RIPRAP, ETC.).
   - E. WINTERIZATION PLAN:
     - I. AT LEAST TWO (2) WEEKS PRIOR TO ANY WINTER SHUTDOWN, THE CONTRACTOR SHALL SUBMIT A PLAN FOR PROTECTING/WINTERIZING THE COMPLETED WORK.
   - F. CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY:
     - I. THE CONTRACTOR SHALL SUBMIT THE NAME AND QUALIFICATIONS OF AN INDEPENDENT THIRD PARTY COMMERCIAL TESTING LABORATORY TO BE USED FOR BORROW SOURCE TESTING OF SOILS/CONSTRUCTION MATERIALS TESTING.
       - THE TESTING AGENCY SHALL BE A RECOGNIZED COMMERCIAL LABORATORY WITH NOT LESS THAN 5 YEARS OF EXPERIENCE IN CONDUCTING RELEVANT FIELD AND LABORATORY QUALITY CONTROL TESTING.
       - THE TESTING AGENCY SHALL MEET THE REQUIREMENTS OF ASTM D–3740.
   - G. BORROW SOURCE(S):
     - I. AT LEAST TWO (2) WEEKS PRIOR TO INITIATION OF APPLICABLE WORK, THE CONTRACTOR SHALL PROVIDE THE PROPOSED SOURCE(S) OF BORROW MATERIALS AND SUPPORTING DATA/RESULTS OF THE SPECIFIED BORROW SOURCE TESTING.
       - TESTING DATA/RESULTS SHALL BE FROM CURRENT TESTING OF SAMPLES OBTAINED FROM THE ACTUAL PROPOSED SOURCE/STOCKPILE AND NOT PRIOR/FILE RESULTS FROM THE SUPPLIER.
   - H. QUALITY CONTROL TESTING REPORTS:
     - I. SUBMIT TWO (2) COPIES OF THE FOLLOWING REPORTS AS SOON AS POSSIBLE, BUT NOT MORE THAN TWO (2) BUSINESS DAYS FOLLOWING COMPLETION OF ASSOCIATED QUALITY CONTROL TESTING.
       - LABORATORY TEST REPORTS FOR PROPOSED BORROW SOURCE MATERIALS. ACCEPTANCE OR REJECTION OR FILL MATERIALS WILL BE BASED ON THE RESULTS OF CURRENT LABORATORY TESTING.
       - FIELD IN–PLACE DENSITY/COMPACTION TEST REPORTS.
10. EARTHWORK:
    - A. SEE SHEET 310–04 FOR EARTHWORK.

ISSUED FOR CONSTRUCTION

100-02

Kleinschmidt

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL: REGISTERED PROFESSIONAL ENGINEER, DATE JUN 1 2021, C. VAN, 9978, PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE . . . . . .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	CMV
CHECKED	__
DATE	2021–06–01
W.O.	XXXX

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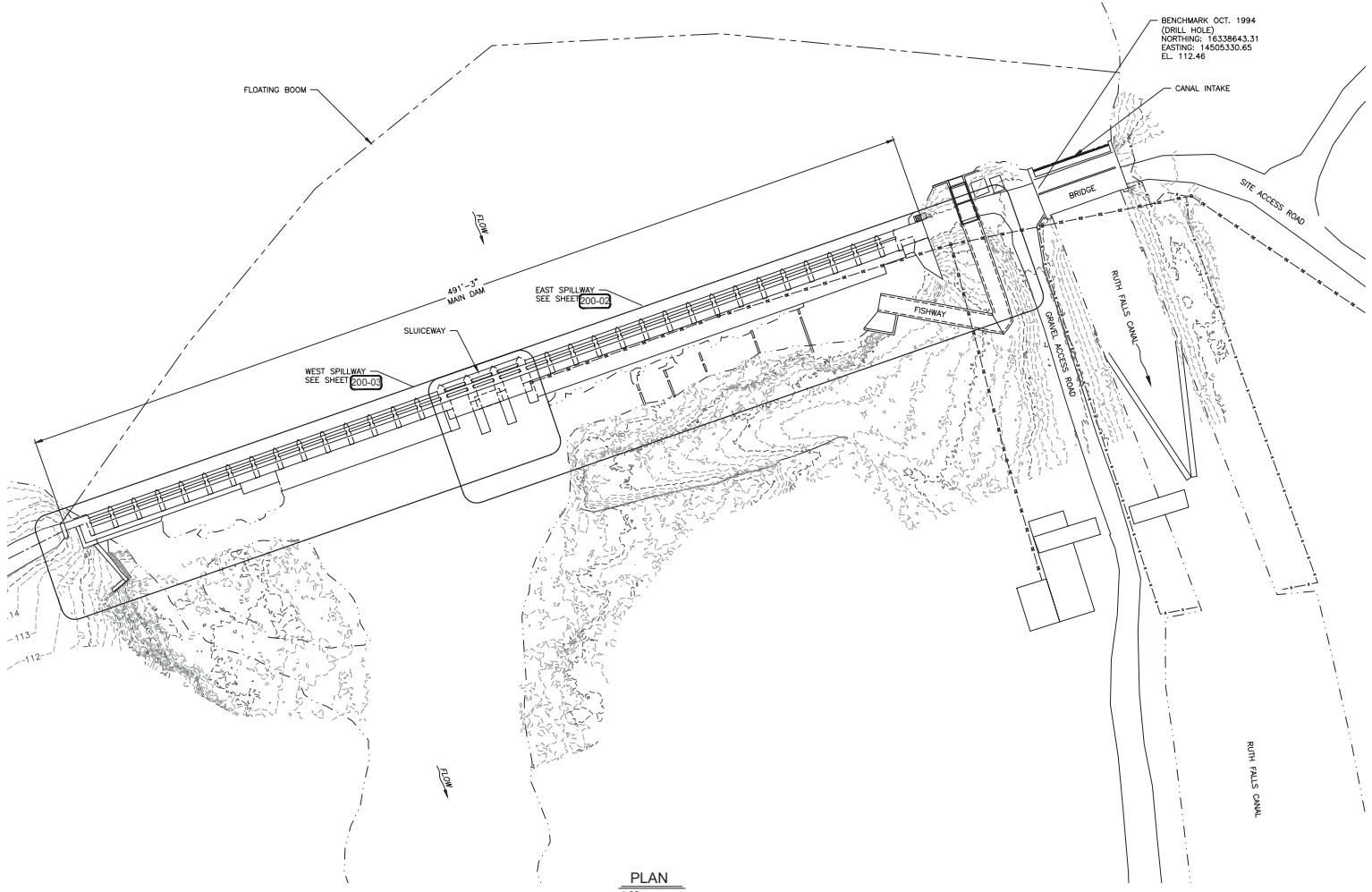
RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

GENERAL NOTES

DWG.NO. H096H1163100042 REV. 0

DWG. NO. H096H1163100043



PLAN
1:30

30 0 30 60
SCALE IN FEET

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

ISSUED FOR CONSTRUCTION

200-01

Kleinschmidt

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PRINTED: Jun. 1, 2021 - 2:05 P.M.

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER
DATE Jun 1, 21
9978
PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

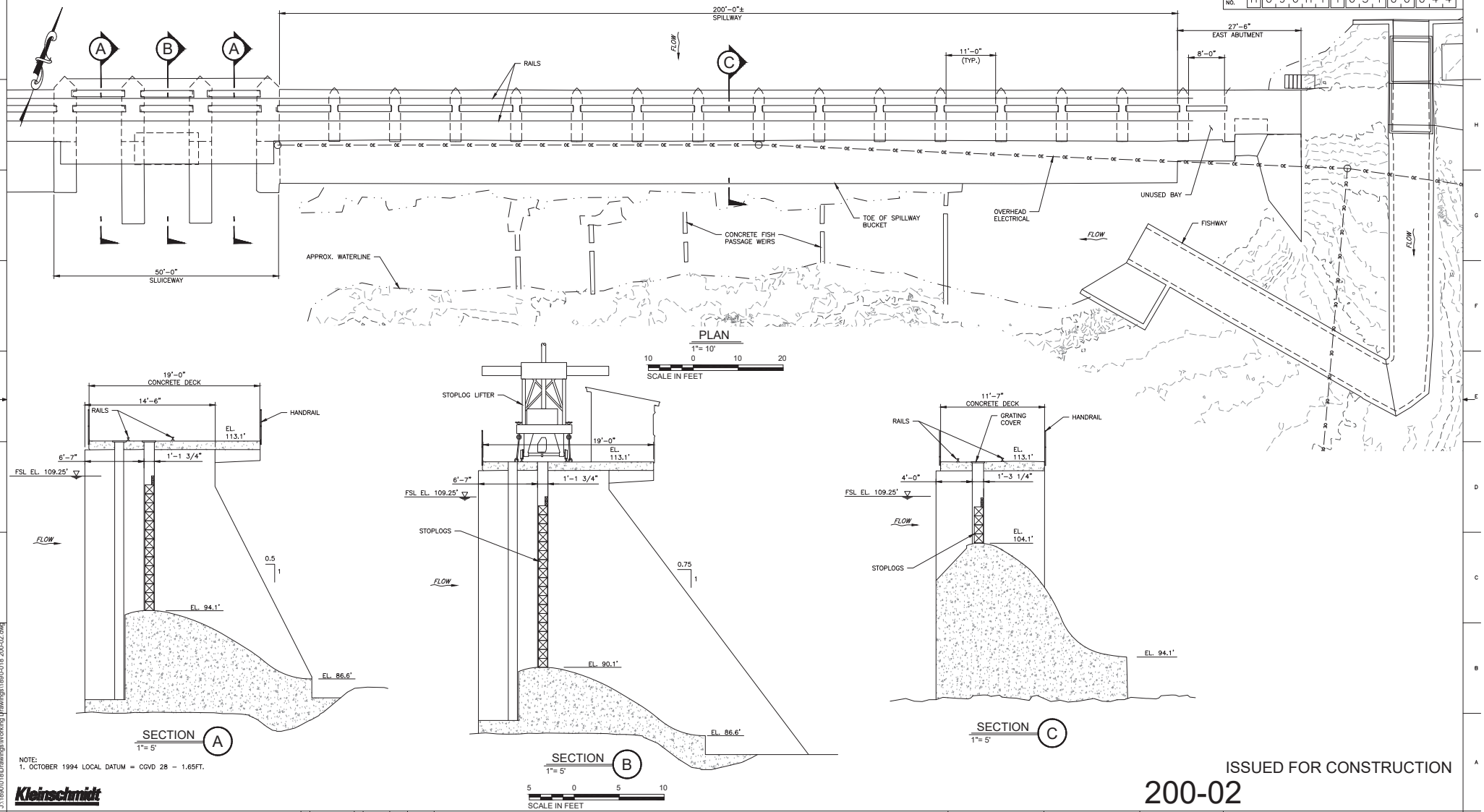
SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2021-06-01
W.O. XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

EXISTING CONDITIONS
OVERALL SITE PLAN

DWG.NO. H096H1163100043 REV. 0



NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 - 1.65FT.

ISSUED FOR CONSTRUCTION

200-02

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PRINTED: Jun. 1, 2021 - 2:10 P.M.

REFERENCE DESCRIPTION	A XXXXXX XXXXXX XXXXXX
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H 0 9 5 H 1 1 6 7 0 0 0 0 3 2
REFERENCE DRAWINGS	DWG.NO.

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER
DATE Jun 1, 2021
9978
PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE . .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2021-06-01
W.O.	XXXX

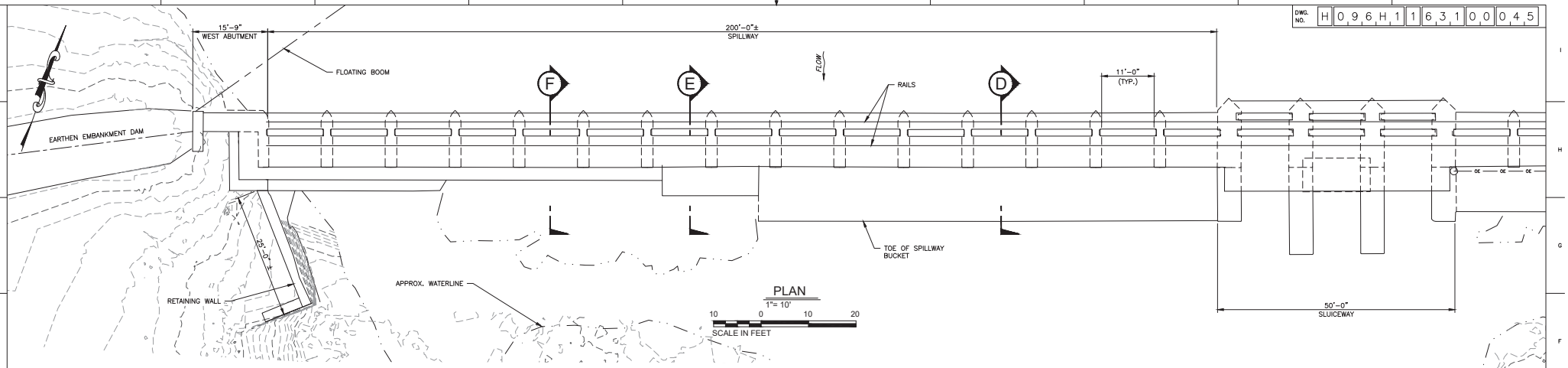
Nova Scotia POWER
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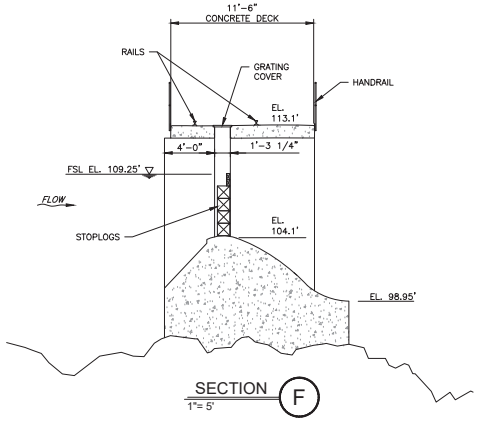
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

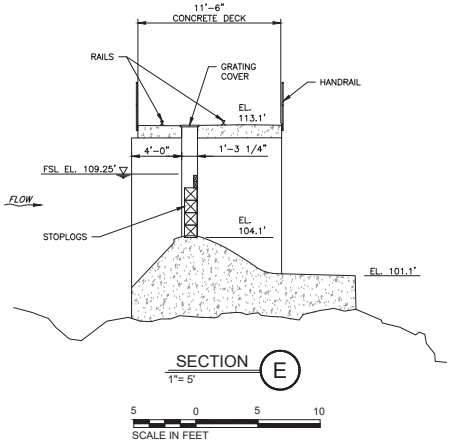
EXISTING CONDITIONS EAST SPILLWAY
PLAN AND SECTION

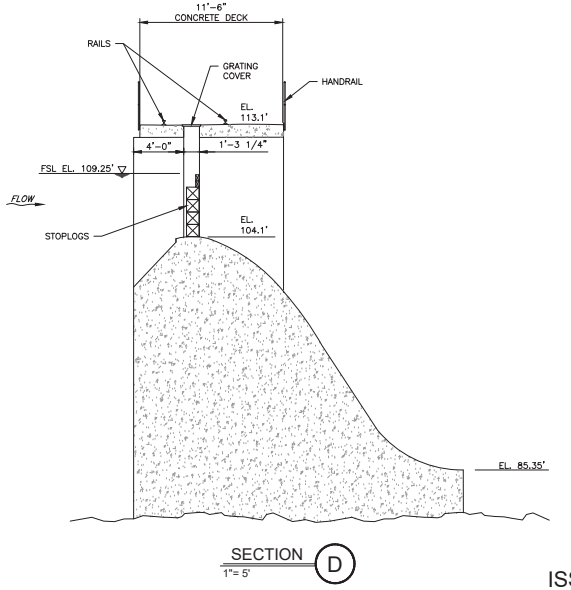
DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 4 REV. 0

DWG. NO. H096H1163100045









NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

ISSUED FOR CONSTRUCTION

200-03

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PRINTED: Jun. 1, 2021 - 2:19 PM

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF NOVA SCOTIA — 9978 — DATE Jun 1, 2021

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE . .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2021-06-01
W.O.	XXXX

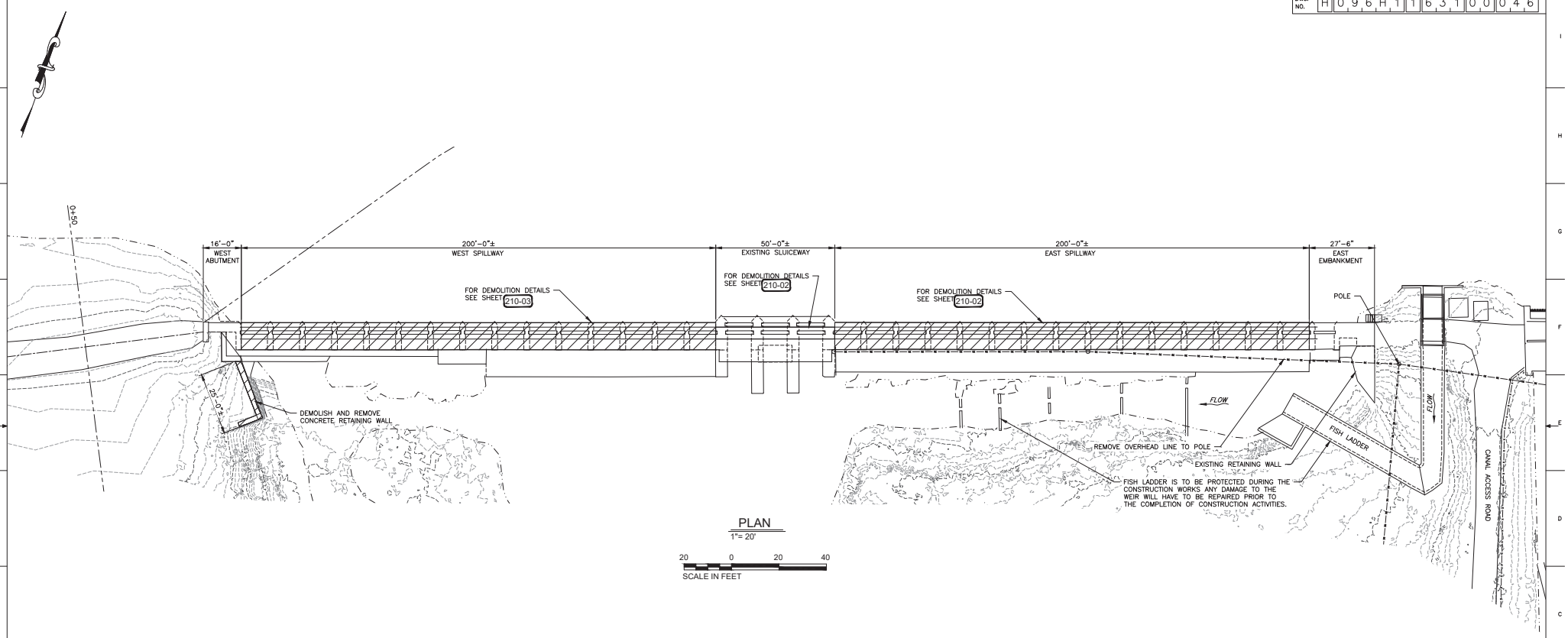
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

EXISTING CONDITIONS WEST SPILLWAY
DAM PLAN AND SECTIONS

DWG.NO. H096H1163100045 REV. 0

DWG. NO. H096H1163100046



PLAN
1"= 20'

20 0 20 40
SCALE IN FEET

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

ISSUED FOR CONSTRUCTION

Kleinschmidt

210-01

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PRINTED: Jun. 1, 2021 - 2:26 P.M.

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF NOVA SCOTIA — 9978

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2021-06-01
W.O. XXXX

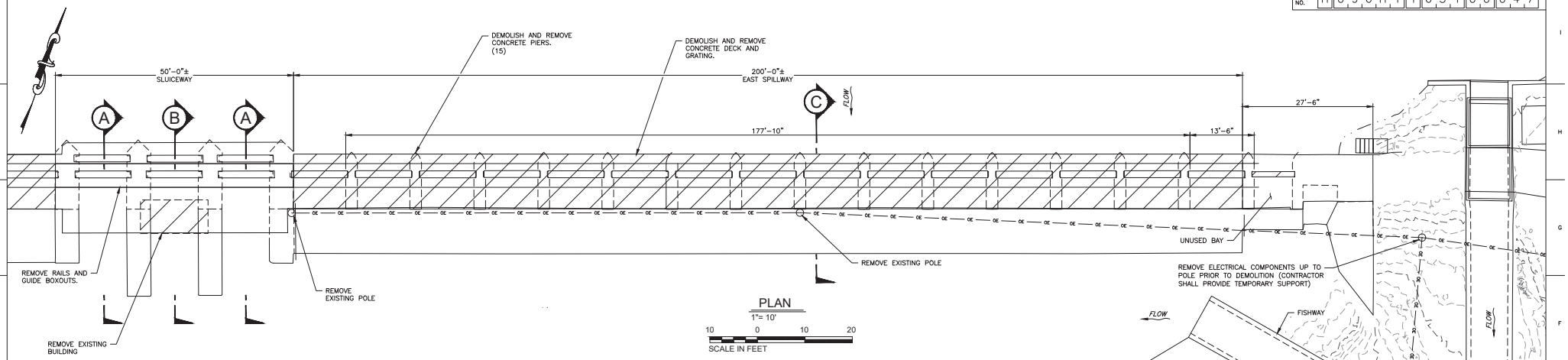
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

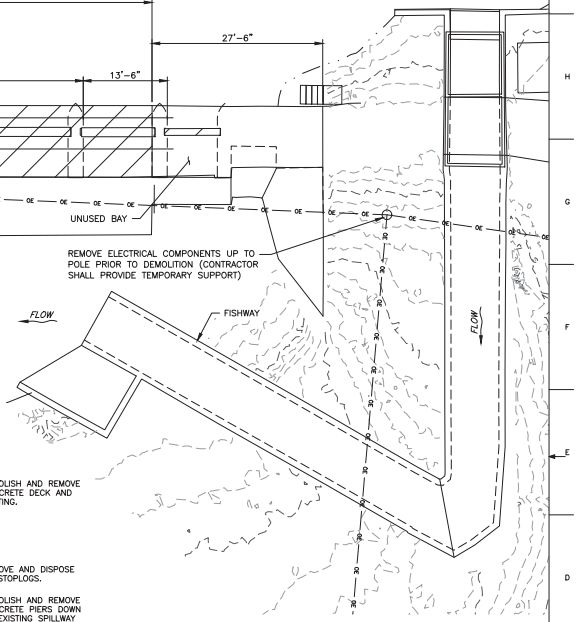
TEMPORARY CONDITIONS/DEMO PLAN

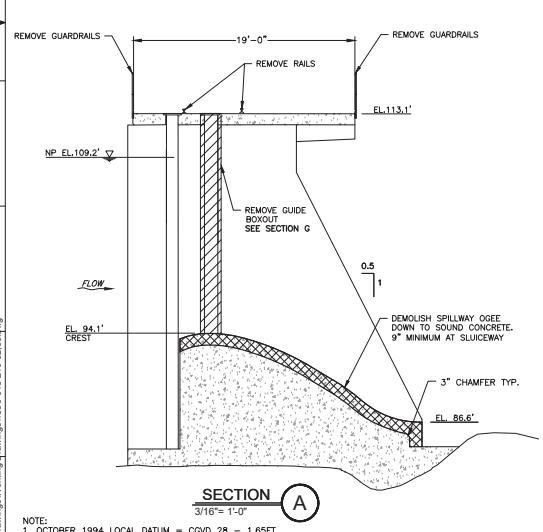
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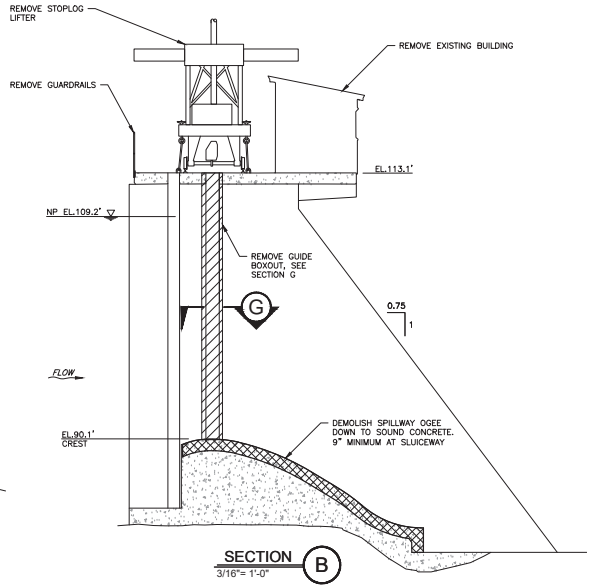


PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

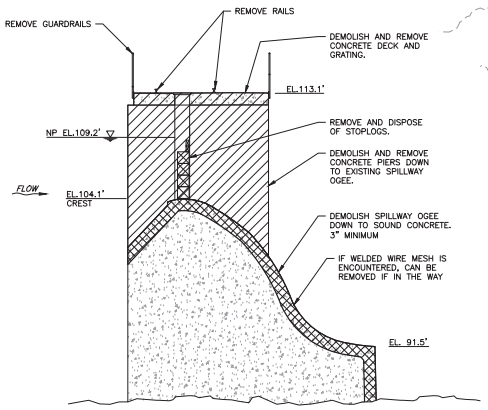




SECTION A
3/16"= 1'-0"

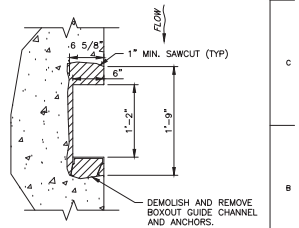


SECTION B
3/16"= 1'-0"



SECTION (TYP EAST SPILLWAY) C
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION (TYP) G
1"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

ISSUED FOR CONSTRUCTION

210-02

Kleinschmidt

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PRINTED: Jun. 1, 2021 - 2:38 P.M.

REFERENCE DESCRIPTION	A X X X X X X X X X X X X
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REFERENCE DRAWINGS	DWG.NO.

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-___-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — 9978 — PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

SCALE

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED

CHECKED

DATE 2021-06-01

W.O. XXXX

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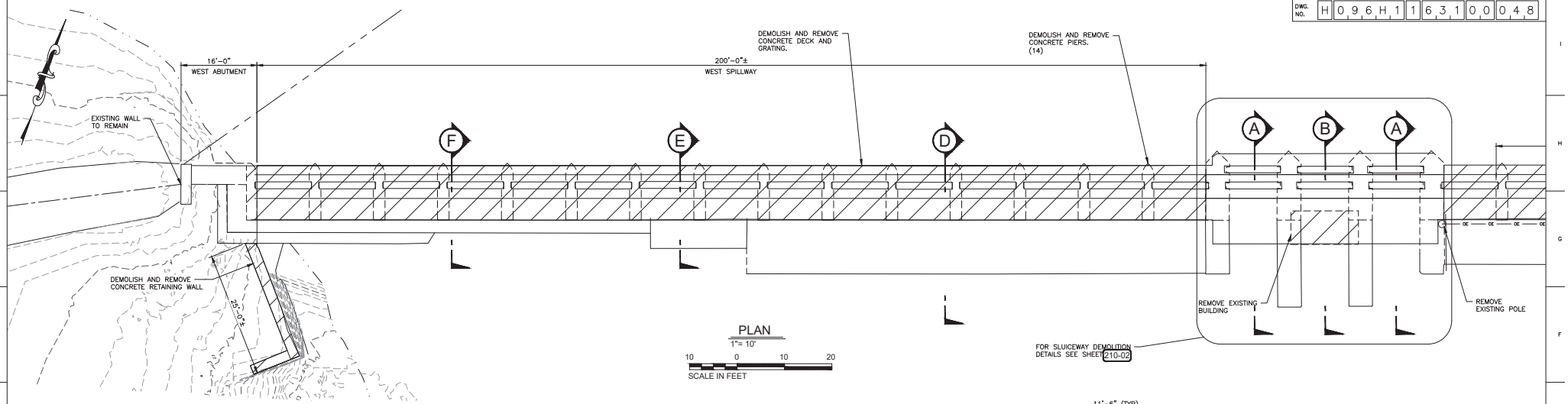
RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

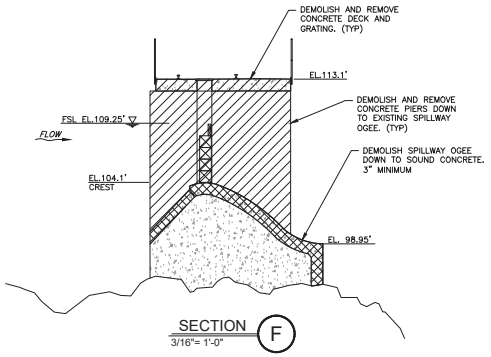
TEMPORARY CONDITIONS/DEMO
EAST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H116310004 7 REV. 0

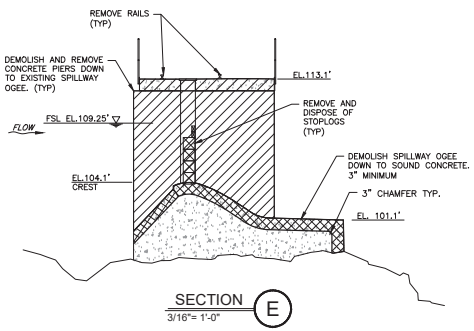
DWG. NO. H096H1163100048



PLAN
1"= 10'
10 0 10 20
SCALE IN FEET

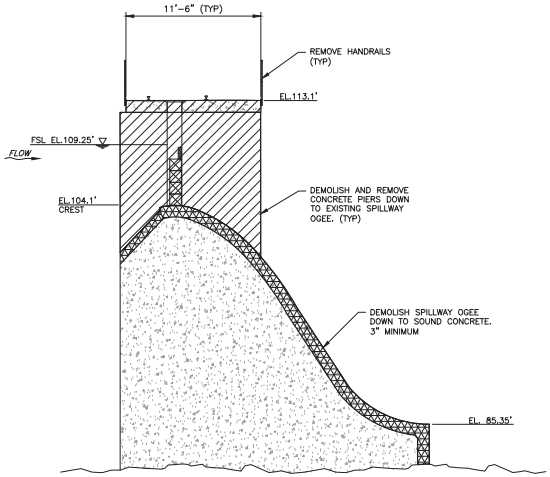


SECTION F
3/16"= 1'-0"



SECTION E
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION D
3/16"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

ISSUED FOR CONSTRUCTION

210-03

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PRINTED: Jun. 1, 2021 - 2:27 P.M.

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — DATE Jun 1, 21 — C. MEL — 9978 — PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE . .

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2021-06-01
W.O.	XXXX

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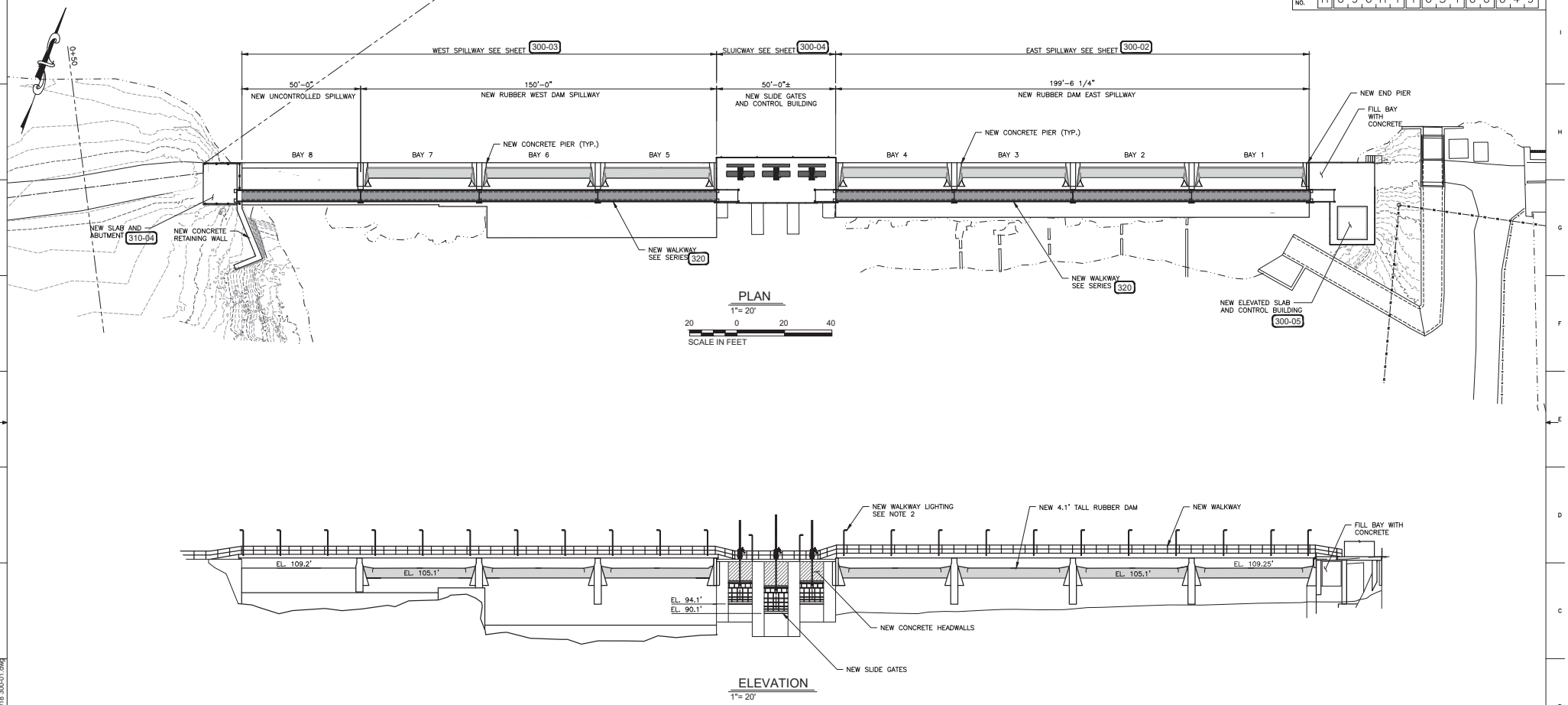
RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
WEST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100048 REV. 0

DWG. NO. H096H1163100049



NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

2. LED LUMINAIRE MOUNTED TO A SWIVEL POLE– 5,300 LUMENS, TYPE 1 OPTIC, MULTIVOLT DRIVER, WARM (3000K) COLOR TEMP. LIGHT TO BE MOUNTED 10' ABOVE WALKWAY AND SPACED AT 20'. WIRING AND CONDUIT RESPONSIBILITY OF CONTRACTOR.

ISSUED FOR CONSTRUCTION

300-01

Kleinschmidt

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PRINTED: Jun. 1, 2021 - 2:41 P.M.

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REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF NOVA SCOTIA — DATE Jun 1, 21 — C. M. Vallis — 9978

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2021-06-01

W.O. XXXX

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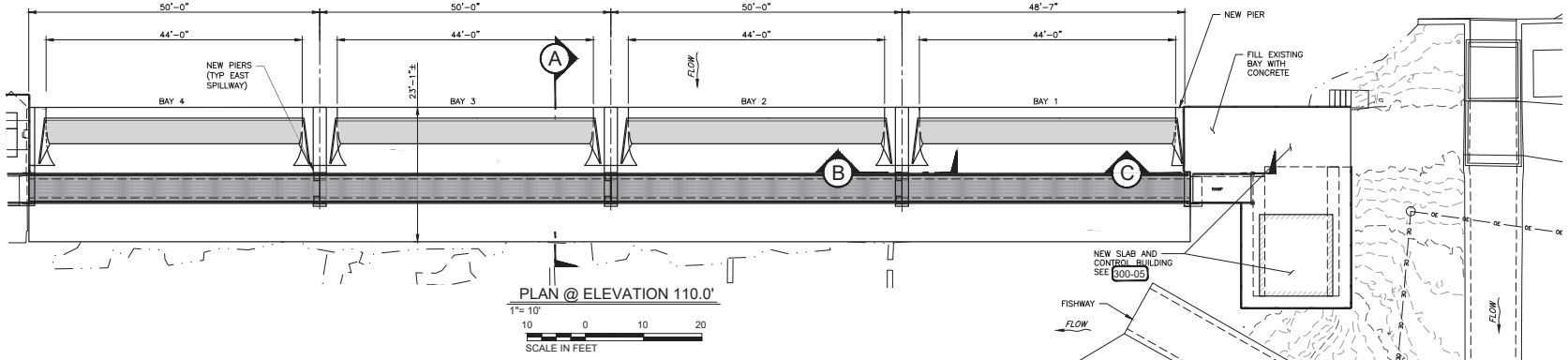
RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

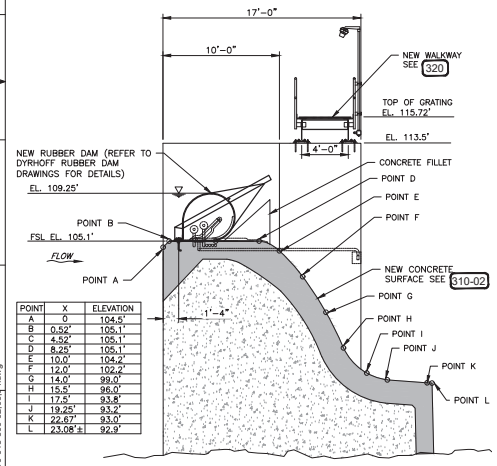
NEW CONDITIONS
DAM PLAN AND ELEVATION

DWG.NO. H096H1163100049 REV. 0

DWG. NO. H096H1163100050

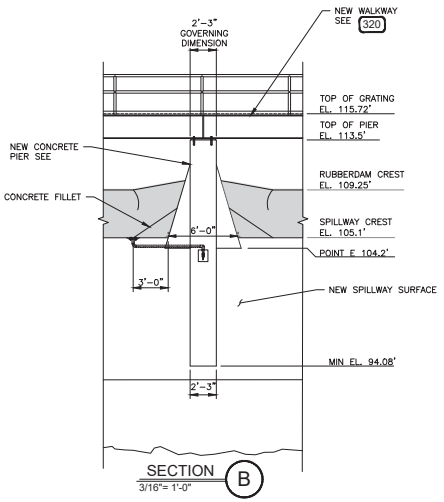


PLAN @ ELEVATION 110.0'
1"= 10'
SCALE IN FEET

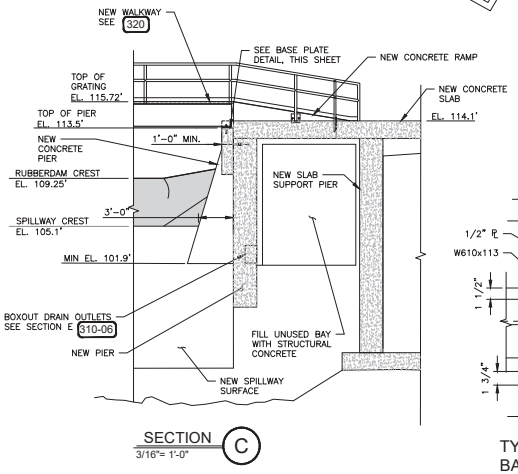


POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	4.52'	105.1'
D	8.25'	105.1'
E	10.0'	104.2'
F	12.0'	102.2'
G	14.0'	99.0'
H	15.5'	96.0'
I	17.5'	93.8'
J	19.25'	93.2'
K	22.67'	93.0'
L	23.08'±	92.9'

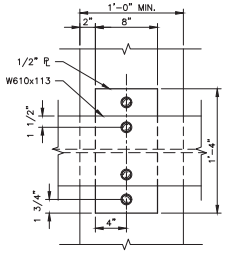
SECTION A
3/16"= 1'-0"
SCALE IN FEET



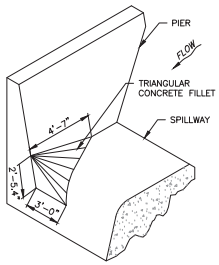
SECTION B
3/16"= 1'-0"



SECTION C
3/16"= 1'-0"



TYPICAL END PIER BASE PLATE DETAIL
1 1/2"= 1'-0"



TRIANGULAR CONCRETE FILLET DETAIL
N.T.S.

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

ISSUED FOR CONSTRUCTION

300-02

Kleinschmidt

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REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF NOVA SCOTIA — 9978

DEPARTMENTAL APPROVALS			
CIVIL		E & I	
MECH		CONST	
APPROVED			
DATE			

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2021-06-01
W.O.	XXXX

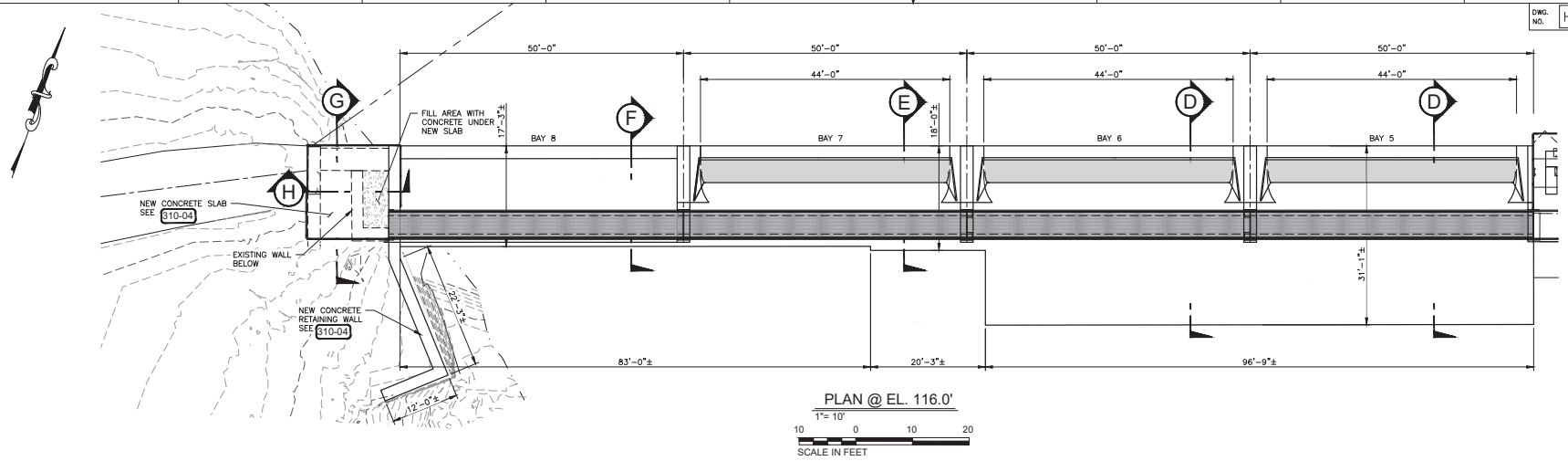
Nova Scotia POWER — An Emera Company — energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

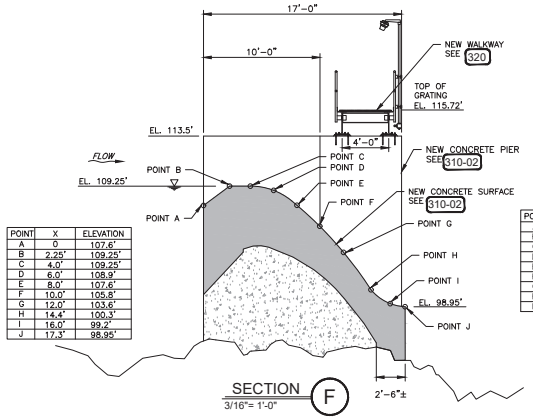
NEW CONDITIONS
EAST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100050 REV. 0

DWG. NO. H096H116310005 1

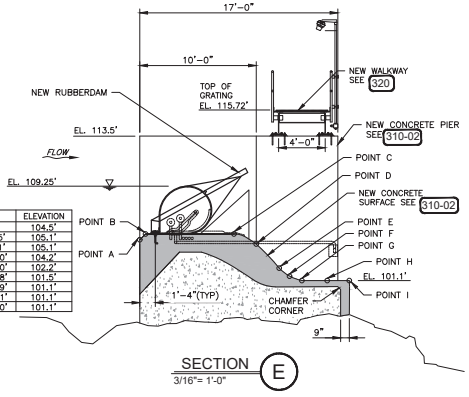


PLAN @ EL. 116.0'
1"= 10'
SCALE IN FEET



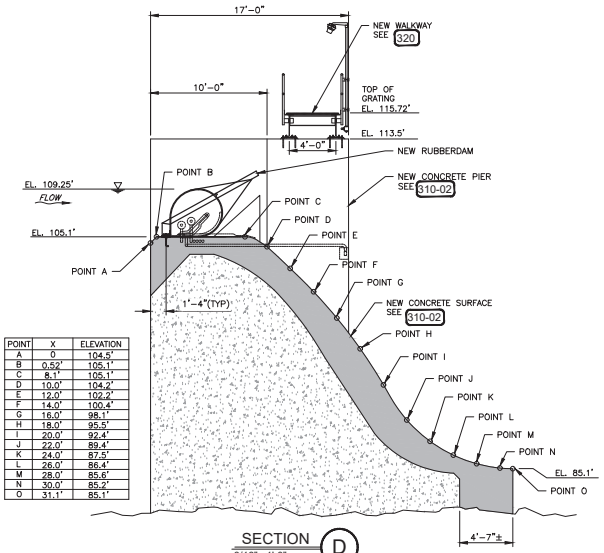
POINT	X	ELEVATION
A	0	107.6'
B	2.25'	109.25'
C	4.0'	109.25'
D	6.0'	108.9'
E	8.0'	107.6'
F	10.0'	105.8'
G	12.0'	103.6'
H	14.4'	100.3'
I	16.0'	99.2'
J	17.3'	98.95'

SECTION F
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.5'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	12.8'	101.5'
G	13.9'	101.1'
H	16.1'	101.1'
I	18.0'	101.1'

SECTION E
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	14.0'	100.4'
G	16.0'	98.1'
H	18.0'	95.5'
I	20.0'	92.4'
J	22.0'	89.4'
K	24.0'	87.5'
L	26.0'	86.4'
M	28.0'	85.6'
N	30.0'	85.2'
O	31.1'	85.1'

SECTION D
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

ISSUED FOR CONSTRUCTION

300-03

Kleinschmidt

J:\18900\018\Drawings\Working Drawings\18900-018_300-02_03_04.dwg

PRINTED: Jun. 1, 2021 - 2:44 P.M.

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REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST
BY:		DATE:			

SEAL

REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF NOVA SCOTIA — 9978

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE

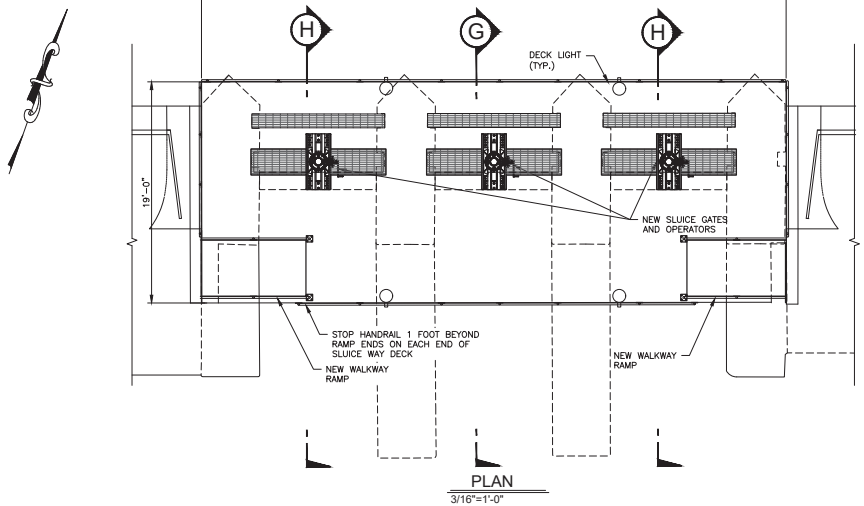
SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2021-06-01
W.O.	XXXX

Nova Scotia POWER An Emera Company — energy everywhere.

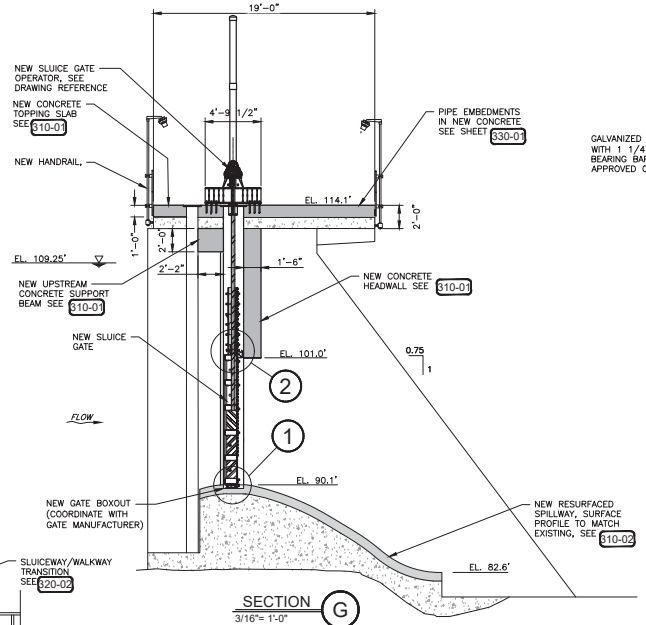
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
WEST SPILLWAY PLAN AND SECTIONS

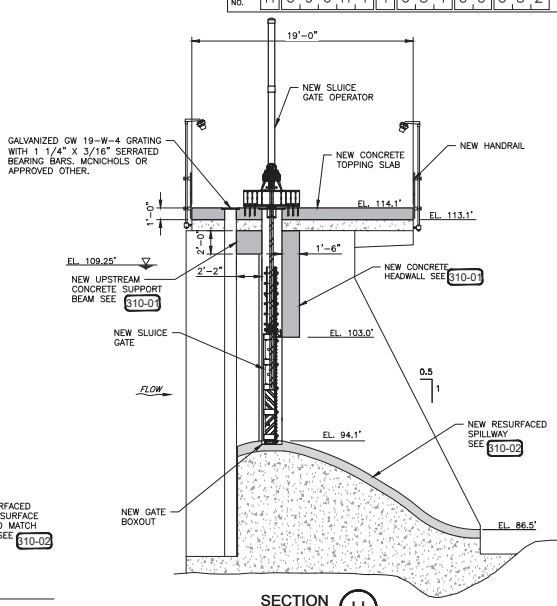
DWG.NO. H096H116310005 REV. 0



PLAN
3/16"=1'-0"

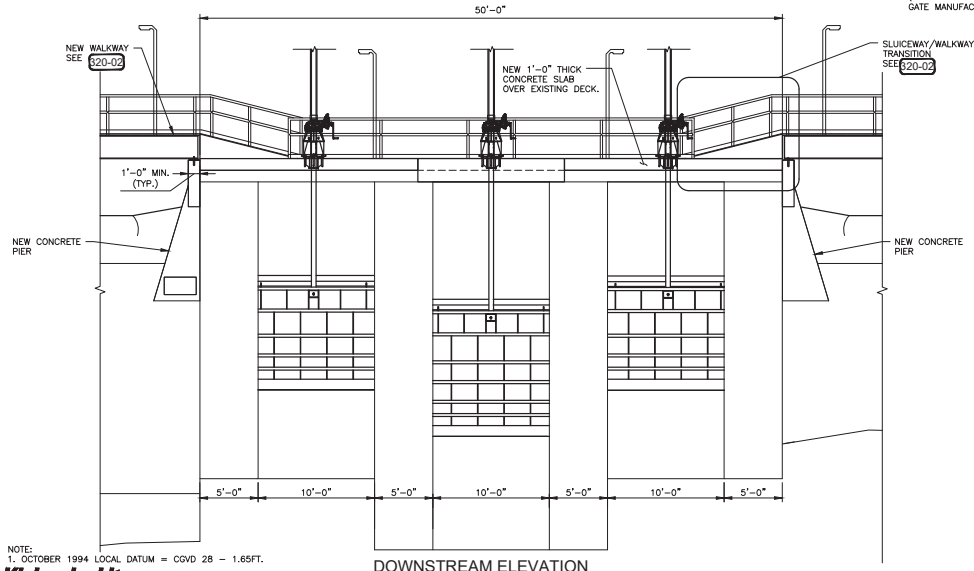


SECTION G
3/16"= 1'-0"



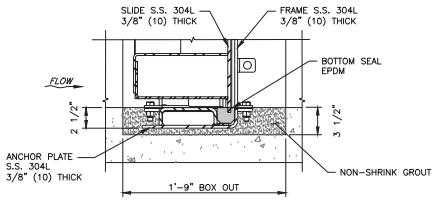
SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



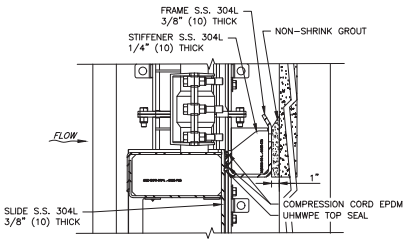
NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

DOWNSTREAM ELEVATION
3/16"=1'-0"



DETAIL 1
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES



DETAIL 2
1 1/2"= 1'-0"

ISSUED FOR CONSTRUCTION

300-04

Kleinschmidt

J:\1890\018\Drawings\Working Drawings\1890-018 300-02,03,04.dwg
PRINTED: Jun 1, 2021 - 2:45 PM

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STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	1
FONTAINE AQUANOX DWG NO. D15542-01-204P2X120107BFE/CW22													
REFERENCE DRAWINGS		DWG.NO.											

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL: REGISTERED PROFESSIONAL ENGINEER, PROVINCE OF NOVA SCOTIA, 9978

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE , ,

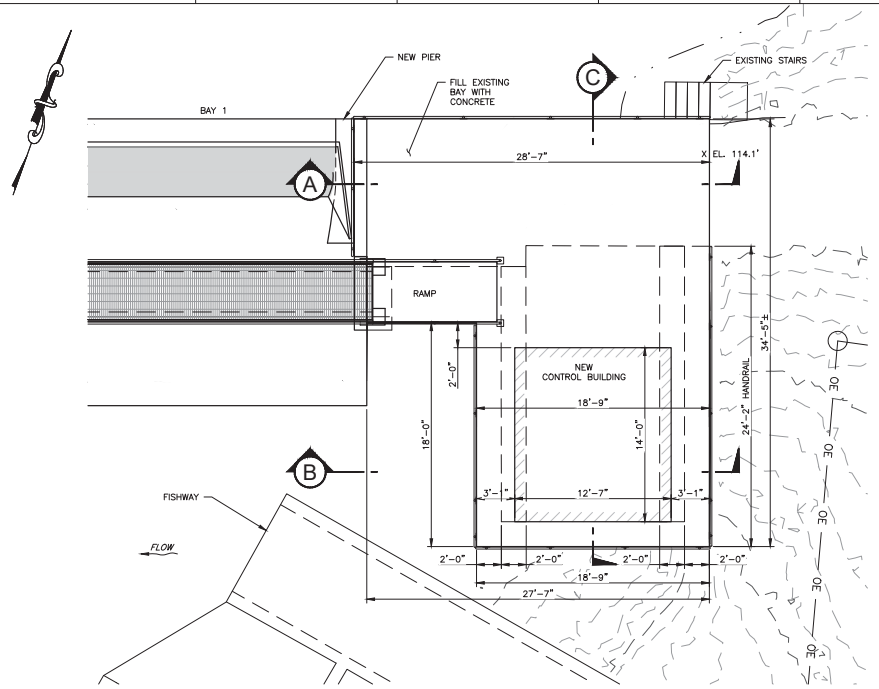
SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2021-06-01
W.O.	XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
SLUICEWAY PLAN AND DETAILS

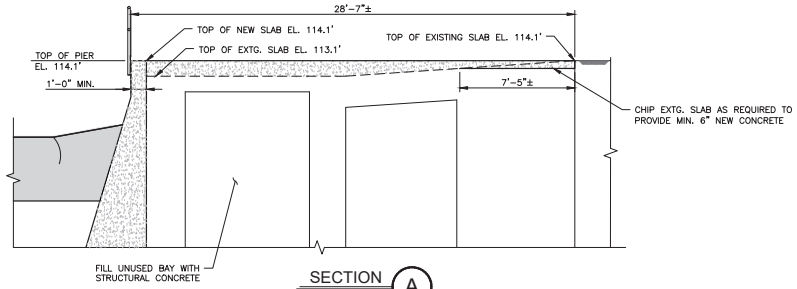
DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 2 REV. 0



PLAN - EAST ABUTMENT EL. 116.0

1"= 5'

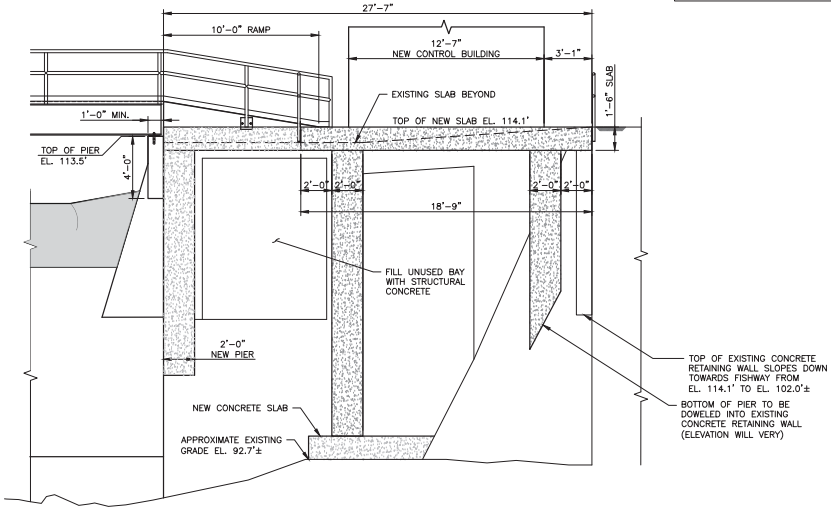
SCALE IN FEET



SECTION A

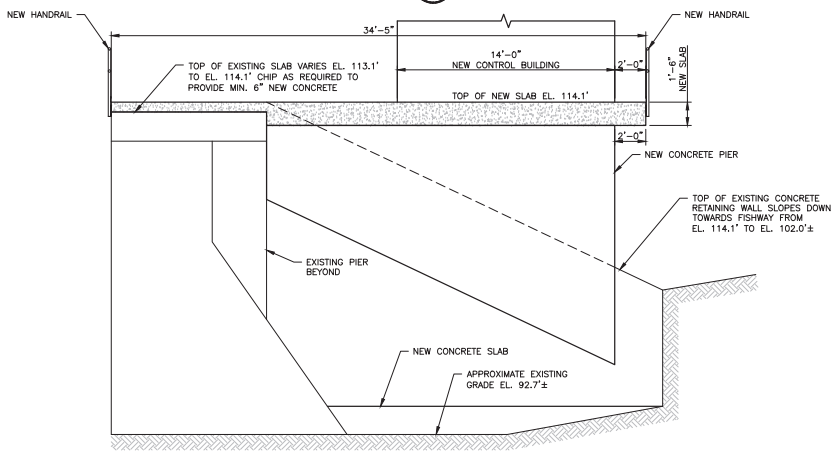
1/4"= 1'-0"

SCALE IN FEET



SECTION B

1/4"= 1'-0"



SECTION C

1/4"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

Kleinschmidt

ISSUED FOR CONSTRUCTION

300-05

DWG. NO. H096H1163100061

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — 9978 — PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS			
CIVIL		E & I	
MECH		CONST	
APPROVED			
DATE			

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	JFB
CHECKED	
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DATE	2021-06-01
W.O.	XXXX

Nova Scotia POWER — An Emera Company — energy everywhere.

RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

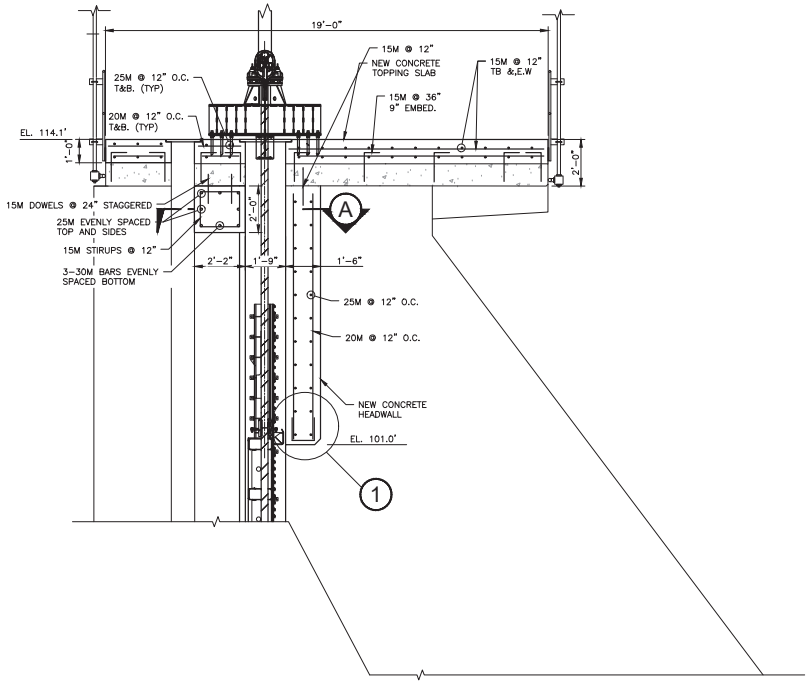
NEW CONDITIONS
EAST ABUTMENT PLAN AND SECTIONS

DWG.NO. H096H1163100061 REV. 0

PRINTED: Jun. 1, 2021 - 2:48 P.M.

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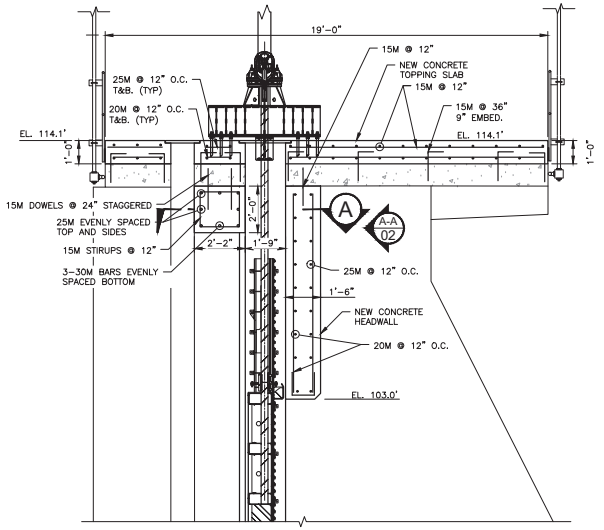
DWG. NO. H096H1163100053



INNER SLUICEWAY DETAIL

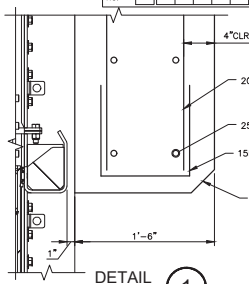
3/8"= 1'-0"

SCALE IN FEET



OUTER SLUICEWAY DETAIL

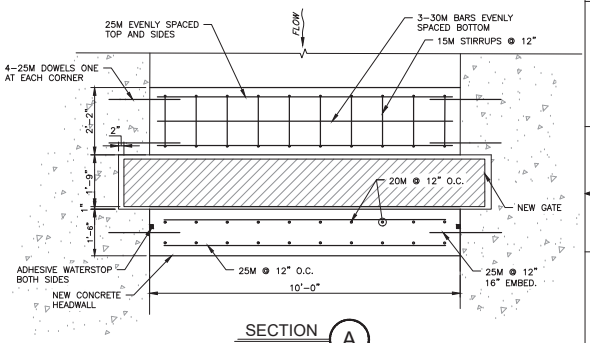
3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

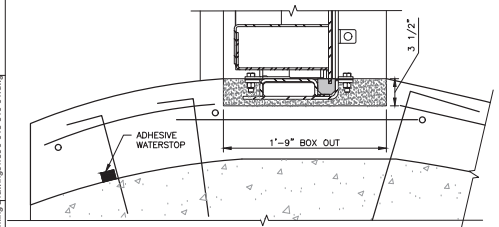
SCALE IN INCHES



SECTION A

1/2"= 1'-0"

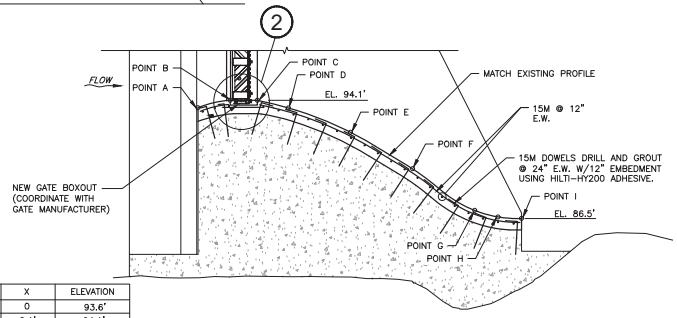
SCALE IN FEET



DETAIL 2

1 1/2"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 - 1.65FT.

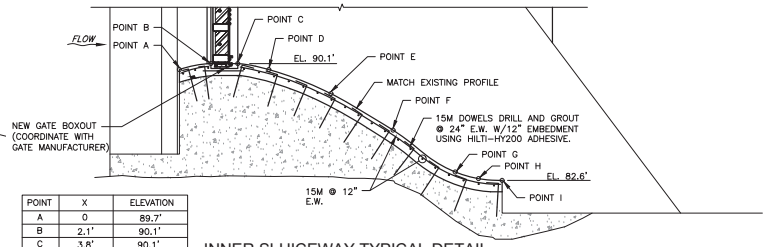


POINT	X	ELEVATION
A	0	93.6'
B	2.1'	94.1'
C	3.8'	94.1'
D	5.8'	93.6'
E	9.8'	92.0'
F	13.8'	89.7'
G	17.8'	87.0'
H	19.3'	86.6'
I	20.8'	86.5'

OUTSIDE SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

SCALE IN FEET



POINT	X	ELEVATION
A	0	89.7'
B	2.1'	90.1'
C	3.8'	90.1'
D	5.8'	89.7'
E	9.8'	88.2'
F	13.8'	85.8'
G	17.8'	83.1'
H	19.3'	82.7'
I	20.8'	82.6'

INNER SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

ISSUED FOR CONSTRUCTION

310-01

Kleinschmidt

J:\1890\018\Drawings\Working Drawings\1890-018 310-01.dwg

PRINTED: Jun 1, 2021 - 2:49 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
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REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF NOVA SCOTIA — 9978 — DATE Jun 1, 21

DEPARTMENTAL APPROVALS		
CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE		

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	
CHECKED	
DATE	2021-06-01
W.O.	XXXX

Nova Scotia POWER — An Emera Company — energy everywhere.

RUTH FALLS

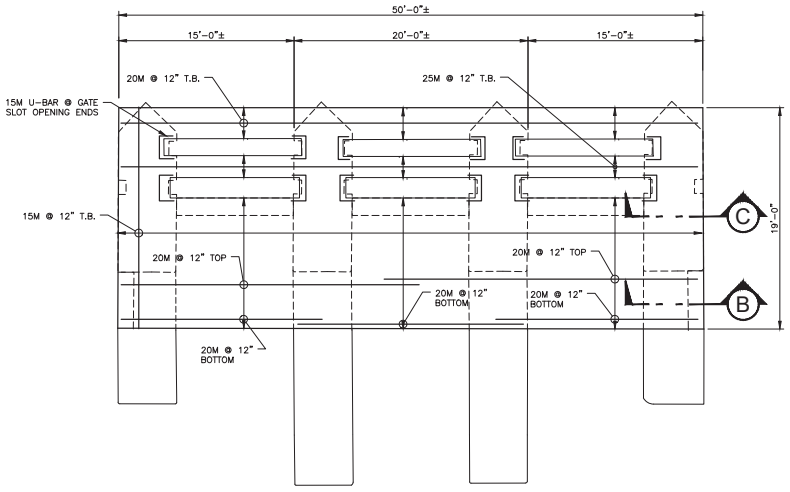
RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

H096H1163100053 REV. 0

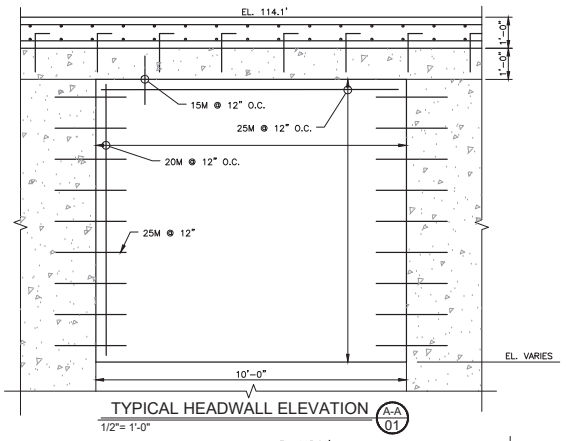
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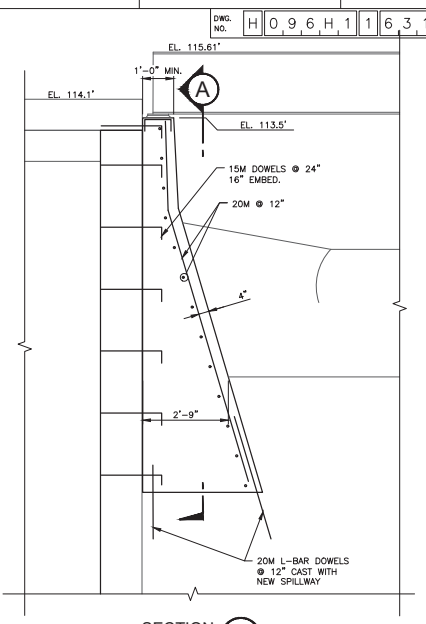


SLUICEWAY DECK REBAR PLAN
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

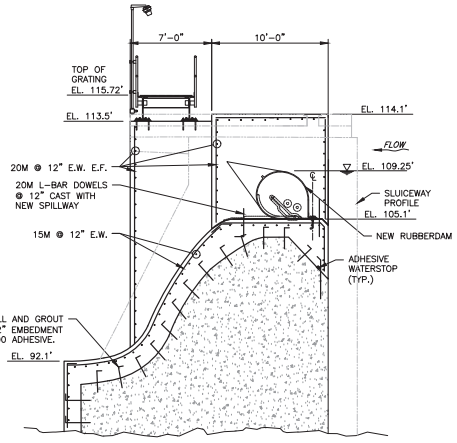


TYPICAL HEADWALL ELEVATION A-A 01
1/2"= 1'-0"

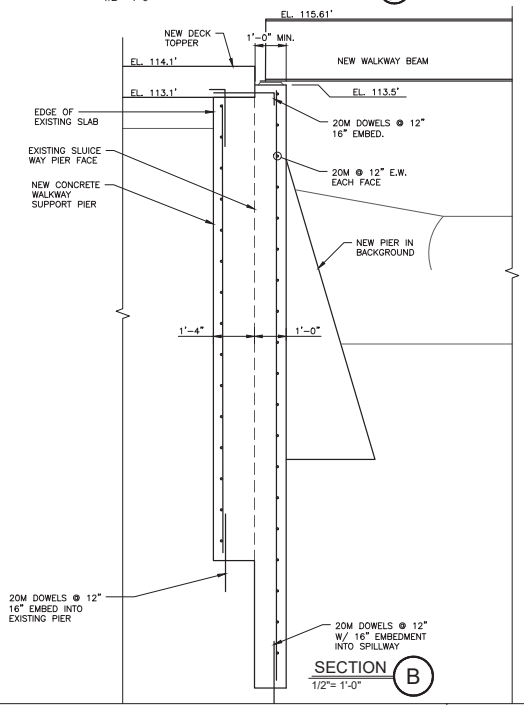


SECTION C
1/2"= 1'-0"

2 0 2 4
SCALE IN FEET



SECTION A
3/16"= 1'-0"



SECTION B
1/2"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

Kleinschmidt

ISSUED FOR CONSTRUCTION

310-02

J:\18900\018\Drawings\Working Drawings\18900-018-310-02.dwg

PRINTED: Jun. 2, 2021 - 3:21 P.M.

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER
DATE Jun 2, 21
9978
PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS		
CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE		

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	__
CHECKED	__
DATE	2021-06-01
W.O.	XXXX

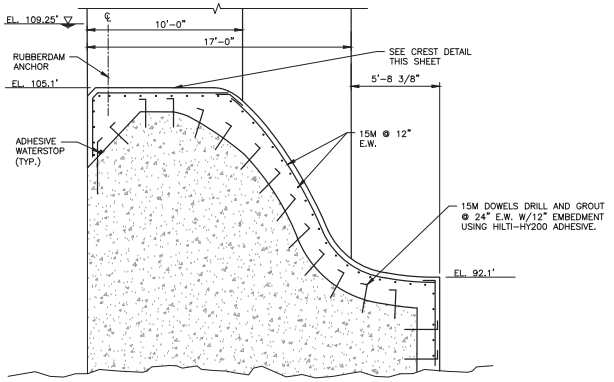
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE
SLUICEWAY HEADWALL AND DECK DETAILS

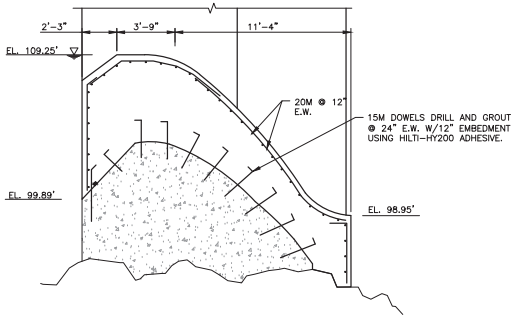
DWG.NO. H096H1163100054 REV. 0

DWG. NO. H096H1163100055



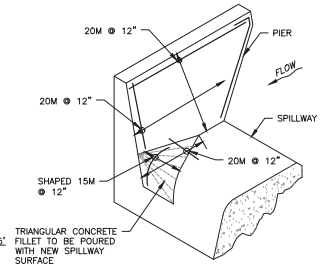
EAST SPILLWAY TYPICAL DETAIL (BAYS 1-4)

1/4"= 1'-0"



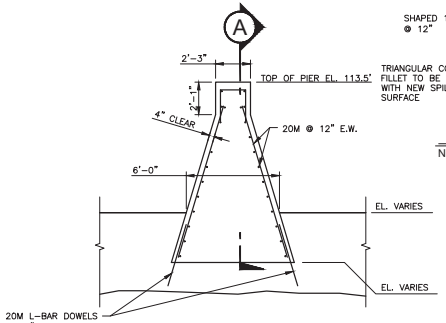
UNCONTROLLED SPILLWAY DETAIL (BAY 8)

1/4"= 1'-0"



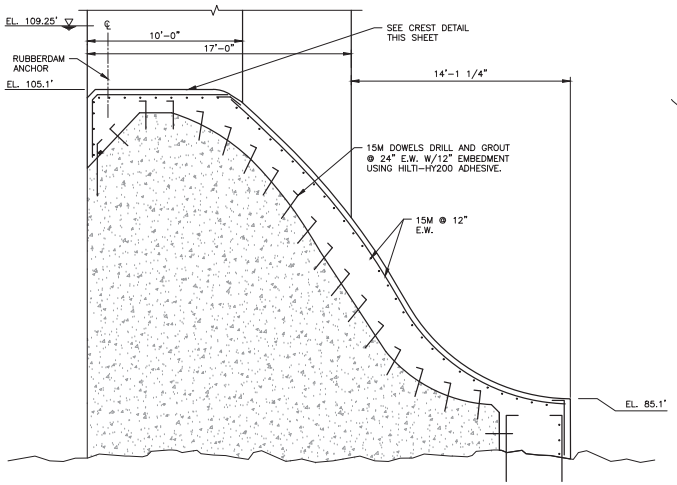
TRIANGULAR CONCRETE FILLET DETAIL

N.T.S.



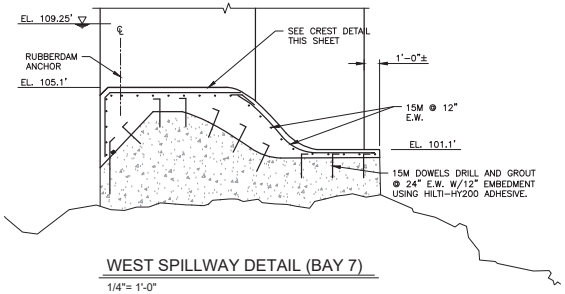
TYPICAL PIER DETAIL

1/4"= 1'-0"



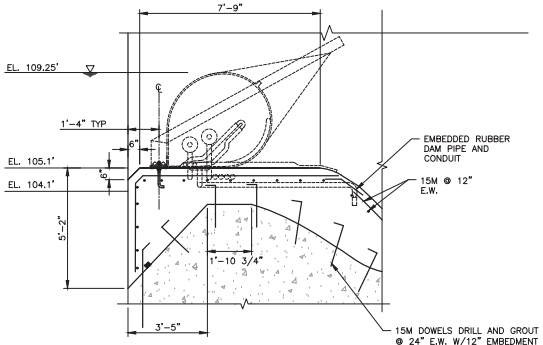
WEST SPILLWAY TYPICAL DETAIL (BAYS 6&5)

1/4"= 1'-0"



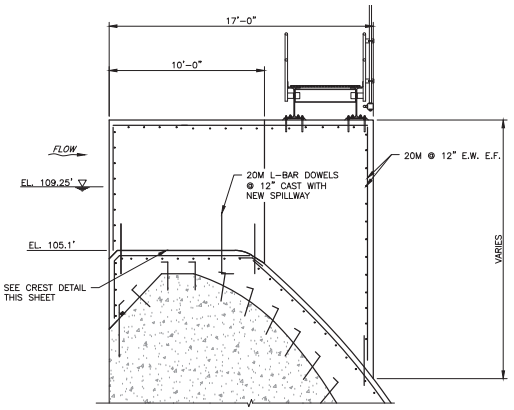
WEST SPILLWAY DETAIL (BAY 7)

1/4"= 1'-0"



RUBBERDAM CREST TYPICAL

3/8"= 1'-0"



TYPICAL PIER SECTION (A)

1/4"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 - 1.65FT.

ISSUED FOR CONSTRUCTION

310-03

Kleinschmidt

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REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

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BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — DATE Jun 15/21 — C. M. Vallis — 9978 — PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS			
CIVIL		E & I	
MECH		CONST	
APPROVED			
DATE			

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DATE	2021-06-01
W.O.	XXXX

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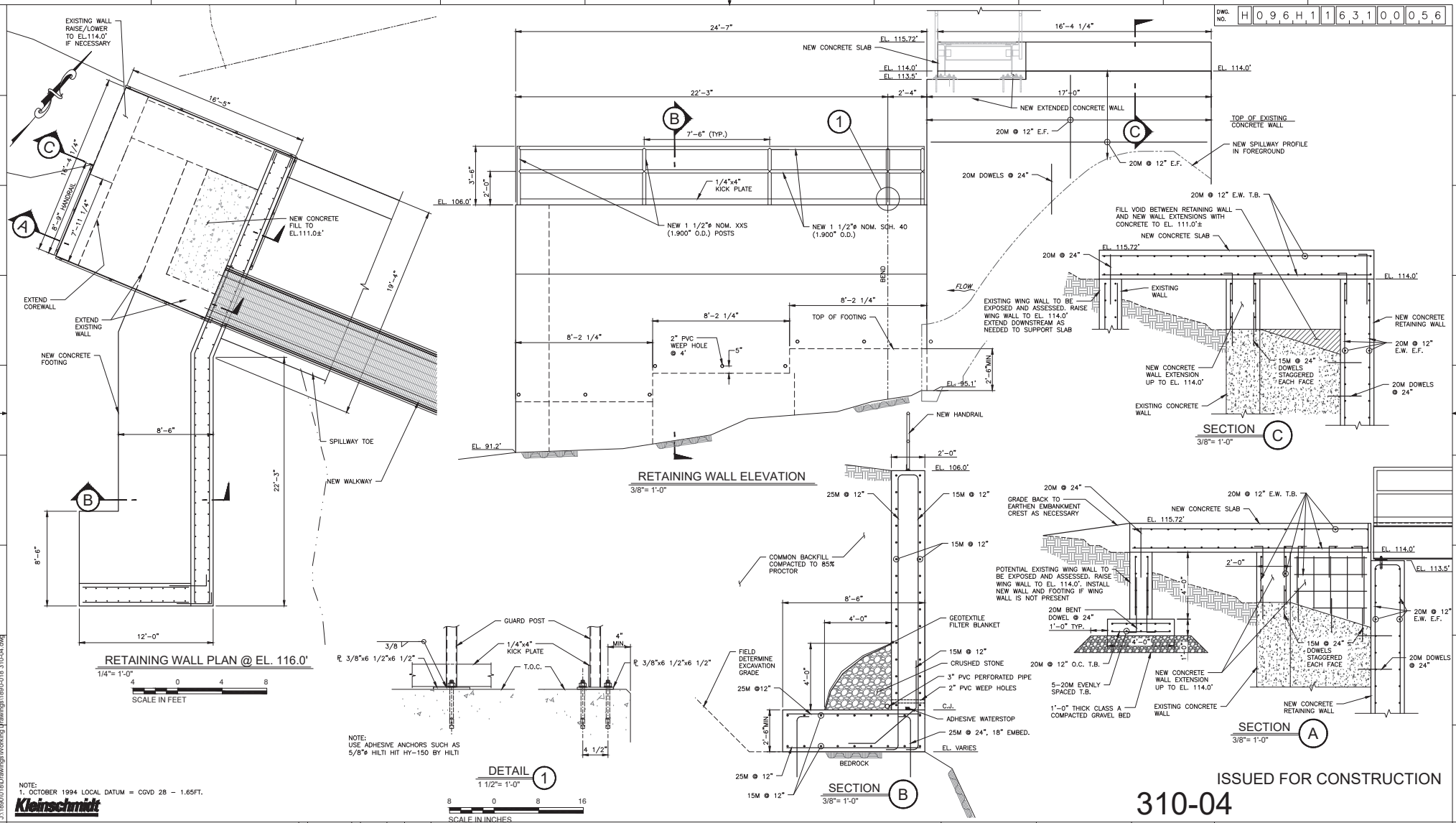
RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SPILLWAY RESURFACING DETAILS

DWG.NO. H096H1163100055 REV. 0

REDACTED (CONFIDENTIAL INFORMATION REMOVED)



NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

Kleinschmidt

ISSUED FOR CONSTRUCTION

310-04

DWG. NO. H096H1163100056

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REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL: REGISTERED PROFESSIONAL ENGINEER, DATE Jan 13, 2021, C. M. Vallis, 9978, PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS

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SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
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DATE	2021-06-01
W.O.	XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

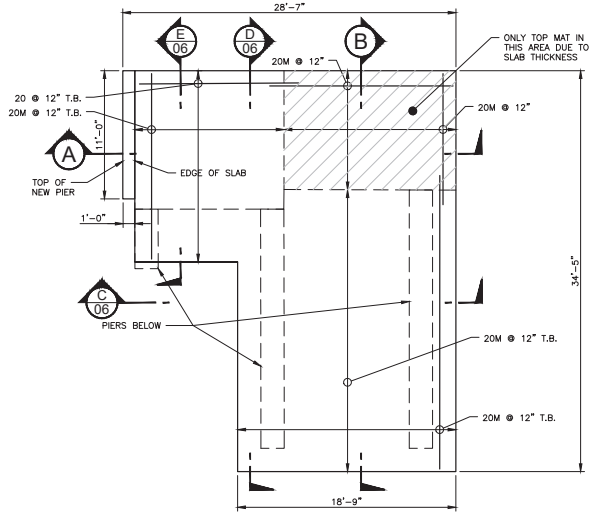
NEW CONCRETE RETAINING WALL AND PIER DETAILS

DWG.NO. H096H1163100056 REV. 0

PRINTED: Jun. 1, 2021 - 4:23 P.M.

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DWG. NO. H096H1163100062

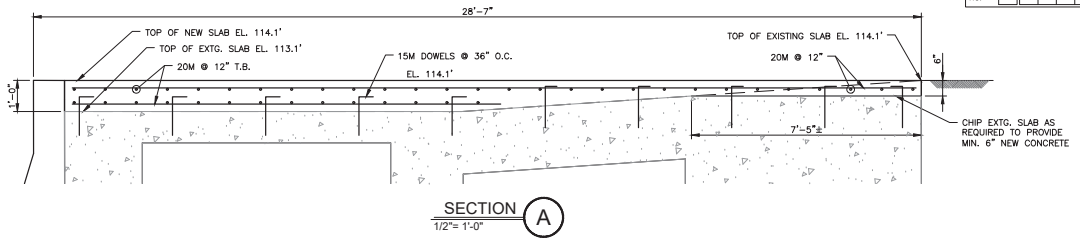


EAST ABUTMENT REBAR PLAN

3/16"= 1'-0"

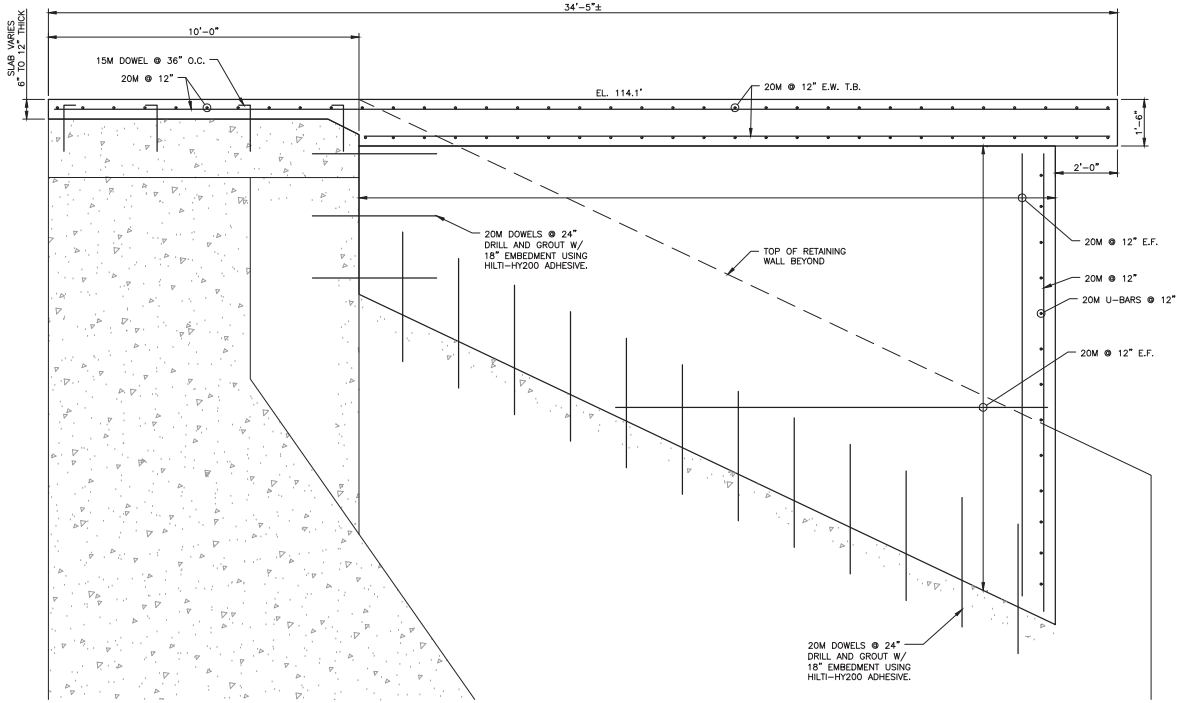
4 0 4 8 12

SCALE IN FEET



SECTION A

1/2"= 1'-0"



SECTION B

1/2"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

Kleinschmidt

ISSUED FOR CONSTRUCTION

310-05

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — DATE Jun 1, 2021 — C. MARK WILLIAMS — 9978 — PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	JFB
CHECKED	__
CHECKED	__
DATE	2021-06-01
W.O.	XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

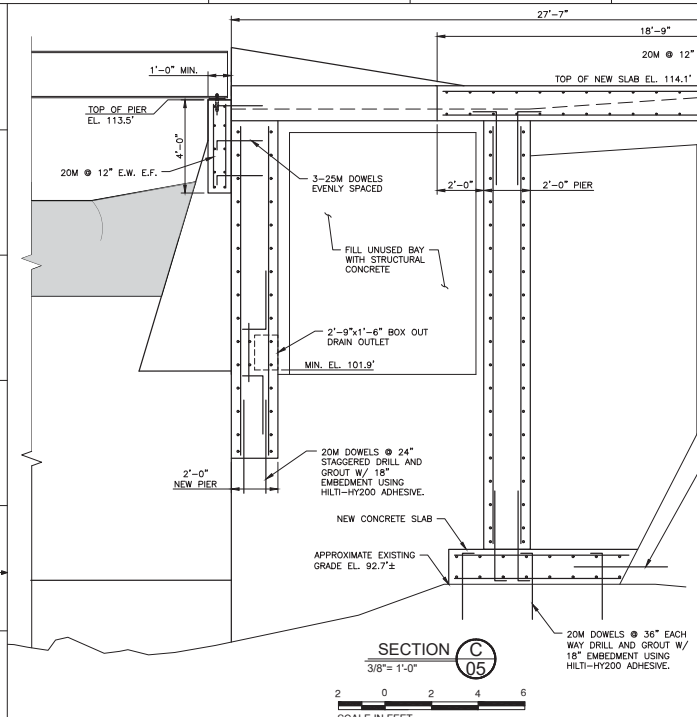
NEW CONCRETE
EAST ABUTMENT PIER & DECK DETAILS

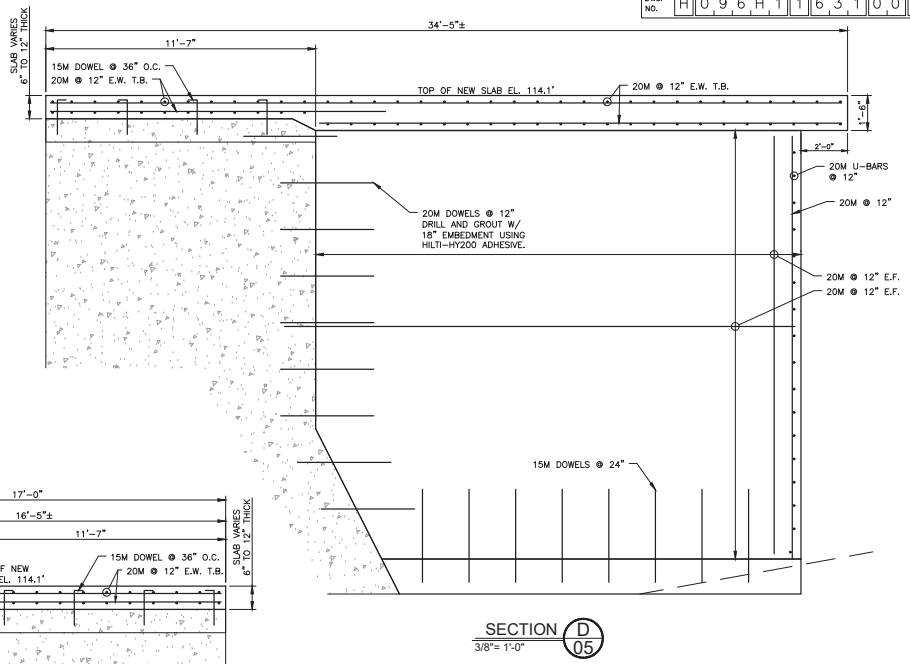
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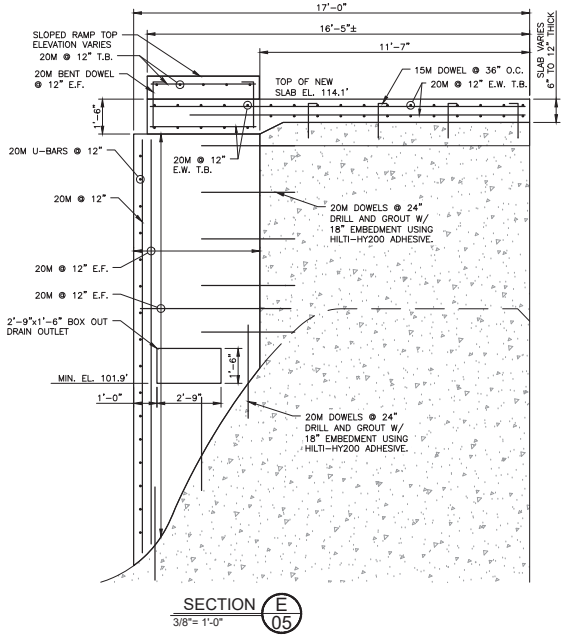
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PRINTED: Jun 1, 2021 - 3:59 PM

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NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 - 1.65FT.

Kleinschmidt

ISSUED FOR CONSTRUCTION

310-06

DWG. NO. H096H1163100063

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.														

REV	CAD	CIVIL	MECH	E & I	CONST
BY:				DATE:	

SEAL: REGISTERED PROFESSIONAL ENGINEER, C. M. Wall, 9978, PROVINCE OF NOVA SCOTIA, DATE Jun 1, 21

DEPARTMENTAL APPROVALS			
CIVIL		E & I	
MECH		CONST	
APPROVED			
DATE			

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
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CHECKED	--
DATE	2021-06-01
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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

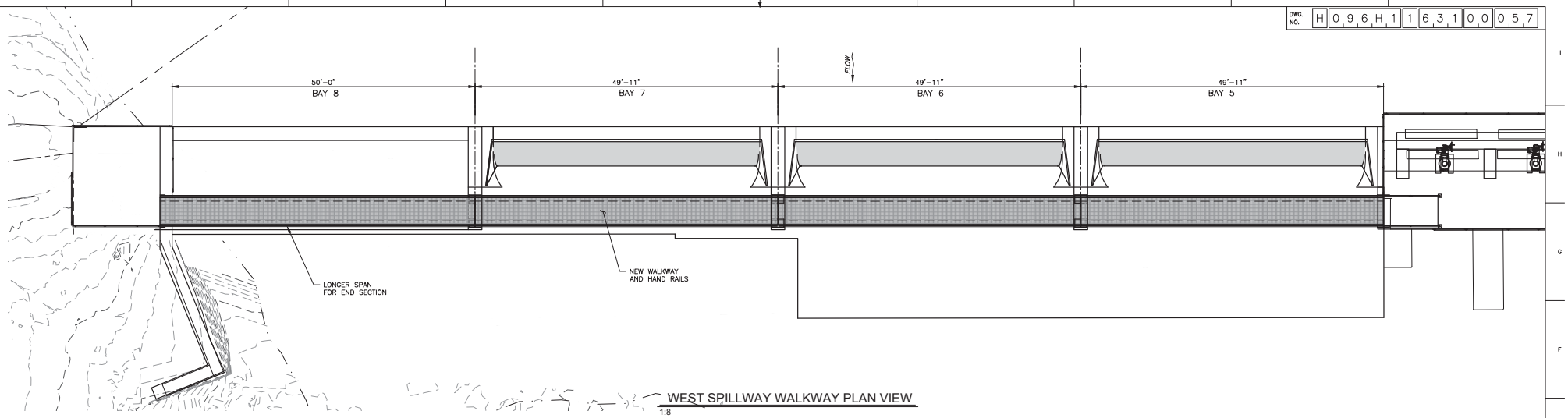
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EAST ABUTMENT PIERS & DECK DETAILS

DWG.NO. H096H1163100063 REV. 0

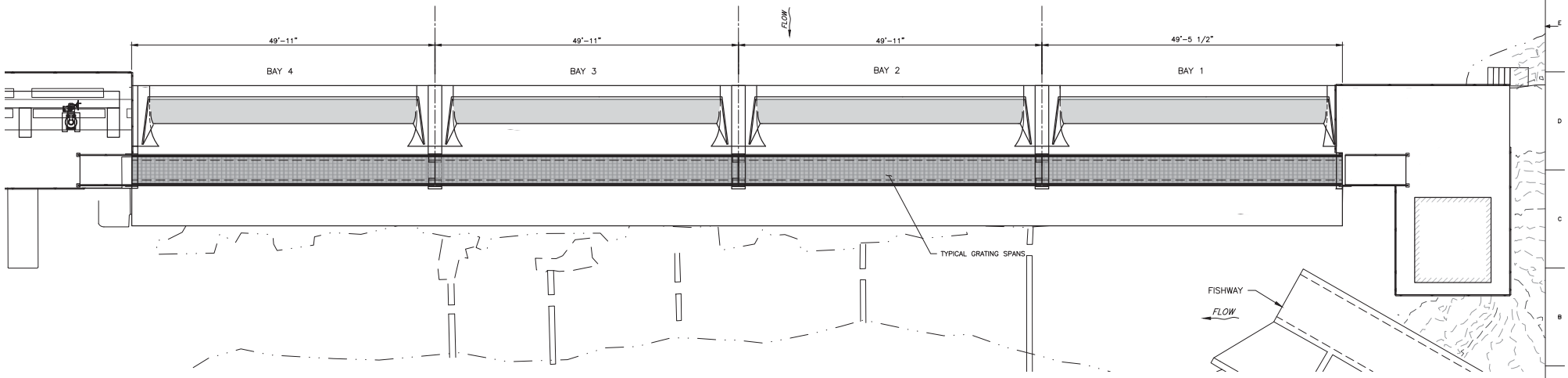
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DWG. NO. H096H1163100057



WEST SPILLWAY WALKWAY PLAN VIEW
1:8



EAST SPILLWAY WALKWAY PLAN VIEW
1:8

8 0 8 16
SCALE IN FEET

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

ISSUED FOR CONSTRUCTION

320-01

Kleinschmidt

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PRINTED: Jun 1, 2021 - 3:09 PM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER
DATE Jun 1, 2021
9978
PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

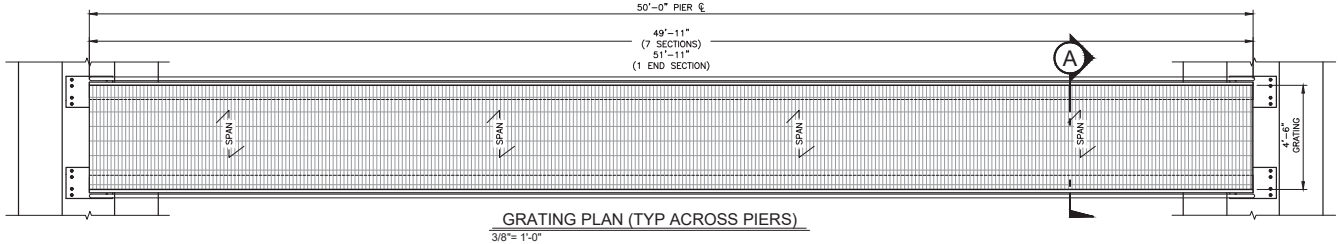
SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
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DATE	2021-06-01
W.O.	XXXX

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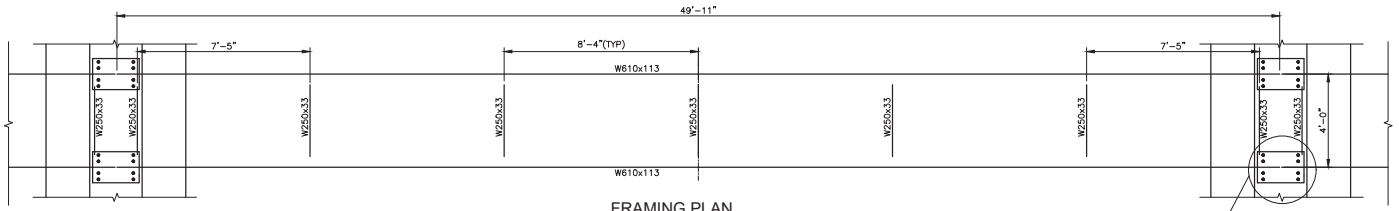
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT
NEW STEEL WALKWAY PLAN VIEW

H096H1163100057 REV. 0
DWG.NO.

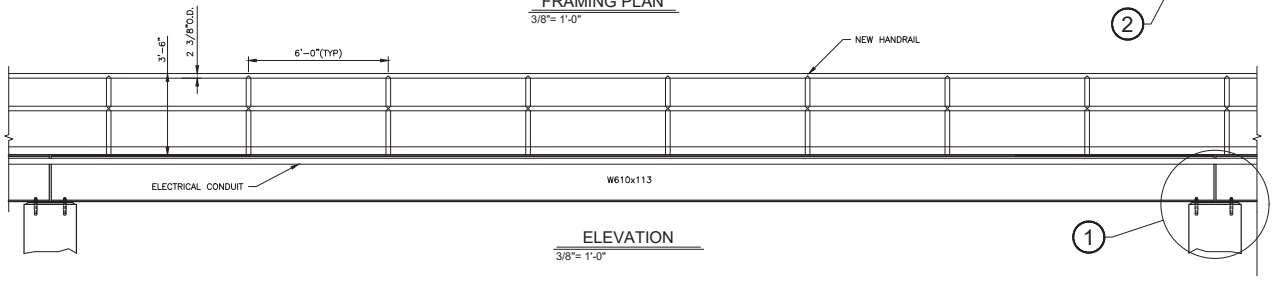
DWG. NO. H096H1163100058



GRATING PLAN (TYP ACROSS PIERS)
3/8"= 1'-0"

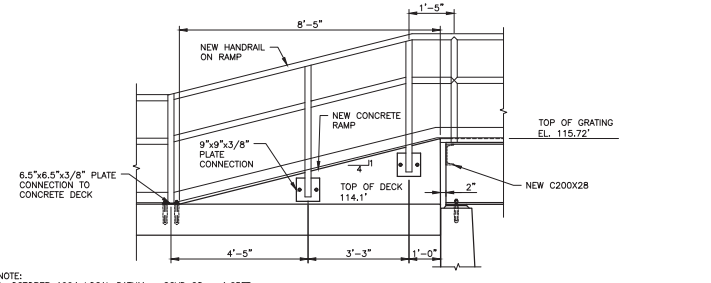


FRAMING PLAN
3/8"= 1'-0"



ELEVATION
3/8"= 1'-0"

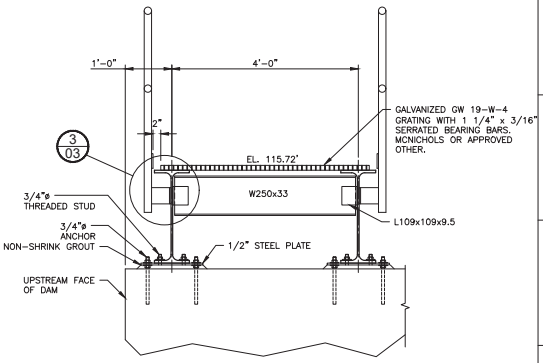
2 0 2 4 6
SCALE IN FEET



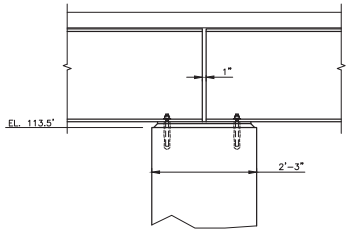
NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 - 1.65FT.

SLUICEWAY/WALKWAY TRANSITION DETAIL
1/2"= 1'-0"

2 0 2 4
SCALE IN FEET

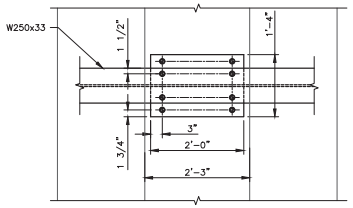


SECTION A
3/4"= 1'-0"



DETAIL 1
3/4"= 1'-0"

1 0 1 2 3
SCALE IN FEET



DETAIL 2
3/4"= 1'-0"

ISSUED FOR CONSTRUCTION

320-02

Kleinschmidt

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	0	1
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — DATE Jun 1, 2021 — C. MARK VOLKER — 9978 — PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

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SCALE .....

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DATE 2021-06-01

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

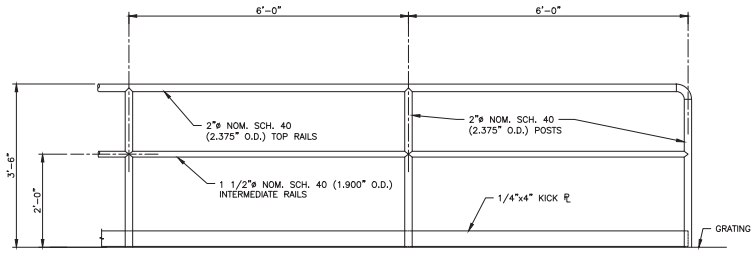
NEW STEEL WALKWAY

DWG.NO. H096H1163100058 REV. 0

PRINTED: Jun 1, 2021 - 3:11 PM

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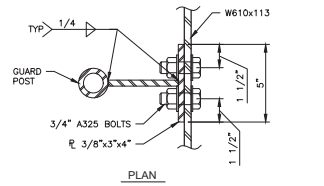


STEEL WALKWAY TYPICAL HANDRAIL DETAIL

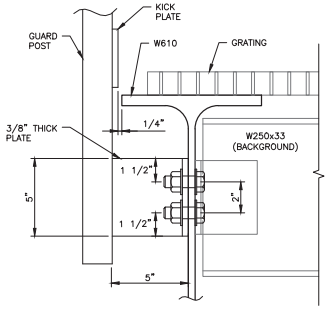
3/4"= 1'-0"

1 0 1 2 3

SCALE IN FEET



PLAN



DETAIL 3/02

3"= 1'-0"

NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

Kleinschmidt

ISSUED FOR CONSTRUCTION

320-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
STANDARD GUARD SYSTEMS DETAILS	H	0	0	1	H	0	1	6	9	0	0	0	1
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — PROVINCE OF NOVA SCOTIA — 9978

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2021-06-01

W.O. XXXX

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RUTH FALLS

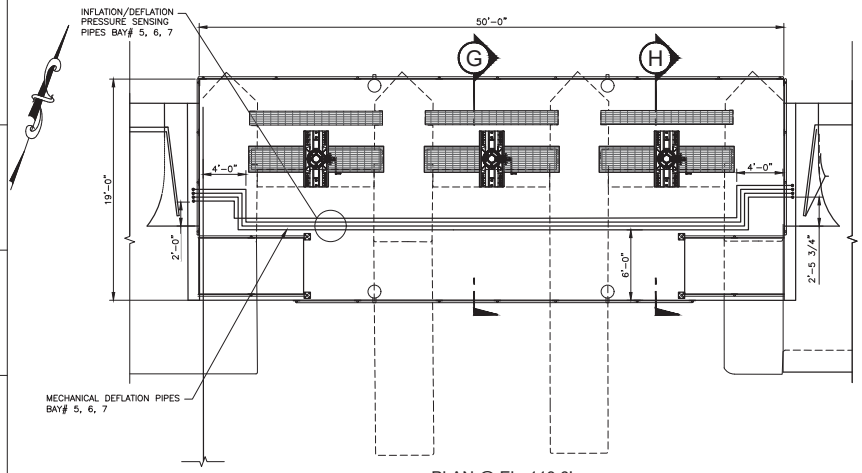
RUTH FALLS REFURBISHMENT PRJECT

NEW STEEL WALKWAY HANDRAIL DETAILS

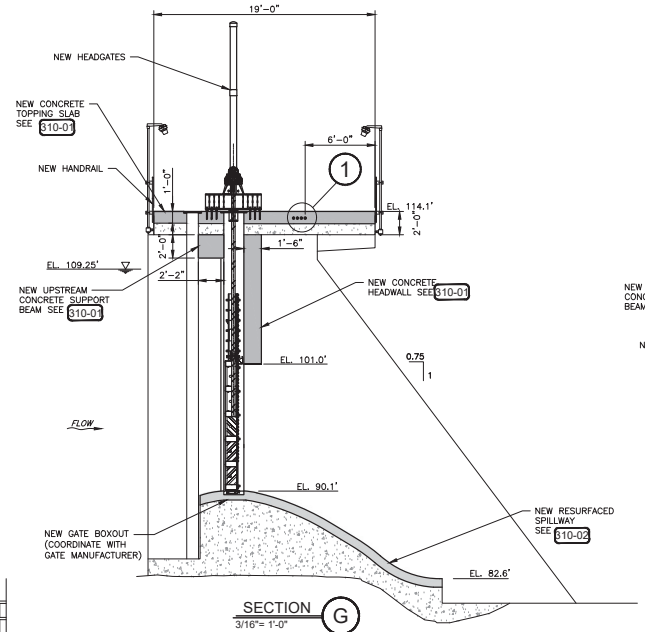
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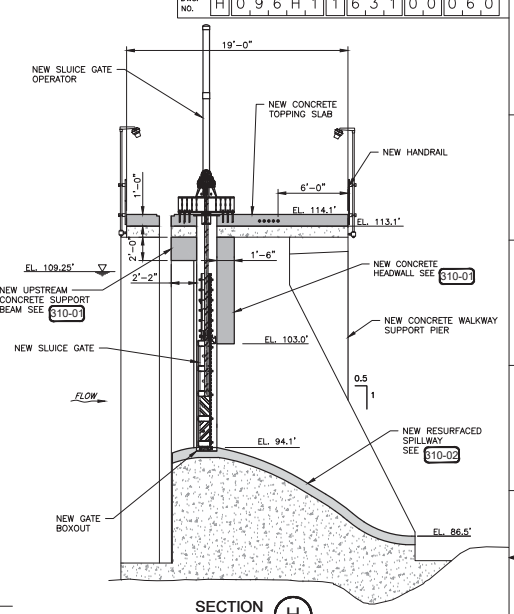
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PLAN @ EL. 113.6'
3/16"=1'-0"

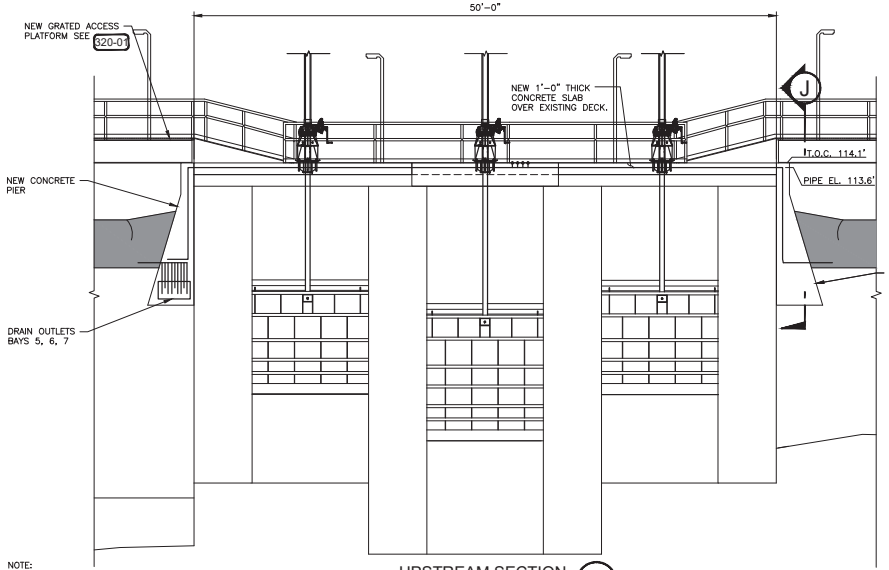


SECTION G
3/16"= 1'-0"



SECTION H
3/16"= 1'-0"

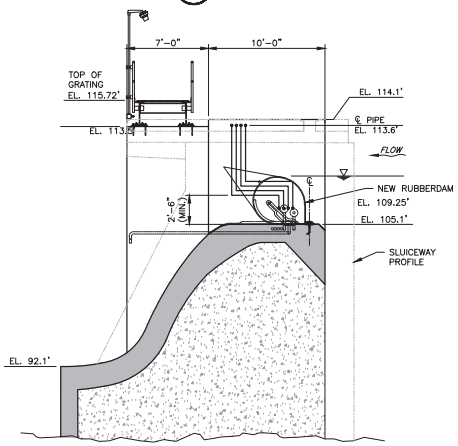
4 0 4 8 12
SCALE IN FEET



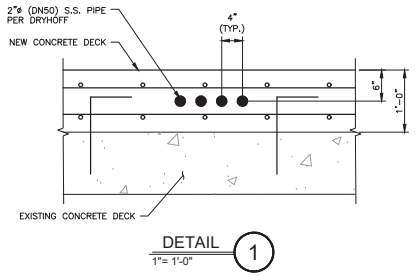
NOTE:
1. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65FT.

UPSTREAM SECTION I
3/16"= 1'-0"

NOTE: SEE DRYHOFF DRAWING 19038-103



SECTION J
3/16"= 1'-0"



DETAIL 1
1"= 1'-0"

ISSUED FOR CONSTRUCTION

330-01

Kleinschmidt

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PRINTED: Jun. 1, 2021 - 3:25 P.M.

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
DRYHOFF DRAWINGS 19038 PACKAGE NOV. 2019													
REFERENCE DRAWINGS	DWG.NO.												

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

REGISTERED PROFESSIONAL ENGINEER — DATE Jun 1, 21 — C. M. Vallis — 9978 — PROVINCE OF NOVA SCOTIA

DEPARTMENTAL APPROVALS

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MECH	CONST

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UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2021-06-01

W.O. XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

RUBBER DAM PIPING AT SLUICEWAY

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 6 0

REV. 0

APPENDIX E – Wetland Monitoring Plan

December 14, 2022

Ms. Kailey Osborne
Nova Scotia Power Inc.
1223 Lower Water St.
Halifax, NS B3J 3S8

Dear Ms. Osborne,

Re: Wetland and Wetland Fish Habitat Monitoring Plan
Ruth Falls Reservoir, Sheet Harbour, NS

INTRODUCTION

Nova Scotia Power Inc. (NSPI) is planning to temporarily lower the headpond at the Ruth Falls Reservoir (the Reservoir) within the Sheet Harbour Hydroelectric System to accommodate refurbishments (the Project). Strum Consulting was retained by NSPI to develop a Wetland and Wetland Fish Habitat Monitoring Plan (the Plan) for the Project.

The objective of the Plan is to determine whether the function of wetlands located along the shore that are contiguous with the headpond are impacted as a result of the lowered water levels. Additionally, the Plan will assess the impact on potential fish habitat provided by these wetlands.

The Plan will outline the general principles and methodology by which the wetlands and fish habitat around the Ruth Falls headpond will be monitored, before and after the water level is altered. Baseline wetland monitoring results will also be included for reference.

PROJECT DETAILS

To accommodate refurbishments at the Ruth Falls Reservoir, the water level in the headpond will be dropped from a full supply level of 109.25 ft down to 91 ft. The headpond will remain lowered for a period of approximately 9 months while work is completed on the Reservoir.

Wetlands

Initial wetland delineation was undertaken along the shores of the Reservoir during the *Vegetation Surveys at the Sheet Harbour Hydroelectric System* completed by Jacques Whitford (JW) in 2007 (JW, 2007). As a result of this delineation, 21 wetlands were identified that are contiguous with the headpond (Table 1; see Drawing 1, Attachment A).

Table 1: Wetlands identified at the Ruth Falls Reservoir (Jacques Whitford, 2007)

Wetland ID	Wetland Type
1	Treed shore bog
2	Treed shore bog
3	**Treed shore bog**
4	Shore bog
5	**Shore bog**
6	**Treed shore bog/floating bog**
7	Shore bog
8	Shore bog
9	Shore bog
10	Shore bog
11	Shore bog
12	Shore bog
13	Shore bog
14	Shore bog
15	**Treed shore bog/treed shore swamp**
16	Treed shore bog
17	**Shore bog**
18	Treed shore bog
19	**Shore bog**
20	Shore bog
21	Shore bog

Fish Sampling

Fish species data collected within the Sheet Harbour hydroelectric system was provided to Strum by NSPI; this historical data, including bathymetry information for the Ruth Falls headpond as well as fish and fish habitat assessment information from the Sheet Harbour Hydro System Relicensing Report (Nova Scotia Power, 2018), was used to establish baseline conditions and will assist in developing fish habitat post-construction monitoring assessments.

WETLAND MONITORING

The wetlands, as identified by JW (2007), provided the initial wetland assessment information; Strum has relied on this previously collected data to select and complete a monitoring assessment on six of these identified wetlands. The six wetlands **bolded** in Table 1 (Wetlands 3, 5, 6, 15, 17, and 19) are those selected for monitoring. Criteria for selection considered distribution throughout the reservoir and representation of different (spatial) areas and various wetland types. The criteria also included screening to ensure that hydrological source, landform, and location within a respective catchment area were represented throughout the Reservoir.

Wetland monitoring activities will consist of four baseline assessments (two of which were completed in July and September 2022), one pre-construction assessment, a minimum of one assessment during

drawdown (pending seasonality and timing of construction), and 5 years of post-construction monitoring. Pre-construction monitoring will be completed prior to the headpond being lowered to establish baseline conditions. Post-construction monitoring will begin after refurbishments are concluded and the Reservoir water level has been returned to its pre-construction full supply level. The findings of the monitoring program will allow for an evaluation of the extent of any changes in wetland characteristics and function as a result of the lowered water levels within the headpond.

Methodology

Wetland monitoring will include detailed vegetative, hydrological, and soil monitoring within the six selected wetlands. Each wetland to be monitored was delineated prior to the commencement of monitoring activities to ensure that wetland boundaries are accurate and up to date, and to establish the current biodiversity of the existing habitat.

Vegetative monitoring will entail an assessment of vegetative composition and cover within quadrats along a transect. The linear transect will consist of a series of four 1 m x 1 m quadrats placed 5-10 m apart along the transect route. Percent cover of the herbaceous, shrub/sapling, and tree species within each quadrat will be assessed. The top right corner of each quadrat will be staked to ensure that the selected areas can be replicated for future monitoring events. Additionally, dominant plant species throughout the wetland, as identified along the transect, will be determined for each stratum based on the percentage of vegetative cover. A general assessment will be made to determine overall plant health and note any species that appear to be unhealthy or dying. Vegetative biodiversity will be considered throughout the monitoring timeline to establish whether there is a change in species composition for vegetation plots assessed.

To aid in the extrapolation of data between the wetlands monitored and those that are not, standardized placement of monitoring wells and vegetation plots within wetlands has been conducted. This will ensure consistency throughout the data set, as well as across the different wetland types.

- Monitoring wells were installed halfway between (1) a point on the upland edge of the wetland furthest from open water, and (2) the nearest open water.
- Vegetation plots were positioned between the monitoring well and the water's edge in a line, spaced 5-10 m apart. Where sufficient distance between the monitoring well and the water's edge wasn't available, the plots were positioned towards the upland edge, maintaining the linear distribution.

During initial delineation, soil test pits were incorporated via manual installation (auger, shovel). Indicators of wetland hydrology were noted, including soil saturation, water table level, and standing water. Soil type(s) within each test pit were identified and will be monitored as the wetlands are re-assessed for function during the 5 years post-construction assessments. Subsequent monitoring activities will follow this same approach.

Photographs will be taken of the wetland from a fixed location (identified via GPS) for comparison with future events. All monitoring methodology will be completed during pre-construction and post-construction monitoring events. Initial monitoring events were conducted by a trained biologist and took place within the growing season (June 1 – September 30) to capture the prime growth period for

plants and assess dry season conditions. Subsequent monitoring events will be timed to coincide with previous years' assessment dates to allow data comparisons to be made with previous and future monitoring events. Given the uncertainty of the timing of drawdown, subsequent monitoring events will be timed to best reflect the changing conditions, while also considering the growing season and previously obtained baseline data to accurately assess any changes to vegetative biodiversity.

A description of the monitoring parameters and assessment methodology for wetlands is provided in Table 2, below. All data gathering techniques will be replicated for each subsequent monitoring event.

Table 2: Wetland Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Methods of Assessment
Hydrology	Depth to groundwater will be measured in monitoring wells.
	Standing water depth measurements will be noted within the existing wetland (if applicable).
	Evidence of other positive indicators of hydrology (*e.g.*, drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen sulphide odour in soils, water marks etc.) will be noted.
	An assessment of the general hydrologic condition will be made.
Vegetation	Herbaceous vegetation assessments (as % cover) will be completed within plots along a vegetative transect throughout the wetland. Assessment of the potential changes in composition, species, and health will be evaluated. Photographs will be taken of each individual vegetation plot for comparison with future monitoring events. Any presence of non-native/exotic species will be noted during all surveys, and are addressed specifically in the WESP-AC assessment.
	General assessment of the above variables throughout the wetland will be completed.
	Dominant plant species throughout the wetland will be determined for each stratum based on the percentage of aerial cover. Changes to biodiversity will be monitored over time through identification of species composition.
	Photographs will be taken of the wetland from a fixed location for comparison with future monitoring events.
Soils	Soil type within test pits will be noted and recorded.
	Assessment of potential changes in soil conditions throughout the wetland habitat will be evaluated, including evidence of sedimentation and siltation.

Wetland Functional Assessments (WESP-AC)

WESP-AC was completed during initial baseline pre-construction surveys and will be replicated during the Year 5 post-construction monitoring event to assess whether the function and relative values of the wetlands were changed as a result of the Project.

WETLAND FISH HABITAT MONITORING

Review of Fish Sampling Results

A review of fish sampling conducted by NSPI was completed for all data available prior to the commencement of monitoring. The review involved data compilation of fish species and abundance,

information related to migratory periods (including applicable date ranges and species types observed) and identified species' habitat requirements.

Desktop Fish Habitat Suitability Review

Prior to the commencement of monitoring, a desktop fish habitat suitability review was completed to assess the quality of fish habitat provided by both the Ruth Falls Reservoir and the wetlands contiguous with the Reservoir's shoreline. This review was used to help identify the wetlands that provide valuable fish habitat and inform the selection of wetlands for both wetland monitoring and wetland fish habitat monitoring, and included the following:

- Accessibility to fish
- Provision of fish cover
- Provision of water quality control features
- Potential sources of food and nutrition
- Bathymetry and water depth of the reservoir
- Review of fish sampling results

Based on this assessment, the six wetlands selected were considered most likely to provide a variety of suitable fish habitat for wetland fish habitat monitoring (in addition to meeting the requirements of the wetland monitoring selection criteria).

Assumptions for Fish Habitat Assessments

Fish habitat field surveys are to be modelled after the Ontario Ministry of Natural Resources Procedure (1991) for the Bay of Quinte. Given that the habitat assessments are taking place along the shoreline of a body of (relatively) still water, rather than along a watercourse, the application of flow assessments and fish habitat in streams is less transferable and resources such as the Nova Scotia Fish Habitat Suitability Assessment (NS Adopt-a-stream, 2018), are not as applicable.

Given NSPI's ongoing fish monitoring at the Ruth Falls fish ladder, it is assumed that fish are present in the Reservoir, and that there are fish that use the habitats being surveyed. Therefore, minimizing damage and disruption to fish in sensitive situations, such as breeding, will take priority over the collection of any single data point. If fish breeding evidence is encountered during surveys, those effected data points may be omitted to prevent disturbance during these sensitive periods. NSPI may also want to consider structuring their work schedule around the known breeding periods of any species of conservation interest, including Atlantic salmon (*Salmo salar*).

Wetlands will be monitored for function and fish habitat during the summer months, though they are likely to provide fish habitat year-round. In this instance, the Ordinary High-Water Mark (OHWM) has been defined as the ordinary high-water level within the Reservoir under normal operating conditions. Given that NSPI has some control over water levels, the OHWM is assumed to be the average of the highest operating-condition water levels. This means that water levels during flood conditions in the spring are not considered as the high-water level for the purpose of this assessment. The delineation of fish habitat occurred during initial baseline surveys with consideration given to the OHWM (as

defined herein), further surveys during drawdown and post construction will assess the current conditions at those times and be compared to the baseline conditions.

Methodology for Fish Habitat Field Assessments

The requirements for the baseline and subsequent fish habitat monitoring are described below in detail, including the timing of each of the field and desktop components.

The initial baseline surveys for fish habitat identification and classification were conducted by trained biologists and took place within the growing season on July 4-5, and again on September 6, 2022. The initial baseline surveys were conducted at the six selected wetlands surrounding the Ruth Falls Reservoir. The six wetlands were surveyed for both wetland function and characteristics as well as wetland fish habitat to incorporate the consideration of fish habitat and details associated with water quality. Upon completion of baseline studies, the monitoring schedule will proceed as outlined in the Proposed Schedule and Reporting section of this Plan.

Following the procedure outlined in the Ontario Ministry of Natural Resources (1991) document, transects will be walked from the Open Lake inland, through the Lakeshore and into the backshore for all subsequent monitoring events. This will align with the program that was completed during the baseline studies. General observations will be made, and specific parameters will be assessed for their likelihood to support fish habitat, as seen in Table 3, below.

Along the transects, the portions of each transect to be assessed will be defined as follows:

Open Lake (OL): Open Lake is the area that is completely inundated with water, and can be definitively considered direct fish habitat. There may be any combination of emergent, floating, and submerged vegetation, though the water depth should be no more than 50 cm. The Open Lake area must also be connected to the main water body of the Reservoir to allow fish passage.

Lakeshore (LS): The Lakeshore (also known as the Foreshore) is the area that is generally above the current water level of the lake (Reservoir), but below the highwater line (during flood conditions) on an annual basis. This area might be considered direct fish habitat, though indirect fish habitat should not be considered a requirement. There is wetland vegetation, with the potential for some aquatic vegetation, especially when in proximity to the Open Lake area. The point for the LS assessment should be where there is a transition from standing water to no standing water.

Backshore (BS): The Backshore is the area at least 30 m perpendicular inland to the shore's highwater line and it should not be saturated in water, though it can be wetland or upland. It is not considered fish habitat and should not be accessible to fish.

The parameters to be monitored at each portion of the transect (i.e., OL, LS and BS) are described in Table 3.

Table 3: Wetland Fish Habitat Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Transect Portion to be assessed	Methods of Assessment
Photos	OL, LS, BS	Photos will be taken of the substrate (where applicable), vegetation, surrounding habitat, and any other observations of note.
GPS	OL, LS, BS	GPS waypoints will be taken to accurately map results and track the movement of OL and LS waypoints based on de-watering activities.
Vegetation	OL, LS, BS	Relevant vegetation within a 5 m radius will be recorded, and the relative abundance within each stratum within a 30 m radius will be estimated.
Aquatic vegetation	OL, LS	Any water-bound vegetation species will be noted within a 5 m radius and the relative abundance as a percent cover within a 30 m radius will be estimated.
Water Quality	OL/LS	Standard parameters including pH, conductivity, temperature, and dissolved oxygen will be measured using a YSI Multiparameter meter where open water is present and can be accessed safely. At the Lake Shore area, this may not be possible given differing water levels and vegetation constraints but it will be captured where feasible.
Substrate	OL, LS, BS	Substrate types and relative abundance will be noted, including bedrock, boulders, rubble, cobble, gravel, sand, detritus, and fines/muck/silt.
Water Level/Depth	OL, LS	The depth or level of water compared to the substrate should be measured using a measuring device. The use of a piezometer for continuous measurement may be required in conjunction with, or as a replacement to, any monitoring wells installed within the selected wetlands to be monitored.

Given that the water level will significantly change during drawdown, the transects where the assessment points are taken will remain the same, however, new assessment points will be added at each of the monitoring sites to reflect the changing OL and LS locations. The transect lines will still inform the placement of those points of assessment, however, if safety challenges prevent access to a specific location, the point will be moved to a nearby and comparable safe location, or omitted entirely if accessible and representative habitat is not present. Upon water levels rising to pre-construction levels (or as close as can be expected in post-construction conditions), the original assessment points will be resumed for all post-construction monitoring, to the best ability of the biologist conducting surveys.

Fish habitat will be classified as it is defined in Table 4, for the purpose of determining the extent to which any given habitat might contribute to fish habitat, either directly, indirectly, or not at all.

Table 4: Criteria to determine habitat

Habitat Type	Location(s)	Definition
Direct	Open Lake, Lakeshore (possible)	"…Water frequented by fish…on which fish depend on…to carry out their life processes including spawning grounds and nursery, rearing, food supply, and migration areas" (Federal Fisheries Act, Section 34.1).
Indirect	Lakeshore	Areas where fish might pass, but are not necessarily reliant upon (the areas) for life processes, areas that may be temporarily inundated, temporarily flowing (ephemeral), or where some direct habitats draw important resources from.
Not Fish Habitat*	Backshore, Lakeshore (possible)	Areas not accessible to fish, including upland areas, water that is too warm/cold (species specific). In this instance, Backshore Areas are the primary concern and will be assumed as the standard for "not fish habitat".

*Note that some nearshore environments may also qualify as "not fish habitat" dependent on factors such as vegetation and water quality. This will be further assessed as a component of the wetland and fish habitat monitoring program.

In all cases, the assessment points and transects will be chosen to best represent the surrounding habitats.

Baseline Monitoring Results

Initial baseline monitoring was conducted on July 4-5, and September 6, 2022. All wetlands were accessed via boat over the Reservoir, and each wetland was accessed successfully, as locations provided by the JW (2007) were confirmed. Each wetland was assessed using WESP-AC functional assessment protocols (Attachment B – WESP-AC Forms) and delineated to establish current boundaries. Once this delineation and functional assessment was complete, the installation of monitoring wells and vegetation plots were done according to the methodologies outlined above. One wetland (WL17) was assessed as an island of wetland habitat within the reservoir, and thus had no associated upland habitat directly adjacent, nor any "Back Shore" for the purposes of fish habitat monitoring. Results from the vegetation plots and monitoring wells can be seen in Attachment C – Wetland Monitoring Data.

Detailed information obtained for each of the selected wetlands during initial baseline monitoring assessments can be found in Drawings 2-7, Attachment A.

Wetland delineation and characterization from initial baseline studies agree overall with the JW (2007) study, though the water's edge where the wetlands are contiguous with the Reservoir has changed slightly, given the variable water levels and weather impacts. Wetland types were confirmed, and fish habitat characteristics were assessed.

Wetland Fish Habitat assessment results are included in Attachment D – Fish Habitat Assessment Data. Fish habitat assessments were conducted after delineation to ensure that boundaries could be used to inform the placement of the transect that was travelled for wetland fish habitat assessment.

Given constraints surrounding accessibility, water quality measurements were only collected at LS locations for each of the wetlands surveyed.
As outlined above, each wetland (aside from WL17 – an island) had a distinctly observable upland edge where "Back Shore" measurements were collected. Significant forestry impacts exist on many of the properties that surround the reservoir, though there is generally a riparian buffer separating the water's edge from those heavily forested areas. Details on habitat for each wetland is outlined in Table 5, as a combination of both initial baseline surveys and general observations.

Table 5: Wetland Fish Habitat - Baseline Observations

Wetland	Open Lake	Lakeshore	Backshore
Wetland 3	Permanently flooded with abundant large woody debris and moderate floating and emergent vegetation. No fish observed, though rocky (primarily rubble) substrate suggests positive attributes to fish habitat. Quite shallow – 25 m offshore there are emergent boulders. Direct fish habitat.	Some overhanging vegetation. Shoreline is quite distinct, though there is slightly more emergent vegetation. Under normal operating conditions should be considered Indirect Fish Habitat.	Spruce dominated forest with clear signs of previous forestry management present. No evidence of watercourses or significant surface flow nearby.
Wetland 5	Permanently flooded with some rocky and woody debris. Substrate slopes away from the wetland edge quite quickly to deep water. Direct fish habitat is present in shaded areas closer to the shoreline, both adjacent to the wetland and further along the shore. Direct fish habitat.	Ephemeral brook flowing along the southeast boundary of the wetland providing cooler water inputs from the forested area upstream for Indirect Fish Habitat.	Young to moderate aged coniferous forest present in all nearby upland, except along lakeshore.
Wetland 6	Plenty of submerged and emergent woody debris and boulders, as well as moderate emergent vegetation. Fish observed. Direct fish habitat.	A poorly defined channel flows out of the wetland near the location of water quality measurements, but no flow was present during baseline monitoring events. Rocky substrate (rubble) with significant silt on top. Indirect fish habitat.	Young-mid aged softwood dominated forest. Appears to have been previously impacted by forestry operations.
Wetland 15	Appears to be permanently flooded with very little vegetation or emergent debris. Appears to drop-off to deeper water quite quickly. Direct fish habitat.	Small ephemeral outflow with boulders and overhanging vegetation present at location of water quality measurements, though the ground level of the wetland is significantly higher than water levels. Indirect fish habitat	Clearcut present approximately 25 m inshore from wetland/upland edge. No signs of waterflow over land, though some small ditches of water are present due to forestry impacts.

Wetland	Open Lake	Lakeshore	Backshore
Wetland 17	Quite shallow all around the wetland (an island), with abundant emergent and aquatic vegetation. Fairly rocky substrate, though some silt on top as well. No deep water for ~5 m in all directions surrounding the wetland. Direct fish habitat.	Shoreline habitats varied from rocky and muddy to fully vegetated. Vegetation remains consistent across the land/water boundary. Indirect fish habitat	No Backshore present. It is suspected that the entire wetland could flood during highwater conditions outside of the flood season.
Wetland 19	Permanently flooded with gravel and sand substrate present on the east side of the wetland, fish observed, and clear signs of Direct Fish Habitat. West side of wetland bordering on small cove has muck/mud substrate and is very shallow providing poor fish habitat.	No clear inflow/outflow present, with the western border of the wetland being contiguous with the open water, while the eastern border having a proper border. Indirect fish habitat on all on sides.	Backshore is young softwood with relatively few undergrowth species. No signs of waterflow overland, nor signs of flooding at any time.

All instances included passage through the Open Water by boat, where observations on habitat and substrate were made. Backshore conditions (where available) included similar species distributions throughout the Reservoir, though the impacts of forestry on those habitats is well established.

During future monitoring events, the locations of water quality measurements (Lakeshore during baseline monitoring), Open Water, and Lakeshore are likely to change, sometimes in a significant way. Pre-construction and post-construction monitoring locations are expected to remain consistent, as outlined above, although during construction there is anticipated to be differing amounts of change at each wetland, considering their positions within the Reservoir. These differences will be noted and aid in the comparison of fish habitat quality and abundance between baseline, during construction, and post-construction conditions.

With fish being observed at both WL6 and WL19, as well as the confirmed presence of fish crossing the dam and spillway at the south end of the Reservoir, it is understood that under current conditions, each of the wetlands monitored provides some level of fish habitat, as well as indirect benefits to fish habitat.

PROPOSED SCHEDULE AND REPORTING

Annual post-construction monitoring reports will be submitted to Nova Scotia Environment and Climate Change (NSECC) for the five years of post-construction monitoring. Vegetation results shall be provided in a cumulative table to allow for inter-annual comparison of data. Table 6 outlines the monitoring and reporting schedule for the Wetland Monitoring Program, while Table 7 outlines the monitoring and reporting schedule for the Wetland Fish Habitat Monitoring Program.

Table6: Monitoring and Reporting Schedule for Wetland Monitoring

Monitoring Event		Wetland and Wetland Fish Habitat Monitoring	WESP-AC	Reporting Submission to NSECC
Pre-construction	Baseline	✓	✓	
During Construction		✓		Memo
Post-construction	Year 1	✓		✓
	Year 2	✓		✓
	Year 3	✓		✓
	Year 4	✓		✓
	Year 5	✓	✓	✓

Information collected from post-construction monitoring events will be compared with the baseline data collected during the pre-construction monitoring events and previous years' monitoring events to evaluate post-construction vegetation (e.g., wetland and vegetation present, invasion of exotic species, success of any re-vegetation, etc.), hydrology, and soils. After Year 5, potential long-term impacts to the wetlands will be assessed, a follow up WESP-AC program will be completed, and required consultation with NSECC will take place.

Table 7: Monitoring and Reporting Schedule for Wetland Fish Habitat Monitoring

Monitoring Event		Fish Habitat Transect Monitoring	Desktop Review of Fish Data	Reporting Submission to NSECC & DFO
Baseline		✓	✓	✓
Pre-construction	1 week before drawdown	✓	✓	✓
During Construction*	1 week after drawdown	✓	✓	✓
	End of growing season during drawdown/construction	✓	✓	✓
Post Construction*	1 week after water level is restored	✓	✓	✓
	Year 1	✓	✓	✓
	Year 2	✓	✓	✓
	Year 3	✓	✓	✓
	Year 4	✓	✓	✓
	Year 5	✓	✓	✓

*Monitoring may be limited depending on the time of year when construction is to be completed, *i.e.,* if construction is completed in January, the first post-construction survey will not be completed before the growing season begins in June.

Information during post-construction monitoring will be used to inform reports submitted to NSECC and Fisheries and Oceans Canada (DFO) on an annual basis, while further consultation with each respective governing body may be required after the post-construction monitoring is completed.

CLOSURE

Thank you for the opportunity to develop this Wetland and Wetland Fish Habitat Monitoring Plan. If you have any questions, please contact us.

Thank you,

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Environmental Scientist
adoane@strum.com

Natasha Myers, BSc., EP, PMP
Senior Environmental Scientist
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REFERENCES

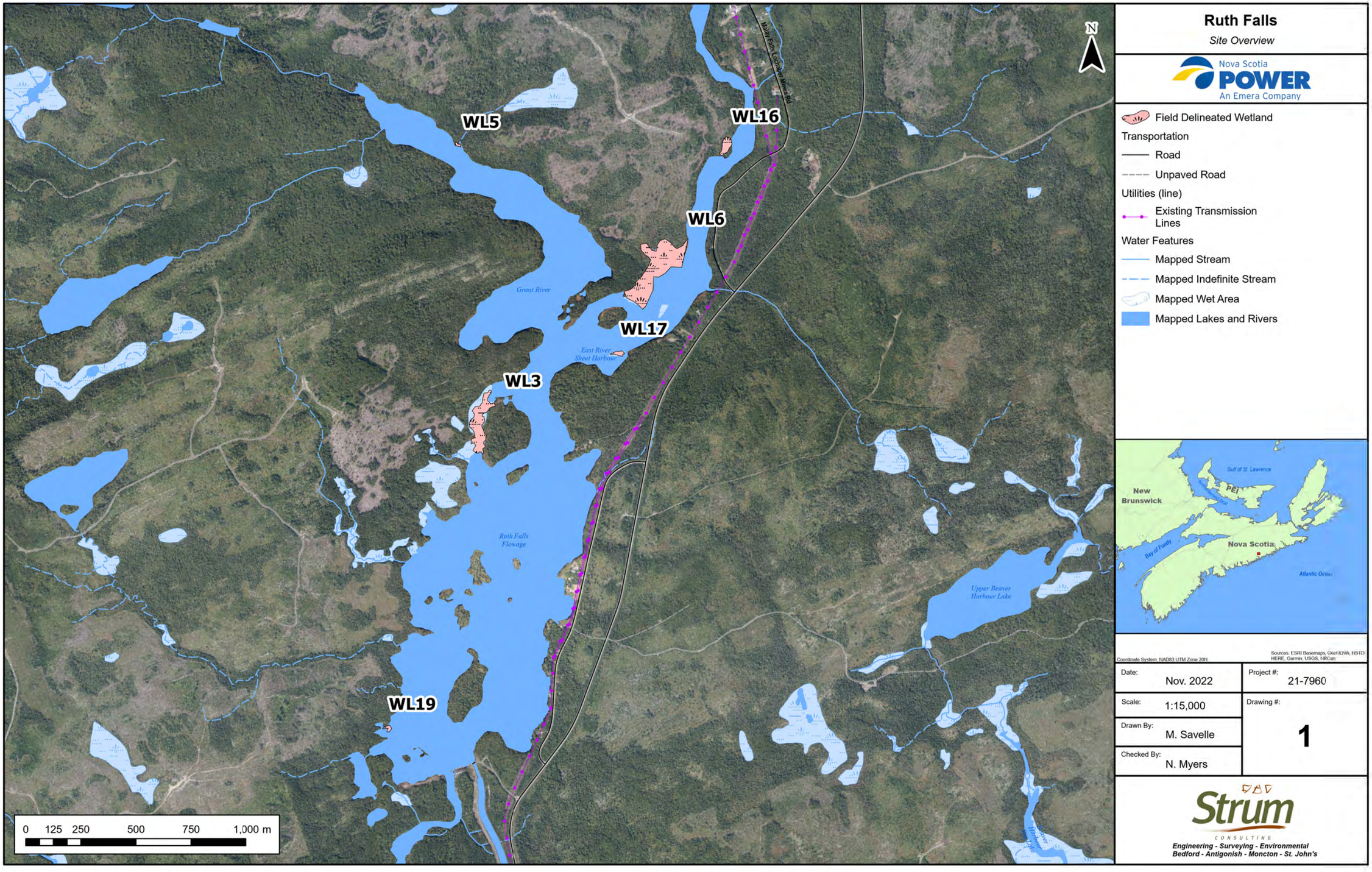
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ATTACHMENT A
DRAWINGS



Ruth Falls

Site Overview

Nova Scotia POWER
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- Field Delineated Wetland

Transportation
- Road
- Unpaved Road

Utilities (line)
- Existing Transmission Lines

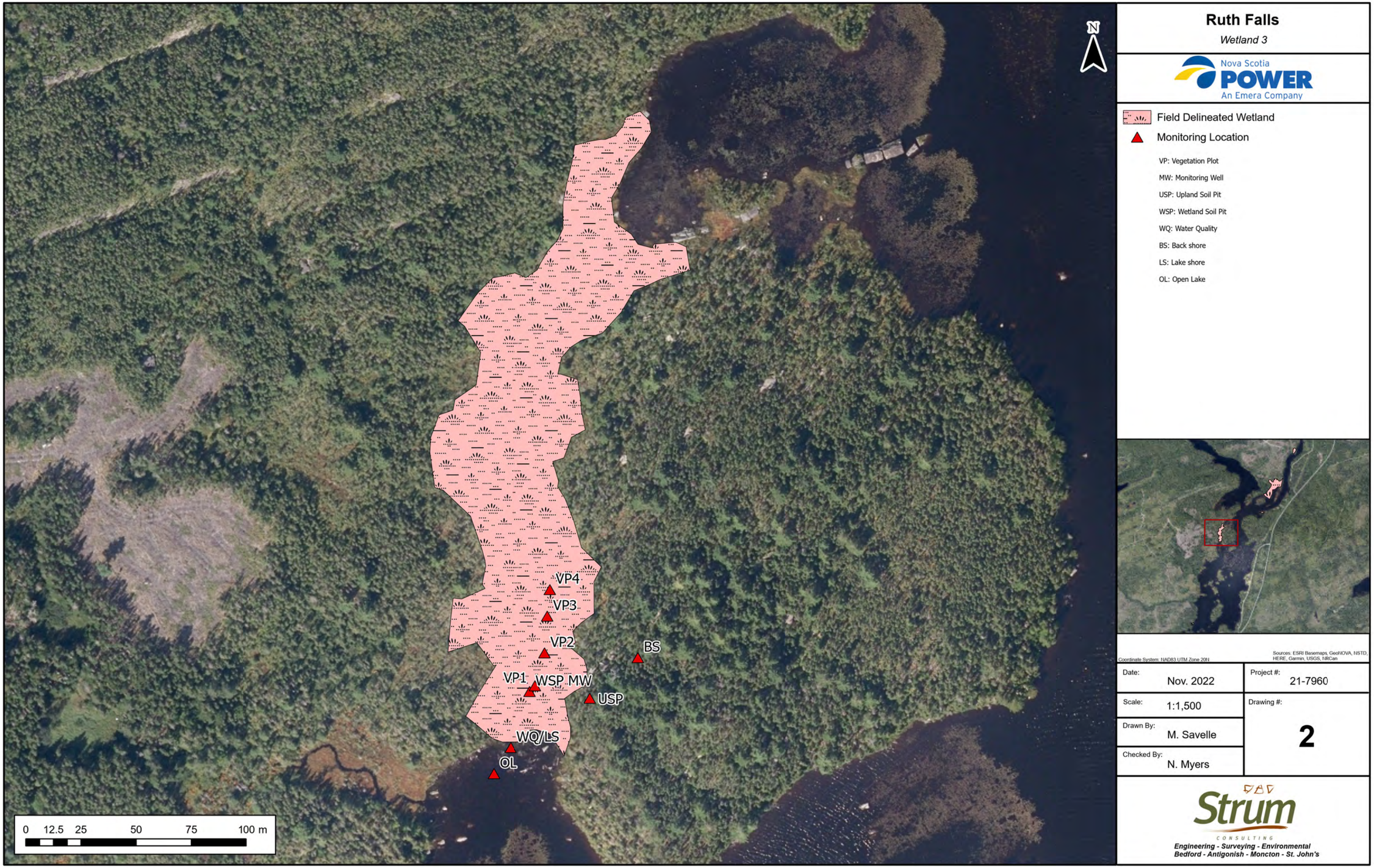
Water Features
- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area
- Mapped Lakes and Rivers

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoEYE, INSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:15,000	Drawing #: 1
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 3

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot

MW: Monitoring Well

USP: Upland Soil Pit

WSP: Wetland Soil Pit

WQ: Water Quality

BS: Back shore

LS: Lake shore

OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:1,500	Drawing #: 2
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 5

Nova Scotia POWER
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- Field Delineated Wetland
- Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

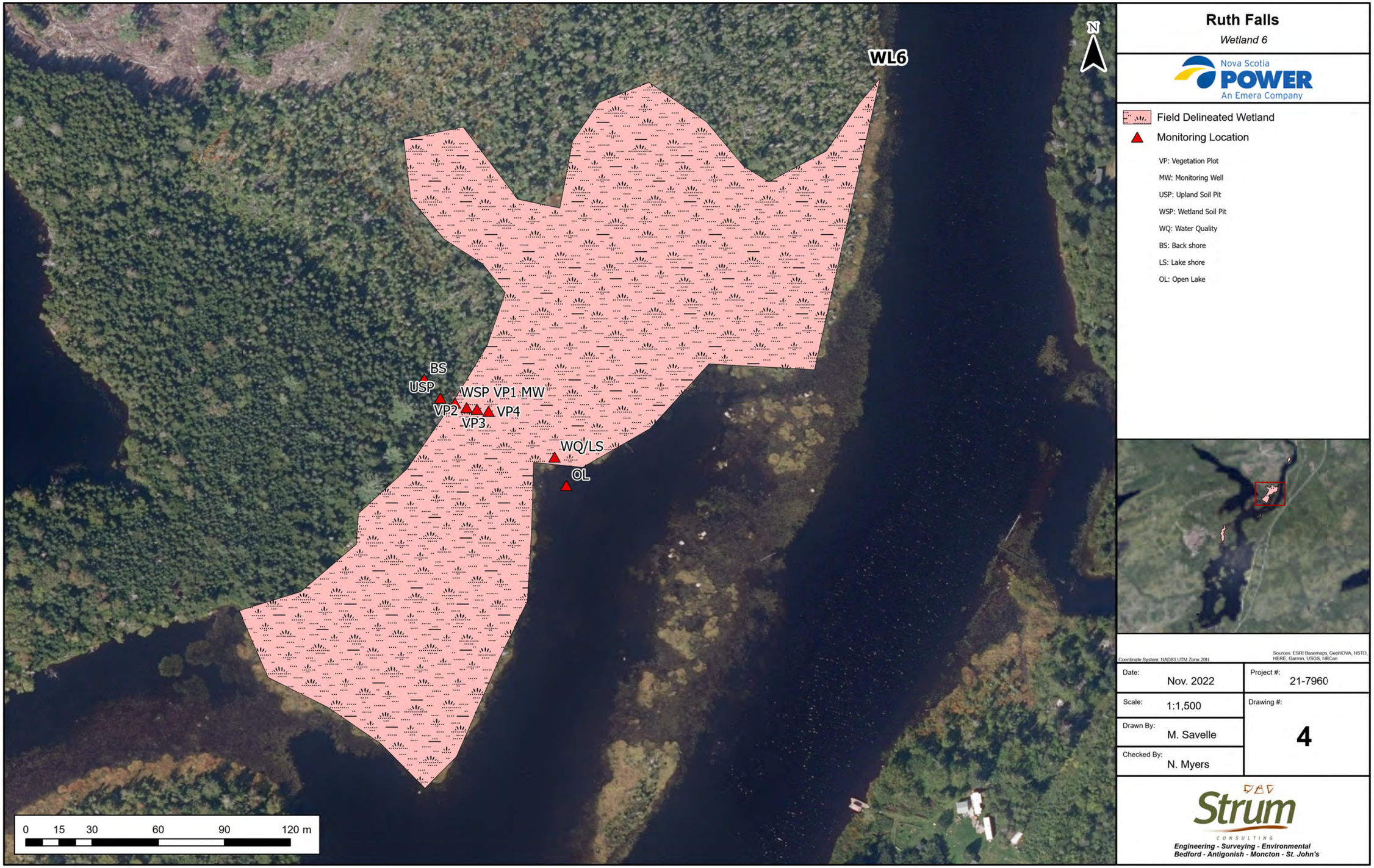


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Ruth Falls

Wetland 6

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:1,500	Drawing #: 4
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 16

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Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

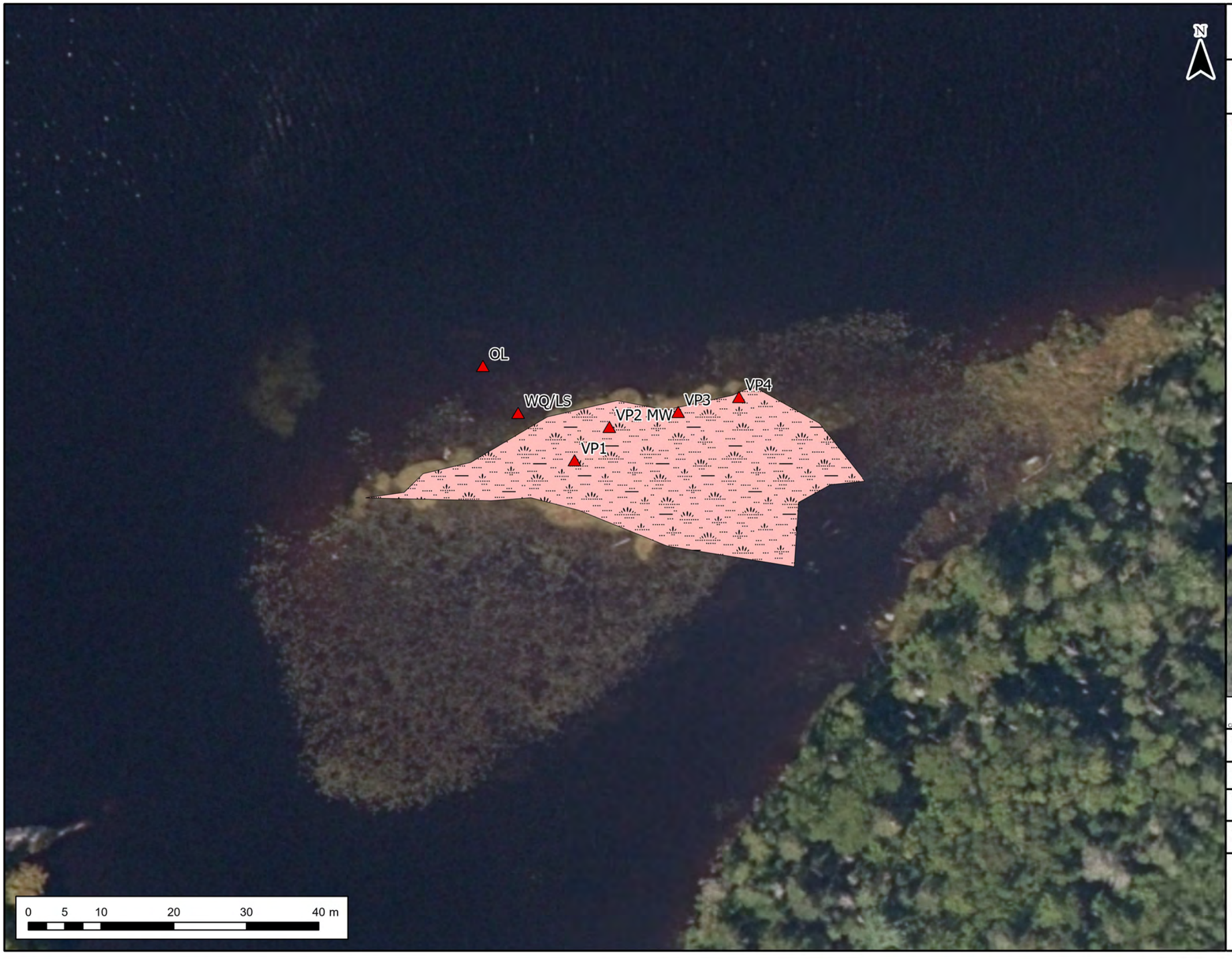
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Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 5
Drawn By: M. Savelle	
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Ruth Falls

Wetland 17

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Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake



Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 6
Drawn By: M. Savelle	
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Ruth Falls

Wetland 19

Nova Scotia POWER
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Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 7
Drawn By: M. Savelle	
Checked By: N. Myers	

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ATTACHMENT B
WESP-AC FORMS

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 3
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.96946
Longitude (decimal degrees):	-62.49768
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	1.35 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	1.35 ha
What percent (approx.) of the **wetland** were you able to visit?	100%
What percent (approx.) of the **AA** were you able to visit?	100%
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

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1	Date: July 5, 2022		Site Identifier: Ruth Falls WL3	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	1	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

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31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	1	
35			50-500 m, but separated by those features.	0	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

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56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	0	
62			>500 m.	1	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	1	
75			1 -2 km.	0	
76			2-5 km.	0	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

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92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

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145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

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1	5-Jul-22		Site Identifier: Ruth Falls WL 3	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	1	
14			A2.	0	
15			B1.	0	
16			B2.	0	

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17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	1	
19			deciduous trees taller than 3 m.	1	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	3	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> **30-70%.** Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	0	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	1	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

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57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	0	
85			100-1000 sq. m.	1	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	1	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

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94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.		
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

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128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

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169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	1	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	0	
243			2-5%.	1	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	1	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	1	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	0	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL 3**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	2
			Sum=	7
			Stressor subscore=	0.58

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	0
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	2
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	3
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	3
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	8
			Stressor subscore=	0.67

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.	
Leveling or other grading not to the natural contour.	
Tillage, plowing (but excluding disking for enhancement of native plants).	
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.	
Excavation.	
Ditch cleaning or dredging in or adjacent to the wetland.	
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.	
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL3

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.96946 & -62.49768

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	7.98	Higher	7.86	Higher	7.90	3.48
Stream Flow Support (SFS)	1.60	Moderate	2.55	Moderate	1.29	1.70
Water Cooling (WC)	10.00	Higher	0.00	Lower	6.67	0.00
Sediment Retention & Stabilisation (SR)	4.30	Moderate	3.12	Moderate	5.56	1.53
Phosphorus Retention (PR)	2.09	Lower	2.77	Higher	5.05	2.15
Nitrate Removal & Retention (NR)	10.00	Higher	5.14	Moderate	10.00	5.14
Carbon Sequestration (CS)	4.69	Moderate			7.42	
Organic Nutrient Export (OE)	8.86	Higher			5.79	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.88	Higher	0.77	Lower	5.89	1.66
Amphibian & Turtle Habitat (AM)	2.22	Lower	4.20	Moderate	4.29	5.22
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	6.51	Moderate	10.00	Higher	5.67	10.00
Pollinator Habitat (POL)	7.48	Moderate	6.67	Moderate	6.20	6.67
Native Plant Habitat (PH)	5.82	Moderate	6.18	Moderate	6.22	6.18
Public Use & Recognition (PU)			2.60	Moderate		2.08
Wetland Sensitivity (Sens)			8.89	Higher		4.71
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			9.42	Higher		4.70
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	7.98	Higher	7.86	Higher	7.90	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	7.64	Higher	4.41	Moderate	8.50	4.04
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	8.29	Higher	1.83	Lower	5.79	1.41
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.33	Lower	2.52	Moderate	2.57	3.13
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.04	Higher	8.81	Higher	6.13	8.81
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			9.16	Higher		4.71

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	62.68937601	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	33.64974214	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	15.16699195	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.362856423	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	62.02430846	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 5
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.981186°
Longitude (decimal degrees):	-62.499067°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.031765
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	0.031765
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL5	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of surface water ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		"Adjacent" means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	0	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of wetlands and surface water ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all adjacent upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	1	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the **center** of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	0	
62			>500 m.	1	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to **blank** if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is **larger than 8 hectares** during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest **tidal water** body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	

	A	B	C	D	E
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.15	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	

	A	B	C	D	E
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

	A	B	C	D	E
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands. Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL5	Investigator: Darcy Kavanagh & Angus Doane	
2	Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia. DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	1	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	0	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11			*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*		
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	1	
15			B1.	0	
16			B2.	0	
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		Deciduous shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the tree/shrubs is <95% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM

	A	B	C	D	E
18			coniferous trees (may include tamarack) taller than 3 m.	2	the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
19			deciduous trees taller than 3 m.	1	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	1	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do not comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% of the woody canopy cover in the AA or >5% of the wooded areas (if any) along its upland edge (perimeter). The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	1	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation taller than 1 m nor the vegetation shorter than that comprise >70% of the vegetated part of the AA. They each comprise 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (diameter >20 cm) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces longer than 2 m and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	

	A	B	C	D	E
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of open water that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and SKIP to F41 (Floating Algae & Duckweed).	0	Open water is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is open (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	

	A	B	C	D	E
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's water edge length that is nearly flat (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage of the emergent vegetation cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		Emergent vegetation is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. SKIP to F38.	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of emergent vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and SKIP to F42.(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of dead wood and undercut banks is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore by water depths >1 m on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the least permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where surface water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by most of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into herbaceous vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into herbaceous vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into tree trunks and/or shrub stems but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly indirect path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	1	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			Evident from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			Likely based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	1	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	1	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL5**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5

Soil or Sediment Alteration *Within the Assessment Area*

In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]

Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.	
Leveling or other grading not to the natural contour.	
Tillage, plowing (but excluding disking for enhancement of native plants).	
Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.	
Excavation.	
Ditch cleaning or dredging in or adjacent to the wetland.	
Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.	
Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
			Sum=	0
			Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL5

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.981186° & -62.499067°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	9.12	Higher	7.88	Higher	8.75	3.49
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	10.00	Higher	0.00	Lower	6.67	0.00
Sediment Retention & Stabilisation (SR)	6.44	Moderate	3.02	Moderate	7.22	1.48
Phosphorus Retention (PR)	1.85	Lower	3.04	Higher	4.91	2.36
Nitrate Removal & Retention (NR)	10.00	Higher	5.56	Moderate	10.00	5.56
Carbon Sequestration (CS)	6.58	Higher			8.31	
Organic Nutrient Export (OE)	5.34	Moderate			3.49	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.88	Higher	0.23	Lower	5.89	1.37
Amphibian & Turtle Habitat (AM)	0.44	Lower	3.88	Moderate	3.36	4.95
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	5.59	Moderate	10.00	Higher	4.86	10.00
Pollinator Habitat (POL)	6.61	Moderate	6.67	Moderate	5.48	6.67
Native Plant Habitat (PH)	3.44	Lower	5.67	Moderate	5.28	5.67
Public Use & Recognition (PU)			2.60	Moderate		2.08
Wetland Sensitivity (Sens)			7.71	Higher		4.37
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			8.41	Higher		4.22
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	9.12	Higher	7.88	Higher	8.75	3.49
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.11	Higher	4.71	Moderate	8.80	4.34
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.65	Higher	0.16	Lower	5.34	0.91
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	0.27	Lower	2.33	Moderate	2.01	2.97
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	5.91	Moderate	8.72	Higher	5.34	8.72
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			8.06	Higher		4.29

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	71.88945608	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	38.22502401	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	1.193241535	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	0.617343402	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	51.55843686	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	WESP-AC version 2
Site Name:	Ruth Falls Wetland 6
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.975436°
Longitude (decimal degrees):	-62.487924°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	3.35 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	3.35 ha
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL6	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.				
3	**#**	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	1	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	

	A	B	C	D	E
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to **blank** if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is **larger than 8 hectares** during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest **tidal water** body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. **This will be true for most** assessments done with WESP-AC.	0	
92	OF17	Flood Damage from **Non-tidal** Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do **not** show Flood Zone or Flood Risk areas (**or no such mapping has been done locally**) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is **no infrastructure** vulnerable to river flooding unrelated to tidal storm surges.	0	

	A	B	C	D	E
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	

	A	B	C	D	E
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]

	A	B	C	D	E
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL6	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	2	
19			deciduous trees taller than 3 m.	2	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>each comprise</u> 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	1	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	0	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	0	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	1	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter **>10 cm**, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	1	
81			Shallow Peat or organic <40 cm deep.	0	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	0	
103			50-95% of the vegetated area.	1	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	1	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL6**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL6

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.975436° & -62.487924°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	9.29	Higher	7.86	Higher	8.88	3.48
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	6.44	Moderate	2.17	Moderate	7.22	1.06
Phosphorus Retention (PR)	1.59	Lower	1.88	Moderate	4.74	1.46
Nitrate Removal & Retention (NR)	10.00	Higher	5.00	Moderate	10.00	5.00
Carbon Sequestration (CS)	6.42	Higher			8.24	
Organic Nutrient Export (OE)	5.30	Moderate			3.47	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	7.88	Higher	1.03	Lower	6.71	1.80
Amphibian & Turtle Habitat (AM)	2.42	Lower	4.49	Moderate	4.39	5.46
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.34	Moderate	10.00	Higher	6.39	10.00
Pollinator Habitat (POL)	7.31	Moderate	6.67	Moderate	6.06	6.67
Native Plant Habitat (PH)	5.32	Moderate	6.37	Moderate	6.02	6.37
Public Use & Recognition (PU)			2.69	Moderate		2.14
Wetland Sensitivity (Sens)			9.23	Higher		4.80
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			8.26	Higher		4.15
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	9.29	Higher	7.86	Higher	8.88	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.06	Higher	4.01	Moderate	8.77	3.75
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.59	Higher	0.68	Lower	4.63	1.20
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.45	Lower	2.69	Moderate	2.64	3.28
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.00	Higher	8.84	Higher	6.27	8.84
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			8.74	Higher		4.47

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	72.99984688	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	32.28886351	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	3.821786962	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.916235569	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	61.84993183	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	WESP-AC version 2
Site Name:	Ruth Falls Wetland 15
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.981144
Longitude (decimal degrees):	-62.483722°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.271124 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	100
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL15	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	1	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

	A	B	C	D	E
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.15	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]

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146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to **blank**.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to **blank** (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank** (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank**.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank**.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to **blank**.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL15	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	0	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	1	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*				
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	1	
14			A2.	1	
15			B1.	0	
16			B2.	0	

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17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	1	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	3	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	1	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. They <u>each comprise</u> 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	

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57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	1	
81			Shallow Peat or organic <40 cm deep.	0	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	1	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	0	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	1	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	1	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	0	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	1	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	1	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	1	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	1	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	1	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	1	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	1	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	1	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	1	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	1	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	1	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	1	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	1	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	1	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	1	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	1	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	0	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	0	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	1	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	0	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
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Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL15**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	0
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	0
			Sum=	3
			Stressor subscore=	0.25

		Data
S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	
Erosion from construction, in-channel machinery in the CA.	1
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	3
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	0
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	5
			Stressor subscore=	0.42

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL15

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.981144 & -62.483722°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	6.22	Moderate	7.88	Higher	6.58	3.49
Stream Flow Support (SFS)	1.03	Lower	0.00	Lower	0.83	0.00
Water Cooling (WC)	5.00	Moderate	0.00	Lower	3.33	0.00
Sediment Retention & Stabilisation (SR)	10.00	Higher	1.80	Moderate	10.00	0.88
Phosphorus Retention (PR)	3.64	Moderate	2.14	Moderate	6.02	1.67
Nitrate Removal & Retention (NR)	10.00	Higher	10.00	Higher	10.00	10.00
Carbon Sequestration (CS)	3.60	Moderate			6.90	
Organic Nutrient Export (OE)	5.91	Moderate			3.86	
Anadromous Fish Habitat (FA)	4.13	Higher	2.71	Moderate	2.71	1.72
Resident Fish Habitat (FR)	5.10	Moderate	2.75	Moderate	2.77	1.72
Aquatic Invertebrate Habitat (INV)	7.52	Higher	7.08	Higher	6.56	5.06
Amphibian & Turtle Habitat (AM)	5.13	Moderate	7.18	Higher	5.81	7.67
Waterbird Feeding Habitat (WBF)	8.65	Higher	10.00	Higher	6.59	10.00
Waterbird Nesting Habitat (WBN)	8.33	Higher	10.00	Higher	6.04	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.39	Moderate	10.00	Higher	6.43	10.00
Pollinator Habitat (POL)	7.64	Moderate	6.67	Moderate	6.33	6.67
Native Plant Habitat (PH)	3.23	Lower	6.48	Moderate	5.19	6.48
Public Use & Recognition (PU)			1.47	Moderate		1.31
Wetland Sensitivity (Sens)			10.00	Higher		5.14
Wetland Ecological Condition (EC)			3.04	Lower		6.67
Wetland Stressors (STR) (higher score means more stress)			5.56	Moderate		2.85
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	6.22	Moderate	7.88	Higher	6.58	3.49
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.41	Higher	7.32	Higher	9.12	7.09
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	6.20	Higher	4.72	Moderate	5.11	3.37
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	7.46	Higher	8.26	Higher	5.69	8.11
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.86	Higher	8.86	Higher	6.21	8.86
WETLAND CONDITION (EC)			3.04	Lower		6.67
WETLAND RISK (average of Sensitivity & Stressors)			7.78	Higher		4.00

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	48.9801358	Moderate
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	61.55144868	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	29.24667855	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	61.64799552	Moderate
HABITAT SUPERGROUP - TRANSITION HABITAT	60.79392506	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	WESP-AC version 2
Site Name:	Ruth Falls Wetland 17
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.972398°
Longitude (decimal degrees):	-62.489619°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.083111 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL17	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	1	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the **edge** of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) **larger than 375 hectares** (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of **paved** roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and **not** separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and **not** separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	0	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the **5-km** radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured **along** the maintained road nearest the AA, the distance to the nearest **population center** is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	1	
55			>5 km.	0	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	1	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

	A	B	C	D	E
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

	A	B	C	D	E
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

	A	B	C	D	E
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL17	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	0	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	0	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	0	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	0	
27			those species together do **not** comprise > 50% of such cover.	1	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	1	
75			Intermediate (1 - 10% of vegetated part of the AA).	0	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	1	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	0	
97			25-50% of the herbaceous part of the AA.	1	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	0	
103			50-95% of the vegetated area.	1	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	1	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	0	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	1	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	1	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	1	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	1	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	1	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	1	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	1	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	1	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	1	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	1	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	1	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	1	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	1	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	1	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	1	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	1	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	1	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	1	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	1	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	1	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]	5.5	
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]	20	
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]	50	
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	1	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	0	
276			25-50%.	0	
277			>50%.	1	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	1	
306			>500 m. away, or no information.	0	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
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Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL17**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	3
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	3
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	2
			Sum=	9
			Stressor subscore=	0.75

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	1
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	1
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	1
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	1
			Sum=	3
			Stressor subscore=	0.33

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	1
Fertilizers applied to lawns, ag lands, or other areas in the CA.	1
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	1
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	1
			Sum=	3
			Stressor subscore=	0.33

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	1
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	1
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL17

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.972398° & -62.489619°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	2.11	Lower	7.86	Higher	3.52	3.48
Stream Flow Support (SFS)	6.28	Higher	4.77	Moderate	5.06	3.17
Water Cooling (WC)	5.29	Higher	6.88	Higher	3.53	3.73
Sediment Retention & Stabilisation (SR)	4.87	Moderate	9.79	Higher	5.99	4.79
Phosphorus Retention (PR)	3.90	Moderate	9.11	Higher	6.18	7.08
Nitrate Removal & Retention (NR)	1.77	Lower	10.00	Higher	4.05	10.00
Carbon Sequestration (CS)	4.09	Moderate			7.13	
Organic Nutrient Export (OE)	9.02	Higher			5.90	
Anadromous Fish Habitat (FA)	7.15	Higher	3.46	Moderate	4.68	2.20
Resident Fish Habitat (FR)	7.50	Higher	3.36	Moderate	4.07	2.10
Aquatic Invertebrate Habitat (INV)	6.14	Higher	6.57	Higher	6.00	4.78
Amphibian & Turtle Habitat (AM)	6.05	Moderate	4.53	Moderate	6.29	5.49
Waterbird Feeding Habitat (WBF)	8.51	Higher	10.00	Higher	6.48	10.00
Waterbird Nesting Habitat (WBN)	9.88	Higher	10.00	Higher	7.16	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	0.00	Lower	0.00	Lower	0.00	0.00
Pollinator Habitat (POL)	0.00	Lower	0.00	Lower	0.00	0.00
Native Plant Habitat (PH)	6.37	Higher	0.00	Lower	6.44	0.00
Public Use & Recognition (PU)			3.52	Moderate		2.71
Wetland Sensitivity (Sens)			3.92	Lower		3.29
Wetland Ecological Condition (EC)			6.52	Higher		8.33
Wetland Stressors (STR) (higher score means more stress)			10.00	Higher		5.46
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.11	Lower	7.86	Higher	3.52	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	4.26	Moderate	9.82	Higher	6.49	8.65
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.85	Higher	6.48	Moderate	5.56	4.34
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	8.85	Higher	8.14	Higher	6.45	7.98
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	4.25	Moderate	0.00	Lower	4.29	0.00
WETLAND CONDITION (EC)			6.52	Higher		8.33
WETLAND RISK (average of Sensitivity & Stressors)			6.96	Higher		4.37

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	16.54837478	Low
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	41.82872928	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	50.87397482	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	71.97293334	High
HABITAT SUPERGROUP - TRANSITION HABITAT	0	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 19
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.957041°
Longitude (decimal degrees):	-62.502964°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.056483
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL19	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	1	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	1	
35			50-500 m, but separated by those features.	0	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	1	
75			1 -2 km.	0	
76			2-5 km.	0	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

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92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

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145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL19	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

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17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	0	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each**</u> **comprise** 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	1	
61			50-95% of the vegetated part of the AA.	0	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]	5.4	
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]	20	
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]	40	
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	1	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
308					

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL19**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL19

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.957041° & -62.502964°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	8.62	Higher	7.86	Higher	8.38	3.48
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	5.73	Moderate	2.04	Moderate	6.67	1.00
Phosphorus Retention (PR)	3.04	Moderate	1.50	Moderate	5.65	1.17
Nitrate Removal & Retention (NR)	10.00	Higher	5.00	Moderate	10.00	5.00
Carbon Sequestration (CS)	6.47	Higher			8.26	
Organic Nutrient Export (OE)	7.44	Moderate			4.87	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	6.20	Higher	0.74	Lower	6.02	1.64
Amphibian & Turtle Habitat (AM)	2.27	Lower	4.15	Moderate	4.31	5.18
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	6.36	Moderate	10.00	Higher	5.54	10.00
Pollinator Habitat (POL)	6.27	Moderate	6.67	Moderate	5.20	6.67
Native Plant Habitat (PH)	6.07	Moderate	5.80	Moderate	6.32	5.80
Public Use & Recognition (PU)			2.69	Moderate		2.14
Wetland Sensitivity (Sens)			8.38	Higher		4.56
Wetland Ecological Condition (EC)			6.52	Higher		8.33
Wetland Stressors (STR) (higher score means more stress)			7.91	Higher		3.98
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	8.62	Higher	7.86	Higher	8.38	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.15	Higher	3.92	Moderate	8.82	3.69
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.43	Moderate	0.49	Lower	4.37	1.09
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.36	Lower	2.49	Moderate	2.59	3.11
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.30	Moderate	8.74	Higher	6.01	8.74
WETLAND CONDITION (EC)			6.52	Higher		8.33
WETLAND RISK (average of Sensitivity & Stressors)			8.14	Higher		4.27

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	67.73492558	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	31.9930733	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	2.671992164	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.390130046	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	55.07618538	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

ATTACHMENT C
WETLAND MONITORING DATA

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

Table 1A. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 3

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	2	35	
Soil Type			
Depleted Below Dark Surface (A11)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Eriophorum virginicum*	Tawny Cotton-Grass		30	
	Glyceria striata	Fowl Manna Grass	20		
	Carex spp.	Carex	50		
	Rhynchospora spp.	Beaksedge		25	
	Sarracenia purpurea	Pitcher Plant	10	10	
	Drosera rotundifolia	Round-leaved Sundew	15	15	
	Vaccinium oxycoccus	Bog Cranberry	10	20	
	Carex stipata	Awlfruit Sedge		30	
Shrubs	*Alnus incana*	Grey Alder		5	
	Spiraea alba	Meadowsweet	10		
	Chamaedaphne calyculata	Leatherleaf	40	40	
	Ilex mucronata	Mountain Holly	5	5	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Sarracenia purpurea	Pitcher Plant	15	25	
Osmunda cinnamomea	Cinnamon Fern	30	30	
Drosera rotundifolia	Round-leaved Sundew	15	15	
Carex spp.	Carex	40		
Maianthemum canadense	False Lily of the Valley	40		
Vaccinium oxycoccus	Bog Cranberry	10	25	
Eriophorum virginicum	Tawny Cotton-Grass		30	
Solidago spp.	Goldenrod		10	
Oclemena nemoralis	Bog Aster		10	
Calamagrostis canadensis	Blue Joint		15	
Carex magellanica	Boreal Bog Sedge		10	
Smilacina trifolia	Three-leaved false Solomon's seal		30	
Chamaedaphne calyculata	Leatherleaf	30	30	
Myrica gale	Sweetgale	15	15	
Ledum groenlandicum	Labrador tea	15	15	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Osmunda cinnamomea*	Cinnamon Fern	25	25	
	Sarracenia purpurea	Pitcher Plant	10		
	Maianthemum canadense	False Lily of the Valley	40		
	Vaccinium oxycoccus	Bog Cranberry	15	15	
	Carex stipata	Awlfruit Sedge		25	
	Oclemena nemoralis	Bog Aster		15	
	Drosera rotundifolia	Round-leaved Sundew		15	
	Vaccinium oxycoccus	Bog Cranberry		15	
	Smilacina trifolia	Three-leaved false Solomon's seal	10	30	
	Carex spp.	Carex	40		
	Eriophorum virginicum	Tawny Cotton-Grass		25	
Shrubs	*Myrica gale*	Sweetgale	30		
	Chamaedaphne calyculata	Leatherleaf	35		
	Kalmia angustifolia	Lambkill	25		
	Ilex mucronata	Mountain Holly		15	
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Sarracenia purpurea	Pitcher Plant	10	20	
Drosera rotundifolia	Round-leaved Sundew	15	15	
Carex spp.	Carex	20		
Maianthemum canadense	False Lily of the Valley	20		
Eriophorum virginicum	Tawny Cotton-Grass		15	
Smilacina trifolia	Three-leaved false Solomon's seal		30	
Rhynchospora spp.	Beaksedge		15	
Vaccinium oxycoccus	Bog Cranberry	10	20	
Platanthera psycodes	Lesser Purple Fringed Orchid	5		
Ledum groenlandicum	Labrador tea	15	25	
Chamaedaphne calyculata	Leatherleaf	25	30	
Kalmia angustifolia	Lambkill	15	15	
Ilex mucronata	Mountain Holly	5	10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1B. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 5

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	N	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	Y	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	4	27	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	
Preceeding 5 Day Precipitation* (mm)	2	2	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Coptis trifolia*	Goldthread	30	40	
	Cornus canadensis	Bunchberry	10	15	
	Vaccinium angustifolium	Lowbush Blueberry	5		
	Carex trisperma	Three seeded sedge	25		
	Vaccinium oxycoccus	Bog Cranberry	40	40	
	Carex spp.	Carex	30		
	Oclemena nemoralis	Bog Aster	5		
	Ajuga reptans	Bugleweed		15	
	Carex trisperma	Three seeded sedge		40	
	Linnaea borealis	Twinflower		15	
Shrubs					
Trees	*Abies balsamea*	Balsam Fir	15	25	

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Coptis trifolia	Goldthread	10	20	
Cornus canadensis	Bunchberry	10	20	
Sarracenia purpurea	Pitcher Plant	15	25	
Oclemena nemoralis	Bog Aster	5	20	
Iris versicolor	Norther Blue Flag	5	5	
Linnaea borealis	Twinflower	10	25	
Carex spp.	Carex	30		
Carex trisperma	Three seeded sedge		40	
Ilex mucronata	Mountain Holly	10	15	
Myrica gale	Sweetgale	30	30	
Spiraea alba	White Meadowsweet	10	15	
Acer rubrum	Red Maple	5	5	

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Calamagrostis canadensis*	Blue Joint	10	40	
	Solidago rugosa	Rough Goldenrod	5		
	Rubus pubescens	Dwarf Red Blackberry	20		
	Vaccinium oxycoccus	Bog Cranberry	15	40	
	Oclemena nemoralis	Bog Aster		15	
	Rubus hispidus	Swamp Dewberry			
Shrubs	*Viburnum nudum*	Wild Raisin		30	
	Spiraea tomentosa	Steeplebush		15	
	Chamaedaphne calyculata	Leatherleaf	20	25	
Trees	*Picea rubens*	Red Spruce	5		

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex grayi	Gray's Sedge	10		
Chamaedaphne calyculata	Leatherleaf	50		
Sarracenia purpurea	Pitcher Plant	10	10	
Solidago rugosa	Rough Goldenrod	5		
Drosera rotundifolia	Round-leaved Sundew	2	10	
Oclemena nemoralis	Bog Aster		25	
Carex trisperma	Three seeded sedge	20	35	
Myrica gale	Sweetgale	5		
Chamaedaphne calyculata	Leatherleaf		75	
Iris versicolor	Norther Blue Flag		20	
Ledum groenlandicum	Labrador tea		10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1C. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 6

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	3	0	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Smilacina trifolia*	Three-leaved false Solomon's seal	30	25	
	Carex spp.	Carex	15		
	Grass spp.	Grass	20		
	Calla spp.	Calla	10	15	
	Dulichium arundinaceum	Three-way Sedge		25	
	Sarracenia purpurea	Pitcher Plant		5	
	Carex trisperma	Three seeded sedge		20	
	Carex magellanica ssp. irrigua	Boreal Bog Sedge		15	
	Vaccinium oxycoccus	Bog Cranberry		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	35	35	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Symphyotrichum puniceum	Swamp Aster	30		
Calamagrostis canadensis	Blue Joint	25	25	
Sarracenia purpurea	Pitcher Plant	10	20	
Carex spp.	Carex	15		
Grass spp.	Grass	20		
Drosera rotundifolia	Round-leaved Sundew		10	
Thelypteris palustris	Marsh Fern	25	30	
Oclemena nemoralis	Bog Aster		30	
Eriophorum virginicum	Tawny Cotton-Grass		20	
Rhynchospora spp.	Beaksedge		20	
Dulichium arundinaceum	Three-way Sedge		35	
Alnus incana	Grey Alder	25	25	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	40		
	Grass spp.	Grass	10		
	Drosera rotundifolia	Round-leaved Sundew	5		
	Vaccinium oxycoccus	Bog Cranberry	15	15	
	Rhynchospora spp.	Beaksedge		40	
	Dulichium arundinaceum	Three-way Sedge		15	
	Sarracenia purpurea	Pitcher Plant		15	
	Carex trisperma	Three seeded sedge		30	
	Carex sparganioides	Bur Reed Sedge		10	
	Eriophorum virginicum	Tawny Cotton-Grass		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	30	30	
	Ledum groenlandicum	Labrador tea	10	10	
	Ilex mucronata	Mountain Holly		10	
	Myrica gale	Sweetgale	10		
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Osmunda cinnamomea	Cinnamon Fern	5	20	
Drosera rotundifolia	Round-leaved Sundew	5	15	
Smilacina trifolia	Three-leaved false Solomon's seal	10		
Vaccinium oxycoccus	Bog Cranberry	5		
Carex spp.	Carex	60		
Rhynchospora spp.	Beaksedge		60	
Eriophorum virginicum	Tawny Cotton-Grass		35	
Dulichium arundinaceum	Three-way Sedge		15	
Sarracenia purpurea	Pitcher Plant		15	
Calamagrostis canadensis	Blue Joint		10	
Ledum groenlandicum	Labrador tea	10	20	
Chamaedaphne calyculata	Leatherleaf	30	20	
Kalmia angustifolia	Lambkill		10	
Picea mariana	Black Spruce	5	10	None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

Table 1D. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 15

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	Y	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	2	6	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	20		
	Oclemena nemoralis	Bog Aster	5	10	
	Dulichium arundinaceum	Three-way Sedge		40	
	Drosera rotundifolia	Round-leaved Sundew		10	
	Vaccinium oxycoccus	Bog Cranberry		10	
	Carex trisperma	Three seeded sedge		20	
Shrubs	*Myrica gale*	Sweetgale	60	25	
	Chamaedaphne calyculata	Leatherleaf		60	
	Viburnum nudum	Wild Raisin		25	
Trees	*Viburnum nudum*	Wild Raisin		25	

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex trisperma	Three seeded sedge	50		
Vaccinium oxycoccus	Bog Cranberry	10		
Osmunda cinnamomea	Cinnamon Fern	15	25	
Eriophorum virginicum	Tawny Cotton-Grass		15	
Drosera rotundifolia	Round-leaved Sundew		10	
Myrica gale	Sweetgale	30	40	
Chamaedaphne calyculata	Leatherleaf	5	25	
Ledum groenlandicum	Labrador tea		20	
Ilex mucronata	Mountain Holly		5	
Picea mariana	Black Spruce	10	10	
Acer rubrum	Red Maple	20		

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Cornus canadensis*	Bunchberry	5	25	
	Carex trisperma	Three seeded sedge	10		
	Vaccinium oxycoccus	Bog Cranberry	5	15	
	Carex trisperma	Three seeded sedge		20	
	Osmunda cinnamomea	Cinnamon Fern	15	20	
	Eriophorum virginicum	Tawny Cotton-Grass		20	
Shrubs	*Ledum groenlandicum*	Labrador tea	5	20	
	Myrica gale	Sweetgale	60	40	
	Chamaedaphne calyculata	Leatherleaf		25	
	Ilex mucronata	Mountain Holly		5	
Trees	*Picea mariana*	Black Spruce	25	30	

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Thelypteris palustris	Marsh Fern	15		
Carex trisperma	Three seeded sedge	15	20	
Calamagrostis canadensis	Blue Joint		15	
Oclemena nemoralis	Bog Aster	5	5	
Osmunda cinnamomea	Cinnamon Fern		20	
Cornus canadensis	Bunchberry	10	20	
Vaccinium oxycoccus	Bog Cranberry		20	
Myrica gale	Sweetgale	50	50	
Acer rubrum	Red Maple	40	20	
Picea mariana	Black Spruce		5	
Ledum groenlandicum	Labrador tea	5	10	
Chamaedaphne calyculata	Leatherleaf		20	
Ilex mucronata	Mountain Holly	5		
Ilex mucronata	Mountain Holly		10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1E. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 17

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Depth to Water (cm)	5	10	

Soil Type
Histosol (A1)

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)

Monitoring Date	Baseline (July 2022)	Baseline (September 2022)	Notes
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex lupulina*	Hop Sedge	60	60	
	Drosera rotundifolia	Round-leaved Sundew	15	25	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	30	40	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex lupulina	Hop Sedge	60	75	
Zantedeschia aethiopica	Calla Lily	10		
Drosera rotundifolia	Round-leaved Sundew	10	15	
Chamaedaphne calyculata	Leatherleaf	20	30	
Alnus incana	Grey Alder	20	20	
Picea mariana	Black Spruce	30	30	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex lupulina*	Hop Sedge	60	60	
	Zantedeschia aethiopica	Calla Lily	10		
	Drosera rotundifolia	Round-leaved Sundew	15	15	
	Vaccinium oxycoccus	Bog Cranberry	10	20	
	Carex oligosperma	Few-seeded Sedge		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	25	25	
	Picea mariana	Black Spruce	15	25	
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex lupulina	Hop Sedge	40	40	
Zantedeschia aethiopica	Calla Lily	5		
Drosera rotundifolia	Round-leaved Sundew	15		
Grass spp.	Grass	15		
Carex sparganioides	Bur Reed Sedge		25	
Carex oligosperma	Few-seeded Sedge		15	
Chamaedaphne calyculata	Leatherleaf	20	35	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1F. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 19

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	Y	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	9	3	September Note: Well cracked off.
Soil Type			
Histosol (A1), Depleted Below Dark Surface (A11)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	30	15	
	Eriophorum virginicum	Tawny Cotton-Grass		25	
	Carex trisperma	Three seeded sedge			
Shrubs	*Ledum groenlandicum*	Labrador tea	40	60	
	Myrica gale	Sweetgale	60	40	
	Chamaedaphne calyculata	Leatherleaf	25	25	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Vaccinium oxycoccus	Bog Cranberry	15	25	
Carex spp.	Carex	15		
Calla spp.	Calla	15		
Drosera rotundifolia	Round-leaved Sundew	15		
Eriophorum virginicum	Tawny Cotton-Grass		15	
Myrica gale	Sweetgale	20	60	
Chamaedaphne calyculata	Leatherleaf	40	15	
Larix laricina	Tamarack	25		
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Oclemena nemoralis*	Bog Aster	15	25	
	Vaccinium angustifolium	Lowbush Blueberry	5		
	Calla spp.	Calla	15		
	Carex spp.	Carex	25		
	Osmunda cinnamomea	Cinnamon Fern		10	
	Eriophorum virginicum	Tawny Cotton-Grass		15	
Shrubs	*Ledum groenlandicum*	Labrador tea	10	10	
	Myrica gale	Sweetgale	80	60	
	Picea mariana	Black Spruce	25	20	
	Vaccinium angustifolium	Lowbush Blueberry		15	
	Ilex mucronata	Mountain Holly	10		
Trees	*Picea mariana*	Black Spruce	25	25	

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex spp.	Carex	25		
Calla spp.	Calla	15		
Oclemena nemoralis	Bog Aster	10	40	
Carex diandra	Lesser Tussock-Sedge		25	
Rhododendron canadense	Rhodora	25	25	
Myrica gale	Sweetgale	30	30	
Chamaedaphne calyculata	Leatherleaf	25		
Picea mariana	Black Spruce	40	40	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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ATTACHMENT D
FISH HABITAT ASSESSMENT DATA

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 3		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	11:00	13:00
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	23
Water Temperature (degC)	23.5	22.0
pH	5.10	5.40
Conductivity (mS/m)	0.04	0.005
TDS (mg/L)	20	20
DO (%)	85	80.6
DO (mg/L)	7.6	7.75
Average Depth (m)	0.6	0.30
Hydroperiod (Flooded (semi) Permanently?)	Permanently flooded	Permanently flooded
Connectivity to Lake	Inflow	Inflow
Deep Open Water Present Nearby?	Yes	Shallow Open Water
Macrophyte (% cover)	Med (10-50%)	Med (10-50%)
Substrate(s)	Muck	Rubble
Turbidity (or other water characteristisc)	Slightly Cloudy	Slightly Cloudy
Vegetation/Debris Cover/Shade	Trace	None
Probability of Fish Presence	Med	Med
Notes	Plenty of submerged logs and rocks. Lots of macrophytic veg. Mucky substrate, plenty of brownish detritus.	Macrophytes and woody debris provide decent cover for fish, though water is warm. Edge of Lake. Silt on rocks. Excess woody debris.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 5		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	13:15	12:23
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	26	22
Water Temperature (degC)	21	15.5
pH	4.93	5.09
Conductivity (mS/m)	0.09	0.04
TDS (mg/L)	30	40
DO (%)	93.9	80.6
DO (mg/L)	9.05	7.05
Average Depth (m)	0.5	0.10
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Inflow	Throughflow
Deep Open Water Present Nearby?	Shallow Open Water	Shallow Open Water
Macrophyte (% cover)	Low (<10%)	Low(<10%)
Substrate(s)	Muck:25%, Gravel:50%, Rubble:25%	Gravel and Rubble
Turbidity (or other water characteristisc)	Slightly Cloudy	Clear
Vegetation/Debris Cover/Shade	Trace	Abundant
Probability of Fish Presence	High	Med
Notes	Small stream/trickle inflow at southeast end of WL (appears to be spring fed). Fish seen off weltand edge. No signs of fish habitat upstream/upland. Extensive cover/shade near inflow, primarily open/unshaded elsewhere.	No flow in stream, though area is well shaded with clear water.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 6		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	15:30	11:30
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	20
Water Temperature (degC)	28	21.3
pH	4.89	5.26
Conductivity (mS/m)	0.05	0.07
TDS (mg/L)	30	30
DO (%)	77	23.1
DO (mg/L)	5.7	2.19
Average Depth (m)	0.5	0.2
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Semi-permanently Flooded
Connectivity to Lake	Inflow	Outflow
Deep Open Water Present Nearby?	Shallow Open Water	No
Macrophyte (% cover)	Low (<10%)	Low(<10%)
Substrate(s)	Muck and Rubble	Muck and Gravel
Turbidity (or other water characteristisc)	Slightly Cloudy	Cloudy
Vegetation/Debris Cover/Shade	None	None
Probability of Fish Presence	High	Low
Notes	Juvenile American Eels spotted durring delineation. Very little shadded water, some areas "in-land" that could be accessible to fish seasonally.	High amount of metals suspended on water surface. Area appears to be poor habitat if at all. Water is stagnant.

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Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 15		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	12:15	11:00
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	20
Water Temperature (degC)	22.8	20.9
pH	5.4	6.12
Conductivity (mS/m)	0.21	0.05
TDS (mg/L)	30	160
DO (%)	93	93.7
DO (mg/L)	7.51	8.43
Average Depth (m)	0.5	
Hydroperiod (Flooded (semi) Permanently?)	Semi-permanently Flooded	Permanently Flooded
Connectivity to Lake	Inflow	Throughflow
Deep Open Water Present Nearby?	Shallow Open Water	Shallow Open Water
Macrophyte (% cover)	Med(10-50%)	Low(<10%)
Substrate(s)	Muck	Rubble
Turbidity (or other water characteristisc)	Clear	Slightly Cloudy
Vegetation/Debris Cover/Shade	None	Trace
Probability of Fish Presence	High	Med
Notes	Dead trees/snags in water.	Lake edge near outflow of watland. Some lily pads present. Woody debris.

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Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 17		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	9:36	10:41
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	20	19
Water Temperature (degC)	21.7	20.3
pH	5.45	7.39
Conductivity (mS/m)	0.05	0.72
TDS (mg/L)	20	40
DO (%)	97.2	80.7
DO (mg/L)	9.03	7.27
Average Depth (m)	0.5	0.5
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Thoughflow	Throughflow
Deep Open Water Present Nearby?	Yes	Shallow Open Water
Macrophyte (% cover)	High(>50%)	Med(10-50%)
Substrate(s)	Muck	Gravel and Silt
Turbidity (or other water characteristisc)	Slightly Cloudy	Slightly Cloudy
Vegetation/Debris Cover/Shade	Trace	None
Probability of Fish Presence	High	Med
Notes	Entire island is wetland. Lily pads all around the perimeter. "Sheltered" coves along island edge. Seems like great fish nursery area.	Lake Edge.

Strum CONSULTING

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 19		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	12:15	13:45
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	26	22
Water Temperature (degC)	25.5	23.5
pH	5.36	5.67
Conductivity (mS/m)	0.04	0.04
TDS (mg/L)	20	30
DO (%)	103.0	105.8
DO (mg/L)	8.42	8.76
Average Depth (m)	0.5	0.40
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Throughflow	Lake Edge
Deep Open Water Present Nearby?	Shallow Open Water	Yes 5m
Macrophyte (% cover)	Low(<10%)	Low(<10%)
Substrate(s)	Gravel	Gravel and Rubble
Turbidity (or other water characteristisc)	Clear	Clear
Vegetation/Debris Cover/Shade	Moderate	Trace on NW side
Probability of Fish Presence	High	High
Notes	Fish observed at lake side pt. Wetland is a peninsula, open water side has excellent habitat. Cove side has mostly muck substrate with some debris/emergent veg.	

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APPENDIX F – Hydraulic Modeling Report



Ruth Falls Dam Refurbishment

3D Modelling and Fish Passage Assessment

Nova Scotia POWER
An Emera Company

FINAL REPORT ver.2

CBCL

Project 221107.00 • 20th March 2023

2	FINAL REPORT ver.2	A Wilson / M Browne	20-Mar-2023	Y Zhang / C Jardine
1	FINAL REPORT	A Wilson / M Browne	13-Mar-2023	Y Zhang / C Jardine
0	DRAFT REPORT	A Wilson / M Browne	22-Feb-2023	Y Zhang / C Jardine
Rev.	Issue	Reviewed By:	Date	Issued By:

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Appendices

A FIGURE 1
B THAUMAS CONSULTANTS REPORT

1 HYDROTECHNICAL ASSESSMENT

1.1 Background

This report addresses the request made by Nova Scotia Power (NSP) by email on the 8th February, 2022, and following discussions. An excerpt is presented below to present the requested scope of work:

We have determined a need for 3D hydraulic modeling to be completed at the Ruth Falls dam for the purpose of assessing post-refurbishment downstream conditions. The main refurbishments include the installation of vertical lift gates in the center section of the dam which will replace the existing stop log bay. Another big change includes the installation of a new rubber dam. We are looking to know how changes in flow releases from the vertical lift gates (and rubber dam) could impact the downstream area – specifically the entrance conditions to the fish ladder.

The following information was discussed with NSP and was used to support the assessment:

- *Historic operation of the gates at the former structure*
- *Proposed operation of the gates at the proposed structure*
- *Flow measurements and discharge curves available at the gates*
- *Maintenance flow schedules during the year*
- *Fishway release flow schedules during the year*
- *Geometry of the proposed structure (IFC drawings)*
- *Bathymetry of the tailrace, from several site surveys*

1.2 Flow Assessment

Spill flow data was available from 2015 to 2022. The full timeseries of the spill flow data is presented below in Figure 1:

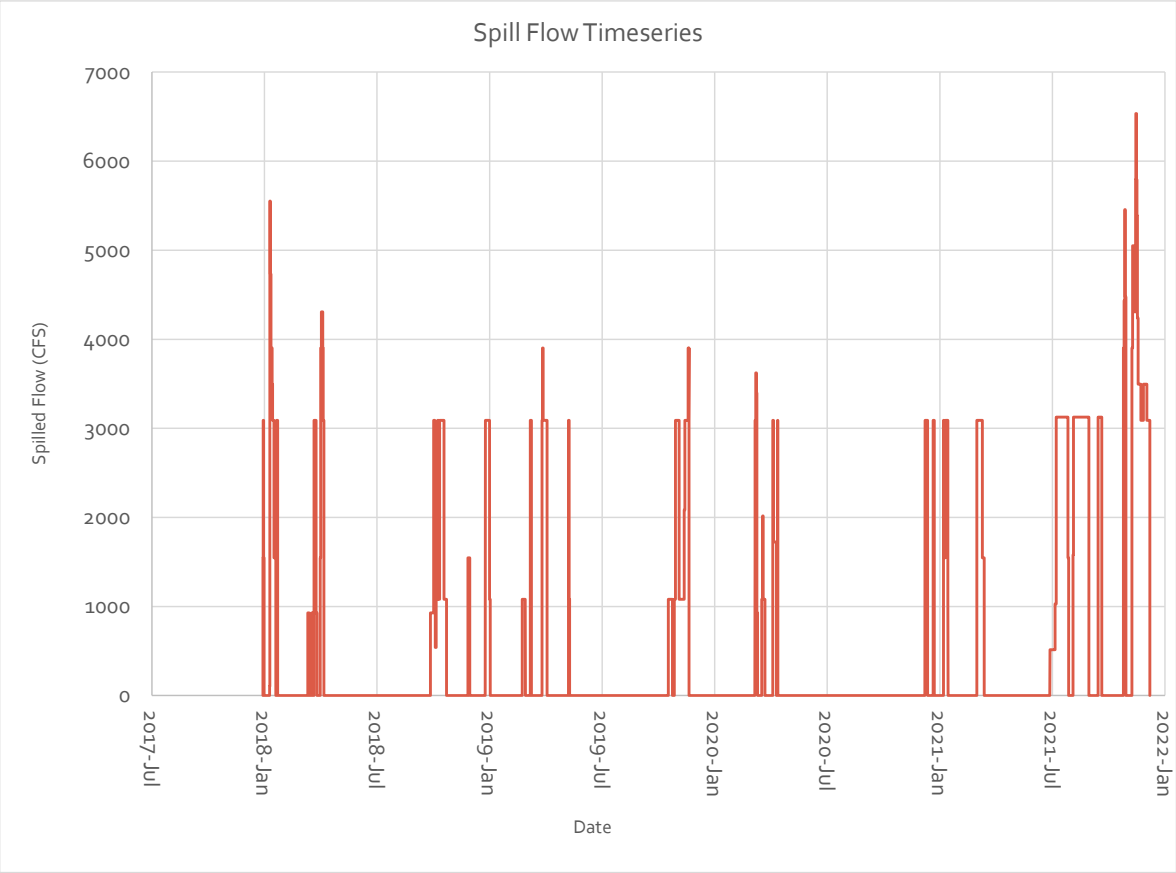


Figure 1: Spill flow Timeseries from 2015 to 2022 at the Ruth Falls Dam

As shown on the figure, spills are rather infrequent at this site. Spills increased in 2021 and 2022 due to construction activity at the dam, which has resulted in more frequent spills than would typically be seen at the site. Those years were therefore removed from the data to allow the assessment to be more representative of typical conditions. The results were also separated into seasonal time spans, to provide seasonal data that would be representative of fish migration windows. The following months were used to represent the various seasons:

Spring: May, June, July

Summer: August, September

Fall: October, November

Winter: December, January, February, March, April

Figure 2 shows the results of the flow duration curve analysis, presented as days during which the flows would be present during the various seasons.

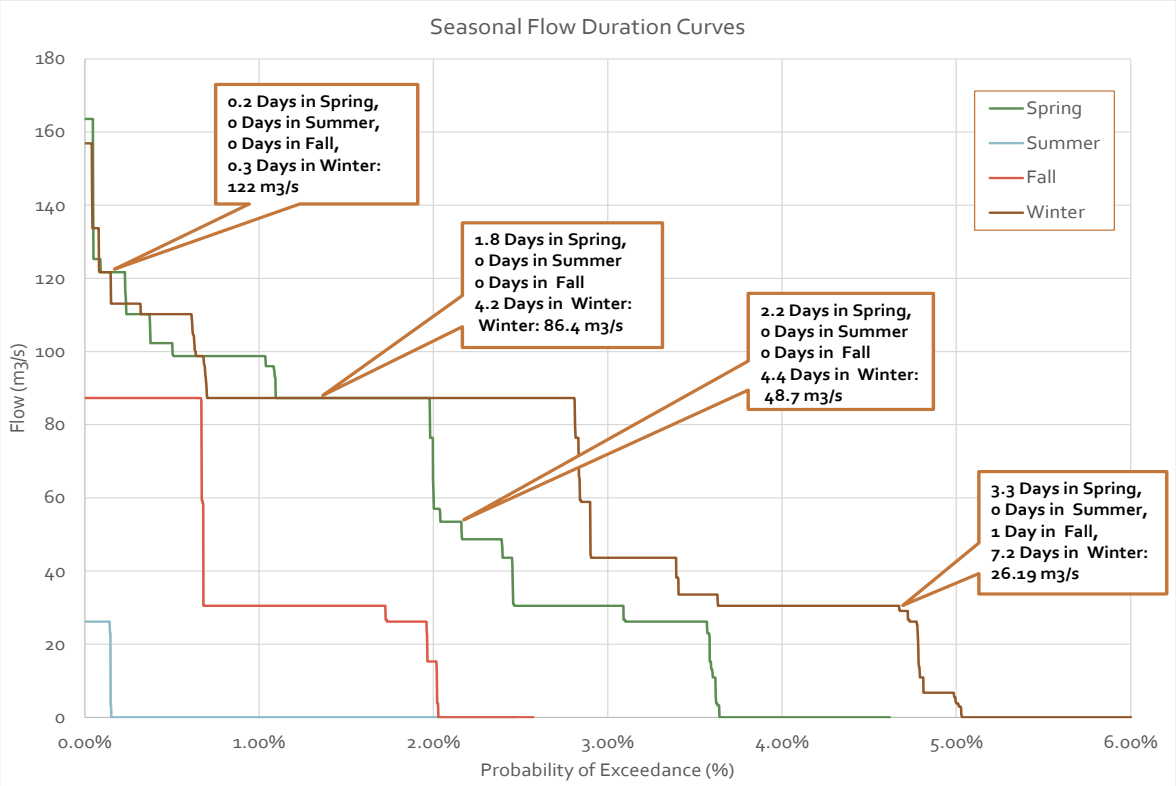


Figure 2: Seasonal Flow Duration Curves at Ruth Falls

Typically, the spills are released fairly evenly between the 3 gates, so the flow scenarios used in model include the 4 flows identified in Figure 2, all released evenly through the 3 gates.

The current structure has leakage through the stop logs, as well as through the existing gate frames. NSP measured the flows downstream of the dam, and obtained a value of 100.2 cfs. Part of this flow is from the fishway (6 cfs) and part of it is from the louvres pipe outflow (29 cfs), leaving 65 cfs as leakage through the structure. From the modelling results (see below) and the interpretation of those results for fish passage (see Thaumas Consultants report), the current flows are estimated to provide suitable conditions for fish passage in the natural river channel downstream of the dam. Higher flows produce higher velocities, especially at the rock sills, which leave no area of low velocity in the river for the passage of fish. Therefore, it was concluded that providing 65 cfs from the gates in the proposed conditions would result in the optimal conditions for fish passage.

Nevertheless, the attraction flows and existing weir configurations were not optimal for fish passage, so the weirs downstream of the fishway were re-configured in the model to improve both attraction flows and velocities for fish passage. The following steps were taken following the various model tests:

1. Existing weir configurations and louvres outflow configurations were modelled and resulted in poor attraction flows (see Figure 3)
2. The louvres outflow was moved to the last fishway to attempt to improve attraction flows towards the most downstream fish passage weir, which resulted in an improvement in attraction flows, but still no suitable passage through the weirs
3. The fish passage weirs were redesigned with the intent of providing approximately 20 cm drops, and a flow of 35 cfs, by also moving the louvres outflow beside the outlet of the fishway. The new weirs were sized to provide 23 cm drops at each pool, with a sufficient distance between the weir, and the last weir was rotated to point at 45 degrees downstream, the opening being on the south side of the weir. A rock diversion weir was also tested to evaluate its use in orienting the gate flows away from the weir attraction flows. The results of this are seen in Figure 4.
4. The same scenario was tested, but without the rock diversion just downstream of the gate (see Figure 5). It was found that with or without the rock diversion, flows from the gates would create back currents towards the last weir, disrupting the attraction flows.
5. The last weir was modified to have its notch on the north (dam) side, to join with the circulating flows from the gates. To achieve this, one weir had to be removed from the set, to maintain the alternating configuration of the notches. This is shown in Figure 6. The results show an improvement, but the strong currents circulating from the gate flows still disrupt the attraction flows.
6. The distribution of flows from the various gates was tested, to produce a more even guiding flow towards the fish passage weir, and minimize the current flowing back upstream. A range of distributions were tested, and the optimal configuration was achieved with a flow distribution of 20 cfs from the west gate, 40cfs from the centre gate, and 5 cfs from the east gate. The flow is highest from the centre gate because the centre gate ogee spillway is lower than the others. The velocity of the water is therefore much reduced, and the flow released enters the river at a lower elevation, where its energy is significantly more dissipated. It is noted that in practice, as the flows and velocity patterns at the gates and downstream may be slightly different than in the model, it is expected that some field verification and gate adjustment will be needed once the dam is completed, to obtain the desired fish passage goals. The gate settings may therefore be different than noted here, while still delivering a total of 65cfs. The results for this scenario are shown the figures S1-1 to S7-13.

For the last geometric configuration (point 5 above), results are shown below for a range of flow scenarios. These include the following:

- S1: 6 cfs from the fishway, 29 cfs from the louvres outfall, 65 cfs from the gates

- S2: 6 cfs from the fishway, 29 cfs from the louvres outfall, 165 cfs from the gates
- S3: 6 cfs from the fishway, 29 cfs from the louvres outfall, 925 cfs from the gates
- S4: 6 cfs from the fishway, 29 cfs from the louvres outfall, 1720 cfs from the gates
- S5: 6 cfs from the fishway, 29 cfs from the louvres outfall, 3051 cfs from the gates
- S6: 6 cfs from the fishway, 29 cfs from the louvres outfall, 4308 cfs from the gates
- S7: 6 cfs from the fishway, 29 cfs from the louvres outfall, 0 cfs from the gates

It is noted that the flow values in cfs for scenarios 3 to 7 correspond to the 4 spill flow values shown in Figure 2 above.

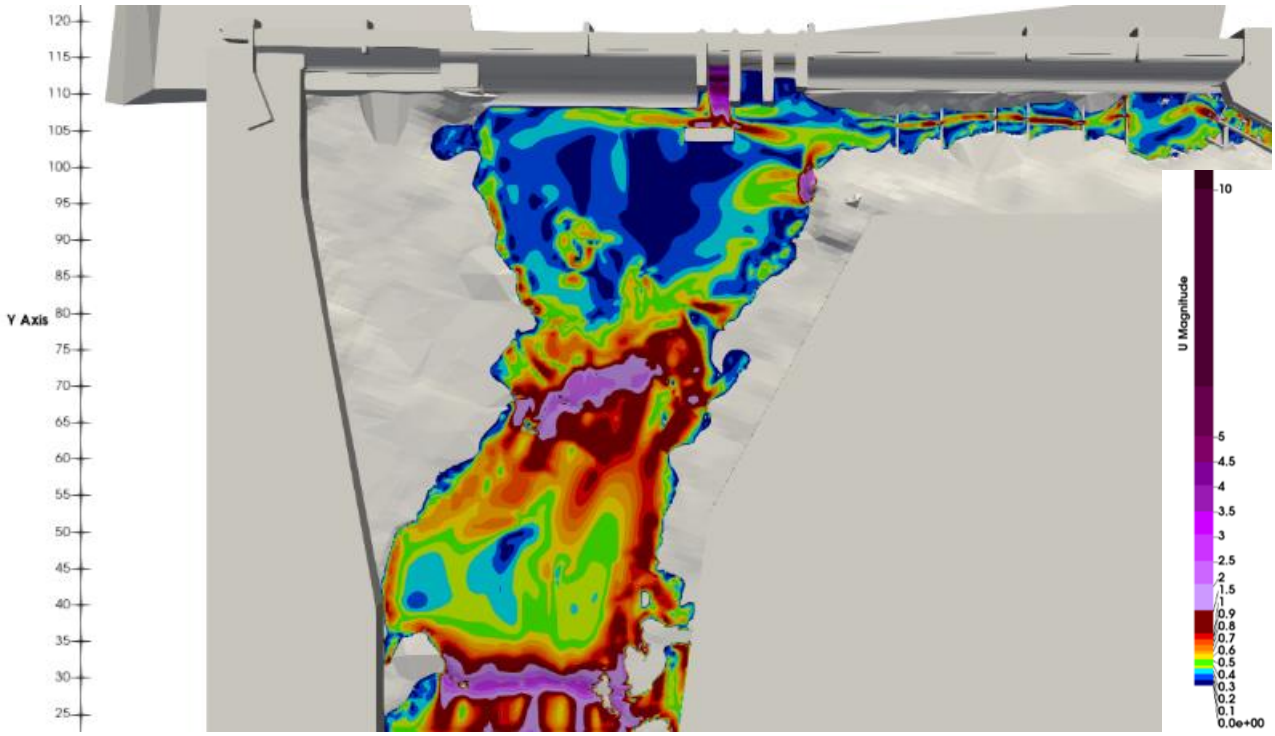


Figure 3: Existing Weir and louvres outflow configuration

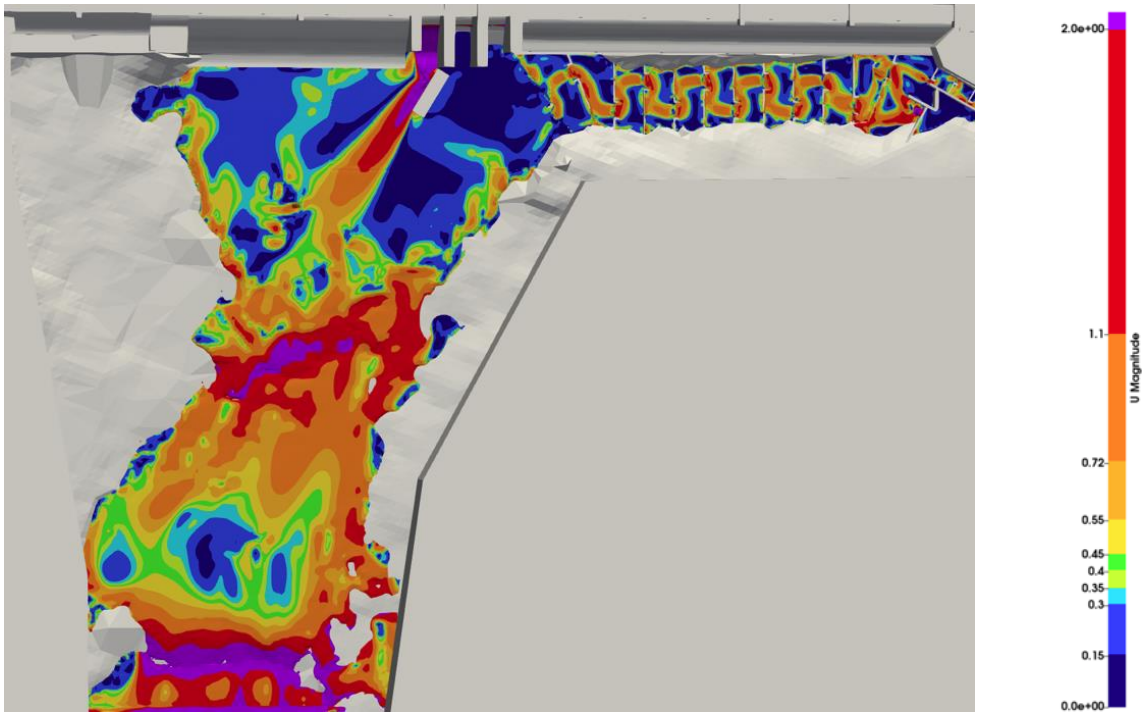


Figure 4: re-Designed Weir and louvres outflow configuration – with Rock Diversion

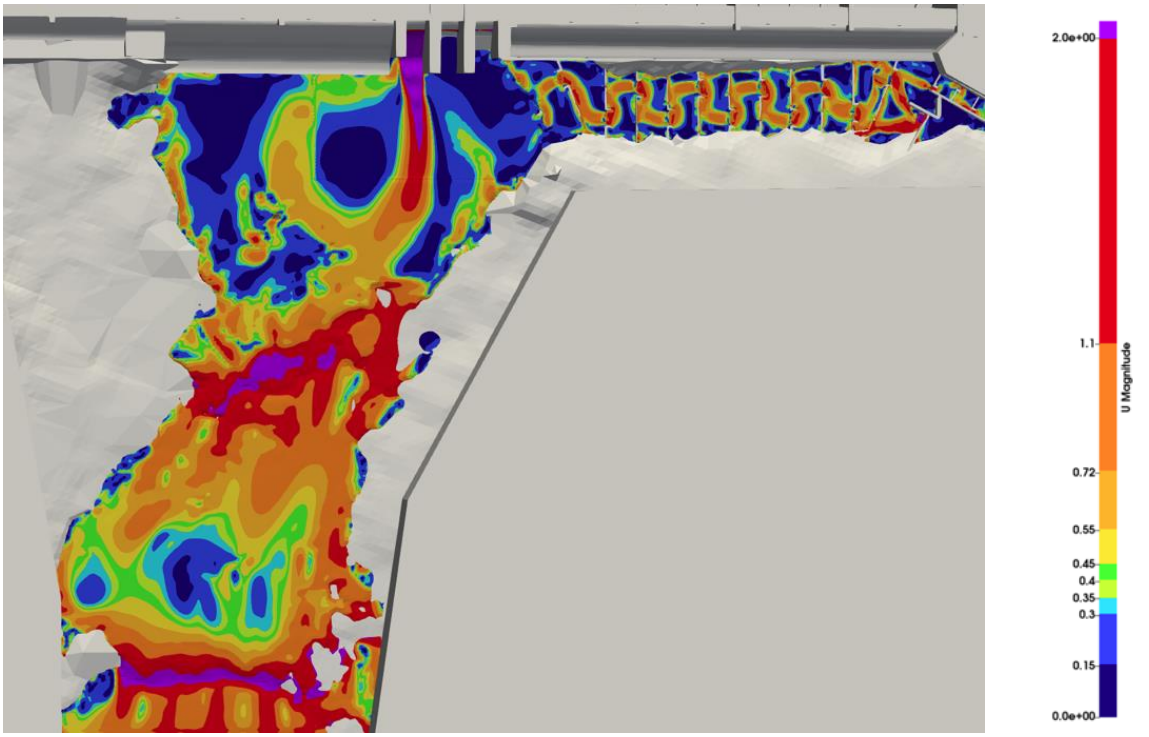


Figure 5: re-Designed Weir and louvres outflow configuration – No Rock Diversion

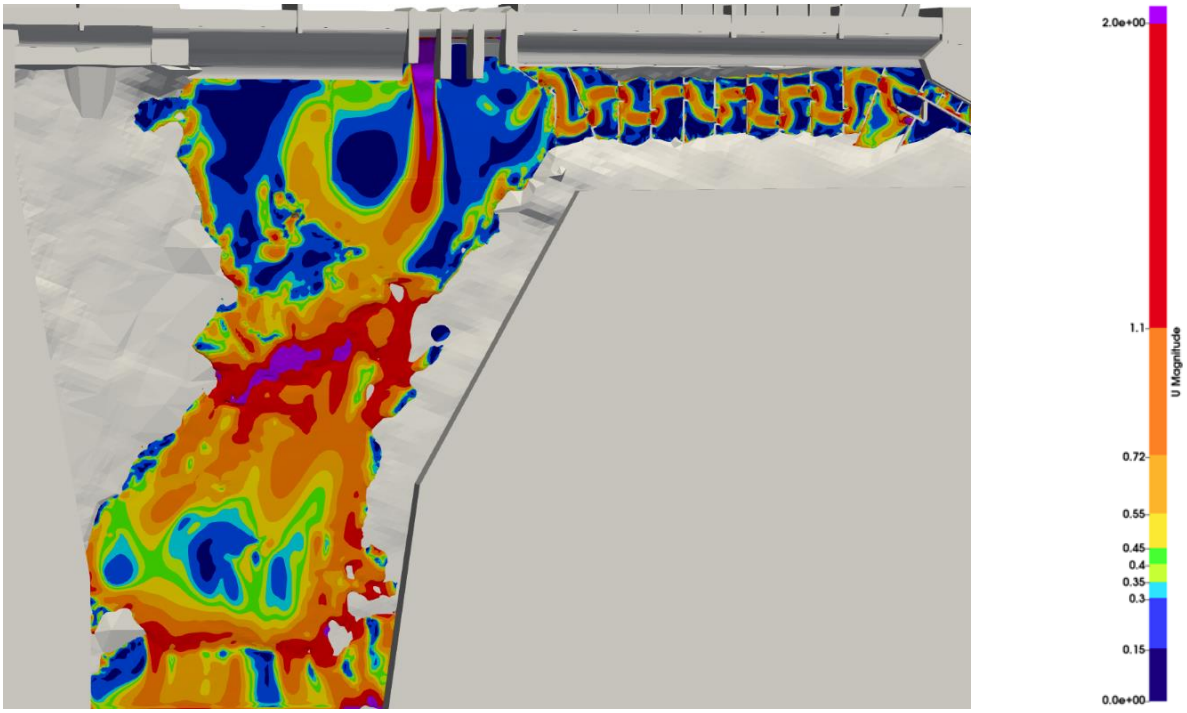


Figure 6: re-Designed Weir and louvres outflow configuration- last weir on Dam Side

1.3 3D CFD Modelling

Once the details of the geometry were fully available and completely understood, a geometric model of the proposed structure (fully constructed), together with the fishway and downstream channel was assembled in Civil3D. The extent of the modelled downstream channel was defined based on expected turbulence patterns, to make sure that the extents of the downstream influence of the fishway flows and attraction flows are included. This is important since the fish need to be able to sense the attraction flows and be guided to the fishway. Once the geometric model was completed in Civil3D, it was be exported to the 3D modelling software.

The modelling software used is OpenFoam, which has the highest recognition for Computational Fluid Dynamics (CFD) modelling in the scientific community. It was developed at Imperial College, London, is open source, and is supported by a community of users that provide technical support and additional tools to the model. CBCL has several years of experience working with this model and has developed workflows from model assembly to data extraction.

Once the geometry was set up in the model, the water levels and flows at the boundaries were set up. These were set depending on the various flow scenarios described above. The results of the modelling then allows the interpretation of fish passage quality for each species during the entire year.

1.4 Modelling Results

Each scenario (S1 to S7) contains 13 figures. Both plan views of the velocity magnitude, as well as cross-sections at regular intervals, with velocity vectors, are shown in panoramic views.

- **Figure 1 to Figure 3**: present the plan view of the water surface, mid-surface, as well as the view taken from the bottom to show the velocities along the bottom.
- **Figure 4 to Figure 8**: panoramic views of entire study domain and close-up views for the fishway area and the river channel; the vectors have a uniform length and are not scaled by velocities. Vectors are coloured by velocity magnitude.
- **Figure 9 to Figure 13**: focus on the bottom velocities (from the geometry bottom to 0.2m above it); vectors are generated only for a depth of 0.2m from the bottom and the vectors have a uniform length and are coloured by velocity magnitude.

The colour scale has been adjusted based on Bob Rutherford's request to show details from 0 to 2m/s, and only one colour for all velocities above 2m/s. The intervals between the cross sections are given in the titles for each figure.

1. Model Results of Scenario S1 with 65 cfs from the gates

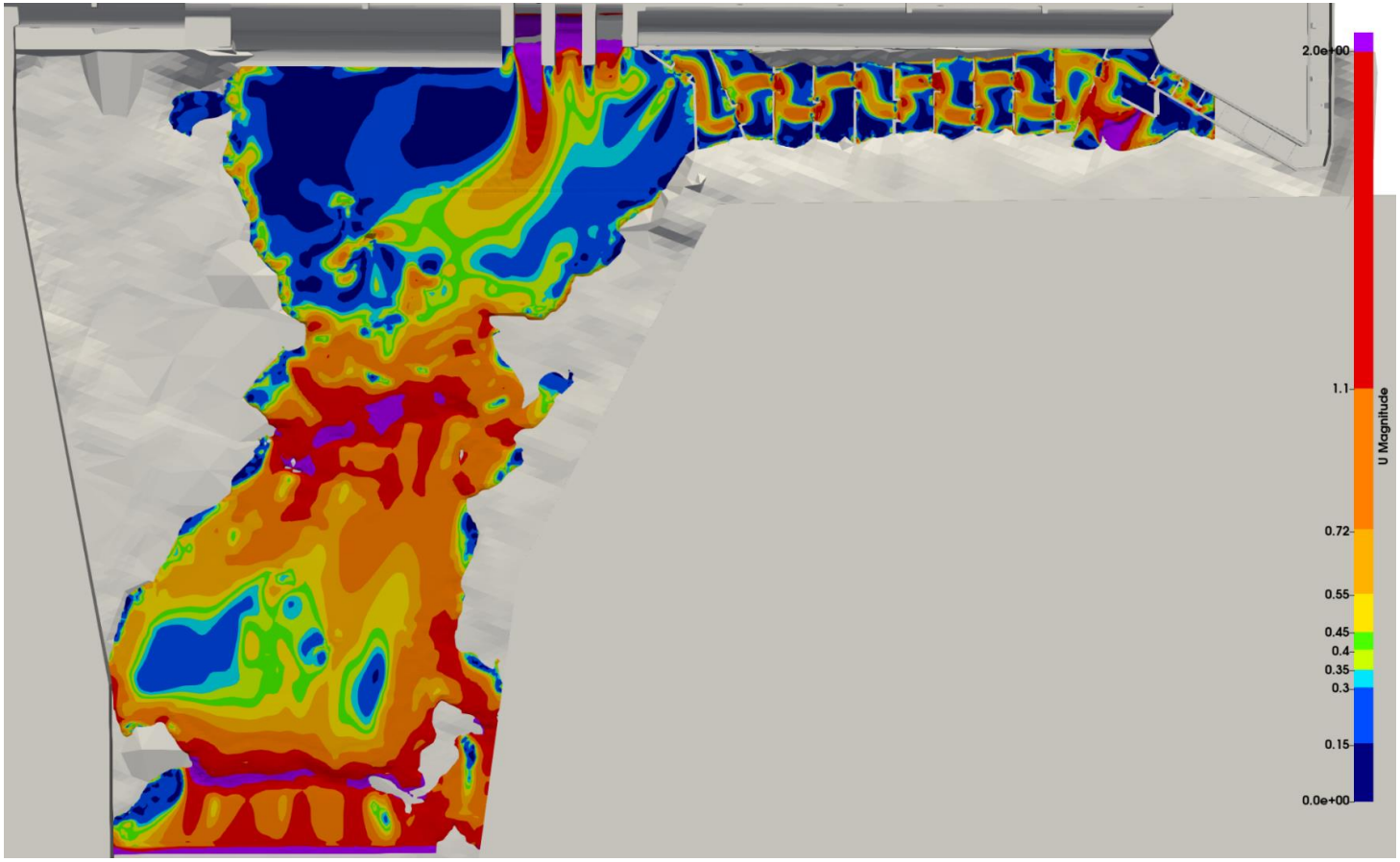


Figure S1-1: Plan view of the Water Surface Velocities

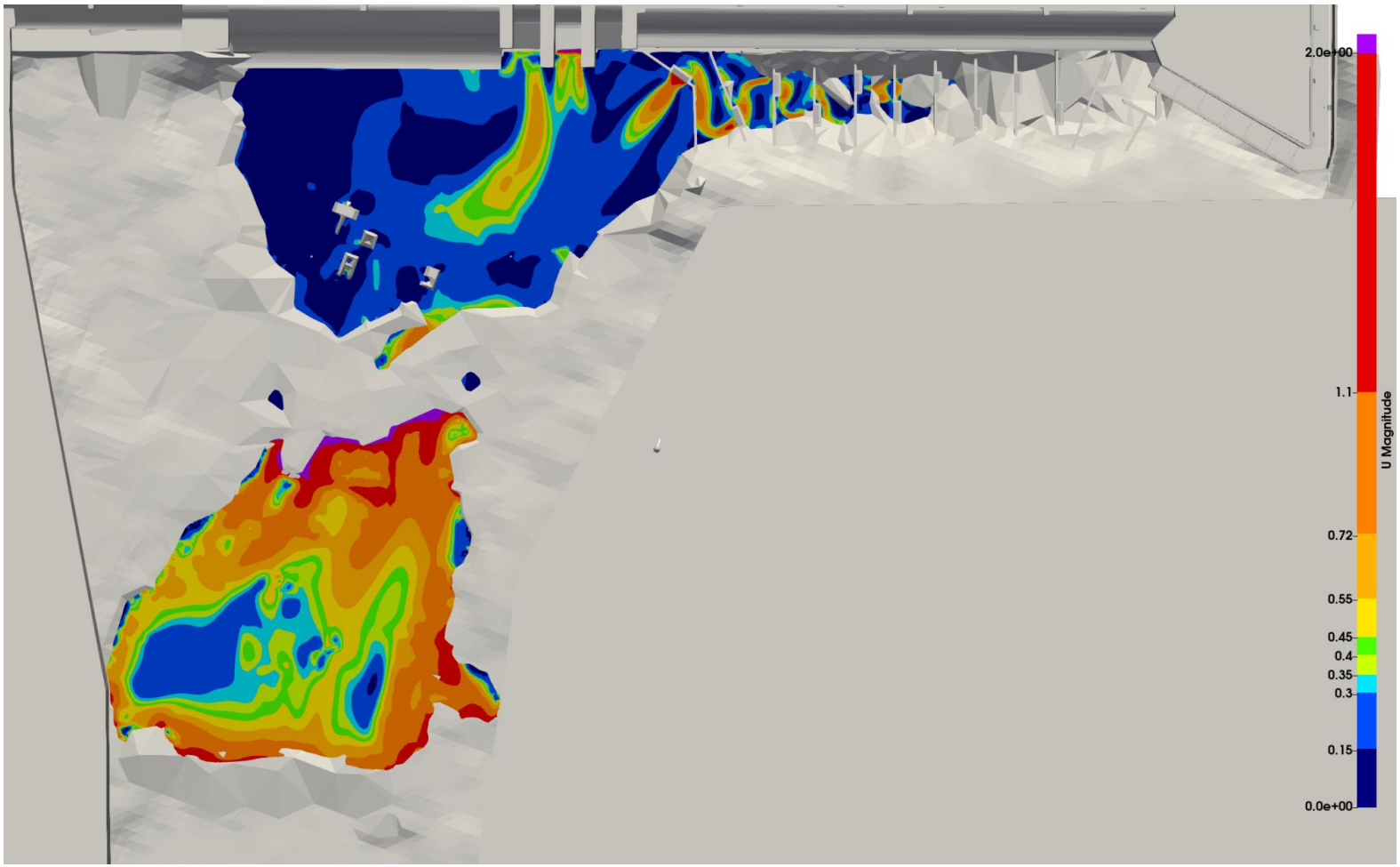


Figure S1-2: Plan view of the Mid-Surface Velocities

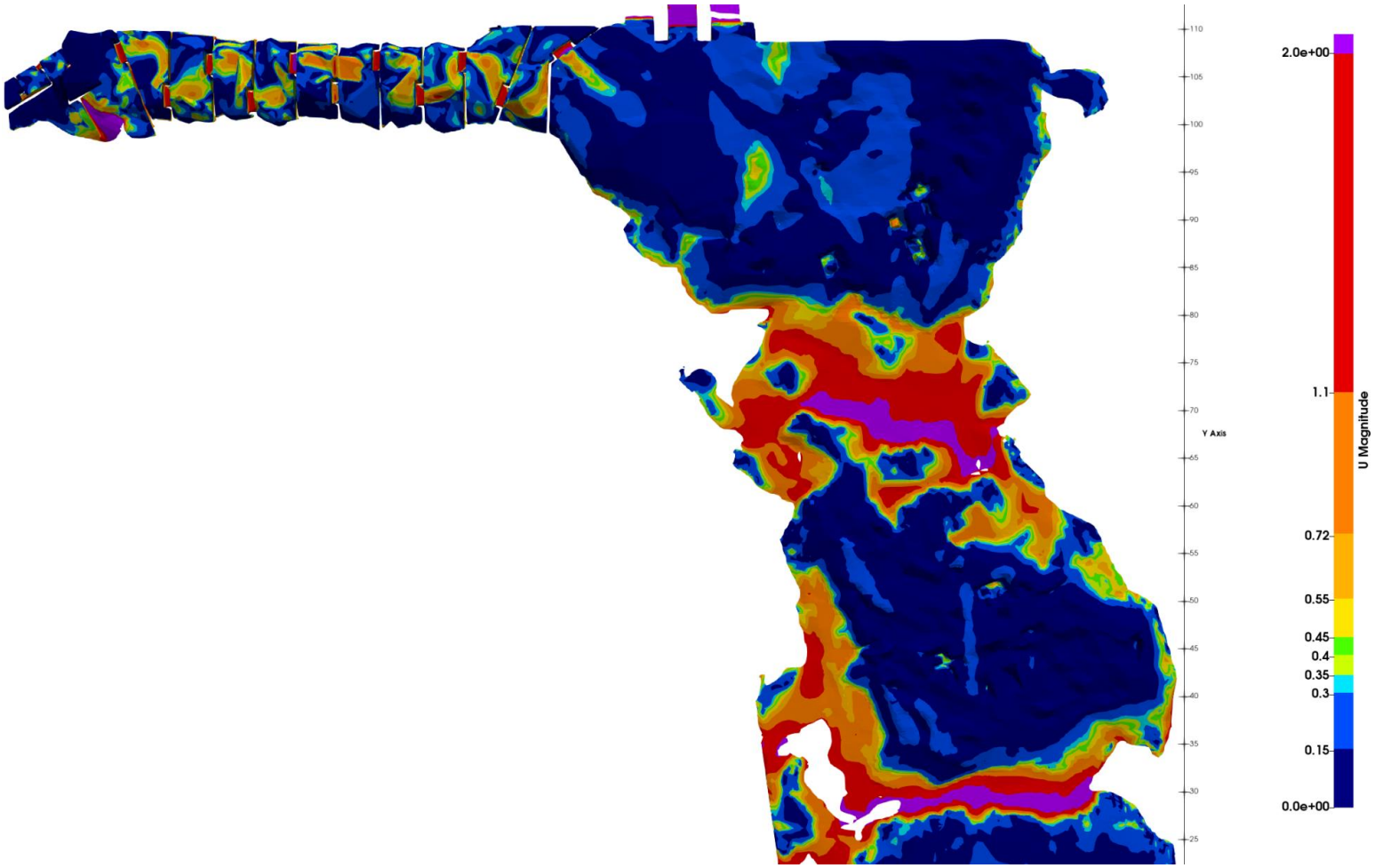


Figure S1-3: View of the Bottom Velocities

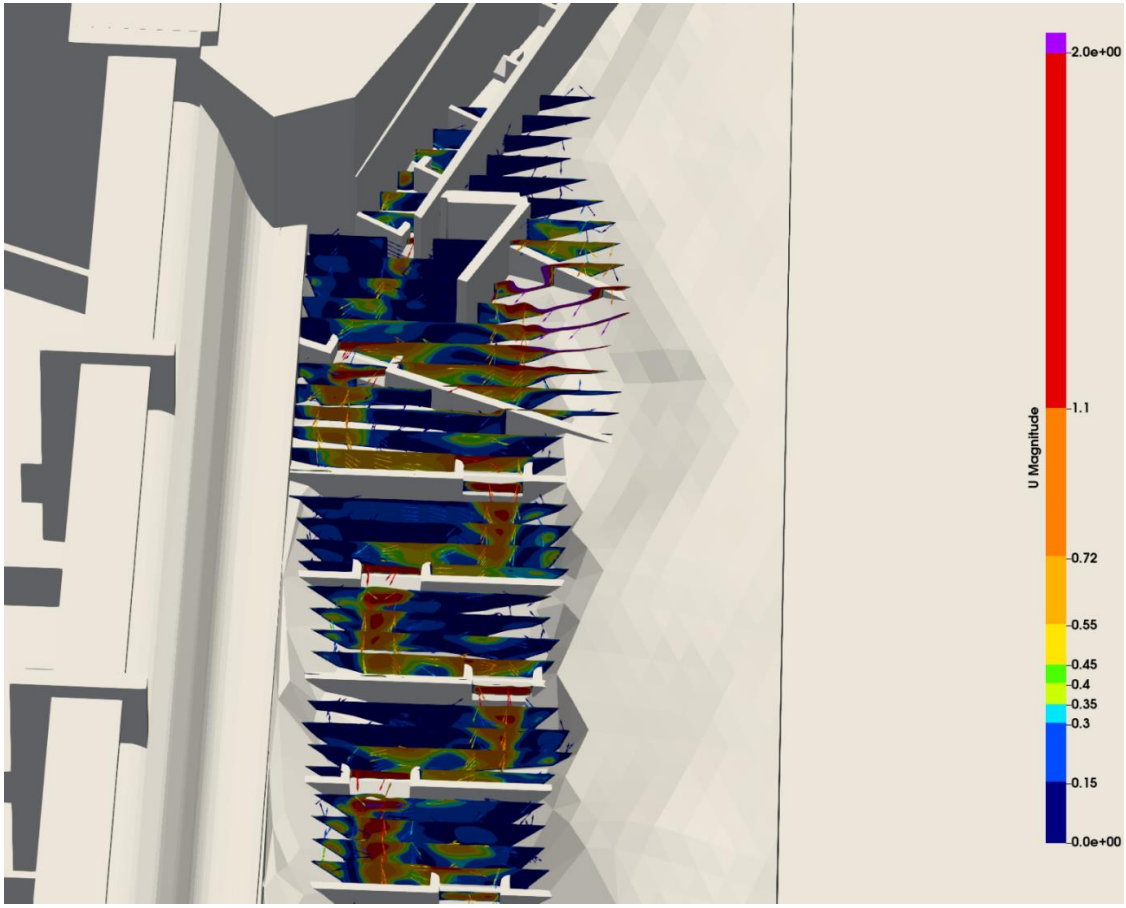


Figure S1-4: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

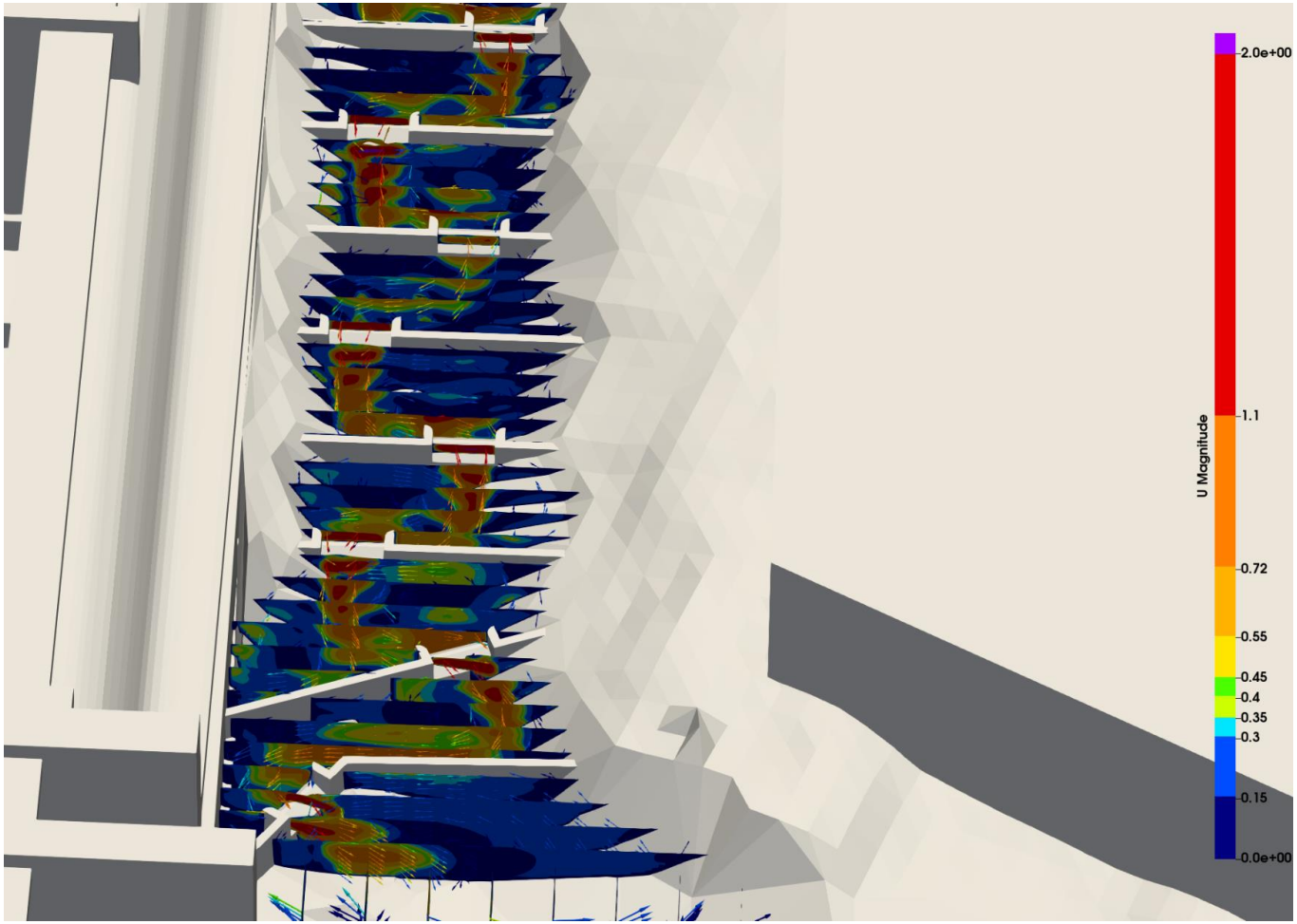


Figure S1-5: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

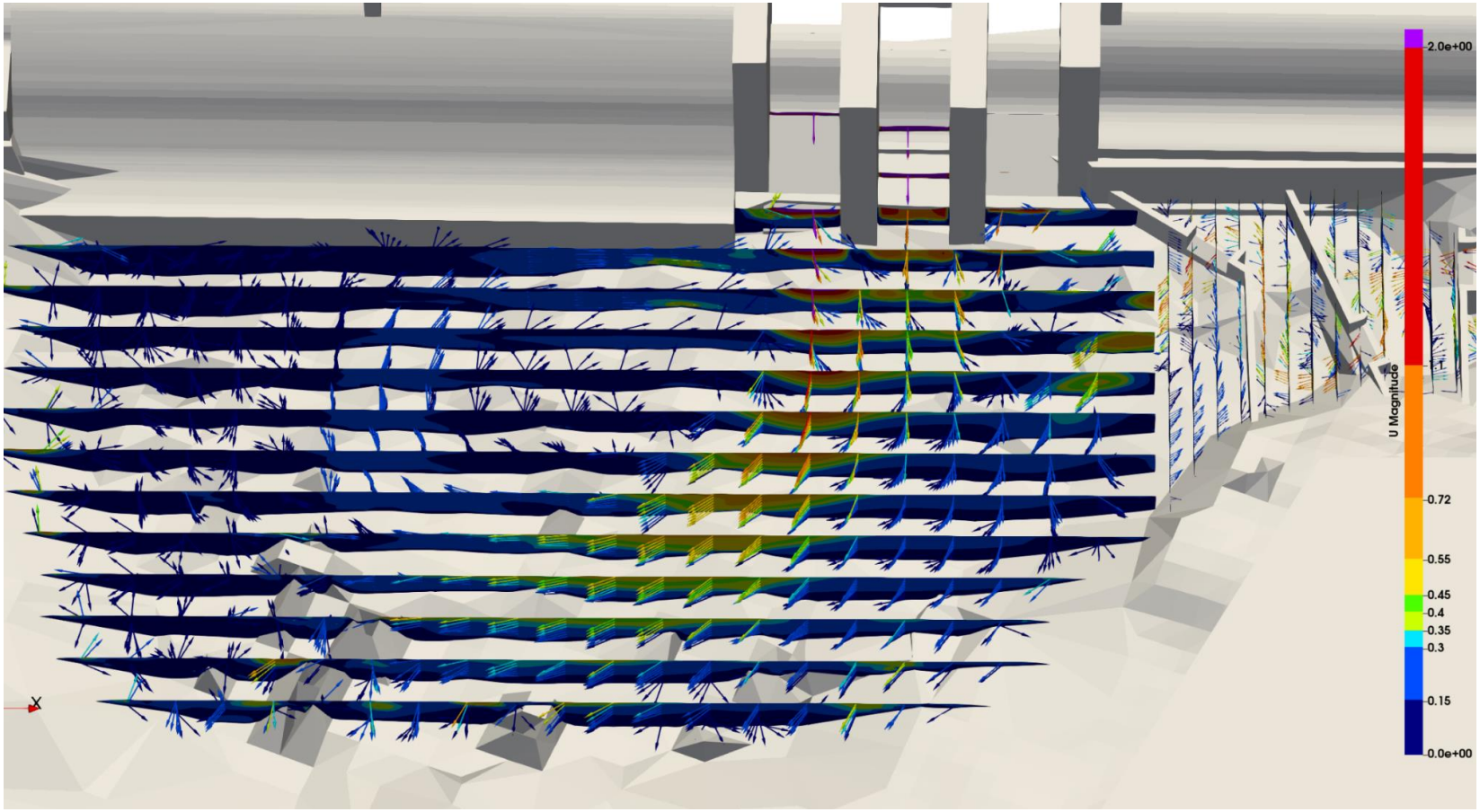


Figure S1-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

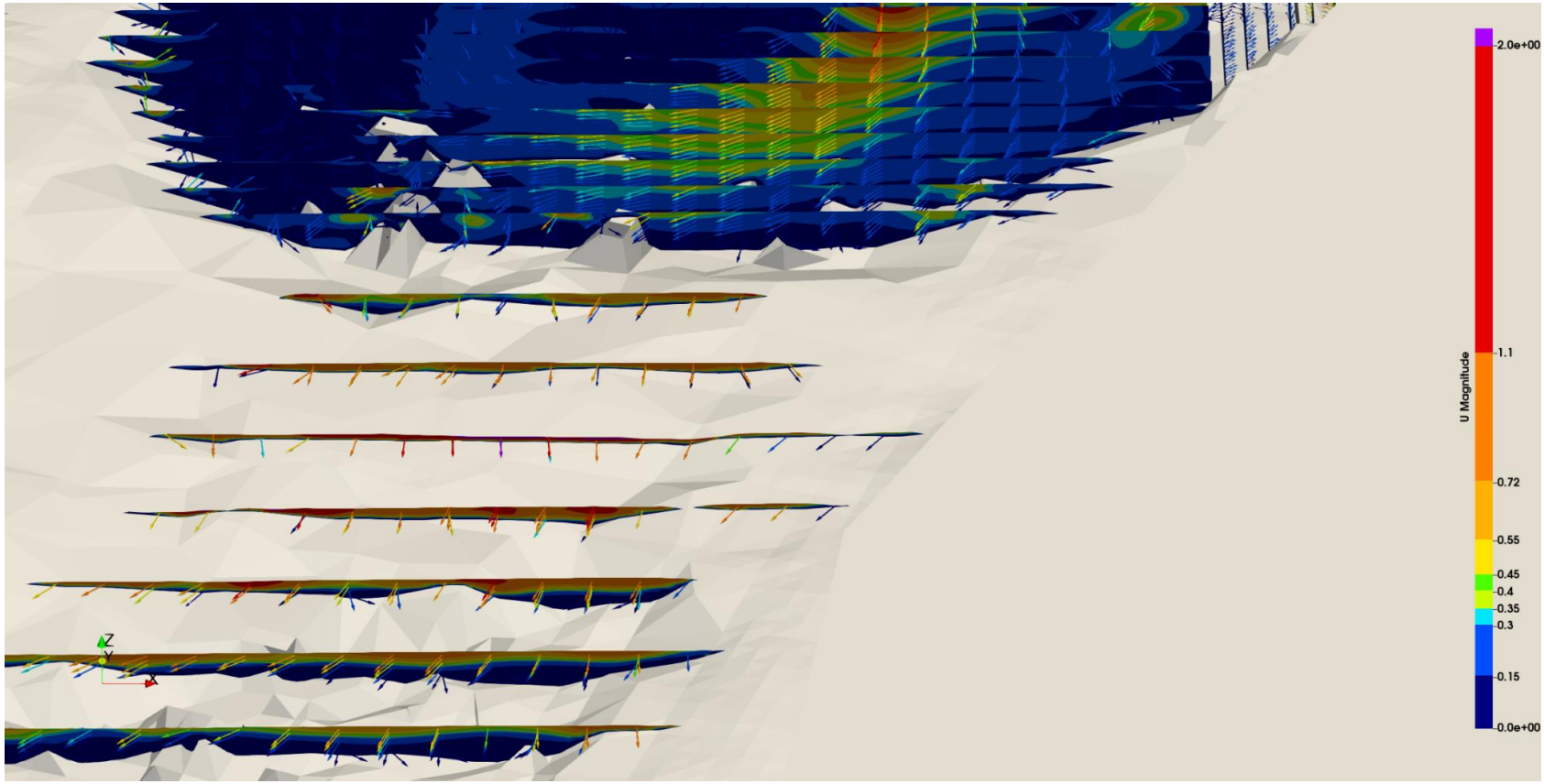


Figure S1-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction



Figure S1-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

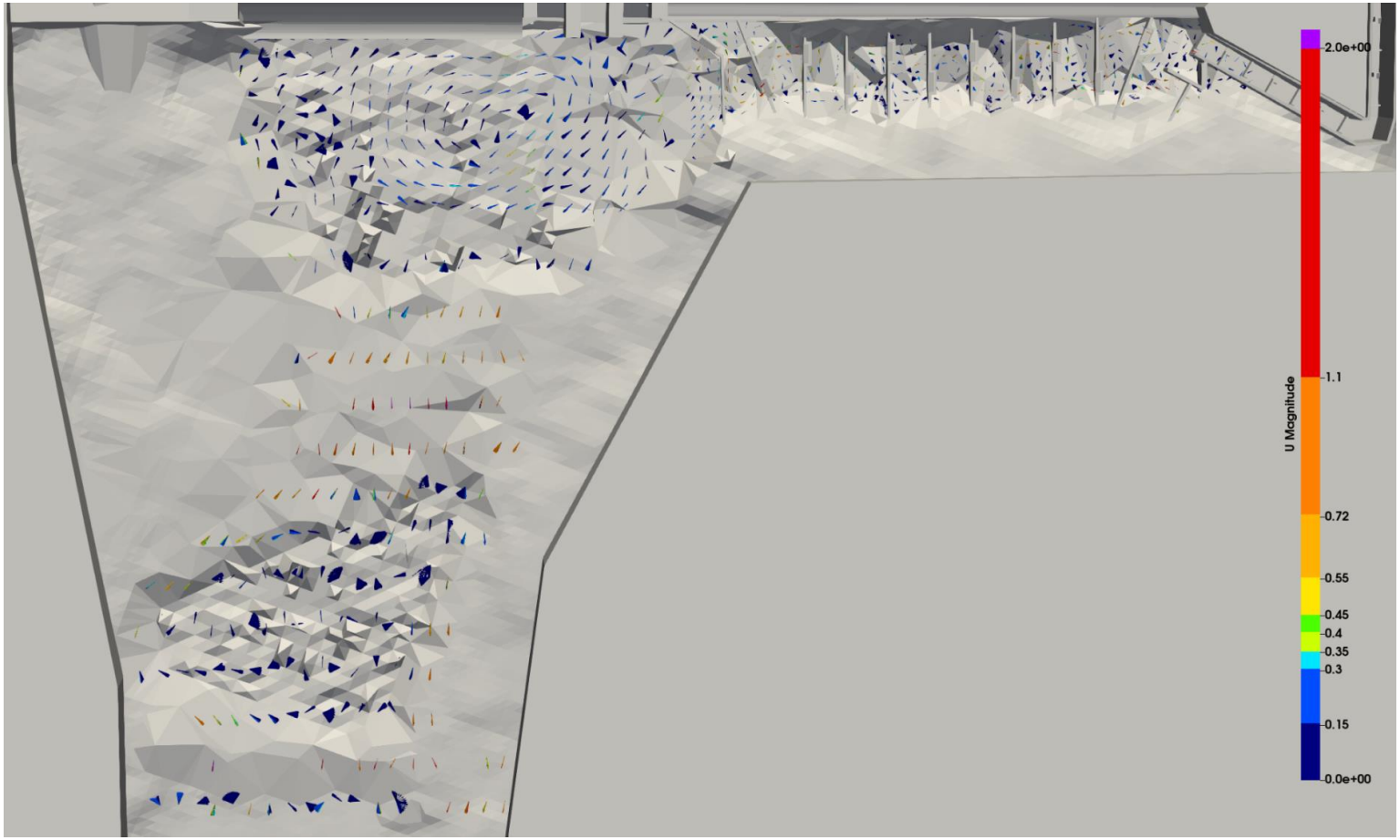


Figure S1-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

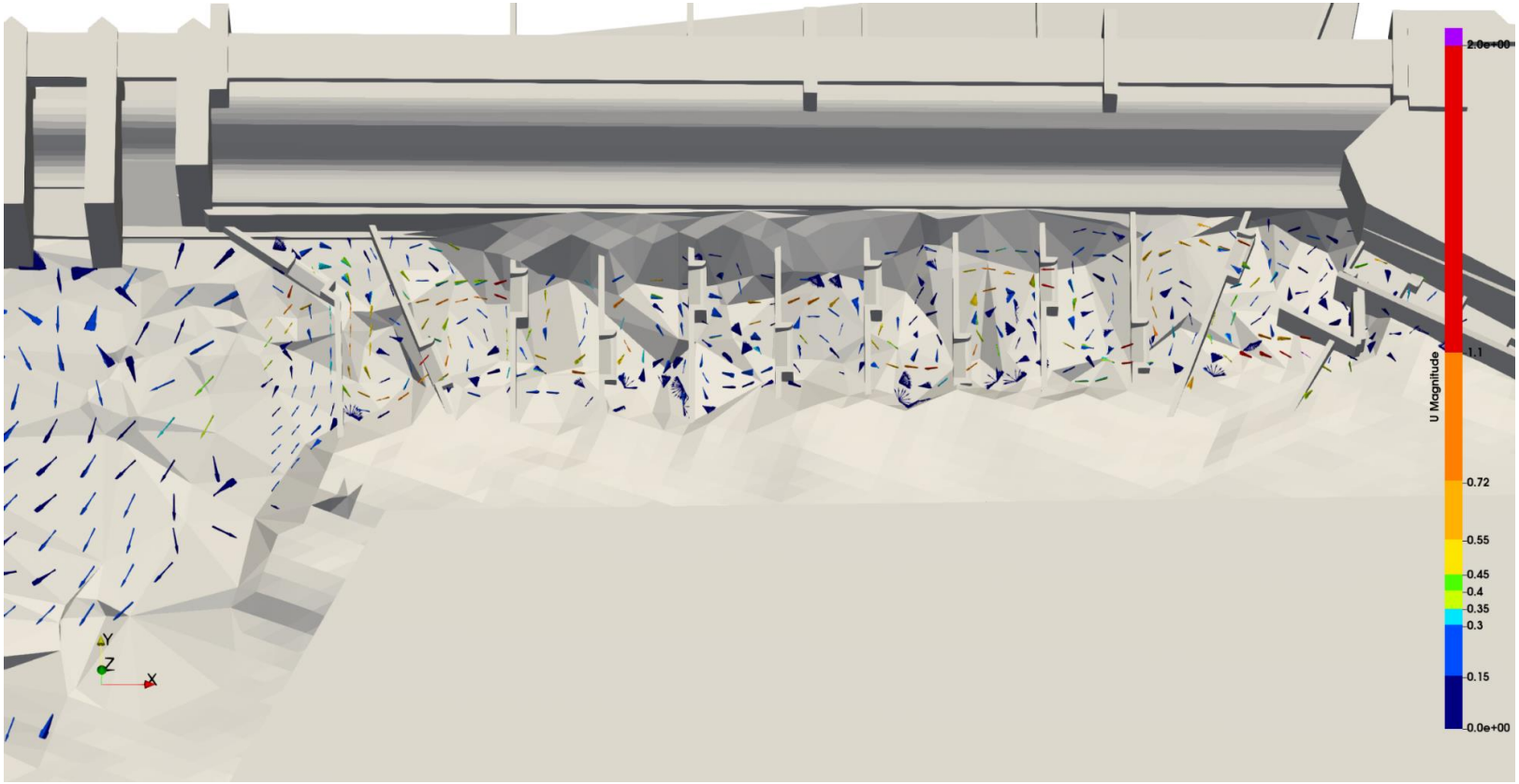


Figure S1-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

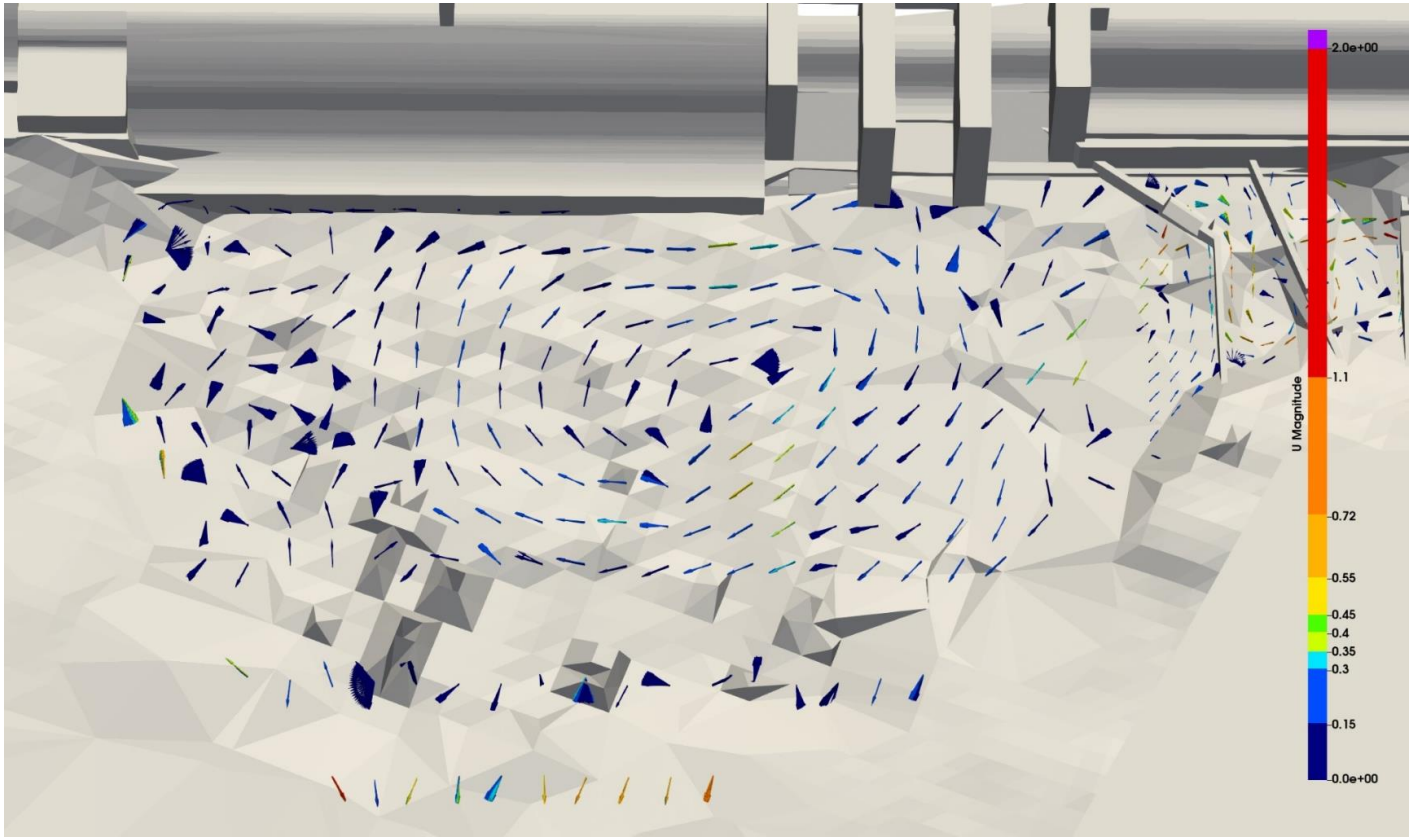


Figure S1-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

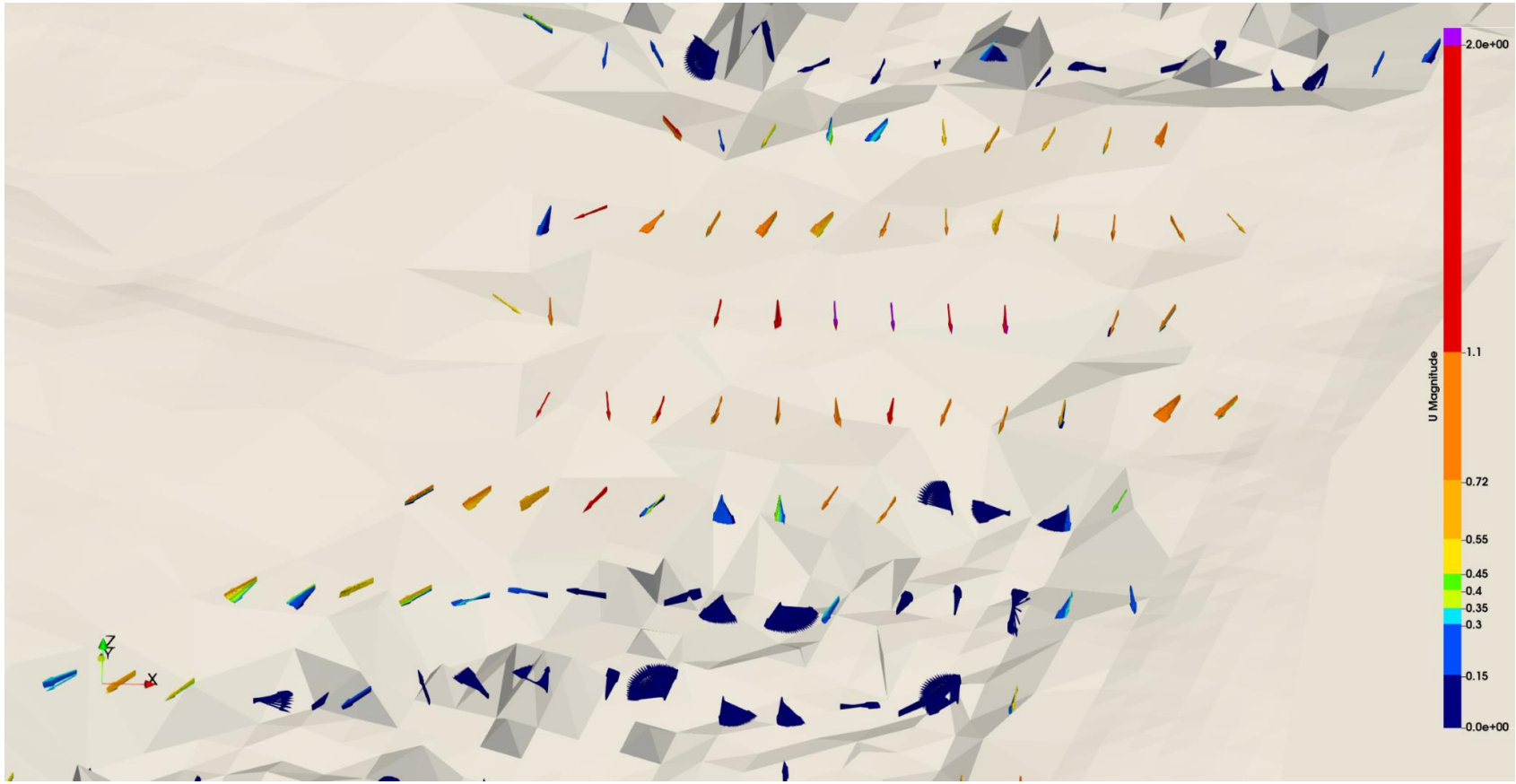


Figure S1-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

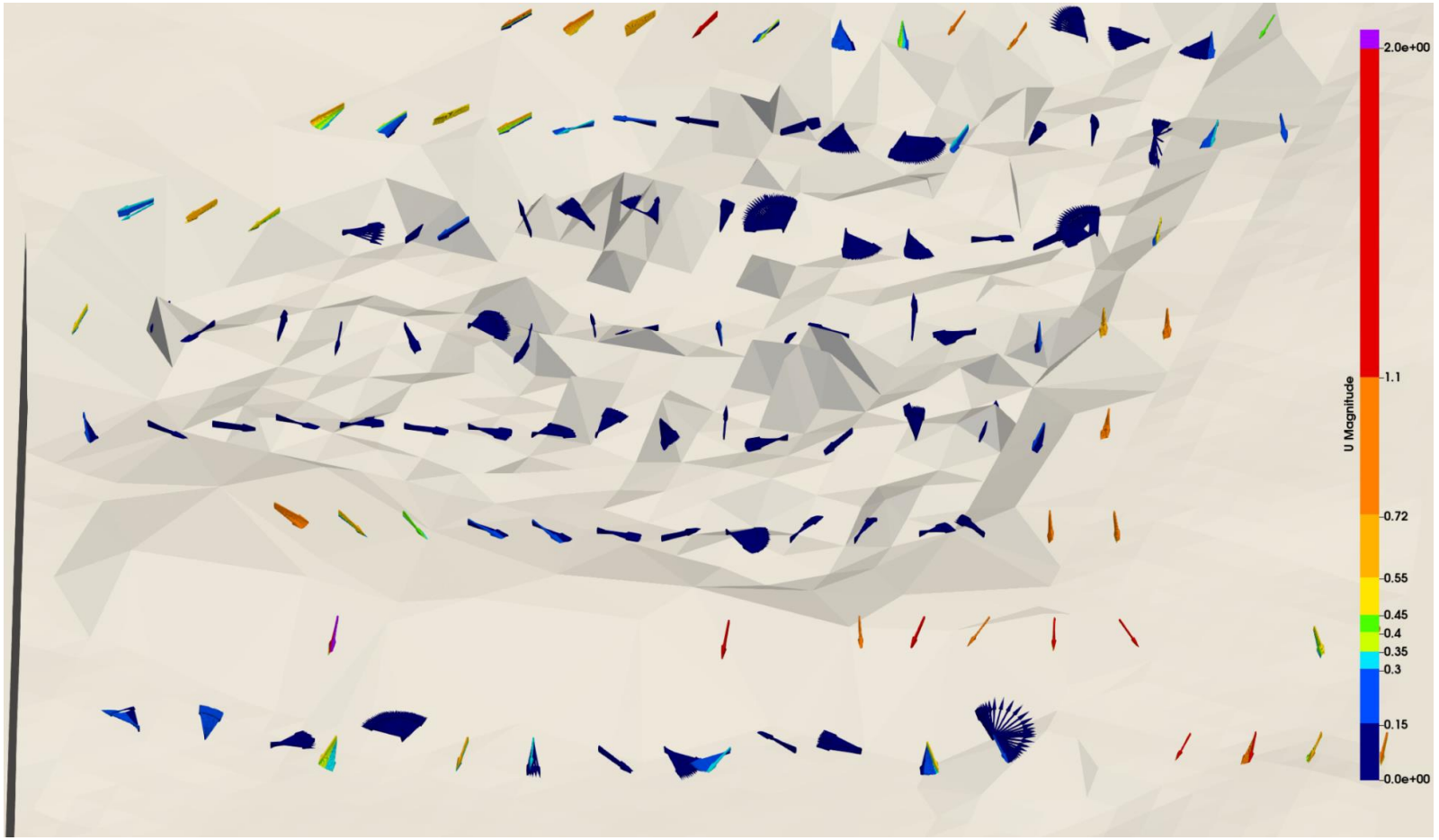


Figure S1-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

2. Model Results of Scenario S2 with 165 cfs from the gates

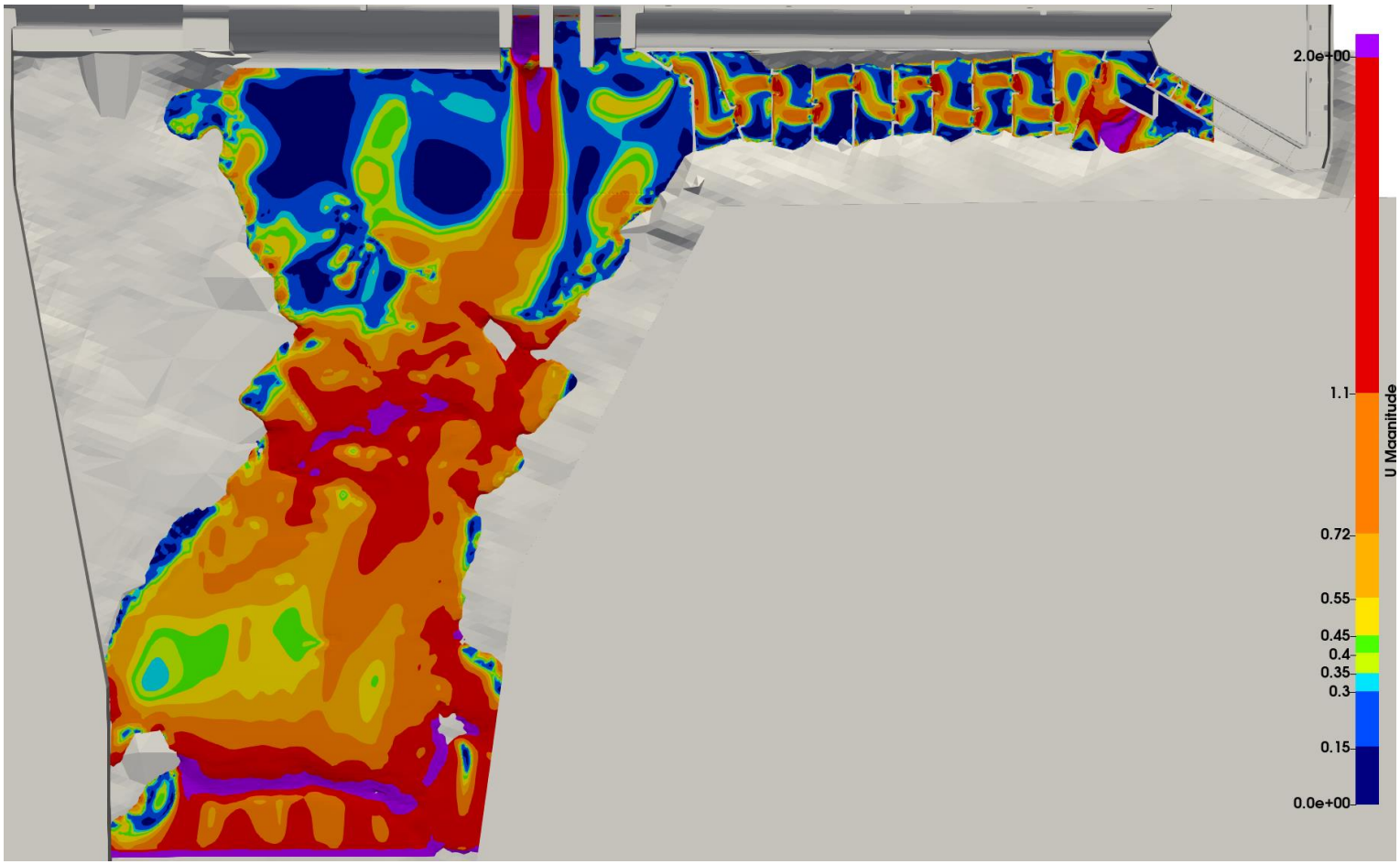


Figure S2-1: Plan view of the Water Surface Velocities

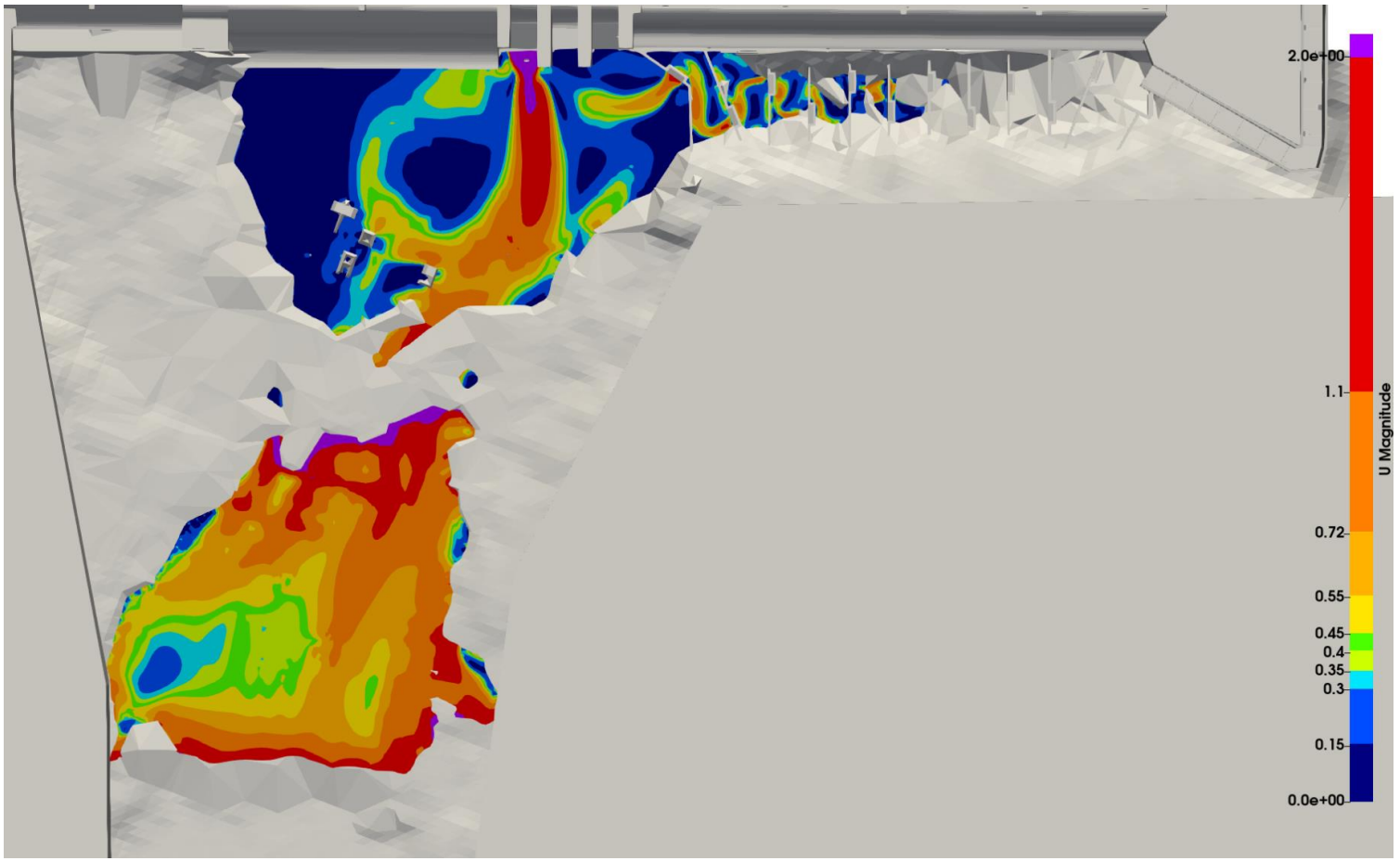


Figure S2-2: Plan view of the Mid-Surface Velocities

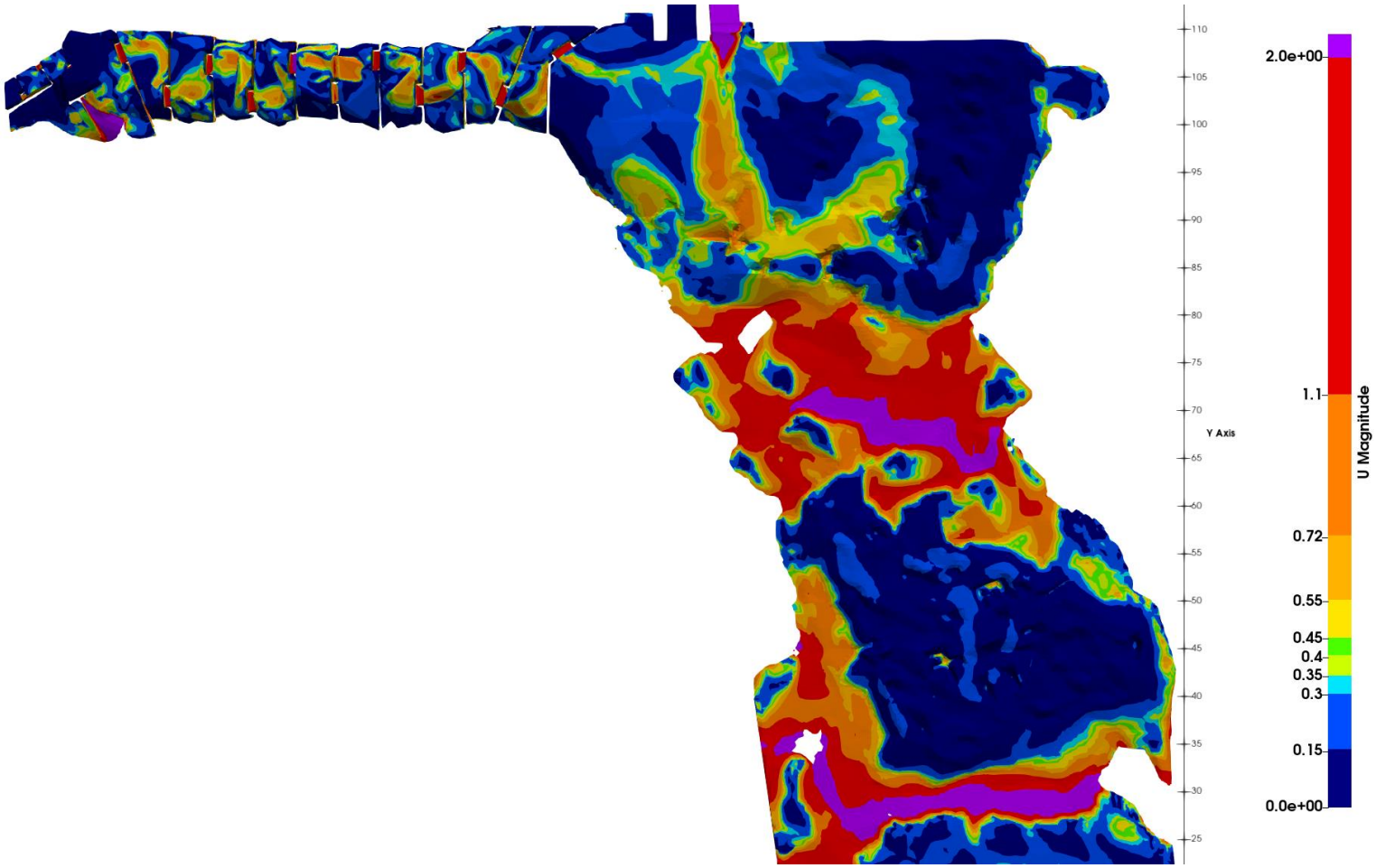


Figure S2-3: View of the Bottom Velocities

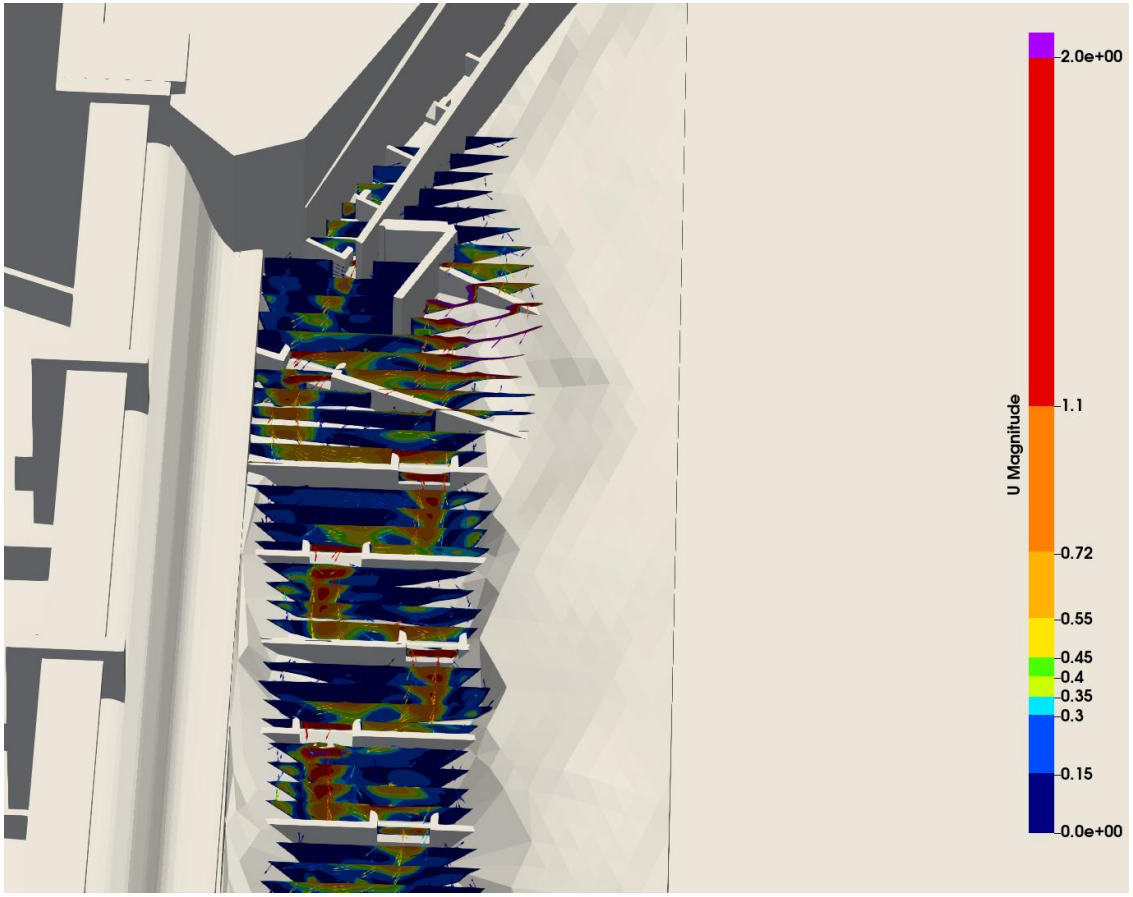


Figure S2-4: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

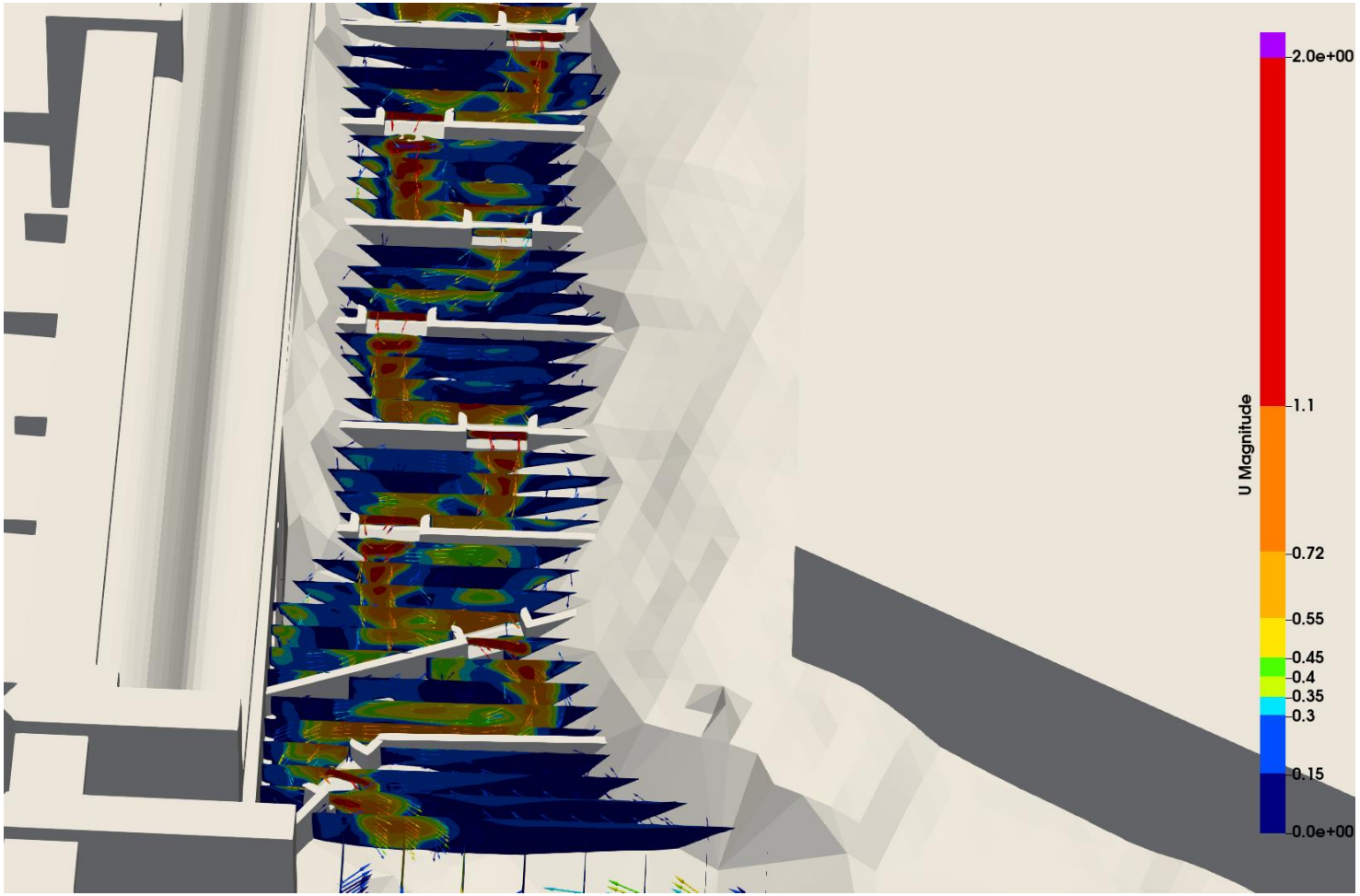


Figure S2-5: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

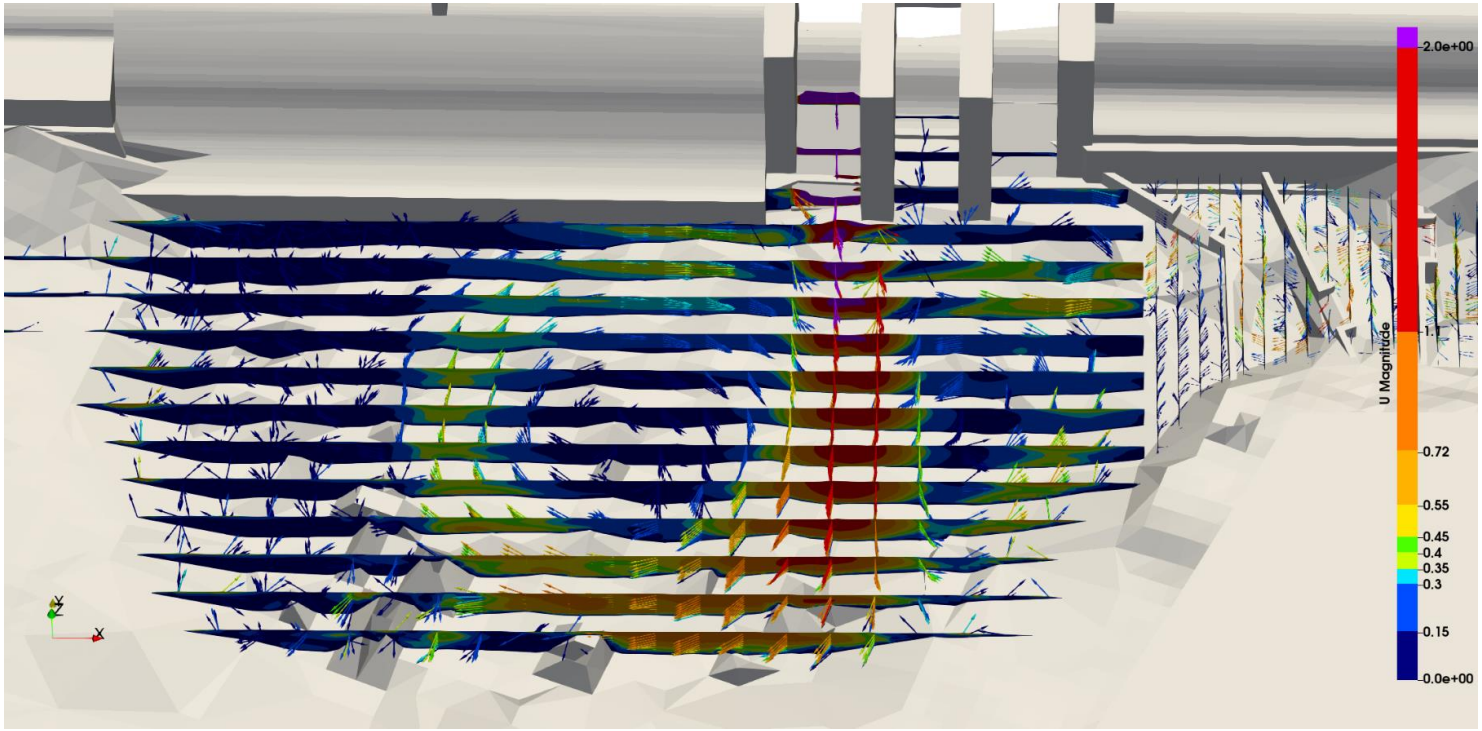


Figure S2-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

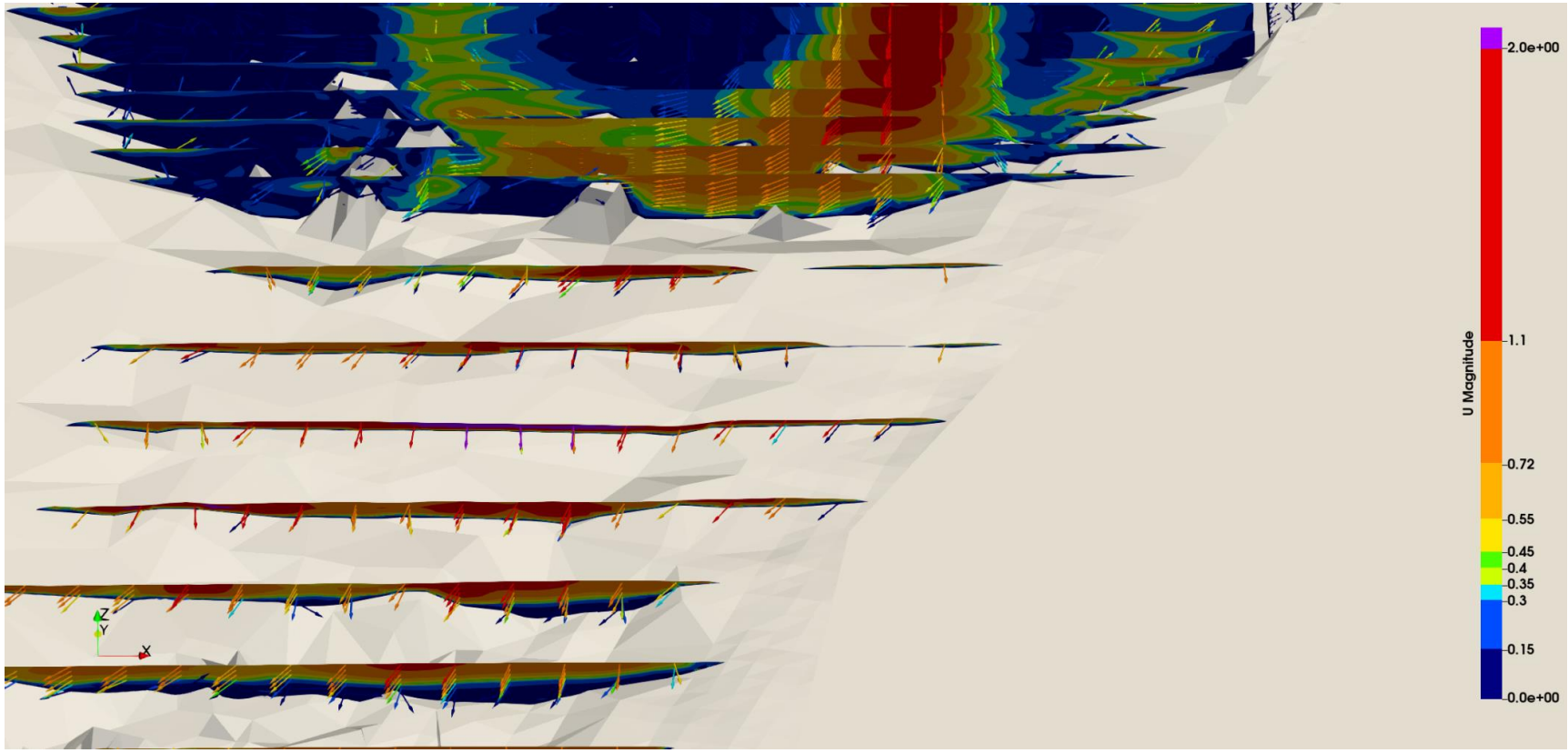


Figure S2-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

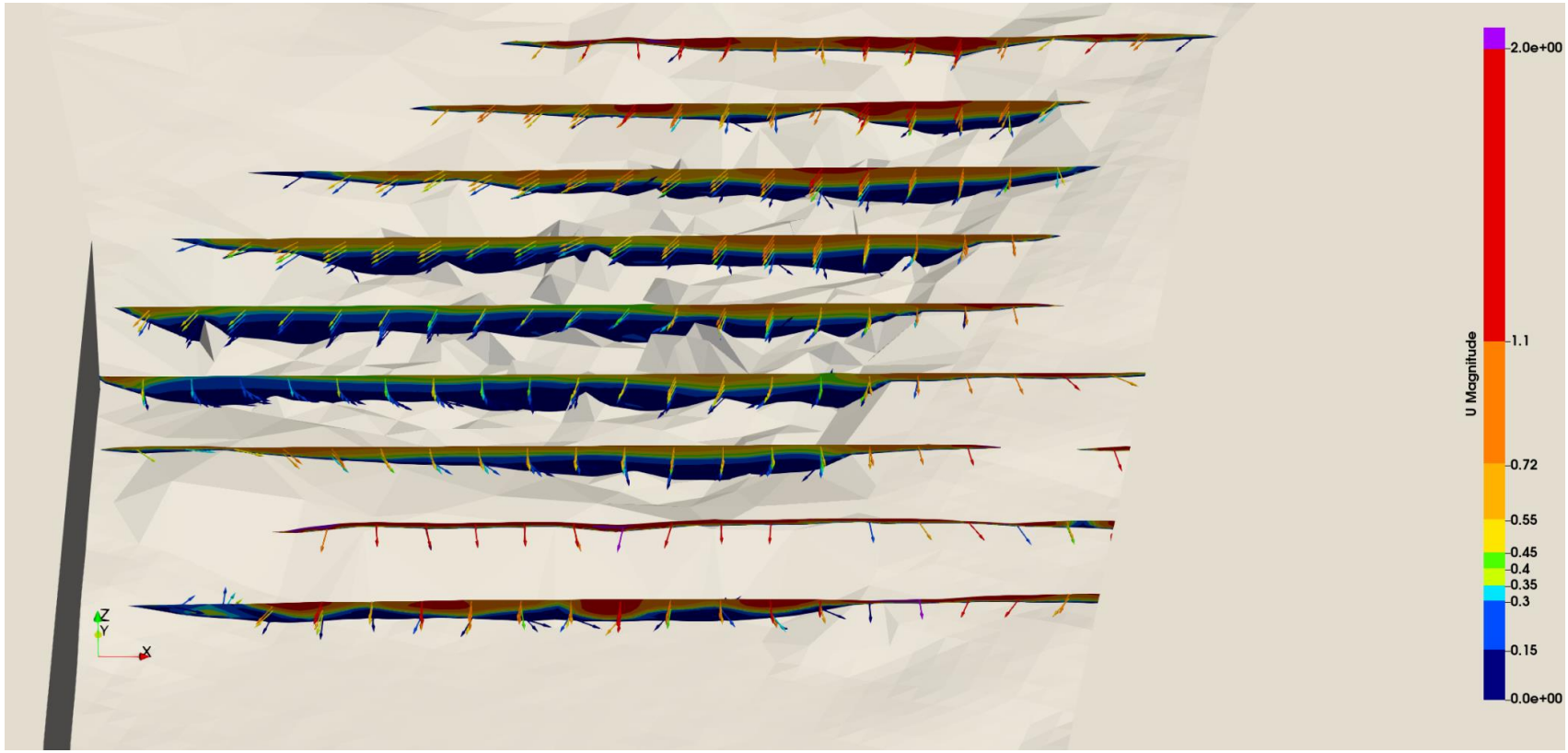


Figure S2-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

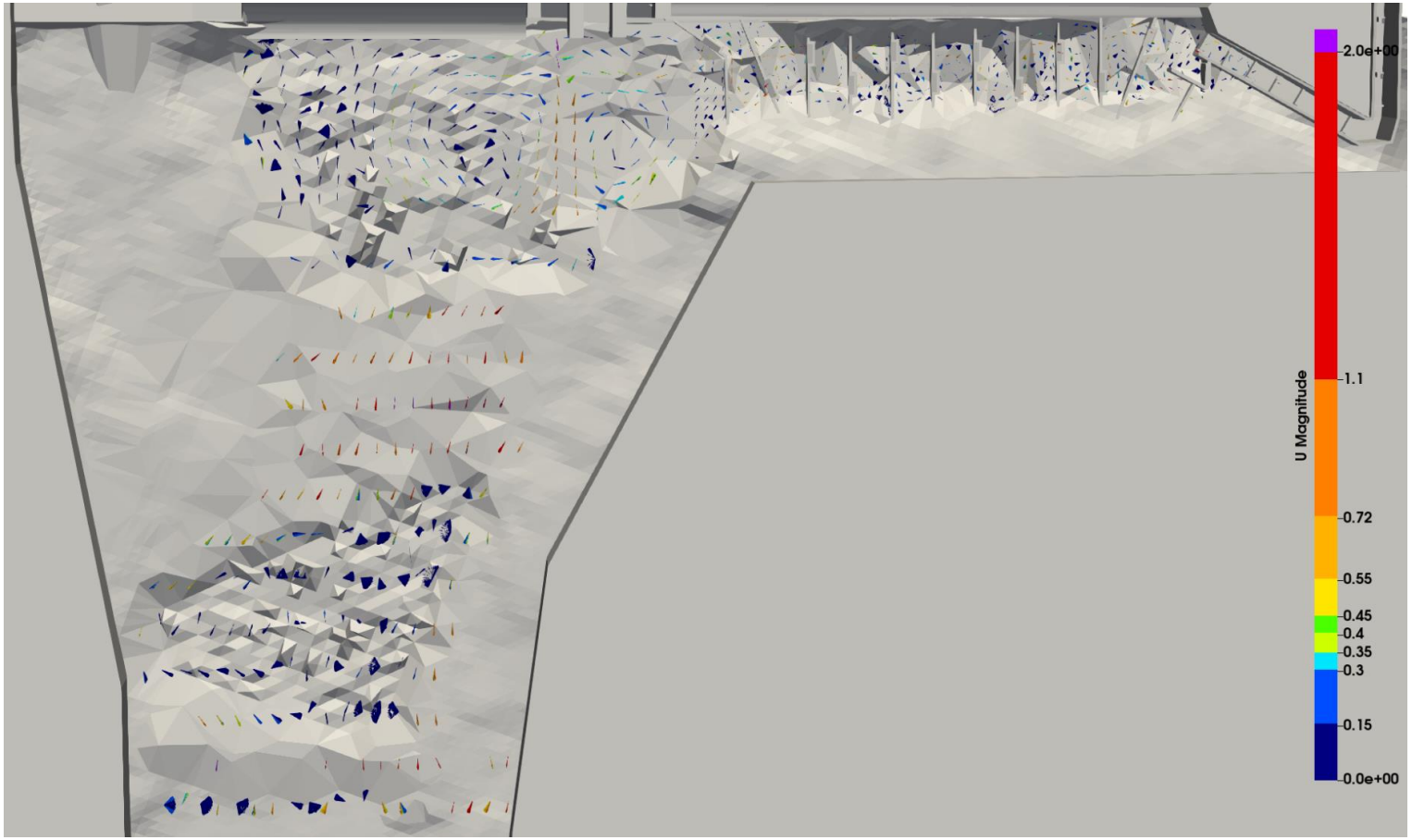


Figure S2-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

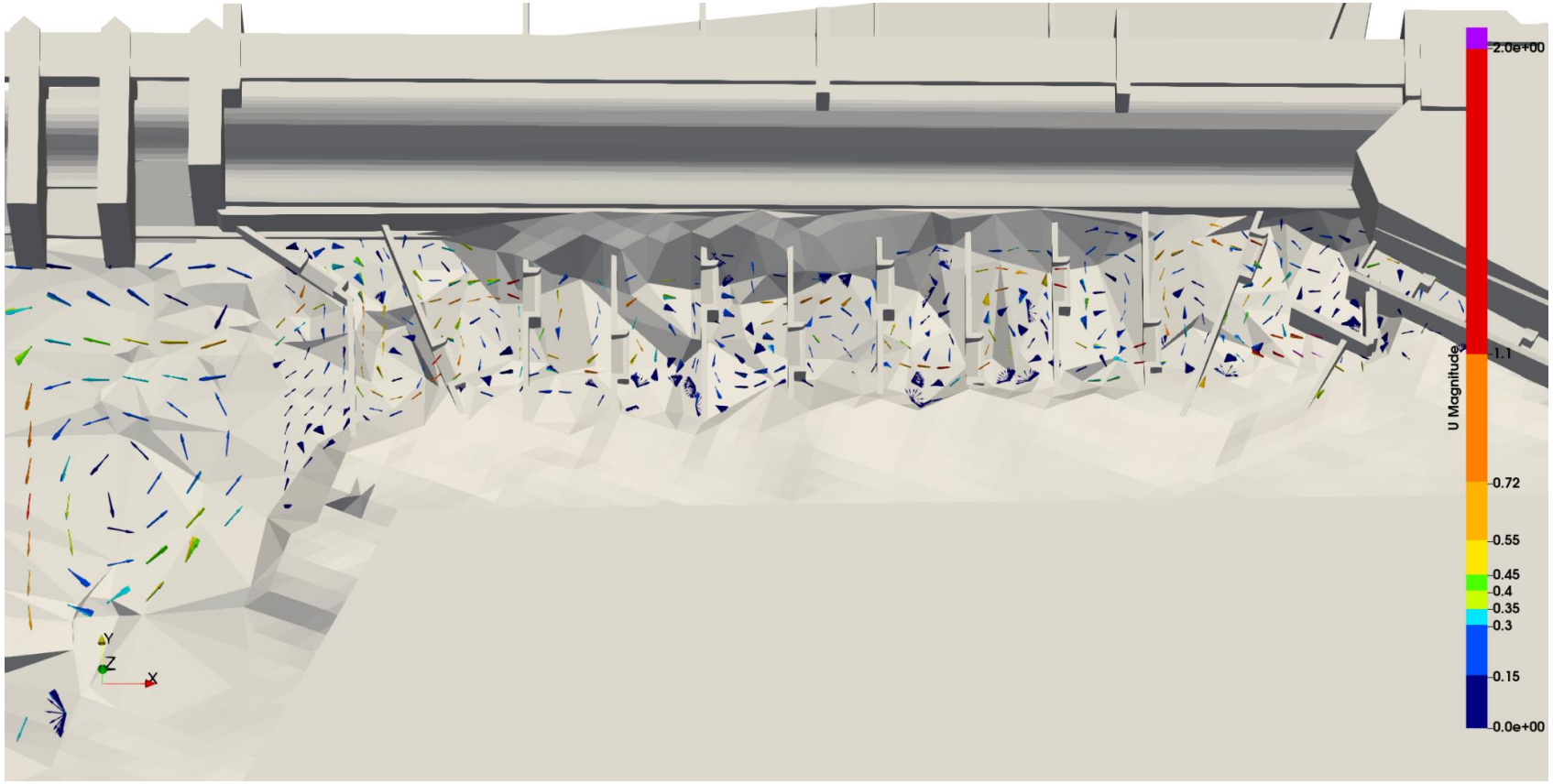


Figure S2-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

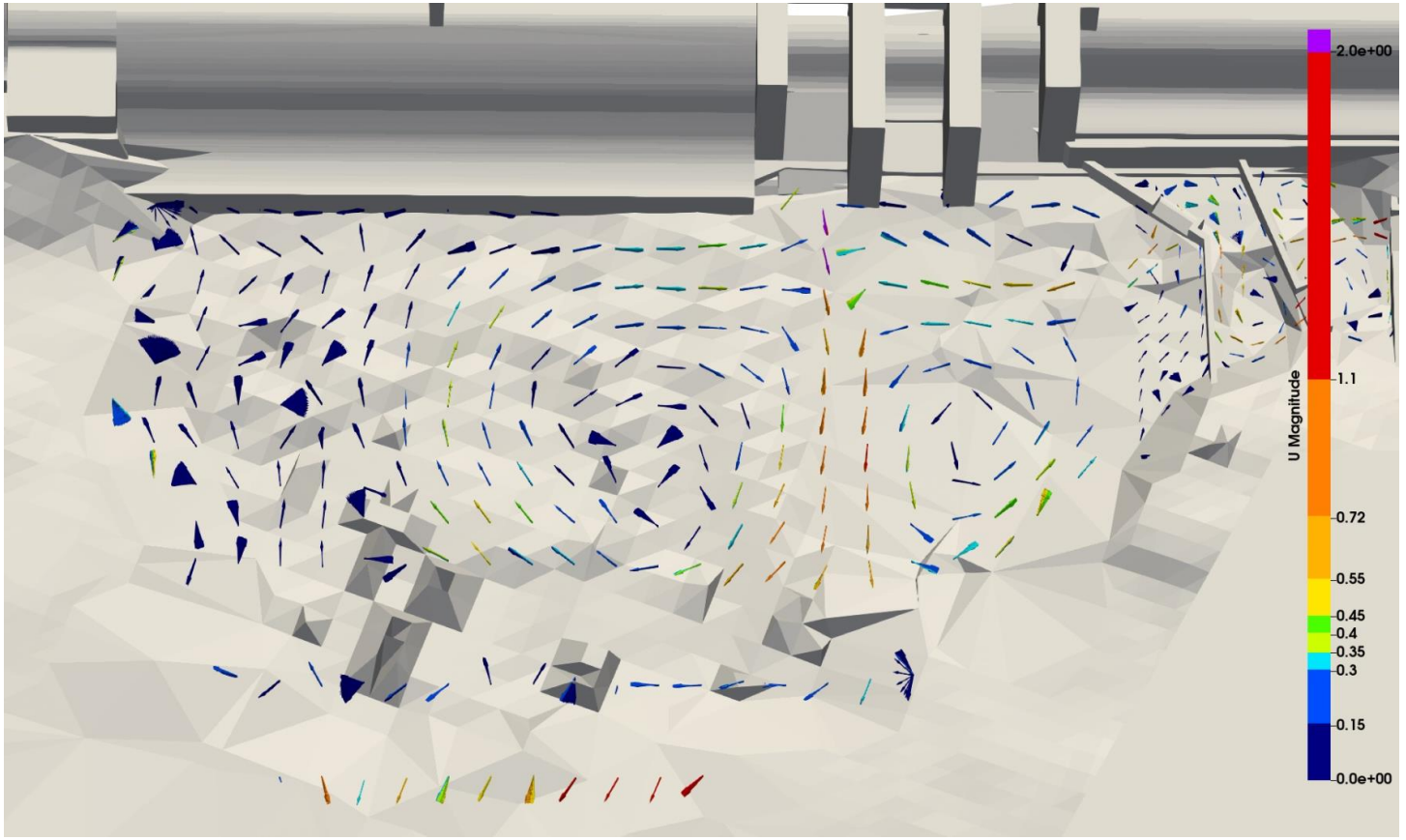


Figure S2-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

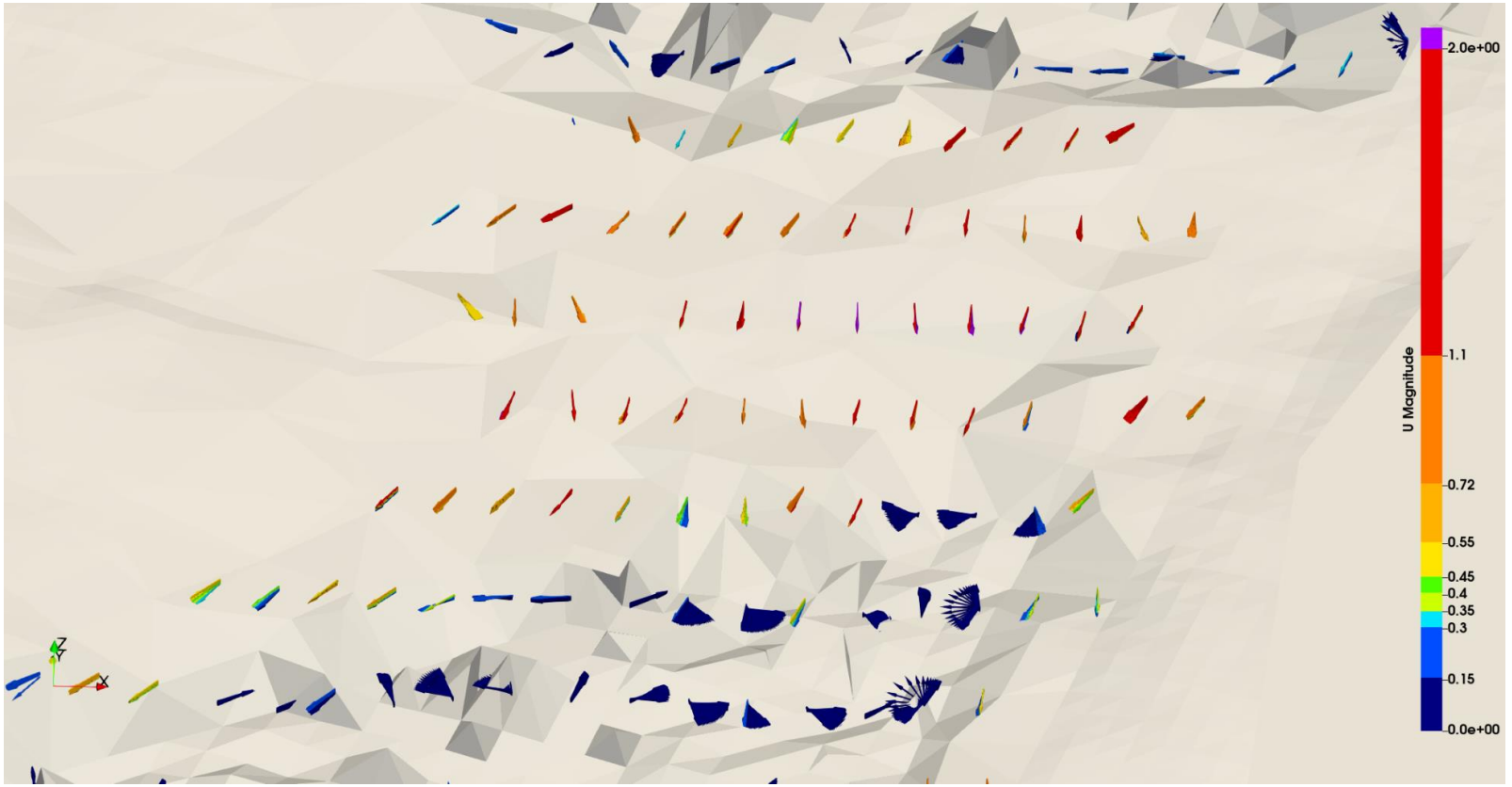


Figure S2-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

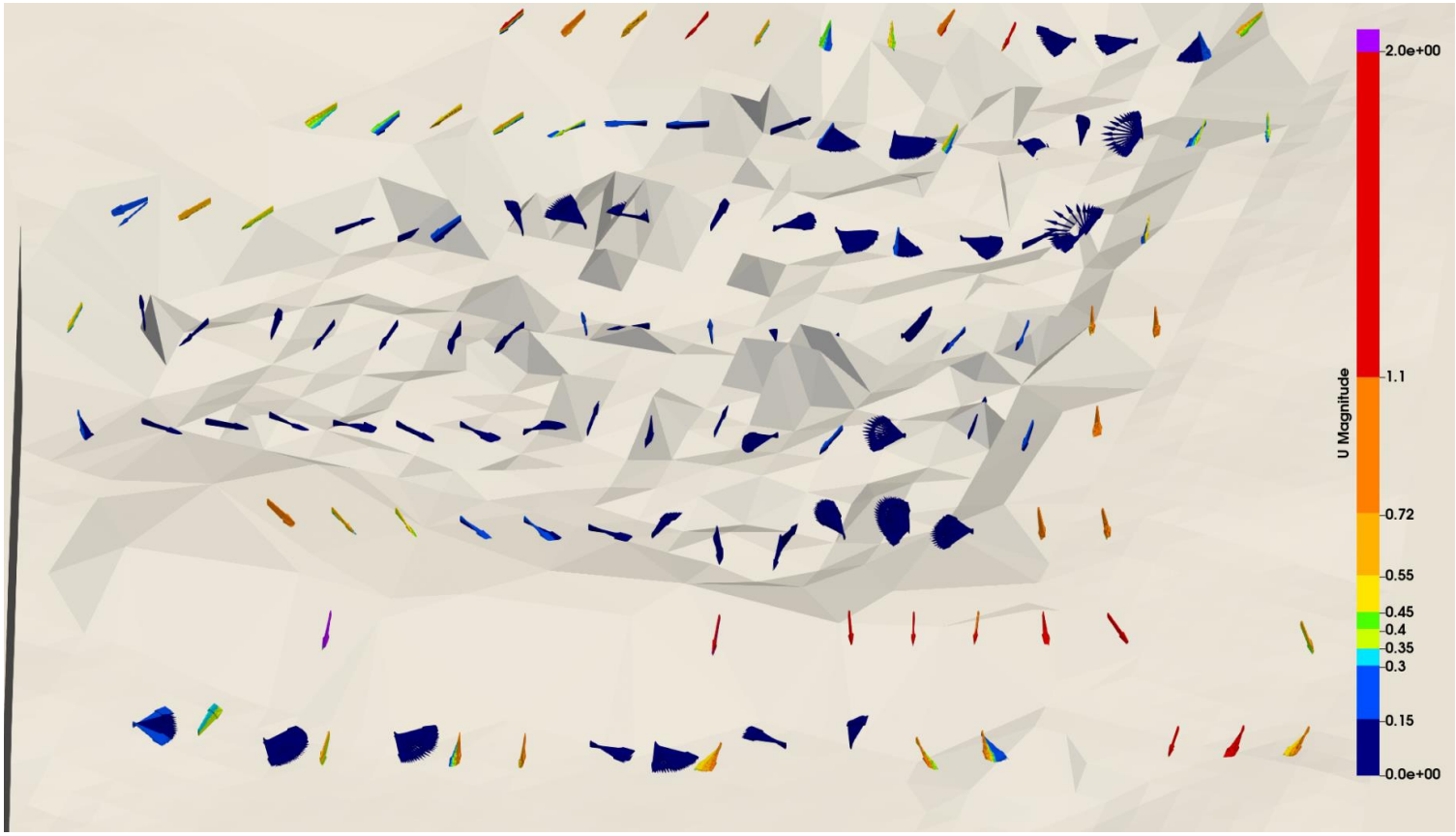


Figure S2-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

3. Model Results of Scenario S3 with 925 cfs from the gates

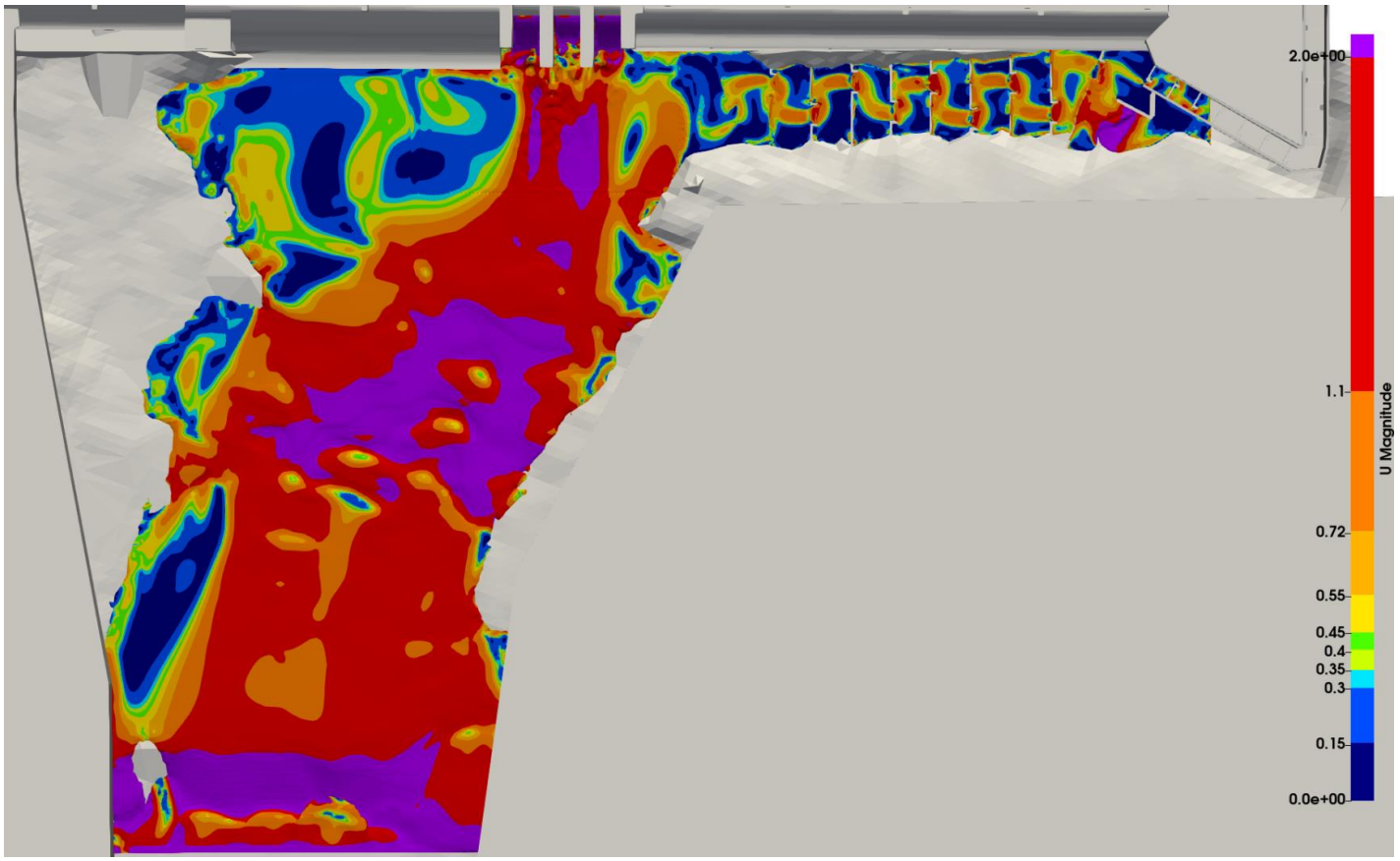


Figure S3-1: Plan view of the Water Surface Velocities

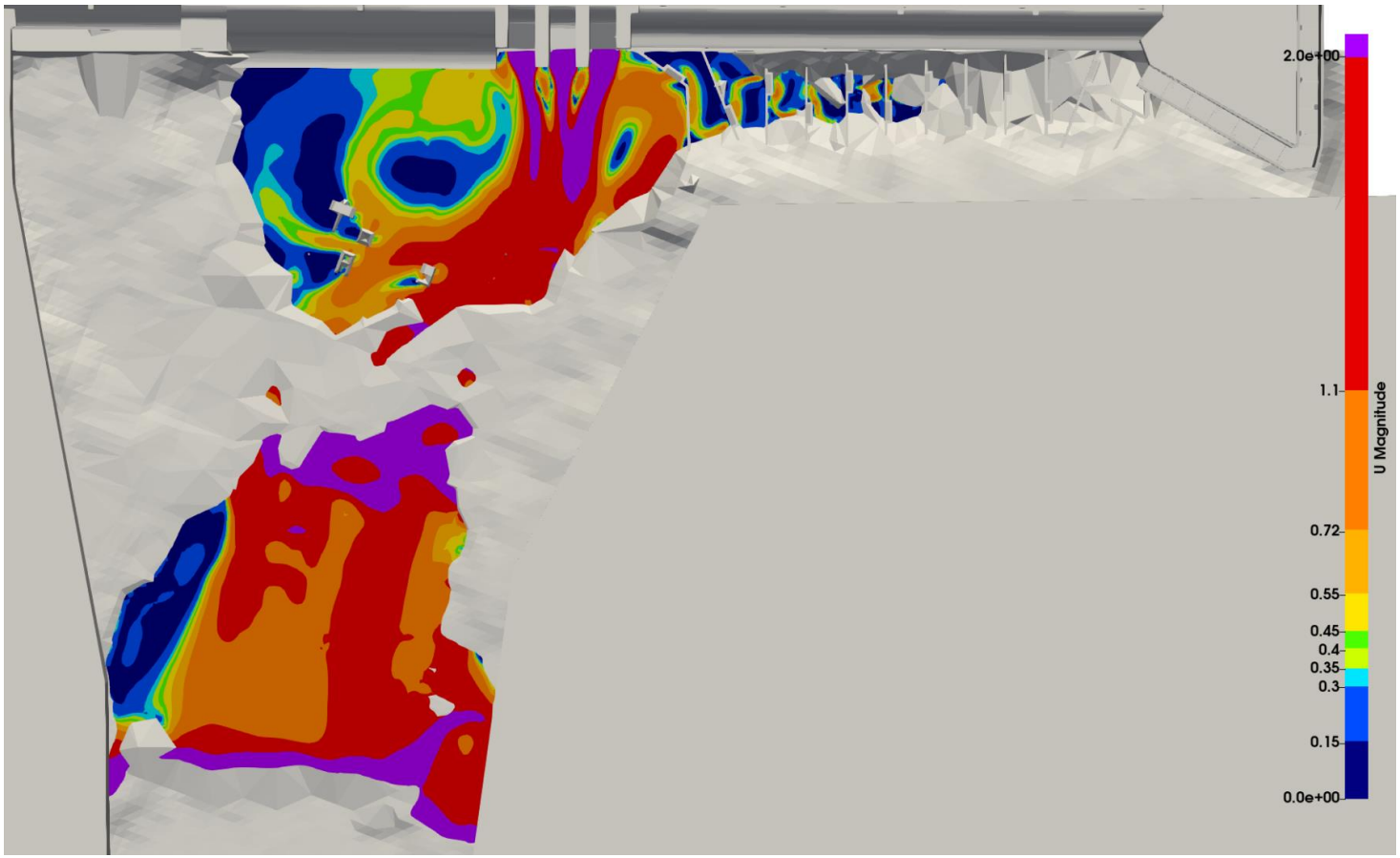


Figure S3-2: Plan view of the Mid-Surface Velocities

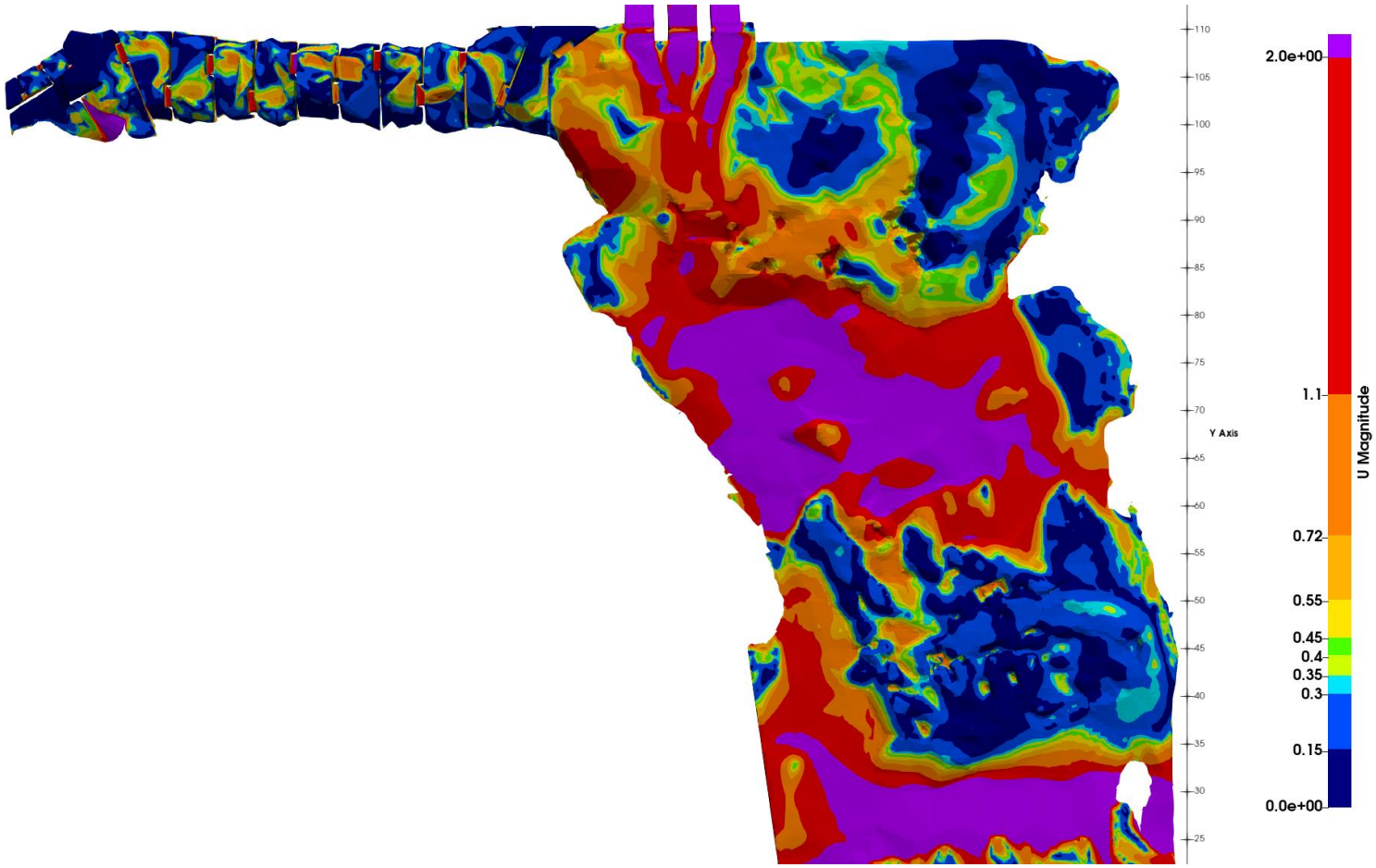


Figure S3-3: View of the Bottom Velocities

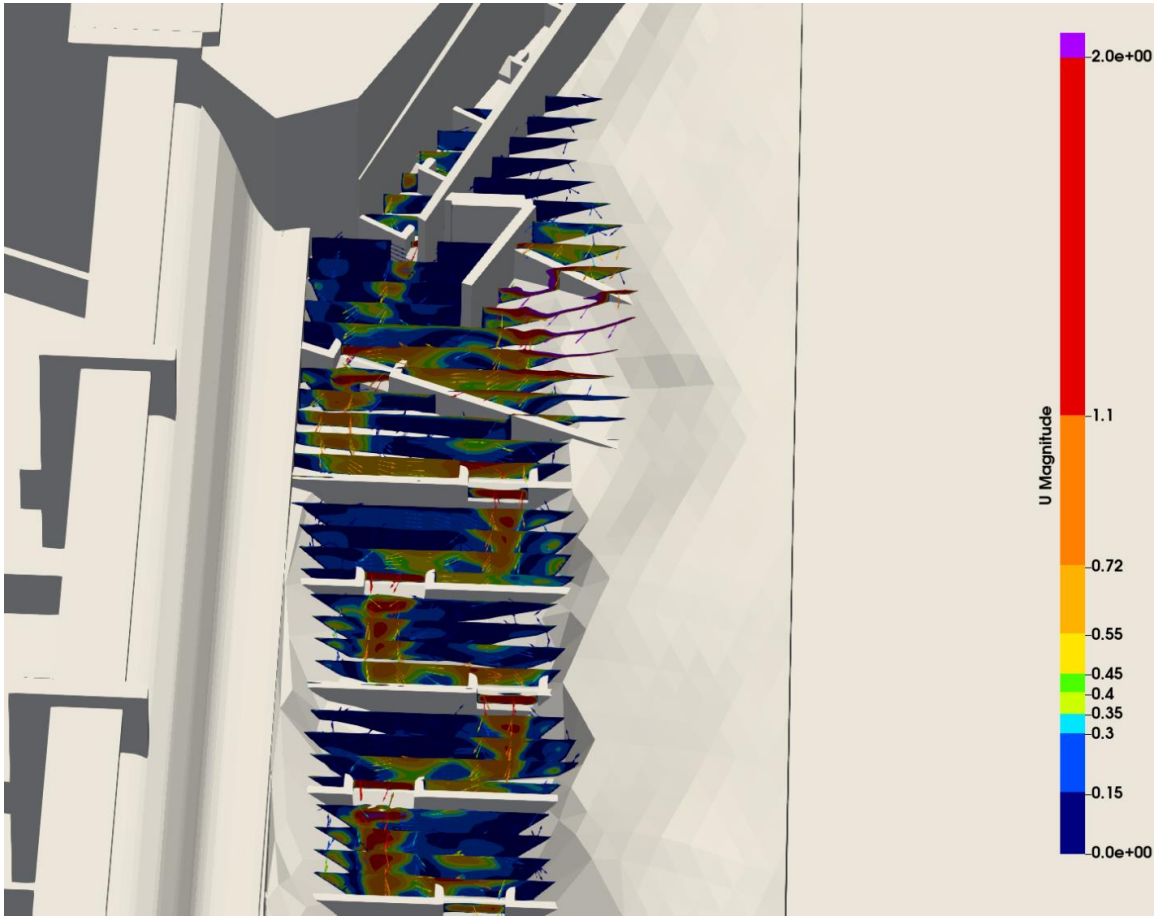


Figure S3-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

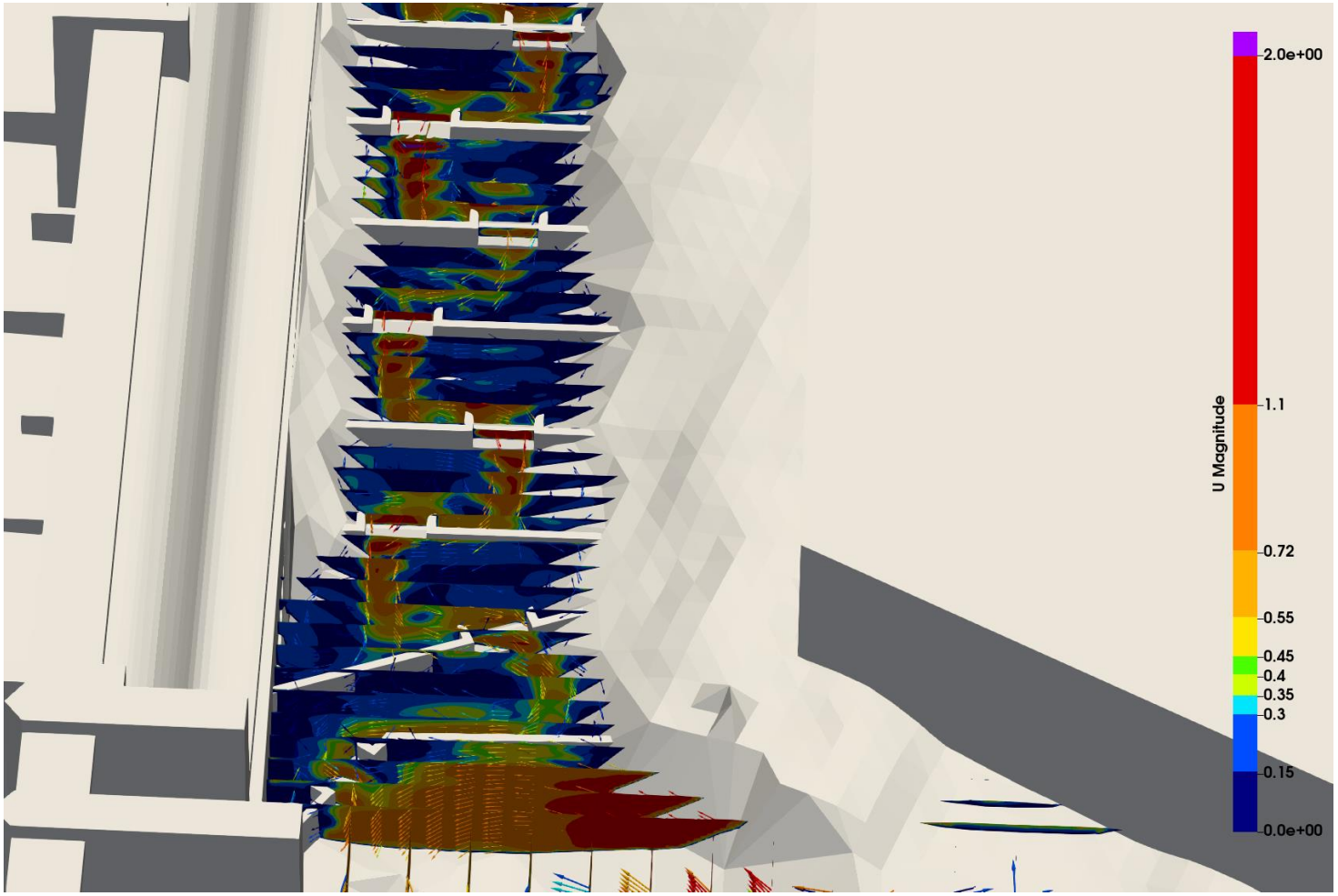


Figure S3-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

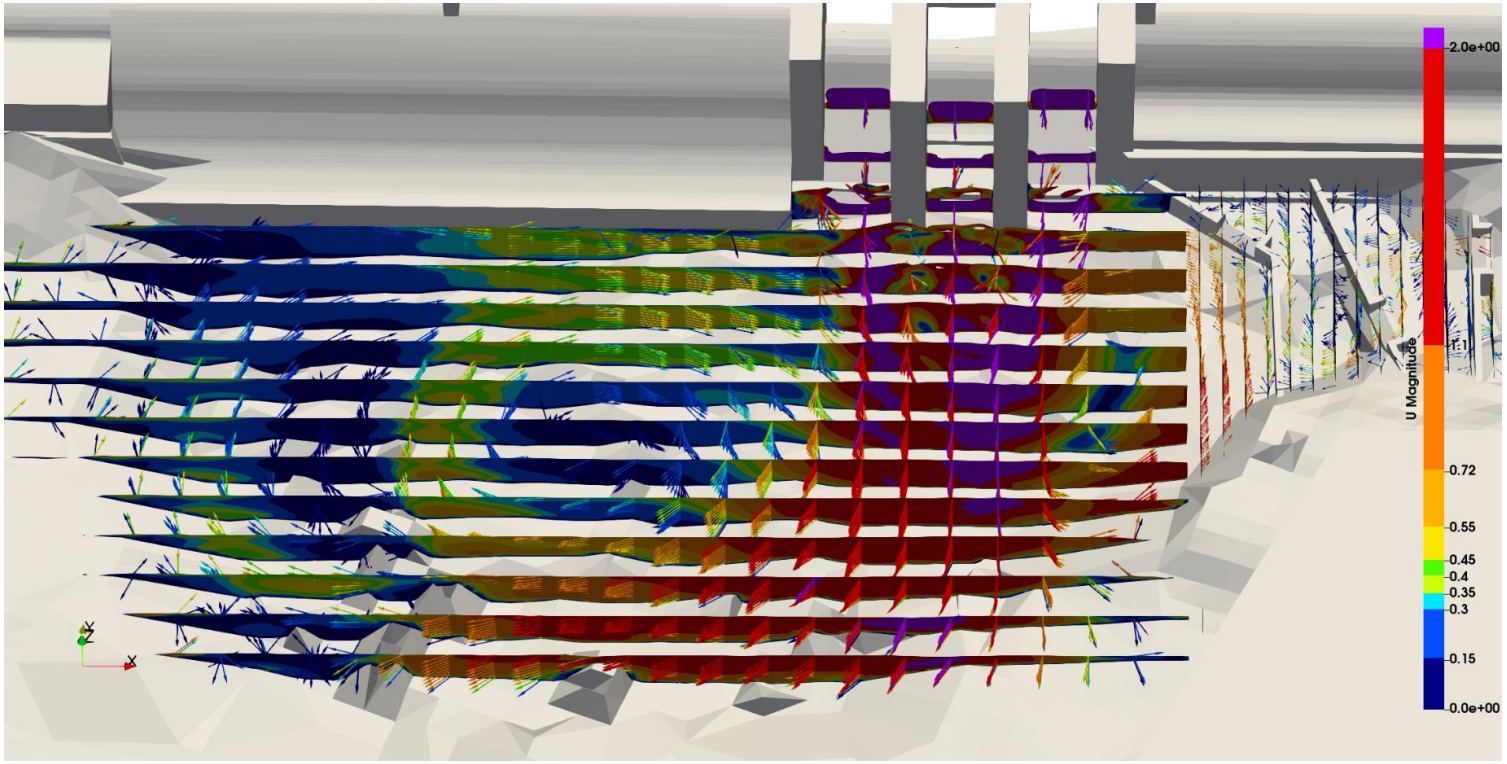


Figure S3-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

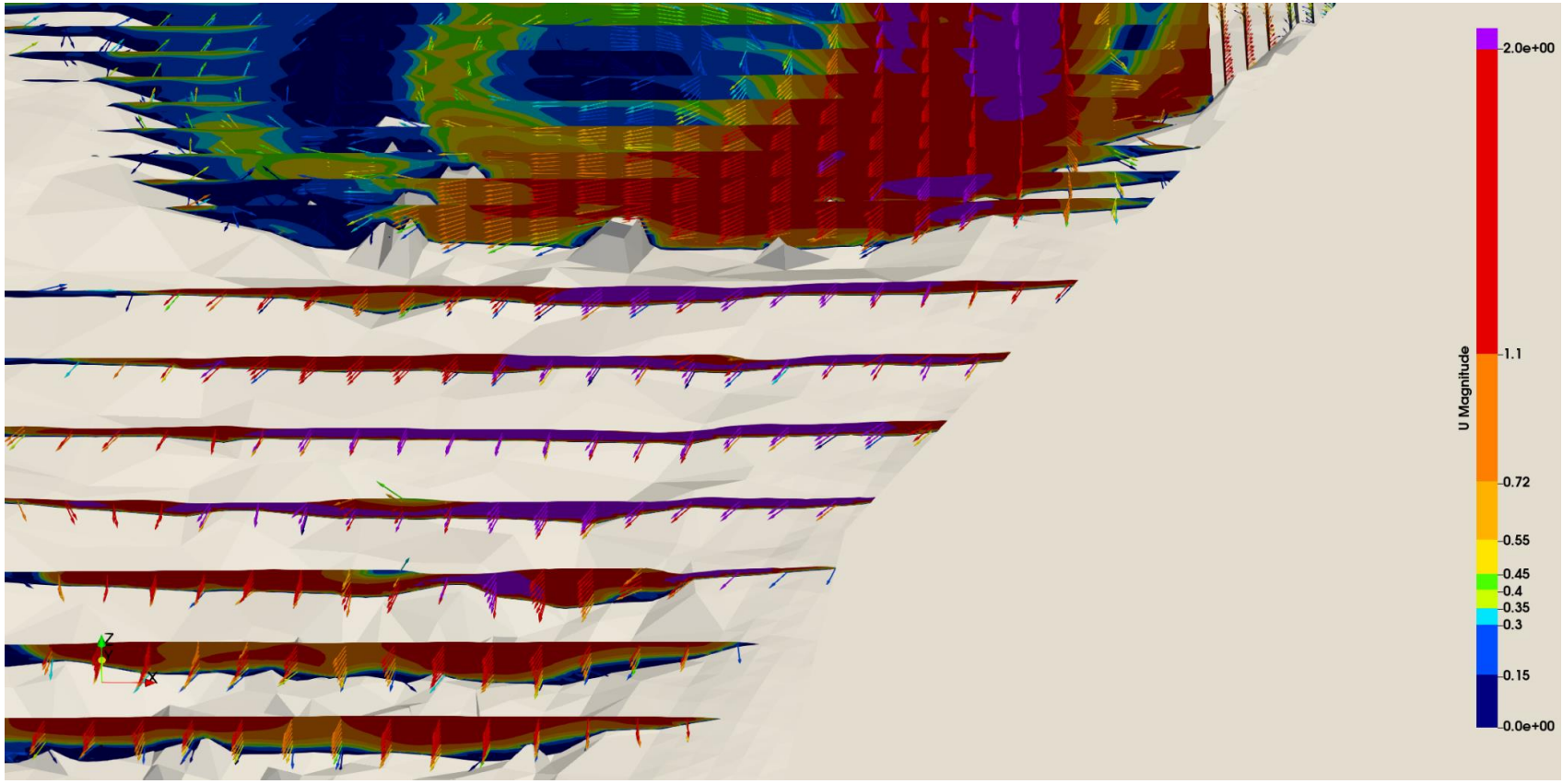


Figure S3-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

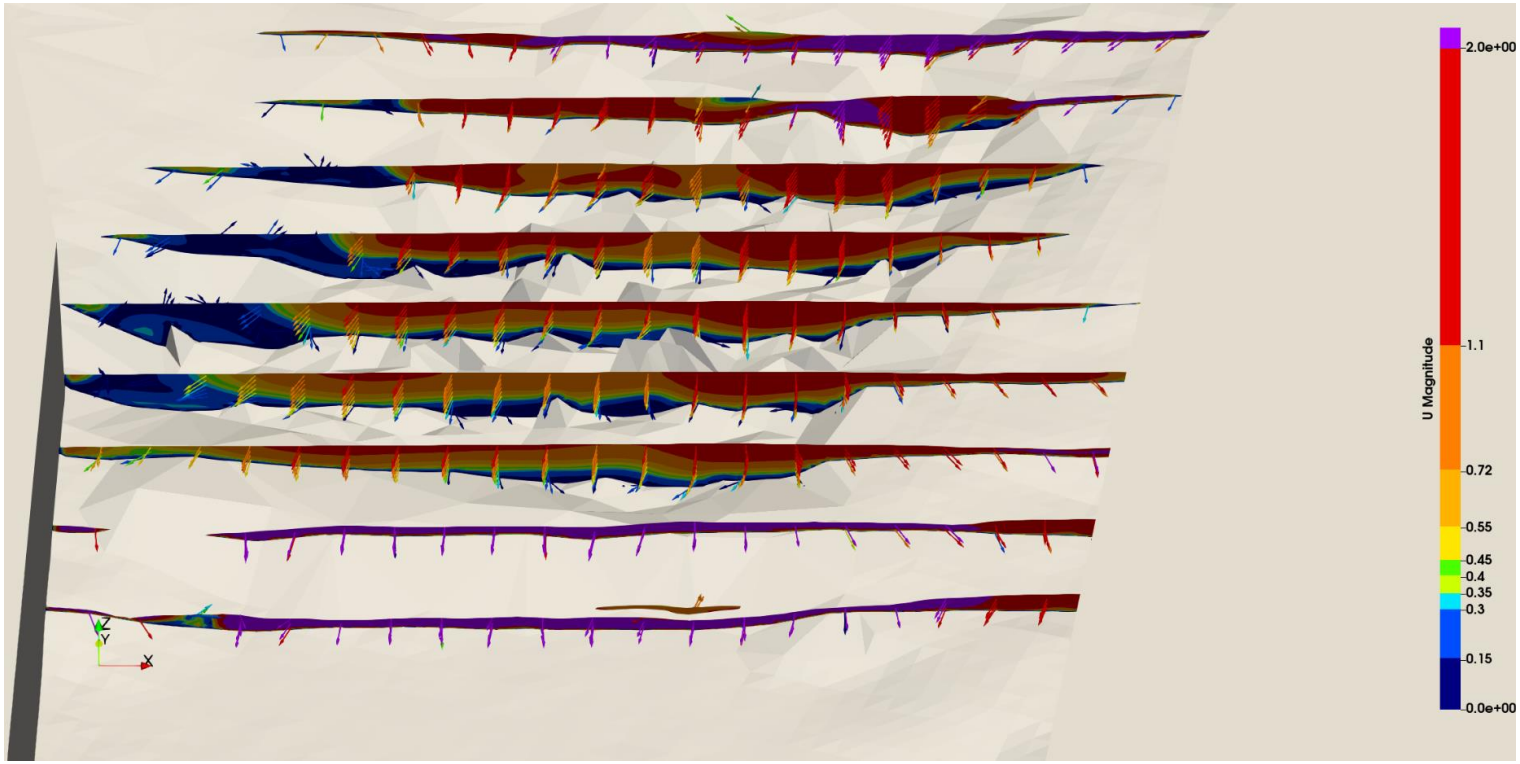


Figure S3-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

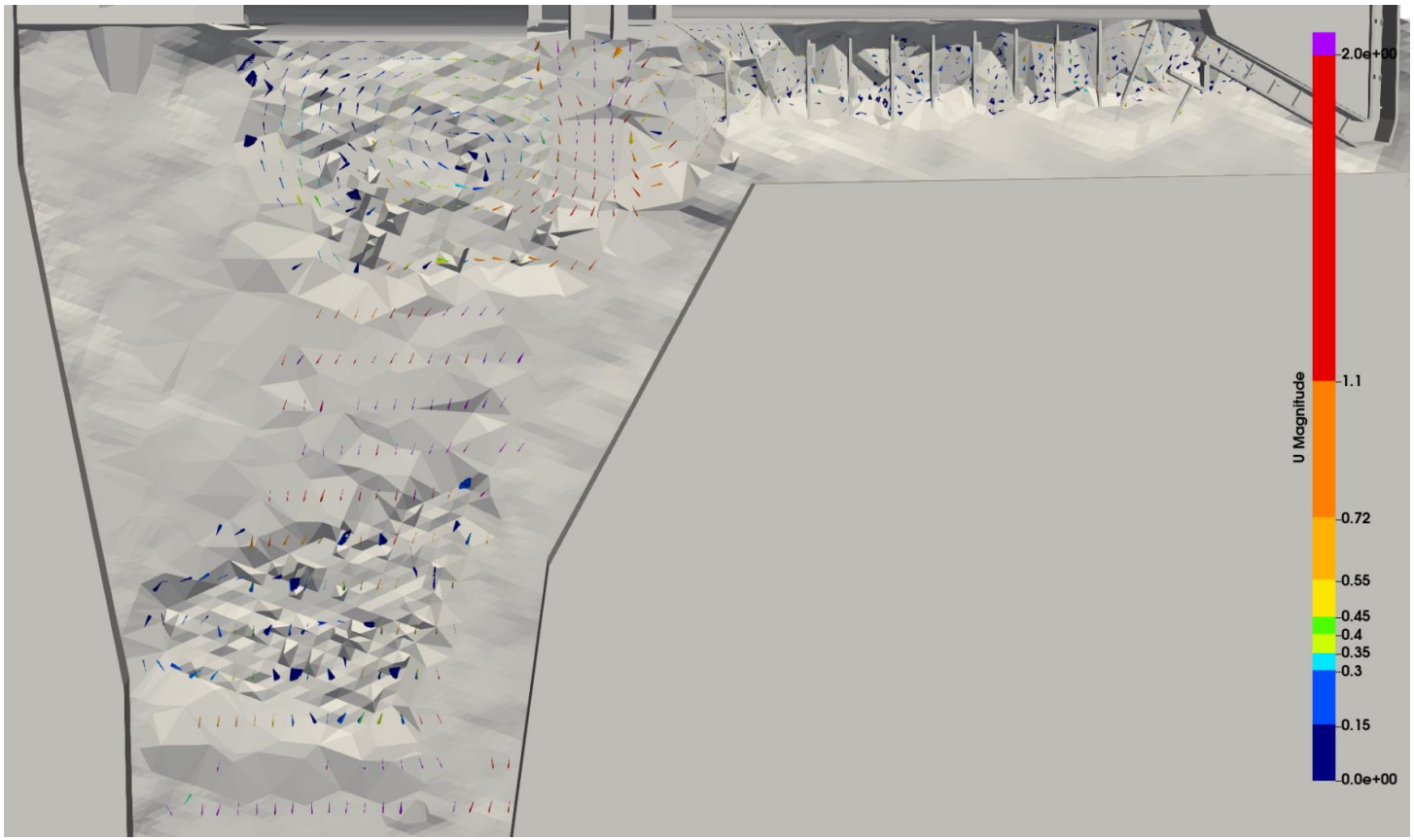


Figure S3-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

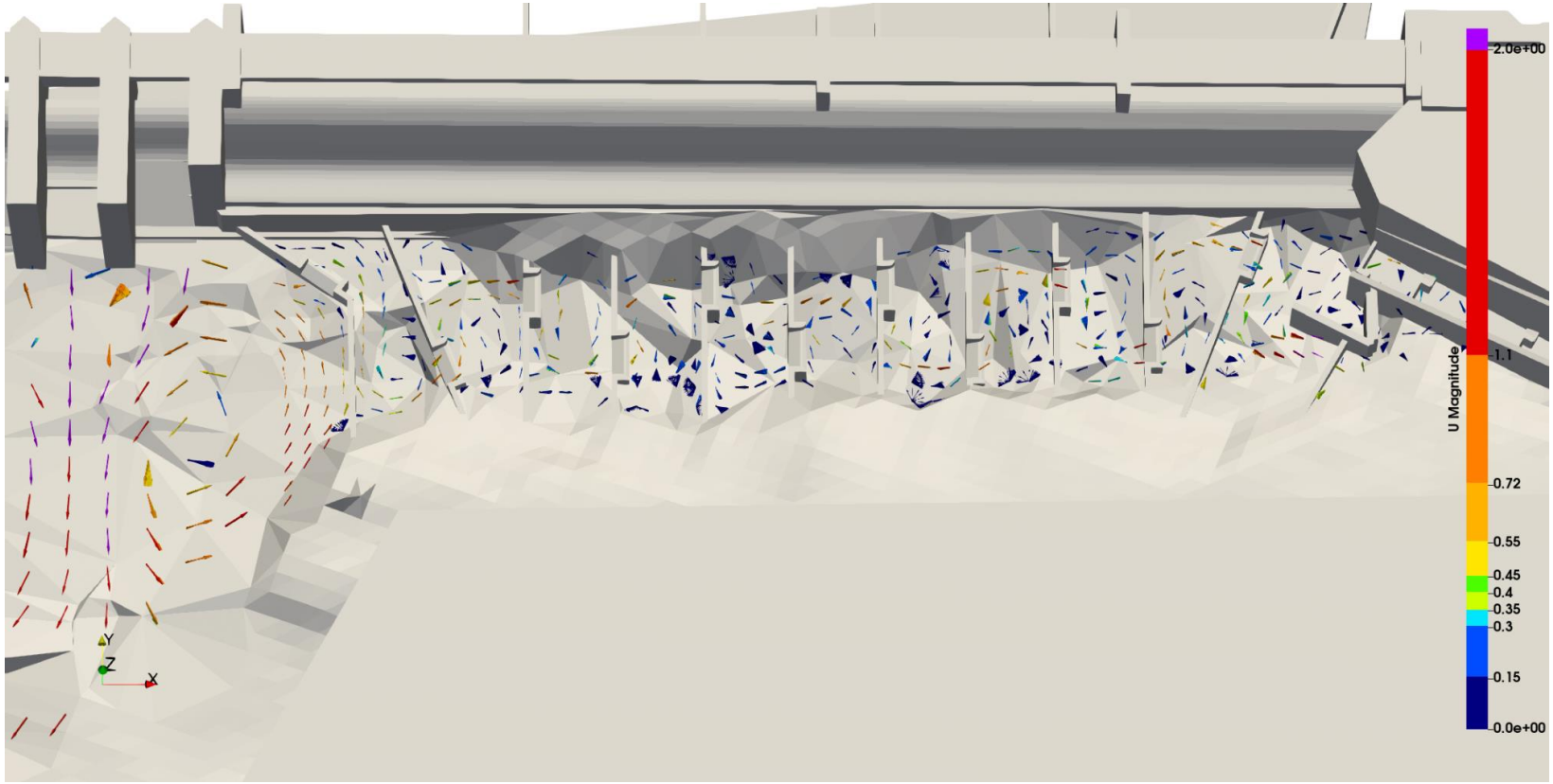


Figure S3-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

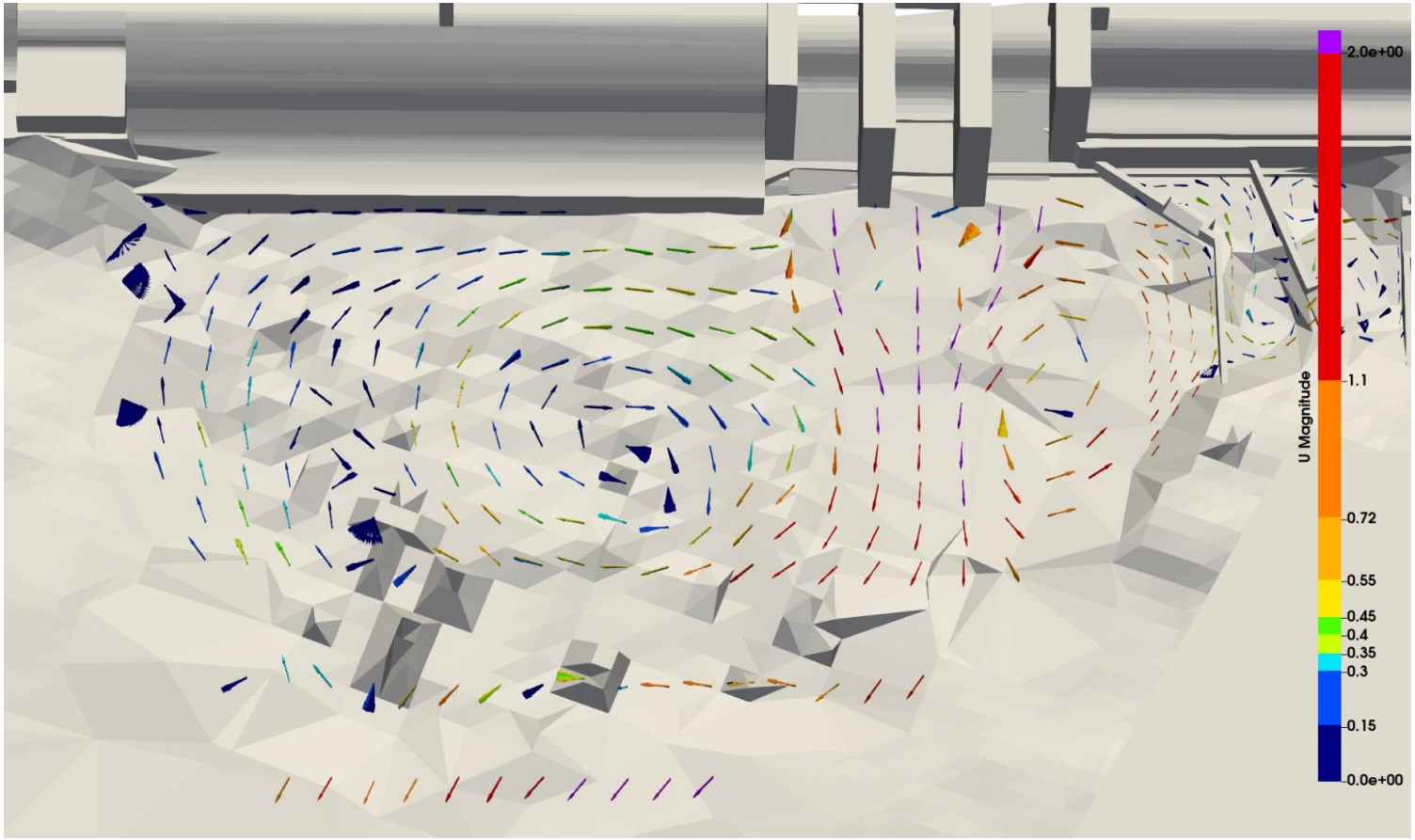


Figure S3-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

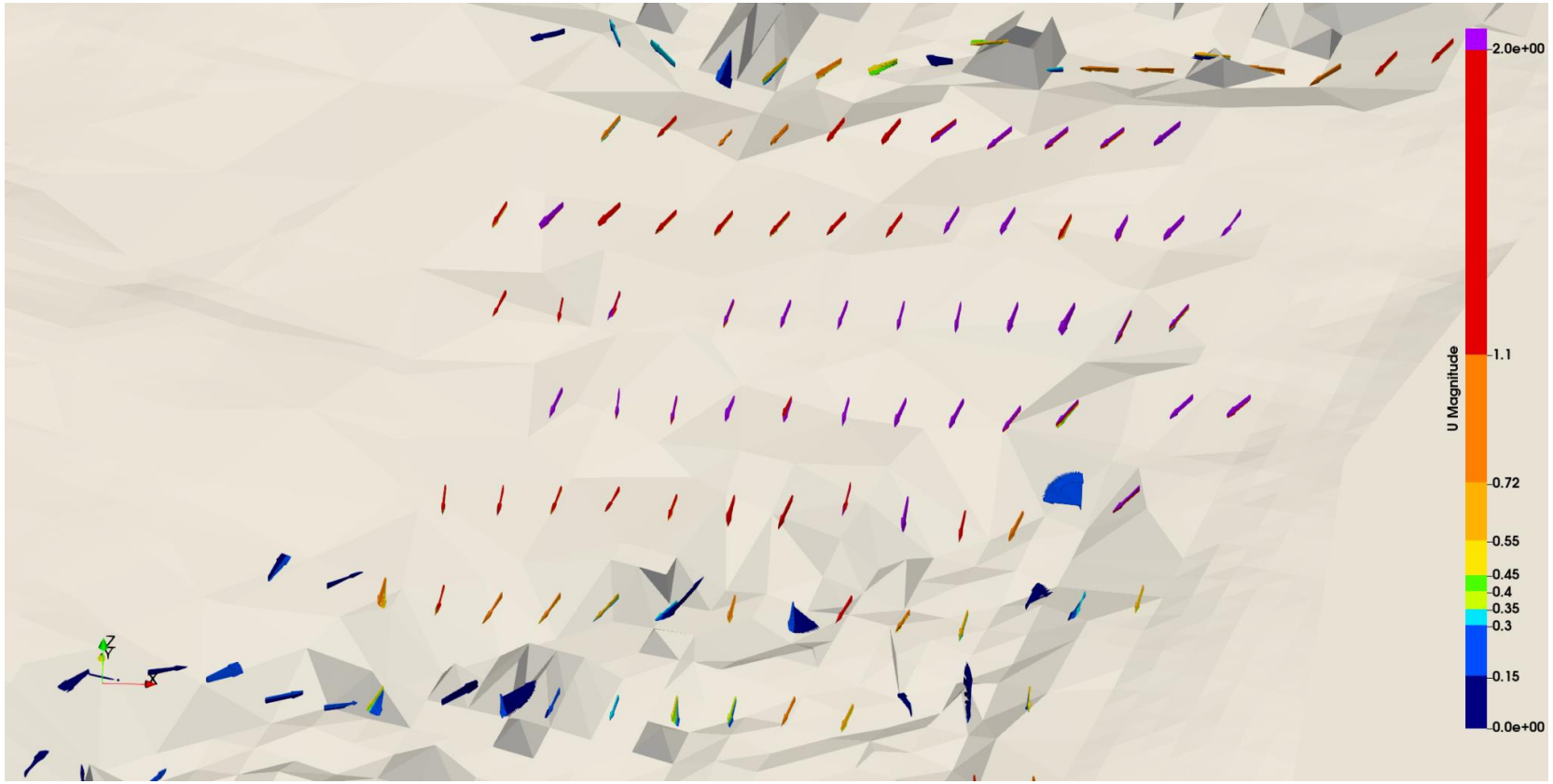


Figure S3-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

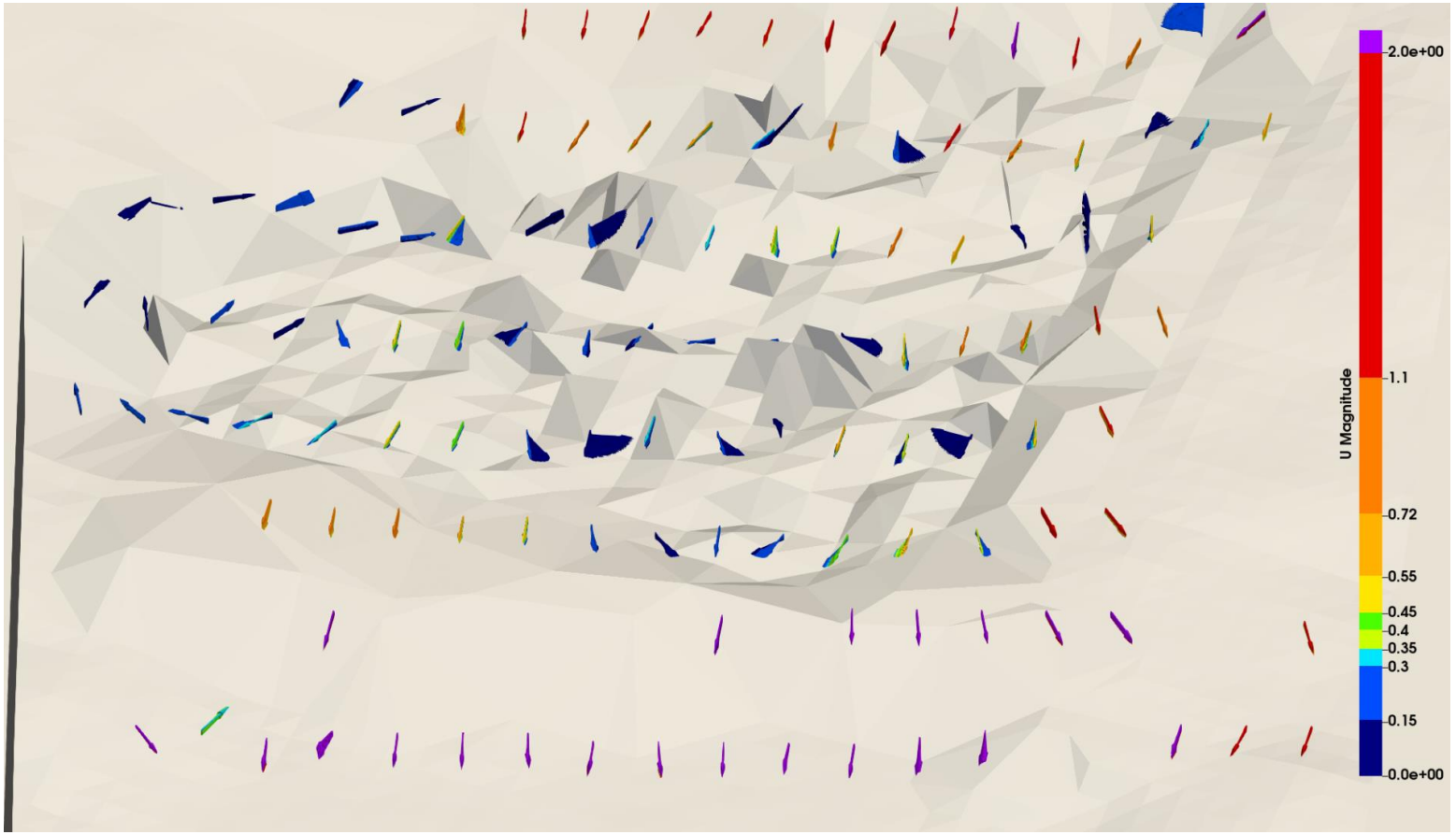


Figure S3-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

4. Model Results of Scenario S4 with 1720 cfs from the gates

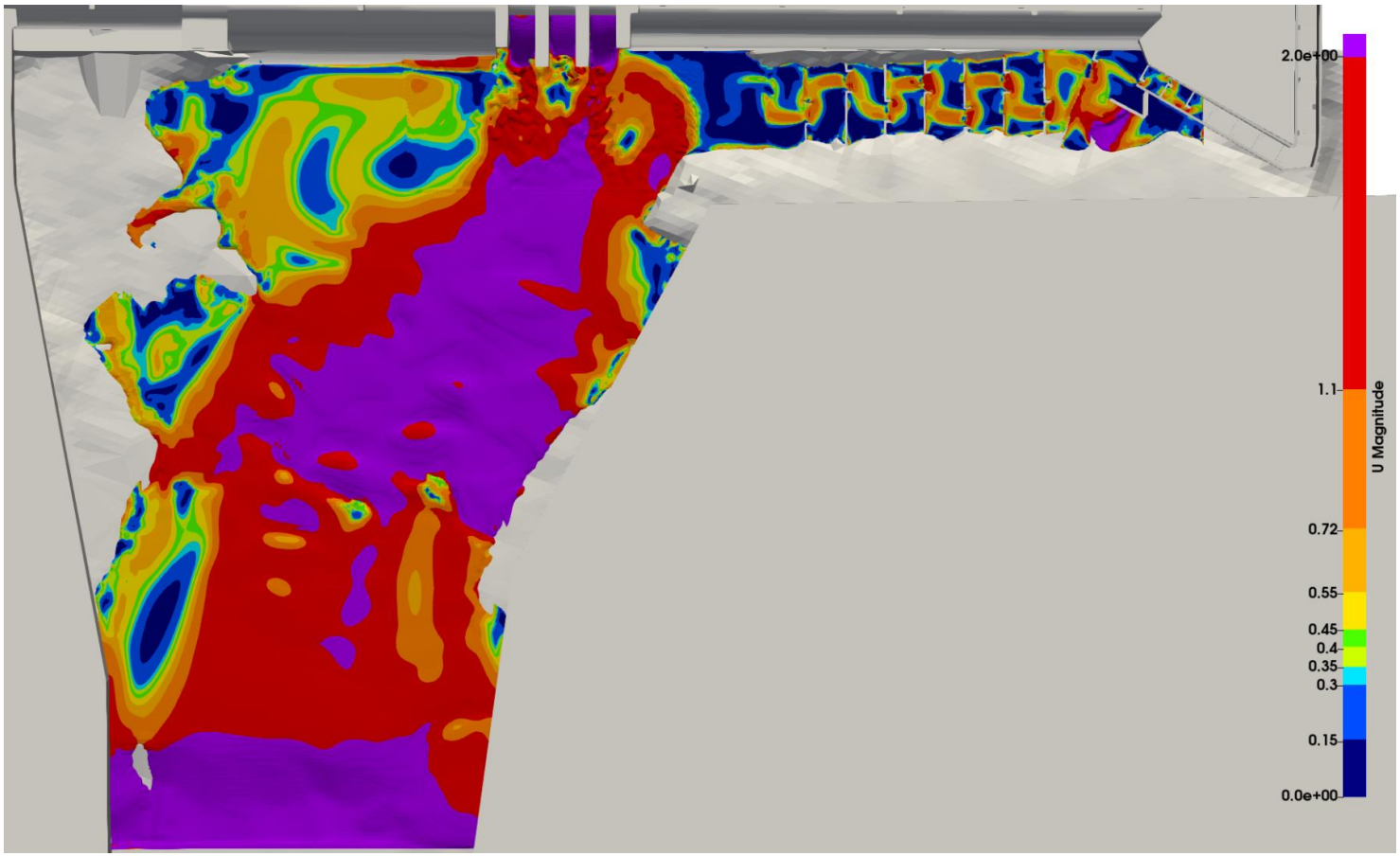


Figure S4-1: Plan view of the Water Surface Velocities

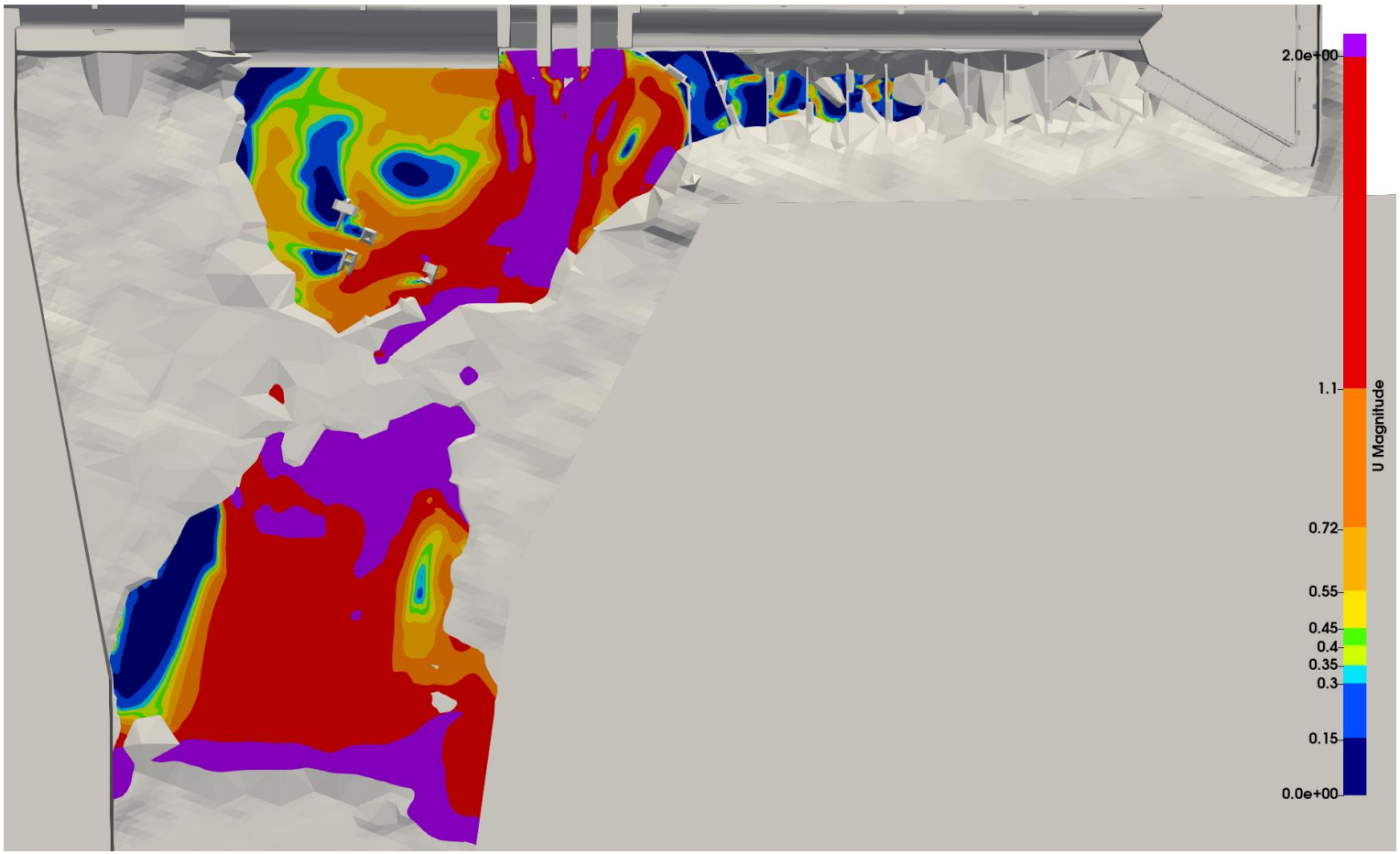


Figure S4-2: Plan view of the Mid-Surface Velocities

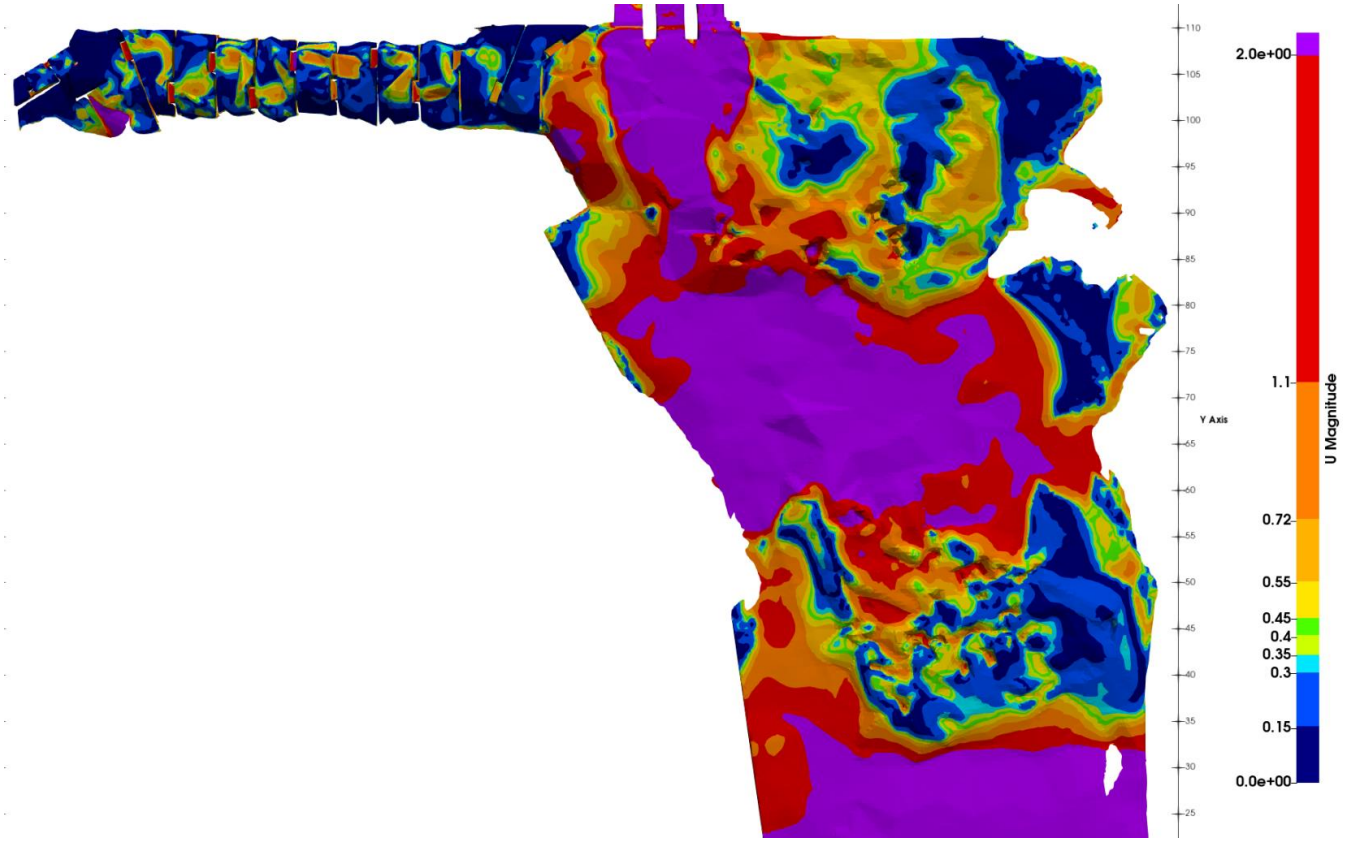


Figure S4-3: View of the Bottom Velocities

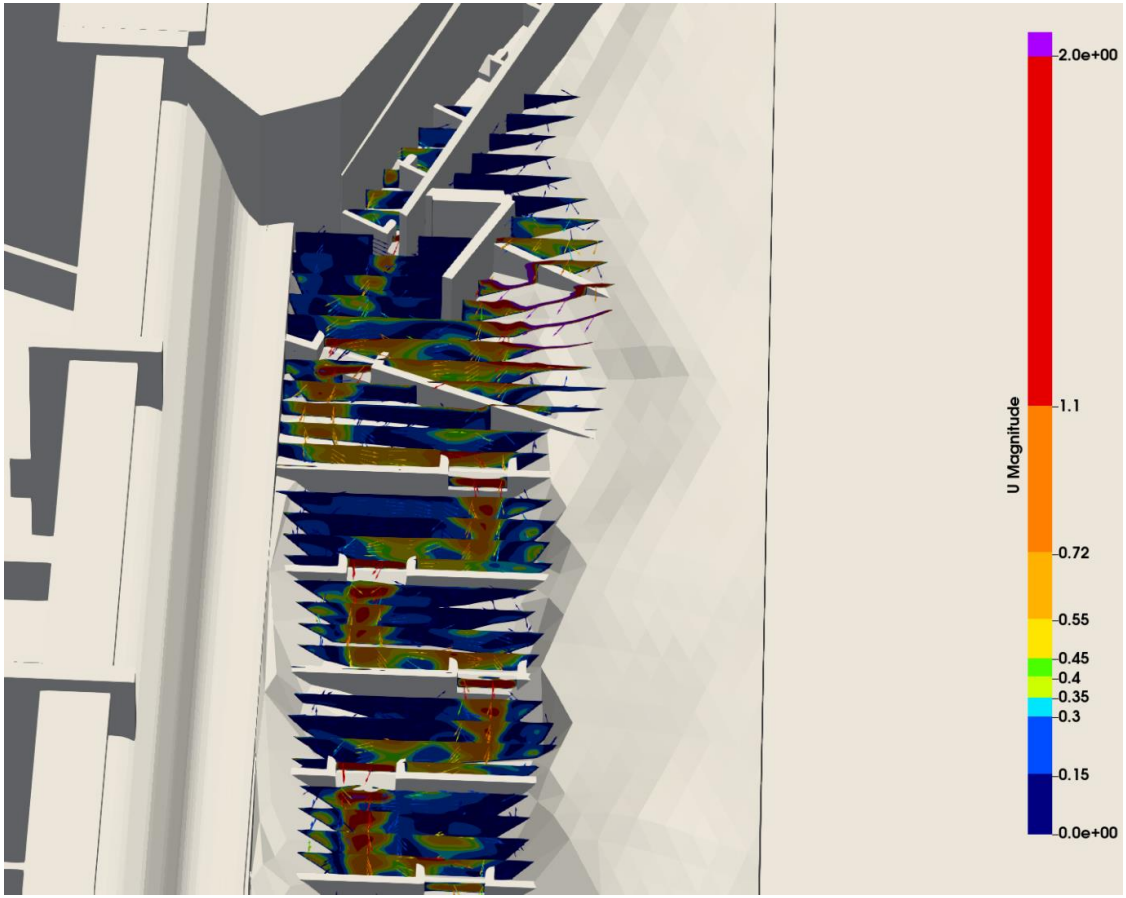


Figure S4-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

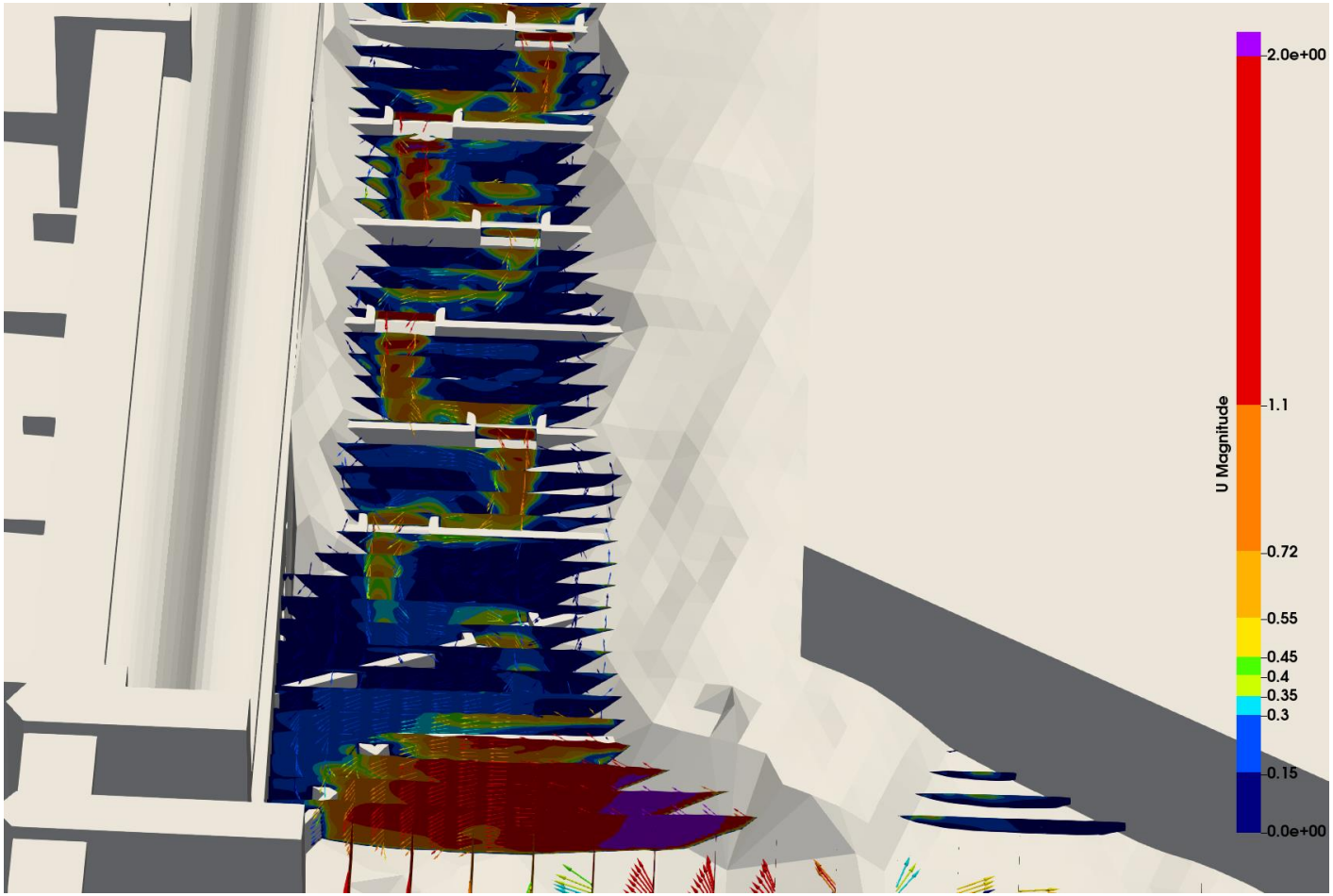


Figure S4-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

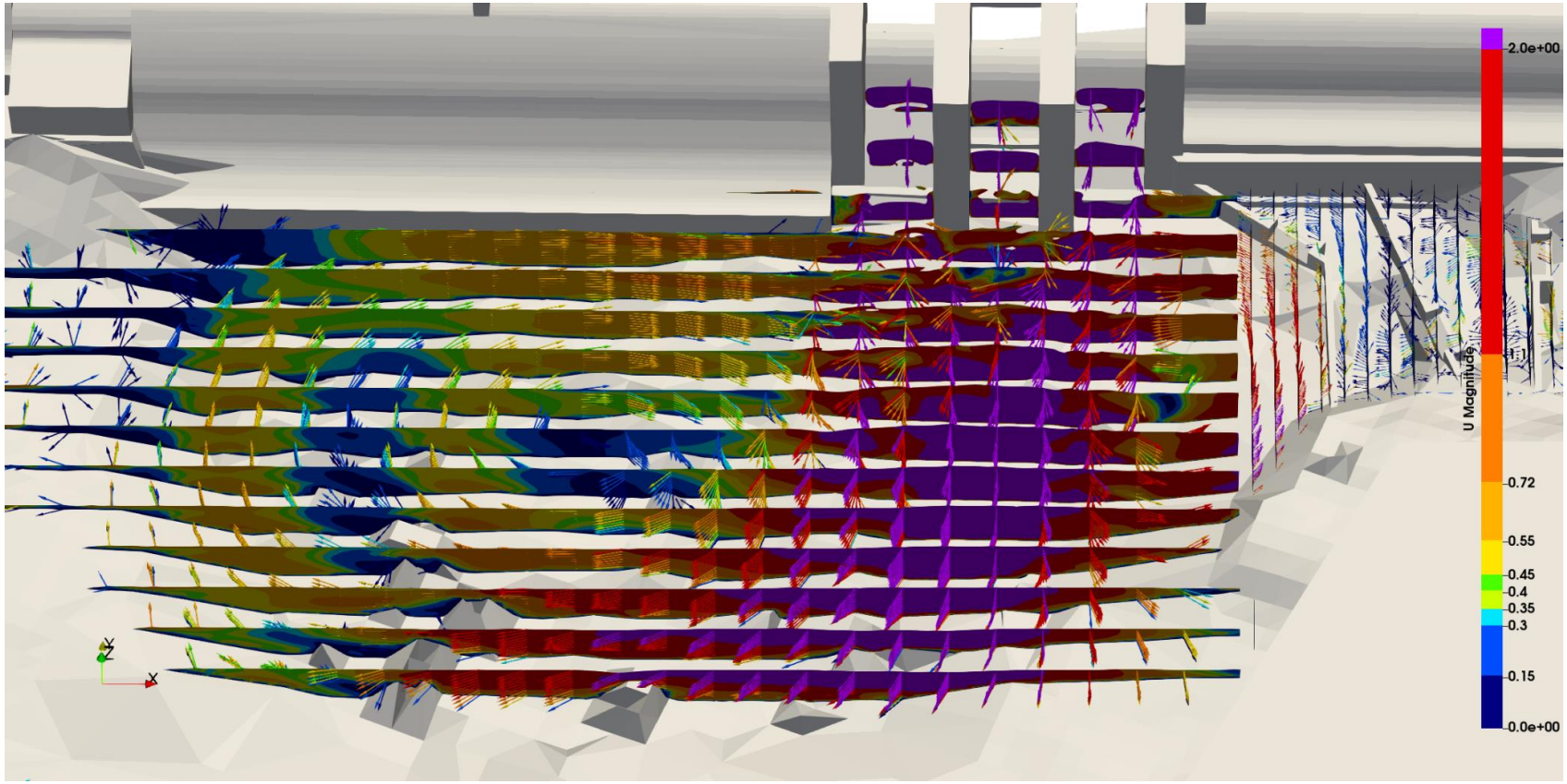


Figure S4-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

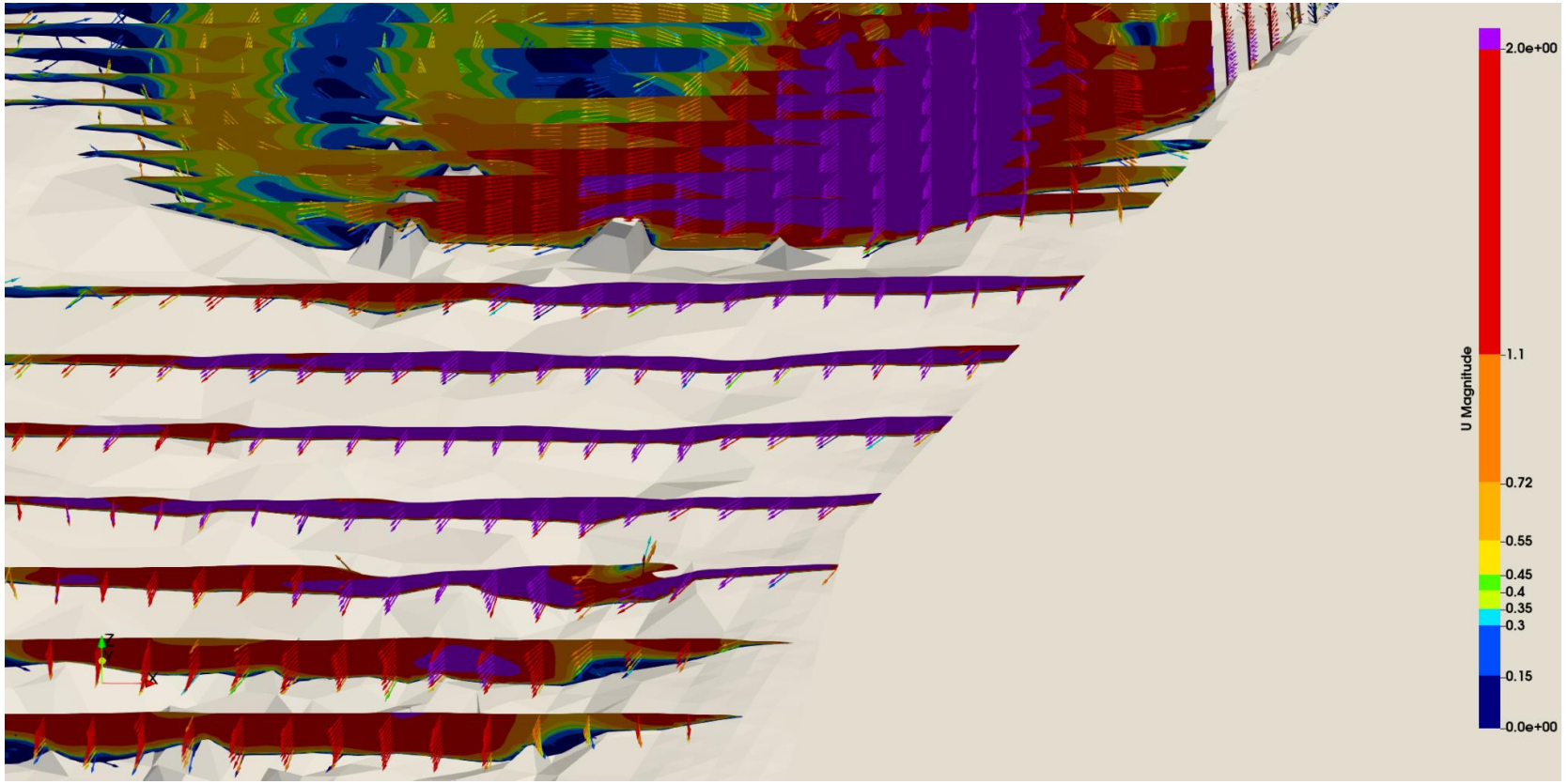


Figure S4-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

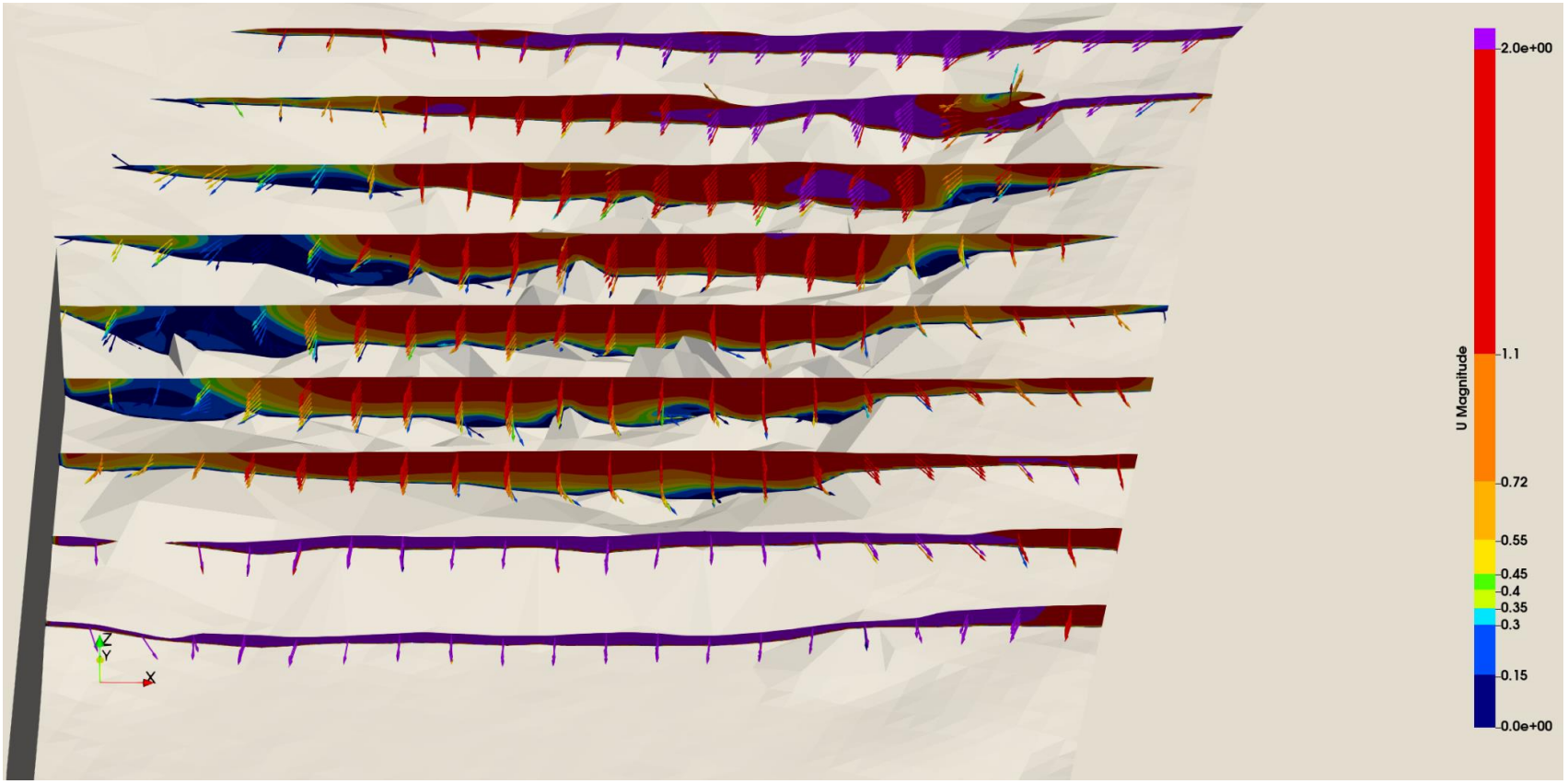


Figure S4-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

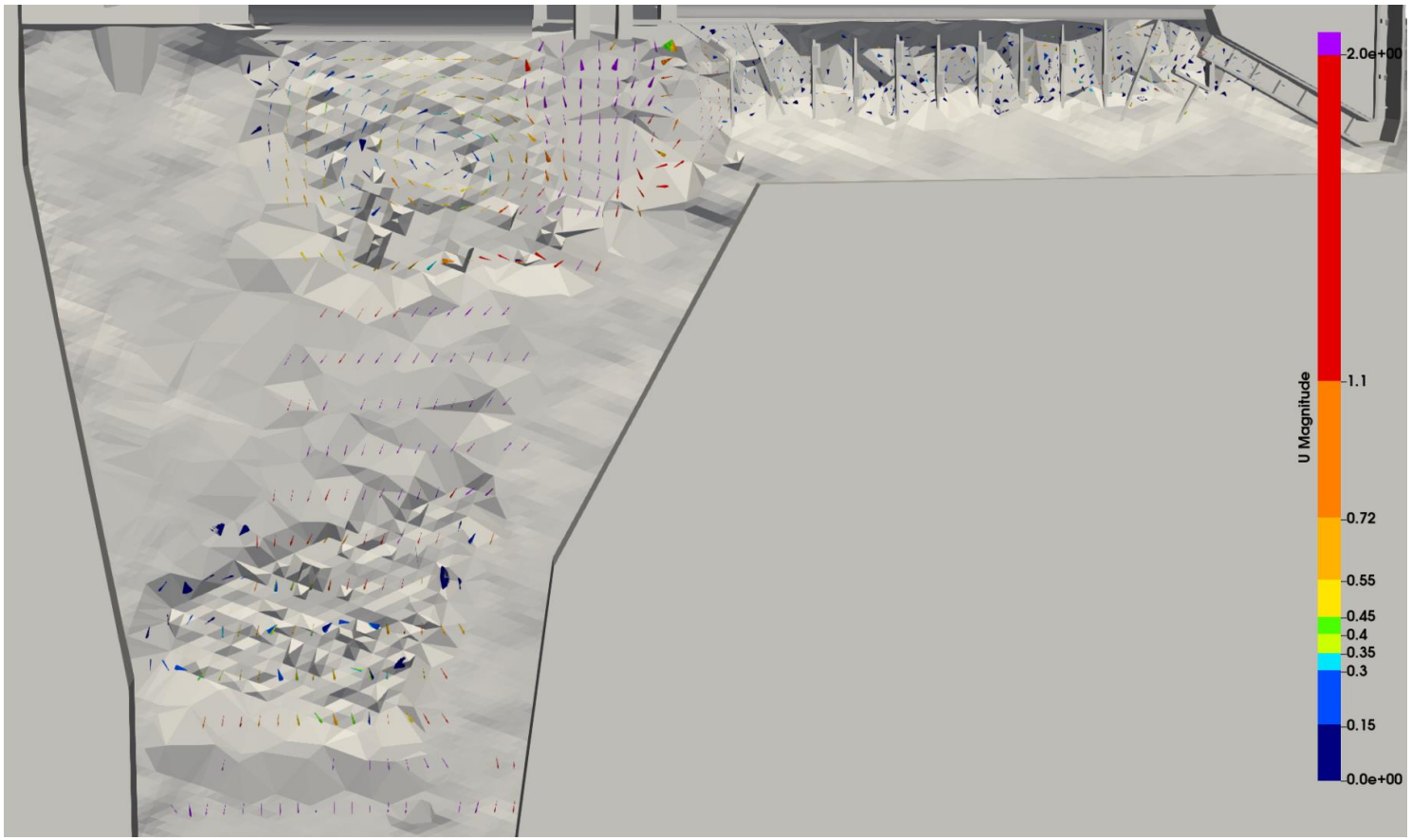


Figure S4-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

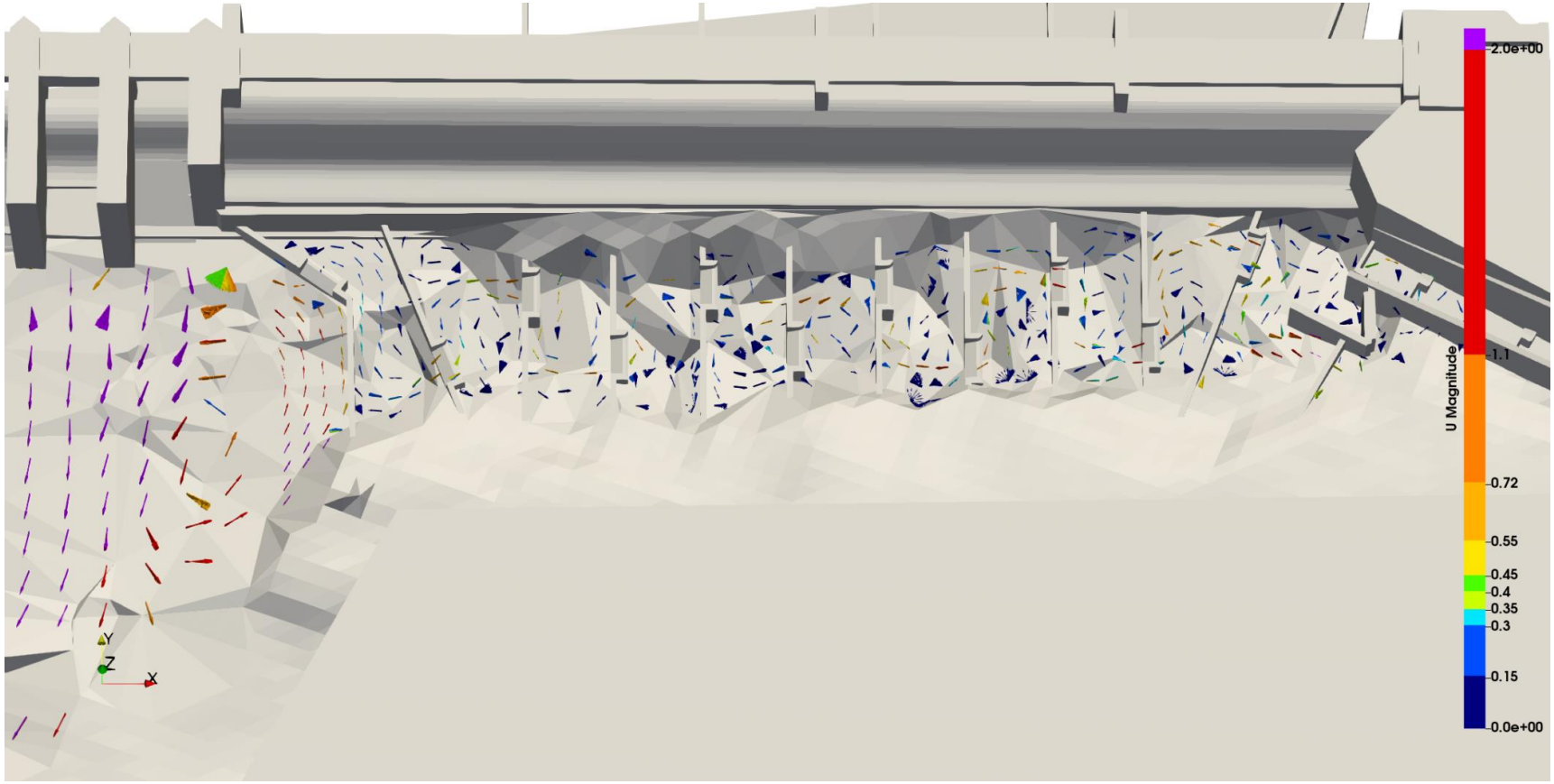


Figure S4-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

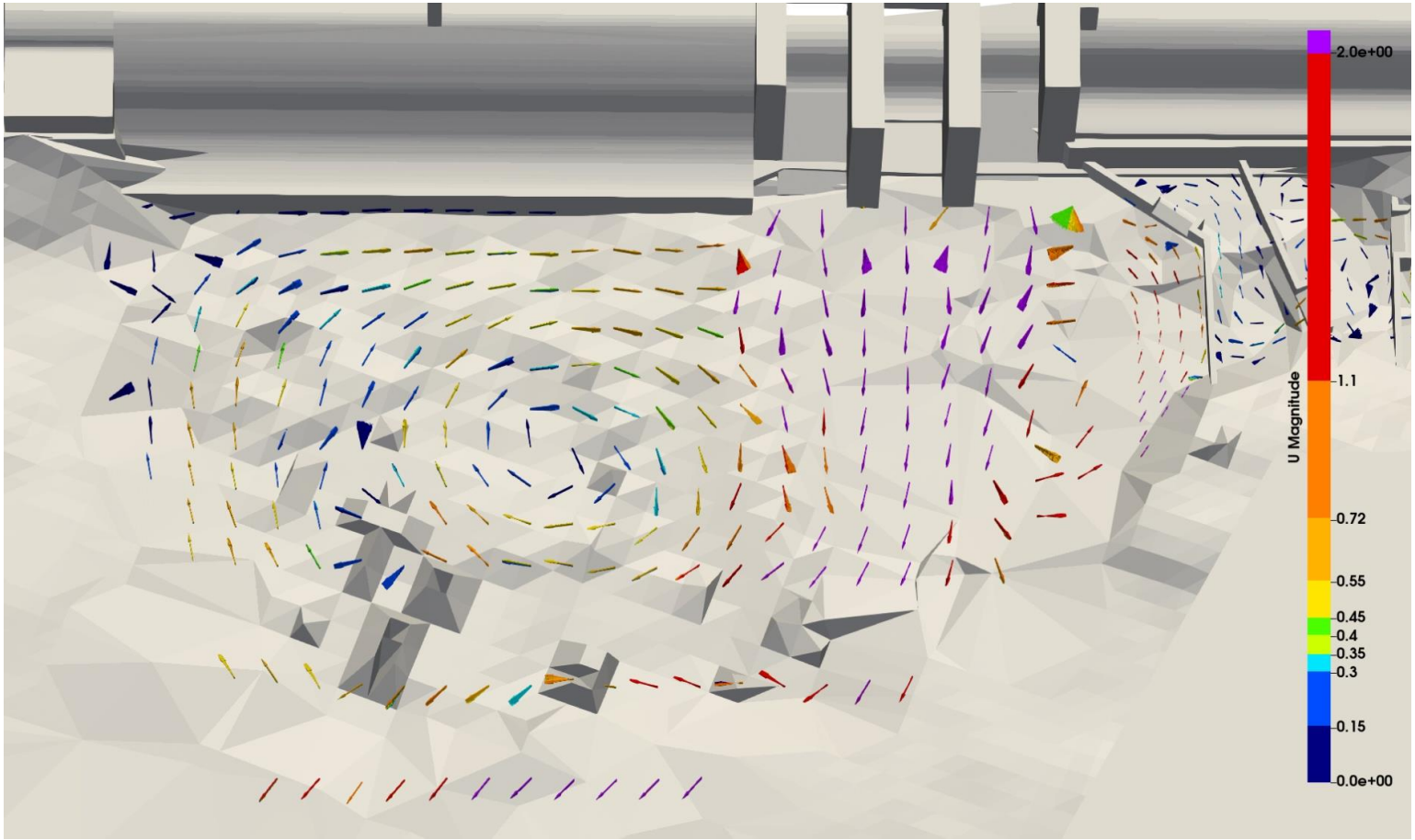


Figure S4-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

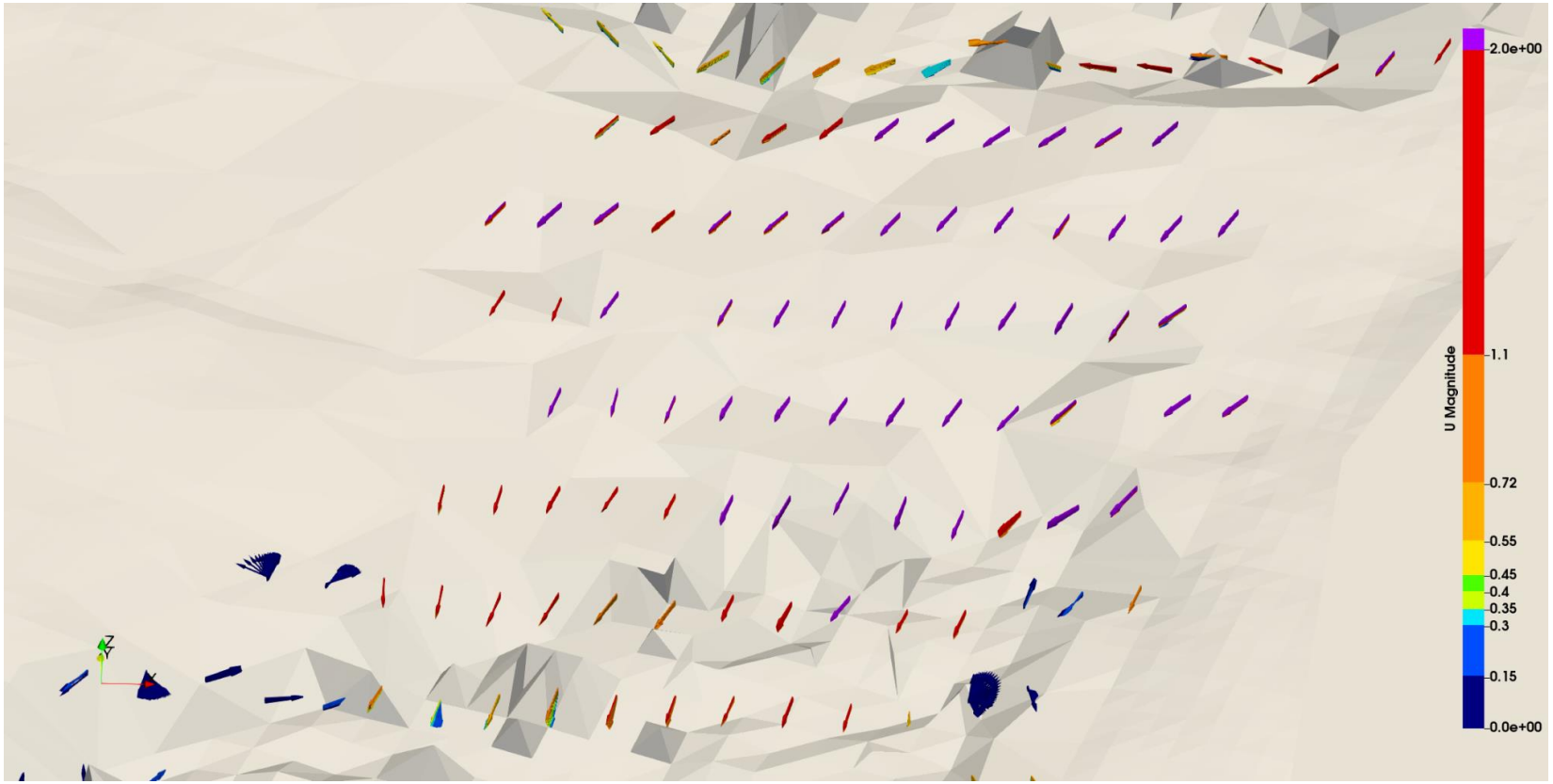


Figure S4-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

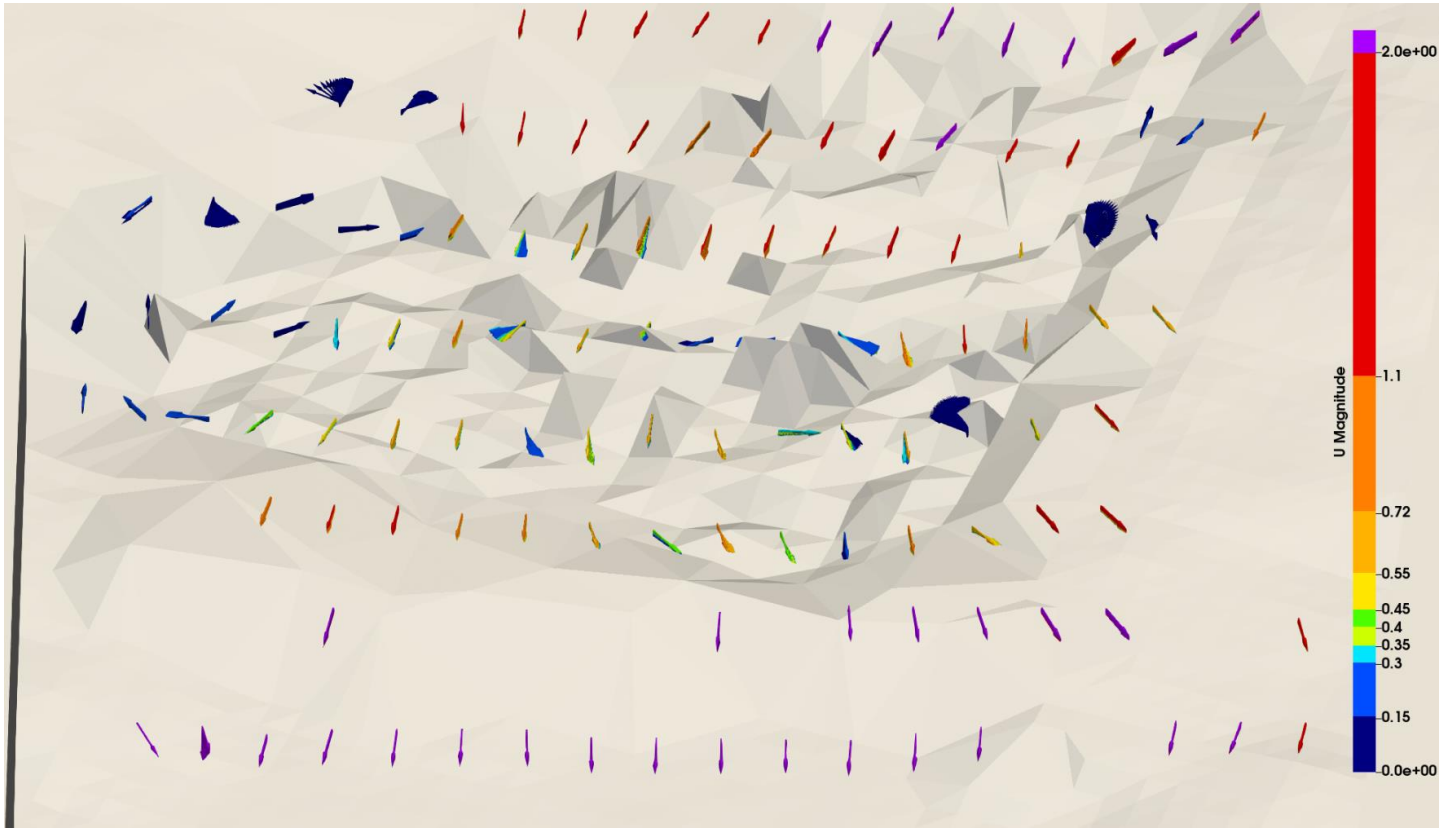


Figure S4-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

5. Model Results of Scenario S5 with 3051 cfs from the gates

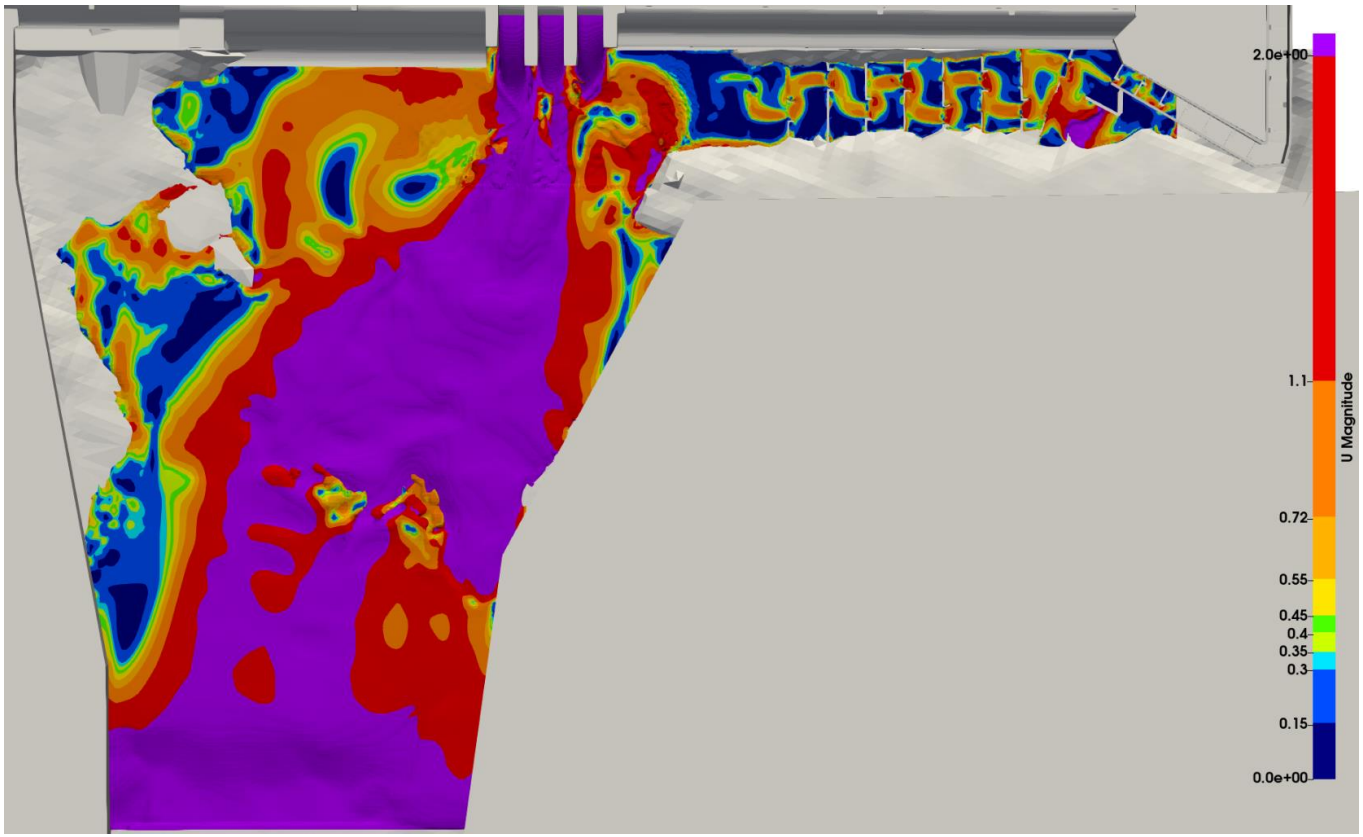


Figure S5-1: Plan view of the Water Surface Velocities

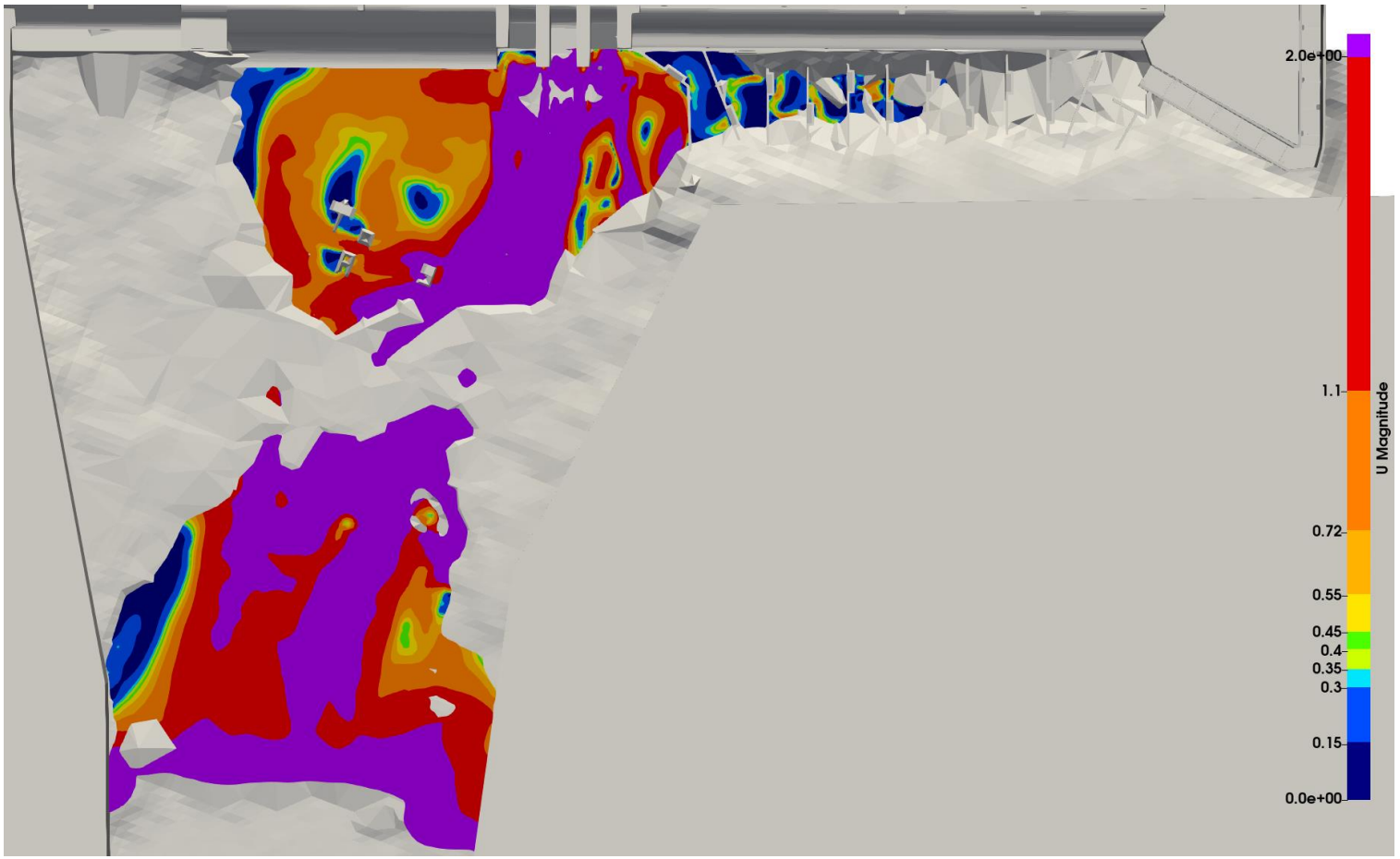


Figure S5-2: Plan view of the Mid-Surface Velocities

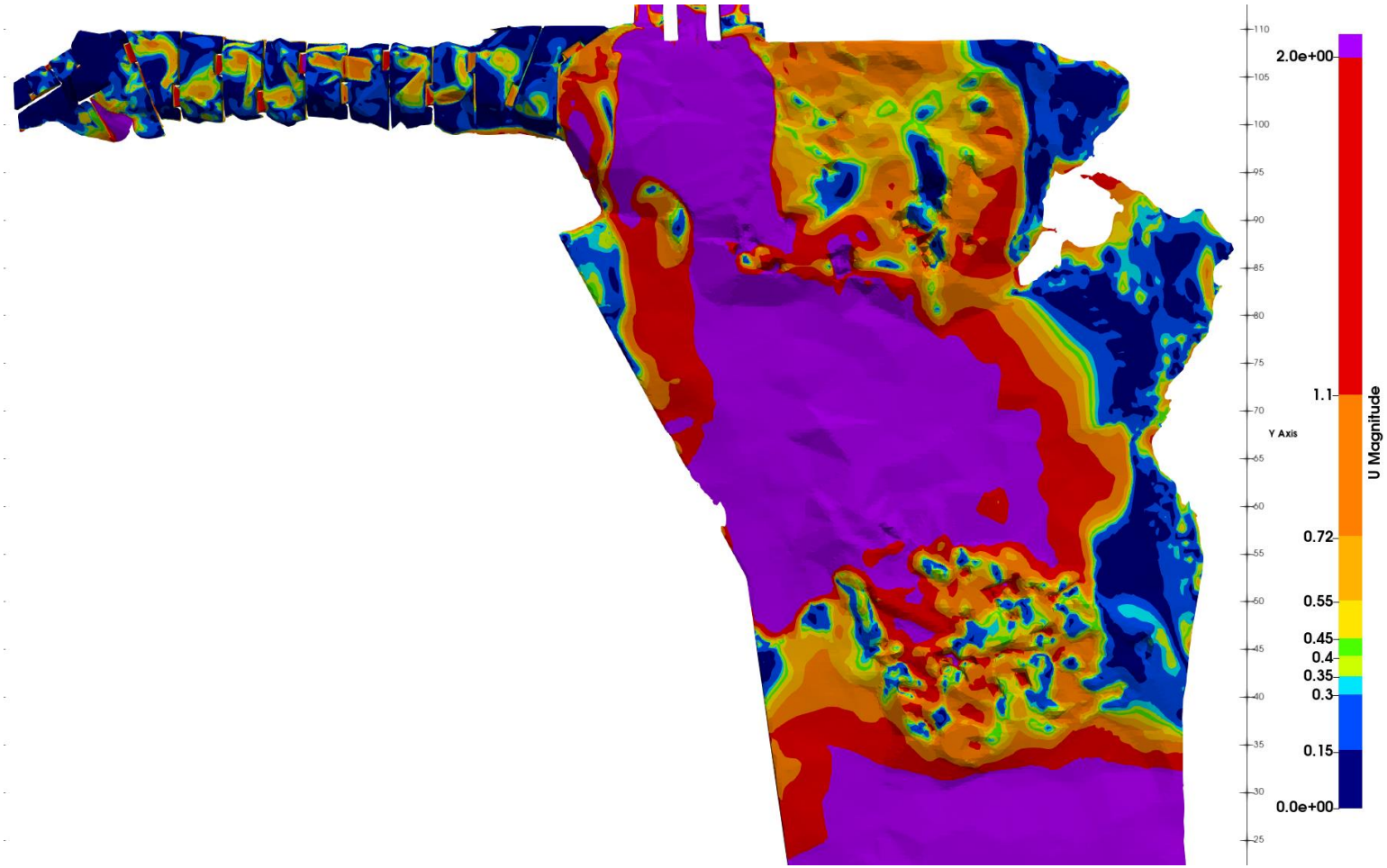


Figure S5-3: View of the Bottom Velocities

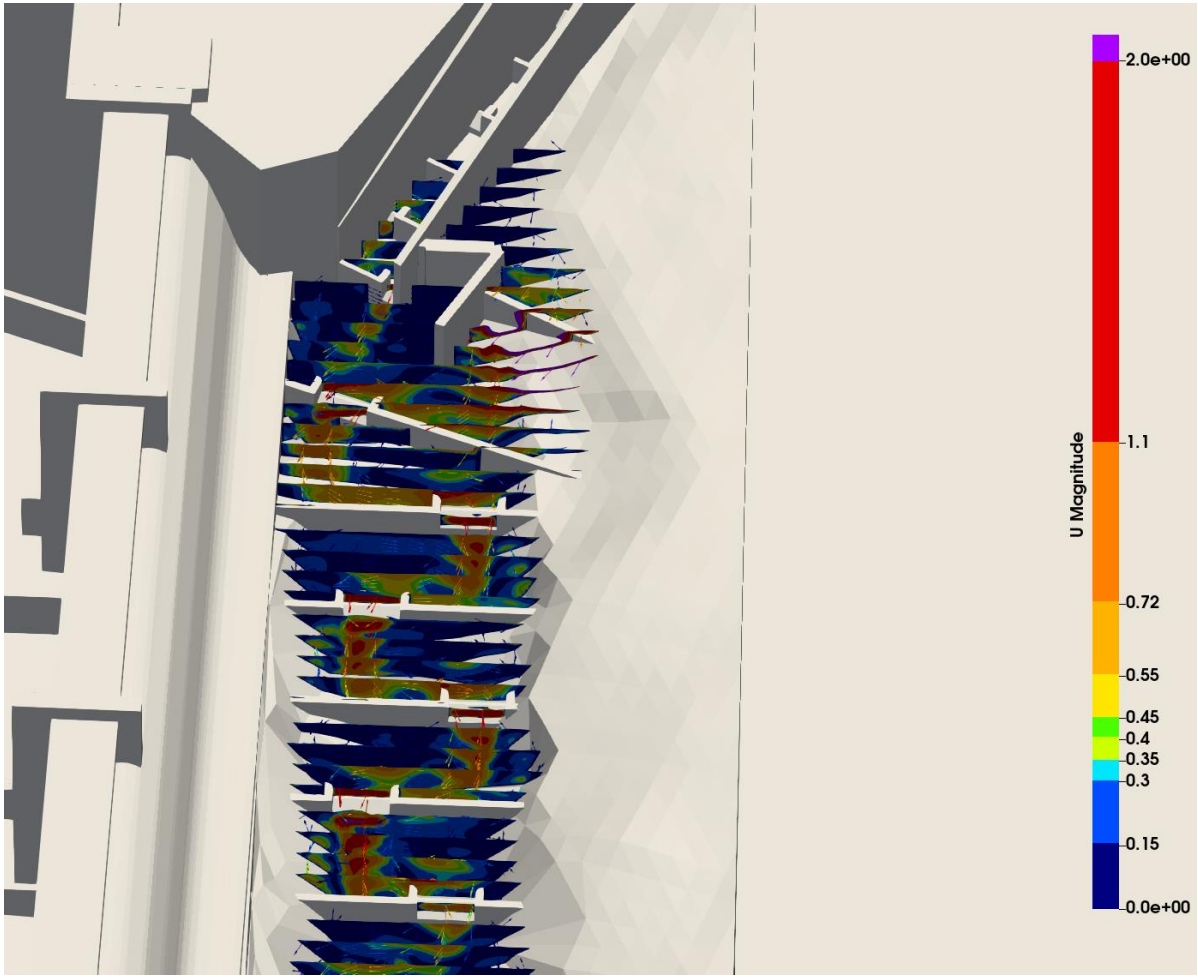


Figure S5-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

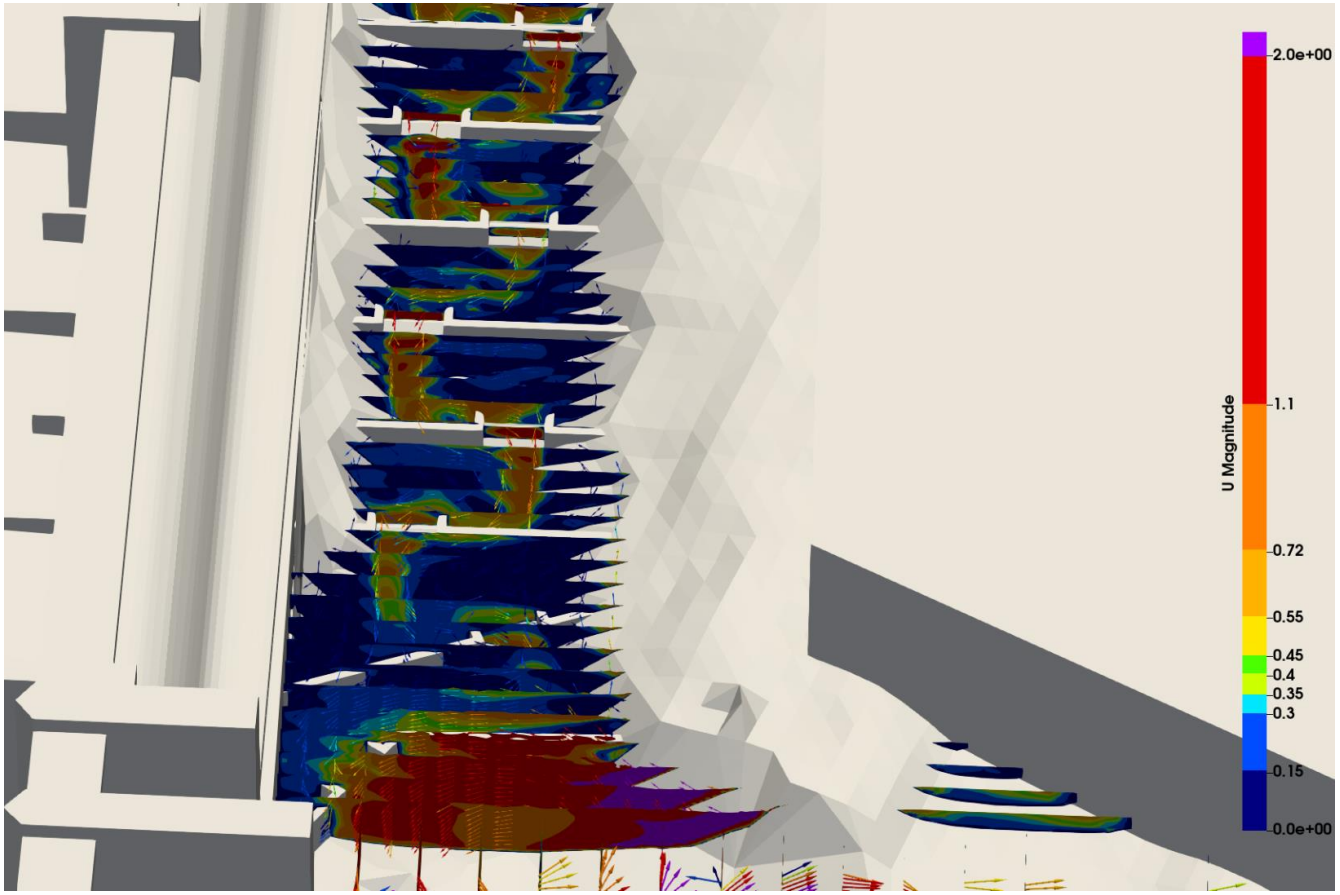


Figure S5-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

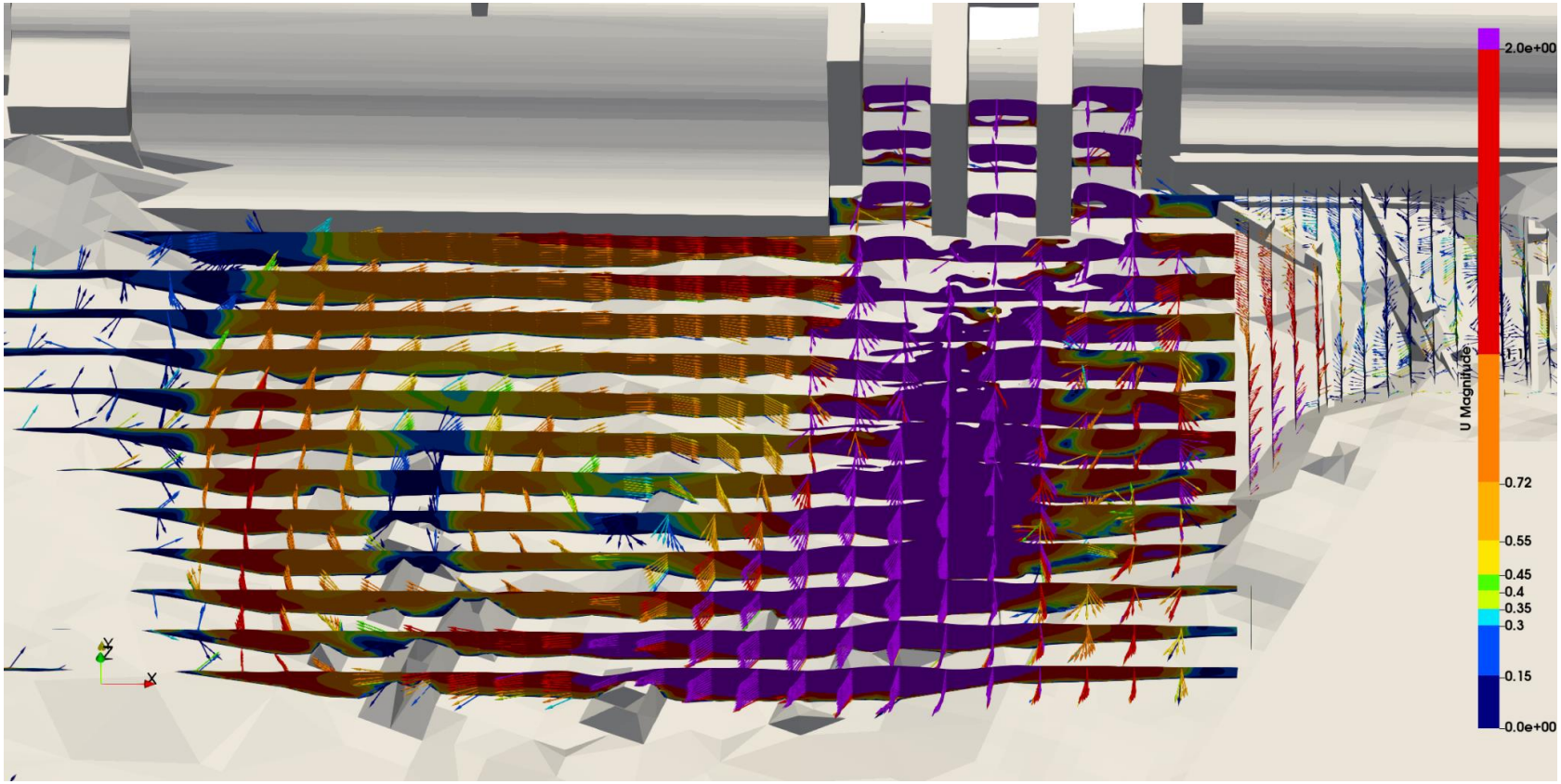


Figure S5-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

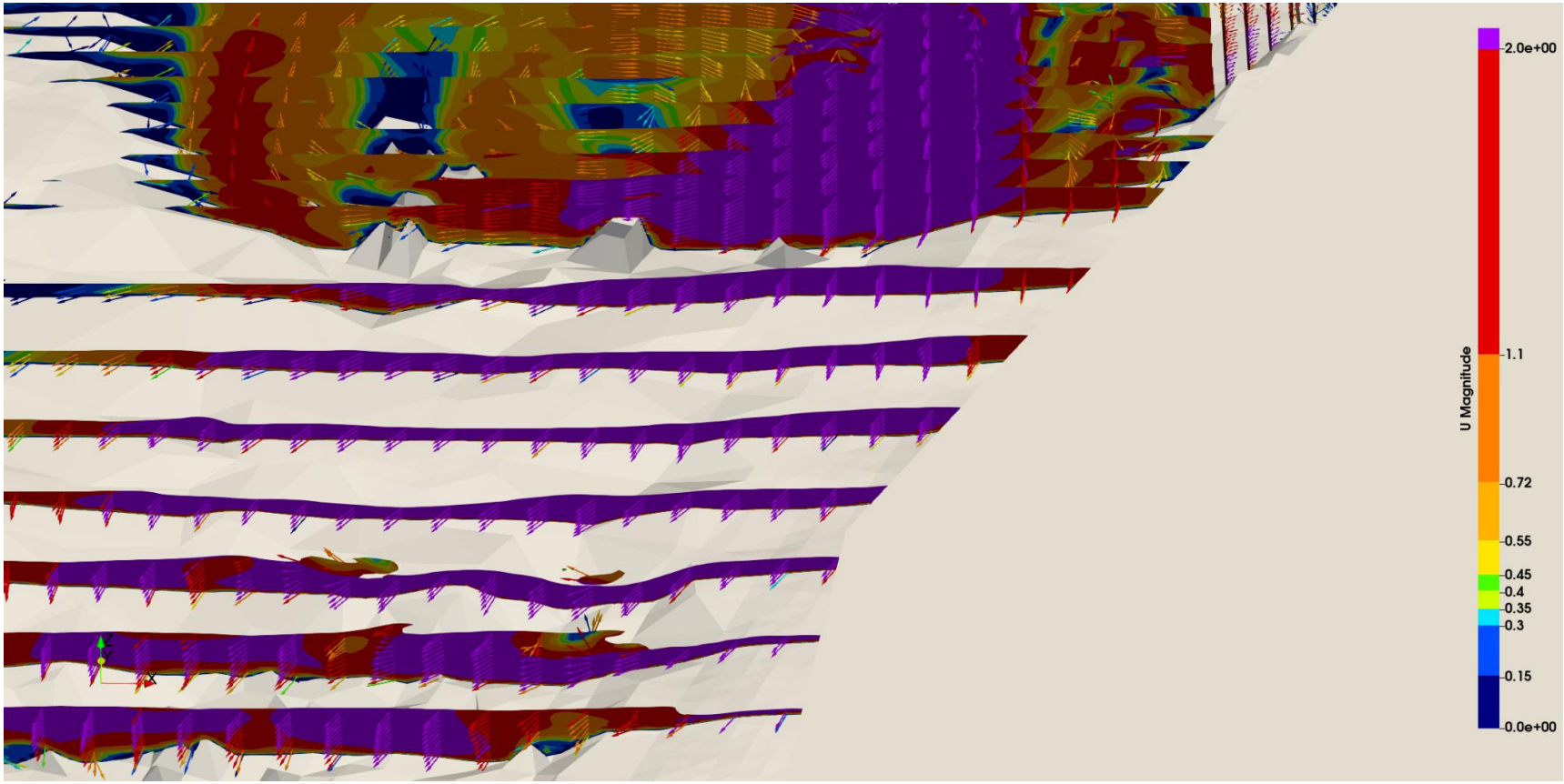


Figure S5-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

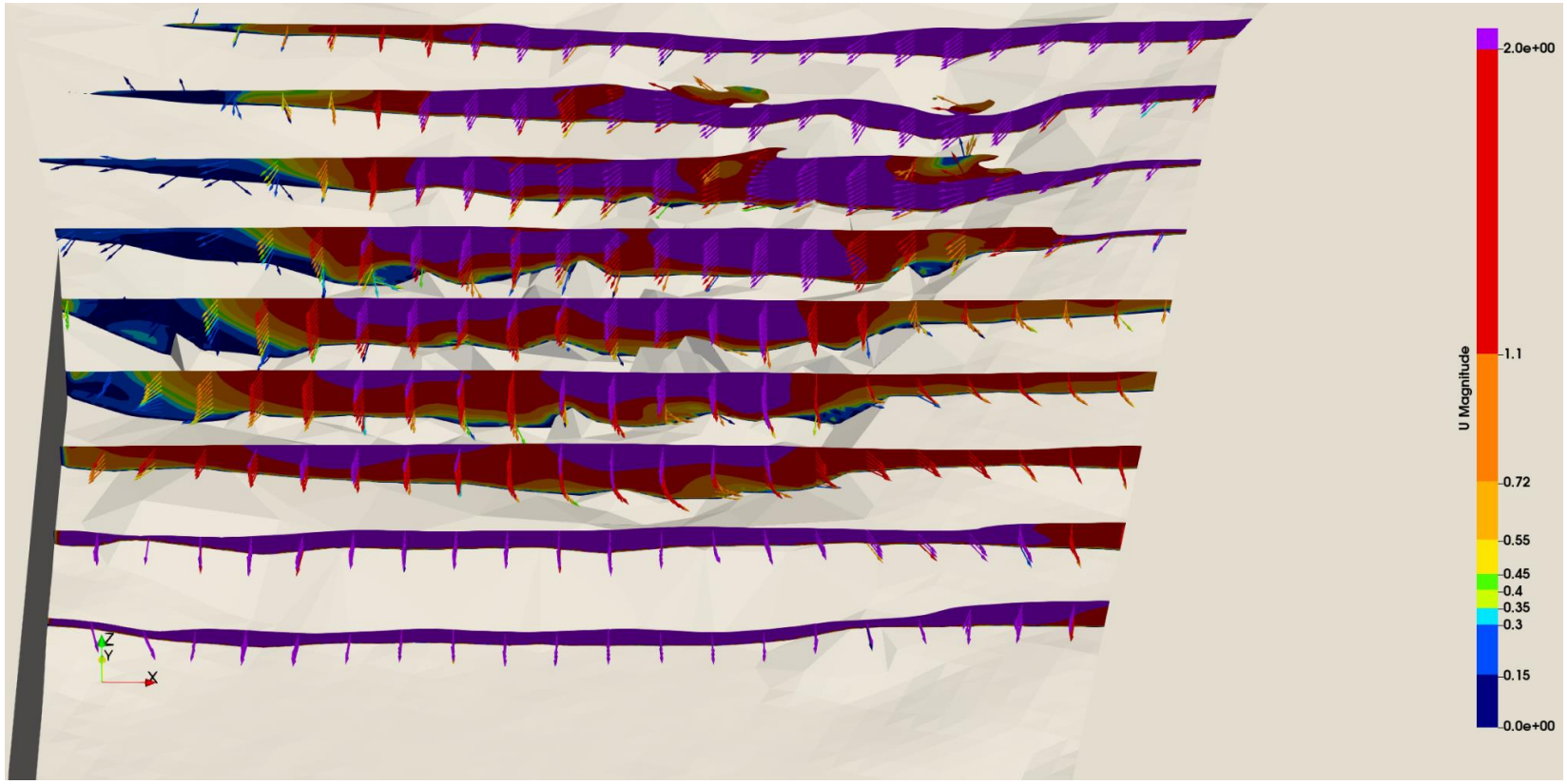


Figure S5-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

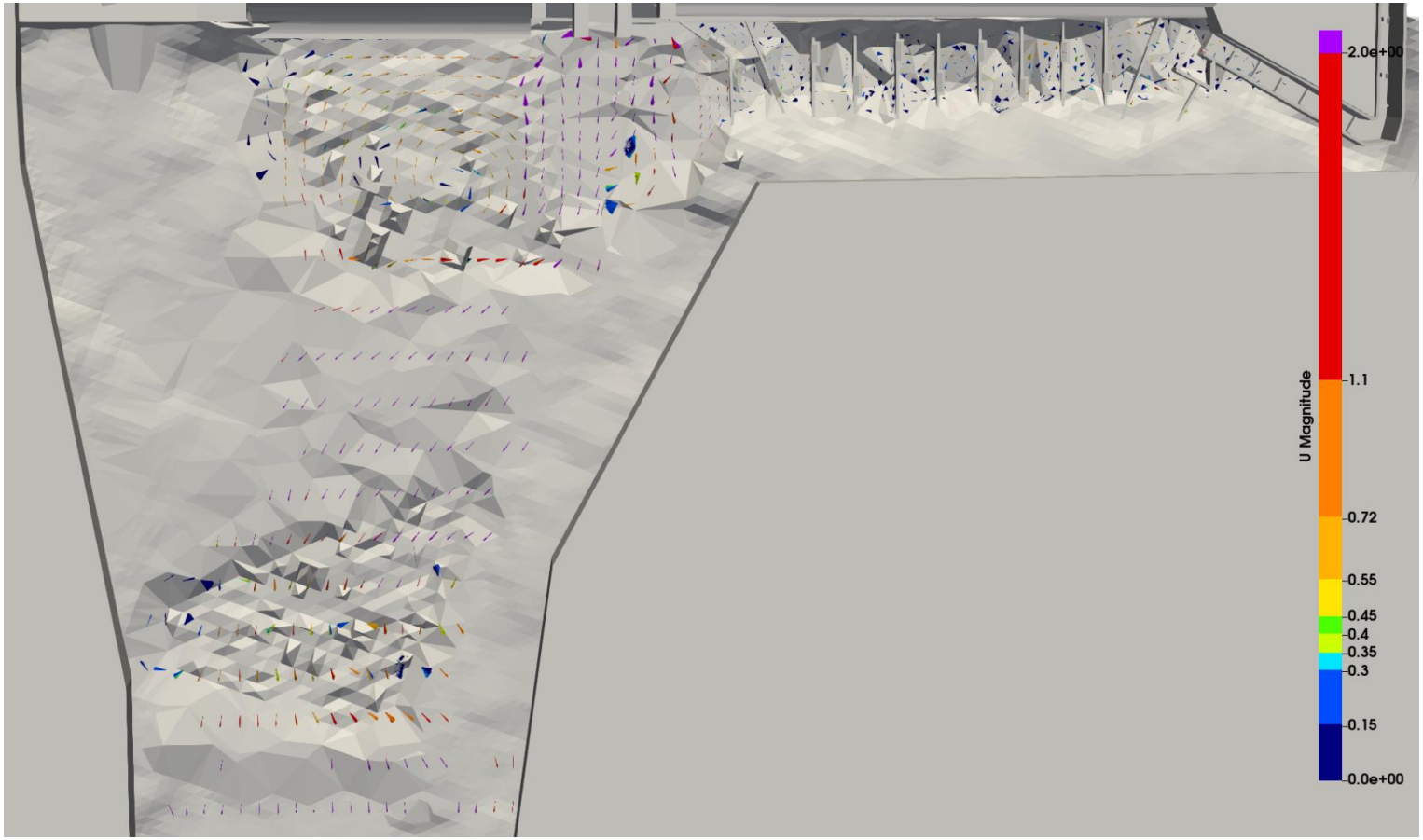


Figure S5-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

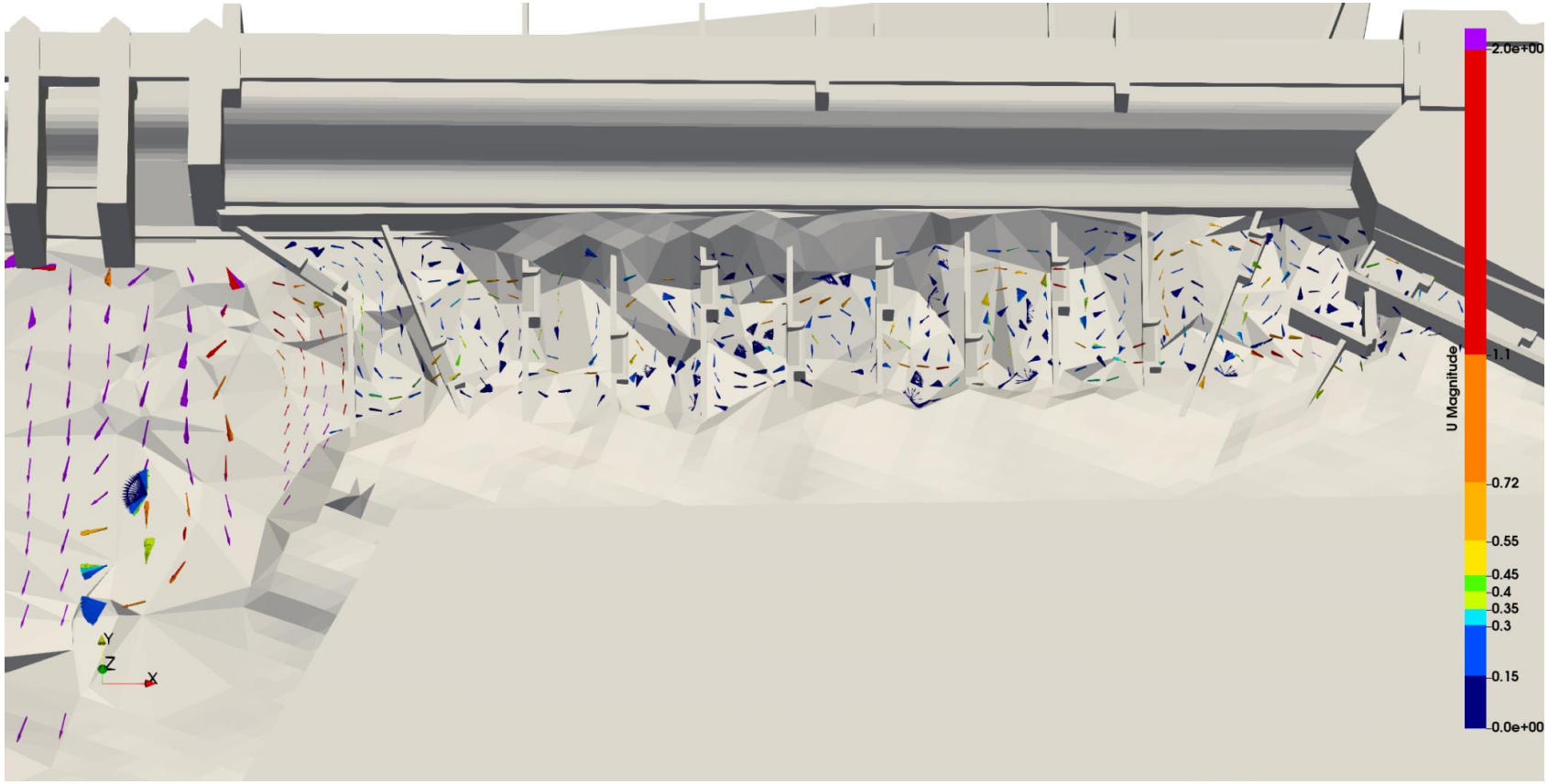


Figure S5-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

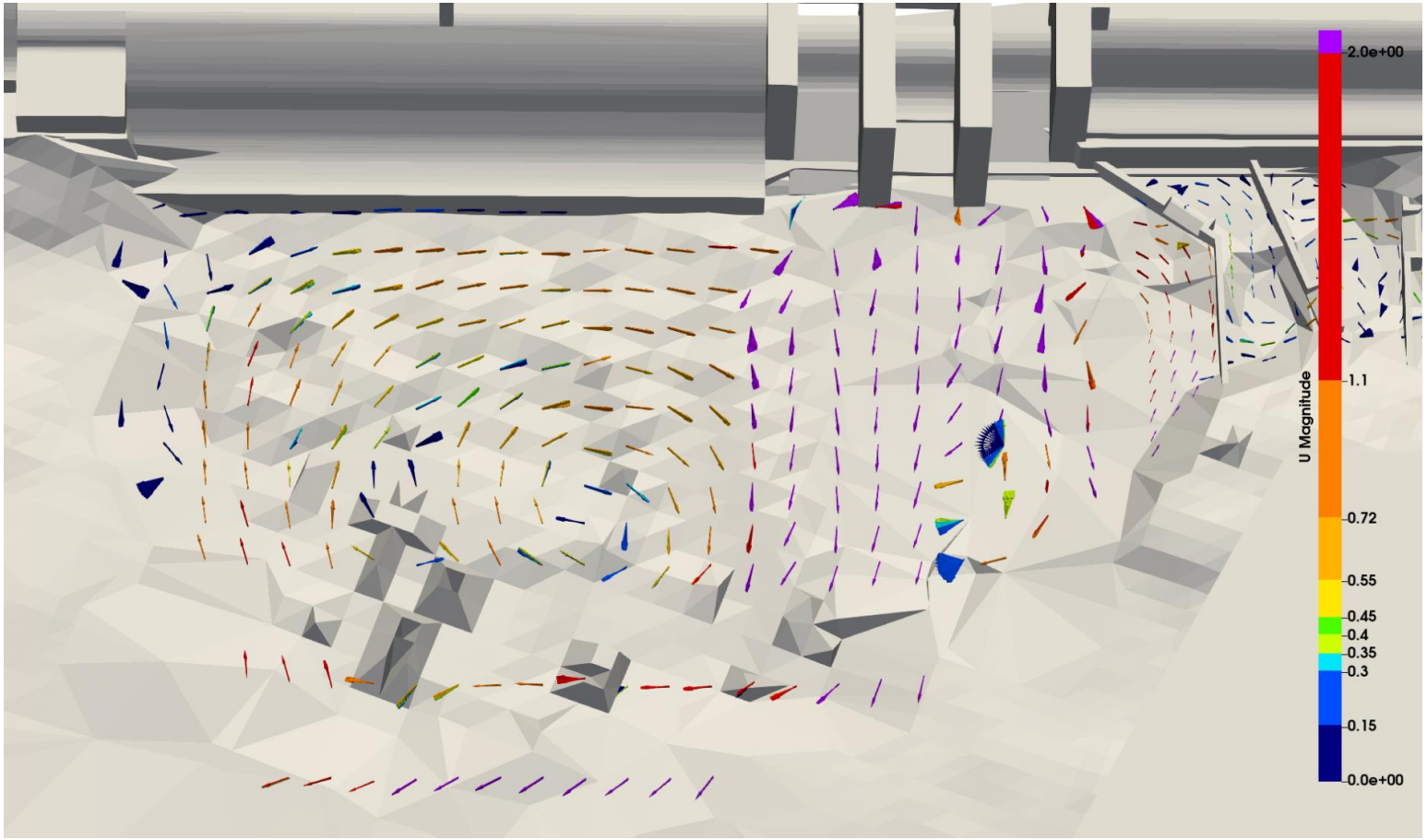


Figure S5-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

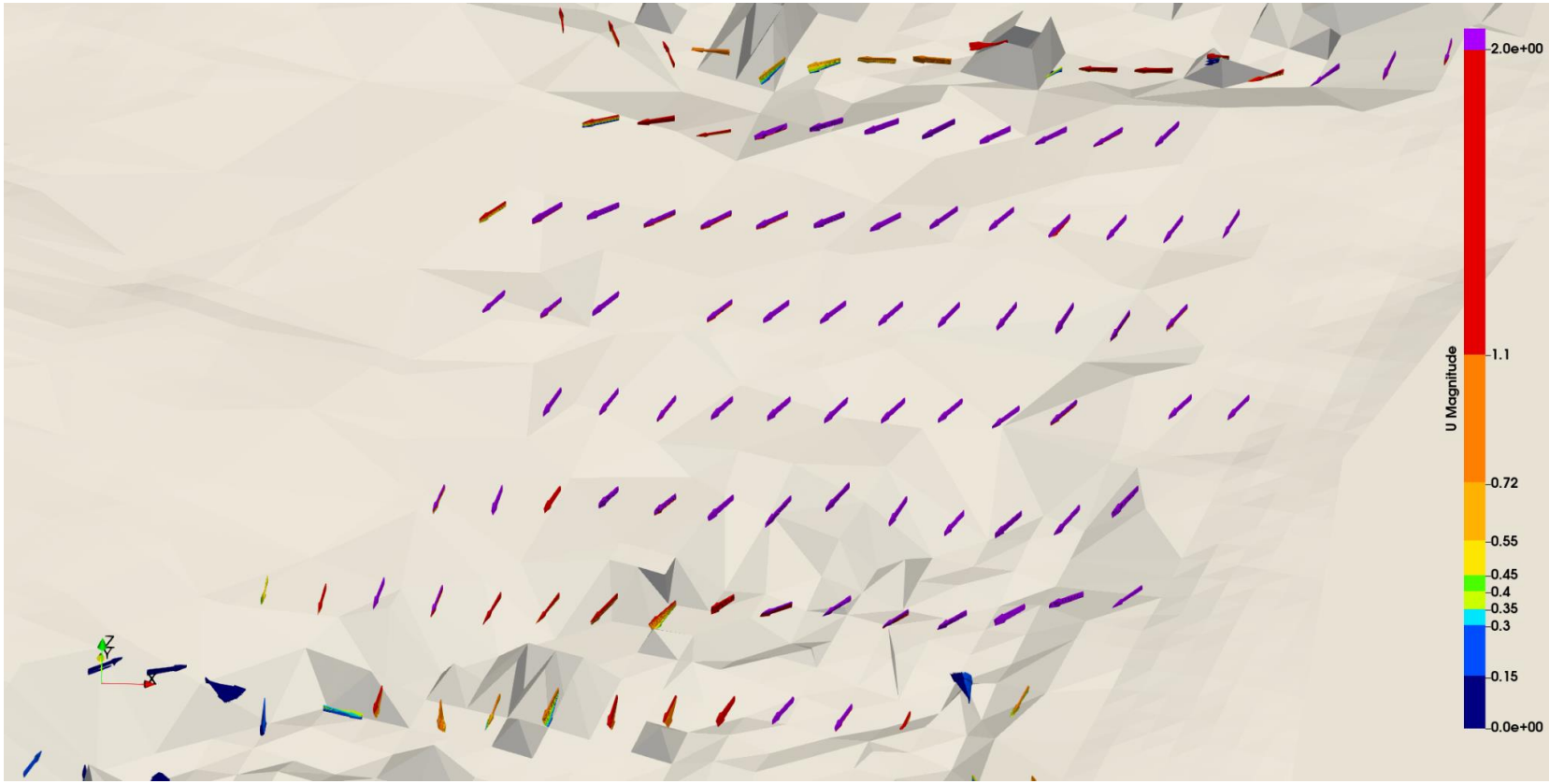


Figure S5-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

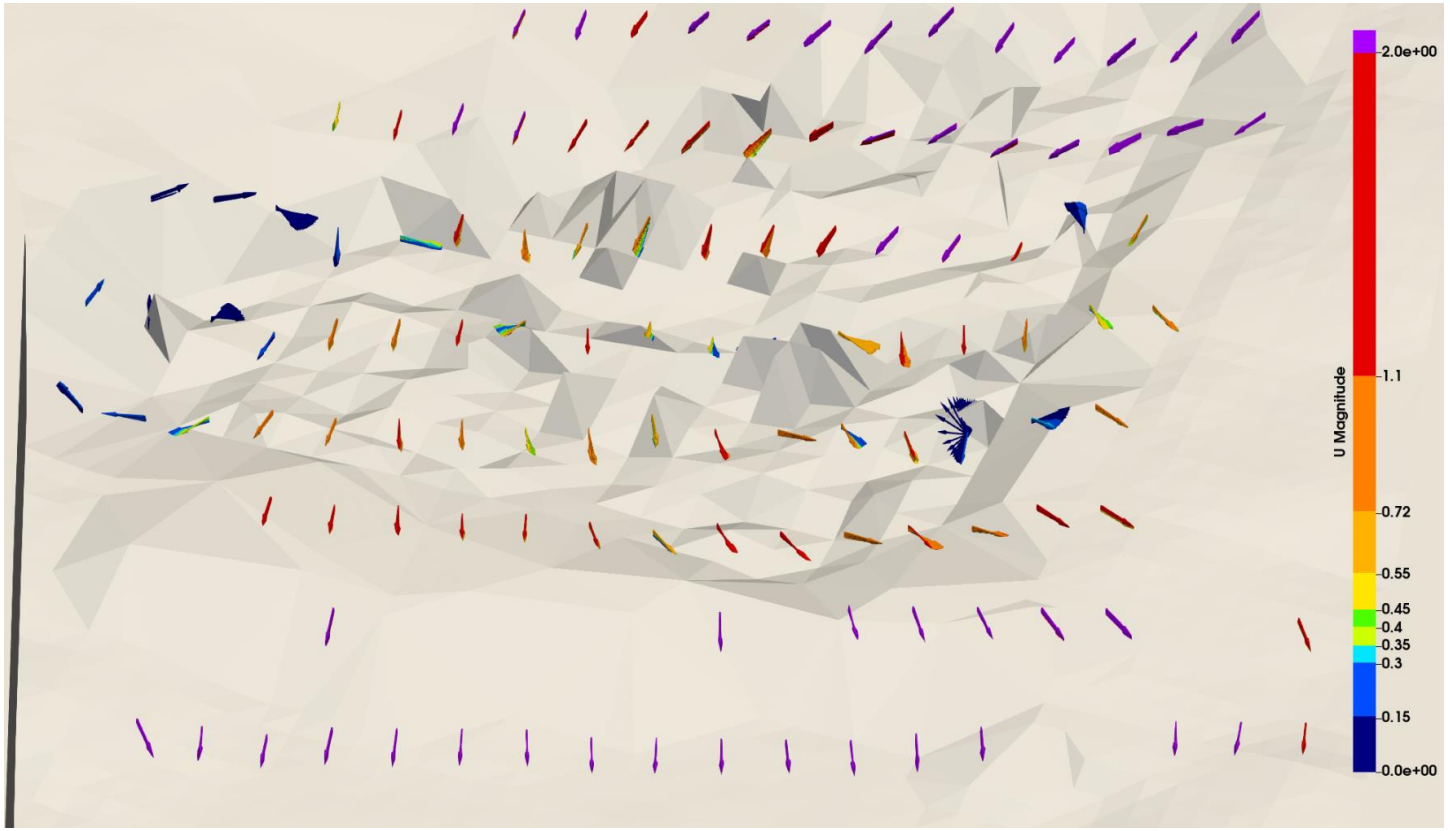


Figure S5-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

6. Model Results of Scenario S6 with 4308 cfs from the gates

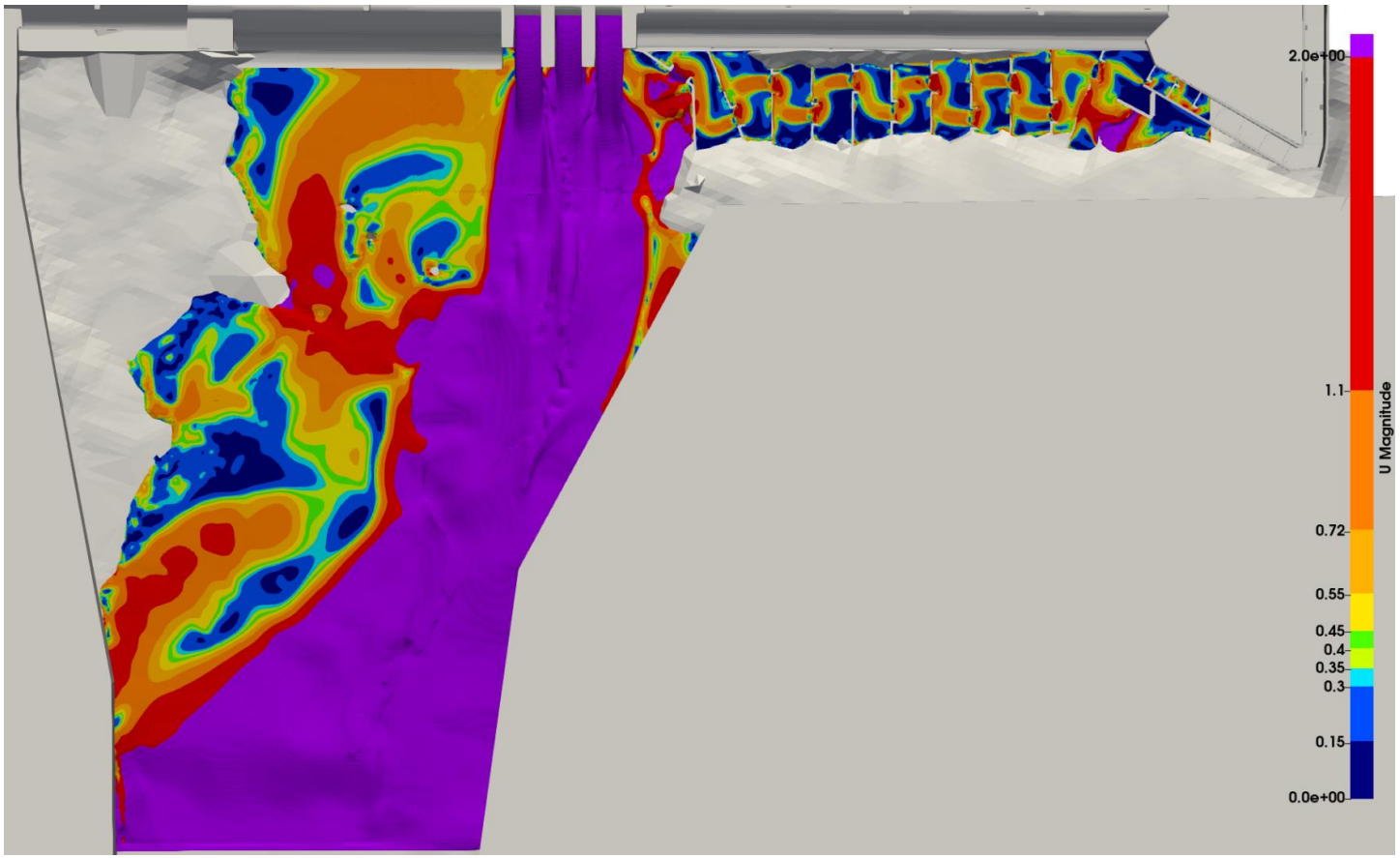


Figure S6-1: Plan view of the Water Surface Velocities

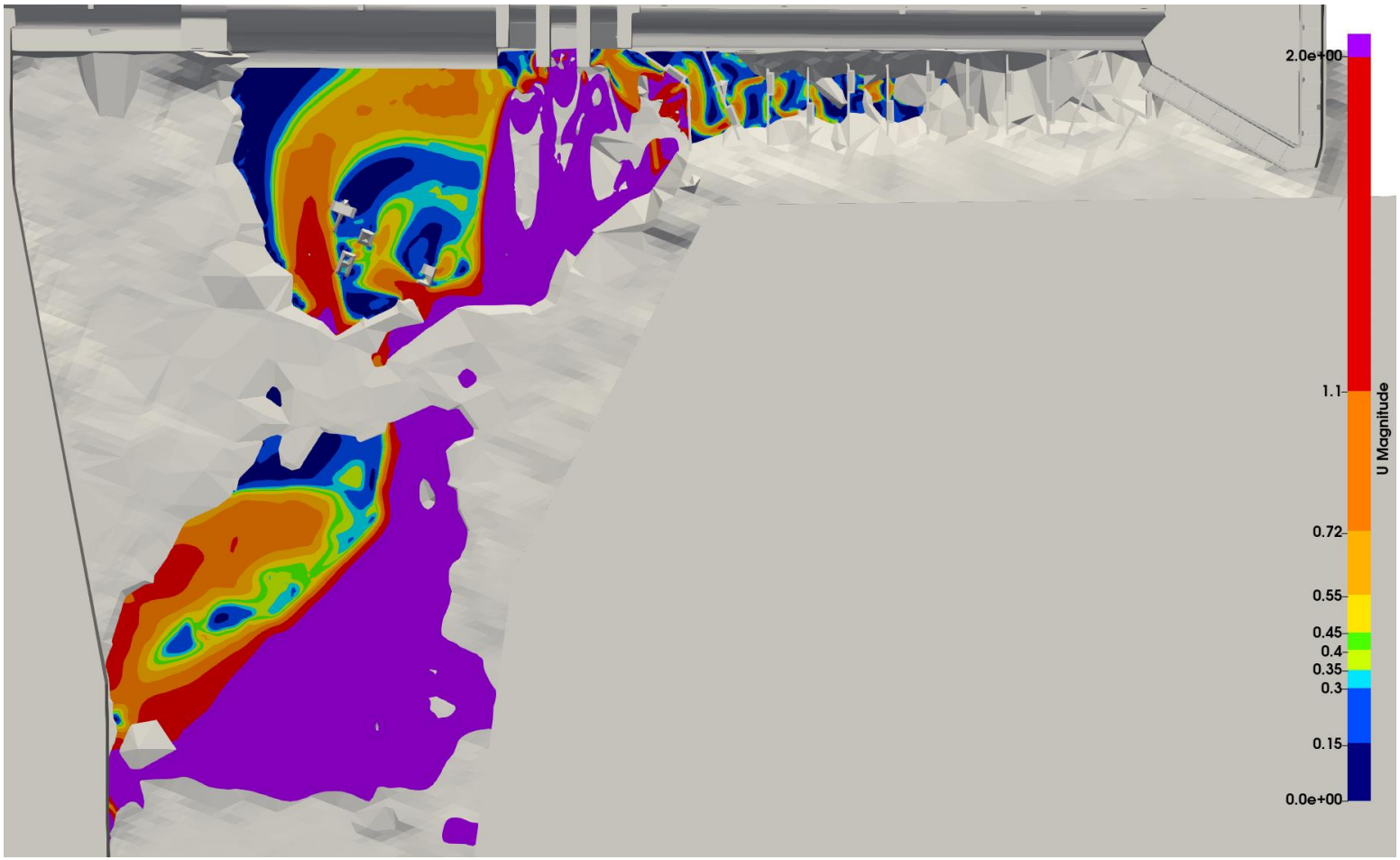


Figure S6-2: Plan view of the Mid-Surface Velocities

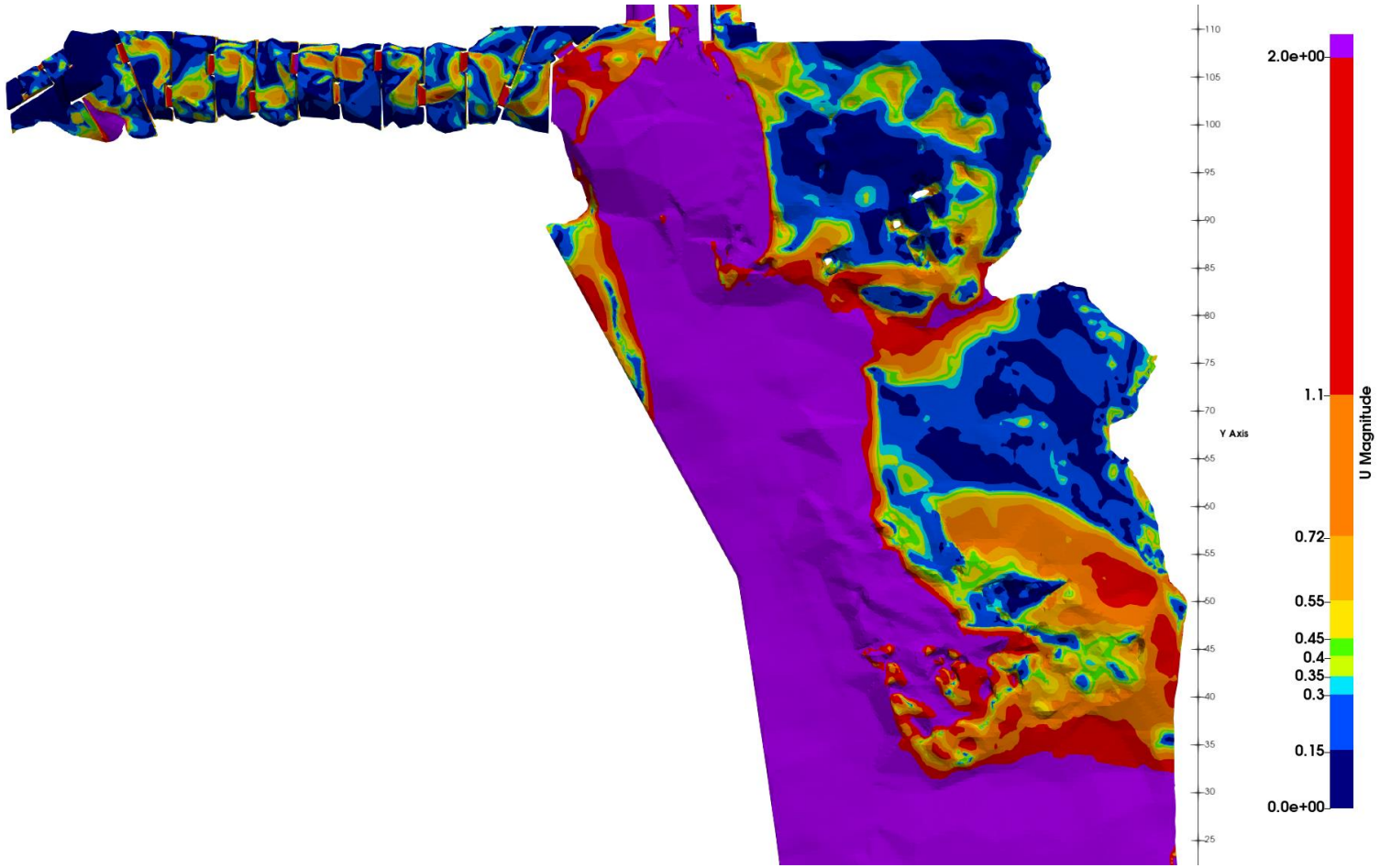


Figure S6-3: View of the Bottom Velocities

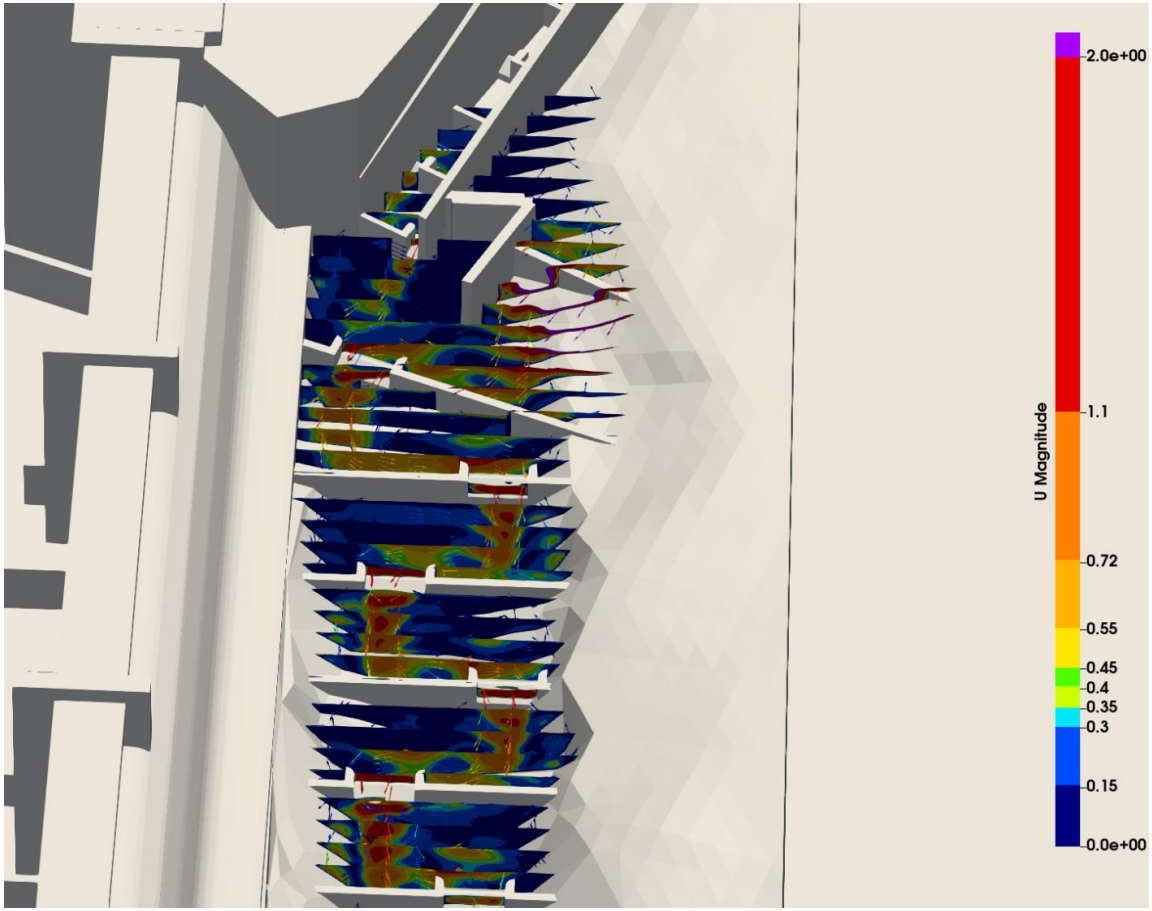


Figure S6-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

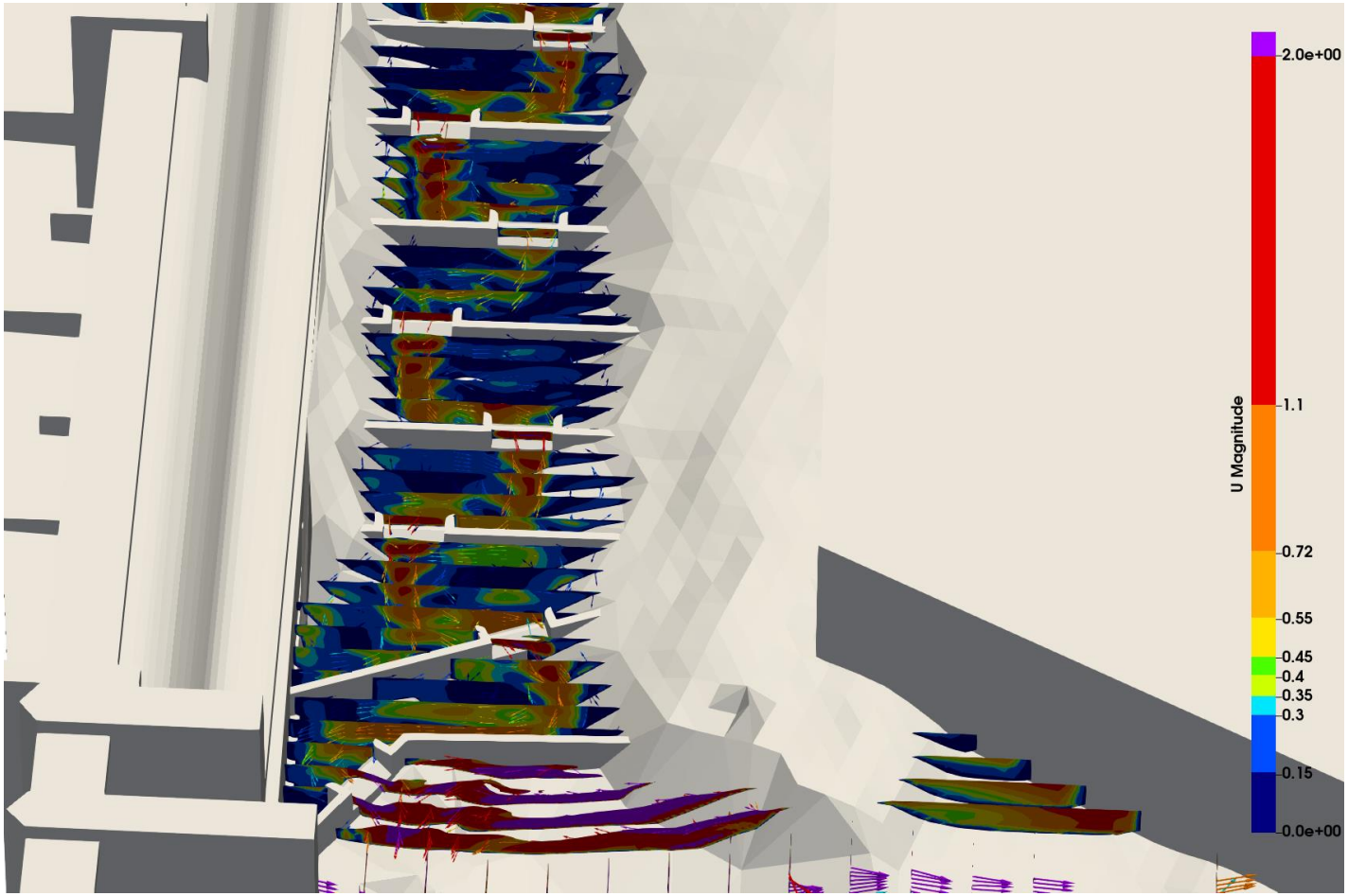


Figure S6-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

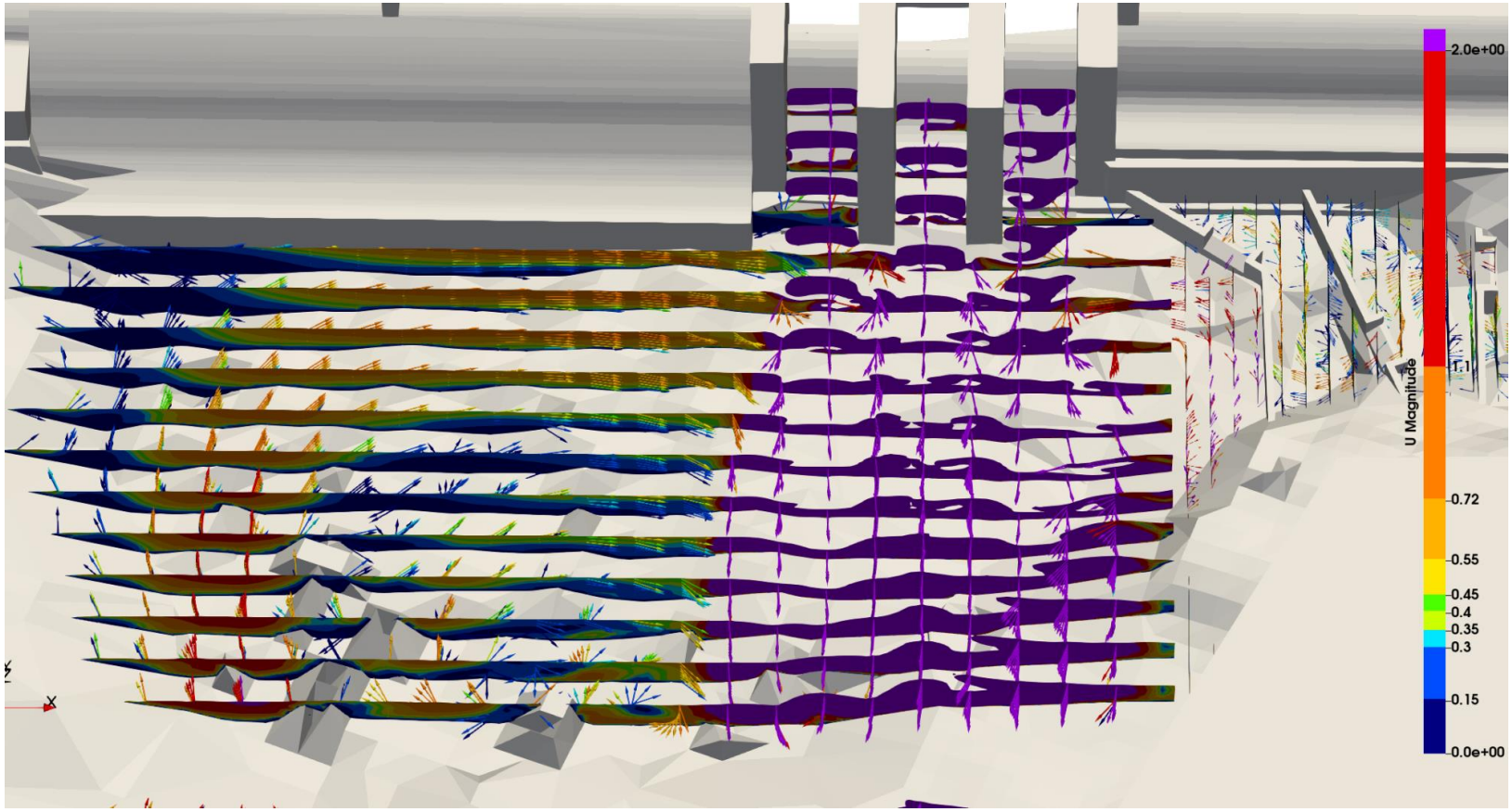


Figure S6-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

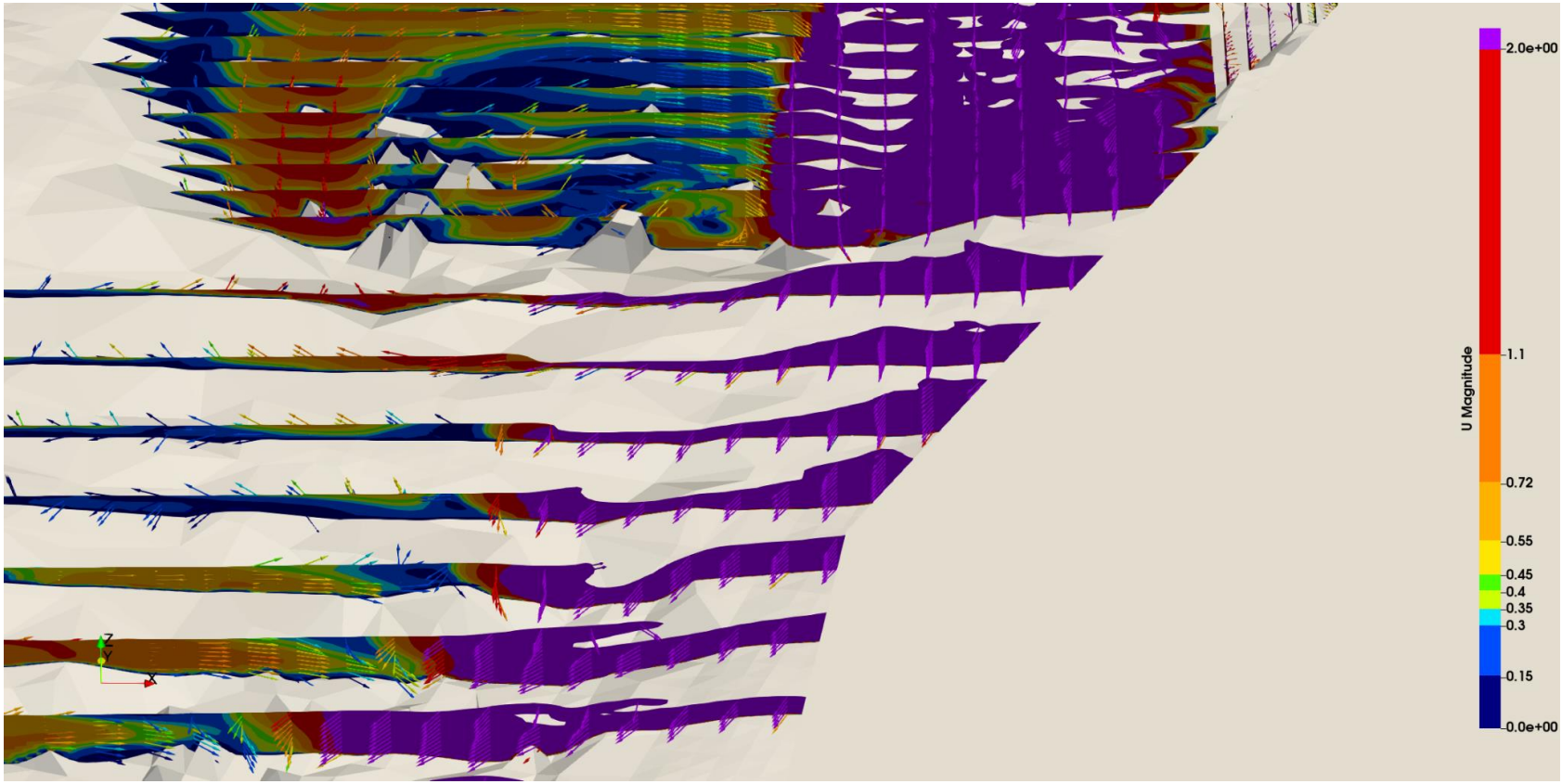


Figure S6-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

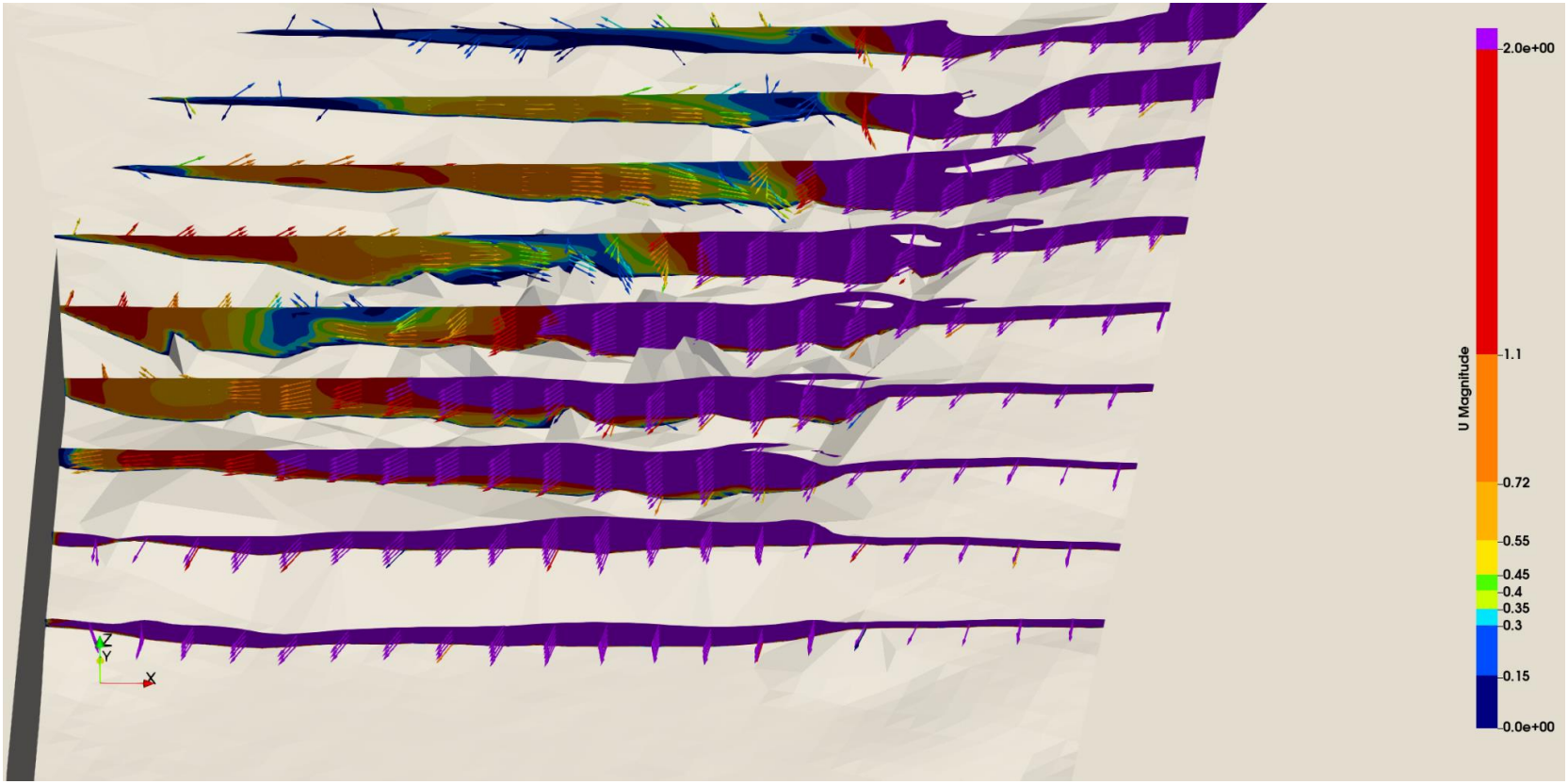


Figure S6-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

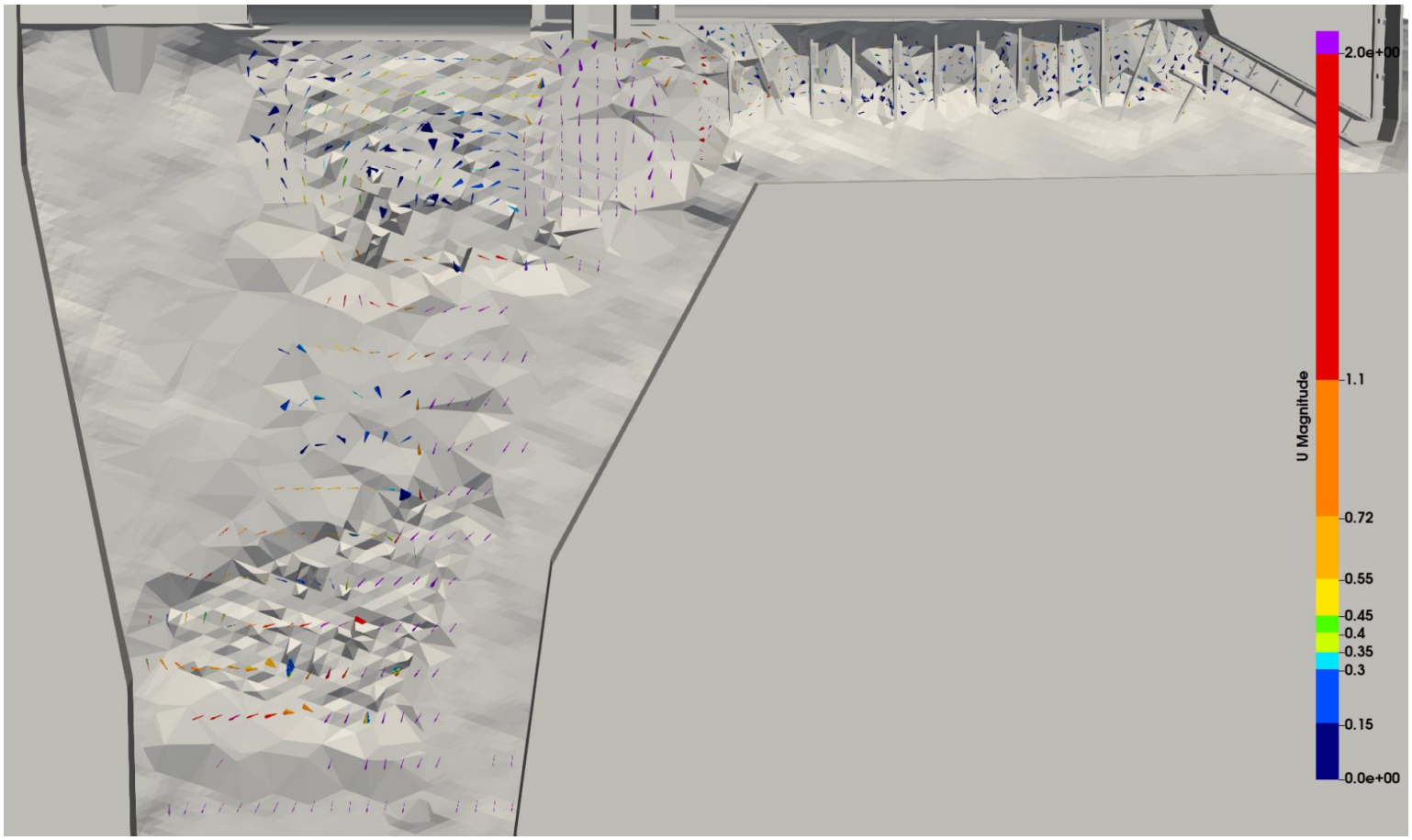


Figure S6-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

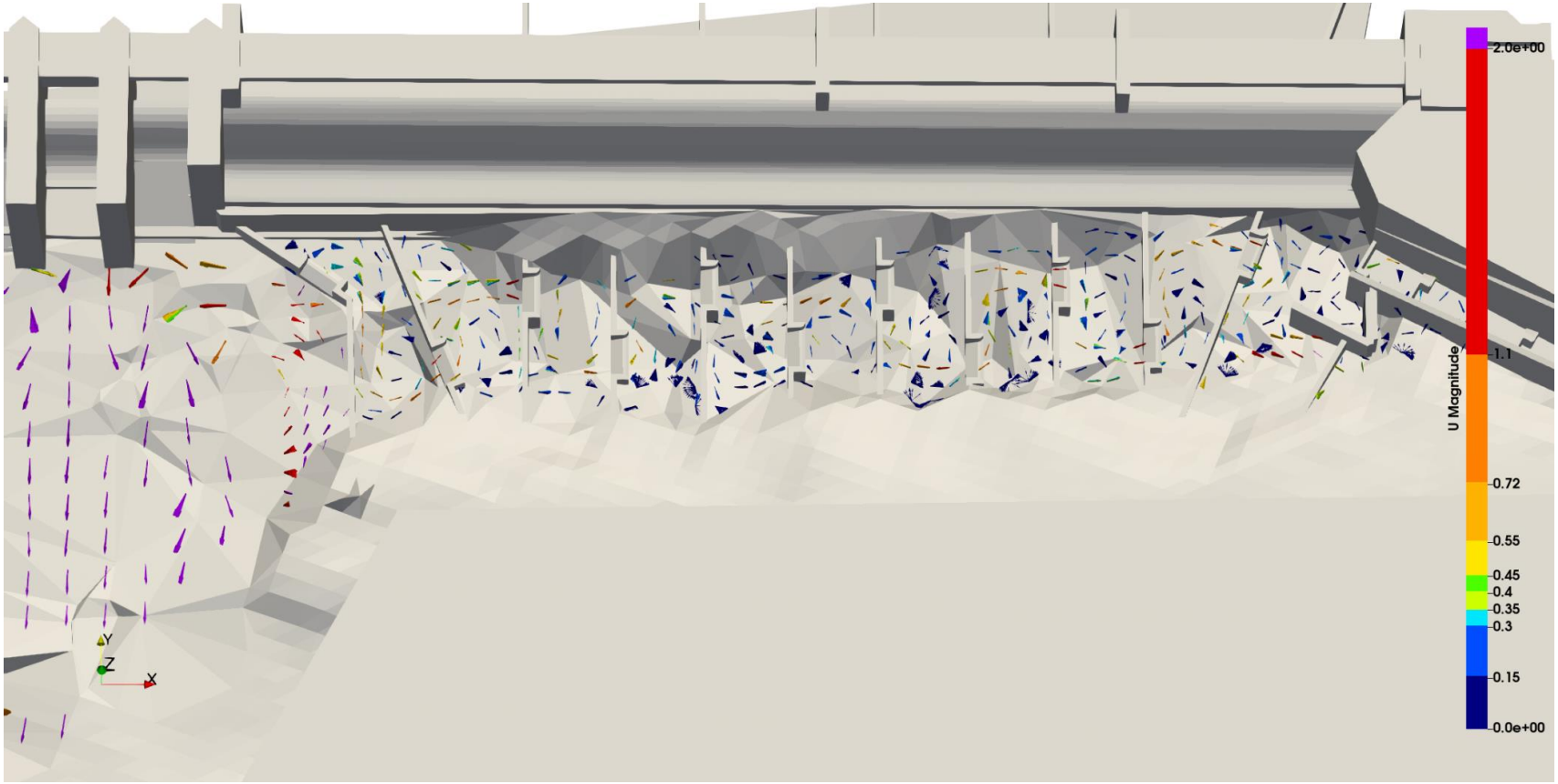


Figure S6-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

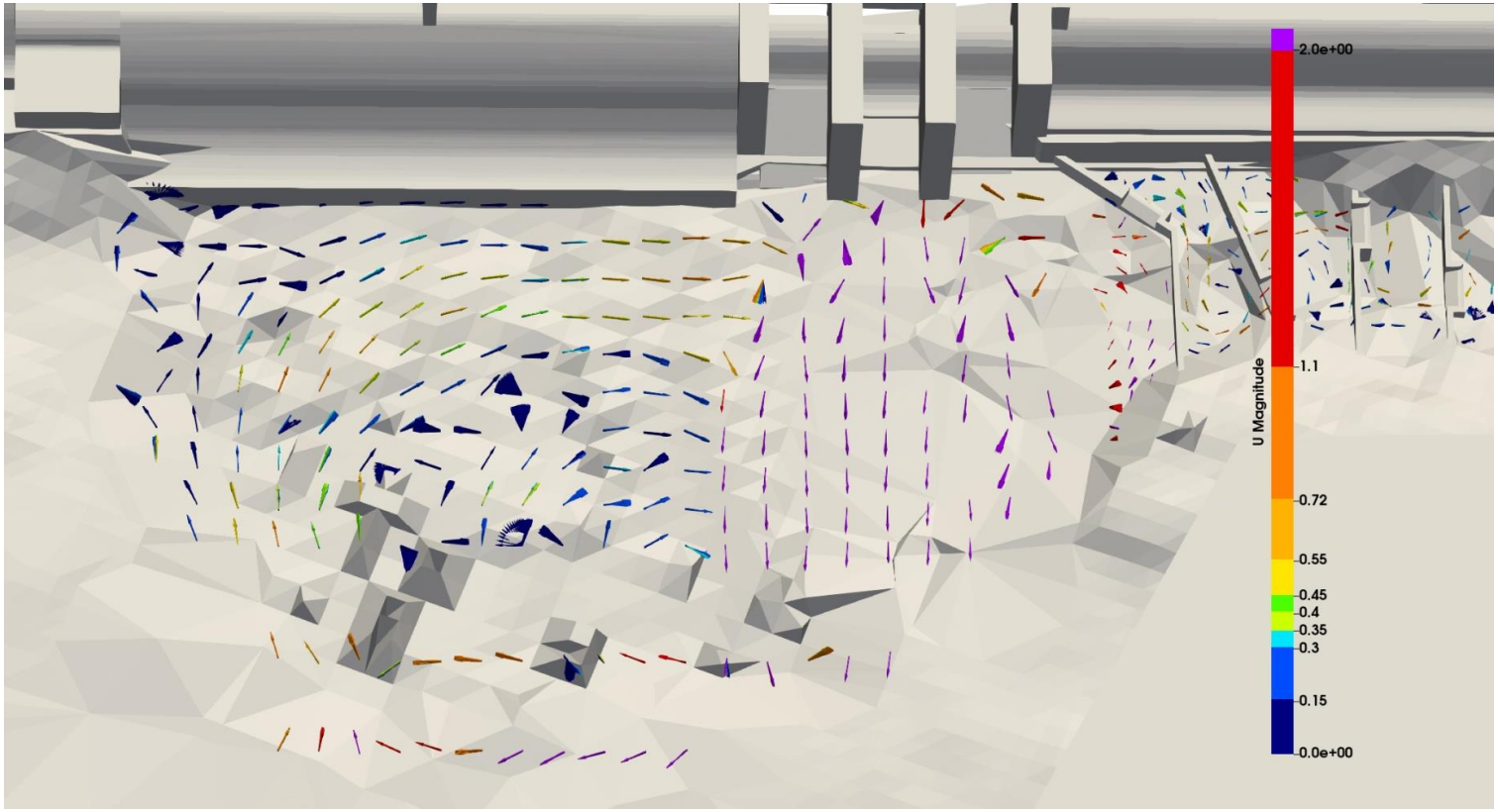


Figure S6-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

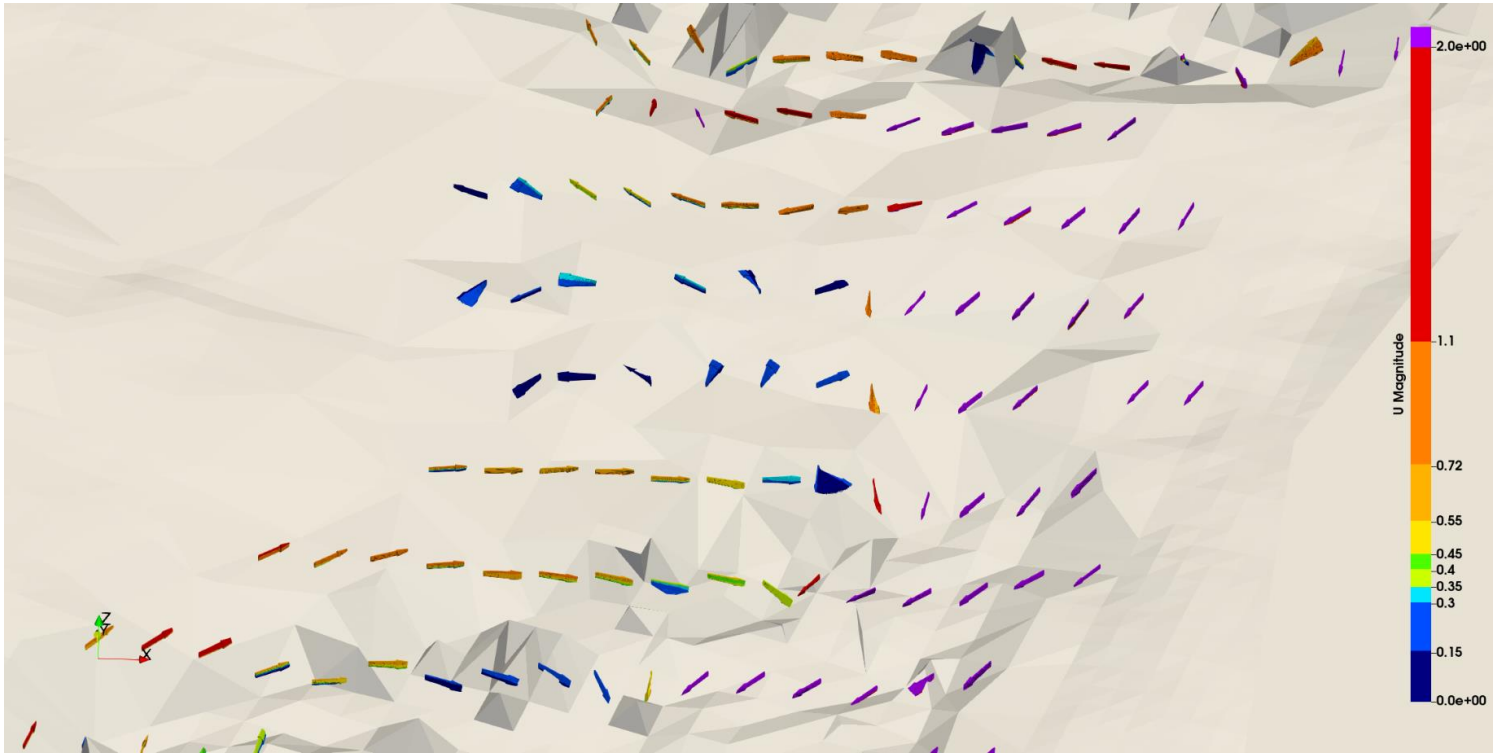


Figure S6-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

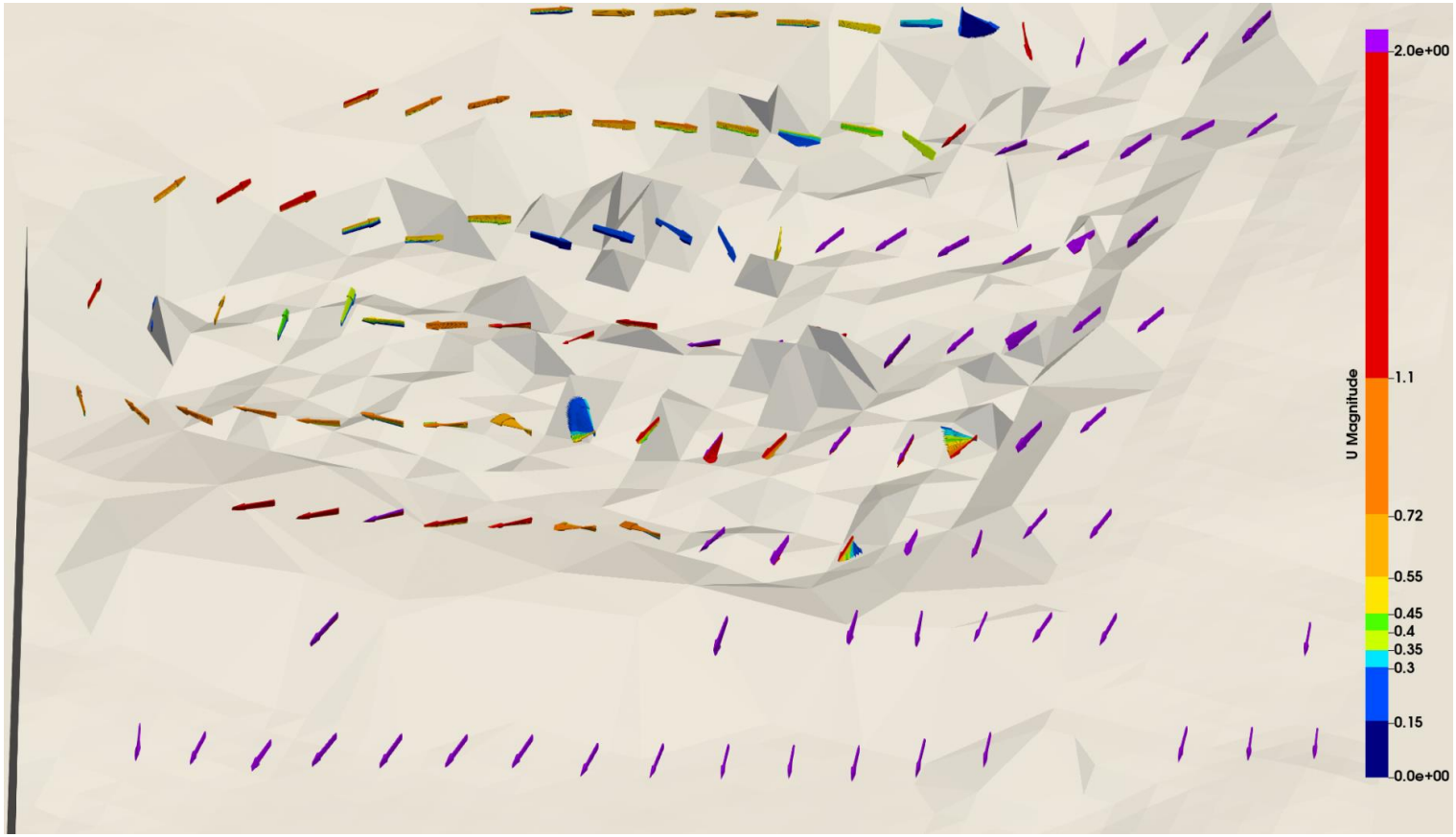


Figure S6-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

7. Model Results of Scenario S7 with 0 cfs from the gates

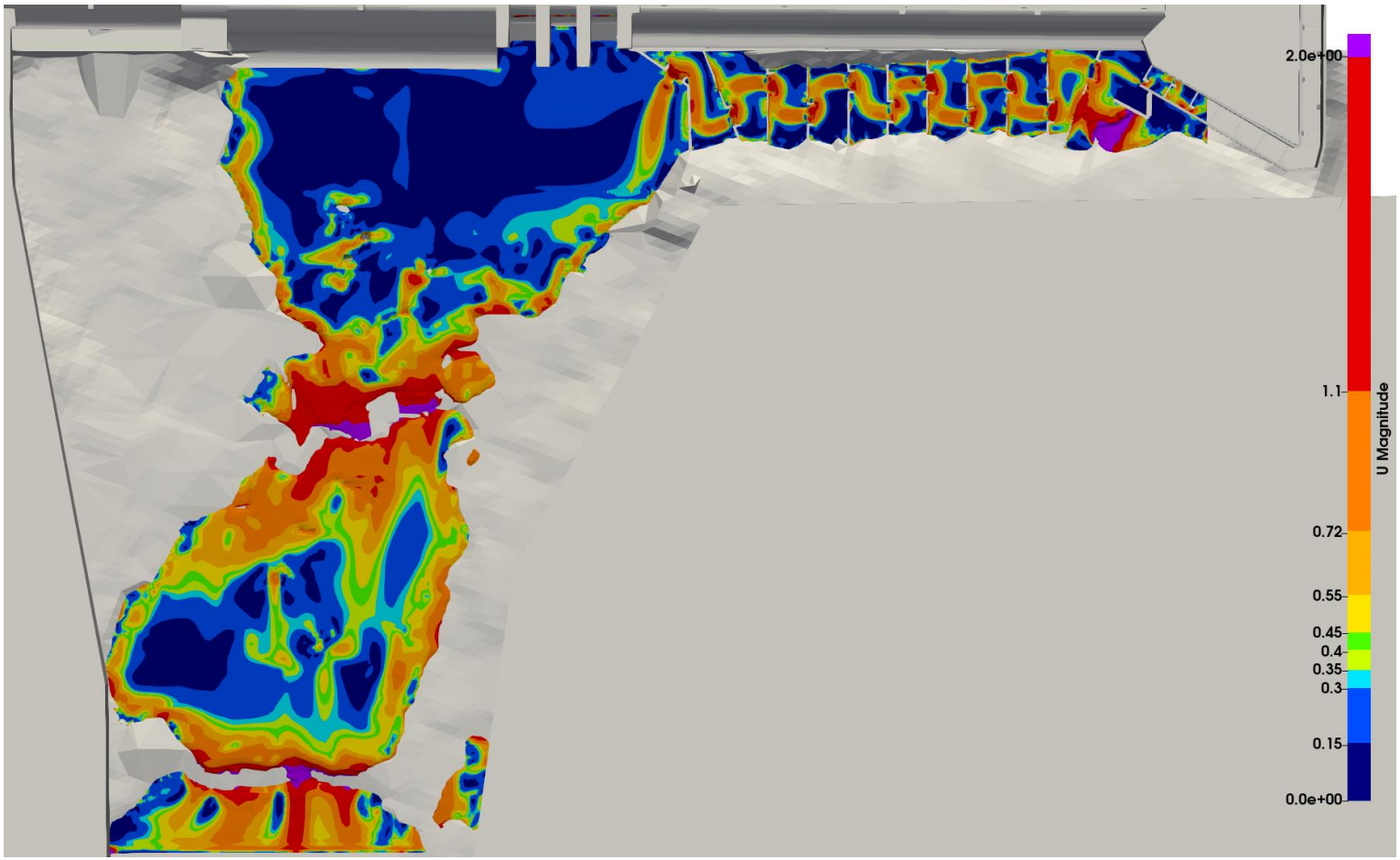


Figure S7-1: Plan view of the Water Surface Velocities

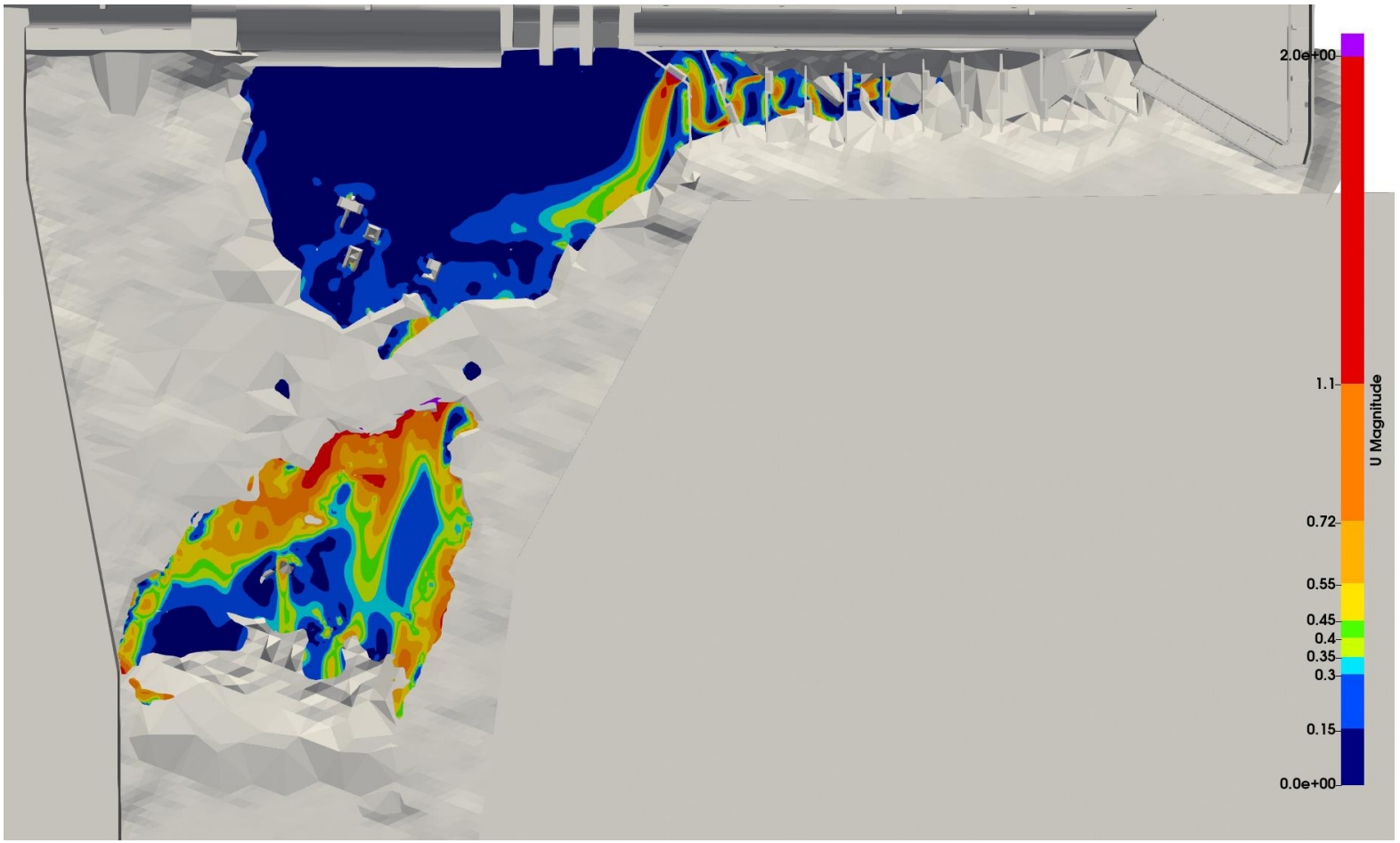


Figure S7-2: Plan view of the Mid-Surface Velocities

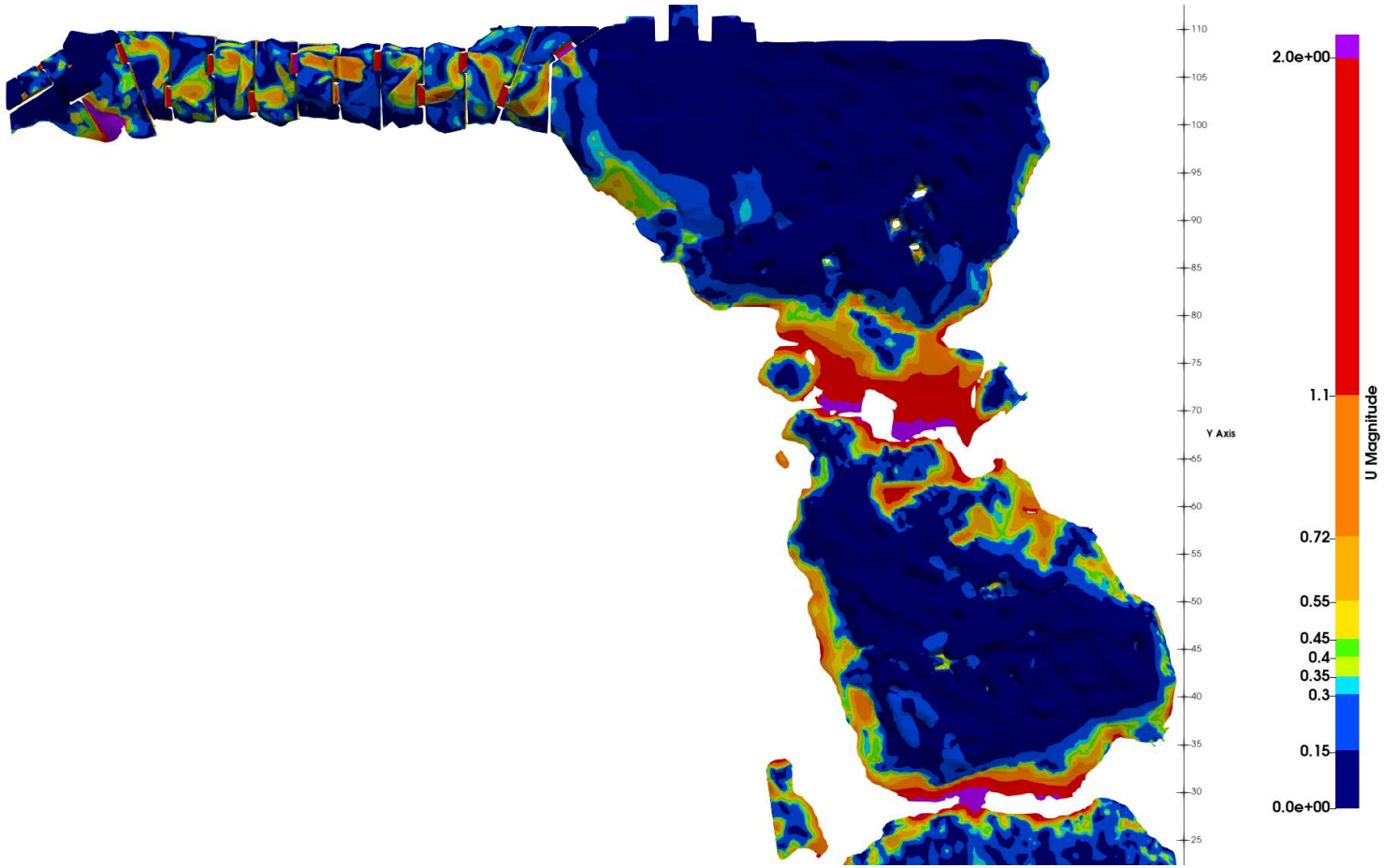


Figure S7-3: View of the Bottom Velocities

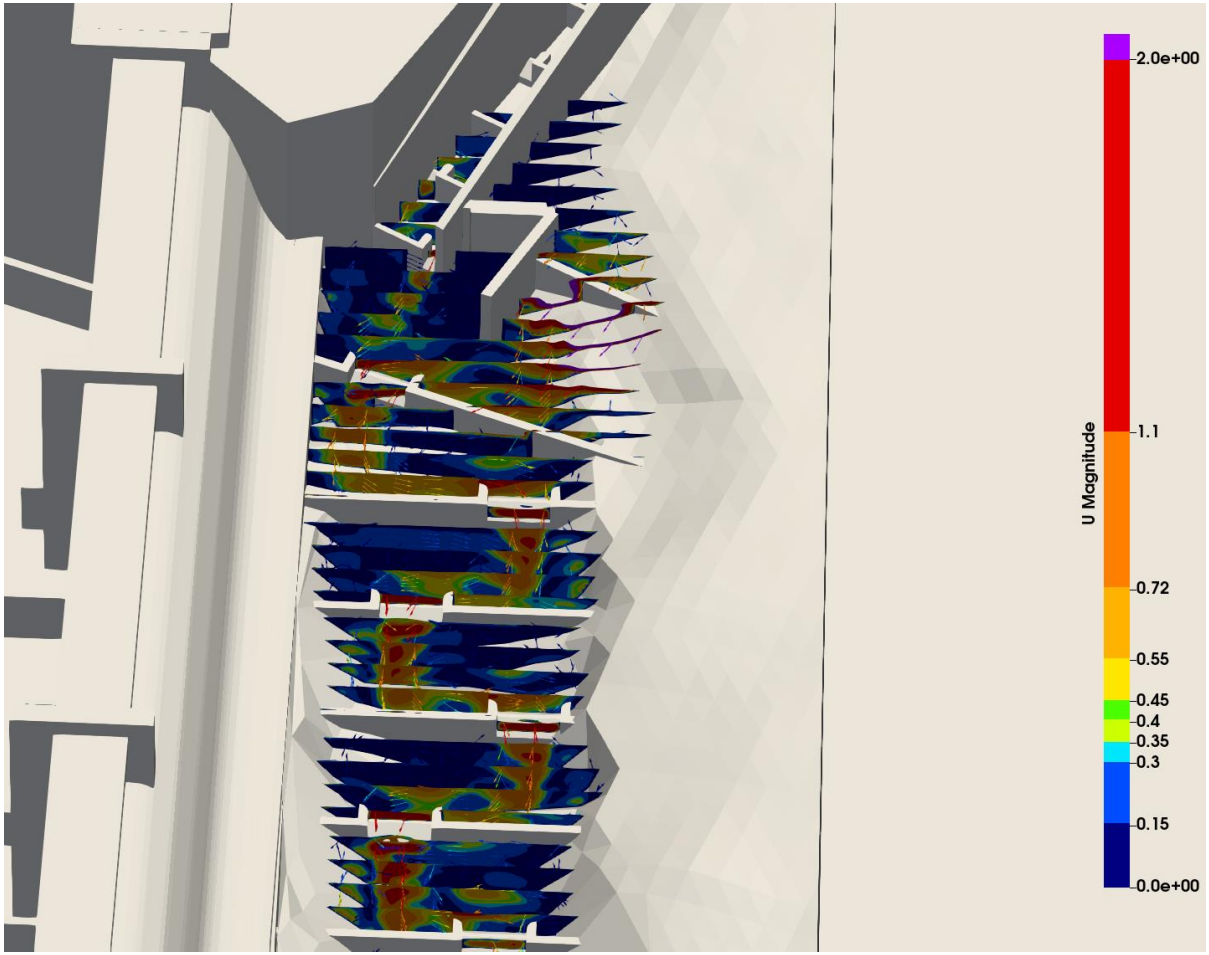


Figure S7-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

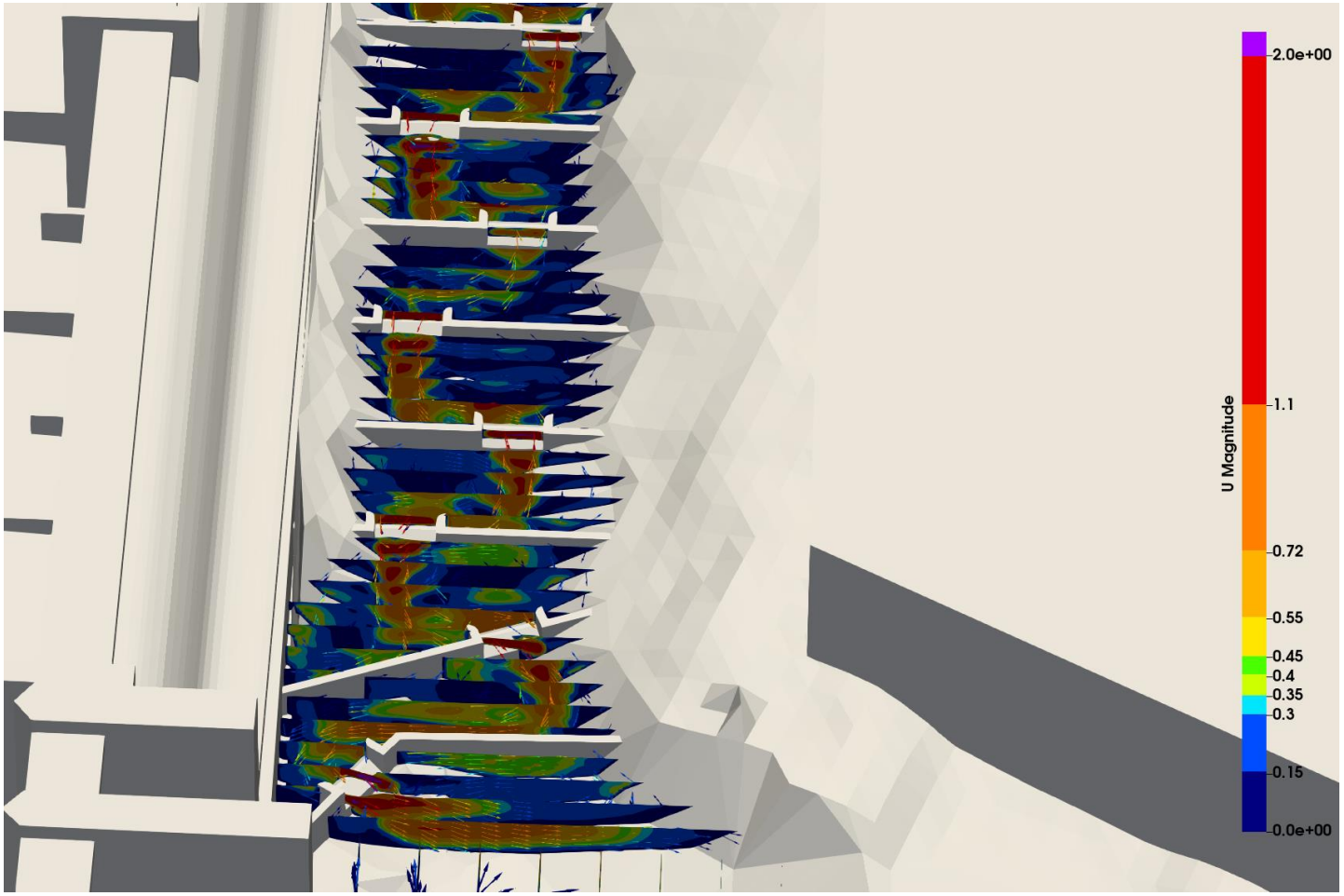


Figure S7-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

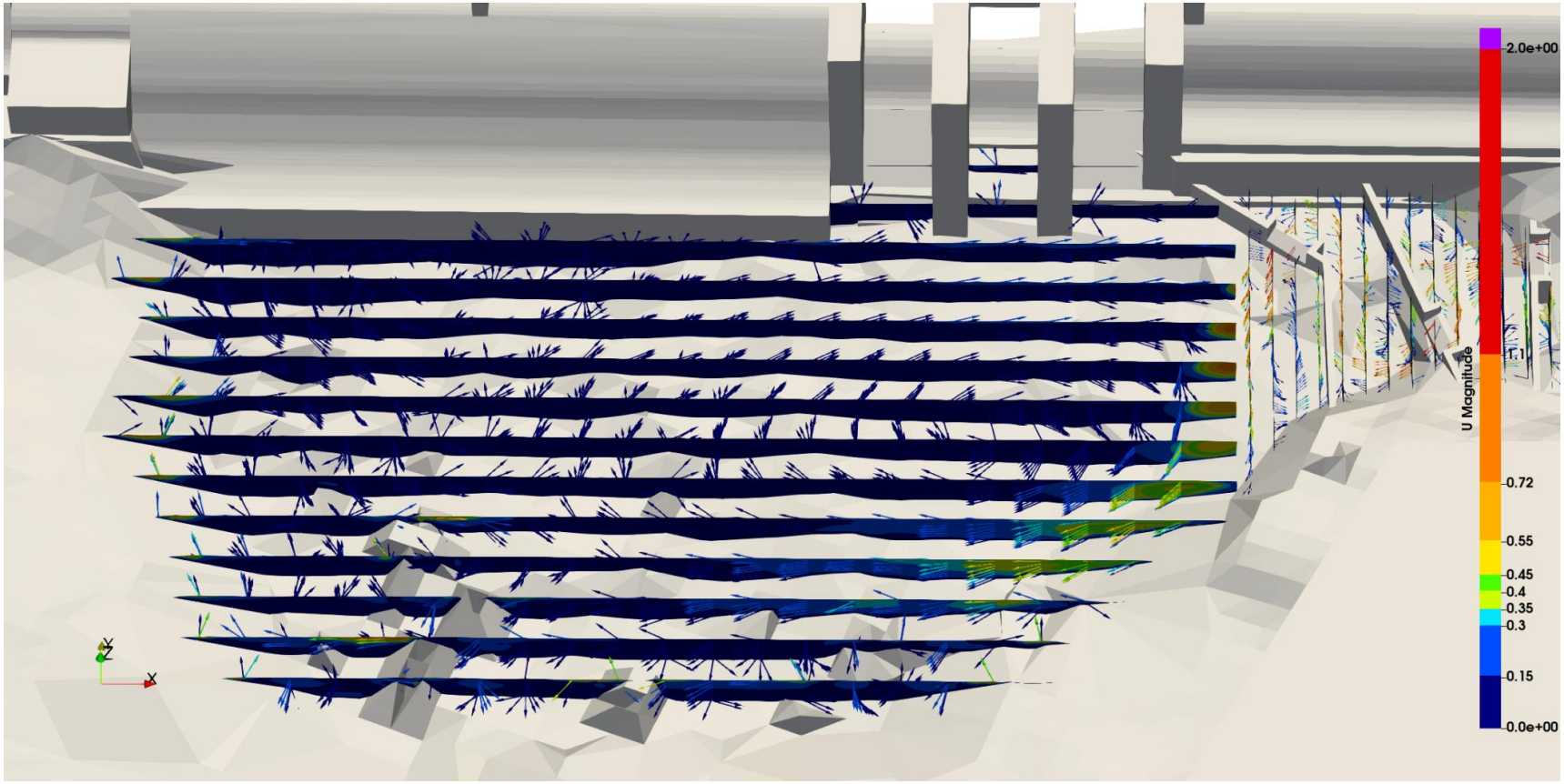


Figure S7-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

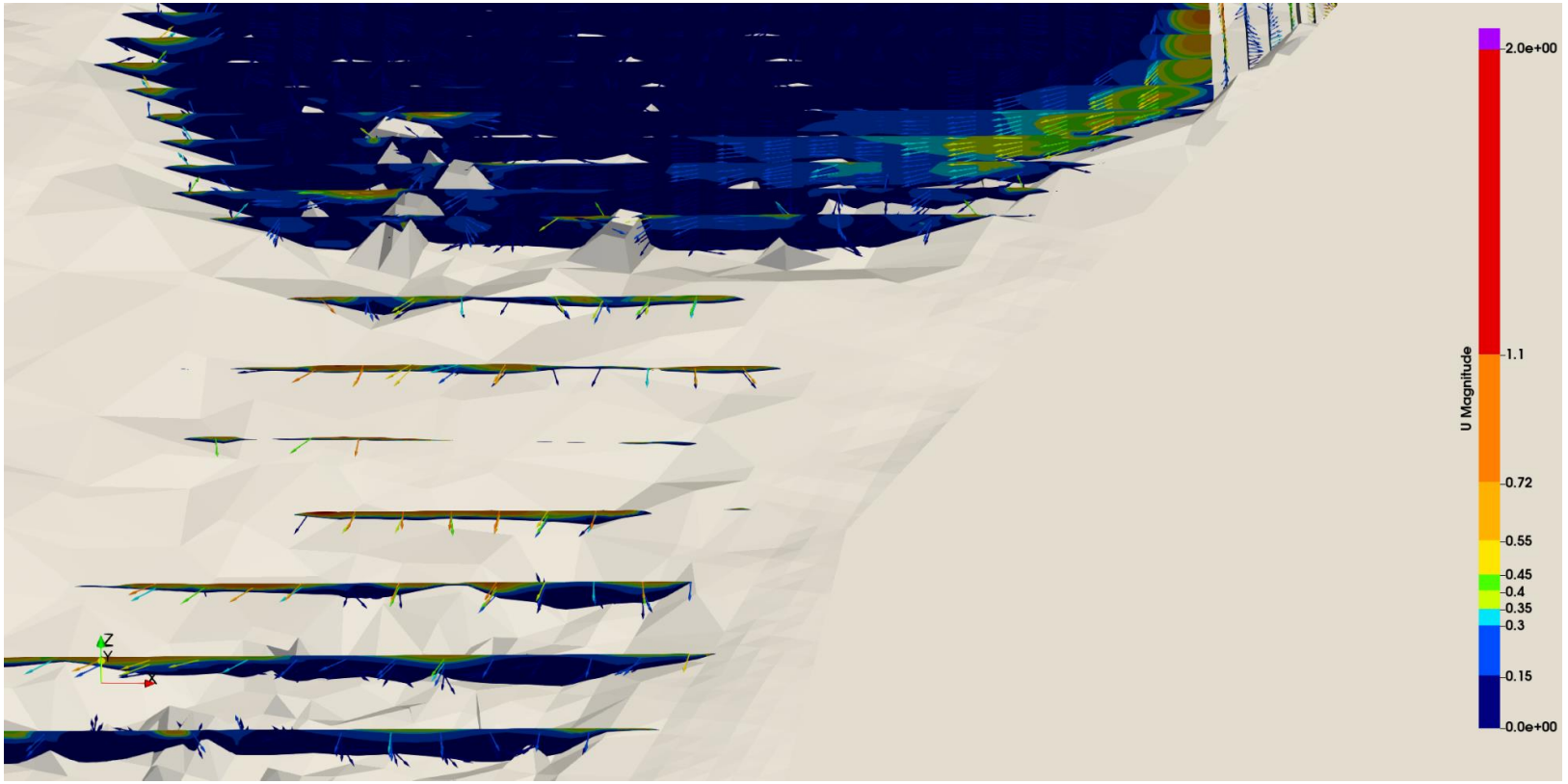


Figure S7-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

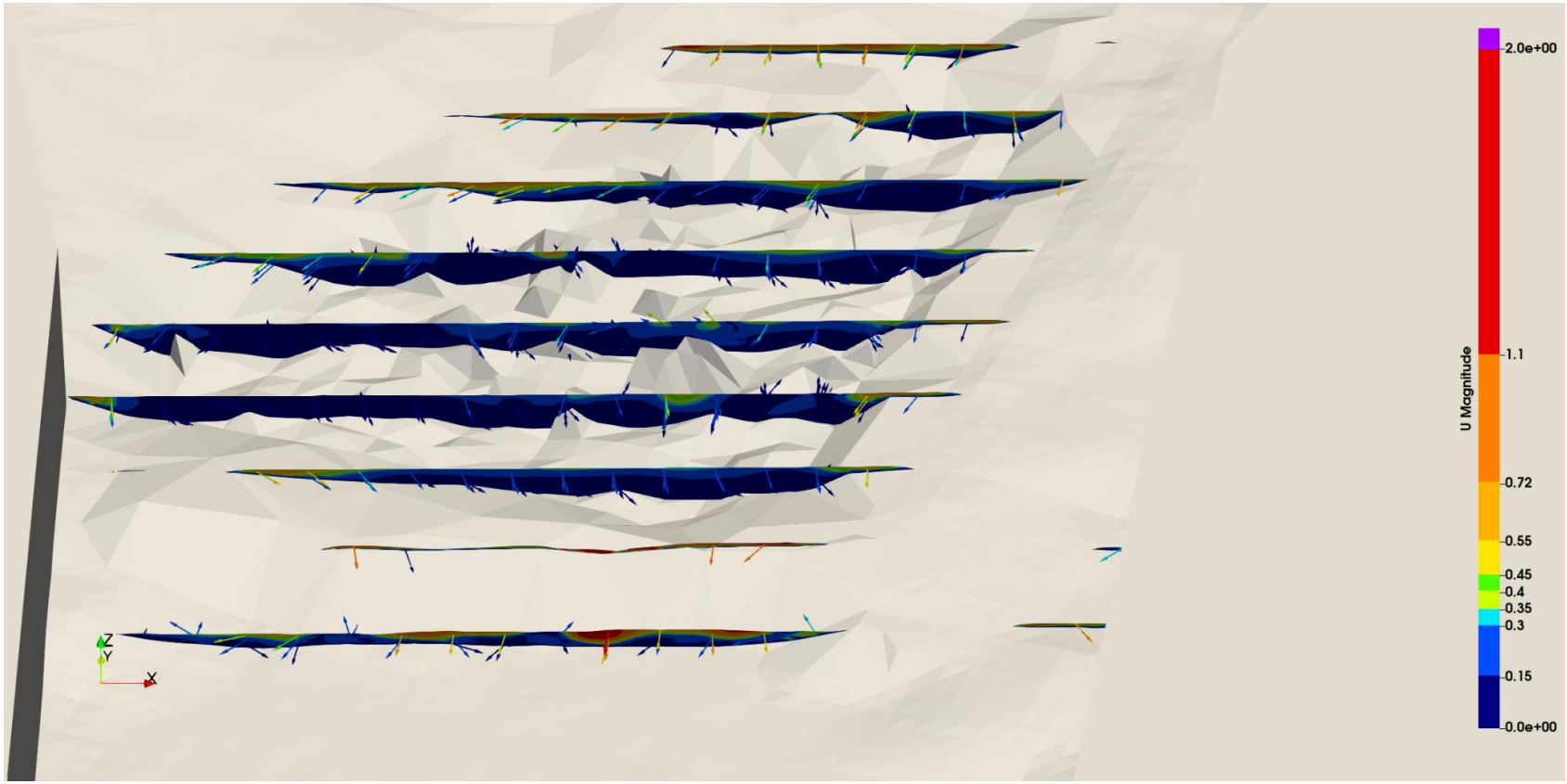


Figure S7-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

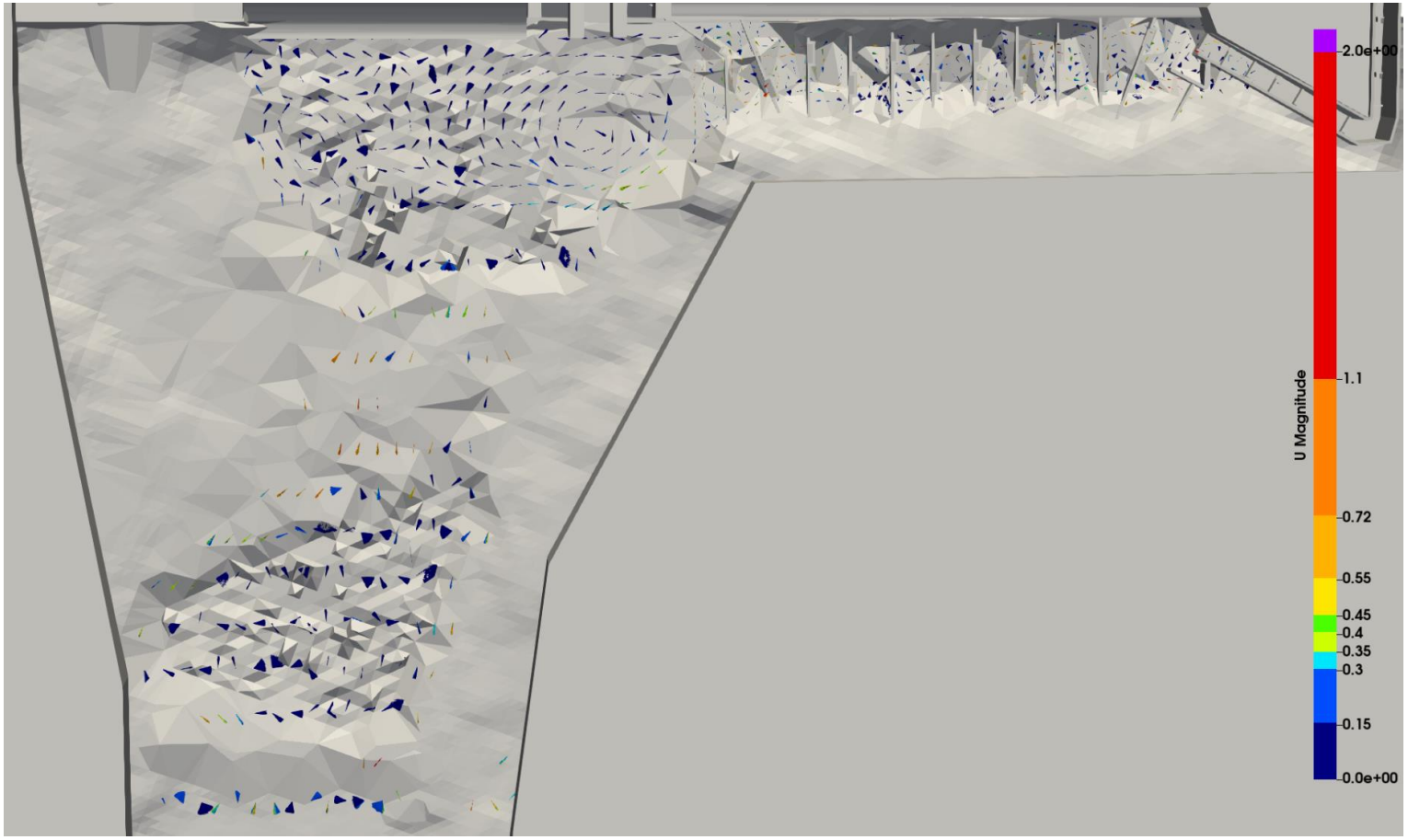


Figure S7-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

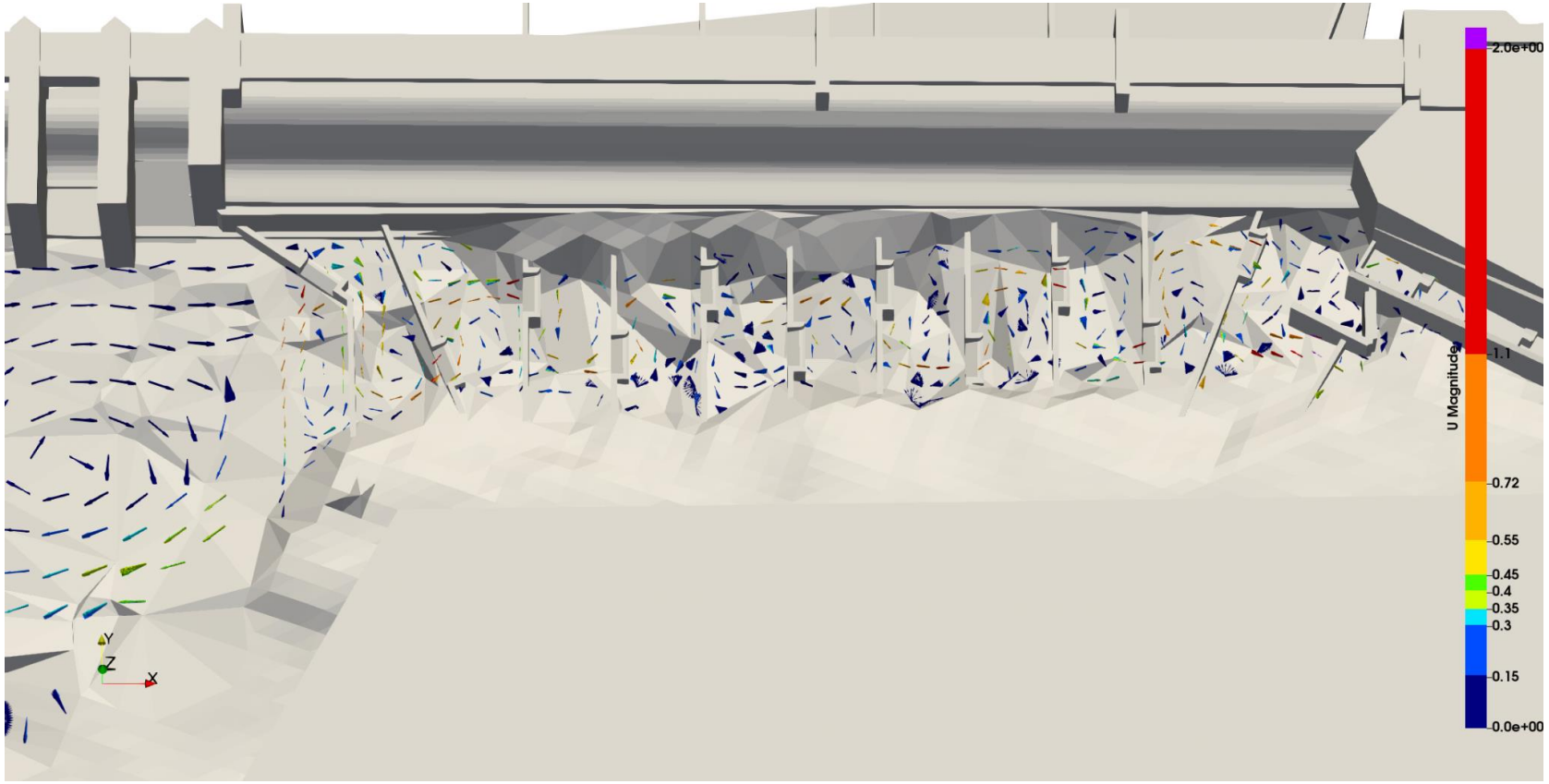


Figure S7-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

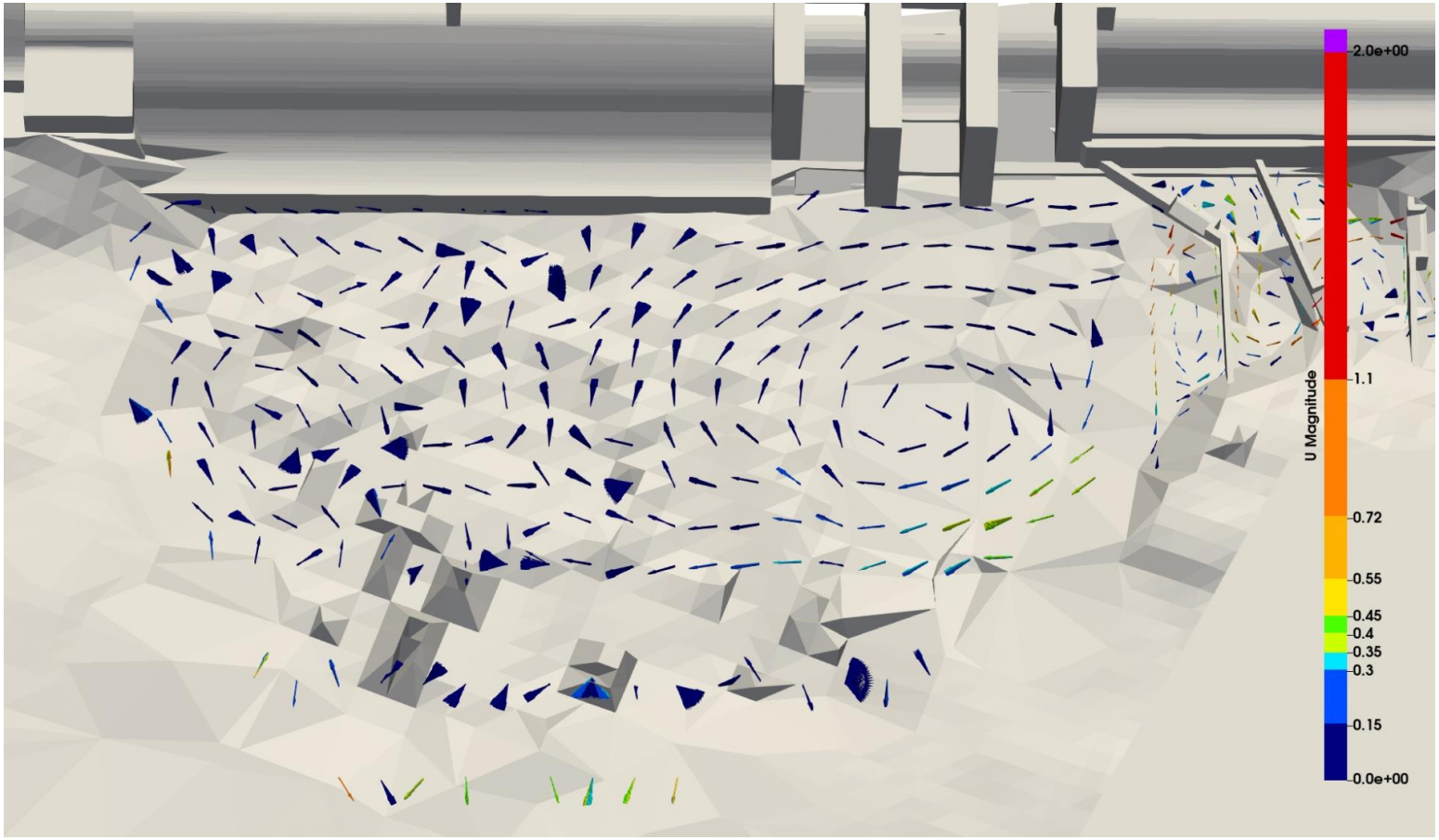


Figure S7-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

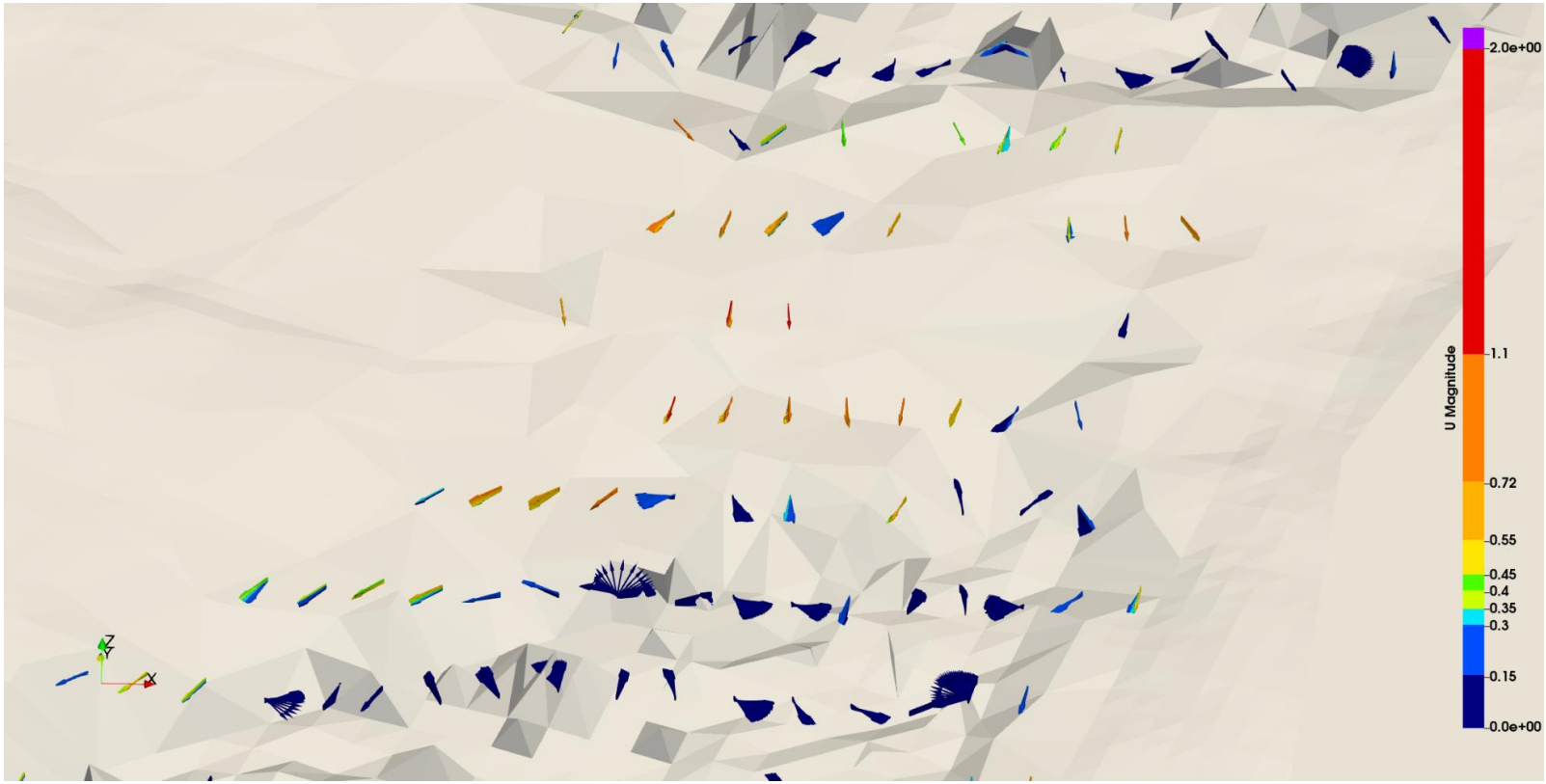


Figure S7-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

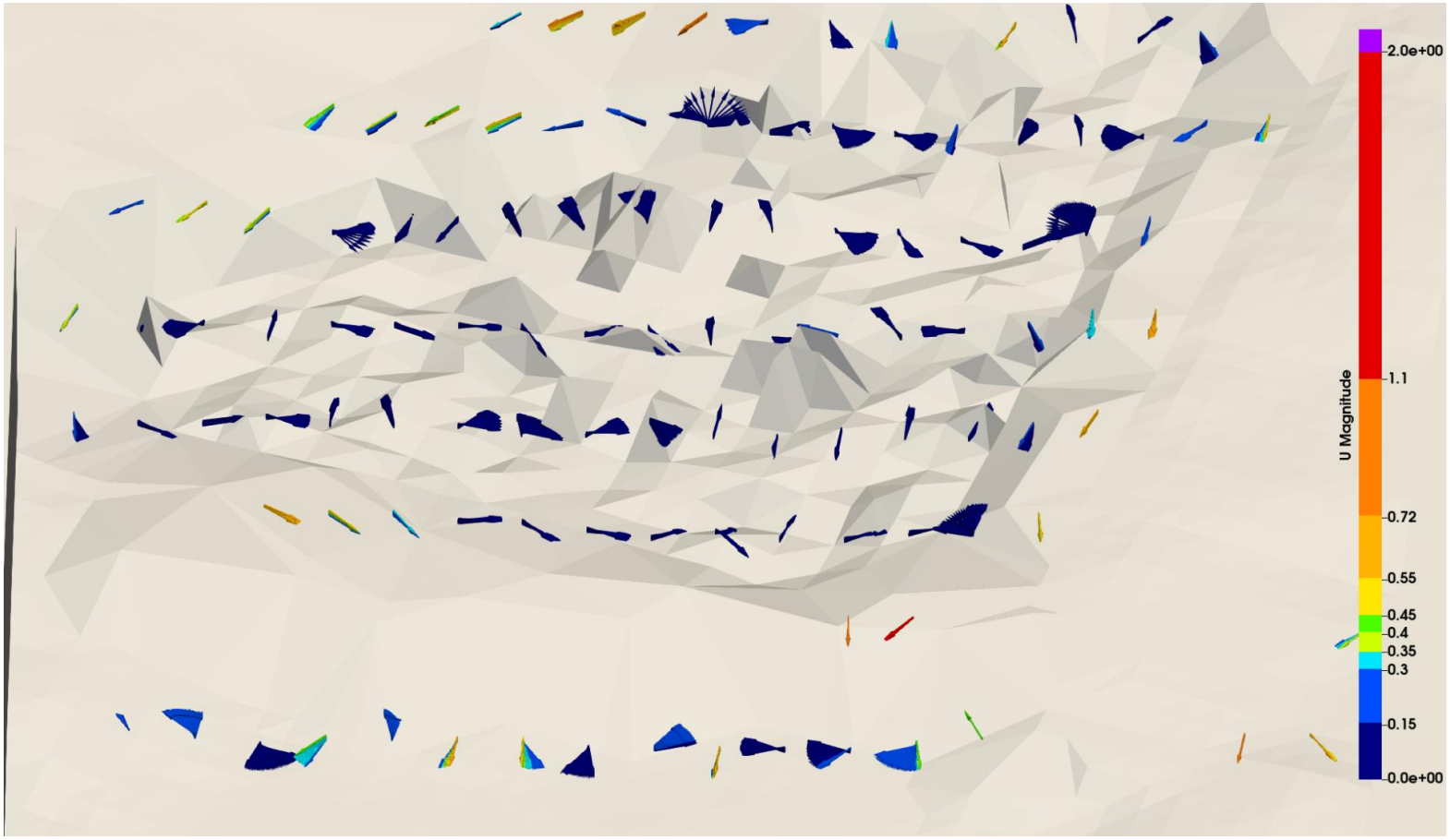


Figure S7-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

2 Ruth Falls Dam – River Fish Passage Modelling: Summary of Thaumas Environmental Consultants Ltd. Report

2.1 Introduction

Nova Scotia Power (NSP) has requested that CBCL Limited (CBCL) conduct 3D Computational Fluid Dynamics (CFD) hydraulic modelling (3D modelling) for the post-refurbished downstream conditions and proposed changes at the Ruth Falls Dam in Sheet Harbour, Nova Scotia (Appendix A: Figure 1). The main refurbishments and changes that were modelled by CBCL and evaluated by Thaumas Environmental Consultants Ltd (Thaumas) are shown in Table 1 and Appendix A: Figure 1).

Table 1: Proposed Refurbishments and Changes to the Ruth Falls Dam and Explanations

#	Proposed Refurbishment / Change	Explanation
1	Replacement of the existing stop log bay with three vertical lift gates in the center of the dam and the flows distributed between the gates.	The current stop logs are leaking and are difficult to adjust to maintain the headpond within a narrow depth range.
2	Installation of a new rubber dam.	Large inflatable rubber cylinders will be replacing the existing stoplog sections, on top of the concrete spillway of the refurbished dam, to replace the existing stop logs and stop all leakage.
3	Eleven new fish passage weirs in the fishway channel section at the toe of the dam.	The existing seven fishway weir configuration has varying drops and pool sizes and does not provide adequate fish passage. The weirs will be replaced with 23 cm drops and notches sized to accommodate the louvre flow for additional fishway attraction flow.

#	Proposed Refurbishment / Change	Explanation
4	Fishway entrance	The notch in the entrance weir is located to the dam side of the fishway channel and aligned to direct its flow along the edge of the gate flows.
5	Louvres flow and bypass pipe relocated	The louvre flow will be relocated to the upper end of the fishway channel to provide additional attraction flow to the fishway.
6	Removal of rock flow diversion at gate three	A rock outcrop in front of gate three will be removed so the flow is directed down river vs. along the toe of the dam.
7	Riverbed bathymetry was flattened in the model just below the fishway and the three spill gates	To remove flow obstructions along the bottom, which disrupt favourable velocity patterns for fish passage.

The modelling was requested to determine if the proposed changes to the refurbished dam would affect fish passage in the river, at the entrance to the fishway, and in the lower channel section of the fishway. At the request of NSP, CBCL performed the CFD 3D modelling with the OpenFoam[1] modelling software. Thaumas evaluated and reviewed the computer modelling for fish passage and provided a report entitled, "Ruth Falls Dam – River Fish Passage Modelling". The following sections are a high-level summary of the Thaumas report and the full Thaumas report is provided in Appendix B.

2.2 Literature and Background Review

Thaumas conducted a background review of the current operating conditions, fish passage facilities at Ruth Falls, and fish swimming abilities and behaviour for the species present at the site. Thaumas found that the Ruth Falls concrete fishway currently passes fish well, based on the modelling and observations, and does not need any modification. Currently, the normal operating conditions of the dam provide approximately 100 cubic feet per second (cfs) of flow to the river below the dam. The licence requirements for the facility requires a minimum fishway flow of 6 cfs, and a minimum louvre flow of 29 cfs. These flows are supplemented by the stoplog leakage providing an additional flow of 65 cfs, for an approximate total flow of 100 cfs. The results of the fish passage background review indicated that these current flow requirements allow satisfactory upstream passage of most fish species; however, the depth over the river's rock sills would need additional flow to provide a water depth of at least 38 cm on the river's rock sills for multi-sea year Salmon passage.

The current operating licence also requires 10 or more supplemental flows from June 15 to July 15 and September 26 to November 30 of greater than 50 cfs overnight for a minimum of 12 hours, and nightly when Atlantic Salmon are present. The location of this release

[1] Open-source Field Operation and Manipulation is a 3D Computational Fluid Dynamics model.

must be immediately below the dam. The supplemental flow events are intended to complement significant high flow events (i.e., ≥ 24 mm of rain in 24 hours) and to attract Atlantic Salmon to migrate upstream to the fish ladder by providing migration flow depth over the river's rock sills.

As part of the literature review, Thaumas evaluated the swimming speeds, swimming endurance, orientation to flows, and behaviours of the fish species found at the site that want to migrate past the dam. The species assessed cover the full range of swimming abilities of all fish species present and include:

- Gaspereau (Alewife and Blueback Herring)
- Brook Trout (20 cm Total Length (TL))
- Atlantic Salmon (Salmon Grilse[2], multi-sea-year Salmon)
- American Eels (Elver 6 cm TL, yellow 20 cm TL, yellow 60 cm TL)

A summary of migration times and cues, size range and the assessed sizes is provided in Table 2. Lake species found in the reservoir that do not need to migrate past the dam to complete their life cycles were not specifically evaluated but their abilities fall within the range of the assessed species (i.e., Yellow Perch, Brown Bullhead, White Sucker, Golden Shiner, and Lake Chub).

Table 2: Migration Times and Cues and Size of Selected Fish Species

Selected Species	Migration Times/Needs Past the Dam	Migration Requirements Assessed	Typical Size Range (cm)	Assessed Size (cm)
Gaspereau	March until Fall, upstream Spring Run: Mid-April to Late June; downstream till fall	- temperature - flow velocity - water depth - orientation to flows - behaviour - swimming ability & endurance	20-35	25
Brook Trout	Year Round & Fall spawning	- flow - temperature - water depth - orientation to flows - behaviour - swimming ability & endurance	20-55	20
Atlantic Salmon - Grilse	Spring, Summer, and Fall	- river migration - velocity - temperature	45-60	50

[2] Salmon that have only been to sea for one year

Selected Species	Migration Times/Needs Past the Dam	Migration Requirements Assessed	Typical Size Range (cm)	Assessed Size (cm)
		- water depth - behaviour - swimming ability & endurance		
Atlantic Salmon – Multi-Sea-Year	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	75-105	100[3]
American Eel Elvers	Mid-March - June	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	6	6
American Eel Yellow 20 cm	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	20	20
American Eel Yellow 60 cm	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	60	60

[3] Larger size was assessed to ensure larger salmon can pass.

2.3 Proposed Scenarios Based on 3D Model Results

Using the OpenFOAM model results, Thaumas, evaluated the routes the fish are anticipated to select in the river below the dam based on their swimming abilities and endurance, required water depth, flow direction, and behaviour to plot routes they could use against the river flow velocities and depths before having to rest. Scenarios were evaluated to find the optimal conditions between the interaction of the fishway attraction flow and the gate flow, to attract the fish to the fishway entrance. The revised lower channel section of the fishway, with its new 11 weirs, the louvre flows of 35 cfs, and the upper concrete fishway section, was also assessed. Seven different flow scenarios from the gates (Scenarios 1-7) (Table 3) were assessed. Details of each flow scenario can be found in the detailed report (Section 3D model results; Appendix B). Under all scenarios the fishway flow and louvre flows remain consistent at the minimum required flow. Changes in flows arise from the gates or the required supplementary flows released from the gates[4]. The supplementary flow events were not modelled during the evaluation. Thaumas considered fish passage downstream of the gates to be occurring mainly within the Scenarios 1 and 2. Since the current operating licence requires supplementary flows of 50 cfs, flow events under Scenario 1 would be approximately 150 cfs in total during those events, which would fall in between Scenario 1 at 100 cfs and Scenario 2 at 200 cfs, which as stated above are the flows where fish passage occurs.

Table 3: Flows Scenarios Evaluated and Considered for Fish Passage

Scenario	Fishway Min Flow (cfs)	Louvre Min Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow* (cfs)	Total Flow (cfs)
Current Scenario (for comparison)	6	29	65	50	100-150**
Fishway	6	29	n/a	n/a	35
Scenario 1	6	29	65	n/a	100
Scenario 2	6	29	165	n/a	200
Scenario 3	6	29	925	n/a	960
Scenario 4	6	29	1720	n/a	1755
Scenario 5	6	29	3051	n/a	3086
Scenario 6	6	29	4308	n/a	4343

[4] Proposed Supplementary flows can be defined as 10 or more supplementary flows of 50 cfs that occur from June 15 to July 15 and September 26 to November 30.

Scenario	Fishway Min Flow (cfs)	Louvre Min Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow* (cfs)	Total Flow (cfs)
Scenario 7	6	29	0	n/a	35
Required Supplementary Flow (not modelled but considered)	6	29	65	50	150

Table Notes:
n/a = not applicable
* Supplementary flows can be defined as 10 or more supplementary flows of >50 cfs that occur from June 15 to July 15 and September 26 to November 30 and each night when salmon are detected.
**150 cfs would only occur during supplementary flows.

2.4 Fish Passage Routes Based on 3D Modelling

The swimming ability and water depth requirements, plus a behaviour evaluation for each of the listed species and size classes, was used to evaluate fish passage routes in the river approaches to the dam and the lower channel fishway section for all the modelled flow scenarios using the details in the 3D model.

The Fish Protection Tools for Swim Distance, Velocity, and Water Depths were used to calculate the swim distance and percentage of fish that could physically pass in each scenario through various routes in the river below the dam. The percent potential passage categories based on swimming ability included the following:

- 97.5% - Always pass fish and will sustain fish populations.
- 87.5% - Acceptable fish passage and will sustain fish populations.
- 50% - Satisfactory fish passage, may not be enough passage to sustain the population for some species.
- 12.5% - Poor fish passage, will not sustain fish populations.
- 2.5% - Unlikely passage, will not sustain fish populations.

When the swim distance, based on velocities encountered before access to a resting area, fell between categories, the lower percent category was used. The potential estimated percent passage of the selected fish species is based on the model results for the best route evaluated for fish passage (see Table 4).

Table 4: Estimated % ability of the selected fish species to pass through the river section modeled to the fishway entrance based on the best routes found in the Evaluated Model Scenarios

Scenario	Gaspereau	Brook Trout*	Grilse Salmon	Multi-Sea-Year Salmon	American Eel - Elver	American Eel – Yellow 20 cm	American Eel – Yellow 60 cm
New Lower Section of the Fishway	97.5%	97.5%	97.5%	97.5%	< 2.5%	97.5%	97.5%
Eel Pass	n/a	n/a	n/a	n/a	97%	97%	n/a
Scenario 1	97.5%	50%	87.5%	97.5%	< 2.5%	12.5%	87.5%
Scenario 2	50%	12.5%	50%	97.5%	< 2.5%	< 2.5%	12.5%
Scenario 3	None	None	12.5%	50%	None	None	None
Scenario 4	None	None	None	None	None	None	None
Scenario 5	None	None	None	None	None	None	None
Scenario 6	None	None	None	None	None	None	None
Scenario 7	None	None	None	None	None	None	None

Table Notes:
*Based on 20cm TL trout, the % passage for larger sea run trout may be higher but was not evaluated.
n/a = not applicable

2.5 Proposed Scenario

Based on the evaluation of the OpenFOAM model results, Scenario 1, with 6 cfs from the upper fishway and 29 cfs from the louvres (combining to provide 35cfs at the fishway entrance), and an additional 65cfs from the gates, provides the best conditions for upstream fish passage in the river up to the dam and the best attraction to the fishway entrance for all modelled species.

This scenario provides the best passage for Eels compared to the other proposed scenarios. Elvers are shown as having poor passage in all scenarios due to the scale of the bathymetry and flow modelling for these very small eels, that require only a very shallow flow. It is expected that the elvers and very young yellow stage eels will preform much better at moving up the river than the modelling shows, as they move between rocks on the bottom and along the shallow low velocity flows along the bank.

The pool and weir fishway will pass the larger eels but the velocities and distances in the notches exceed the passage ability of the elvers and smaller eels. For this reason, the addition of an Eel pass is proposed for American Eels to provide passage past the dam for

all upstream migrating age classes of eels. The best location for an American Eel pass is depicted on Figure 1 in Appendix A.

This scenario provides a minimum passage depth over the river's rock sills for the multi-sea-year Salmon so it is likely they will choose not to pass until the water level is deeper during the supplemental flow releases. Under Scenario 1, the 10 or more nighttime supplemental flow releases from June 15 to July 15 and September 26 to November 30, of 50 cfs, as currently provided under the licence, are required and are best released from the three gates. The number and timing of the supplemental flows provides the attraction and water depths over the river's rock sills the Salmon need, while still providing passage for the other species during the day and on the other nights.

Table 5: Proposed Scenario Based on Estimated Fish Passage of Selected Fish Species

Scenario	Fishway Flow (cfs)	Louvre Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow (cfs) (≥10 Events)	Total Flow (cfs)
Scenario 1 with Eel Pass	6	29	65	50	100-150*

Table Notes: *150 cfs would only occur during supplementary flows.

2.6 Closure

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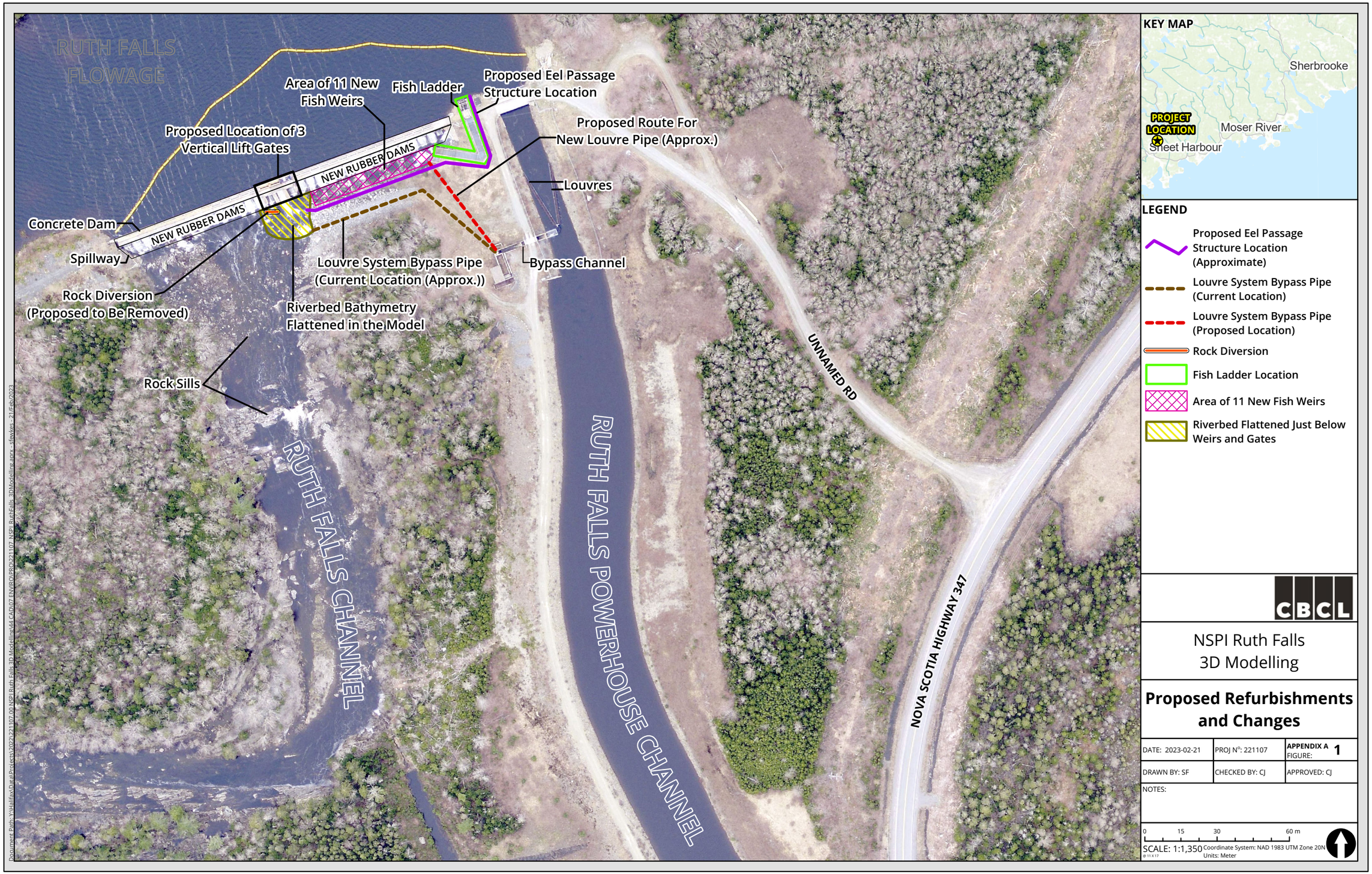
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APPENDIX A

Figure 1


RUTH FALLS FLOWAGE
Area of 11 New Fish Weirs
Fish Ladder
Proposed Eel Passage Structure Location
Proposed Location of 3 Vertical Lift Gates
Proposed Route For New Louvre Pipe (Approx.)
NEW RUBBER DAMS
NEW RUBBER DAMS
Louvres
Concrete Dam
Spillway
Louvre System Bypass Pipe (Current Location (Approx.))
Bypass Channel
Rock Diversion (Proposed to Be Removed)
Riverbed Bathymetry Flattened in the Model
Rock Sills
UNNAMED RD
RUTH FALLS CHANNEL
RUTH FALLS POWERHOUSE CHANNEL
NOVA SCOTIA HIGHWAY 347
KEY MAP
Sherbrooke
PROJECT LOCATION
Moser River
Sheet Harbour
LEGEND
Proposed Eel Passage Structure Location (Approximate)
Louvre System Bypass Pipe (Current Location)
Louvre System Bypass Pipe (Proposed Location)
Rock Diversion
Fish Ladder Location
Area of 11 New Fish Weirs
Riverbed Flattened Just Below Weirs and Gates
CBCL
NSPI Ruth Falls 3D Modelling
Proposed Refurbishments and Changes
DATE: 2023-02-21
PROJ N°: 221107
APPENDIX A FIGURE: 1
DRAWN BY: SF
CHECKED BY: CJ
APPROVED: CJ
NOTES:
0 15 30 60 m
SCALE: 1:1,350 @ 11 x 17
Coordinate System: NAD 1983 UTM Zone 20N
Units: Meter
Document Path: X:\Halifax\Data\Projects\2022\221107.00 NSPI Ruth Falls 3D Modelling\mxd\CAD\07 ENVIRO\PRO\221107 NSPI RuthFalls 3DModelling.aprx - sfewkes - 21/Feb/2023

APPENDIX B

Thaumas Consultants Report

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Ruth Falls Dam – River Fish Passage Modeling

THAUMAS ENVIRONMENTAL CONSULTANTS FEBUARY 10, 2023

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Introduction

Nova Scotia Power Inc has requested 3D hydraulic modeling to be completed at the Ruth Falls dam East River Sheet Harbour for the purpose of assessing post-refurbishment downstream river flow conditions. The main refurbishments to the dam include the installation of vertical lift gates in the center section of the dam which will replace the existing stoplog bays. The change also includes the installation of a new rubber dam along the other stoplog spillways. The modeling is to assess how changes in flow releases from the vertical lift gates and rubber dam would impact fish passage in the river area downstream of the dam and specifically the entrance conditions to the fish ladder. The lower section of the fish ladder is changed to improve fish passage and operate effectively with the changes in the refurbished dam (Thaumas 2023 a, b, c) and these new fishway conditions have also been modeled.

The 3D modeling has been done by CBCL and the results provided in their memo dated January 27th, 2023, titled "NSPI Ruth Falls 3D Modelling Model Results with new fish passage weirs pointing south-west, louvres flow relocated, with no rock flow diversion and bathymetry flattened just below weirs and gates, and flows distributed between the 3 main gates." The model results were also provided in electronic format for further fish passage route computer analysis.

The fish route plots are drawn on plots provided in this CBCL memo.

Ruth Falls Fish Passage Background

Fishway Layout and Operation

The Ruth Falls concrete fishway passes fish well based on the modeling and observations and does not need any modifications. Measurements taken showed some pools had a slightly larger drop than others, but this is due to either plugged drain holes or materials built up in the pool, is well within the proper operating range of depth, and this will be fixed when the fishway is dewatered. The notch width is 1.75 ft, with a typical water depth of 1ft over the crest of the notches. The pool size is 8 ft wide by 10 ft long with a sloping floor, containing a water depth of 2 ft at the upstream end and 3 ft at the downstream end. There is a range of velocities in the notches with the maximum velocity of 1.2m/sec (3.9 ft/sec). The EDF in the pools is 1.8 (ft-lb/s-ft3) and the fishway flow is 6 cfs Velocities are lower at the bottom and especially in the corners of the notch as the water level in the pool below backs the water level up to the crest of the weir for a combination plunging and streaming flow which is better for fish passage. This notch design is very good for fish passage and the operating depth range at or a few inches above 1 ft must be maintained.

Current flow requirements

The current fishway and flows were modeled with the minimum depth over the concrete fishway notches of 1 ft, the minimum fishway flow of 6 cfs, the minimum louvre flow of 29 cfs, and the stoplog leakage and spill of 65 cfs. Some of the stoplog leakage increases the flow in the lower fishway channel section but the amount is not known and was included in the gate release as the new dam will not have any leakage along this part of the dam.

From June 15 to July 15 and September 26 to November 30 there are weekly supplemental flow events when the Ruth Falls headpond elevation is at 33.3 m (109.4ft). These supplemental flow events are scheduled to complement significant inflow events, where a significant inflow event is defined as greater than or equal to 24 mm of rain in a 24-hour period, as measured at the Malay Falls office where a rain gauge is maintained and checked on weekdays. A total of 10 or more supplemental flow events are to occur within these dates. A supplemental flow event is defined as release of water exceeding 50 cfs immediately downstream from the discharge point for a minimum of 12 hours released overnight. These flows are intended to attract salmon out of the tide and to migrate upstream. These supplementary flows are not modeled and would fall between the modeled current flows of a minimum of 6cfs from the fishway, 29 cfs from the louvre outfall, 65cfs from the gates for a total of 100cfs and the modeled flows of 200cfs.

Refurbished Dam Layout and Operation

The plans for the dam refurbishment were used to identify where there will be fish passage issues, where changes may need to be made to the flow requirements and flow patterns to provide good fish passage following the refurbishment.

Changes to the flow pattern

The current fishway flow does not provide significant attraction flows on it own. The stoplog leakage along the fishway channel at the toe of the dam does not add enough flow to significantly improve attraction, and this leakage equivalent can not be provided through the new rubber dam spills. The design of the fishway channel that runs along the toe of the dam was designed for salmon but does not meet the proper design criteria even for them with inline small size notches, pools with various lengths, widths, and depths, plus flow over the lower weirs even in low flow, and excessive pool turbulence when additional flow is added from the spillways to provide entrance attraction. This section of the fishway is poor, so a redesign is needed with additional flow.

The fishway channel weirs will be replaced by 11 new weirs that will handle the fishway flows plus the louvre flows. This provides a good flow of (35cfs) at the fishway entrance to attract fish under various gate releases (Thaumas 2023 a).

The gate flows are released at different depths with the two outside gates releasing at the river surface water level, parallel to the surface, so there are high velocities across the surface in the river but not at depth. The center gate releases deeper in the river and affects velocities right to the bottom where the salmon, trout, and eels swim and at mid water where the migrating gaspereau swim in this depth of water. This flow energy dissipates quickly in the deeper water vs the other two gates that show high velocities across the surface.

To provide a consistent downstream flow and minimize the back eddies, especially in front of the fishway, the flow has been distributed between the three gates. Various combinations were modeled, and the best was 20 cfs from the west gate, 40 cfs from the deeper center gate, and 5

cfs from the east gate closest to the fishway. The rock in front of the west gate will be removed and the bathymetry in front of the fishway has been smoothed.

This combination of flows will need to be checked when operational to get the best balance of flows from the gates as the bathymetry in the area is not very detailed so the model only gives a good indication of the flows and velocities but may not be giving the best combination of gate flows.

The fish passage migration routes are predicted based on the swimming abilities, distance against the velocity, behaviour, and required water depth for Gaspereau, Brook trout, Salmon grilse, multi-sea-year Salmon, and American eels. These species requirements span the upstream passage requirements for all the species that need to migrate up past the dam to complete their life cycle.

The fishway operation is the same under all scenarios. It is only the gate flows that change.

Fish Swimming Performance Background

Loss of habitat connectivity due to built structures is among the greatest threats to freshwater fish populations. Re-establishing river connectivity through fishways can be an effective and cost-efficient method of enhancing the watershed's productivity, but many are unsuccessful due to flow patterns in the tailrace, location of the fishway entrance, poor attraction flows without suitable velocities, and within the fishway due to excessive turbulence due to low pool volumes, high velocities and low water depths in the notches, and poor notch design, that are not suitable for migration and resting for all the species that require passage.

A good understanding of swimming performance and behavioural response to hydraulic conditions for all the species present is needed to assess fish passage and migration conditions in the following locations: the river below to determine where the fish will approach the dam, near the dam face for fish searching for the fishway, and in the immediate area around the fishway entrance for attraction and entrance conditions.

Ideally a fishway including the entrance attraction flow in the river should allow fish to continue their upstream and downstream migration with no delay, added risk of predation, or extra energy expenditure compared to the natural migratory route, and without reducing fitness due to stress, disease, or injury (Castro-Santos, 2009). Evaluation of fish pass effectiveness is largely dependent on determining attraction, for example the percent of migrating fish in the dam tailrace that are able to find the fishway entrance without delay, the proportion of fish that approach the fishway and enter, and the proportion of the fish which successfully ascend/descend and the related efficiencies and length of delay (Castro-Santos, 2009; Bunt, 2012).

It has long been recognised that the success of mitigation measures to maintain freshwater connectivity are dependent on a good understanding of fish swimming ability (Brett, 1964). Water velocities exceeding the capability of the individual species and related fish size will prevent passage, therefore this is the main ecological metric accounted for in fishway design

(Clay, 1995). Fishway length, slope, dimensions of pools, water depths, weir, the design of slots and orifices, and the frequency and size of resting pools all have to be determined based on the resultant water velocity and depth and the ability of fish to move upstream (Clay, 1995; USFWS, 2019). Perhaps most importantly, the fishway entrance and its attraction flow must be located properly with a strong enough flow to be detected by fish within the dam tailrace without excluding weak swimming species (Weaver, 1963).

Literature Background

Despite a long history of research into fish swimming abilities (Katopodis & Williams, The development of fish passage research in a historical context, 2012), fishway attraction and passage efficiencies remain highly variable (Bunt, 2012; Noonan, 2012). As swimming ability depends on fish species and life stage (Katopodis & Gervais, 2012), where there has been historically a bias towards designing fish passes for strong swimming salmonids on their spawning migration, which has been widely blamed for low efficiencies for other species and life stages (Petts, 1989; Mallen-Cooper, 2007; Katopodis and Williams, 2012; Foulds and Lucas, 2013).

The widespread swim chamber methodologies used to quantify swimming ability have also come under recent criticism. Several studies have shown that data obtained in swim chambers can underestimate swimming ability and result in conservative fishway and migration flow velocities, which can be a problem for upstream passage route determination and attraction to fishway entrances. These studies are also limited by the size of fish studied and the water temperature, so swimming ability is often extrapolated from younger life stages but seldom reflect the temperature effects both positive and negative. Oxygen levels in the water are also critical but not reported in most the swimming tests. Also, fish muscle function is related to water temperature (Brett and Glass 1973; Bernatchez 1985) which has a strong influence on both swimming ability and fish behaviour which are not fully accounted for in these studies. (Plaut, 2001; Peake, 2004a; Peake and Farrell, 2006; Tudorache *et al.*, 2011; Castro-Santos and Haro, 2006). It has also been shown that the habitat the fish is reared in, fast flowing stream vs a lake or pond, affects their swimming ability and endurance (Jones P. E. 2020).

Basing designs on swimming ability alone has resulted in a lack of consideration of a fish's behavioural response to the hydraulic conditions they experience, which may improve, prevent, limit, or delay passage (Castro- Santos and Haro, 2008; Castro-Santos, T. (2005; Enders *et al.*, 2017; Rice *et al.*, 2010; Williams *et al.*, 2012). Fish behaviour including preferred migration velocities they swim against and swimming depth; orientation to the bed and banks; and the use of currents and turbulence patterns they use to ride upstream reducing energy expenditure while for some species, maintaining a preferred ground speed, all need to be considered but not well studied if at all for the species present at this site.

The Biology of Fish Swimming Abilities

Fish swimming behaviour uses different speeds that have been classified into four modes based on the muscles activated and the relationship between speed and endurance. The four modes are sprint, burst, prolonged and sustained swimming (Beamish, 1978; Nelson *et al*., 2002).

Sustained speed (also known as continuous or cruising) can be maintained for long periods, primarily using energy derived from aerobic processes to power red muscles (Brett *et al*., 1958), and is used for holding, resting, and routine movements. Water velocities in structures and rivers below a fish's maximum sustained speed are passable regardless of the distance covered. This is often recommended for very long culverts, fishway pools, at the approach to fish screens, and for resting areas (Peake *et al.*, 1997). During laboratory tests a time limit of 200 minutes (recommended by Brett, 1967) is often used in endurance tests, after which time it is assumed, fish are swimming at sustained speeds. However, 60, 100, and 120-minute-long trials are also common (McDonald *et al*., 1998).

Prolonged swimming uses both aerobic and anaerobic processes to power red and white muscle fibres, with an increasing contribution from the white muscle at higher velocities. Prolonged speeds are those resulting in fatigue following a swimming duration between 20 seconds to 200 minutes (Brett, 1964). These intermediate speeds are regularly used during ascent of fishways and culverts (Bunt *et al.*, 1999). Swimming at prolonged speeds is also reflected in a gait change for many fish species, whereby more white muscle fibres are used, and anaerobic processes must be increased (Peake and Farrell, 2004). The prolonged speed that fish can swim at decreases rapidly as the time increases, so the velocity that fish must swim against and the time to make it through the river flows or fishway before reaching a resting area, must both be considered. Also, the condition of the fish, how fatigued they are approaching the fishway, and the availability and size of resting areas upon exiting must be considered.

Burst swimming is powered by anaerobic metabolic processes and contraction of white muscle fibres. This high-speed swimming can only be maintained for a short time before a rest period is required for glycogen resynthesis and removal of muscle lactate (Wilson and Egginton, 1994). Burst speeds are usually defined as speeds that result in fatigue within 20 seconds (Beamish, 1978). Short duration, high swimming speeds are essential for predator escape, prey capture and passage through short velocity barriers. Passage success at sluices, pool and weir, vertical slot, and orifice fishways is determined by burst swimming ability (Russon *et al.*, 2011).

Sprint swimming refers to very high speeds that are maintained for only 1 to 5 seconds (Nelson *et al*., 2002, Castro-Santos, 2005). Sprint speed can be used for very short high velocity sites but is normally just used for predator escape and is not recommended for fish migration design, even in very short sections of flow.

Prolonged, burst, and sprint swim speeds can be combined with a glide behaviour. A burst swim speed in a high velocity flow so that the fish is moving faster than its usual ground speed can be followed by a glide, where they continue upstream, but their ground speed slows until the next burst and glide movement. This is used in turbulent flows, in streams with a stepped pool structure, or in baffled fishways where the velocity is high at a baffle and lower or even moving upstream above it.

Critical swimming speed (U_{crit}) is a special category of prolonged swimming first introduced by Brett (1964). The protocol is carried out on fish enclosed in a swim tunnel respirometer, during which the fish are forced to swim against a particular water velocity for a set time interval. Water velocity (and therefore swimming speed) is then increased by a set increment until the individual fails to swim for an entire time interval. Critical swimming speed is calculated as the sum of the ultimate velocity attained and a fraction of the velocity increment proportional to the time spent swimming at the final velocity relative to the full-time interval (Hammer 1995). Although U_{crit} has often been used to estimate maximum sustained speed, it has also been defined as the highest swimming speed that a fish can maintain for a period equal in magnitude to the time interval used in the test (Peake et al. 1997c). Time intervals as low as 2 min, and as high as 60 min are used in these trials, although values greater than 20 min are most common. Critical swimming speed separates the sustained and prolonged performance swim speeds, and it is therefore considered the best available metric for establishing water velocity criteria for fish passage.

The time limits commonly applied to define swimming modes during performance studies (i.e., sprint < 5 sec, burst < 20 sec, prolonged > 20 sec and < 200 sec, sustained > 200 min;) are somewhat arbitrary values. The transitions do not occur at discrete time intervals and are variable between species. Some species move seamlessly between the different modes while others show definite changes in swim speed and gait.

As swimming speed increases the energy derived from anaerobic processes increases. The use of anaerobic energy stores leads to physiological effects, which must be reversed following exercise, through increased oxygen consumption (known as postexercise oxygen consumption). The anaerobic cost of swimming can therefore be studied by evaluating EPOC (excess post-exercise oxygen consumption) and the time needed for oxygen consumption to return to resting levels (Peake and Farrell, 2004). This recovery time after fatigue can be one or more hours (Lee *et al*., 2003; Reidy *et al*., 1995), therefore, fish swimming endurance at a test velocity can also depend on previous exercise intensity (Jain and Farrell, 2003). The migration conditions in the river below the dam needs to be considered as the fish approach the dam, the time spent searching for the fishway entrance, and where they have been able to find suitable resting areas to rest and recover from this exercise before using the fishway.

Water velocities exceeding the fish swimming capability will prevent passage, therefore it is the main ecological metric accounted for in fish pass design guidance (Clay, 1995, FAO and DVWK, 2002). Also, the attraction flow must be strong enough to be detected by fish within the barrier's tailrace flows without excluding weak swimming species (Weaver, 1963). However, other factors such as water temperature, fish condition including both how well fed they are and if they have been recently fatigued, body condition, age, behaviour with respect to the reason for migration such as spawning, feeding, or habitat selection, and physical parameters such as the orientation to velocities, shoreline, substrate, swimming depth, reaction to turbulence both positive and negative, tidal levels, current patterns, and light conditions all are important factors affecting fish swimming ability and behaviour.

Fish Swimming Behavior

Fish have five swim behaviours they use to try to maintain their ground speed while migrating upstream. The five modes can be combined so that the fish use the least effort possible.

Mode one is to swim against a preferred migration velocity that is, for example, approximately 1 to 1.5 body lengths per second for gaspereau, which would be 0.30 m/sec to 0.4 m/sec. This is a velocity range used by most species but varies a bit from species to species. It is a bit higher for the larger salmonids, and slower for most benthic species and smaller species.

Mode two is to use upstream currents along the side of faster flows, both swimming and riding up on them to maintain a preferred ground speed. If the flow is faster than their preferred ground speed, they tend to turn and face into the current instead of riding on it. This is an issue in back eddy flows and in downstream passage locations.

Mode three is to use the vortices, which are small clockwise and counter-clockwise eddies found along both sides of a faster flow moving through slower flowing water. In Karman Gate (Liao 2017) swim behaviour, fish swim along vortices of approximately 1 to 1.5 body lengths, using the side of the vortices that are headed upstream to make upstream migration easier, but they will use smaller and larger horizontal vortices as well. Fish can be seen swimming in these circulation patterns along the side of faster currents.

Mode four is maintaining their preferred ground speed and adjusting their swimming speed along the route as the currents change. To do this they will use sustained, prolonged, burst and glide, burst, and even sprint speeds if needed, but anything more than low prolonged speed, normally used for migration, shortens the distance they can swim before resting.

Mode five is to school. In this mode they create their own turbulence to aid in swimming. The lead fish keep changing but they are still orienting to the flow and physical parameters.

For mode one, when fish are swimming against a constant velocity, a maximum distance needed between resting areas can be estimated. The estimate is conservative as all the other modes save energy and allow the fish to swim further before resting. Fish can switch easily between modes and combine modes as the conditions along the route change. The swim ability modeling has been conservative.

As fish are migrating upstream or downstream, they orient to physical features, such as the banks, the bottom, the water surface, as well as light intensity and direction using sight and adjusting to currents or turbulence using the lateral line. They also orient to chemical cues such as water temperature, salinity, acidity, and the chemical ion makeup that distinguishes individual rivers due to the geology and recent land use using their olfactory and lateral line senses.

Schooling Behavior

Schools of fish adjust in numbers of fish and shape, both in width and depth, to match conditions. This often puts fish deeper and shallower than the depths noted below. The schools are a predator avoidance technique as well as for swimming assistance, so they can be very large and come in a continuous stream when the fish numbers are high. As an example, early and late in the migration run the numbers are small and the upstream movement for gaspereau occurs in the early morning and at dusk in otherwise ideal route conditions (Alcott 2021). Schools at this time can be as small as 3 or 4 fish. When they are running strong, the highest rate of passage or greatest numbers of fish are migrating in the afternoon to early evening. The fishing weirs use the gaspereau's orientation to the physical stream profile and flows to guide them to the dipping station location (Peake 2008) using a guide wall, which is a simulated diagonal riffle creating shallower and faster flow that the fish avoid and lead along to the upstream end. Individual species behaviours will be noted below.

Passage Depth

The next thing to consider is the depth the fish are swimming at, as the flow velocity and patterns change with depth and fish also need a minimum depth for safe passage, which for most fish is a minimum of 1/3 the body length, although a water depth of two body depths is often recommended. Alewife, for example, move up and down in the water column with the light level. Typically, in deep water, if they are not crowded, they swim with their dorsal fins at the secchi disc depth (the point where a white object disappears), which changes with the light level. So, they will be deeper in the sunlight and shallower in the early morning, evening, and at night. In shallow water they swim at mid water. Other species such as trout and salmon orient to the bottom in shallow water and eels always orient to the bottom no matter what the depth is, in rivers, lakes, and estuaries. This behaviour is likely due to a combination of a need for cover from predators and the light level to see for orientation. However, they will all make short term movements into other water depths.

All species, if they are crowded by a migration restriction, such as approaching an obstruction like a dam, can fill the water column. If there are not suitable holding or resting areas providing enough space for each fish, some will fall back. Also, in a crowded environment fish have trouble orienting to flows as they are blocked by other fish. This over crowding often happens in fishway pools where they are trying to rest or orient to the flows, or when there is a change in light levels, all creating a passage barrier which should be avoided.

Upstream and downstream fish passage routes are complex to plot as the fish behaviour and response to conditions is variable, but general routes and bounds can be established.

Fish Swimming Speeds and Behaviours by Species

Based on the available literature and fish swim speed models, criteria have been developed to guide the assessment of fish passage in the river and the lower fishway. The fish size selected is the mean size of the smallest spawning adults and the velocity and endurance are set for the fish's ability to successfully pass 97.5% of the time for a fish of this size. This means excellent passage potential for larger individuals and lower passage potential for the smallest individuals in a population.

Gaspereau

This group includes Alewife and Blueback Herring. Adult Alewife are usually 25-35 cm, and Blueback Herring are often 20 cm (Scott & Scott, 1988). They are present in the tide from late March until Fall. They begin running into the river mid to late April, when river water temperatures are above 9°C, and end in late June (Jessop 2003). They are expected to run at dawn and dusk in the early and late run times and peak in the late afternoon early evening during the main run, but it can be any time of the day (Alcott 2021). Timing is mainly driven by water temperature. They use visual and lateral line cues to orient upstream in water with all velocities less than 0.30 m/sec and in turbulent or back eddy flows.

For their size gaspereau are better swimmers for short distances than the salmonids but do have issues with currents hitting them from the side that the salmonids don't, something we must watch for where the currents come a right angle, or the side turbulence/circulation pattern velocity is high. The model does not show these small circulation patterns but clearly shows the flows from the fishway and gates. While they can swim a bit faster than salmonids of the same size, they have less endurance so the distance they can swim against a current is less.

Table 1: Swimming Speeds by Time for 250 mm gaspereau in m/sec (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 + seconds
97.5	3.19	1.82	0.723	0.614	0.465	0.299
87.5	3.49	2.00	0.792	0.673	0.529	0.327
50.0	3.97	2.27	0.901	0.765	0.579	0.332

Brook trout

Sea trout that overwintered in the estuary will follow eels, and gaspereau into the river on feeding runs and will go back and forth following the food supply, staying in the estuary when the river temperature is >20°C. There is a spawning run in the fall following the fall rains with spawning in mid October to mid November depending on flows and water temperatures. They can move from the estuary to freshwater several times a year and may stay in the freshwater. Adults range in size from 20cm to 55cm, with a mean length of 35 cm (MacMillan & Madden, 2007).

Table 2: Swimming Speeds by Time for 350 mm Trout in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.64	1.20	0.672	0.608	0.511	0.388
87.5	2.22	1.57	0.883	0.789	0.671	0.510
50.0	3.27	2.31	1.300	1.18	0.988	0.751

There are also resident Brook trout that are generally smaller and may also need to pass upstream at the dam for spawning or feeding runs. The criteria for the smaller resident trout are the same as for the generally larger sea run Brook trout but this assessment focuses on the smaller trout averaging 20 cm in length.

The length assessed for swimming capabilities was 200 mm. Trout rest in velocities of < 0.2 m/sec and hold in velocities of 0.2 - 0.3 m/sec (Tudorache 2011). Their preferred migration velocity is 0.3 to 0.4 m/sec, which 20 cm long trout can swim against for 16 m (Katopodis 2016).

Table 3: Swimming Speeds by Time for 200 mm long Trout in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.19	0.843	0.474	0.428	0.360	0.274
87.5	1.57	1.11	0.623	0.563	0.473	0.359
50.0	2.31	1.63	0.917	0.828	0.697	0.529

Atlantic salmon

Salmon may come out of the tide at any time of the year if the water is under 20°C and there is a good flow. There are spring, summer, and fall runs, with the latter being the spawning run. They wait in the tide until water temperatures are generally between 9°C and 20°C and flows are high enough to provide a water depth > 2 body depths in shallow reaches of the river. Normally they will move upstream at dawn and dusk, but it can be at any time of day. Spawning runs can continue till freeze up or late December.

Salmon use freshwater cues to migrate upstream and strongly orient to the flow. Salmon will need velocities under 0.2 m/sec for resting and can hold oriented to the flow in velocities of 0.2 – 0.4 m/sec.

Salmon are strong swimmers and can go long distances between resting areas. The ability of Atlantic salmon to swim for long distances against relatively strong currents, makes it easy for them to go up the fishways. It also gives them an advantage navigating the eddies and fast flows present in the tailwater. They have a good chance of navigating the currents, finding the fishway, and swimming up it before needing to rest.

Grilse

Atlantic salmon Grilse range in size from 450 mm to 600 mm in length and 500 mm was used for assessment. They have a preferred migration velocity 0.4 to 0.5 m/sec, which they can swim against for 110 m (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016).

Table 4: Swimming Speeds by Time for 500 mm Salmon Grilse in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	2.11	1.49	0.84	0.759	0.639	0.458
87.5	2.78	1.96	1.10	0.998	0.839	0.637
50.0	4.09	2.89	1.63	1.47	1.24	0.938

Atlantic salmon multi sea year

The larger multi sea year Atlantic salmon are 850 mm to 1050 mm long (Reid 2012). The length assessed for swimming ability was 1000 mm. They have a preferred migration velocity of 0.4 - 0.55 m/sec, which they can swim against for 340 m (Katopodis 2016).

Sufficient water depth over the bedrock sills in this river is an issue for multi-year Salmon at Ruth Falls, especially in the lower flows.

Table 5: Swimming Speeds by Time for 1000 mm Salmon Grilse in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	3.26	2.30	1.30	1.17	0.985	0.78
87.5	4.29	3.03	1.70	1.54	1.29	0.983
50.0	6.30	4.46	2.51	2.27	1.90	1.45

American Eels

American eels live in both the estuary and the freshwater. Access to the freshwater is needed as most of the females develop in freshwater habitats. Some of the eels will move in and out of the estuary several times during their life.

The eel tiles that are proposed to be used contain two different sizes of pegs. The smaller pegs have a space of 17.5 mm between them and will pass elver and yellow stage eels up to 25 cm long. The larger pegs have a space of 29.6 mm between them and can accommodate eels up to around 44 cm long, based on a body depth to length ratio of 0.068 cm (Berry & Escott Ltd., 2020). The larger eels are capable of swimming up through the main fishway.

Yellow stage eels and silver stage eels and lamprey require downstream passage. They travel on the bottom with occasional movements up the water column.

American eel elvers 60 mm long

Elvers will begin their upstream migration in mid March. They will use the eel pass. They have a swimming ability of 0.11 m/sec for 60 sec, which results in very short distances between resting areas. They tend to use upstream currents along the edges of rivers to aid passage.

Table 6: Swimming Speeds by Time for 60 mm long American Eel Elvers in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.367	0.221	0.0948	0.0817	0.0634	0.0423
87.5	0.456	0.274	0.118	0.102	0.0787	0.0526
50.0	0.621	0.373	0.160	0.138	0.107	0.0716

Yellow stage American eel (200 mm)

Yellow stage American eels do not move around until water temperatures are above 12°C. The eel pass has a section suitable for the passage of yellow stage eels under 45 cm long. 20 cm long eels have swimming speeds of 0.35 m/sec for 60 sec and they travel very short distances at a time.

Table 7: Swimming Speeds by Time for200 mm long Yellow Stage American Eels in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.836	0.503	0.216	0.186	0.144	0.0964
87.5	1.04	0.625	0.268	0.231	0.179	0.120
50.0	1.41	0.850	0.365	0.315	0.244	0.163

Yellow stage American eel (600 mm)

These eels will be too big for the eel pass, but they do have a strong swimming ability 0.87 m/sec for 60 sec and modeling shows they can pass though the fishway near the bottom surface or along the edge of the notches. They prefer to travel short distances at a time which would be limiting. They also use the drain hole orifices at the bottom of the baffles.

Table 8:Swimming Speeds by Time for 600 mm long Yellow Stage American Eels in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.77	1.07	0.457	0.394	0.306	0.204
87.5	2.2	1.32	0.568	0.490	0.380	0.254
50.0	3.0	1.80	0.774	0.667	0.517	0.345

Lake Species

The following species were found in the reservoir above the dam and do not need to pass to complete their lifecycles.

Yellow Perch

Yellow perch are freshwater fish but may be found in brackish water up to 10 ppt. they use a wide range of habitats from large lakes to ponds to slow moving sections of rivers or the upper estuaries. They are most abundant in open water of lakes with moderate amount of vegetation.

They spawn in the spring in from mid April to early May along the shallow shoreline of lakes or in the tributaries. They live up to 9 years and are 200 mm to 300 mm when caught by angers (Scott & Crossman, 1973).

Brown Bullhead

The Brown bullhead is a freshwater fish that lives in lakes and ponds but may venture into brackish water. They spawn in late spring or early summer in shallow water along the shoreline of lakes and ponds. Most adults are between 250 mm to 300 mm long (Scott & Crossman, 1973).

White Sucker

White suckers generally live in warm, shallow lakes and tributary rivers of larger lakes. They are bottom feeders and have been known to live for up to 15 years, reaching sexual maturity at age 5-8. In the spring, they begin migrating to spawn when daily water temperatures stay above 10°C. They often move out of the lake to spawn in tributary streams with shallow water and gravel bottoms, but they sometimes spawn on the lake margins. They move off the spawning

grounds 10-14 days later. The young begin to migrate into the lake about a month after spawning beginning when they are around 15 mm in length (Scott & Crossman, 1973).

The sizes of White suckers are difficult to determine as they grow at different rates depending on sex and location. A 200 mm average size was used for the assessment which is typical of the spawners seen on the eastern shore.

White suckers do not need to pass by the dam to complete their lifecycle, but they are strong enough swimmers that they should be able to get up the fishway if they choose to or accidentally go down the downstream bypass.

Table 9: Swimming Speeds by Time for 200 mm long White Sucker in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.19	0.843	0.474	0.428	0.360	0.274
87.5	1.57	1.11	0.623	0.563	0.473	0.359
50.0	2.31	1.63	0.917	0.828	0.697	0.529

Minnow Species

Minnow species do not need to pass the dam to complete their lifecycle. Both minnow species identified were found in the reservoir above the dam and will spawn on the margins of the lake.

Golden Shiner

The Golden shiner, (*Notemigonus crysoleucas)*, has an average length of 76 – 127 mm and has a golden colouration. It is a lake fish, and moves in schools in weedy, shallow areas. Spawning occurs when water temperatures reach 20°C over filamentous algae or aquatic vegetation (Scott & Crossman, 1973).

Lake Chub

Lake chub (Couesius plumbeus) are a freshwater fish found in lakes, ponds, and streams. They move from the lakes to streams in early spring to spawn usually in April. They are a large minnow that can reach 150mm in length and even larger if they have been in brackish water. Average length of an adult is 10 cm (Scott & Crossman, 1973).

Table 10: Swimming Speeds by Time for a 100 mm long minnow in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.773	0.546	0.307	0.278	0.234	0.177

87.5	1.02	0.718	0.404	0.365	0.307	0.233
50.0	1.49	1.06	0.594	0.537	0.452	0.343

Summary of Passage Metrics for all Species

Figure 1: Swim distance vs. water velocity for the species present shows how far each of the species requiring passage below the dam can swim over a range of water velocities (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020). For this graph average fish sizes were used and swim distances are those at which 97.5% of fish of that size will be able to achieve.

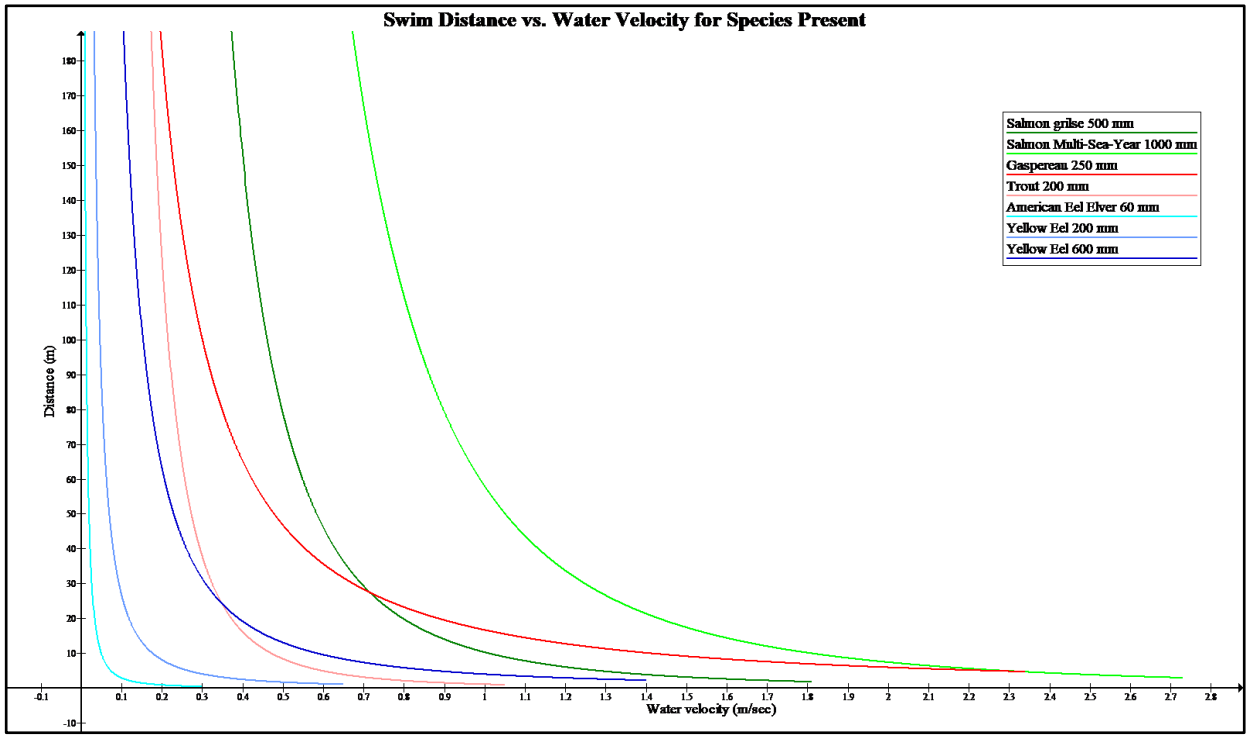


Figure 1: Swim distance vs. water velocity for the species present at 97.5% passage

Table *11* shows the same information for swim distance vs. velocity as in written form above, with categories for distances matching those from the modeling. The table also shows the body depth of the fish and the minimum depth required for passage, based on the largest of each species. The body depth is taken from US Fish Passage Engineering Design Criteria (2019), but the minimum passage depth was taken as 1/3 of the length of the largest fish size to accommodate extended dorsal and ventral fins. Eels are the exception to this, as they have a small body depth for their length. Ideally, the eels would have three times the body depth for safe, comfortable passage (US Fish and Wildlife Service, 2019).

Table 11: Distance before resting for each modeling category at 97.5% passage (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020)

Species	Gaspereau	Trout	Salmon Grilse	Salmon Multi-Sea-Year	American Eel Elver	Yellow Stage American Eel	Yellow Stage American Eel
Average Size (cm)	25	20	50	100	6	20	60
max size (cm)	35	55	60	105	7	45	100
Max body depth (cm)	8	14	13	23	0.5	3	7
Depth required for passage (cm)	12	18	20	35	0.5	3	7
Velocity range (m/sec)	Distance before resting (m)						
0 – 0.15	Resting	Resting	Resting	Resting	1 – 3	15 – 30	Resting
0.15 – 0.3	Holding oriented to flow	Holding oriented to flow	Holding oriented to flow	Holding oriented to flow	< 1	5 – 15	30 – 100
0.3 – 0.35	80 – 100	25 - 40	225 – 355	>620	No passage	3 – 5	25 – 30
0.35 – 0.4	65 – 80	15 – 25	150 – 225	>620	No passage	3	20 – 25
0.4 – 0.45	55 – 65	10 – 15	110 – 150	>620	No passage	2	15 – 20
0.45 – 0.55	40 – 55	6 – 10	60 – 110	340 – 620	No passage	1	10 – 15
0.55 – 0.72	25 – 40	3 – 6	25 – 60	155 – 340	No passage	< 1	7 – 10
0.72 – 1.1	15 – 25	< 3	10 - 25	45 – 155	No passage	No passage	3 – 7
1.1 - 2	5 – 15	No passage	1.5 - 10	7 – 45	No passage	No passage	No passage
>2	Limited passage	No passage	No passage	Limited passage	No passage	No passage	No passage

3D model results

NSPI requested 3D hydraulic modeling to be completed at the Ruth Falls dam for the purpose of assessing post dam refurbishment downstream flow patterns and velocities as they relate to fish passage. The main refurbishments include the installation of vertical lift gates in the center 3 gate section of the dam which will replace the existing stoplog bays and the installation of new rubber dams along the spillways adjacent to the lower section of the fishway that runs along the toe of the dam. The changes will affect the fishway operation and entrance conditions including the river routes to the fishway for migrating fish.

The diagram of velocities 20 cm from the bottom was used to display the fish migration routes below the dam, as this route best represents the velocities that fish will be traveling though. These velocities are most representative of the mid water velocities that gaspereau will be swimming through and they are the velocities that trout and salmon will be moving through along the bottom. Eels will be traveling directly on the bottom and will find areas with slower moving water as they have a small body depth so can move between cobbles and small boulders on the bottom.

All the fish swimming abilities and behaviours described above have been taken into consideration in determining the migration routes.

Fish migration routes were determined directly from the computer model using all the available models to get a detailed picture of the routes. This included point depths, velocities, and flow direction along the routes. These detailed 3D assessments were transposed on the diagrams.

There are two shallow bedrock sills that fish must pass over to get to the area below the dam. These sills have shallow fast flows that present passage problems for weaker swimming fish, especially as the flows increase below the dam. The first sill is located at around 30 m on the Y Axis of the diagrams and the second sill is located between 65 m and 75 m. Generally, the river flows are very shallow and fast over the sills and become faster as the flow increases. Depth in the dark blue areas is up to 1 m deep and the depth over the rock outcrop sills is shallow except for the one channel near the left bank (looking downstream) which is used by most fish for migration due to both a suitable depth and a passable velocity. The most downstream rock sill shown in the plots may have better passage opportunities than it appears because the velocities and depth here may not be correct since the model's bathymetry is cut off on both banks and the lower end of all models does not have the effect of the downstream bathymetry backwater effect. Further downstream in the river there are several other bedrock sills. Passage over these sills is unknown, so the percentage of fish attempting passage from the mouth of the river that reach the dam is unknown.

The Fish Protection Tools Swim Distance and Velocity tool was used to calculate distances and percentage of fish that have the ability pass along certain routes (Di Rocco, 2020; Katopodis C. a., 2016). The estimates are given in levels for 97.5%, 87.5%, 50%, 12.5%, and 2.5% passage. When swim distance was between levels, the lower passage percentage was used. Passage rates are very conservative, as fish may use other swim modes to decrease energy expenditure, or they may find small eddies behind and between boulders.

The Fishway Flows

The upper, concrete section of the fishway has been designed to operate with 1 ft of water over the crests of the notches with the water level in the pool below equal to the elevation of the notch crest. The velocity in the notches ranges from 1.0 ft/sec (0.3 m/sec) at the bottom up to 4 ft/sec (1.2 m/sec) at mid to surface depth. These velocities are passable by all the species needing to pass using burst or sprint speed over this short distance. Part of the reason for the lower velocities at the bottom is that the water level in the pool below the notch is backed up to at least the level of the notch crest above it when operating with at least 1 ft of water depth. When the notch depth is higher the velocities at the bottom decrease as the notch is further backwatered.

The flow depth in the channel portion of the fishway is now designed to carry 35 cfs at a depth of 1 ft and 9 inches in the notches, backwatered by 1 ft, for drops of 9 inches. This provides easier passage for fish, with a range of velocities in the notches from 1 ft/sec to 6 ft/sec (0.3 – 1.8 m/sec). The pools have good resting areas and a range of velocities for migration.

Fishway attraction velocities extend from the surface to the bottom in the range most fish seek for upstream migration and this is combined with a strong flow along the side of the gate flows to orient fish toward the fishway.



Figure 2: Fishway and entrance area velocities

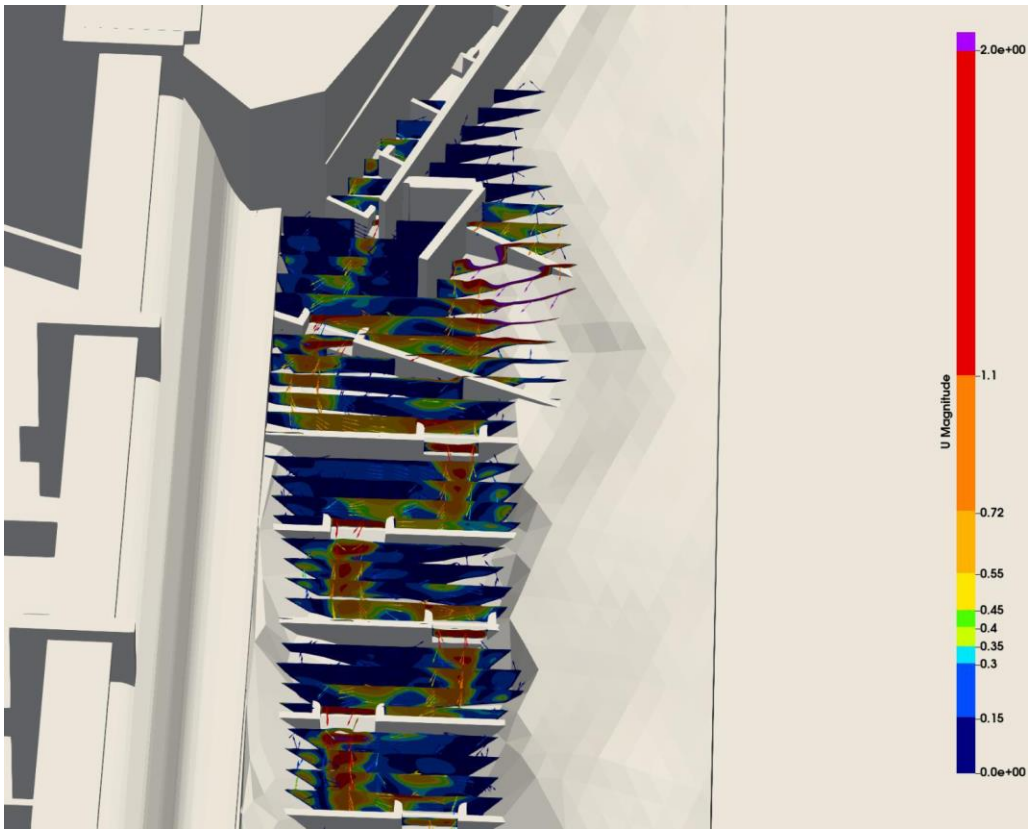


Figure 3: Cross section view of the fishway flows

The velocities in the notches of the concrete fishway are shown in Figures 4 and 5. The maximum velocity shows in the red but is just a maximum of 1.2 m/sec. In the pools, faded out in these screen shots you see the resting areas in the blue and a current through the pool for the fish to follow notch to notch. These velocities are within the swimming ability of all the migratory species with the exception of the smallest eels.

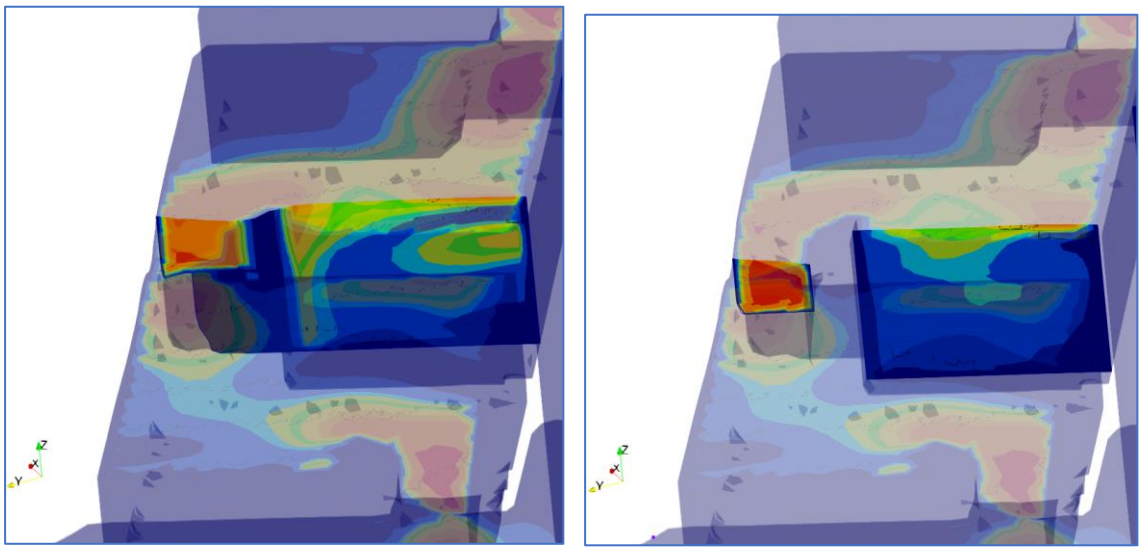


Figure 4: Velocity at top of notch (left); velocity at 23 cm down (right) showing the max notch velocity.

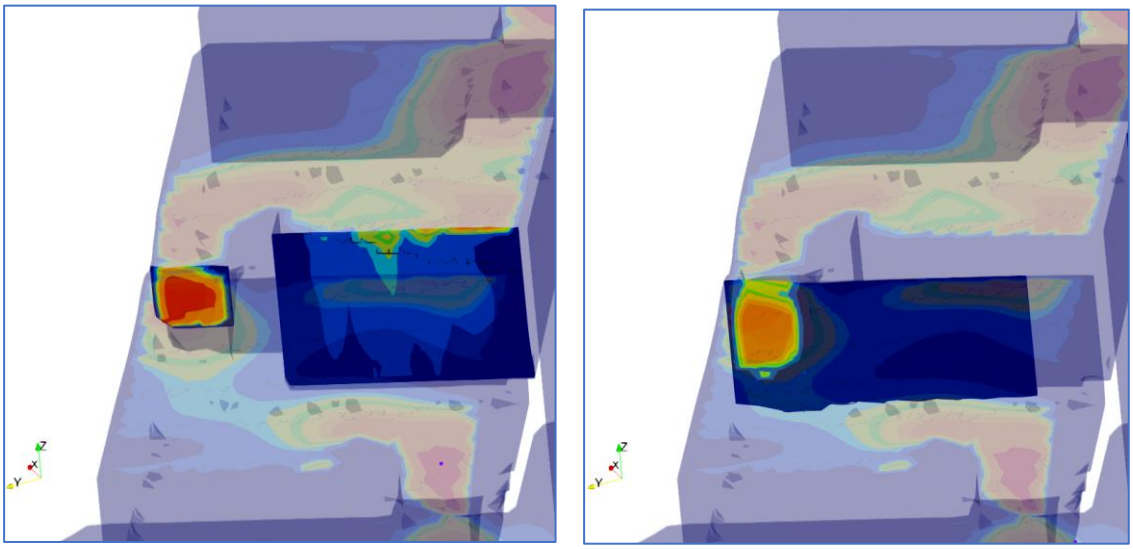


Figure 5: Velocity 46 cm down in notch (left); velocity as notch enters the pool (right)

The velocities in the notches of the channel fishway, shown in Figure 6, with a flow of 35 cfs have a similar pattern to the other fishway but with velocities in the cross sections mid way along the notch range from 1.8 m/sec in the center to 0.8 m/sec along the sides and bottom. Providing good fish passage for all the migratory species except the smallest eels. There are large resting areas and a flow pattern through the pools that has migration velocities.

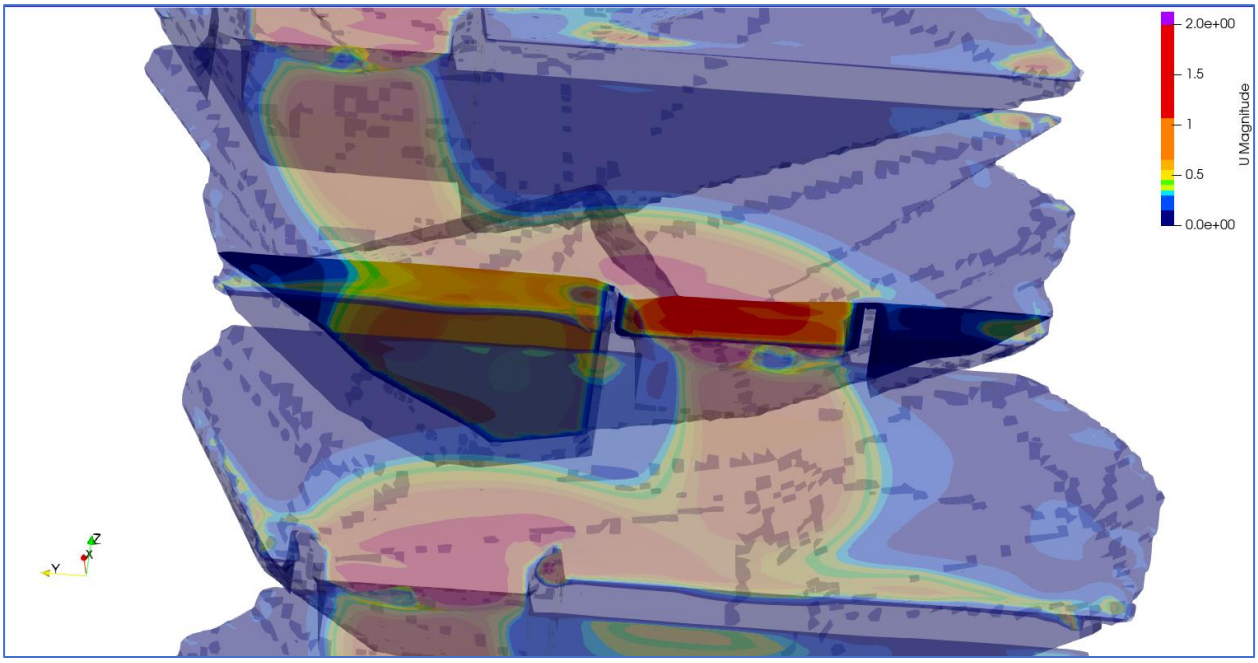


Figure 6 The velocities in the notches of the channel fishway section with 35 cfs flow.

S1: 6 cfs from the fishway, 29 cfs from the louvres outfall, 65 cfs from the gates

This flow scenario has the best passage for gaspereau, trout, grilse, and eels, but has barely enough water depth for the larger salmon.

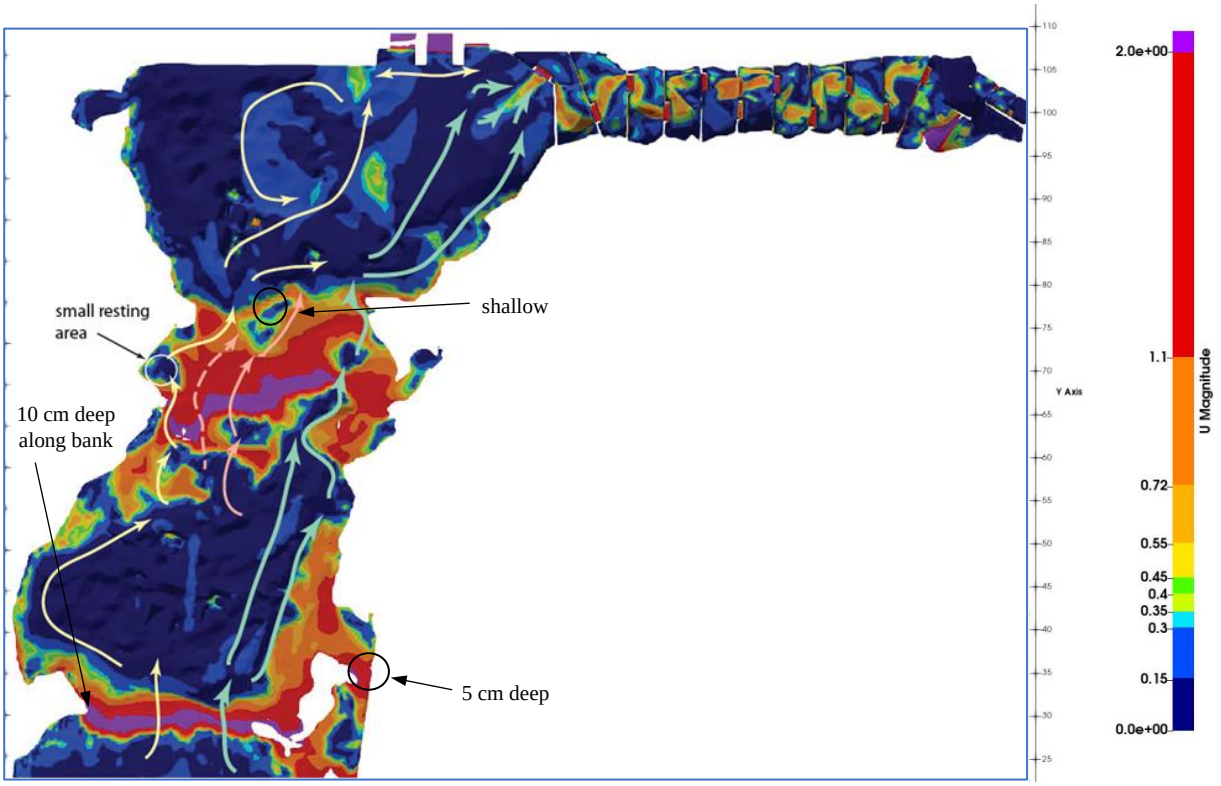


Figure 7: S1 routes for gaspereau, trout, and grilse on velocities 0.2 m from the bottom

Gaspereau

The route marked with green arrows follows the main thalweg of the river and will be the most used route for gaspereau as it is the easiest. Using this route fish can avoid velocities greater than 2 m/sec over the first sill by traveling through the deepest channel, where the water is around 30 cm deep, and the velocities are the slowest at depth in this cross-section. Since the distance to get over the sill is less than 5 m 97.5% of gaspereau should make it over. Then they can rest before attempting to go over the second sill, which has lower velocities, under 1.1 m/sec, but the distance fish must swim before resting is much longer, around 20 m. This is within the swimming ability of gaspereau.

The yellow route is the next best route, but limited numbers of gaspereau will be able to use it due to the small size of the resting area on the right bank. Using this resting area, the fish won't have to go more than 10 m in dark orange and reds, which is well within the swimming abilities for the distance involved of 97.5% of gaspereau. Once the resting area fills up fish may fall back.

The route marked with orange arrows is at the edge of how far gaspereau can go without resting. There is 20 m of fast water, with velocities ranging from 0.55 m/sec – 2.0 m/s. Only the strongest fish will choose this route, passing 50% of 250 mm gaspereau. Some may fall back and choose another route.

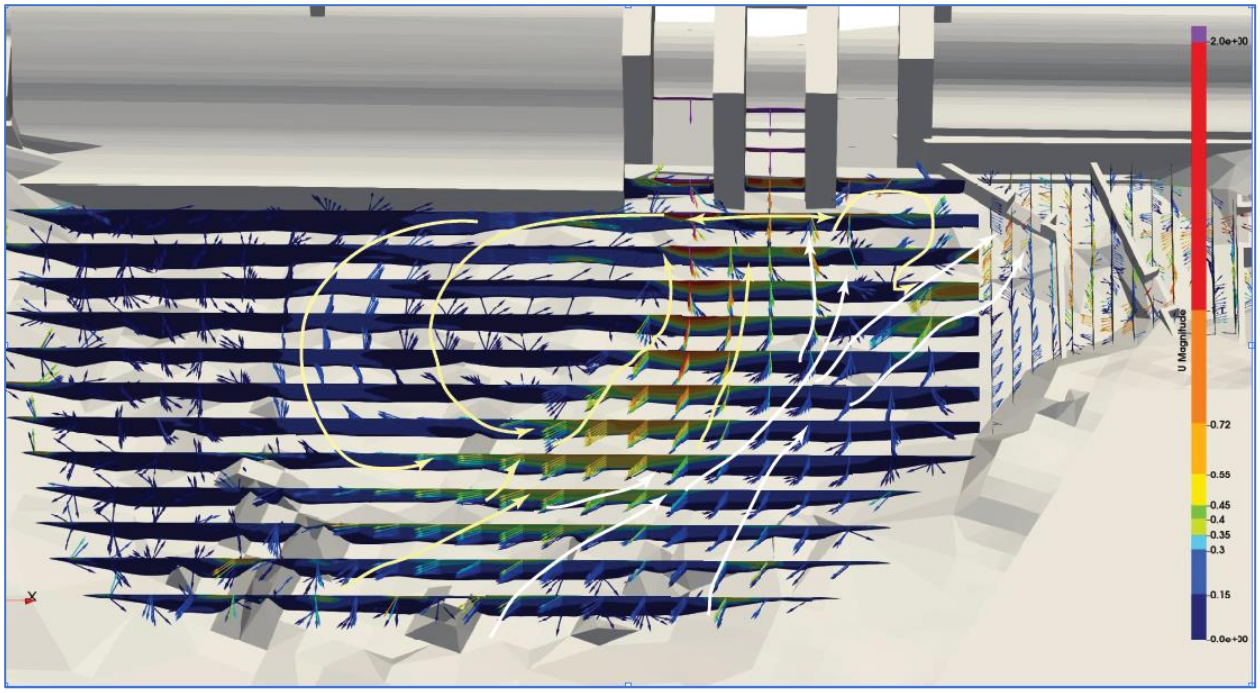


Figure 8: A close up of the routes for gaspereau below the dam with cross-sections spaced at 5 m

It is expected that the gaspereau will gather in the resting areas below the dam for some time to rest before seeking the fishway to move further upstream. The velocities just below the dam are well within swimming abilities of gaspereau and they can choose their preferred velocity to follow. Those on the left bank will easily find the fishway, as the new fishway entrance has good attraction velocities throughout the water column. Those on the right bank side of the main flow will have to look around for a bit and eventually will cross under the main flow to find the fishway or will not have to go too far downstream to be able to cross the surface flow, as velocities near the streambed are well within swimming abilities. The main migration route is in white. The yellow areas the fish will be delayed looking for the fishway.

Trout

Trout are much smaller than the salmon so have a weaker swimming ability. They will have a hard time getting through the fast flows on the bedrock sills. About 50% of 200 mm trout will be able to pass through the green route, 12.5% through the yellow route, and 2.5% through the orange route. Larger Sea Trout will have better passage success. The main route is the white arrows in fig 9 with delays if they take the other routes as they have to search for the fishway.

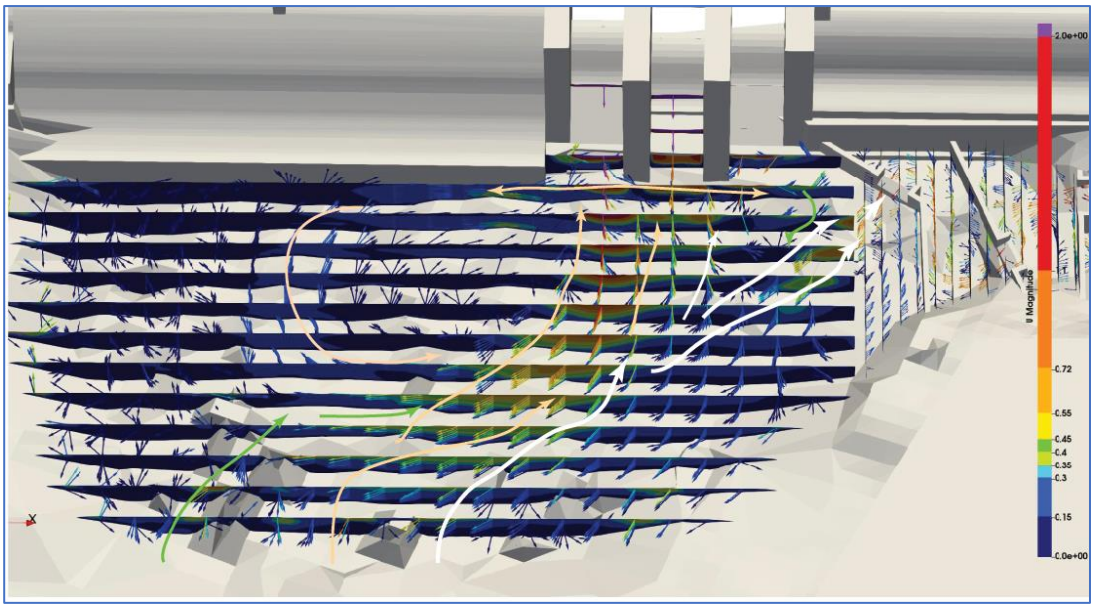


Figure 9: A close up of the routes for trout below the dam with cross-sections spaced at 5 m

Salmon Grilse

Grilse will follow the same routes as gaspereau, the green route will have 87.5% passage, the yellow route will have 50% passage, and the orange line will have 50% passage.

Multi-sea-year-salmon

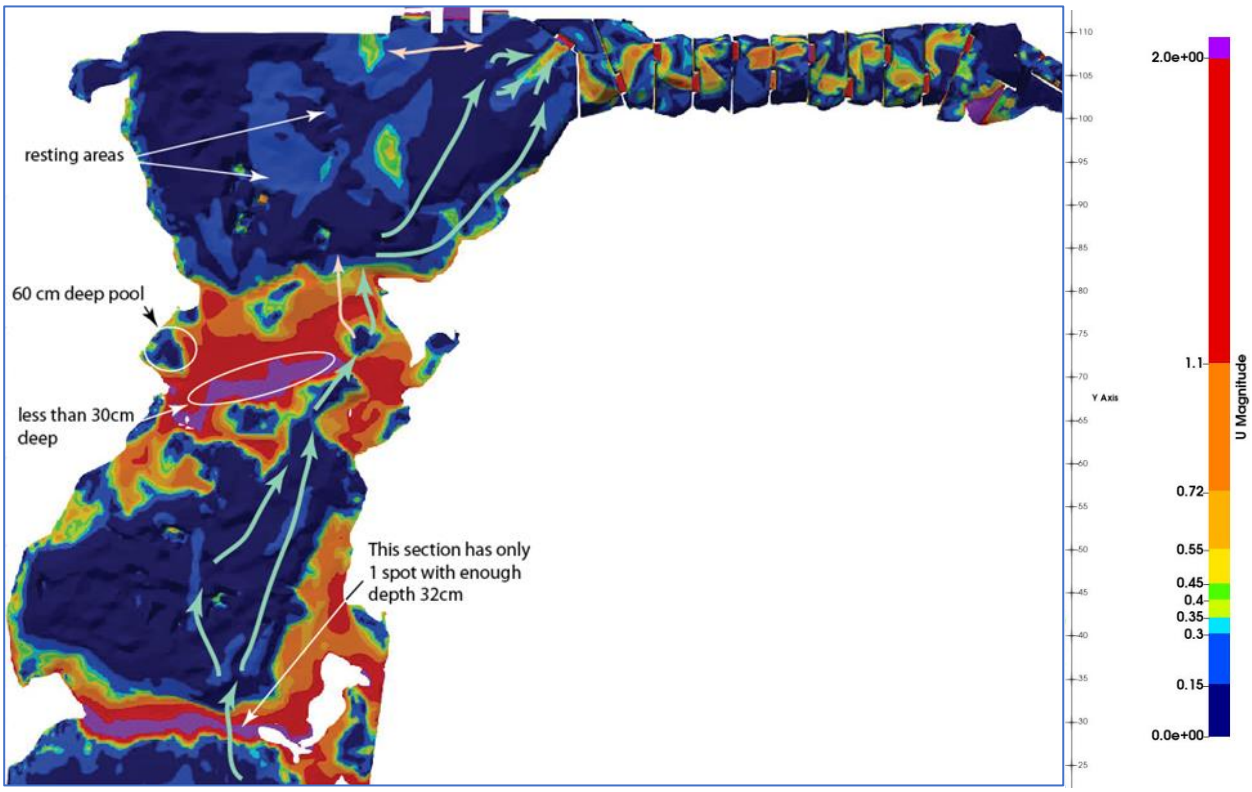


Figure 10:S1 routes for multi-sea-year salmon on velocities 0.2 m from the bottom

The route through the deeper main channel is the only one with enough depth for multi-sea-year salmon to pass. This route has areas with a minimum depth as low as 32 cm. They are strong swimmers and will not have any issues with water velocities on this route.

In the pool below the dam, both lines here are well within swimming abilities of salmon. Those on the left bank will easily find the fishway. Those on the right bank side of the main flow will have to look around for a bit and eventually will cross the main flow to find the fishway. At these flows Salmon will not have to go too far downstream to be able to cross the flow, as velocities near the streambed are well within their swimming abilities.

American eel

Elvers

Elvers can only navigate in the dark blue and medium blue colors (<0.3 m/sec). Velocities over the bedrock sills are too high for them to navigate.

Yellow stage eels

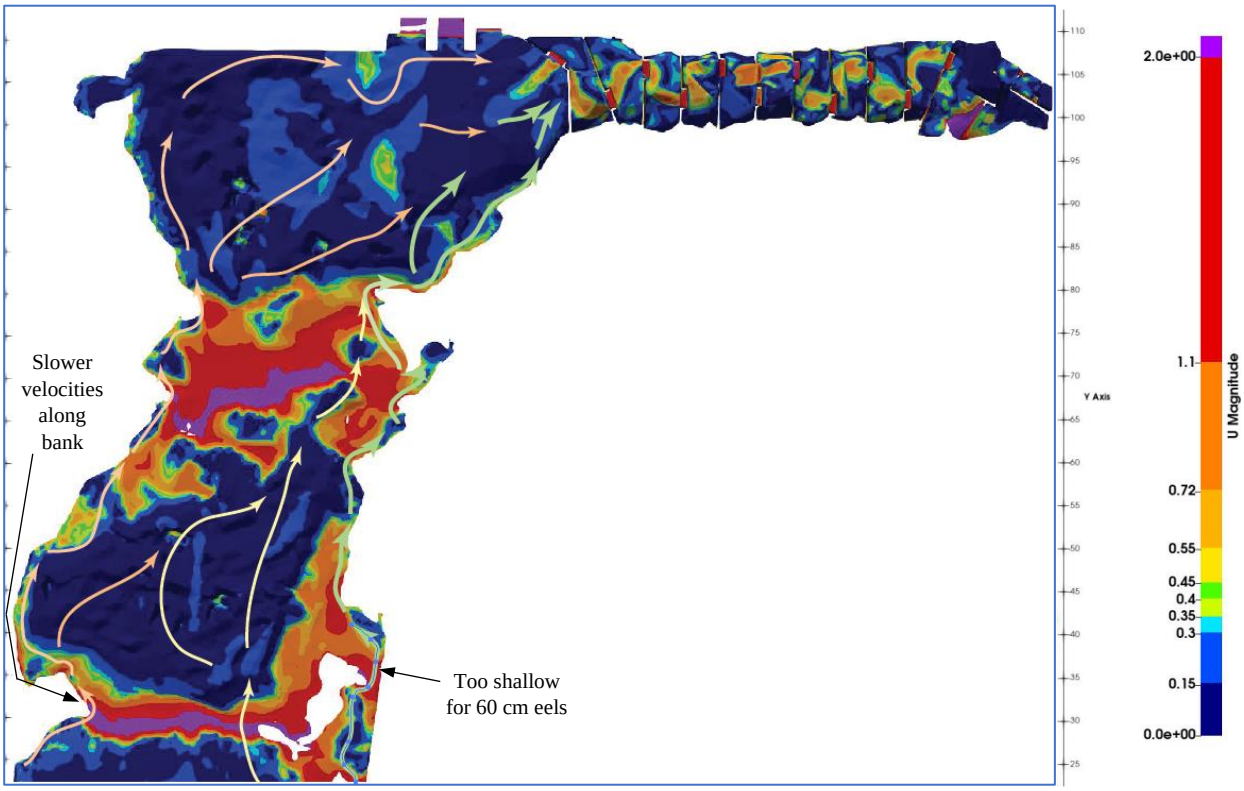


Figure 11: S1 routes for yellow stage eels shown on velocities 0.2 m from the bottom.

The yellow stage eels will be oriented to the bottom. They can navigate comfortably in the blue colors and can't go more than a few meters in higher velocities, so eels will struggle with the high velocities over the two sills but will find large resting areas in between and at the base of the dam to recover. For 97.5% passage they can't navigate in the dark orange, red, and purple colors. The passage rates derived from the model for 20 cm long eels would be very low, varying form 2.5% - 12.5% passage for the different routes, while passage for 60 cm eels would be close to 90%. Actual passage rates may be higher as eels can use small eddies between and behind boulders and large cobble for resting that are not shown within the level of detail of the model.

The orange route that goes up the right bank (looking downstream) from the dam and uses the low velocity water on the river margins, that are mostly under 0.3 m/sec. The eels will need to navigate through some faster water getting around the edge of the first bedrock sill. There is 4.5 m of fast water on the edge of the sill in the dark orange to red coloring, providing passage for the strongest 12.5% of 20 cm eels and 87.5% of 60 cm eels. This route along the right bank margin has around 10 cm of water in it at the shallowest of places, giving enough depth for both sizes of eels. There is a large resting area after the first sill where eels can spread out and rest before continuing along the right bank margins in low velocity water. At the point where the stream narrows near the large pool at the base of the dam there is another short area with higher velocities. In this area the eels can continue along the side and will need to swim through 1.5 m of water with velocities in the light to dark orange range. This short section will pass 87.5% of 20 cm eels and 97.5% of 60 cm eels.

There is a large resting area on the right side of the spill flows where eels can gather before heading towards the fishway. The velocities on the bottom are low, so eels will be able to pass under the spill flow towards the fishway. Eels over 10 cm will be able to go up the main fishway, but eels up to 50 cm long may choose to use the eel pass.

The yellow route goes through the thalweg. Using the deepest area over the first sill lowers the distance that the eels must travel through the fast moving water to 4 m. Velocities over the sill are up to 1.7 m/sec, which is too fast for most 20 cm eels. Passage over this sill will be 2.5% for 20 cm eels and 50% for 60 cm eels. Once eels are over the sill there is a large slow area for resting, where the eels will follow upstream along the bottom. There is some fast water again going over the second sill. Here, there is a deeper channel where the eels will be traveling that stays over 30 cm deep with slower velocities on the bottom. In deeper areas there is a good depth of slow moving water with a velocity under 0.15 m/sec, but in areas where the channel is shallower than 50 cm eels may experience higher velocities of up to 1.1 m/sec for up to 5 m. This section will pass 2.5% of 20 cm eels and 87.5% of 60 cm eels.

The green route follows along the margins of the left bank, looking downstream. One section, about 10 m up along the route is only 4 cm deep so 20 cm eels will fit but 60 cm eels would be partially out of water. In this route eels must swim 5 m through velocities between 0.7 m/sec and 2 m/sec, passing 12.5% of 20 cm eels and 87.5% of 60 cm eels. The route continues along the left bank margins. There are a few places larger eels may have to come further into the main flow velocity to get enough depth. They may have to enter velocities in the range of 0.45 m/sec - 0.72 m/sec for a few meters at a time. The larger yellow stage eels should be able to handle these velocities. There is a narrow area before the large pool at the base of the dam with velocities in between 0.7 m/sec and 2 m/sec along the left bank margin. This area will pass 12.5% of 20 cm eels and 87.5% of 60 cm eels.

From there eels will enter a large resting area and will be able to follow the flow to the fishway.

S2: 6 cfs from the fishway, 29 cfs from the louvre outfall, 165 cfs from the gates

This scenario has worse passage for gaspereau, trout, grilse, and eels, due to higher velocities, but better passage for multi-sea-year salmon, as the water depth increases.

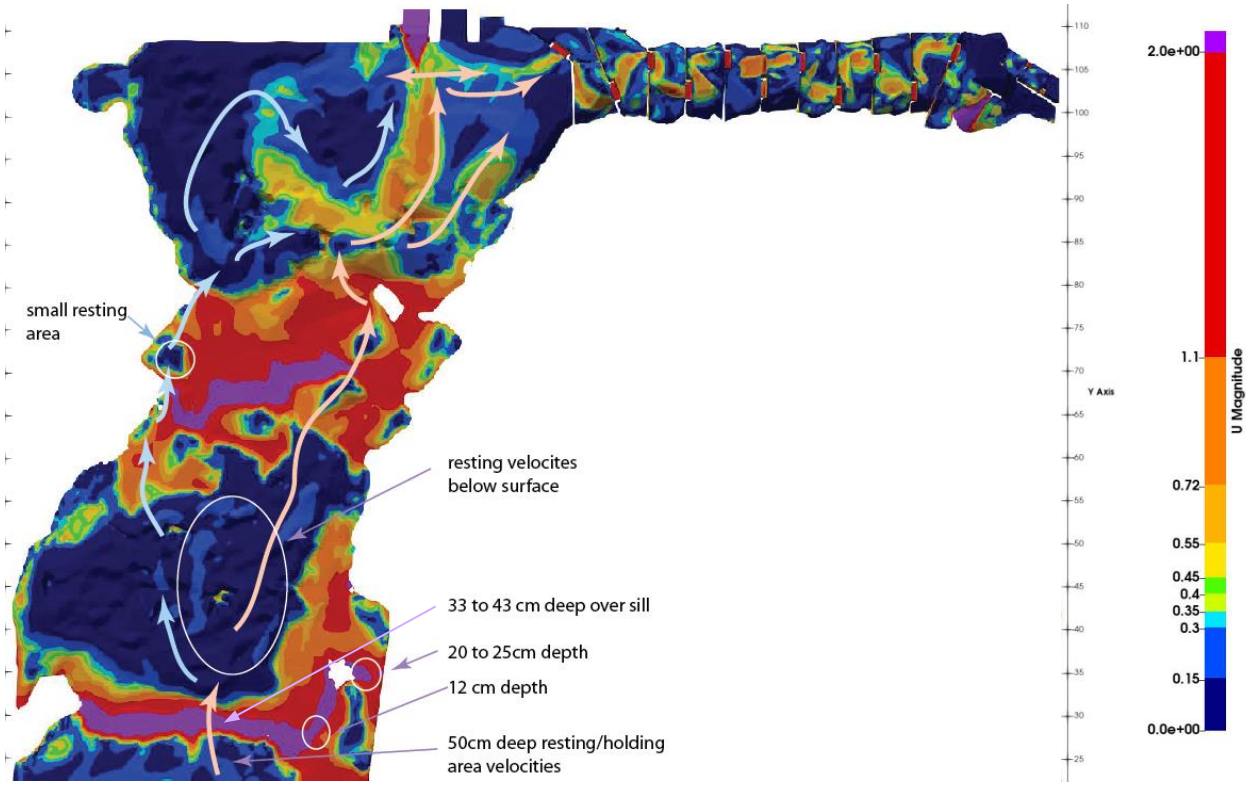


Figure 12: S2 routes for gaspereau, trout, and grilse on velocities 0.2 m from the bottom

Gaspereau

Using the orange route gaspereau will have 12.5% passage overall. Over the first sill there is 5.5 m where the gaspereau must pass through velocities of up to 2.5 m/sec. 87.5% can pass over the first sill. Then they enter resting velocities present under the surface flows where they can recover. Over the second sill there are 35 m of fast velocities, mostly under 1.1 m/sec but with a short section with velocities up to 1.5 m/sec, that the gaspereau must pass through, giving 12.5% passage, due to the length of the section.

Using the blue route gaspereau will have 50% passage, but the size of the resting pool will limit the numbers that can use the route. After passing over the first sill, the gaspereau can rest and then head towards the right bank, looking downstream. They must pass through water velocities in the 0.55 m/sec – 1.1 m/sec range for 10 m, then pass through 7 m of water at velocities up to 1.5 m/sec, before reaching a small resting pool. From the resting pool it is another 10 m through velocities of up to 1.1 m/sec before the fish reach a larger resting area. This route will have 50% passage if there is room to rest in the small pool and 2.5% passage once the pool fills up.

There are other routes around the first sill, but none that offer better then 12.5% passage.

Trout

20 cm Trout will have poor overall passage in these flows. Using either route the passage will be 12.5%. On the blue route, once the resting pool is full of fish the passage will be reduced and will be 2.5%.

Salmon Grilse

Grilse will have around 50% passage using either route. They will not need to use the resting pool on the right bank.

Multi-sea-year salmon

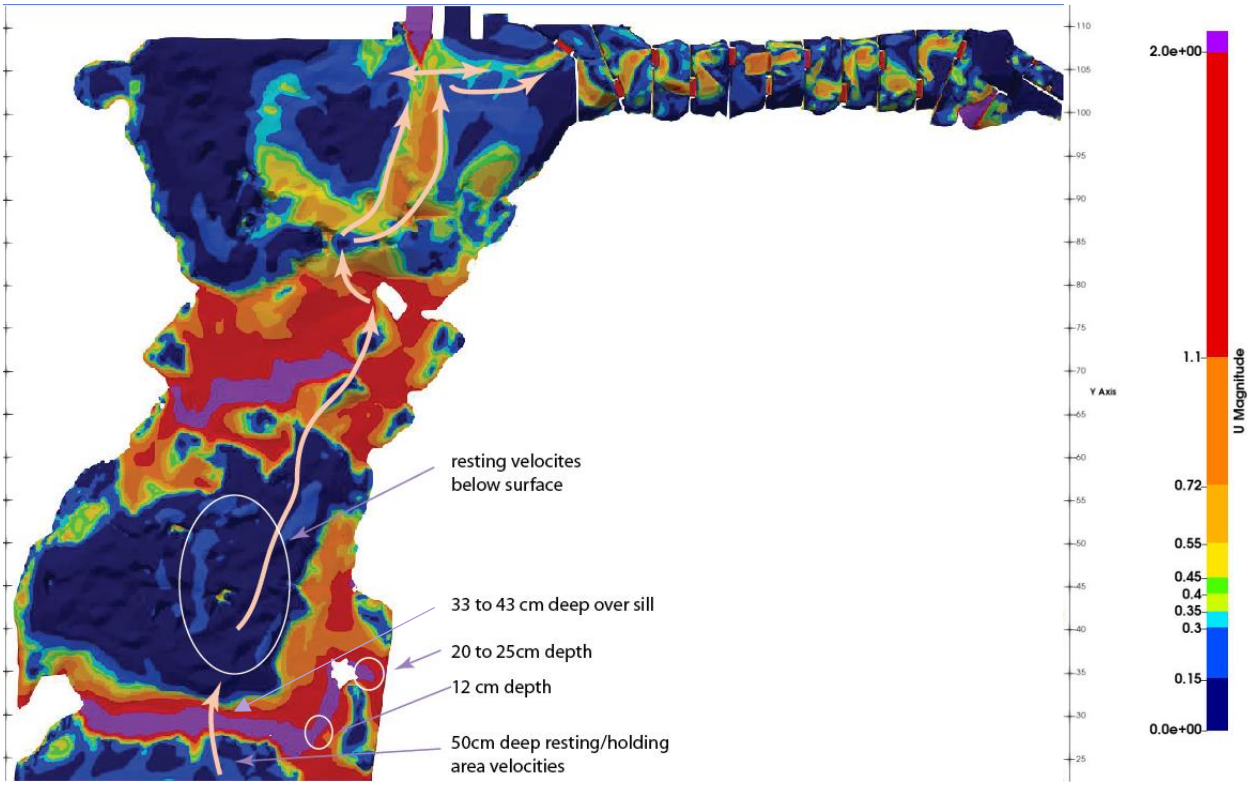


Figure 13: S2 routes for multi-sea-year salmon on velocities 0.2 m from the bottom

There is enough depth in the main channel for multi-sea-year salmon, with 45 cm over the first sill in the thalweg. The velocities going over the first sill are less than 2.5 m/sec. Multi-sea-year salmon are strong swimmers and should be able to overcome these velocities since the distance is only 4.5 m in the high velocities. The salmon can rest after going over the high velocities at the first sill. Then they will continue 35 m through mainly dark orange with a short section of red to the resting areas below the dam. 97.5% of multi-sea-year salmon should be able to swim against these velocities.

American eel

Elvers

The water velocities over the sills are too fast for elvers. Any passage will be along the very edge in shallow areas or back eddies.

Yellow stage eels

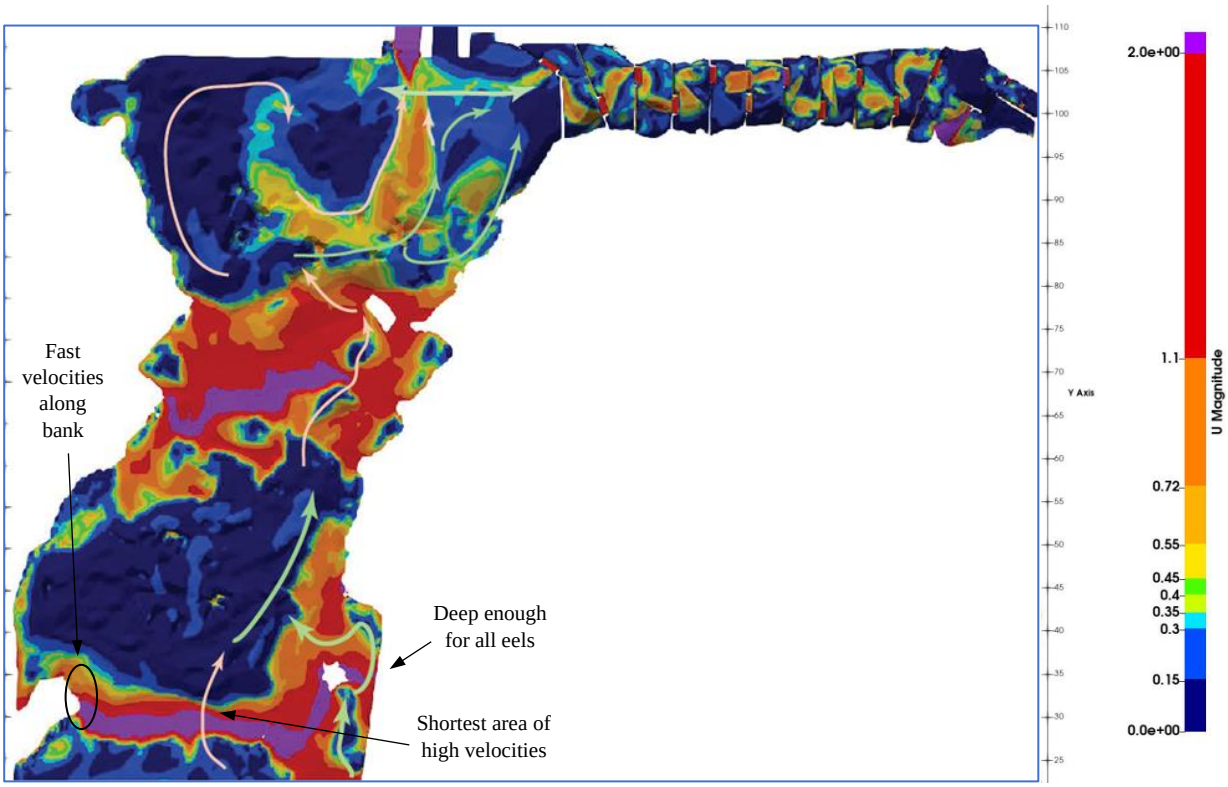


Figure 14: S2 routes for yellow stage eels on velocities 0.2 m from the bottom

Some yellow stage eels will be able to navigate up to the fishway with 165 cfs of spill, but there are areas of fast velocity that will prevent the majority from being able to get past. The velocities will prevent the smaller 20 cm long eels from getting up, but a small number of larger eels will be able to get up. Both routes will pass 12.5% of 60 cm yellow stage eels.

S3: 6 cfs from the fishway, 29 cfs from the louvre outfall, 925 cfs from the gates

At these flows the resting areas in the middle of the channel are almost gone, but there are some eddies with resting velocities that form on the right bank, looking downstream, for fish that are strong enough swimmers to make it over the first sill. Velocities over the first sill are too high for gaspereau, trout, and eels. There will be limited passage for Salmon.

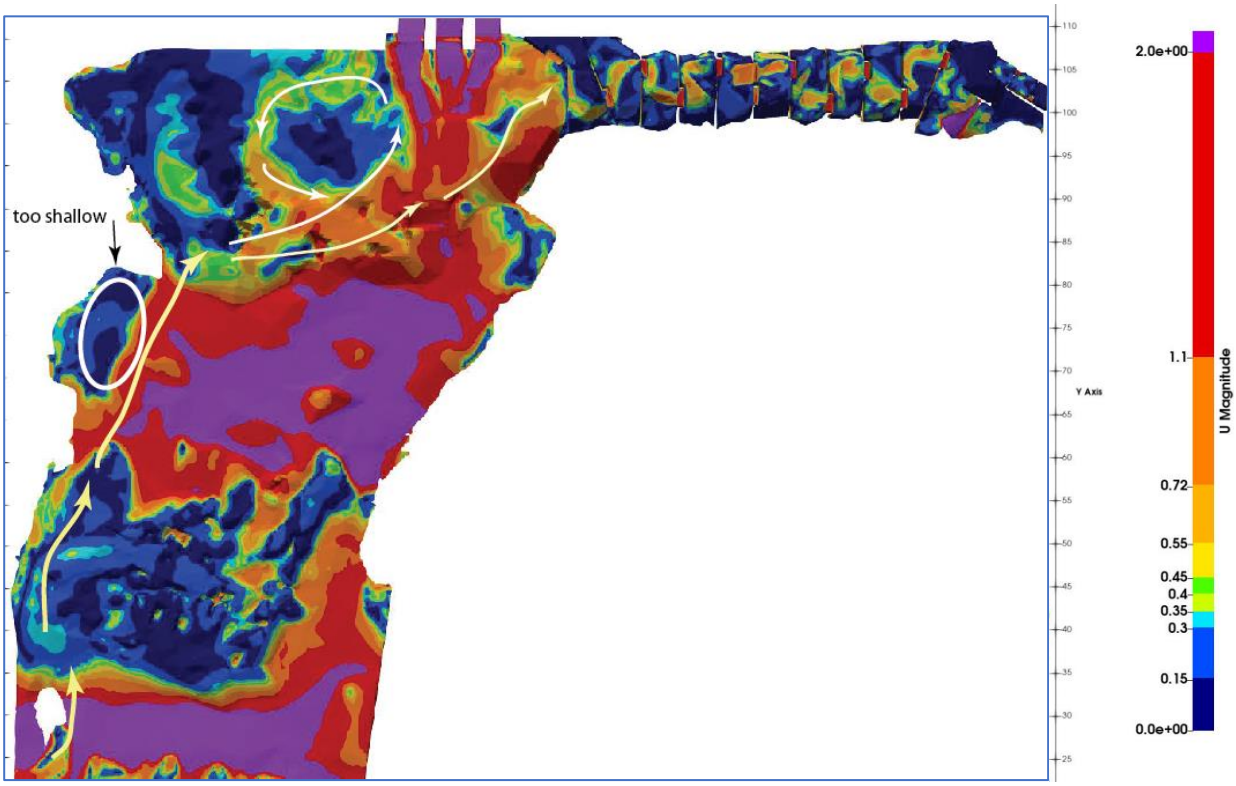


Figure 15: S3 routes for salmon on velocities 0.2 m from the bottom

Salmon Grilse

Grilse will have 12.5% passage.

multi-sea-year Salmon

Multi-Sea-Year salmon will have 50% passage to the dam. Over the first sill fish must pass through water with velocities up to 2.5 m/sec for 20 m in the model, but with unknown distance from the downstream resting areas this may be limiting. Over the second sill fish must pass 30 m of water in velocities up to 2 m/sec which should be passable if they rest between the sills.

S4: 6 cfs from the fishway, 29 cfs from the louvres outfall, 1720 cfs from the gates

Velocities are too high for passage.

S5: 6 cfs from the fishway, 29 cfs from the louvres outfall, 3051 cfs from the gates

Velocities are too high for passage.

S6: 6 cfs from the fishway, 29 cfs from the louvres outfall, 4308 cfs from the gates

Velocities are too high for passage.

S7: 6 cfs from the fishway, 29 cfs from the louvres outfall, 0 cfs from the gates

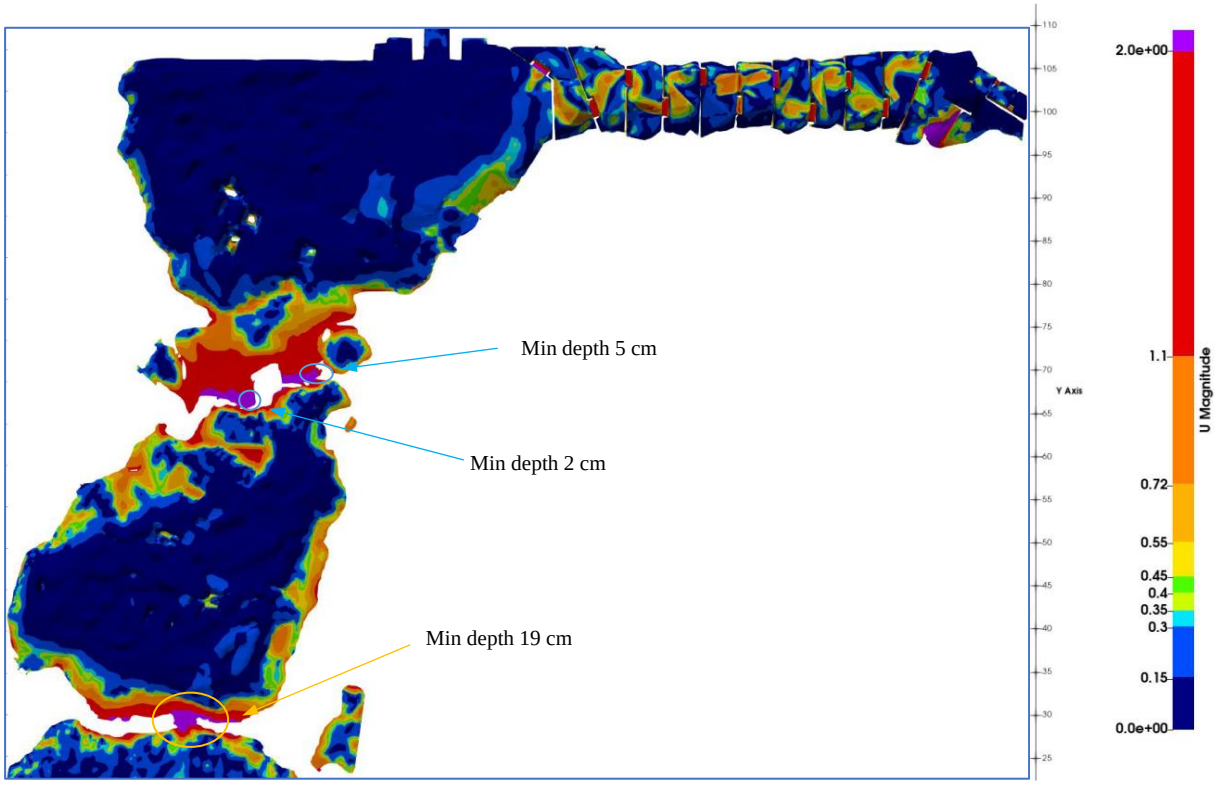


Figure 16: S7 velocities 0.2 m from the bottom

There is no passage in this scenario. The deepest area for passage over the second sill is only 5 cm deep, which is too shallow for gaspereau, trout, salmon, and larger yellow eels. Elvers and smaller yellow stage eels would have enough depth to pass, but the velocities over the sills are too high.

Conclusion

The fishways and eel pass will provide good passage for the fish that make it up the river to the dam. Attraction flow to the fishway is good with a volume of 35 cfs of attraction flow against a gate flow of 65 cfs in the first scenario, which is normal operations. The addition of 50 cfs supplementary flows as required should provide enough depth of water over the sills for all salmon as the flows are just slightly to shallow for the multi sea year salmon without these additional flows. The duration of the supplementary flows at 12 hours each is good as it allows for better passage of the other species in between. Care should be taken in using this flow all the time when salmon are present as it would limit the passage of other species.

The fishway /louvre flow of 35 cfs is not sufficient to provide fish passage in the river below the dam. This has not been an issue due to the leakage of at least 65 cfs from the stoplogs. However, the new dam will not have this leakage so the 65 cfs should be provided to the river through the gates on an ongoing basis.





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APPENDIX G – Fish Passage Assessment

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To: Kailey Osborne, BMgmt, EP
Environmental Scientist
Nova Scotia Power

January 31, 2023

Re: Ruth Falls Fish Passage Assessment

Introduction

Nova Scotia Power (NSPI) has requested an assessment of the existing downstream and upstream passage and a concept design be developed for changes needed to improve passage and to work with the proposed refurbished dam at Ruth Falls. The detailed engineering drawings will follow based on the recommendations of this concept design and review by NSPI and the regulatory government departments. This report gives an overview of the upstream fish passage and modifications and refers to the more detailed reports for the downstream passage louver upgrade, upstream fishway passage and eel pass, and the in-river fish passage routes and related issues.

Upstream passage

The fishway at Ruth Falls dam is a pool and weir fishway with two distinct sections.

The upper section is a concrete fishway with 1 ft drops between pools, the pools are 8 ft wide by 10 ft long, each pool is 2 ft deep at the top end and 3 ft deep and the downstream end with a sloping floor. There is a fish trap in the top pool then six pools down to a large corner resting pool that turns the fishway approximately 135 degrees to the right followed by 6 more pools for an overall drop of 13ft. The notches are 3 ft 3inches wide and against the outside wall in an alternating pattern. The top inside corner of the notch is curved on a 6-inch radius. The notch crest has a 4inch flat area at the upper end dropping on a 2H:1V slope over 2 ft for a drop of 1ft. Running with 1ft of water at the crest of the notches, the water level in the pools below is at the crest of the notch above. The fishway is required to be run at 12 inches of flow over the crest of the notches. Water flow is approximately 5.56cfs with this type of notch with the 1ft depth in the notch with the sloping backwatered apron verses the 6cfs that would be the flow from a sharp crested weir. So, some small variation of the flow above the 1ft depth is acceptable.

This upper section is a concrete fishway connects to a **channel fishway** section running along the toe of the dam that is cut into bedrock with concrete weirs across the channel each taking a portion of the head drop to the river. The drop through this section is 8.35ft with nominal river

level and the drop is taken up on 7 weirs. The first weir is located approximately 35 ft downstream of the concrete fishway then the weirs are spaced at 20, 25, 15, 25, 20, and 20ft apart. These fishway channel weirs currently have various drops on the weirs ranging from 1.63 ft to 1.17 ft and notches 1.75 wide and 1.67 deep. The three lower weirs have a 1V:2H sloping floor in the notch, the upper 4 weirs have level floors in their notches. Under the 5.6cfs fishway flow these notches run full. These weirs do get additional flow from the leakage through the stoplog sections in the adjacent spillway, but the amount is not known. From observations this leakage backs the water up on the lower notches so the flow is over the weirs but has no effect on the uppermost notch. The upper weir does not properly back the water up on the notch in the entrance to the concrete fishway which should be higher up to the notch crest height.

From June 15 to July 15 and September 26 to November 30 there are weekly supplemental flow events of 50cfs are released immediately downstream from the discharge point for a minimum of 12 hours released overnight, when Ruth Falls headpond elevation is at 33.3m (109.4ft). These supplemental flow events are scheduled to complement natural significant inflow events, where a significant inflow event is defined as greater than or equal to 24mm of rain in a 24-hour period, as measured at the Malay Falls office where a rain gauge is maintained and checked on weekdays. A total of 10 or more supplemental flow events are to occur within these dates. These flows are intended to attract salmon out of the tide and to migrate upstream. When salmon have been caught in the fishway trap these flows are to continue nightly. This flow of a total river flow of 150cfs has not been modeled.

When the new dam is built there will be no leakage or additional flow available for this channel section of the fishway.

Pool and Wier fishway design background

Pool-and-weir fishways are very sensitive to water level fluctuations at both the upstream and downstream ends.

In these fishways, low tailwater levels will result in a high drop out the entrance notch increasing velocities and reducing or eliminating the backwatering of the notch which is important for fish passage. High tailwater levels will lead to drowning of the fishway entrance and, consequently, poor fish attraction flows with low velocities. The entrances are often supplied with additional attraction flow, and this aids entrance attraction flow conditions during fluctuating water levels.

Changes in the upstream water level affects the turbulence conditions in the fishway pools. High water levels increase flows through the fishway reducing or eliminating fish resting areas due to turbulence in the pools limiting fish passage. A very low upstream water level will result in low discharges and very shallow or no water depths in the notches passable by the fish. The water surface in the pool below the notch should be equal or above the crest of the notch. With low flows, shallower depths in the notches than designed for, drops the pool water surface below the crest of the notch making fish passage more difficult. Water depth should also be at least 1/3 the

body length of the fish requiring passage. So, the 1ft depth is the minimum for multi-sea year salmon.

It is very important that the fishways operate with the flows and drops between pools they were designed for with very little water level fluctuation. Any fluctuation should be above the design water depth for the notches.

Fishways at most NSPI sites are designed as what has been termed "salmon" fishways as historically the fishways were designed only for anadromous salmon on their spawning migration as this was the focus in the Department of Fisheries and Oceans (DFO) and was the Salmon section of the Science Branch the fishway engineers were in who developed the designs and provided the federal *Fisheries Act* approval. That is the case for this fishway. What makes them "salmon "fishways is the turbulence in the pools which is created as the notch flow velocity dissipates the energy of the drop as it reaches the pool bottom, upwells on the downstream weir, turning back and across the pool upwelling on the side opposite the upstream notch then down the next notch. So, the drop between pools, the volume of flow, and pool size length, width and depth that make up the water volume in the pool are important when looking at passing species and age classes other than the upstream migration of salmon spawners. The various species deal with the turbulence in the pools differently and most require more frequent resting areas than the salmon. Salmon also arrived in relatively small numbers, moved though the fishway quickly not needing to rest in these relatively short fishways in Nova Scotia. Gaspereau are at the other extreme arriving in large numbers and requiring resting areas while passing through these fishways. Crowding in the pools is also an issue that can slow down or even stop passage so the fishway has to take the numbers of fish at a given time into the design consideration.

This basic "salmon" design was then copied with some minor modifications to dimensions for other salmonid species, gaspereau, and in a few cases smelt. This was done by designing the fishways to operate with a lower drop between pools generally 8 to 9 inches for gaspereau and 6 inches for smelt while maintaining the 8ft wide x10ft long x 2 to 3 ft deep pools. These lower drops between pools lowered the velocity some in the notches while still backwatering the notches, but mainly by reducing the flow volume so there was less energy to dissipate resulting in less turbulence in the pools and in turn more resting areas. The flow volume can be reduced by narrowing the notches where the pool turbulence is too high, which also allows for them to be backwatered more improving passage. The burst or sprint swim speeds for the short distance through the notches are greater than the velocities with the one-foot drop between pools for all migratory species but the gaspereau and smelt do not have the endurance the salmon have, so need those resting areas in the pools provided by the lower flow volume into the same pool size. The same is true for the smaller and weaker swimming fish species. It is that greater energy dissipation in the pools for the volume of water dropping into the pool that makes the distinction between fishway types. The lower drops still maintained the notch design including having the pool water surface level at least equal to the notch crest but work better for all fish species if backwatered preferably by a minimum of 2 inches or 20% of the notch depth above the crest. This design feature changes the flow in the notch from a fully plunging flow if there was no

backwater on the notch slope, to one that is a combination of plunging and streaming flow. This improves passage for all species. It also introduces the flow deeper in the pool below and that increases the energy dissipation resulting in lower turbulence and velocity in the pools and more resting area.

The Ruth Falls upper concrete fishway

At Ruth Falls the water elevation in the pool below the notch is designed to be at the level of the notch crest when there is a 1ft deep flow in the notch. This is the proper operational water depth for this fishway and is acceptable for the passage of all the major species.

This concrete fishway should be operated with a 1ft of flow depth or slightly above through the notches to meet the design criteria. If it is observed during monitoring that the pools do not provide enough resting area for the number of weaker swimming fish present then the notches can be narrowed from the wall side to reduce the fishway flow while maintaining the notch depth and pool volume there by reducing the pool turbulence providing more resting are for gaspereau, smelt, suckers etc. while keeping the notch operating within parameters. The modeling of the fishway and the operation with 1 ft water depth in the notches, and observations of the flow patterns, confirm the turbulence in the pools is good providing resting areas and needs no adjustment with the expected numbers of fish.

The lower fishway channel and entrance

The current attraction to the fishway entrance is poor with the louver flow at a minimum of 29cfs coming out at right angles to the river flow and the water from the spillway aligned with the river flow boxing in the 5.6 cfs fishway flow. This is causing the fish to collect either downstream of the louver flow or on the right side of the gate flow missing the flow from the fishway. It is not known what the current flow is out of the channel section of the fishway is as in addition to the 5.6cfs of the concrete fishway flow it collects additional flow from the stop log spillways along its right side. When the fishway is run at 1 ft deep and a flow of 5.6cfs plus the leakage and additional supplemental flow of 50cfs it is more competitive with the other flows but still boxed in. This large supplemental flow overtopping the weirs creates very turbulent pools between the weirs and is particularly bad at the narrow weirs with shorter, shallower pools. With the new dam these additional flows, both the stoplog leakage and the supplemental 50cfs flow, will be eliminated from this part of the fishway and relocated to the spill gates.

Eel passage past the dam is possible as indicated by the population upstream but they must pass through the existing fishways to get upstream. This is limited to the larger eels that can swim through the fishway velocities.

Changes to provide improved fish passage at the refurbished dam

To provide attraction flow from the fishway and eliminate the larger flow from the louvers, just downstream of the fishway entrance, the louver flow will be realigned to the top of the fishway channel as described within the downstream passage report. This will provide a combined

fishway minimum flow of 5.6cfs with a minimum louver flow of 29cfs for a total at least 34.6 as attraction flow at the fishway's river entrance. To properly accommodate this flow in the fishway channel, the 7 existing weirs are to be replaced by 11 new weirs each with a 0.75 water drop, 11ft wide by 1.75 deep notches with sloping on at 2H:1V, backwaterd over the crests of the notches by 1ft. Pools between the weirs will be at least 4ft deep with the notches are running at 1.75 depth over the crest of the notches, and a weir width of 25 ft bank to bank. The modeling of the flow pattern and velocities in the pools and notches has shown that this design will provide easy passage though this section of the fishway for the fish including resting areas in each pool.

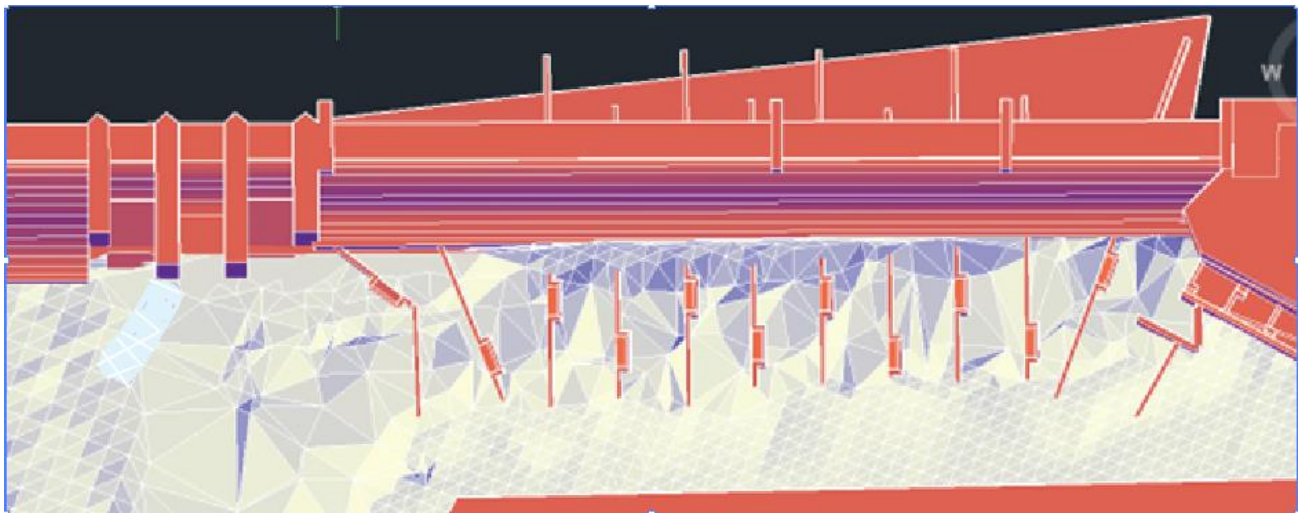


Figure 1: The layout of the 11 channel fishway weirs

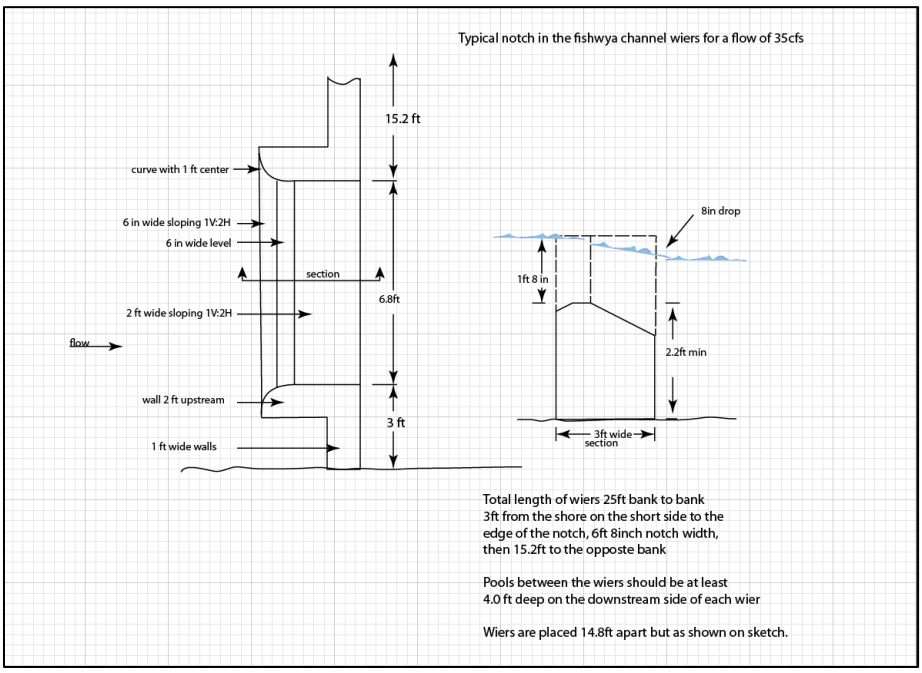


Figure 2: Design details of the notches in the channel fishway weirs

It is preferable to have the fishway entrance flow at least 10% to 15 % of the river flow, if possible, to attract the fish. The upper concrete fishway flow of 5.6cfs provides 16% of the combined fishway and louver flow in a small area where the two flows meet at the top of the fishway channel with its new baffles. At the entrance to the fishway at the river the percentage will vary depending on the flow from the gates but at the minimum flow of 65cfs from the gates the fishway flow will be up to 39% of the total flow. During higher river flows they could go as high as 390 cfs and still meet the 10% criteria.

Additional fish passage for eels

One species that cannot use the fishway effectively are the smaller American eels. Having the louver flow moved to the fishway as attraction flow, the river flow currents will lead the majority of the eels to the downstream corner of the lowest fishway notch. The upstream eel pass entrance is to be located at the downstream corner of the fishway entrance. See eel pass report for more details.

Eels tend to be smaller near the tide and Ruth Falls is close to the tide, so designs have to accommodate the 0+ year class. There are some challenging natural sections for these young eels in the river below the dam but there are likely locations along the bottom or along the shore they can use for migration over these natural sections particularly under low flows. For this reason, an eel pass is designed to provide this passage for the smaller eels. The lower channel fishway with its drowned weirs and the concrete fishway when the weirs are backwatered with 1 ft of flow allow eels larger than 15cm long to use their burst speed over the notches along the bottom and especially in the bottom corners of the notches where the velocity is lower. Passage is also available through the 3-inch diameter drain hole in each weir. Details regarding the eel pass are outlined within the upstream eel passage report.

Downstream passage

The diadromous fish need to come back down past the dam at some point in their life cycle and resident species may choose to migrate down seeking suitable habitat. Some may come back down through the fishway or exit through the gate flows, but it is expected most will follow the power cannel flow and be led through the louvers. The louvers are currently of the best designs used to date for downstream passage but there are a few improvements that can be made at this site. Eels travel along the bottom and do not guide well with currents at louvers so a solid wall fitting tight to the bottom is needed guide them to the exit. Bottom outlets are best for eels, or they need to be led up to the surface outlet. To do this a slated ramp is to be installed to lead them up. See the louver report for eel behaviour and design requirements for downstream passage.

For all fish the velocity into the louver exit is good but below their burst speeds. Then they reach a series of partial barrier stop log sections that they have to go up and over. As a partial barrier these sections will cause many of the fish to return back upstream. To prevent movement back up and out of the louvers a trap funnel will be installed, and the stop log sections will become

orifices vs the overflow weirs in the concrete transition channel. This will ensure quick passage through a barrier free transition channel to the louver outflow pipe. See the downstream passage louver report for more details.

Louve pipe outlet is designed to discharge into pool sized to dissipate the energy from the head drop through the piped section and then the vertical drop into the top pool of the channel fishway section. The pipe can come down from the end of the louver system's concrete transition channel on a 3% slope which leaves a 6.45ft drop into the 4ft deep pool. This stays within the USFW guideline for safe downstream passage.

Summary

This completes the full loop of fish passage from the upstream river passage routes, the fishway sections and the downstream louver system discharging between the two fishway sections to provide good attraction flow to the fishway at the river.

Figure 3 provides a diagram of the location of the proposed changes. To the left of the figure and running along the toe of the spillway with its rubber dams are the series of 11 new fishway weirs in the fishway channel. These weirs are designed to have velocities and water depths for passage for all species and to carry both the concrete fishway flow and the louver flow. Above that is the existing concrete fishway which meets design standards for a good fishway. Running alongside of these fishway sections, as a blue line in Figure 3, is an eel pass for the smaller life stages of eel. This eel pass is a design that is commonly used in Europe and around the world. This completes the upstream passage. Downstream passage is through the fishway and gates but primarily through the louvers in the power canal. The louvers with their solid wall along the bottom, guide ramp to the outlet, and swimming depth passage through the transition channel to the outlet pipe removes the existing partial barriers to downstream passage for all species. They then complete the journey down the lower portion of the fishway to the river.

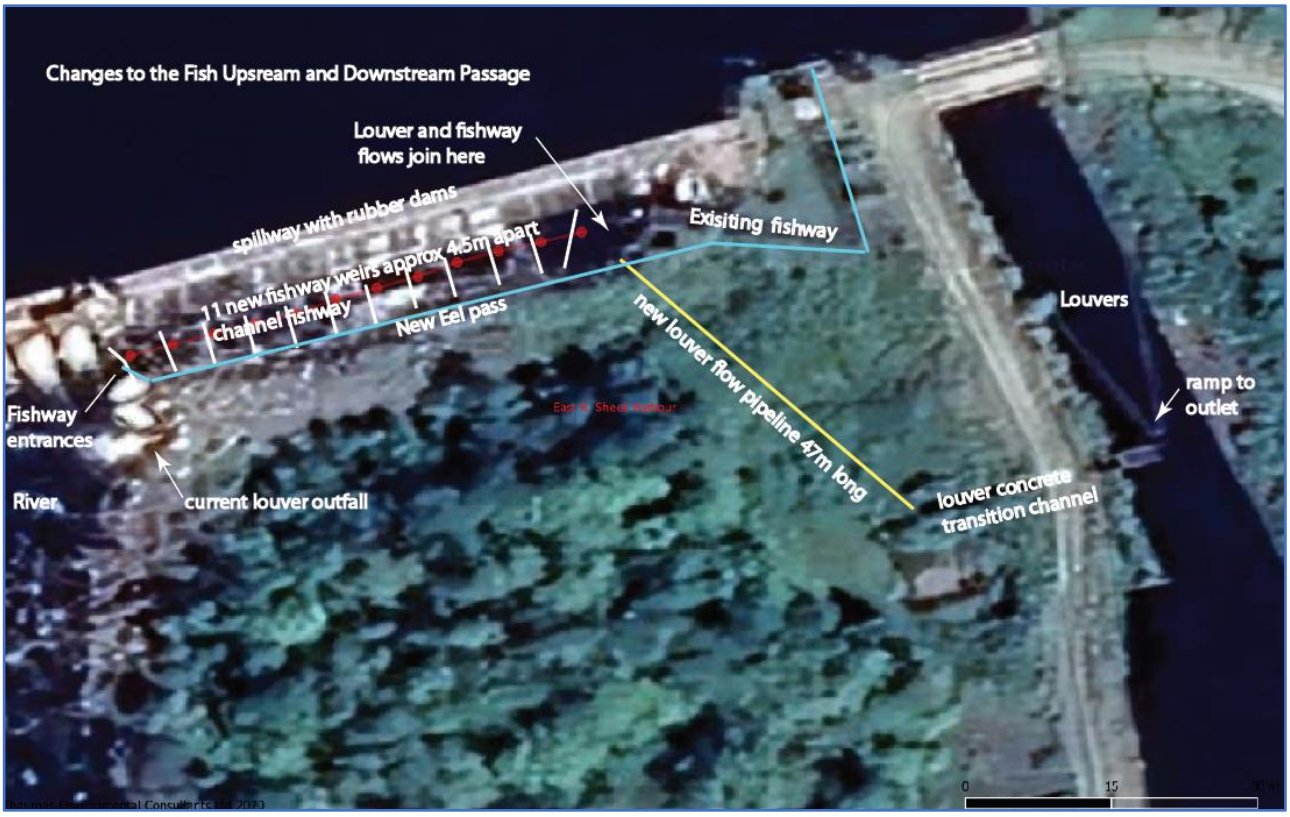


Figure 3: The overall layout of the fish passage facilities

Conclusion

Fish passage that meets or exceeds modern fish passage criteria will be provided for all species that need to migrate past the Ruth Falls dam to complete the life cycle with a few modifications to the existing fish passage facilities.

The new dam will eliminate the spill along the lower channel portion of the fishway and this required changes to be made to provide good attraction flow to the fishway entrance at the river. To provide this attraction flow the louver flow carrying the fish downstream will be diverted into the top of the channel section of the fishway. The existing 7 weirs with various head drops and notch designs will be replaced by 11 weirs with large, drowned notches to carry the additional flow without over topping. This will provide good passage for all the required fish species.

The additional eel pass will provide the latest eel pass design for upstream passage of elvers and small yellow stage eels.

The downstream passage already has a set of well-designed louvers, but the efficiency has been compromised for the benthic species, eels and suckers, by raising the outlet 5 ft above the bottom. A sloping ramp to lead the fish up to the outlet combined with walls along the bottom of

the louvers will greatly improve efficiency. The passage was further hindered by stoplog overflow weirs in the outlet transition channel combined with the slower bottom and mid water velocities the fish could swim against to return to the power canal. These have been replaced by a trap funnel to limit fish from returning upstream and orifice openings in the stop logs to remove these barriers and maintain the velocity through to the pipe. Returning the fish through the pipe diversion shortens the length and the overall drop brings this flow in halfway up the fishway. Taking the fish down the fishway will help those returning to find the fishway entrance.



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APPENDIX H – Louvre Assessment

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January 31, 2023

Re: Concept Design Report -Downstream Passage of Silver Stage Eels at Ruth Falls Dam – Draft

1. Introduction

Nova Scotia Power Inc (NSPI) requested a condition assessment of the louver system which forms a part of the fish diversion structure at the upstream end (entrance) of the power canal at Ruth Falls Dam. NSPI also requested a concept design of improvements to the louver system to increase it effectiveness in bypassing silver stage American Eels (*Anguilla rostrata*).

2. Site Visit

On May 31, 2022, Thaumas Environmental and Wood Canada Limited (Wood) visited the fish diversion louvers at the entrance to the Ruth Falls power canal in Sheet Harbour, NS. The purpose of the site visit was to determine the current configuration of the louvers and the overall fish management infrastructure at the site. It was also an opportunity to understand how the louvers are currently functioning, and to assess what opportunities there are for improving downstream American silver eel (*Anguilla rostrata*) passage at the site. A second visit to assess the condition of the louvers for damage to the louvers and attachment to the bottom was not done as the headpond was not drawn down as originally planned in 2022. It is noted we do not know what the condition of the louvers were during the 2009/ 2010 eel passage study conducted by NSPI. Another site visit was undertaken on October 20th, 2022, to check the flow volume through the louvers and to take a second look at the overall configuration.

3. History of the Fish Diversion Louvers

The louvers were originally installed in 1966 as a downstream bypass and counting facility for the passage of Atlantic salmon smolts. The louvers have been modified several times since then to improve smolt passage based on studies on smolt behaviour and passage rates from 1967 to 1971. In 2005 Nova Scotia Power contracted Alden Research Laboratory, Inc. to assess the louvers and provide an Engineering and Biological Assessment Ruth Falls Fish Deflection Facility, authored by Gregory Allen (Allen 2005).

Major changes were undertaken during the rebuild of the louver bypass exit and monitoring shed operations based on Nova Scotia Power plans dated in 2006.

Initially the louvers had a bottom outlet pipe. However, it was found that the migrating salmon smolts were concentrated in the upper 4.5 ft of the water column so the louver exit / bypass entrance was changed to provide a surface outlet that used less water and improved surface velocities and attraction for the smolt. The bottom outlet pipe was reportedly filled with concrete as part of that modification.

The powerhouse intake canal is located adjacent to the dam's east abutment. The louver facility is located about 75 ft downstream of the canal entrance. The intake canal was reconstructed and widened in 2000 downstream of the louvers to improve the conveyance capacity of the canal to the powerhouse to its original design flow rate. The original intake canal where the louvers are located is approximately 42 ft wide at the top bank, a bottom width of 14 ft, and bank slopes at 1:1 (H:V). Downstream of the louvers the canal widens to a top width of approximately 100 ft and a 25 ft bottom width. The louvers are shown in Figure1.



Figure 1: Looking downstream at the louvers May 31, 2022

4. Description of the Louvers

As shown in Figures 2 and 3, the louvers are arranged in a V pattern across the intake canal and consist of steel bars orientated perpendicular to the flow. Each leg of the V is approximately 50 ft long and orientated 12 degrees to the approach flow with a fish bypass located downstream at the vertex. As shown in Figure 4, the louver bars are 2 inches apart and extend from the bottom of the canal to a top walkway deck at elevation 114.0 ft. Every sixth bar (12 inches) has a flow straightener extending from the bar in an arc that forces flow to exit the louvers parallel to the

canal. The fish bypass is located at the vertex of the louver V array. As previously noted, the original bypass entrance design extended the full depth of the intake canal. Testing conducted in the late 1960's suggested optimizing the entrance design by blocking off the lower 5 ft creating a surface bypass and increasing the bypass velocity. The bypass entrance is 18 inches wide with an invert at El. 104.0 ft. (Allen et al 2005). The 2006 modifications built a new bypass entrance with the bottom 5ft closed off by a concrete block that supports a metal bypass with 18-inch-wide vertical opening curving 90 degrees and widening to 6 ft wide and 4 ft deep into a concrete channel. The operating water depth in the channel is 2 ft at 29 cfs minimum flow. This channel incudes the diversion to the monitoring shed and ends with the inlet to a 32-inch diameter pipe that carries the flow to the river where it drops into the river just downstream of the fishway entrance and at right angles to the spill gates.



Figure 2: Looking upstream at the louvers May 31,2022

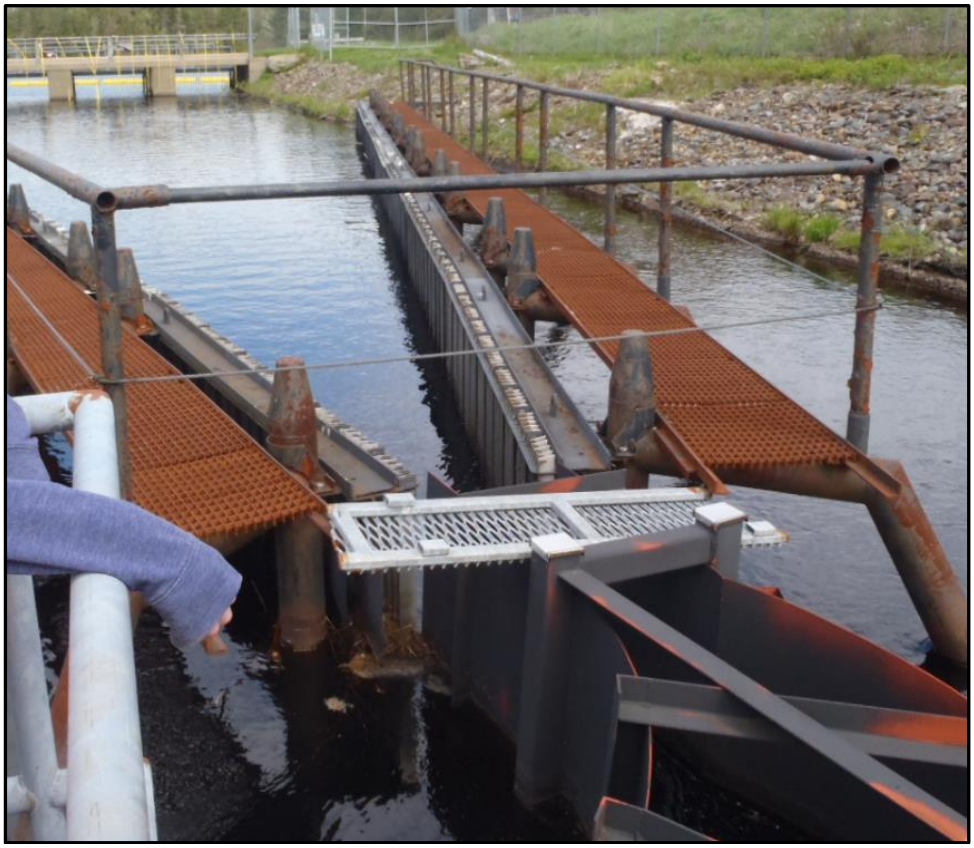


Figure 3: Looking at the louver /Bypass connection gap May 31, 2022

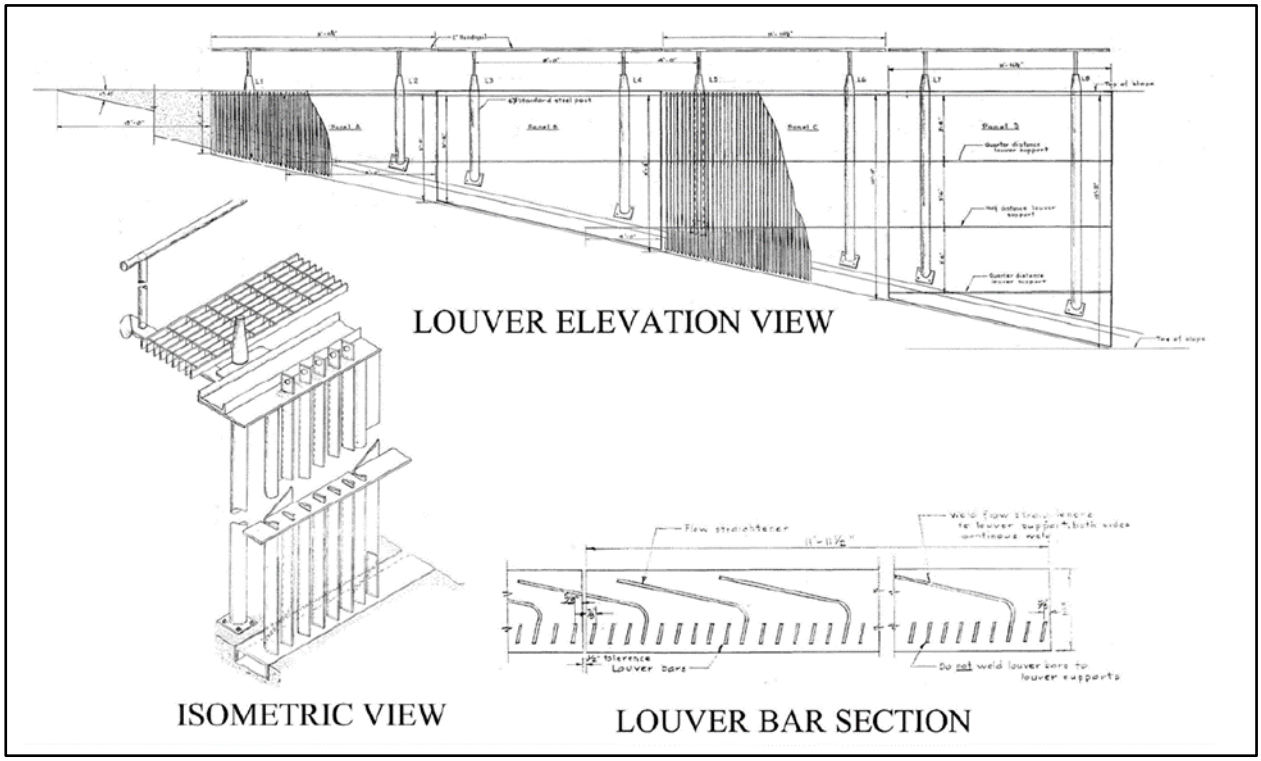


Figure 4: DFO Louver design from Ducharme 1972

Louvers can be very effective at guiding all fish including eels to a bypass if properly designed (Beck 2020) and modeling conducted at the Alden Research Laboratory (Allen 2005). Guiding angle is very important and (Amaral 2003) found a 15-degree angle to the flow was better than a 45-degree angle. In Ruth Falls the angle is even better at 12 degrees to the flow. The effectiveness for most species was very high when the flow velocities were good, and they are at Ruth Falls (Allen 2005) so eel fish guidance efficiency (FGE) should be in the 90% range.

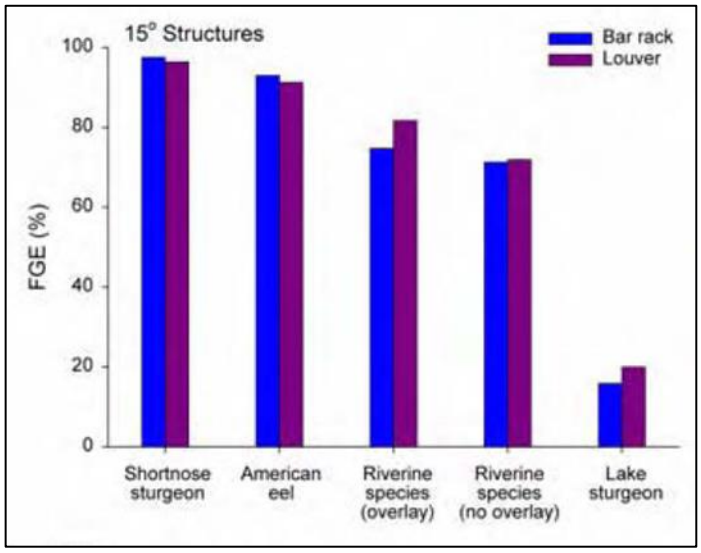


Figure 5: from Amaral 2003

The one thing that is missing at Ruth Falls that they found added efficiency for eel guidance is a barrier along the bottom (termed overlay). Figure 6 shows the difference they found with and without the barrier along the bottom.

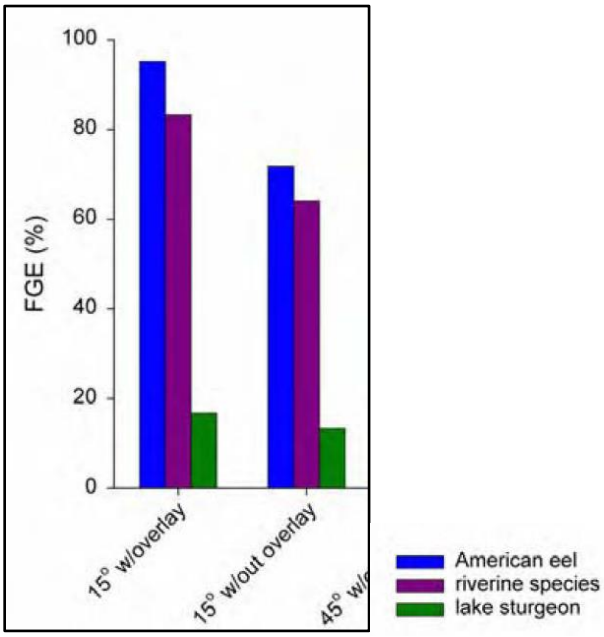


Figure 6: from Amaral 2003

So, since the basic design is good we need to look at how it is working and how it can be upgraded to work better.

5. American Eel (*Anguilla rostrata*) Silver Stage Downstream Passage

With the recent focus on the American eel, NSPI has been asked to review potential options for improving the effectiveness of the louvers to bypass downstream migrating silver stage American eels.

NSPI studies in 2010 indicated that of 30 acoustic tagged silver stage eels released above the headpond, all reached the dam, 21 (70%) were detected in the power canal downstream of the louvers, of those 8 were detected down river, and another 9 detected downstream either used the louver bypass, the fishway, or the spillway, for survival of 56.7%. There is no information on the detection efficiency of the receivers in the river below the powerhouse and this is especially important as the assumption of mortality rates is not sound if the detection rate was low as those not detected were assumed to be mortalities. This river section likely required two recorders in this channel on opposite sides to get a high detection rate. The observed results for the louvers efficiency are poor as 21 of 30 were below the louvers in the power canal at one point in their migration.

Eels are known to actively search for a downstream passage route near the bottom of the water column in forebays of structures such as hydropower stations and navigate by following the walls and bed of the headpond or power canal until the reach a barrier then they venture higher in the water column looking for a way downstream (Piper 2015) (Brown 2009) (Haro 2000). Consequently, bypass location will influence the ability of eels to find the bypass entrance. Flow is one of the main drivers for the downstream spawning migration and thus providing an attractive flow at the entrance to the bypass increases the likelihood of eels successfully locating the entrance and subsequently entering. However, they do not necessarily follow the greatest flow past a dam (Piper 2015). Understanding the swimming capabilities and behaviour of emigrating eels at a particular site is essential to ensure that they enter the bypass eventually encounter water velocities that exceed their burst swimming speed, hence preventing them from swimming upstream against bypass flow or a restriction that prevents them from moving back upstream (Baker 2019). The louvers at Ruth Falls provide the attraction flow velocities and the bypass velocities at their burst swimming ability without any sudden acceleration, and so just meets requirements for eel downstream passage based on the Alden modeling (Allen et al 2005) and supported by velocity readings taken during the October 2022 site visit and modeled for the bypass entrance. However, the bypass channel then widens, and velocities change to levels that would allow them to move back upstream. The drops over the stop logs that control the flow in the upper part of the concrete bypass channel are approximately 4 inches which allows the eels to move back upstream and out of the bypass. These 6 stop log weirs are 21 inches high with 4 inches of water over them in a 6 ft wide concrete channel leading to the pipe that carries the flow to the river. They create a series of partial barriers for eels traveling on the bottom which would lead them to use search behaviour that could result in an upstream movement back out of the bypass. Also, the flow velocity over the weirs in the channel is well within the eel swimming ability so they could move upstream back into the louvers in the power canal.

Silver eels travel on the bottom of the watercourse with occasional movements up in the water column. They tend to spend considerable time migrating near the bottom and are often insensitive to velocity changes until they encounter an obstruction, e.g., a physical guidance or exclusion device. Deep bypasses tend to be more effective than surface bypasses for downstream migrant eels (Gosset et al. 2005) (Russon et al. 2010). Movements up in the water column are common at dams and in lakes where the bottom velocities are low and do not provide an indication of downstream direction. These movements do allow some of the eels to find surface bypasses, spill over spillways, or spill under gates but can also attract them to leakage from stoplog sections.

The current design of the louvers, extending to the bottom of the power canal and with the vast majority of the flow past the dam through the canal, provides good attraction and velocities along the bottom (1 to 2 ft/sec). The physical visual behavioural barrier and the water turbulence along the louvers should be effectively leading the eels to the bypass. Full-depth guidance structures like this one can potentially guide all fish species regardless of migration depth (Linnansaari 2017). Louvers are behavioural devices, so it is critical that fish efficiently enter the bypass and do not delay or hold at any partial barrier. However, the surface outlet is 5 ft above the bottom so the eels would tend to collect at the bottom until individuals chose to move up in the water column or numbers build up so those at the top come in contact with the bypass opening and flow. With this dead-end bottom passage causing crowding, many would move back upstream or just to the sides and find their way through the louvers or seek other ways downstream through the fishway or via the spill. As previously noted, this behavior aligns with the findings of NSPI's acoustic tagging study and staff observations with 70% of the eels in the power canal below the louvers while large numbers appear in a mass at the louver vertex. Passage would have been better for the eels with the original bottom outlet, this would not be as good for the fish swimming up in the water column like the target salmon smolts.

Extensive laboratory studies were conducted by EPRI to determine if louver arrays could be employed to guide various riverine fishes and the catadromous American eel (EPRI 2001). The louvers at Ruth Falls meet or exceed the best configurations studied except they found better results if an inclined plane was used to bring eels and benthic species of fish to the surface outlet and a solid wall is placed along the sides at the bottom 1 ft of the louvers. It is also unclear what the bypass-to-louver approach velocity ratio is currently. The ratio should be 1.5 or slightly greater. The current flow through the bypass is 32cfs as set by 4inch high stoplogs so there is a slight change above and below this number as logs are removed or added with headpond fluctuation. Velocity in the bypass notch is calculated to be in the 5.0 to 6.0 ft / second range. We do not have direct measurement of the velocity along the louvers, but the Alden report (Allen et al 2005) set it at 3.1 to 3.4ft/sec depending on generation levels. This gives a ratio of 1.6 to 1.78 which is very good. The United States Bureau of Reclamation (USBR 2006) gives a general design value of 1.1−1.5 for louver bypass systems for all fish species and these louvers meet that guide without acceleration that would cause the fish to avoid passage. This velocity drops when the fish enter the concrete channel with 4 to 4.5 ft /sec with a 4 inch drop over the stoplogs and no bottom flow which acts as a barrier at each of six stoplog sections.

To ensure silver stage eel downstream passage, particular attention needs to be paid to the velocity along the face of the louvers near the bottom of the canal to get it in the right range that will lead the eels to the outlet. We have not been able to check this and are relying on

the Alden modeling (Allen et al 2005) that indicates the velocities are good for guiding the eels to the bypass both at the bottom and along the louvers. Observations made by the NSPI staff have seen large numbers of eels at the bypass entrance, so the louvers are effective at leading them to this location.

The louvers need to be checked along the bottom to see if there are any gaps in the louvers at or near the bottom that the eels may have been passing through in the earlier study. This could not be checked as the headpond was not drawn down this past summer but can be checked and repaired during dam construction.

There needs to be a design change to lead the eels to the existing surface outlet.

There are several modifications required to improve passage efficiency.

5.1 Lead the Eels to the Surface Outlet and Remove All Barriers Delaying Passage.

The surface outlet is just 5 ft above the bottom but for eels traveling on the bottom, in fact usually in close contact with the bottom, this becomes a barrier and causes the eels to begin a search behaviour to find a way past the barrier at the bottom. They would search for an opening with a current to follow. This behaviour would also include rising to find the bypass outlet, but this would involve a significant delay and the search behaviour would include movement through the louvers. Since the eels orient to the bottom, and they need to find the outlet quickly, providing a bottom structure to follow up to the bypass opening simulates the natural outlet from a lake or pond providing an easy to find the downstream route reducing the crowding.

The design shown in Figures 7 and 8 are for a proposed sloping ramp on a 15-degree slope up to the bypass with 1.5ft high sides of the ramp (Amaral 2003) to prevent the eels from moving to and through the louvers as the numbers build up in the narrowing exit area. The ramp is made of (steel or HDPE) plates 10 inches wide on an additional 15-degree slope (30-degrees to the horizontal) overlapping so that there is just a 2-inch opening between them (a 7-inch spacing along the ramp). This meets the best configuration for slope and openings tested by EPRI (EPRI 2001). Similar ramps are used at Garvin's Falls Project and Holyoke Dam louvers in New England. This ramp could be solid but using the angled plate will allow any fish that find themselves under the ramp to move up and follow the ramp to the louver outlet.

To rise the 5 ft, the ramp will extend out into the louvers by 18.66 ft with an upstream end width of 9.5ft and a width at the bypass entrance of 1.5ft. Migrating eels will follow up the ramp which will appear to them to be a solid bottom. The velocities along the ramp will be ideal for downstream passage. If fish that go through the louvers and return ending up under the ramp, they will be able to come up through the openings. There is no loss of habitat with this design and debris build up is not an issue vs fine mesh excluding screening.

A 1ft to 1.5 ft high solid barrier along the full length of the louvers, where the existing louvers meets the bottom of the canal, is needed to guide eels and benthic fish following the bottom to the vortex and the ramp.

There is currently a gap along the sides where the louvers meet the bypass as seen in Figure 3. It is not known if this extends to the bottom but needs to be closed as it is large enough to allow eel

passage as well as other species at a critical point where the water is accelerating and there is a change in the structure.

There is also a gap where the louvers meet the shoreline as can be seen in Figure 1 and these should be blocked off.

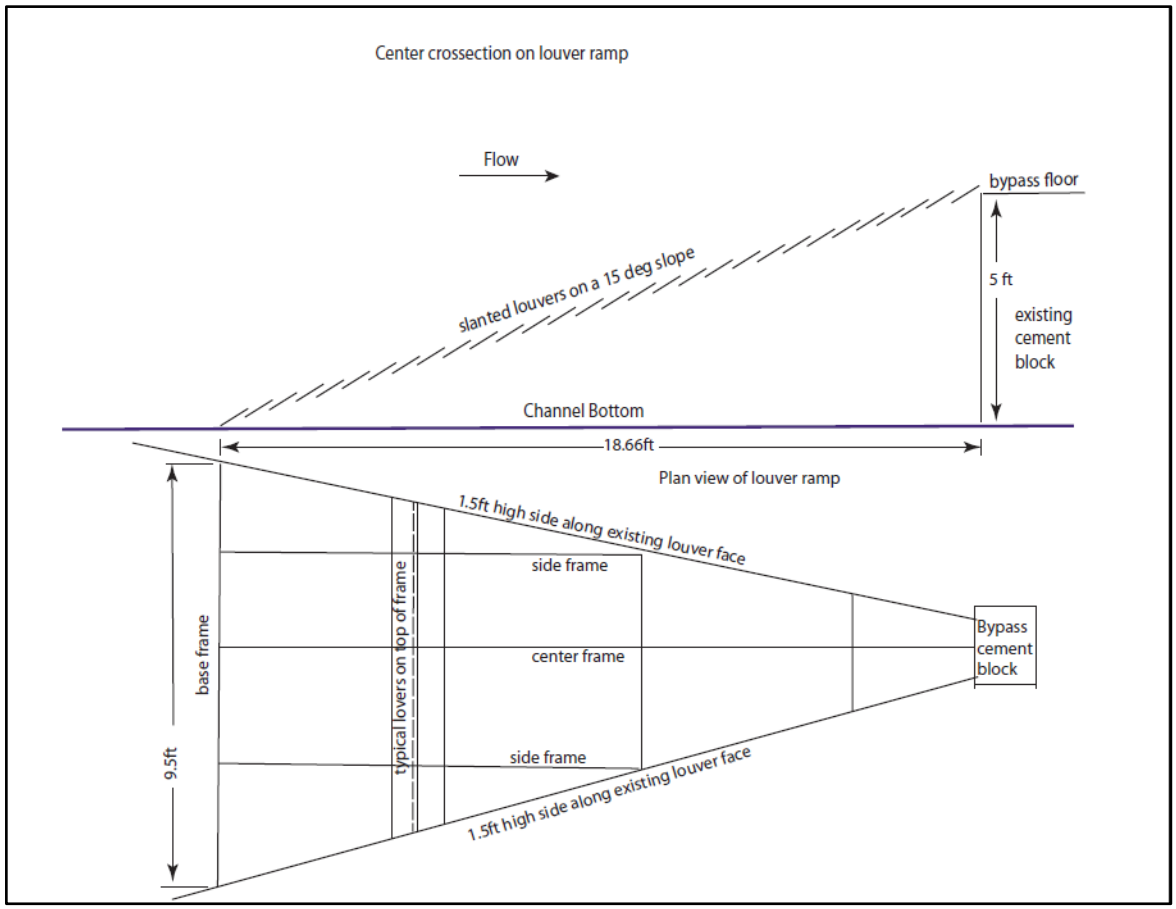


Figure 7: Longitudinal cross section (top) and plan view (bottom)

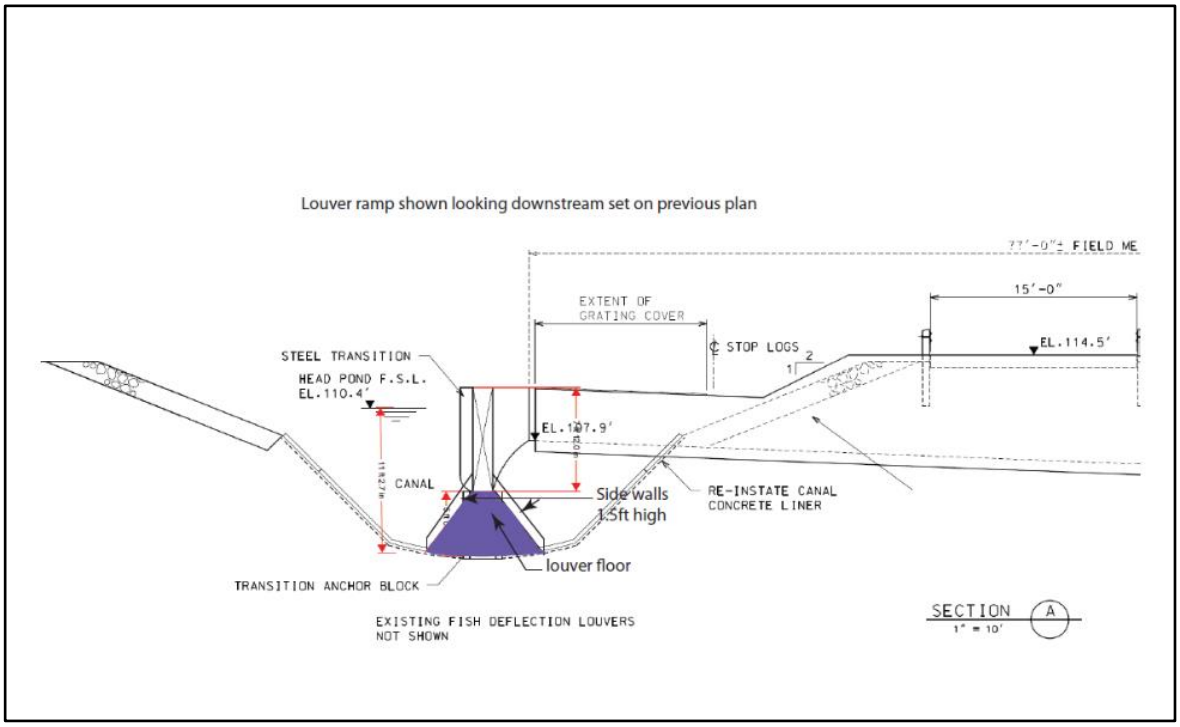


Figure 8: End View Looking Downstream

5.2 Keep the Fish in the Bypass Channel and Improve Downstream Passage

In the concrete channel, it is proposed that a trap funnel be installed at the most upstream stop log guide. This funnel would narrow the opening to 1.25ft and lead the eels and fish up 1ft to create a trap preventing them from easily returning upstream as shown in Figure 9. Then each of the 6 stop log sections that currently present partial barriers to all species will be modified to have a bottom orifice to carry the majority of the flow with an opening of 1 ft high by 3.32 ft wide as shown in Figure 10. The orifices will provide good downstream passage at the bottom for all species and eliminate the series of resting pool areas currently in place that slow eel and all other species migration and encourage them to find another way downstream.

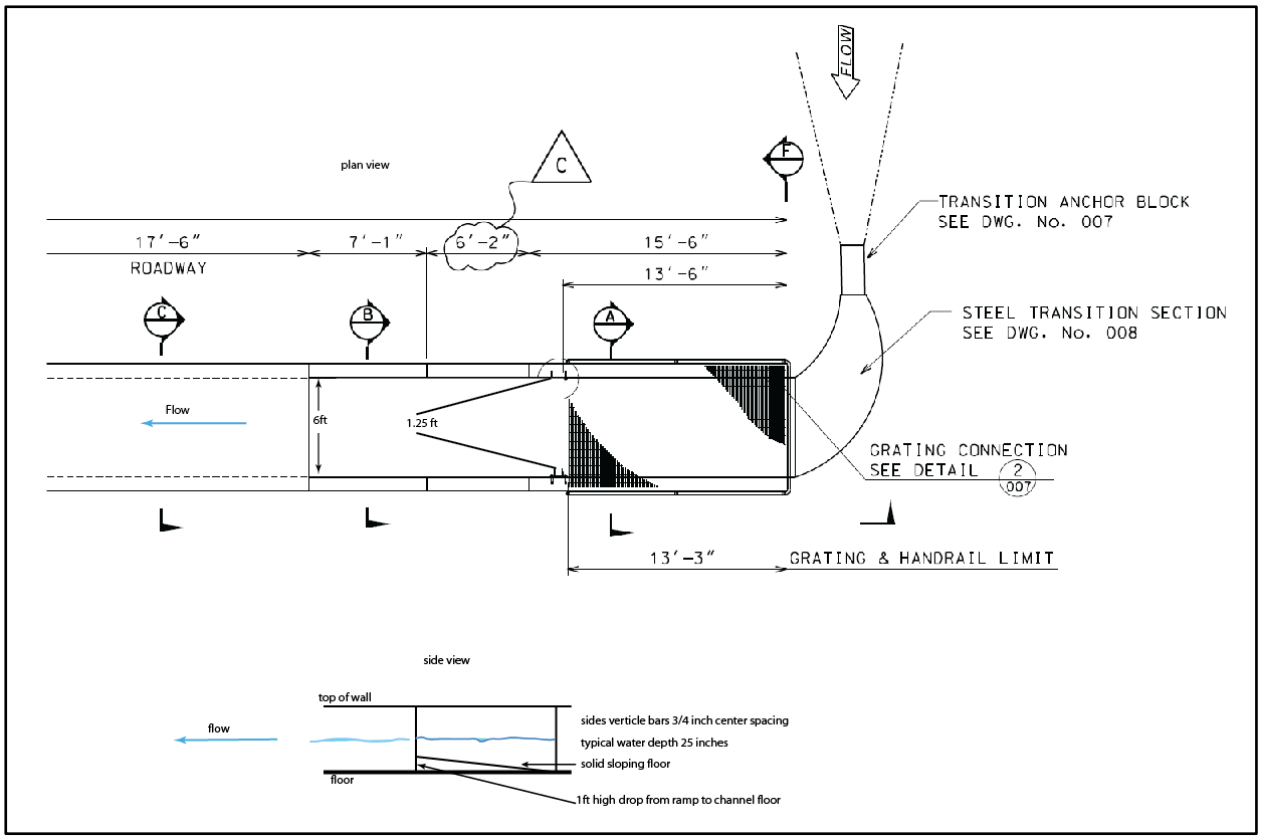


Figure 9: Trap funnel in the bypass concrete channel

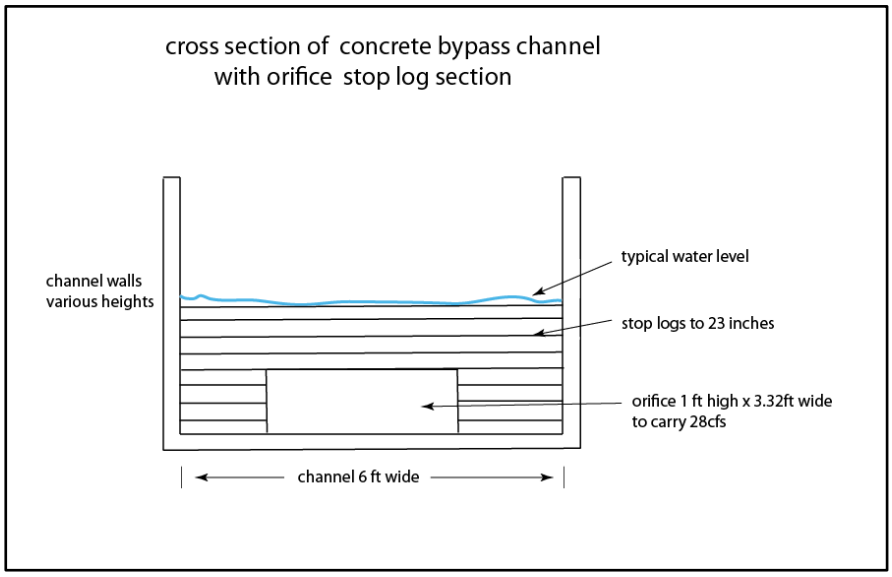


Figure 10: Typical stop log section with orifice

5.3 The Transition from the Bypass Channel to the Pipe

The next problem location is where the cement channel connects to the pipe to the river. This is a very turbulent pool as the flow drops over the stop logs down to a bottom the outlet pipe. To reduce this turbulence and possible harm to the fish, the orifice in the stoplog section entrance to

this pool will lower the drop and a surface mounted slide gate will be installed so that the flow to the pipe can be adjusted to back up water partially filling this pool and dissipating the energy in the flow. The slide gate will allow for adjustment to the water depth in the pool and allow for any future changes in louver water flow. The pipe will need an air vent to balance the pressures in the pipe.

5.4
The louver pipe is to be realigned to enter the fishway between the upper section, the concrete fishway, and the lower section, the channel fishway that enters the river. This is to provide additional attraction flow to the fishway entrance replacing the stoplog leakage currently entering the lower channel fishway section which will no longer be available with the new dam. This louver flow will discharge into the pool between the two fishway sections. The pipe will be realigned to come down from the end of the louver concrete channel on a 3% slope toward the fishway which will leave a 6.45ft drop into the 4ft deep pool just to the left of the counting bypass holding area at the downstream end of the concrete fishway. This overall drop from the 32-inch diameter pipe with the design flows stays within the USFW guideline for safe downstream passage.

6. Conclusions
    1) The installation of a ramp and bottom walls along the louver will greatly improve entrance conditions for eel and other benthic species traveling along the bottom. This option would provide passage for yellow stage eels throughout the year, silver stage eels in the fall, as well as all other species or individual fish that may be swimming deeper than the bypass inlet during downstream habitat migration or seasonal spawning movements. The Alden Research Laboratory modeled flow conditions at this site, with this addition, will provide good downstream passage for the silver stage American eels and all fish species.

    2) It is important that the louver bypass entrance is designed to keep the fish from returning upstream once they enter, so either velocities have to be above their burst/sprint swimming speeds or as proposed a trap funnel to prevent most upstream movement and bottom orifices in the stop logs to provide quick downstream migration.

        The flow in the bypass entrance is just at the sprint speed of the large eels and most species. It could be adjusted by removing stop logs at the second set of stop logs to increase the flow to ensure velocities are high enough to prevent a return upstream, but this would increase the acceleration of the flow above 1m/sec/m guideline for downstream passage at the bypass entrance and the fish would startle and go back upstream. This would also require at least 40cfs which will increase velocities in the fishway channel, where the louver flow is needed for attraction water to the upstream fishway and create velocities and turbulence at those weirs that would not be good for good passage of upstream migrating fish.

        So, stoplogs with orifices will provide the required flow at or just above the minimum of 29cfs and the orifices will provide rapid downstream movement rather than the surface overflow partial barriers.

3) The bypass pipe outfall drop to the river and plunge pool as currently operating meets the drop and depth requirements to ensure it is safe for the eels and all other species and life stages. When it is realigned to the top of the fishway channel the drop to the plunge pool and this pool's water depth exceed the USFW criteria for drops of all species and age classes at the site.

4) We were not able to conduct a condition assessment of the louver system to see if there were damaged louvers or other openings along the bottom that would allow eels to pass through rather than leading along the louvers. Such a condition assessment and repairs will be carried out when the channel is dewatered for the dam construction. A solid wall along this bottom will correct any potential issue of louvers damaged at the bottom but all bent or otherwise damage louvers must be repaired.

5) Additional eel passage monitoring studies are recommended following the modifications suggested above. When these studies are done it is suggested that some eels be released in the channel downstream of the power canal trash racks and some above to determine the effect of the trash racks on passage and calculated louver efficiency. There are suggestions in the literature (Piper 2015) that a portion of the migrating eels would be deterred by the trash racks and seek other ways downstream. Receivers should also be placed in the fishway as the bars on the trap allow for eels to pass downstream and by any gate openings to see if they are using other routes. The current dam has leakage and some spill from stop log sections high on the dam that may have provided an attraction and possible downstream passage for eels. The new dam will have minimal leakage, but it will have bottom outlets in the spill gates that will be very attractive to the eels for downstream passage being both a concentrated flow and at the bottom. This route and the fishway should monitor for downstream passage in future studies.

6) The louvers are the best downstream passage design to guide fish to a surface outlet. There are some weaknesses in the current design for benthic species like the eels and the retaining fish in the bypass channel. The modifications proposed here will correct these weaknesses. The modifications will greatly improve eel downstream passage and passage for all other species as well bringing the system up to new standards.



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APPENDIX I – Upstream Eel Passage

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To: Kailey Osborne, BMgmt, EP
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Nova Scotia Power

January 31, 2023

Re: Concept Design Report - Upstream Eel Passage at the Proposed Refurbished Dam at Ruth Falls

1. Introduction

NSPI requested a concept design be developed for upstream eel passage at the proposed refurbished dam at Ruth Falls. This is an update of the November 2020 report.

2. Eel Behaviour

American eel (Anguilla rostrata) elvers migrate upstream from the ocean in the spring and can continue until fall. The older yellow eels may move repeatedly, irregularly, or seasonally, between freshwater and marine habitat and may continue to move upstream for several years after entering freshwater (Jessop, B.M., 2003). They tend to swim along the bottom but do swim up into the water column occasionally. They have average swimming ability but have strong burst or sprint swimming speeds (Langdon, S.A., 2000). Small eels can climb wet surfaces if they are rough or covered with algae or moss and do pass through some technical fishways particularly pool and weir design where there is a skim of water over algae or moss-covered weirs. They normally move at night but can be seen at any time-of-day swimming short distance of a few meters at a time through the higher velocities to resting areas and congregating in very low velocity areas. Eels start migration behaviours at temperatures above 10^0 C. Therefore, the eel pass will need to operate whenever the water temperatures are at or above 10^0 C to accommodate these movements. (Haro, A. 2013) (Shepard, S.L. 2015)

3. Modern Eel Passes

Generally, technical upstream fishways, such as fish ladders and fish lifts, are ineffective at passing juvenile eels. Therefore, specialized eel pass structures are required to provide a path for them over the dam (Vowles,2015) (Padgett 2020). Larger eels can use typical pool and weir fishways of the design currently in place at Ruth Falls and are often found living in them.

Modern eel passes consist of linear metal, plastic, or wooden channels lined with climbing substrate, and equipped with a pumped water flow and, in some cases, additional attraction water. Eels utilize the wetted substrate to propel themselves up the ramp. In this case, a metal enclosed box similar to that shown in figure 3 is used to protect the eels from predators and keep the pass dark. The entrance is uncovered to allow entrance between high and low tail water levels expected for durations of more than a couple of days at a time so neither short term extreme water levels need to be accommodated.

4. Eel Pass at Ruth Falls

4.1 General

A modern eel pass will be an effective option for upstream passage of eels at the re-constructed Ruth Falls dam. The location of the eel pass entrance at Ruth Falls is dependent on the flow patterns along the bottom below the refurbished dam under the various spill flow regimes.

4.2 Flow Conditions

Hydraulic modeling was used to identify flow patterns, velocities, and depths, downstream of the dam that support fish passage (including eels) under various flow scenarios. The results of this flow modelling have been used to determine the best location for the eel pass entrance which must be located at the most upstream point that the elvers and young yellow stage eels can reach. (Solomon, D. J. 2004) (Watz J. 2019)

The modeling shows the eels will have the ability to move along both banks and along the bottom, across the whole river where the uneven bottom creates low velocities and resting areas every few meters. These areas are coloured blue on figure 1. There was a general bathymetry of the river bottom below the dam in the physical model, so it does not show this fine scale roughness the eels use to travel along the bottom and along the banks. However, the main travel routes will be along the banks as they move short distance using burst speed between the cobbles and boulders.

The eels will come up along both banks in the dark blue-coloured currents. Both banks will have generally equal numbers of eels as the passage is divided by the naturally high velocities across bedrock sills in the river below which they cannot cross due to the smooth bedrock surfaces. Along both banks there is cobble and boulder substrate and shallow flows the eels will use. Along the left bank they continue upstream to large blues are they can rest before following slow currents to the fishway entrance. Those coming up the right bank also come into the blue area suitable for resting and follow the bottom currents toward the gates and over to the fishway. Most of those coming up this right bank will distribute through the rearing area so that the majority are expected to be following the flow from the fishways as it joins the gate flows diagonally across this area and has an influence along the bottom.

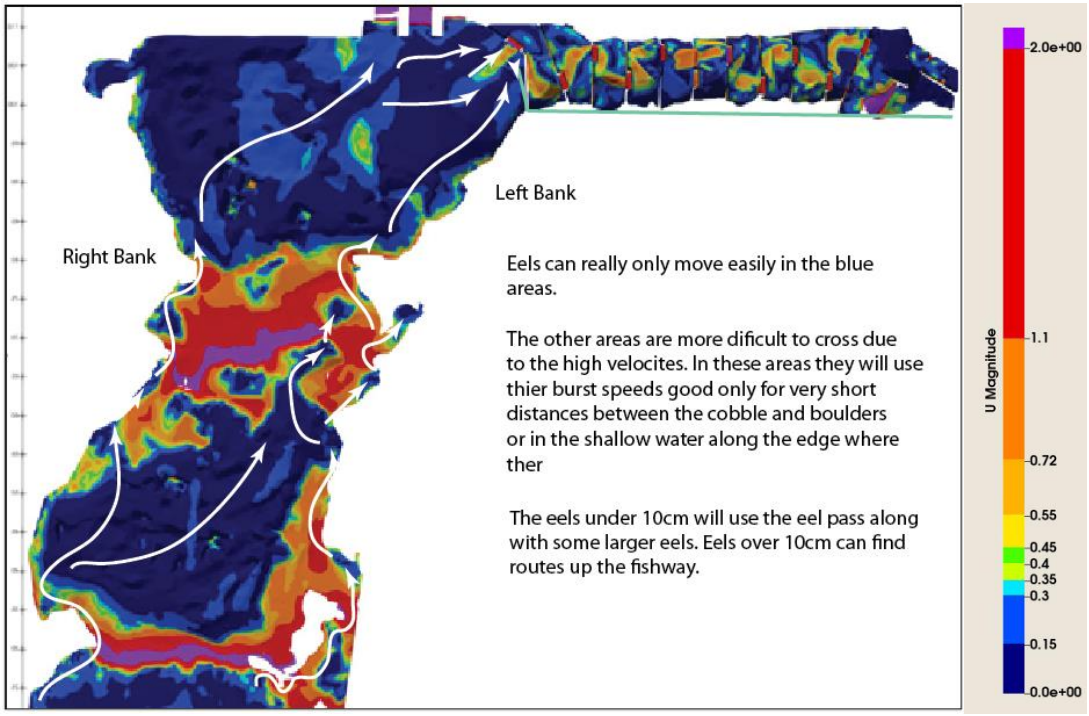


Figure 1: Bottom flow patterns (coloured by velocity) below the refurbished dam.

4.3 Concept Design

As previously noted, for upstream eel passage at the refurbished Ruth Falls dam, it is recommended to use a modern eel pass. The modern eel pass will consist of a covered linear metal, plastic or wooden channel lined with climbing substrate, and equipped with pumped water. The features / modifications of the suggested option are:

1) Louver flow going down a re-designed baffled fishway channel along the toe of the dam

2) Removal of the boulder in front of the spill gate to allow this flow to move straight downstream or be directed more to the right bank and smoothing of the bathymetry in front of the fishway entrance toward the gate flow.

3) The distribution of the gate flow between the three gates in a, 20, 40, 5cfs distribution to reduce the back eddies and provide currents that leads the eels and other fish to the fishway or as needed based on observation following the dam refurbishment.

The flow modelling shows the most appropriate location for eel pass entrance will be immediately downstream of the fishway channel lowest outlet notch on the left bank.

The eel pass, shown as a green line in figure 2, is the most appropriate route under all scenarios that were considered. It is the only good location of the entrance segment. As shown in figure 1, the lower segment will rise quickly to the height of the bank and then run on a very low slope to the corner of the concrete fishway. From there, it will turn to run along the left wall of the fishway to the head pond.

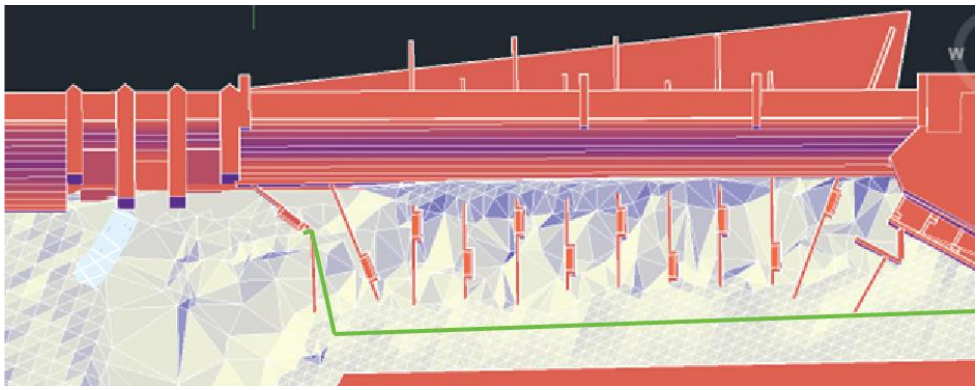


Figure 2: Eel Pass Route

The pass will be enclosed and use eel tiles by Aquatic control, https://www.aquaticcontrol.co.uk/products/eel-passes or Barry and Escott https://www.berryescott.co.uk/eel-tiles, and follow the USFW engineering guide for slope, climb heights and distances between resting areas, water supply design and drop into the head pond. Typical photos of an eel pass using the proposed design are shown as figures 3 to 6.

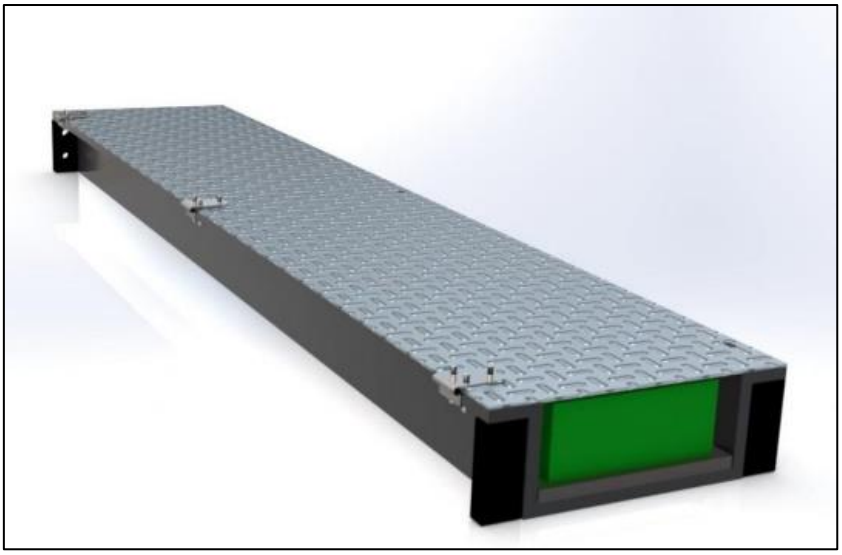


Figure 3: Aquatic enclosed eel pass box



Figure 4: Barry Escott eel boards for elvers and small yellow stage eels. good for eels 50mm to 500mm+ long



Figure 5: A typical design of an enclosed eel pass



Figure 6: An eel using the peg style substrate.

4.4 Design Criteria

To meet the USFW service recommendations, the final design will include:

- Construction Materials:
  - Ramps, pools, and supporting structural elements will be built of rust-resistant metal (typically aluminum) or UV-stable plastic for permanent facilities
- Cover:
  - To minimize predation, a fully secured, opaque cover on the entire unsubmerged length of ramp (and resting sections) the cover will remain open at the entrance below high-water level to allow entry at the water surface.
- Entrance:
  - The following specifications apply to the lower most end of the eel ramp:
    - The entrance will be matched to the surface upon which it rests; this may necessitate shaping the entrance lip to meet an irregular bedrock surface or providing a level sill upon which the entrance invert may rest and will be designed to the specific site chosen.
    - The final location of the entrance will be determined upon completion of the as built fishway and river bottom.
    - The entrance will be uncovered up to the maximum tailwater elevation so that eels may enter at any depth.
    - The entrance will be assessed for the need to be equipped with fencing, netting or other material to guard against predation by birds and carnivorous mammals.
- Climbing substrate:
  - Will run down through the entrance to the minimum tailwater elevation
- Exit: the following specifications apply to the upstream terminal end of the eel ramp:
  - Elevation: the ramp will be well above the fluctuations in headpond levels

- Location: the exit is situated at the head pond between the fishway exit and the utility shed away from turbine intakes, spill gates, and spillways and other structures that may entrain eels.

- Ramp: the following specifications apply to the sloped ramp channel:
  - Height: 6 in. high sidewalls.
  - Width: two tiles wide 3ft 4in wide
  - Length: dependent on slope; uninterrupted runs (i.e., without resting/turning pool) of sloped ramp will not exceed 10 vertical feet; total sloped length without resting pools will be less than 100 feet.
  - Slope: slopes will be 45 degrees or less on the entrance section of the ramp. The second section is very low slope then a 10% slope along the fishway.
  - Depth of Water: ramp will always remain wetted across the surface; depth is dependent on ramp width, flow, slope and influenced by substrate; 1/8 in. of water should be maintained across a flat ramp; flows can be adjusted to provide water depths up to 70mm were needed.
- Resting Section: the following specifications apply to the resting area in the ramp. Turns in the ramp layout will serve as resting pools designed to this standard:
  - Placement: a minimum of one horizontal resting section (resting pool) per 10 vertical feet of ramp.
  - Width: equal to ramp width.
  - Length: equal to the pool width, or longer.
  - Depth of Water: at least 1 inch of water should be maintained in resting pools; to accommodate uniform depth, the resting pools floors may need to be level and deeper than ramp sections to which they are connected.

5. Conclusions

1) The young eels cannot effectively use the pool and weir fishway and require an eel pass to facilitate passage.
2) A modern eel pass will be used at Ruth Falls, following the alignment shown in Figures 1 and 2.
3) The entrance will be on the downstream side, adjacent to the fishway that will provide attraction flow and on the adjacent bank below the low water level.
4) The design criteria for eel passes are set out in the USFW 2019 “Fish Passage Engineering Design Criteria” and will be followed in the detailed engineering design using tiles that have been specifically designed for eels 2 inches (5cm) and up to a size that can use the pool and weir fishway.



Bob Rutherford
President and
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APPENDIX J – Communication Plan

Nova Scotia POWER
An Emera Company

COMMUNICATION PLAN

Ruth Falls Main Dam Refurbishment Project

NSE Application #2019-2638165-00

Revision 2: February 8, 2023

Ruth Falls Main Dam Refurbishment Project Communication Plan

Purpose

Nova Scotia Power (NS Power) is committed to proactively communicating and engaging with community stakeholders, the Mi'kmaq, regulators and the public on the Ruth Falls Main Dam Refurbishment Project (Project). This document is a high-level overview of NS Power's plan for engaging and communicating with the Provincial government, Mi'kmaq and stakeholders regarding 2024 construction activities for the Project. The plan has been prepared as part of NSE Application # 2019-2638165-00

Overview

The Sheet Harbour Hydro system, including generation at Malay Falls and Ruth Falls has been providing clean, renewable electricity to Nova Scotians for nearly one hundred years. The system requires maintenance and upgrades to ensure safe and reliable electricity for many years to come. Nova Scotia Power plans to refurbish the Ruth Falls Main Dam starting in the spring of 2024. The refurbishment will include the replacement of 30 stoplog bays - which adjust water levels in the reservoir - with rubber inflatable dams along the crest of the dam. It also includes replacing 3 deep stoplog bays with sluice gates. To do this safely, NS Power would lower Ruth Falls headpond to pre-inundation conditions.

There are two phases of work associated with the dam refurbishment. The first phase included the installation of the rubber dam control building which was complete in September 2022. Now that this phase of work is complete – all future work will be referred to as the Ruth Falls main dam refurbishment.

NS Power is currently in the regulatory permitting process for the main dam refurbishment, A Fisheries Authorization from DFO (Department of Fisheries and Oceans) and a Watercourse Alteration Approval from NSECC (NS Environment and Climate Change) is required to start any in-stream work. In order to do the work in the safest manner, the Ruth Falls headpond will be temporarily lowered by approximately 18 feet to which is an elevation of 91 feet. This would allow for a dry construction area. The reservoir would remain lowered for approximately 9 months. Pending Permits and approvals, this work is expected to start in July 2024.

Another aspect of this project involves a habitat offsetting project to support recovery efforts of Atlantic Salmon, as part of NS Power's regulatory permitting process. There has been ongoing restoration work on the West River Sheet Harbour to improve Atlantic salmon habitat and restore salmon migration, including significant investment into acid rain mitigation and previous instream habitat restoration. Building on the previous recovery efforts, Nova Scotia Power is partnering with the Mi'kmaw Conservation Group (MCG) and NS Salmon Association on a 7-year habitat offsetting project on the West River Sheet Harbour. The project includes the restoration of a section of the West River to contribute to overall improvements to habitat conditions and fish migration to the upper reaches of the watershed.

There continues to be ongoing engagement between NS Power, the MCG and Millbrook First Nation throughout the planning and implementation of the habitat offsetting program to ensure the community is able to provide input into the program and is aware of any employment opportunities.

Engagement Goals

NS Power's engagement goals are to:

- develop relationships and collaborate with stakeholders, local and Mi'kmaq communities.
- provide accurate and timely Project information that is accessible and easy to understand.
- provide a forum for the exchange of information and dialogue between NS Power, stakeholders and the Mi'kmaq to understand and address areas of interest and potential concerns.

Key Stakeholders and Mi'kmaq Groups

The target audiences and key stakeholders are identified with the associated team member's responsibility to meaningfully engage and communicate relevant Project information.

Elected officials/Municipalities

- Member of Parliament (MP) for central Nova Scotia
- Municipality of the District of Guysborough Eastern-Shore government representatives and key staff
- MLA for the Municipality of the District of Guysborough Eastern-Shore
- Councillor of Preston-Chezzetcook-Eastern-Shore-HRM

Homeowners/Local Residents

- Local community residents on who live/recreation on Ruth Falls head pond
- Local businesses

Mi'kmaq

- Local Mi'kmaq communities, including Millbrook First Nations and the KMKNO

Fishers/Fishing Associations

- Local fishing and recreational associations
  - NS Salmon Association
  - Mi'kmaw Conservation Group
- Regulators, including Nova Scotia Environment (NSE), Department of Fisheries and Oceans (DFO) and Transport Canada (TC)

Engagement Plan

The tables below detail the method and frequency of engagement.

Stakeholder	Contact	Website	Method	Frequency 1	Frequency 2	Frequency 3
Member of Parliament (MP) for Central Nova	Sean Fraser sean.fraser@parl.gc.ca 902-735-7103	Member of Parliament for Central Nova	Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration. In-person meeting with MP, as required.	May 2022	June 2022	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca

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Municipality of the District of Guysborough Council	Fin Armsworthy 902-533-370	Municipality of the District of Guysborough	Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration. In-person meeting with Mayor and Council, as required.	May 2022	June 2022	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca
MLA for Guysborough, Eastern Shore - Tracadie Honorable Greg Morrow	gregmorrow4gt@gmail.com 902-533-2777	Honourable Greg Morrow	Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration. Offer to meet in-person.	May 2022	June 2022	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca

Ruth Falls Main Dam Refurbishment Project
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Stakeholder	Contact	Website	Method	Frequency 1	Frequency 2	Frequency 3
Local residents / property-owners community residents who live / recreation of the Ruth Falls Head Pond	Identify sheet harbour/area residents (larger community) through Canada Post/Postal Code.	N/A	In person delivery of communication notice to property owners whose property is situated along the Ruth Falls Head Pond. Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration.	May 2022	June 2022	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca
Local businesses	Identify sheet harbour/area residents (larger community) through Canada Post/Postal Code.	N/A	Provide communication notice letter via mail to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration.	May 2022	June 2022	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca

Stakeholder	Contact	Website	Method	Frequency	Frequency 2
Nova Scotia Salmon Association (NSSA)	mailto:info@nssalmon.ca	Nova Scotia Salmon Association	Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration.	Ongoing	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca
Mi'kmaw Conservation Group (MCG)	Alyx MacDonald mailto:amacdonald@mikmawconservation.ca	Mi'kmaw Conservation Group	Communications to advise of the Ruth Falls Head Pond	Ongoing	NSP will update all stakeholders once permits are

			drawdown and associated construction activities including expected timeframes and duration.		in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca

Mi'kmaq Community	Contact	Website	Method	Frequency	Frequency 2
Millbrook First Nation and KMKNO	Millbrook First Nation & KMKNO distribution lists.	KMKNO Millbrook First Nation	Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration.	Ongoing	NSP will update the Mi'kmaq community once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca

NOVA SCOTIA

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Our File Number: 95100-30-BED-2019-2638165

May 25, 2023

NOVA SCOTIA POWER INCORPORATED
PO BOX 910, 25 LAKESIDE PARK DR
HALIFAX, NS
B3J 2W5

Dear NOVA SCOTIA POWER INCORPORATED

RE: Application # 2019-2638165-00

With reference to your application please be advised that as a result of an initial review, your application has been deemed incomplete. As a result, Nova Scotia Department of Environment and Climate Change (ECC) is requesting the following information to process your application:

- The fishway modeling provided in the submission recommended the replacement of the lower non-technical fishway weirs, and the removal of rock material and some flattening. It is likely the footprint of the removal of rock material extends beyond where the 11 new concrete weirs are proposed to be placed. Provide updated or additional figures of the fishway portion of the refurbishment project. Provide clarification on the proposed footprint of the changes to the fishway portion of the refurbishment project.
- The Species at Risk report provided by the Atlantic Canada Conservation Data Centre is out of date. Provide an updated Species at Risk report.
- Conveyance of 1:10 year flood conditions information provided in the submission is based upon a six-hour rainfall duration. 1:10 year flood conditions should be based on 24-hour rainfall. Provide updated information that 1:10 year flood conditions, based on 24-hour rainfall has been considered in assessing the conveyance capacity for the project duration.
- It is stated in the submission that the headwaters of Ruth Falls have storage capacity to attenuate storm water flow in lowered reservoir conditions. Please quantify the amount of storage available, and how that was included in the modeling of the stated ability to accommodate a 1:10 year flow condition.
- It is stated in the submission that the access roads will be designed to be overtopped in storm conditions, after the removal of the temporary bridge. Provide standard industry reference regarding the construction details of a stable road that is capable of being overtopped in conditions of fast flow.
- Provide a detailed sediment release monitoring plan that considers the duration of the project.

- Vegetation monitoring plots in Wetlands 5 and 16 appear to be outside the delineated wetland boundary. Provide confirmation that the wetland boundaries in the submission are correct and clarify whether the previously mentioned vegetation plots are in upland habitat or wetland habitat.

ECC is requesting this information be submitted by August 25, 2023. Please note that in accordance with *Section 7 of the Approval and Notification Procedure Regulations,* if information is not supplied by an applicant within 3 months of a request, the Minister may reject your application. Should your application be rejected, you will be informed of that decision in writing.

Yours truly,
Erik Van Lunen



cc:

Nova Scotia POWER
An Emera Company

Environmental & Project Description for Construction Activities

Sheet Harbour Hydro System

Ruth Falls Dam Refurbishment

2024

Nova Scotia POWER
An Emera Company

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PROJECT OVERVIEW

NS Power is proposing refurbishment of the Ruth Falls Dam (the "Project"), located on the Sheet Harbour Hydro System in Sheet Harbour NS, in 2024. This work is necessary in order to address structural and freeboard deficiencies and to meet the requirements of the Canadian Dam Association (CDA) Dam Safety Guidelines. Refurbishment of the Ruth Falls Dam was identified as a high priority within NS Power's dam safety risk prioritization due to the deteriorated condition of the concrete structures and the stability deficiencies in the embankment and spillway/sluiceway structures. The project involves refurbishing the main dam by replacing the existing 30 stop log bays with a series of rubber dams, installing an uncontrolled overflow spillway at the northwest end of the dam, refacing the concrete on the crest and downstream slope of the main dam ogee section, and replacing the sluiceway bays with vertical lift gates. In conjunction with main dam refurbishments, improvements will be made to the upstream fishway, and downstream louvre system to make it more suitable for all fish species migrating around the dam to complete their lifecycle. The addition of an upstream eel pass will also be installed to support specific upstream passage for eels.

Activities proposed for the Project include lowering the Ruth Falls Headpond and canal approximately 18 feet while also dewatering the Ruth Falls fish ladder and downstream bypass during construction. During construction fish will be moved downstream via the sluiceway bay and/or spillway.

The Project is scheduled to take approximately 9 months to complete starting with the installation of the downstream access roads and temporary bridge in early July 2024. After the water is drawn down, the installation of upstream access roads will take place and main dam construction will commence in mid-July 2024.

NS Power has provided several iterations of the Ruth Falls Dam Refurbishment Project Watercourse Alteration Application (2019-2638165-00) to NSECC since the first application in December 2019. The scope and timeline of the project has been adjusted several times with a separate approval received for the refurbishment of the sluiceway/installation of the vertical lift gates and control building in advance of the main dam refurbishment under approval 2021-2840307-00 in October of 2021. In 2022, NS Power made the decision to proceed with aspects of approval 2021-2840307-00 in June 2022, but not the sluiceway refurbishment. An amended approval was received in September 2022 (2021-2840307-01) excluding the sluiceway refurbishment/vertical lift gate scope, to complete the scope associated with the new control building. NS Power notified NSECC at this time that the sluiceway refurbishment/vertical lift gate installation is planned to take place under the main dam refurbishment scope (application 2019-2638165-00). NS Power received an additional letter from NSECC on May 25th, 2023 stating the application remained incomplete. NS Power has provided response to the letter within this updated Project and Environmental Description document.

NS Power has provided a summary timeline of the regulatory process below:

Main Dam Refurbishment Application 2019-2638165-00
NS Power Initial Application Submission December 20, 2019
NSECC Incomplete Letter Received January 7, 2020
NS Power Updated Submission February 27, 2020
NSECC Incomplete Letter Received March 25, 2020
NS Power Updated Submission June 22, 2020
NSECC Incomplete Letter Received March 31, 2021
NS Power Updated Submission April 14, 2021
NSECC Incomplete Letter Received June 18, 2021
NS Power Updated Submission February 14, 2022
NSECC Incomplete Letter Received April 1, 2022
NS Power Updated Submission May 6, 2022
NSECC Incomplete Letter Received December 9, 2023
NS Power Updated Submission March 20, 2023
NSECC Incomplete Letter Received May 25, 2023

Vertical Lift Gate / Control Building Approval 2021-2840307-00
NS Power Initial Submission July 12, 2021
NSECC Approval Received October 22, 2021
NS Power Amendment Submission July 11, 2022
NSECC Amended Approval Received September 5, 2022

Previous applications as noted above reference construction taking place in a phased approach, with phase I including new control building with Ruth Headpond at normal operating levels, and phase II including a drawdown of Ruth Headpond and refurbishment of the remaining dam structure. Phasing of construction is no longer required for the purposes of this application (2019-2638165-00). Work related to the control building was completed in 2022 under approval Approval 2021-2840307-00), which has been closed.

This document provides an updated project and environmental description to support NS Power's application for watercourse alteration approval 2019-2638165-00 for the Project and supersedes previous iterations submitted to NSECC. The information in this document is intended to address NSECC's most recent incomplete letter, issued to NS Power on May 25, 2023. The following concordance table outlines the specific questions within the Incomplete Letter and the location within this document where the corresponding responses can be found.

NSECC Information Request	Response Location
The fishway modeling provided in the submission recommended the replacement of the lower non-technical fishway weirs, and the removal of rock material and some flattening. It is likely the footprint of the removal of rock material extends beyond where the 11 new concrete weirs are proposed to be placed. Provide updated or additional figures of the fishway portion of the refurbishment project. Provide clarification on the proposed footprint of the changes to the fishway portion of the refurbishment project.	Section 5.2, Appendix K
The Species at Risk report provided by the Atlantic Canada Conservation Data Centre is out of date. Provide an updated Species at Risk report.	Section 5.5, Appendix L
Conveyance of 1:10 year flood conditions information provided in the submission is based upon a six-hour rainfall duration. 1:10 year flood conditions should be based on 24-hour rainfall. Provide updated information that 1:10 year flood conditions, based on 24-hour rainfall has been considered in assessing the conveyance capacity for the project duration.	Section 4.4
It is stated in the submission that the headwaters of Ruth Falls have storage capacity to attenuate storm water flow in lowered reservoir conditions. Please quantify the amount of storage available, and how that was included in the modeling of the stated ability to accommodate a 1:10 year flow condition.	Section 4.4
It is stated in the submission that the access roads will be designed to be overtopped in storm conditions, after the removal of the temporary bridge. Provide standard industry reference regarding the construction details of a stable road that is capable of being overtopped in conditions of fast flow.	Section 4.4
Provide a detailed sediment release monitoring plan that considers the duration of the project.	Section 5.3.1.
Vegetation monitoring plots in Wetlands 5 and 16 appear to be outside the delineated wetland boundary. Provide confirmation that the wetland boundaries in the submission are correct and clarify whether the previously mentioned vegetation plots are in upland habitat or wetland habitat.	Section 5.5

This project and environmental description is also intended to address all questions and information requests previously directed to NS Power in incomplete letters issued by NSECC for application 2019-2638165-00 as outlined above. Therefore, NS Power assumes that all previous incomplete letters are no longer relevant, and any remaining questions or information requests directed to NS Power through a new incomplete letter, if required.

Further, NS Power assumes that, given the information in this document has been provided to NSECC several times and NSECC has had adequate time to review and request additional information (as demonstrated through the 7 incomplete letters for this application), that any further information requests will be pertaining only to new information that has not been previously reviewed by NSECC.

1.0 INTRODUCTION

The Sheet Harbour Hydro system is located on the East River in Halifax County, with the easternmost extents of the drainage area extending into Guysborough County. The system has a drainage area of 573.9 km^2. Presently there are 6 controlled reservoirs, including Governor, Sloane, Anti Dam, Marshall, Malay Falls Headpond and Ruth Falls Headpond. Ten Mile Reservoir was previously controlled until the dam was removed in 2012.

Governor Reservoir is located at the head waters of Twelve Mile Stream, which flows through Union Flowage into Marshall Reservoir. Sloane Reservoir is located near the headwaters of Seventeen Mile Stream which passes through Anti Dam Reservoir and into Marshall. Marshall Reservoir comprises the principle reservoir for the Sheet Harbour System. Malay Falls Headpond is directly downstream from Marshall; the Malay Falls power canal conducts water from the Malay Falls Headpond to the generating station intake. Flow discharges from Malay Falls Generating Station into the Ruth Falls Headpond. A power canal moves water from the Ruth Falls Headpond to the Ruth Falls Generating Station, where it is discharged into the original East River Sheet Harbour channel. Malay Falls Generating Station is capable of producing 3.6 MW of power, while Ruth Falls is capable of producing 7.0 MW of power. Mapping of the Sheet Harbour System can be found in Appendix A.

The Ruth Falls dam has structures to support upstream and downstream fish passage. The upstream fishway consists of a technical (concrete) ladder section on the upper section which connects to a non-technical channel fishway that runs along the toe of the dam. Downstream passage is facilitated by a louvre system which is situated at the entrance of the powerhouse canal. The louvre redirects fish through a bypass downstream of the dam.

2.0 CONSTRUCTION

2.1 Existing Project Area

Ruth Falls Headpond is located immediately downstream of the Malay Falls Headpond. The reservoir is contained by a 190 m (620') long earthfill embankment and a 150 m (490') long concrete spillway structure. The spillway structure consists of thirty stop-log overflow bays, a 15.2 m long three-bay stoplog-controlled sluiceway section in the center, and two short concrete gravity bulkhead sections that abut either side of the spillway. The crest elevation of the spillway is 31.7 m (104.00') and stoplogs can be installed to an elevation of 33.3 m (109.25'). The dam contains a fish ladder for the upward migration of fish and a louver/fish bypass system located in the canal for the downward migration of fish. The louvers prevent fish from entering the power canal by directing them to a fish bypass pipe that carries fish to an area of the spillway adjacent to the fish ladder entrance. Refer to Appendix B for pre-construction site photos.

Water levels in Ruth Headpond can fluctuate between the full supply level of 33.7 m (110.5') and the low supply level of 27.5 m (90.1'). A minimum operating level of 33.3 m (109.25') is observed from April 1 - November 30 each year. The Ruth Falls Headpond has a storage volume of 2.3M cubic meters (1888 acre-ft) when at the minimum operating level of 109.25 ft.

The site will be surveyed prior to the construction works to ensure that the elevations are accurate with respect to the current configuration and the new design. As noted by NSECC, the Sheet Harbour Hydro System Water Approval shows the minimum operating level of Ruth Headpond

between April 1-November 30 as 109.4 ft. The engineering drawings associated with the Project, show the crest of the refurbished dam structure to be below this minimum level, at 109.25 ft. Discrepancies noted between minimum operating levels of the reservoir (109.4ft and 109.25 ft) are datum related, as there have been many datums used over the years, including different coordinate systems and local datums. The minimum operating levels of the reservoir based on engineering drawings and Dam Safety Reviews is noted to be 109.25 ft. The current minimum operating level will remain unchanged with the new dam design.

As per the NSECC Sheet Harbour System Water Approval, the following ecological maintenance flows are provided at Ruth Falls:

- Year round – 35 cfs downstream of the Ruth Falls Dam
- April 1- November 30th – 6 cfs provided to fish ladder, 29 cfs provided to operate the louvers and downstream bypass
- May 15 – November 1 – salmon trap in the fish ladder in operation. DFO is contacted if the trap exceeds 50 salmon in order to determine the target release locations.

Water elevations in Ruth Falls are mostly controlled to operate the fish ladder, louver and bypass system and to generate electricity at Ruth Falls generating station. Excess water is spilled through the dam by manually removing spillplanks or stoplogs from the spillway and/or sluiceway bays. The Ruth Falls Dam has an overflow spill capacity of approximately 350 cfs while at full supply elevation of 110.5 ft. The overflow spill is provided over the stoplogs along the full length of the dam. From May to August 2021, overflow spill was approximately 350 cfs, this was due to a lack of generation a result of Ruth Falls switch gear refurbishment project.

Atlantic salmon have been the species of interest historically in the system for DFO. However, the low numbers of returns on East River in recent years indicate that there is unlikely a breeding population. Work is ongoing to improve the water quality in the West River and it may be that higher returns are observed in the East River over time. Of note, only 11 salmon have been captured in the Ruth Falls fish ladder salmon trap since 2007 with no salmon being captured in 2017 and 2018, two in 2019, and one in 2020. There were no salmon captured in 2021 and 2022.

Alewife and American eel are species of interest that have been observed in Ruth Falls headpond and below the Ruth falls dam and are known to ascend the Ruth falls fish ladder.

The Ruth Falls Headpond was sampled by NS Power in 2017 during the relicensing of the Sheet Harbour Hydro System using gill nets, minnow traps and eel pots. Species found to be present in the headpond include American eel, alewife, brown bullhead, lake chub, golden shiner, speckled trout, white sucker and yellow perch. High concentrations of mercury have been observed in white perch, yellow perch and speckled trout in the system. No aquatic invasive species have been observed in the project area or adjacent habitat. No critical habitat for aquatic species at risk is found in the area.

In July 2021, NS Power staff observed a Barn Swallow nest located in the centre of the dam on top of one of the concrete piers and underneath the deck of the dam. An additional Barn swallow nest was also observed on the bridge across the upstream side of the canal. The NS Department of LNatural Resources and Renewables (DNRR) issued NS Power a Species at Risk (SAR) permit which granted permission to remove the nests, the use of deterrents to temporarily prevent nesting during construction activities and the installation of an alternative nesting structure fitted with nesting cups at a 3:1 ratio. The nesting structure was installed and a deterrent program was put in place during Phase I construction which took place in 2022. This permit expires March 31, 2023. A new SAR permit will be obtained for the 2024 construction season to deter birds from nesting within the construction area.

Twenty-one (21) wetlands that are contiguous to the Ruth Falls headpond edge have been identified through previous assessment conducted in 2007. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was not identified during the 2007 survey. For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond. 6 of the 21 wetlands identified at the time of the survey were characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered. Refer to Section 5.5 - Wetlands and Rare Species for more detail.

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. An updated ACCDC search was completed in 2023 for the study area, there are no records of aquatic species of conservation concern or endangered species within the area. Refer to Section 5.5 - Wetlands and Rare Species and Appendix L – ACCDC Report for full details.

2.2 Proposed Refurbishment Activities

The proposed refurbishment activities are listed below. Please note that the installation of the control building (under separate Approval 2021-2840307-00) is complete and is not included in the scope of work below:

- Installation of downstream access road and temporary bridge (to start prior to drawdown activities). Downstream access roads will need to be in place in order to access the right side of the dam
- Lowering of Ruth Falls Headpond approximately 18 ft.

- Dewatering of the Ruth Falls fishladder and canal and fish rescue
- Installation of temporary access for machinery on the upstream side of the dam – access from the right side and the left side. The area in front of the sluiceway bays will remain open to allow water to pass through.
- Removal of stoplogs from existing sluiceway bays, prepping of bays, and installation of vertical lift gates.
- Removal of the existing stoplogs from stoplog bays, piers, stoplog lifter and walkway.
- Reface the concrete on the crest and downstream slope of the spillway ogee sections.
- Installation of new rubber dam bladders on the crest of the ogee spillway sections.
- Construction of a free overflow spillway section at the right end of the dam.
- Installation of a new steel walkway for access across the dam.
- Improvements to the upstream fishway.
- Improvements to the existing downstream louvre system.
- Installation of an upstream eel ramp.
- Removal of the temporary access road material.
- Watering up of the headpond to within normal operating levels, return of fish ladder and louvre system to normal operation.
- Contractor Demobilization from site.

2.3 Construction Schedule

The Project is scheduled to take approximately 9 months to complete starting with the installation of the downstream access roads and temporary bridge in early July 2024. After the water is drawn down, the installation of upstream access roads will take place and main dam construction will commence in mid July 2024. The work includes both the lowering and subsequent recharging of water in the headpond. The water level will be drawn down after July 10th, allowing time for fish eggs to hatch, and YoY Gaspereau to move downstream naturally or transported during fish rescue. Lowering the reservoir will occur after July 10th, and will take approximately 8 days; however, NS Power has incorporated additional time into the schedule so that the drawdown can be conducted slowly in a controlled manner to ensure upstream and downstream erosion or scour is minimized and the level of entrainment of fish is low.

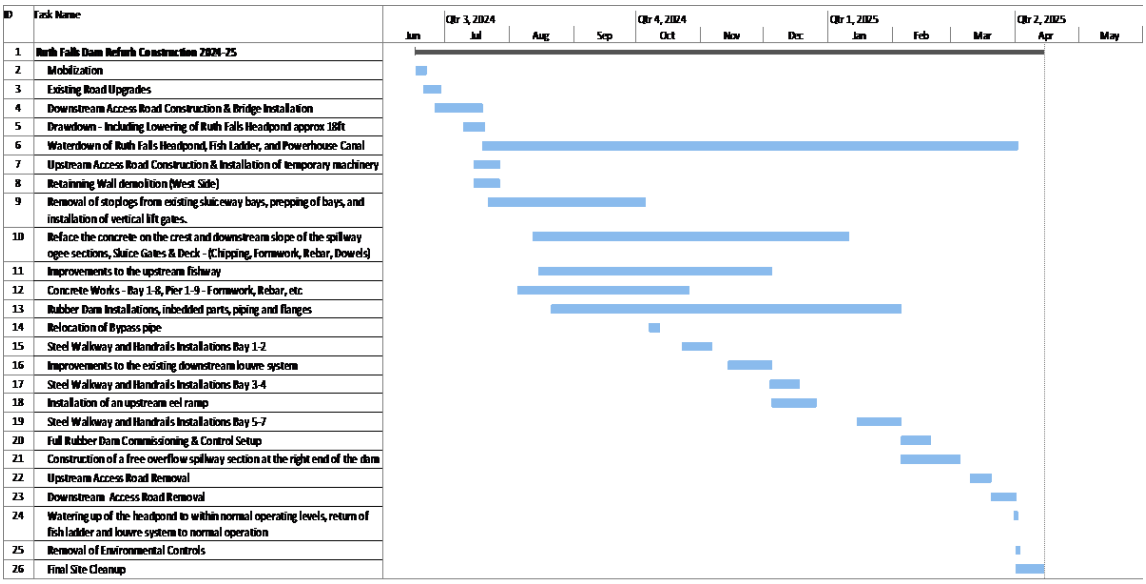
The construction schedule is as follows:

- Installation of the downstream access roads and temporary bridge will commence two weeks prior to the start of the drawdown. This work is intended to be completed prior to the drawdown in preparation for main dam construction work to take place in mid-July after the lowering of Ruth Falls Headpond. Access to the right side of the dam will be provided by the downstream access roads connected by the temporary bridge.

- Construction activities associated with the sluiceway, main dam refurbishment, and improvements to fish passage will commence in mid-July after the lowering of Ruth falls headpond. The lowering of the Ruth Falls Headpond will commence no earlier than July 10th 2024 and will take place over the course of 8 days.
- After the water is at an elevation of 91 ft, construction activities will then begin with the installation of the upstream access roads. Once access is installed on the upstream side, demolition of the west retaining wall and removal of stoplogs, bay prep and installation of vertical lift gates will take place. NS Power will aim to complete the new sluice gates first in the low flow window of July-September. It is anticipated that each gate bay will take approximately 3-4 weeks to complete, and a total of 9-12 weeks to complete the entire sluice structure. This may be affected by weather should heavy inflows be required to be passed for a significant period of time.
- Next, refacing of the crest and downstream side of the dam including chipping, rebar, form work and dowels will take place. Improvements to the upstream fishway, concrete works on bay 1-8 and pier 1-9, and rubber dam installation will take place simultaneously.
- Relocation of the bypass pipe, installation of handrails, improvements to the louvre system and installation of the eel ramp will take place between October and December followed by the rubberdam commissioning / control set up and construction of the overflow spillway on the western side.
- Once all main construction works are complete – the contractor will remove the upstream access roads followed by the downstream access roads including the temporary bridge. The watering up of the Ruth Falls headpond is expected to take one day which will be complete by April 1, 2025. Removal of all applicable environmental controls and final site clean-up will take place over the following weeks.

To accomplish this scope and construction schedule, NS Power is requesting an approval expiry date of December 31, 2025.

NS Power has developed a Gantt chart which outlines the detailed work schedule. Please note that the schedule may not be followed exactly as indicated and is subject to change. Refer to Figure 1 – Construction Sequencing Gantt Chart for full details.



ID	Task Name
1	Ruth Falls Dam Refurb Construction 2024-25
2	Mobilization
3	Existing Road Upgrades
4	Downstream Access Road Construction & Bridge Installation
5	Drawdown - Including Lowering of Ruth Falls Headpond approx 18ft
6	Waterdown of Ruth Falls Headpond, Fish Ladder, and Powerhouse Canal
7	Upstream Access Road Construction & Installation of temporary machinery
8	Retainning Wall demolition (West Side)
9	Removal of stoplogs from existing sluiceway bays, prepping of bays, and installation of vertical lift gates.
10	Reface the concrete on the crest and downstream slope of the spillway ogee sections, Sluice Gates & Deck - (Chipping, Formwork, Rebar, Dowels)
11	Improvements to the upstream fishway
12	Concrete Works - Bay 1-8, Pier 1-9 - Formwork, Rebar, etc.
13	Rubber Dam Installations, inbedded parts, piping and flanges
14	Relocation of Bypass pipe
15	Steel Walkway and Handrails Installations Bay 1-2
16	Improvements to the existing downstream louvre system
17	Steel Walkway and Handrails Installations Bay 3-4
18	Installation of an upstream eel ramp
19	Steel Walkway and Handrails Installations Bay 5-7
20	Full Rubber Dam Commissioning & Control Setup
21	Construction of a free overflow spillway section at the right end of the dam
22	Upstream Access Road Removal
23	Downstream Access Road Removal
24	Watering up of the headpond to within normal operating levels, return of fish ladder and louvre system to normal operation
25	Removal of Environmental Controls
26	Final Site Cleanup

Figure 1: Construction Sequencing Gantt Chart

3.0 REGULATORY PERMITS/APPROVALS

In addition to the Watercourse Alteration Approval required in accordance with Section 5(A)(1)(c) of the Activities Designation Regulations of the *Environment Act*, an authorization under Section 35(2)(b) of the *Fisheries Act* is required for this scope of work.

A variance to the Sheet Harbour Hydro System Water Approval (#2008-062826-01) for water withdrawal/storage will also be required in order to carry out the proposed scope of work. This includes the following:

- operation of the Ruth Falls fishladder, louvre system and salmon trap, which will be non-operational throughout construction
- 35 cfs maintenance flow, during the refurbishment of the middle sluiceway bay and installation of vertical lift gate (approximately 4 weeks).
- minimum water elevations for the period of April 1-November 30th for Ruth Falls Headpond.
- Supplementary flow release requirements for Atlantic salmon, which are unable to be adhered to during construction due to lowered water levels. As part of NS Power's water management plan water will be free flowing through the deep sloplog/sluiceway bay, providing continuous downstream flow, however standard supplementary releases for specific time periods will not be provided.

A Species at Risk permit will be obtained by NSDNRR as per Section 50(1), 51(a) of the *Wildlife Act*, and Section 14(1) of the *Endangered Species Act*.

An authorization in accordance with Transport Canada's Navigation Protection Program is also required for construction activities for the Project.

4.0 WATER MANAGEMENT DURING CONSTRUCTION

4.1 Drawdown of Ruth Heapdond

In an effort to provide the safest and most reliable construction execution during one drawdown period, lowering the reservoir to elevation 91 ft is required. A construction elevation of 91 ft (approximately 18 ft below minimum operating level of 109.25 ft) allows for the portions of the concrete dam to be refurbished to be fully exposed. The canal, fishladder, and downstream bypass will be dewatered and a fish rescue completed by qualified staff. The drawdown to 91 ft represents a difference in storage of approximately 2.295M cubic meters or 1884-acre-ft from full supply (2.3M m3 and 1888 acre-ft, respectively).

To complete the drawdown, NS Power will use the Ruth Falls generating units to initially lower the headpond elevation from full supply level at 33.7 m (110.5 ft) (if required) to the minimum operating level of 33.3 m (109.25 ft). Once the headpond reaches an elevation of 33.3 m (109.25 ft) – the top of the spillway stoplogs - the drawdown will be controlled by removing the spillway stoplogs until an elevation of 31.7 m (104.1 ft) - the concrete spillway crest - is reached. After this point, the sluiceway bay stop logs will removed be until the desired elevation of 27.7 m (91 ft) is achieved. The drawdown flow will be directed through areas that are part of the normal flowage channels. At least one gate will remain in full open throughout construction to maintain lowered water elevations and provide a method of fish passage.

Table 1 displays the decrease in flow velocities as the headpond elevation lowers over the course of the 8-day drawdown period.

Table 1: Estimated Flow and Velocities for an 8-day drawdown of Ruth Falls Heapond

Time (day)	Beginning Elevation (ft)	Bays 1-15	Bays 16-30	Outer Sluice	Middle Sluice Opening (ft)	Total Discharge (cfs)	Velocity through each bay (fps)	Downstream Velocity (fps)
0	109.2	1	0	0	0	159	2.1	6.6
0.5	109.1	1	1	1	1	281	2.0	8.5
1	108.1	2	1	1	1	102	1.8	5.7
1.5	107.6	2	2	2	2	93	1.4	5.4
2	107.4	3	2	2	2	189	2.2	8.6
2.5	106.6	3	3	3	3	91	1.4	5.4
3	106.4	4	3	3	3	190	2.3	8.6
3.5	105.6	4	4	4	4	91	1.4	5.4
4	105.4	5	4	4	4	190	2.3	8.6
4.5	104.6	5	5	5	5	91	1.4	5.4
5	104.5	5	5	7	7	99	3.1	5.7
5.5	103.7	5	5	9	9	187	3.8	8.6
6	102.2	5	5	11	11	244	4.2	8.1
6.5	100.3	5	5	13	13	258	4.3	8.3
7	96.2	5	5	15	15	90	3.0	5.4
7.5	94.2	5	5	15	17	30	1.0	3.4
8	93.1	5	5	15	19	51	3.6	4.2
8.5	91.0	5	5	15	19			

The flow downstream will be controlled in order to avoid scour and sedimentation. The 35 cfs maintenance flow and downstream fish passage will be provided through the open sluiceway bays with the exception of when the centre bay is being worked on. During this time, water will be pumped around the centre bay down through the other bays which sit at a higher elevation to maintain flow. NS Power may not be able to provide the entire 35 cfs by pumping activities, but will provide as much flow as possible using multiple pumpsQualified NS Power personnel will be on site during the drawdown to monitor water quality (visual observations) and conduct a fish rescue for any isolated fish in the headpond and canal. Once the headpond level reaches 91 ft most of the canal will be dewatered. NS Power will drain the remaining water using the drain valve at the powerhouse.

Following the completion of refurbishment activities, the headpond will be subsequently recharged at a controlled rate.

4.2 Temporary Structures

Prior to the drawdown taking place, a temporary rockfill downstream access road will be constructed using clean rock that is free of fines with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes. The downstream access road will be equipped with a temporary bridge that will be located over the spillway discharge channel (refer to Appendix C - Proposed Water Management Structures). The temporary bridge will be approximately 4 ft tall and 42 ft wide and will be constructed to pass upwards of 3200 cfs (refer to Table 2 for details). The bridge will be constructed using steel beams that are removable using an excavator should additional if required if a large rain event is anticipated (refer to section 4.4).

Ice build-up is not anticipated on the temporary access road as the water will be constantly flowing downstream. Excavators will be using the access roads on a continual basis during construction which will break up any ice that could accumulate. If significant ice accumulation was to occur, the ice could be removed physically by the contractor.

Following the completion of the drawdown to elevation 91 ft, two rockfill access roads will be constructed on the upstream side of the dam; one extending from the left abutment to the left end of the sluiceway, and one extending from the right abutment to the right end of the sluiceway. The access roads will be constructed to elevation 100.0 ft (30.5 m) with a crest width of 12.0 ft (3.6 m) and 1.5H:1V side slopes using clean rock material that is free of fines. The left upstream access road will be 209 ft (64 m) long while the right upstream access road will be 343 ft (104.5 m) long. The estimated temporary instream footprint of the left access road is 576 ft^2 (535 m^2) while the right access road is 747 ft^2 (694 m^2). Using available bathymetry, approximately 74% of the upstream access road will be placed in the dry at an elevation of 91.0 ft.

The upstream access roads will serve primarily to provide access for machinery to complete refurbishment activities. It should be noted that there are no cofferdams being constructed on the construction site that are required to hold back water; there is no requirement for construction to take place behind cofferdams, or to isolate work areas. Temporary access roads are being constructed of clean rockfill, and water will be allowed to equalize between the dam structure and roads. The drawdown to the desired 91 ft is the primary means of water control for the Project.

All access roads will be developed to and meet industry standards. This includes adhering to required crest width and height to accommodate machinery. The access roads are built to be held in place until removed and therefore, are capable of withstanding all four seasons changing weather and precipitation conditions. The access roads pose very low risk to the project and the environment.

4.3 Water Management Planning

Once the drawdown is complete, all stoplogs from the ogee spillway sections and sluiceway section will be fully removed to prepare for refurbishment activities. As shown in drawing 210-03 and 300-03 of the project design package, concrete will be demolished in bay 8 to prepare for the construction of the new uncontrolled spillway. This bay will be demolished to an elevation of 98 ft, which is approximately the elevation of the toe of the ogee for the new uncontrolled spillway section. The concrete in bay 8, where the uncontrolled spillway section is being constructed, will need to be brought down to beyond the minimum 3 inches to 98 ft

To maintain desired construction elevations and to manage periodic fluctuations in Ruth Headpond, the open sluiceway bays will be used for passage of water through the dam during construction, with the deepest bay in the centre of the structure constructed first during the expected low flow period. (July and August). During this time, work will also begin on one of the outer bays simultaneously, with one bay always open to pass water. The sill elevation of the middle sluice gate is 90.1 ft, whereas the sill elevation of the outer two gates is 94.1 ft. Therefore, at a headpond level lower than 94.1 ft, only the middle vertical lift gate deep sluice bay will be available to discharge flows. To keep the centre bay as dry as possible during the four-week period needed to complete the work, a steel barrier will be placed in the notches of the sluiceway bay to divert water (which will then be pumped through the other sluiceway bays via pumps). During construction of the centre bay/gate, upstream fish passage may be temporarily affected as passage is not possible through the higher outer bays unless the headpond elevation was to rise to 94.1ft.

Once the centre sluice bay/gate is completed, this bay will be used as the primary method of managing water through the construction site while the remaining outer bays are constructed. Once the entire sluiceway is operational, all three bays will be used to manage water.

The sluiceway is intended to manage the majority of water fluctuation in the headpond while construction is ongoing. To manage a wider range of fluctuation caused by heavier precipitation which could occur during the drawdown, water will be passed through the open bay 8, where the new uncontrolled spillway is to be constructed. Existing concrete in bay 8 will be demolished to elevation 98 ft, and will be left open until the new uncontrolled spillway will be constructed toward the end of the construction window. As shown in drawing 300-03, bay 8 is 50 ft wide.

Armour stone will be placed on the upstream side of the right downstream access road to reinforce the road from the impact of spill from bay 8, should water levels rise to above 98 ft. It is

important to note that the headpond would need to rise by 7 ft (91 ft-98 ft) before the spillway would be available for passing water. Refer to Table 2 Section 4.4 more details.

As shown in Table 2, the bridge opening can tolerate discharge associated with a rise in elevation to 101 ft, at which point the bridge would then be removed to pass additional water. This is further discussed in Section 4.4.

The estimated discharge flows through the open sluice bays, bay 8 uncontrolled spillway opening, and the bridge opening are shown in Table 2.

Table 2 : Estimated Discharge for the New Vertical Lift Gates

Reservoir El.	91 ft	93 ft	95 ft	97 ft	99 ft	100 ft	101 ft	103 ft	104 ft
Outer Gate 1	N/A	N/A	30 cfs	180 cfs	390 cfs	510 cfs	650 cfs	940 cfs	1270 cfs
Outer Gate 2	N/A	N/A	30 cfs	180 cfs	390 cfs	510 cfs	650 cfs	940 cfs	1270 cfs
Middle Gate	35 cfs	180 cfs	390 cfs	650 cfs	940 cfs	1100 cfs	1270 cfs	1630 cfs	2025 cfs
Total Gate Discharge	**35 cfs**	**180 cfs**	**460 cfs**	**1010 cfs**	**1720 cfs**	**2120 cfs**	**2570 cfs**	**3510 cfs**	**4565 cfs**
Spillway (Crest – El 98ft)	**N/A**	**N/A**	**N/A**	**N/A**	**125 cfs**	**355 cfs**	**650 cfs**	**1400 cfs**	**840 cfs**
Total Discharge	**35 cfs**	**180 cfs**	**460 cfs**	**1010 cfs**	**1845 cfs**	**2475 cfs**	**3220 cfs**	**4910 cfs**	**6405 cfs**
Depth Under Bridge	0.2 ft	0.6 ft	1.1 ft	1.8 ft	2.5 ft	31. ft	**3.7 ft**	4.8 ft	4.6 ft

The two outer gates are identical in their dimensions; therefore, yield the same outflows. All gates were considered to be fully open for the purpose of these calculations. The spillway crest sits at 98ft, therefore will act as a contingency for passing additional flows.

It is expected that at a minimum, natural inflows from Grant River Watershed, which is uncontrolled by NS Power, water from intermittent precipitation events as well as required maintenance flows and spill over the Malay Falls rubber dams would be managed through the construction site which will result in water level fluctuations in Ruth Falls Headpond throughout construction. Temporary upstream access roads on the upstream side of the dam will be designed to an elevation of 100 ft. This allows for approximately 9 ft of water level fluctuation within the headpond during construction before the access roads would be submerged. The access roads will be constructed using clean rock free of fines. The roads are not intended to hold back water and it is expected that in the event of increased water elevations, work will be able to continue until the top of the access roads is reached (100 ft).

NS Power believes that by having 9 ft of headpond capacity available that work crews will have sufficient time to plan and remove any necessary equipment should the forecast warrant such planning. NS Power manages water levels on a continual basis, including monitoring impending storm conditions. Refer to section 4.4 - Contingency planning for more details.

It is also important to note that even with the new sluiceway and vertical lift gates under construction, NS Power still has the ability to use the open gate bays to pass water if an extreme precipitation event is forecasted. The scope of the sluiceway refurbishment includes only pepping the concrete bays for installation of the new vertical lift gates. Work on the sluiceway can be halted quickly and the bays stabilized to prepare for passage of water as required. NS Power may generate at Malay Falls to continue to pass water through the system and maintain required water levels in the upper reservoirs. This will only be completed to a level that is manageable at the construction work area and with oversight from the NS Power's Construction Project Management and Hydro System Superintendent.

Fish will have the ability to move downstream and upstream through the sluice bay during construction, with the exception of when the centre sluice bay gate is under construction. The passive opening under the bridge will allow fish to move freely downstream. It should be noted that in all scenarios, the minimum 35 cfs discharge requirement will be maintained throughout construction with the exception of the approximately 4 week window where the centre sluicebay is under construction, during which time water will be pumped around the centre bay construction area (through the outer sluiceway). A six inch pump will be used to discharge the flow through one of the other sluiceway bays. During construction of the centre gate, should inflows result in water levels to increase, the outer sluice bays will be operational once elevations reach 94.1 ft. At elevation 95 ft, the outer sluice bays can pass a total of 70 cfs, and up to 780 cfs if water levels were to raise to 99 ft. There would be no negative impacts to the passage of water during all scenarios.

4.4 Contingency Planning

The hydrological information provided below references the Sheet Harbour system flood study, which was completed as part of NS Power's dam safety program in addition to the system dam safety reviews. Figure 2 below displays the Elevation – Storage Curve for Ruth Falls from Hatch's 2008 Flood Study.

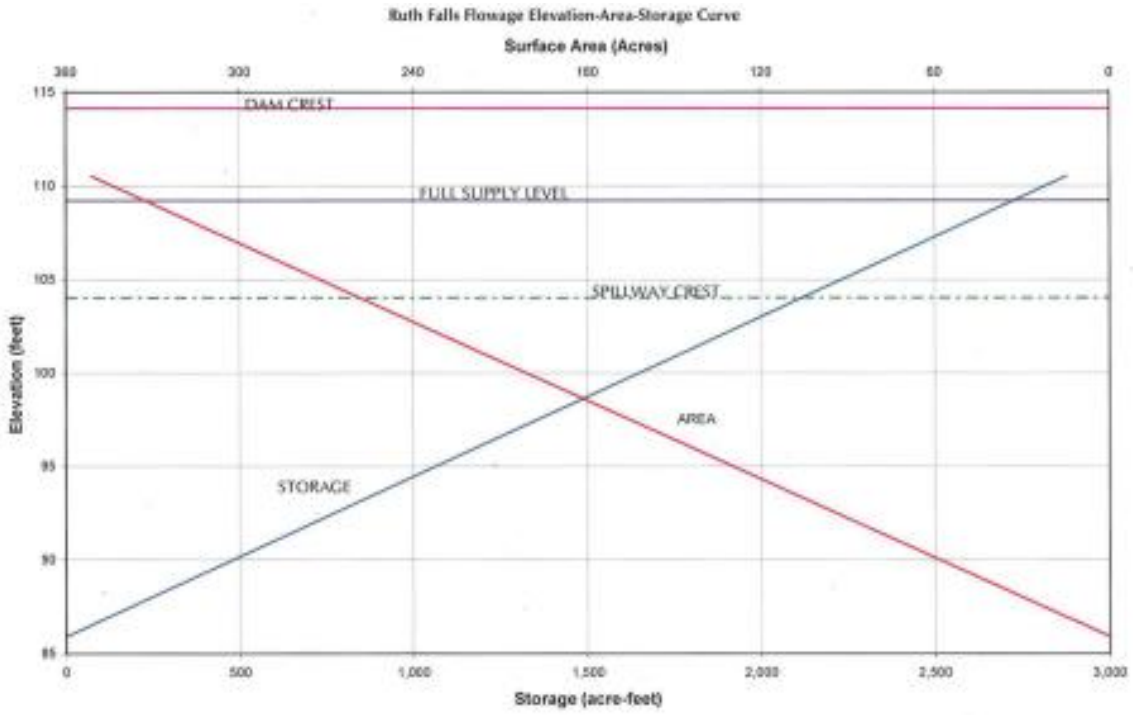


Figure 2: Elevation Storage Curve for Ruth Falls

The storage curve above indicates that there is 1150 Aft of available storage between El 100 (the crest of the upstream access road) and the middle (El 90) sluice, and 600 Aft of live storage between El 100 (the crest of the upstream access road) and the outer (El 94) sluices. This storage availability provides NS Power with sufficient time to remove construction equipment should water levels continue to rise after the headpond has been brought down to 91 ft.

The maximum mean annual flows for the Ruth Falls headpond was calculated using the 2008 Sheet Harbour Hydro System Flood Study. The discharge values were calculated using a 24-hour sub basin unit hydrograph for the Sheet Harbour hydro system and the 24-hour duration rainfall from Atmospheric Environmental Service, Rainfall Intensity-Duration Frequency Values for Shearwater Airport. Figures are presented in Table 3 below.

Table 3: Mean Annual Flood for the East River

Return period (years)	Maximum Mean Flow (cfs)
2	3,582
5	4,702
10	5,485
50	7,053
100	7,836

The maximum mean flows outlined in Table 3 take into consideration inflows from the Grant River, which was included in the 2008 flood study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond. The water management plan for the Project has considered the ability to pass discharge associated with the mean annual floods for the East River associated with a 1:10 return period (equivalent to approximately 5,485 cfs). It is important to note that the gates and spillway are capable of passing approximately 6405 cfs if the headpond was to reach an elevation of 104 ft, this is just below the threshold a 1:50 return event. Contingency measures have been considered below for precipitation events that may occur resulting in higher discharge associated with a 1:10 return period event.

The following list outlines the sequence of events associated with increasing headpond elevations:

- At elevation 91 ft, the centre sluice bay can pass 35 cfs without any water level fluctuation. If water was to rise to an elevation of 94.1 the outside sluiceways would come into operation and the three bays would be capable of passing approximately 320 cfs.
- Between 94 ft and 97 ft, water would continue to pass through all three gates - discharging approximately 1010 cfs once 97 ft is reached.
- Once an elevation of 98 ft is reached, the concrete spillway (which will be prepped for construction of the new uncontrolled spillway section during the last phase of construction) will be available for passing additional water in addition to the three gates. At 99 ft, the gates and the spillway will be capable of discharging approximately 1845 cfs. The right downstream access road will be reinforced on the upstream side using large riprap to withstand any incoming spill from the spillway should this occur.
- At a headpond elevation of 100 ft, the top of the upstream access roads will begin to become submerged. Any machinery will need to be moved in advance of this; however, the access roads will be built to tolerate submersion. At this point, approximately 2475 cfs will be passing through the gates and the spillway. At 101 ft, it is anticipated that the water will be approaching the underside of the downstream bridge (water coming up to approximately 3.7 ft under a 4 ft bridge). At this point, the bridge will be removed using an excavator on site. This type of removal is expected to take approximately 4 hours.
- Once an elevation of 104 ft is reached, the gates and spillway will be discharging approximately 6405 cfs combined. The crest of the ogee section of the dam is situated at 104 ft. This discharge exceeds a 1:10 year return period for mean annual flows. Refer to Table 2 for more details.

NS Power operations and the contractor will be monitoring the water inflows and discharges throughout the construction activities and will be able to adjust to the changing conditions, as required, to ensure that the headpond levels are managed accordingly. Temporary upstream access roads will be installed to withstand a rise in the headpond to elevation 100 ft. The access rocks will be constructed using large rock free of fines making it permeable and able to pass water through without becoming compromised. At 101 ft the temporary bridge would need to be

removed. Once elevations hit 104 ft, the water would begin to overtop the ogee section of the spillway causing work to halt until water levels recede. This is not anticipated to occur during the construction period as this would be approaching a 1:50 return period event.

Should high return period rain events (i.e. 1:10 year return period) be received during construction activities, the Ruth Falls Headpond can withstand an increase in water elevation to 104 ft, based on the discharge capacity of the sluice bays, spillway opening, and expected inflows during a 1:10 return period event (Table 3 – approximately 4,468 cfs). With all three sluice bays available and the spillway also passing water, approximately 6405 cfs can be passed at an elevation of 104 ft, (Table 2) During such an event, NS Power and the contractor would plan to shut down all construction activities. Keeping in mind that the reservoir would already be drawn down, inflows would be able to attenuate in the reservoir, essentially raising the level of the reservoir over time from 91 ft to 104 ft (13 ft differential). If extreme heavy rain or significant sustained flows are forecasted, which could result in water levels to exceed the 100 ft elevation, the construction infrastructure that can be quickly removed to meet the sluiceway width capacity are:

- The temporary work platforms and construction materials supporting gate installation
- The installed vertical gates if they are not fully operational at the time of the event
- The removal of temporary bridge
- Removal of any temporary formwork supporting the construction of the uncontrolled spillway section.

During the construction of bay 8, the uncontrolled spillway section, water management will be achieved using the operational sluiceway. If a high return period event is forecasted while the spillway is under construction, which would cause headpond elevations to rise above 98 ft work associated with the installation of the new spillway section would be paused until water levels recede. Concrete pouring will only proceed if no significant rainfall is forecasted.

The upstream access roads will be constructed in a manner as to not impact the discharge capacity of the sluiceway. Both upstream and downstream temporary access roads will be constructed with large rock material properly sloped, to safely flood and overtop if a return period event of high water levels are received. The temporary access roads will be constructed with clean rockfill material and no easily erodible material (such as clay, sandbags, filter fabric, plastic liner) will be used because there is no need for the access paths to hold back water (access roads are not cofferdams) If in the event migration of material is observed, the associated risk of sedimentation or debris being deposited downstream is extremely low. NS Power will assess the access road material migration once water levels have receded and develop plans for material removal in coordination with NSECC and DFO, if required.

NS Power relies on guidance from the contractor to install sufficient access roads to support the work. NS Power has used a similar approach with access roads on other projects where water was expected to rise during construction. A specific example of this is an access road built across the tailrace of MacDonald Dam on the Avon River System where water would overtop the access road regularly. The access roads will be built to be passive and not hold back water, allowing for water

to progressively equalize around the access road. The selected contractor has confirmed that this approach is used elsewhere within the construction industry. Large rock / riprap will be used to build the access roads on the downstream side, providing extra reinforcement for any flowing water.

5. ENVIRONMENTAL PROTECTION AND MITIGATION

5.1 Hydraulic Modeling

NS Power engaged CBCL Ltd. to complete 3D hydraulic modeling to assess post-refurbishment hydraulic conditions. The objective of the modeling was to evaluate whether the refurbishment and subsequent operation of the new dam would result in negative impacts to fish and fish habitat downstream of the dam, namely impacts to upstream and downstream fish passage.

The following was completed as part of the 3D hydraulic modelling:

- Modelling of historical spill data to assess potential impacts to fish passage during various expected flow conditions (i.e. base flows – high flow spill conditions), as a result of the proposed refurbishment dam design operation.
- Modelling of existing ecological maintenance flows (as required in accordance with the Sheet Harbour Hydro System) and current estimated leakage rates (i.e. base flows) to evaluate whether ecological flows are sufficient for optimal fish passage, and modelling of different gate configurations to provide the ecological flows (i.e. gate openings).
- Modelling of passage conditions in the existing fish ladder and downstream bypass, and testing of a range of configurations to optimize upstream and downstream passage. Modelling results can be found in Appendix F.

The hydraulic modeling provides insight as to how the post-refurbishment design would impact the entrance conditions to the fishway and support fish as they migrate towards the dam. Specific considerations have been made to design and operations plans to allow for improved conditions below and at the fishway entrance. This includes designing for appropriate velocities which will allow for prolonged swimming and burst swimming for species looking to migrate upstream.

The following will be implemented to mitigate or avoid negative impacts to fish passage and optimize upstream and downstream passage, as supported by the 3D modelling exercise:

- The current downstream base flow condition, which is a combination of the required ecological flow of 35 cfs plus standard leakage rates through the dam (approximately 100

cfs), will be maintained as the minimum ecological flow for optimal fish passage between April 1-November 30th.

- The current ecological flow for the upper technical (concrete) fish ladder and louver (downstream bypass) system (6 cfs and 29 cfs, respectively), will be maintained.
- Adjustments to attraction flow within the lower (non-technical) section of the fish ladder will be made (refer to section 5.2).
- Modifications to the lower (non-technical) section of the fish ladder will be made to improve upstream passage for all species (refer to Section 5.2).
- Modifications to the louver/downstream bypass system will be made to improve downstream passage for all species (refer to Section 5.2).
- The remaining base ecological flow (approximately 65 cfs) will be provided using the new vertical lift gates, with the use of the most easterly gate reduced or avoided to avoid sub-optimal flow conditions for upstream passage. Once the dam is constructed, the gate flow will be optimized to provide the best flow conditions for fish (avoiding back eddies) using a combination of all three gates, two gates, or just one gate to provide the maintenance flow. refer to Appendix F – Hydraulic Modeling Results for more information.
- Excessive spill will be avoided between May 1 - June 30th where possible. While infrequent as shown in the modelling, when required it is expected that the duration will be short (1-2 days) and therefore will not negatively affect upstream passage.
- Supplemental flows (50 cfs) of 10 or more occurrences will be provided through the gates between the dates of June 15 to July 15 and September 26 to November 30 as per the Sheet Harbour Water Approval.

For full hydraulic modeling results and interpretation by Thaumus Environmental, please see Appendix F.

5.2 Fish Passage Improvements

In addition to 3D hydraulic modelling, NS Power contracted Wood and Thaumas Environmental consulting firms to complete an evaluation of existing upstream and downstream passage and recommend operational or structural modifications to improve fish passage, as required. Refer to Appendix G – Fish Passage Assessment for more details. Figure 3 shows a site overview of refurbishments associated with improvements to fish passage as described below.



Figure 3: Site diagram outlining refurbishments associated with upstream and downstream fish passage.

Downstream Louver System

The assessment of downstream passage included looking at the existing infrastructure to evaluate the effectiveness of a louvre system at facilitating downstream passage for species that would be required to move downstream of the dam in order to complete their life cycle, and to assess the need for upgrades and general repairs. This included assessing whether the louvres system meets the US Fish and Wildlife Association (USFWA) Fish Passage Engineering Design Criteria. A conceptual design for proposed improvements were provided to address improvements identified within the assessment (refer to Appendix H – Louvre Assessment for more details). Recommendations for improvement for downstream passage were made and proposed changes to the louver system are as follows:

- Repairs to the existing louvre slats may be required to ensure a complete system. These repairs will be identified when the water is drawdown and canal dewatered in July 2024. Anticipated repairs include replacing partially broken / damaged slats.
- Installation of a trap funnel to prevent upstream movement once fish have moved through the entrance of the bypass. Bottom orifices will also be installed in the stoplogs to support downstream migration.
- A ramp is recommended to facilitate movement from the bottom of the water column towards the bypass pipe at the top of the water column. This would benefit those bottom

dwelling species such as American eel, Brown bullhead, White suckers etc. by guiding the fish from the bottom to the convergence of the slates in order to find the bypass pipe. Refer to Appendix H for concept sketches of the new ramp.

- Realignment of the bypass outfall into the top of the non-technical lower fishway section. The plunge pool water depth will be designed to meet or exceed the USFW criteria for drops of all species and age classes at the site. See Figure 1 to view the placement of the new bypass pipe.

Upstream Fish Passage

Results of the 3D hydraulic modeling determined that improvement to the lower non-technical section of the existing fishway should be made to improve passage for species migrating upstream to complete their lifecycle. The current fishway was originally designed for salmon; the proposed improvements will look to improve velocity and flow conditions to support other species such as gaspereau, which will in turn improve conditions for all species as the swimming capability of gaspereau is the limiting criteria for the fishway. The following improvements are proposed:

- Replace the existing lower non-technical fishway weirs with 11 new concrete weirs, including an additional weir immediately below the upper technical (concrete) fish ladder. The weir at the entrance to the fishway will be placed on a diagonal pointing south-west to provide improved entrance conditions. Refer to Appendix G – Fish Passage Assessment for concept sketches.
- Relocate the louvre bypass outflow pipe to connect into the fishway to provide additional attraction flow through the fishway. The fishway currently provides a minimum of 6 cfs and the bypass pipe provided a minimum of 29 cfs making the new total coming down through the fishway 35 cfs. Refer to Appendix G – Fish Passage Assessment for concept sketches.

Detailed engineering designs for improvements for the non-technical fish way are provided in Appendix K. As shown in the detailed designs, the additional weirs will sit within the existing vertical footprint of the fishway. The widening of the fishway channel will be accomplished by recontouring the rocks on the southside (opposite of the dam) to accommodate the wider weirs, expanding the overall footprint of the fishway in the area where the rock shoreline currently sits. This is not anticipated to have negative impacts on fish, but rather have a positive impact allowing species with weaker swimming capabilities the ability to traverse the fishway and ladder. Additionally, the area directly in front of the vertical lift gates will be smoothed down (currently there is a large boulder which impacts water flow). This is expected to positively impact the entrance conditions of the fishway. NS Power does not see this as a change in overall footprint but rather an improvement to the existing riverbed to support fish passage.

Upstream Eel Passage

An eel ramp is proposed to facilitate upstream eel passage as it was determined through the evaluation that a separate stand-alone structure was required for effective upstream eel passage, beyond the existing fishway. The design consists of a metal enclosed box lined with a climbing substrate and equipped with pumped water to facilitate eel movement up the ramp. The placement of the eel ramp will sit on the outside of the upper technical (concrete) fishway – following the general outline of the fishway up to the headpond (refer to Appendix I – Upstream Eel Passage for more details). The hydraulic modeling results were used to confirm the placement of the eel ramp including entrance conditions (Appendix F).

Detailed engineering designs for all fish passage improvements including proposed improvements to the upstream fishway, louvre system and installation of the eel ramp can be found in Appendix K- Fish Passage Improvement Designs.

5.3 Erosion and Sedimentation Control

Erosion and sedimentation control materials such as hay, silt fencing, etc., will be used to control sediment laden water from entering the headpond while it is dewatered. Any silt-laden water in the work area will be recovered and pumped away from the headpond to areas with sufficient vegetation to facilitate filtration. The headpond will be recharged at a controlled rate with NS Power personnel monitoring for any visible water quality issues. NS Power is not anticipating any issues with erosion or scour when passing the various return period flood events down the spillway channel. High return period flood events have been safely passed as part of past normal operation of the dam, without evidence of erosion or scour. Bi-annual inspections and weekly checks are conducted downstream of the Ruth Falls Dam. Observations during the inspections and checks indicate that scour is not of concern when spilling in excess of 500 cfs.

NS Power Project personnel will remain in regular contact with Hydro Operations personnel throughout construction to ensure periods of high inflows and discharge are communicated and planned for appropriately.

All access road material will be clean, appropriately sourced rock material that is free of fines, to significantly reduce potential sedimentation of the upstream and downstream work areas. Rockfill cofferdams have been used by NS Power on other hydro refurbishment projects and have proven to have little effect on sedimentation of the surrounding watercourse, even during periods of high inflows/discharge. Pumps will be used, as required, to assist with removing any silt laden water, which will be pumped to a designated area.

The proposed scope of work for the Project involves minimal excavation of soil material, as the focus of construction is the refurbishment of the existing concrete dam structure. The primary method of erosion and sedimentation control is the water management strategy outlined in Section 4.

There will be some excavation of the right (west) abutment retaining wall that is scheduled for removal and replacement. During construction activities for the retaining wall, silt fencing will be used along the boundary of the spillway bank to protect the adjacent spillway channel. The excavation for the retaining wall is anticipated to be small and as such, soil material will not be exposed for a significant length of time. Pumps will be used to keep the retaining wall work area dry and silt laden water will be pumped to the west of the dam in an area designated as acceptable to filter water prior to re-entry into a watercourse. Hay will be used to cover any temporarily exposed work areas, as required. Based on initial scoping of surrounding lands, NS Power has identified two potential areas to be used for water filtration areas or installation of sediment traps. One area is immediately west of the dam and the other is located north east of the dam, see Figure 4 below. Both areas are on NS Power property and have been evaluated for possible wetland/rare species habitat. Both areas are forested and provide suitable vegetation to aid in water filtration. Additional field scoping will be completed to confirm areas to be used and method of water filtration.



Figure 4: Potential locations for water filtration to support pumping activities. Areas to be field verified in spring 2023.

The removal of access road material will take place with Ruth Falls Headpond at elevation 91 ft, which will allow for visual observation of the majority of material being removed. Washed rock will be used to ensure no silt or fines interacts with the watercourse. Siltation monitoring will take place as debris from the access road is removed. Monitoring will be carried out by NS Power downstream during the removal to ensure siltation is not occurring.

The selected contractor for the Project will be required to submit a site-specific erosion and sedimentation control plan designed for the planned scope of work. This will include identification of any additional site-specific controls required and location of water filtration operations or requirements for sediment traps for pumping activities. NS Power would request that, if required, a condition be incorporated into the Approval, if issued, for NS Power to provide a site-specific plan to confirm the above outlined measures prior to construction activities starting. Additional impacts as a result of sedimentation beyond the in-water work window (June 1 – September 30) are unlikely. In addition to the mitigation measures discussed above, NS Power will monitor weather closely to ensure appropriate planning/mitigation is in place prior to a heavy rain event. This may include temporary closure/stabilization of site, temporary work stoppage, or removal of access road sections to allow for increased passage of water. Site inspections will be completed immediately after heavy rain events to monitor for erosion or sedimentation issues.

NS Power will also require the general civil contractor to implement daily site inspections and completes overarching environmental inspections on a weekly basis during construction. This will allow NS Power to ensure compliance to regulatory requirements and best practices, while ensuring deficiencies are assigned an appropriate corrective action to be addressed in a timely manner.

5.3.1 Sediment Release Monitoring Plan

NS Power will implement a regular water quality monitoring program. The water quality checks will be completed daily to assess turbidity levels in the river downstream of the construction area. During each check, two samples will be taken. The first will be to assess the regular conditions of the river upstream of the dam and the second will be taken downstream of the temporary bridge to assess the conditions below the work area using a HACH 2100Q Portable Turbidimeter monitor. A differential of 8 ntu will be used as a threshold for turbidity – this threshold has been suggested from DFO in the past and has been used on other NS Power projects. If the sample below the work is > 8 ntu compared to the upper sample, then work will all work will stop until turbidity levels return to below this threshold, and work will then resume. If turbidity levels are consistently over threshold while the work is taking place, NS Power will work with the contractor to assess the situation and make necessary adjustments to manage the sediment. NS Power will complete daily visual inspection of the area below the work site for discoloration which would indicate silt. Visual

inspections will be documented with photos. Should visual observation of a plume be observed the contractor will stop work and notify NSECC of the incident.

As noted above, NSP does not anticipate scour or silt being produced from the work area during construction.

5.4 Water Quality

NS Power conducts water quality surveys as part of the hydro relicensing program, the process by which the water approvals for storage/withdrawal are renewed for each hydro system. Relicensing studies for the Sheet Harbour Hydro System were completed in 2017 in preparation for the relicensing of this system. The water quality surveys completed for the headpond show acidic conditions with an in-situ pH range of 4.43-4.52, presence of phosphorus and chlorophyll and good conductivity. Based on these results, the headpond is classified as meso-eutrophic or eutrophic. A small thermocline was observed at 3.2 ft (1 m) depth; however, dissolved oxygen remained consistent to sample depth 19.7 ft (6 m).

Using available bathymetry for the headpond (see Appendix A), approximately 0.5 miles square (1.15 km^2) of total shoreline will be exposed as a result of a drawdown to 91.0 ft from FSL. The majority of shoreline to be exposed is very shallow under normal FSL of 109.25 ft, with depths of less than 9.8 ft (3 m). At an elevation of 91.0 ft, the headpond will look similar to pre-inundation conditions of the East and Grant Rivers. It is unknown how the drawdown of approximately 18 ft for a period of 9 months will influence water quality; however, it is expected that inflows from Grant River, and small inflows from Malay Falls will provide continuous oxygenated water to Ruth Falls Headpond throughout the drawdown. It is unknown how much inflow is contributed by the Grant River Watershed; although, inflows from this watershed were included in the 2008 Flood Study as the Grant River Watershed contributes significant inflow to Ruth Falls Headpond.

NS Power proposes to complete monthly water quality sampling from a deeper area of the headpond, to compare various water quality parameters with those observed under normal operation. NS Power will use the location of the water quality sample site used during the 2017 relicensing of the Sheet Harbour Hydro System for direct comparison to normal operating conditions. Water quality sampling will be completed from July to November for temperature, dissolved oxygen, total suspended solids and turbidity.

The monitoring site for monthly sampling will be established at the deepest part of the headpond, using available bathymetry or manual soundings if bathymetry is not available.

Monthly monitoring will be conducted from July to November and will include the following parameters:

- Secchi depth

- Temperature
- Dissolved oxygen
- Nutrient content (lab analysis)

5.5 Wetland and Rare Species

As part of the 2007 relicensing of the Sheet Harbour Hydro System, a qualified wetland consultant was contracted to complete a wetland and littoral zone vegetation survey on Ruth Falls Headpond. Twenty-one (21) wetlands that were contiguous to the headpond edge were identified and mapped at the time of the survey. In cross referencing the mapped wetlands during the 2007 survey with the current NS provincial wetland GIS data, only one wetland on the west side of the Ruth Falls Dam was not identified during the 2007 survey. For planning purposes, NS Power will assume that there are 22 possible wetlands located on the Ruth Falls Headpond.

Table 4 shows the type of each wetland mapped in 2007; 6 of the 21 wetlands identified at the time of the survey where characterized for vegetative communities. The majority of wetlands (14 of 21) identified are shore bogs, which are typically not tolerant of extended periods of deep flooding and indicates that Ruth Falls Headpond may fluctuate similarly to natural lakes. No vascular plant species sampled in the 6 wetlands characterized are listed as rare or endangered.

Table 4: Wetlands Found Within the Littoral Zone of Ruth Falls Headpond. Wetlands 3,5,6,15,17,19 are highlighted as they have been selected for Wetland Monitoring as described below.

Wetland ID Number	Wetland Type	Wetland Description
1	Coniferous treed shore bog	No
2	Coniferous treed shore bog	No
3	Coniferous treed shore bog (two subtypes)	Yes
4	Shore bog	Yes
5	Shore bog	No
6	Wetland complex composed of coniferous treed shore bog and floating bog (two subtypes)	Yes
7	Shore bog	Yes
8	Shore bog	No
9	Shore bog	No
10	Shore bog	No
11	Shore bog	Yes
12	Shore bog	No
13	Shore bog	No
14	Shore bog	No
15	Wetland complex composed of coniferous treed shore bog and coniferous treed shore swamp	Yes
16	Coniferous treed shore bog	No
17	Shore bog	No
18	Coniferous treed shore bog	No
19	Shore bog	No
20	Shore bog	No
21	Shore bog	No

As part of the littoral zone survey on Ruth Falls Headpond in 2007, an ACCDC search was used to identify potential rare or endangered vegetation that could be present on Ruth Falls, which was then used to ground truth whether these species were present. No rare or endangered species were identified during field surveys. An updated ACCDC search was completed in 2023 for the study area, there are no records of aquatic species of conservation concern or endangered species within the area. See Appendix L – ACCDC Report for full details.

Given the short duration of the potential change to water levels on portions of these wetlands as a result of the drawdown (9 months), NS Power is not anticipating long term impact to species composition, soils or overall hydrology of the wetland that would constitute an alteration; however, NS Power recognizes that the potential for and extent of impacts to wetlands as a result of the drawdown of the Ruth Falls Headpond for a 9 month period is unknown. NS Power has contracted a third-party qualified wetland consultant to develop and execute a wetland monitoring program to monitor for changes to wetland plant species cover values and health, soil moisture levels, water levels, and impacts to fish and fish habitat throughout the duration of the Project. Full details can be found in Appendix E - Wetland Monitoring Plan.

Six wetlands have been selected for monitoring. Figure 5 displays the mapped wetland on the Ruth Falls Headpond, with the six wetlands to be monitored highlighted in red. Wetland locations to be monitored include wetlands WL3, WL5, WL6, WL15, WL17 and WL19 which are described in Table 4.

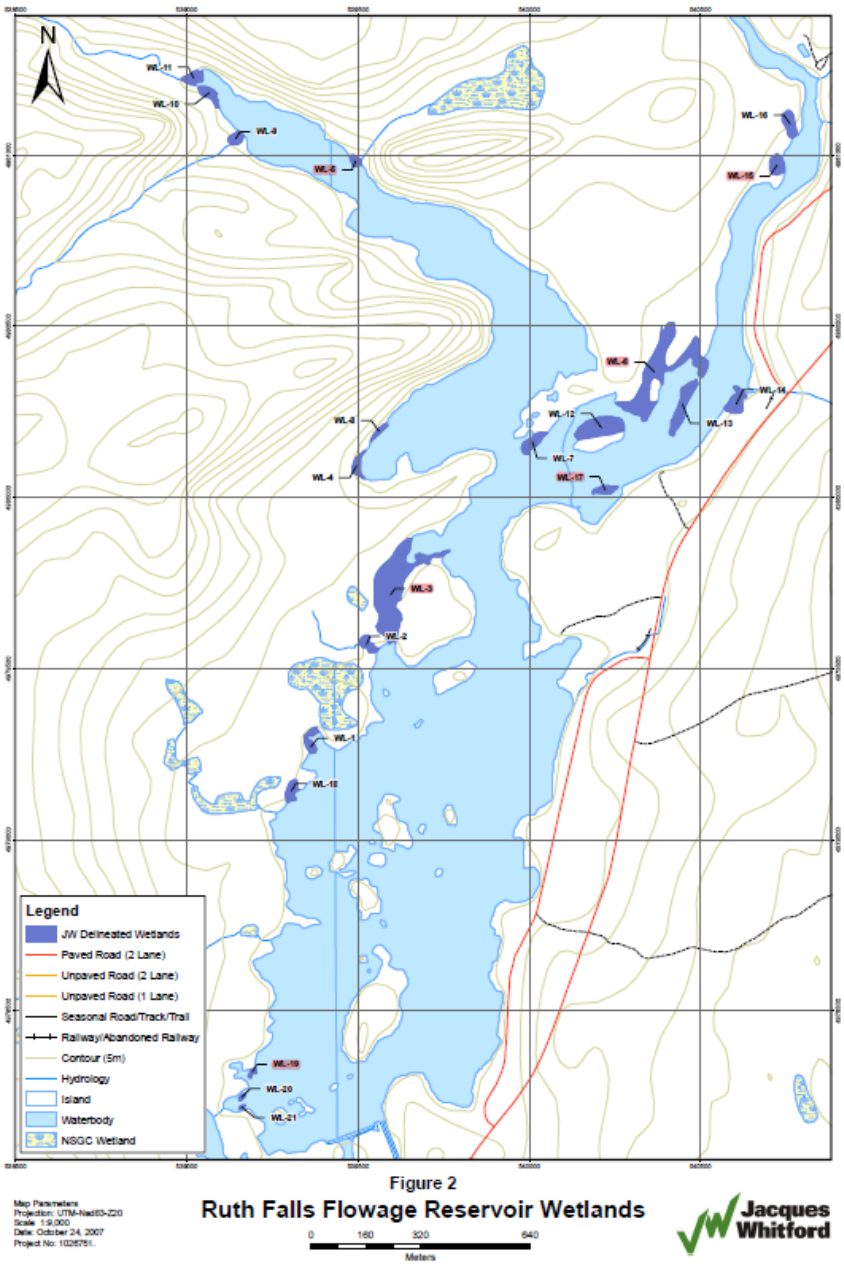


Figure 5: Mapped wetlands on Ruth Falls Headpond (2007). Proposed Wetland Monitoring locations are highlighted in red (6 locations)

Wetlands selected for monitoring were chosen based on the following considerations:

- representative of various wetland types identified (as per the results of the previously completed assessment).
- capture the geographic spread of the Headpond.
- represent the varying wetland sizes observed.
- capture some of the most species-diverse wetlands (as per the results of the previously completed species assessment).
- representative of variations in fish habitat.
- consideration of landowner proximity and/or access considerations/limitations.

Wetland monitoring will include detailed vegetative, hydrological, and soil monitoring within the six selected wetlands. Each wetland to be monitored was delineated prior to the commencement of monitoring activities to ensure that wetland boundaries are accurate and up to date, and to establish the current biodiversity of the existing habitat. Baseline wetland monitoring took place in July 2022. Preliminary monitoring results of the 2022 baseline assessment are provided within the updated wetland monitoring plan (Appendix E).

An error in the GIS mapping was identified in Wetlands 5 and 16, where the vegetation monitoring plots were situated outside of the delineated wetland boundary, This has been adjusted to the correct version and provided within the updated wetland monitoring plan in Appendix E.

5.6 Construction Material and Debris

Measures will be taken to prevent any materials used in the various work activities from entering the watercourse. All such materials will be applied in a controlled manner and any excess material will be contained during application. All construction debris will be stored on NS Power property or disposed to an approved landfill. Any debris that requires disposal will be done so in accordance with NSECC Construction and Demolition Debris Disposal Site Guidelines.

5.7 Equipment and Machinery

All equipment and machinery required to be operated on or near a body of water will be mechanically sound with no leaking fuel tanks or hydraulic connections. Refueling and lubrication shall be in designated areas not within 30 m of any wetland or water body. Storage of petroleum products will be at least 100 m from a water body. Machinery and equipment will be stored above flood water levels. Oil spill contingency plans will be followed, and spill kits maintained on-site, in the event a petroleum product spill occurs.

5.8 Rehabilitation

Following any excavation and placement activities, areas disturbed by machinery or equipment will be returned to pre-construction condition. Any exposed soil areas will be stabilized to prevent erosion. In the event that long-term erosion problems, resulting from the clearing of the area, cannot be dealt with at the time construction is complete, temporary measures shall be taken.

6.0 ARCHAEOLOGICAL CONSIDERATIONS

An Archaeological Screening and Reconnaissance (ARIA) for the Ruth Falls Headpond was completed in 2017. The purpose of the ARIA was to assess the potential for archaeological resources in the project area, which included approximately 5 hectares surrounding the dam and earthen embankment primarily on the downstream side. The ARIA included a background study and visual assessment of the study area. The assessment identified three areas considered to exhibit high potential for encountering Precontact and/or early historic Native archaeological resources and/or historic Euro-Canadian archaeological resources. It was recommended that if these areas could not be avoided, shovel testing be conducted.

Shovel testing in 2 of the identified areas was conducted in 2018 and included 64 shovel tests. No archaeological resources were encountered and no evidence of historically significant cultural modification was identified during the course of the shovel testing. Based on the results of the 2018 shovel testing, the potential for encountering significant, intact archaeological resources within the two areas is considered to be low. It was recommended that the two shovel tested areas be cleared of any requirement for further archaeological investigation and that development within these areas may proceed as planned.

During the drawdown, archaeological reconnaissance will take place within the Ruth Falls Headpond by a qualified Archaeologist. The objective of the reconnaissance is to inspect the exposed shoreline for evidence of any previously unrecorded archaeological resources within the dewatered reservoir. In the event that archaeological resources are identified during the archaeological reconnaissance, it is proposed that two separate rounds of documentation and mitigative artifact collection will be conducted during the course of the drawdown.

7.0 ABORIGINAL ENGAGEMENT

NS Power initiated engagement with the Millbrook First Nation in January 2020 to provide an overview of the project and discuss next steps and approach to engagement for the project. In 2021 attended a Chief and Council meeting on April 20th, to share updated information on the Project. Chief and Council requested a site visit during this meeting. In Sept 2021 NS Power organized a site visit with Millbrook First Nation – participants included Millbrook Consultation Lead and Communications Officer. In January 2022 NS Power held meeting with Millbrook Consultation Lead and Millbrook Director of Fisheries to discuss fish passage and monitoring at Ruth Falls. As requested by Millbrook, NSP followed up with information about eel passage from the previous Relicensing studies. In January of 2023 NS Power met with Consultation Lead from Millbrook First Nation to discuss project updates and timeline. Millbrook requested additional discussion about community involvement in the archaeological reconnaissance and fish monitoring when the reservoir drawdown and construction begins.

NS Power has also been working with the Mi'kmaw Conservation Group (MCG) of the Confederacy of Mainland Mi'kmaq (CMM) to collaborate with Millbrook First Nation on an offsetting plan for potential impacts to fish and fish habitat that are anticipated as a result of the Project. This offsetting Project will be included with NS Power's Application for Authorization to DFO.

In August 2022 NS Power met with Maritime Aboriginal Peoples Council (MAPC) to discuss the Ruth Falls Refurbishment Project. MAPC requested additional information about archaeological reconnaissance during the planned drawdown, and information about the fish rescue process and offsetting and monitoring plans for the project. NS Power followed up with additional information regarding this discussion in November 2022.

NS Power will continue engagement regarding the project with monthly project updates to the KMKNO and regular updates and meetings with Millbrook Frist Nation. NS Power will send notifications regarding the permitting schedule for the submission of permits and authorizations such as the NSECC Watercourse Alteration application and DFO Fisheries Authorization. During construction, regular project manager communications will be provided to Millbrook and KMKNO.

7.0 OTHER STAKEHOLDER ENGAGEMENT

NS Power is committed to proactively communicating and engaging with community stakeholders, the Mi'kmaq, regulators and the public on the Ruth Falls Dam Refurbishment Project. As part of this commitment, NS Power has developed a communication plan which outlines NS Power's detailed execution plan for engagement and communication on the Project. Refer to Appendix J – Communication plan for further details.

APPENDIX A – HYDRO SYSTEM OVERVIEW

1. Sheet Harbour Hydro System Map
2. Ruth Falls Plan View
3. Ruth Falls Reservoir Bathymetry

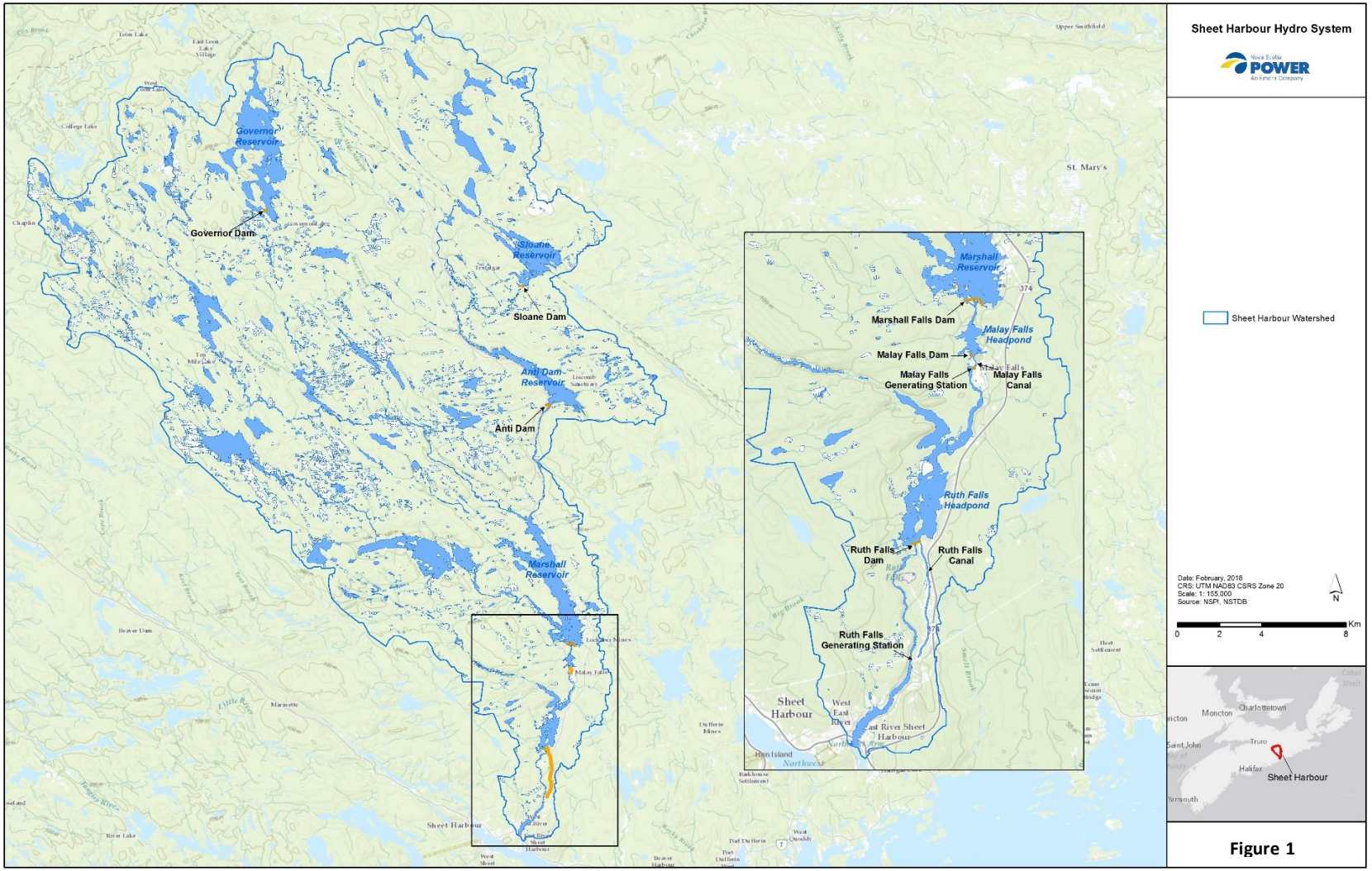

Governor Reservoir
Governor Dam
Sloane Reservoir
Sloane Dam
Anti Dam Reservoir
Anti Dam
Marshall Reservoir
Marshall Falls Dam
Malay Falls Headpond
Malay Falls Dam
Malay Falls Generating Station
Malay Falls Canal
Ruth Falls Headpond
Ruth Falls Dam
Ruth Falls Canal
Ruth Falls Generating Station
Sheet Harbour
Sheet Harbour Hydro System
Sheet Harbour Watershed
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1: 155,000
Source: NSPI, NSTDB
N
Km
0
2
4
8
Moncton
Charlottetown
Saint John
Truro
Halifax
Sheet Harbour

Figure 1

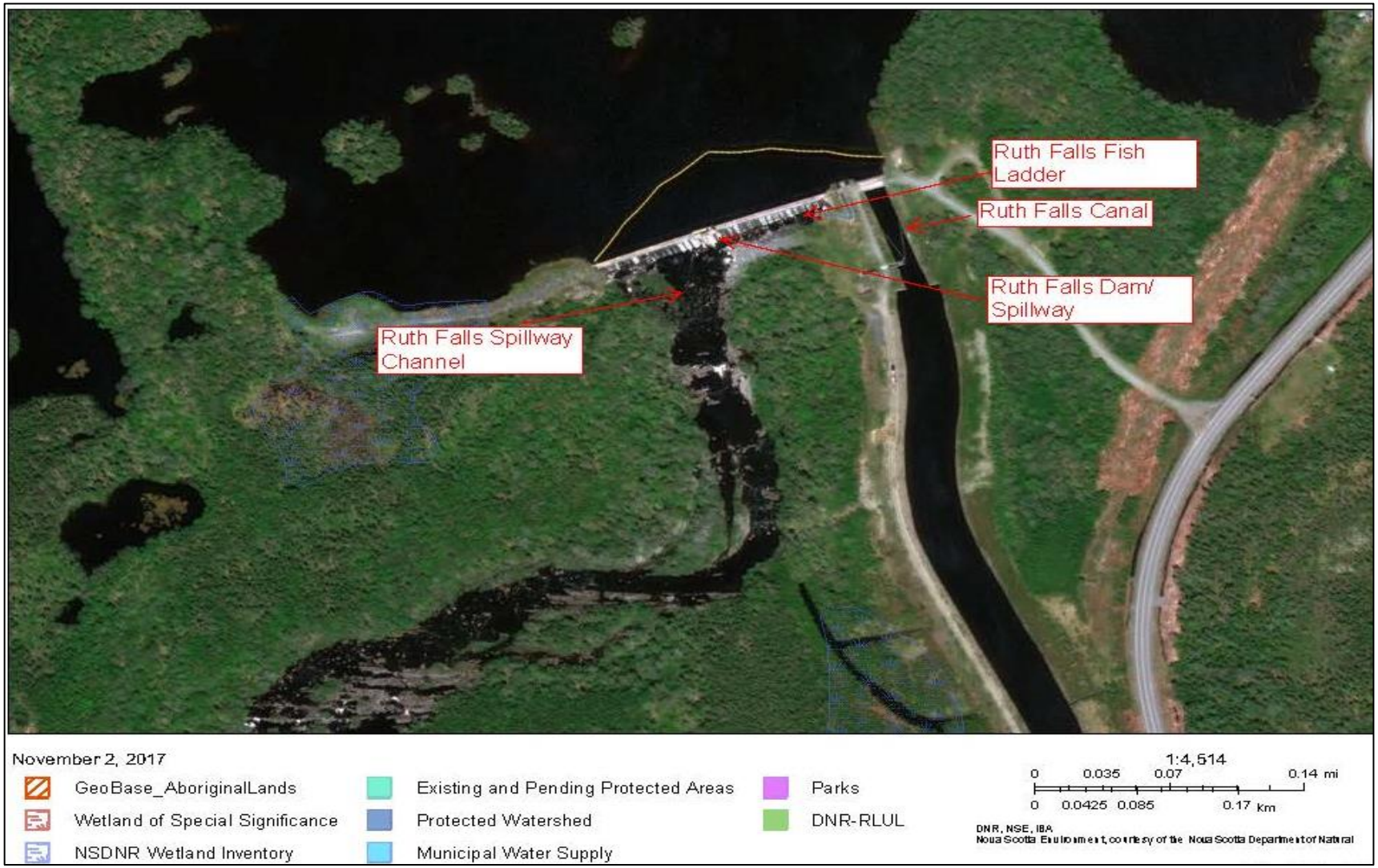


Figure 3. Ruth Falls Plan View

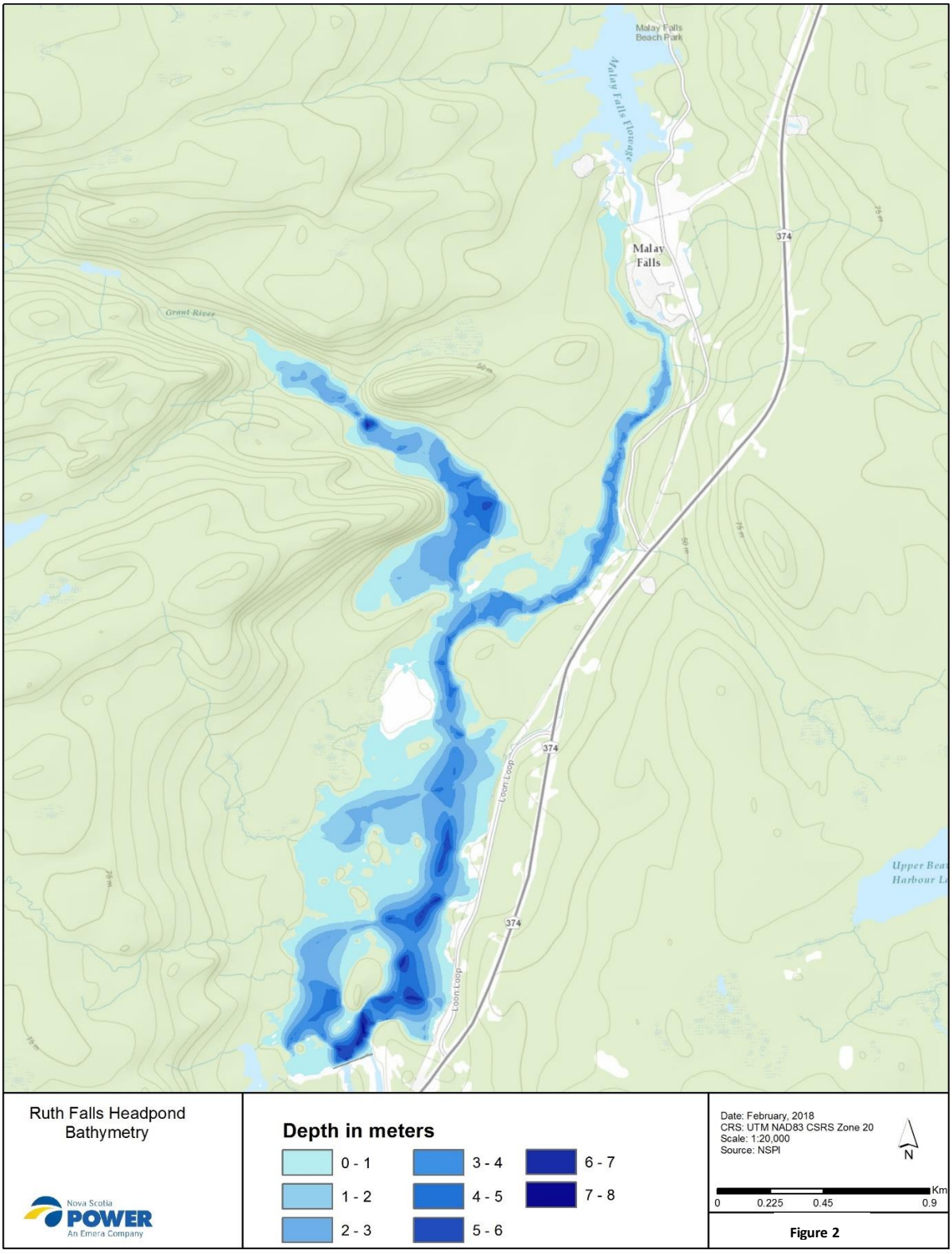

Malay Falls Beach Park
Malay Falls Flowage
Malay Falls
374
Grant River
50 m
75 m
Loon Loop
Upper Beaver Harbour Lake
Ruth Falls Headpond Bathymetry
Depth in meters
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Date: February, 2018
CRS: UTM NAD83 CSRS Zone 20
Scale: 1:20,000
Source: NSPI
N
Km
0
0.225
0.45
0.9

Figure 2

APPENDIX B – SITE PHOTOS



Photo 1: View of Ruth Falls Dam, facing north



Photo 2: View of Ruth Falls Dam, facing west



Photo 3: Ruth Falls fishladder and bypass pipe facing east



Photo 4: Downstream of Ruth Falls Dam facing south



Photo 5. Upstream of Ruth Falls Dam facing northeast

APPENDIX C – PROPOSED WATER MANAGEMENT STRUCTURES

SITE PLAN SHOWING UPSTREAM AND DOWNSTREAM ACCESS ROADS AND BRIDGE

FOOTPRINT OF TEMPORARY STRUCTURES

LEFT DOWNSTREAM ACCESS ROAD: 10,530 SQ FT (978 SQ M)

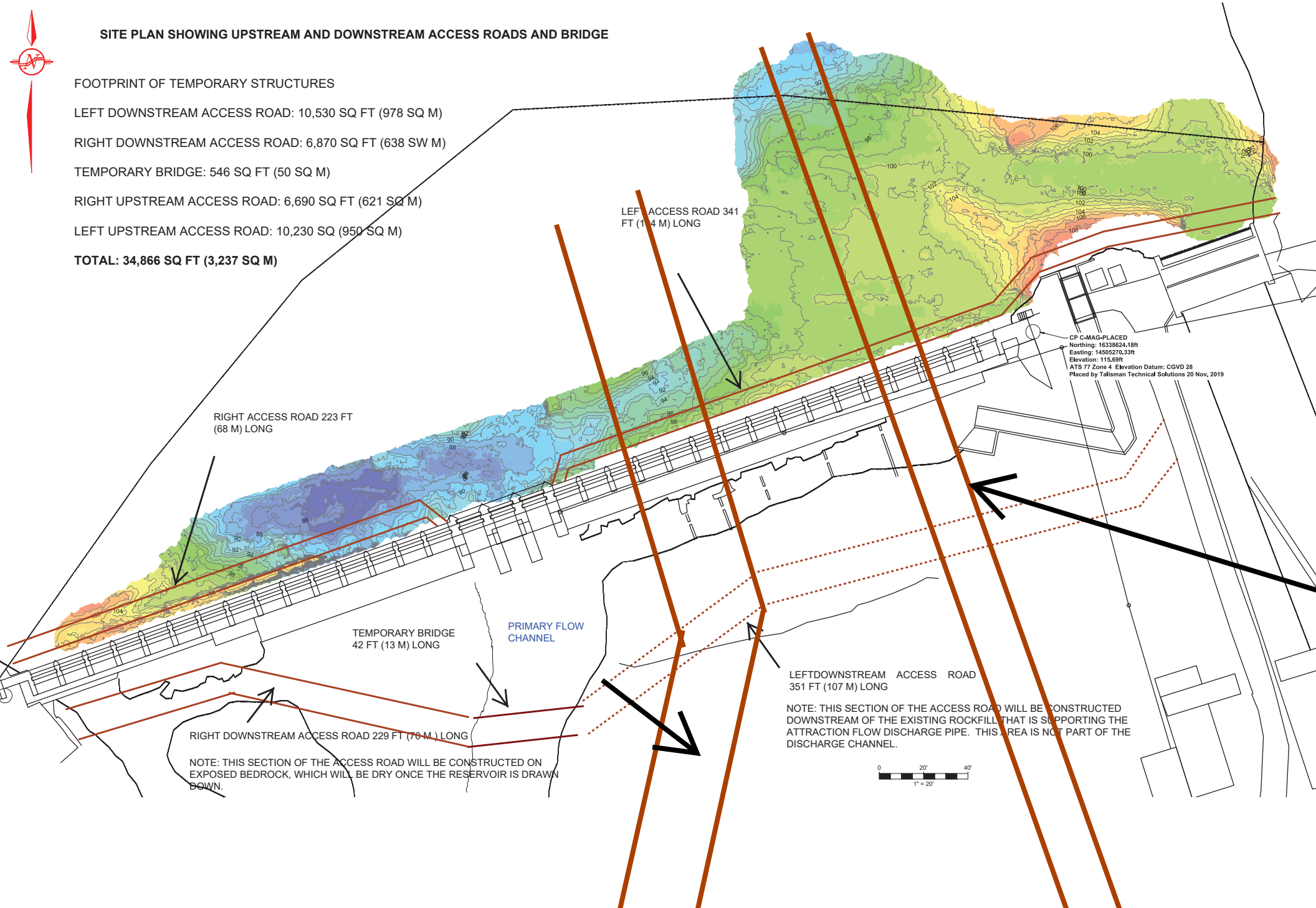
RIGHT DOWNSTREAM ACCESS ROAD: 6,870 SQ FT (638 SW M)

TEMPORARY BRIDGE: 546 SQ FT (50 SQ M)

RIGHT UPSTREAM ACCESS ROAD: 6,690 SQ FT (621 SQ M)

LEFT UPSTREAM ACCESS ROAD: 10,230 SQ (950 SQ M)

TOTAL: 34,866 SQ FT (3,237 SQ M)



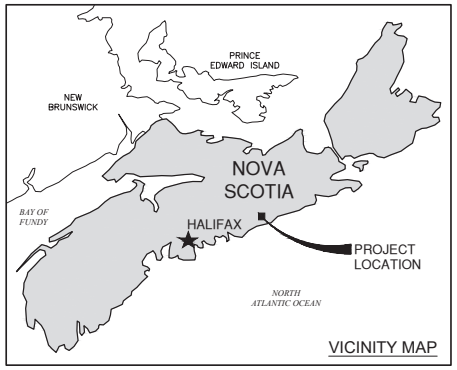
APPENDIX D – ENGINEERING DRAWINGS

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NOVA SCOTIA POWER INC.

HALIFAX, NOVA SCOTIA

RUTH FALLS
SPILLWAY REFURBISHMENT PROJECT



VICINITY MAP





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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

COVER SHEET

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DWG. NO. H096H1163100041

DRAWING LIST

SHEET NO.	SHEET DESCRIPTION	DATE	REVISION	STATUS	NSPI DRAWING No.
100-01	DRAWING LIST	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-041
100-02	GENERAL NOTES	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-042
200-01	EXISTING CONDITIONS OVERALL SITE PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-043
200-02	EXISTING CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-044
200-03	EXISTING CONDITIONS WEST SPILLWAY DAM PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-045
210-01	TEMPORARY CONDITIONS/DEMO PLAN	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-046
210-02	TEMPORARY CONDITIONS/DEMO EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-047
210-03	TEMPORARY CONDITIONS/DEMO WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-048
300-01	NEW CONDITIONS DAM PLAN AND ELEVATION	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-049
300-02	NEW CONDITIONS EAST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-050
300-03	NEW CONDITIONS WEST SPILLWAY PLAN AND SECTIONS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-051
300-04	NEW CONDITIONS SLUICEWAY PLAN AND DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-052
310-01	NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-053
310-02	NEW CONCRETE SLUICEWAY HEADWALL DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-054
310-03	NEW CONCRETE SPILLWAY RESURFACING DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-055
310-04	NEW CONCRETE RETAINING WALL AND PIER DETAILS	2020-12-18	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-056
320-01	NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-057
320-02	NEW STEEL GRATED ACCESS PLATFORM	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-058
320-03	NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-059
330-01	RUBBER DAM PIPING AT SLUICEWAY	2020-12-11	C	90% REV. 1 REVIEW SUBMITTAL	H-096H1-1--631-00-060

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GENERAL NOTES

1. GENERAL:
   - A. CONTRACTOR SHALL DETERMINE LOCATIONS, EXISTING CONDITIONS, AND DIMENSIONS BY THEIR OWN INVESTIGATION.
   - B. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON LIMITED FIELD MEASUREMENTS, REFERENCE DRAWINGS AND SURVEY. FIELD VERIFY ALL DIMENSIONS, AND NOTIFY THE OWNER AND ENGINEER OF DISCREPANCIES.
   - C. CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION, AND WILL NOTIFY THE OWNER FOR AN APPROVAL, IF REQUIRED.
2. SURVEY:
   - A. GEOMETRY OF THE EXISTING DAM STRUCTURE SURVEYED BY TALISMAN TECHNICAL SOLUTIONS, LANTZ, NS, IN 2017.
   - B. ELEVATIONS ARE BASED ON OCTOBER 1994 GEODETIC DATUM. ELEVATIONS AND DIMENSIONS ARE NOMINAL. ACTUAL ELEVATIONS VARY THROUGHOUT EXISTING STRUCTURES.
   - C. UTILITIES LOCATED BY SURVEY OR SHOWN ON DRAWINGS ARE APPROXIMATE AND SHALL BE CONFIRMED IN FIELD.
   - D. CONTRACTOR SHALL COORDINATE WITH NSPI FOR TEMPORARY RELOCATION OR PERMANENT RELOCATION OF POWER LINES AND POLES IF REQUIRED.
   - E. OCTOBER 1994 LOCAL DATUM = CGVD 28 – 1.65 FT
3. DESIGN LOADS:
   - A. NORMAL HEADPOND: EL. 109.25 FT
   - B. INFLOW DESIGN FLOOD HEADPOND: EL. 114.0 FT AT PEAK FLOW OF 29,183 CFS
   - C. SEISMIC COEFFICIENT: 0.1g
   - D. ICE LOAD AT NORMAL POND ELEVATION: 5,000 LB/FT
4. JOB CONDITIONS:
   - A. SITE INFORMATION:
     - I. ANY SUBSURFACE CONDITIONS SHOWN ON THE DRAWINGS ARE BASED ON INTERPRETATIONS/INTERPOLATIONS OF DATA OBTAINED FROM BACKGROUND DOCUMENTS AND WIDELY SPACED EXPLORATIONS BY OTHERS. VARIATIONS MAY EXIST AND SHOULD BE EXPECTED.
   - B. EXISTING UTILITIES:
     - I. THE CONTRACTOR SHALL LOCATE EXISTING UNDERGROUND AND OVERHEAD UTILITIES IN THE AREAS OF WORK. IF UTILITIES ARE TO REMAIN IN PLACE, PROVIDE ADEQUATE MEANS OF PROTECTION DURING EARTHWORK OPERATIONS.
     - II. NOTE THAT THERE ARE EXISTING OVERHEAD POWERLINES AND ASSOCIATED POLES ALONG AND ADJACENT TO THE EMBANKMENT DAM. THE CONTRACTOR SHALL COORDINATE WITH OWNER FOR TEMPORARY OR PERMANENT RELOCATION OF POWERLINES AND POLES; AS REQUIRED.
     - III. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATION, CONSULT THE OWNER AND UTILITY OWNER/OPERATOR IMMEDIATELY FOR DIRECTIONS.
     - IV. THE CONTRACTOR SHALL REPAIR DAMAGED UTILITIES TO SATISFACTION OF THE OWNER AND UTILITY OWNER/OPERATOR.
5. QUALITY ASSURANCE:
   - A. HORIZONTAL AND VERTICAL CONTROL:
     - I. THE CONTRACTOR IS RESPONSIBLE FOR AND SHALL PROVIDE ALL CONSTRUCTION LAYOUT.
     - II. SURVEYS FOR CONSTRUCTION ELEVATIONS AND LOCATIONS OF THE WORK SHALL BE PERFORMED BY OR UNDER THE SUPERVISION OF A QUALIFIED SURVEYOR.
   - B. OWNER'S REPRESENTATIVE:
     - I. THE OWNER'S REPRESENTATIVE WILL PROVIDE PERIODIC TO REGULAR REVIEW OF THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR REGULAR COMMUNICATION OF THE CONSTRUCTION SCHEDULE AND FOR PROVIDING AMPLE NOTICE TO THE OWNER'S REPRESENTATIVE FOR CRITICAL REVIEWS SPECIFIED HEREIN.
     - II. THE OWNER'S REPRESENTATIVE MUST REVIEW ALL EXPOSED SUBGRADES PRIOR TO PLACEMENT OF FILL MATERIALS.
     - III. THE CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY (QCTL) SHALL PERFORM QUALITY CONTROL TESTING DURING CONSTRUCTION, AS SPECIFIED HEREIN. THE CONTRACTOR'S QCTL SHALL SHARE TEST RESULTS ON–SITE WITH THE OWNER'S REPRESENTATIVE UPON REQUEST.
     - IV. THE OWNER MAY CHOOSE TO EMPLOY AN INDEPENDENT THIRD PARTY TESTING AGENCY TO PERFORM QUALITY ASSURANCE (QA) TESTING.
6. EROSION & SEDIMENT CONTROL:
   - A. EROSION PREVENTION AND SEDIMENT CONTROL SHALL BE IN ACCORDANCE WITH LOCAL AND PROVINCE STANDARDS AND OWNER'S STANDARDS. ALL MEASURES SHALL BE CONSISTENT WITH THE NOVA SCOTIA DEPARTMENT OF ENVIRONMENT EROSION AND SEDIMENTATION CONTROL HANDBOOK FOR CONSTRUCTION SITES, AT A MINIMUM.
   - B. SUBMIT PLAN AND DETAILS TO OWNER FOR REVIEW AND APPROVAL.
   - C. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE REMOVED WITHIN 30 DAYS AFTER FINAL SITE STABILIZATION OR AFTER THE TEMPORARY MEASURES ARE NO LONGER NEEDED, UNLESS OTHERWISE AUTHORIZED BY THE OWNER.
7. DEMOLITION:
   - A. DEMOLISH PORTIONS OF THE EXISTING CONCRETE DAM AS SHOWN IN THE PLANS.
   - B. CONTRACTOR SHALL DEWATER WORK AREAS AS NEEDED TO PERFORM DEMOLITION AND EXCAVATION AND TO ACCOMMODATE NEW CONSTRUCTION.
   - C. CONTRACTOR SHALL CONFORM TO ALL OWNER SAFETY PROCEDURES.
   - D. CONTRACTOR SHALL NOT BEGIN ANY DEMOLITION OR EXCAVATION UNTIL AFTER RECEIVING WRITTEN AUTHORIZATION TO BEGIN DEMOLITION FROM OWNER'S PROJECT MANAGER.
   - E. CONTRACTOR IS RESPONSIBLE FOR CARE OF ANY LEAKAGE INTO THE WORK AREAS DURING CONSTRUCTION.
   - F. CONTRACTOR SHALL DISPOSE ALL DEMOLITION MATERIAL AT A LOCATION THAT HAS BEEN APPROVED BY OWNER.
8. MATERIALS:
   - A. STEEL:
     - I. BOLTS ASTM A325 (THREAD EXCLUDED FROM SHEAR PLANE) COMPLETE WITH A563 HEX NUT AND HELICAL SPRING WASHER ANSI B 18.21.1 UNLESS OTHERWISE SPECIFIED. ALL HARDWARE SHALL BE GALVANIZED AS PER ASTM A153.
     - II. STRUCTURAL W SHAPES: ASTM A992, OR CSA G40.21–350W.
     - III. STEEL PLATE: ASTM A–36, OR CSA G40.21–300W.
     - IV. ANCHOR RODS: ASTM A 36, A 307, OR F1554. HOT DIPPED GALVANIZED PER ASTM A 153, AS INDICATED ON DRAWINGS.
   - B. CONCRETE:

     SUBMIT MIX DESIGN AND REINFORCEMENT SHOP DRAWINGS FOR APPROVAL BY OWNER.

     SURFACE PREP:
     - I. REMOVED DETERIORATED SURFACE MATERIAL IN DESIGNATED AREAS DOWN TO SOUND CONCRETE. SOUND CONCRETE IS DEFINED AS WHEN THE SURFACE IS STRUCK WITH A GEOLOGIST'S HAMMER, THE AGGREGATE OF THE CONCRETE FRACTURES BEFORE THE CEMENT PASTE BOND IS BROKEN.
     - II. PERFORM REMOVAL WITH POINTED TOOLS THAT DO NOT DAMAGE OR FRACTURE THE UNDERLYING SOUND CONCRETE, OR BY PRESSURE WASHING OR AIR BLASTING.
     - III. ROUGHEN ALL SURFACES TO GREATER THAN 1/4" AMPLITUDE. CLEAN SURFACE TO REMOVE ALL DELETERIOUS MATERIAL, INCLUDING DIRT, GREASE, ETC. WASH WITH HIGH PRESSURE WASH AT LEAST 6,000 PSI.
     - IV. CONCRETE SURFACE SHALL BE SATURATED AT TIME OF CONCRETE PLACEMENT, BUT NO STANDING WATER.
     - V. DO NOT PLACE CONCRETE AGAINST ACTIVE LEAKS OR SEAMS WITH FLOWING WATER. STOP FLOW OR INSTALL DRAINAGE TO DIVERT FLOW AWAY FROM FRESH CONCRETE.

     SPECIFICATIONS:
     - I. MINIMUM F'c = 30 MPa AT 28 DAYS (4,000 PSI),
     - II. MAX W/C RATIO 0.45
     - III. FLYASH: ALL FLY ASH SHALL BE CLASSIFIED "FLY ASH CLASS CI OR F", CONFORMING TO CSA A3000 AND AS FURTHER DESCRIBED IN CLAUSE 2.2.1, CONCRETE MIXES. THE TOTAL ALKALI CONTENT OF THE FLY ASH SHALL BE LIMITED TO 4.5% MAXIMUM. THE FLY ASH SHALL BE OBTAINED FROM THE TRENTON GENERATING STATION UNIT 6 AS MARKETED BY SHAW RESOURCES.
     - IV. AIR ENTRAINMENT 6–8%
     - V. SLUMP AT PLACEMENT SHALL BE 100mm +/– 25mm (4" +/– 1")
     - VI. MAX AGGREGATE SIZE SHALL BE 25mm (1")
     - VII. CONCRETE PLACEMENT AND CURING SHALL BE IN ACCORDANCE WITH CSA 23.1, EXPOSURE CLASS F–1, "SPECIFICATION FOR STRUCTURAL CONCRETE FOR BUILDINGS".
     - VIII. CONCRETE WORK SHALL CONFORM TO CSA 23.1. CONCRETE STRENGTH SHALL BE VERIFIED BY STANDARD 28 DAY TESTS.
     - IX. REINFORCEMENT = CSA G30.18, GRADE 400W DEFORMED. STANDARD HOOKS PER CSA A23.3.
     - X. NON SHRINK CEMENT GROUT: MINIMUM F'C = 35MPA AT 7 DAYS.
     - XI. ADHESIVE ANCHORS SUITABLE FOR USE IN DAMP OR WET ENVIRONMENT: HILTI–HIT HY 200 ADHESIVE OR APPROVED EQUAL. ANCHORS ASTM F1554 GRADE 55, MINIMUM Fy=380MPA; Fu=520MPA.
   - C. NON–SHRINK GROUT: CRD–C 621, FACTORY PREMIXED GROUT
     - I. EARLY VOLUME CHANGE: ASTM C–827: 0.00% SHRINKAGE
     - II. HARDENED VOLUME CHANGE: 0.00% SHRINKAGE AND EXPANSION AFTER SET.
     - III. COMPRESSIVE STRENGTH: ASTM C–109 MIN. = 35 MPA AT 7 DAYS
     - IV. ACCEPTABLE SUPPLIERS: "FIVE STAR GROUT" BY US GROUT CORP, OR APPROVED EQUIVALENT.
9. SUBMITTALS:
   - A. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO OWNER FOR APPROVAL PRIOR TO FABRICATION.
   - B. EXCAVATION AND FILL PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE A WRITTEN EXCAVATION AND FILL PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL DETAIL THE FOLLOWING ITEMS, AT A MINIMUM:
       - SCHEDULE AND SEQUENCE OF WORK IN EACH AREA.
       - ACCESS TO EACH AREA.
       - LOCATION OF MATERIAL STOCKPILES IN EACH AREA.
       - EQUIPMENT TO BE USED IN EACH AREA.
       - MONITORING AND QUALITY CONTROL PROCEDURES.
       - MEANS/METHODS AND MATERIALS TO PROTECT EXISTING FEATURES DESIGNATED TO REMAIN.
   - C. DEWATERING PLAN:
     - I. DEWATERING WILL BE DONE IN CONJUNCTION WITH NSPI HYDRO SYSTEM PERSONNEL AND THE NSPI PROJECT MANAGER/ENGINEERS. THE CONTRACTOR SHALL PROVIDE A DETAILED DEWATERING PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING ITEMS, AT A MINIMUM:
       - MEANS/METHODS OF TEMPORARY EXCAVATION DEWATERING.
       - EQUIPMENT TO BE USED.
       - SETTLEMENT BASINS, IF REQUIRED, FILTER BAG LOCATIONS AND POINTS OF DISCHARGE.
       - SEQUENCING OF DEWATERING, EXCAVATION, AND FILL PLACEMENT.
   - D. EMERGENCY SEEPAGE PLAN:
     - I. THE CONTRACTOR SHALL PROVIDE AN EMERGENCY SEEPAGE PLAN SUPPORTED BY FIGURES AND/OR ANNOTATED DRAWINGS. THE PLAN SHALL INCLUDE THE FOLLOWING, AT A MINIMUM:
       - TYPE, QUANTITY, AND LOCATION OF EMERGENCY FILTER/BALLAST STOCKPILES.
       - OTHER MATERIALS TO BE USED, (E.G., SANDBAGS, NON–WOVEN GEOTEXTILE, FILTER STONE, SMALL RIPRAP, ETC.).
   - E. WINTERIZATION PLAN:
     - I. AT LEAST TWO (2) WEEKS PRIOR TO ANY WINTER SHUTDOWN, THE CONTRACTOR SHALL SUBMIT A PLAN FOR PROTECTING/WINTERIZING THE COMPLETED WORK.
   - F. CONTRACTOR'S QUALITY CONTROL TESTING LABORATORY:
     - I. THE CONTRACTOR SHALL SUBMIT THE NAME AND QUALIFICATIONS OF AN INDEPENDENT THIRD PARTY COMMERCIAL TESTING LABORATORY TO BE USED FOR BORROW SOURCE TESTING OF SOILS/CONSTRUCTION MATERIALS TESTING.
       - THE TESTING AGENCY SHALL BE A RECOGNIZED COMMERCIAL LABORATORY WITH NOT LESS THAN 5 YEARS OF EXPERIENCE IN CONDUCTING RELEVANT FIELD AND LABORATORY QUALITY CONTROL TESTING.
       - THE TESTING AGENCY SHALL MEET THE REQUIREMENTS OF ASTM D–3740.
   - G. BORROW SOURCE(S):
     - I. AT LEAST TWO (2) WEEKS PRIOR TO INITIATION OF APPLICABLE WORK, THE CONTRACTOR SHALL PROVIDE THE PROPOSED SOURCE(S) OF BORROW MATERIALS AND SUPPORTING DATA/RESULTS OF THE SPECIFIED BORROW SOURCE TESTING.
       - TESTING DATA/RESULTS SHALL BE FROM CURRENT TESTING OF SAMPLES OBTAINED FROM THE ACTUAL PROPOSED SOURCE/STOCKPILE AND NOT PRIOR/FILE RESULTS FROM THE SUPPLIER.
   - H. QUALITY CONTROL TESTING REPORTS:
     - I. SUBMIT TWO (2) COPIES OF THE FOLLOWING REPORTS AS SOON AS POSSIBLE, BUT NOT MORE THAN TWO (2) BUSINESS DAYS FOLLOWING COMPLETION OF ASSOCIATED QUALITY CONTROL TESTING.
       - LABORATORY TEST REPORTS FOR PROPOSED BORROW SOURCE MATERIALS. ACCEPTANCE OR REJECTION OR FILL MATERIALS WILL BE BASED ON THE RESULTS OF CURRENT LABORATORY TESTING.
       - FIELD IN–PLACE DENSITY/COMPACTION TEST REPORTS.
10. EARTHWORK:
    - A. SEE SHEET 310–04 FOR EARTHWORK.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

100-02 Kleinschmidt

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REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———
MECH ——— CONST ———

APPROVED

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SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED CMV
CHECKED __
DATE 2020–12–11
W.O. XXXX

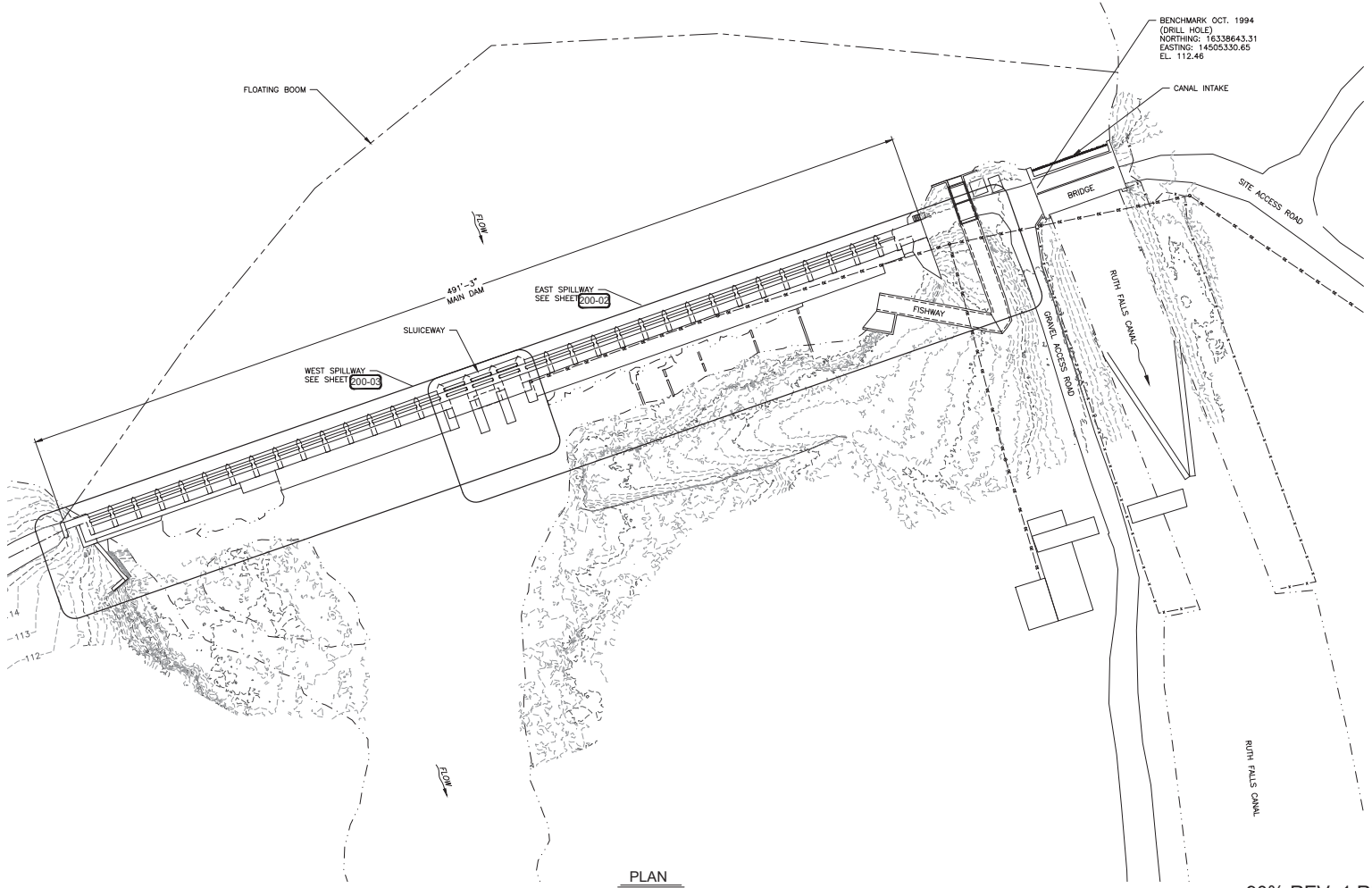
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

GENERAL NOTES

DWG.NO. H096H1163100042 REV. C

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 3



PLAN
1:30

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SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

200-01

Kleinschmidt

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DEPARTMENTAL APPROVALS

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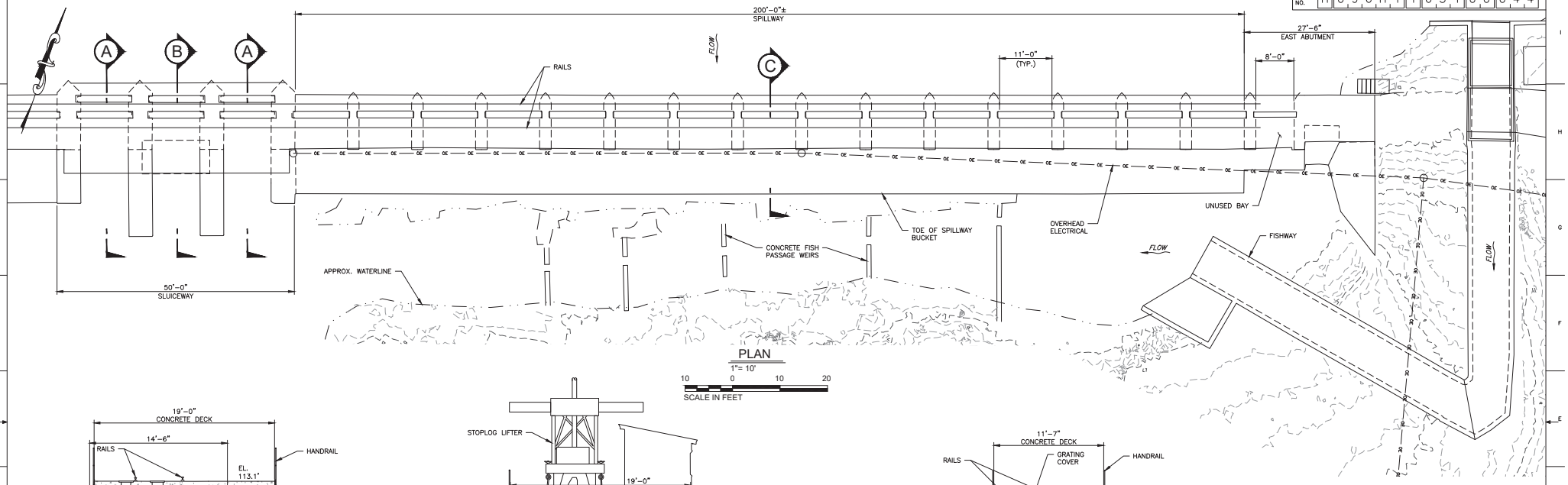
RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

EXISTING CONDITIONS
OVERALL SITE PLAN

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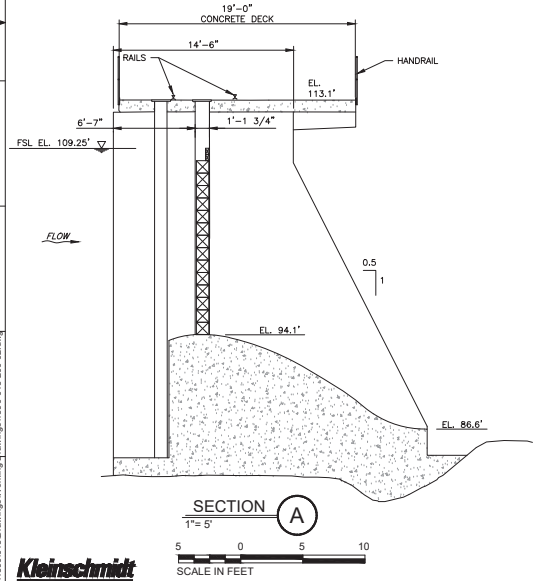


PLAN

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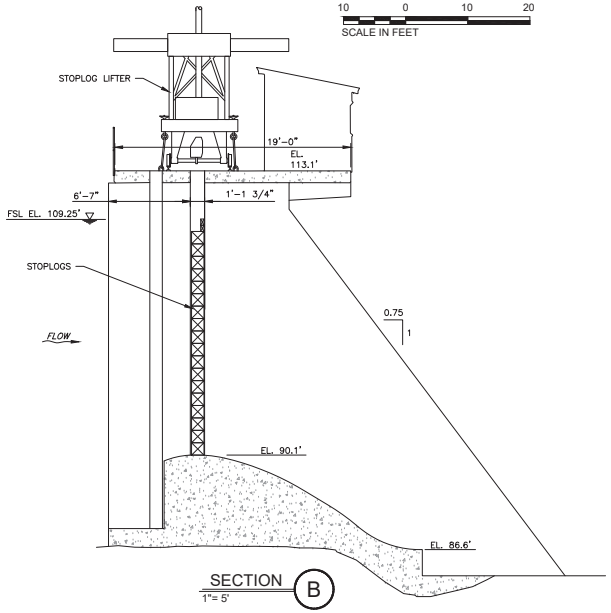
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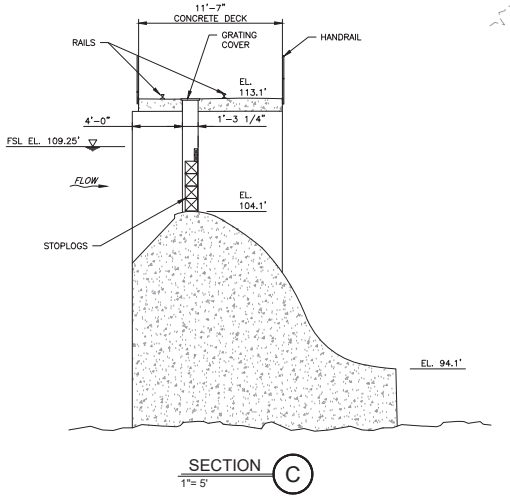
SECTION A

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SECTION B

1"= 5'



SECTION C

1"= 5'

5 0 5 10

SCALE IN FEET

90% REV. 1 REVIEW SUBMITTAL
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200-02

Kleinschmidt

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REFERENCE DRAWINGS	DWG.NO.

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BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

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UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

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DATE 2020-12-11

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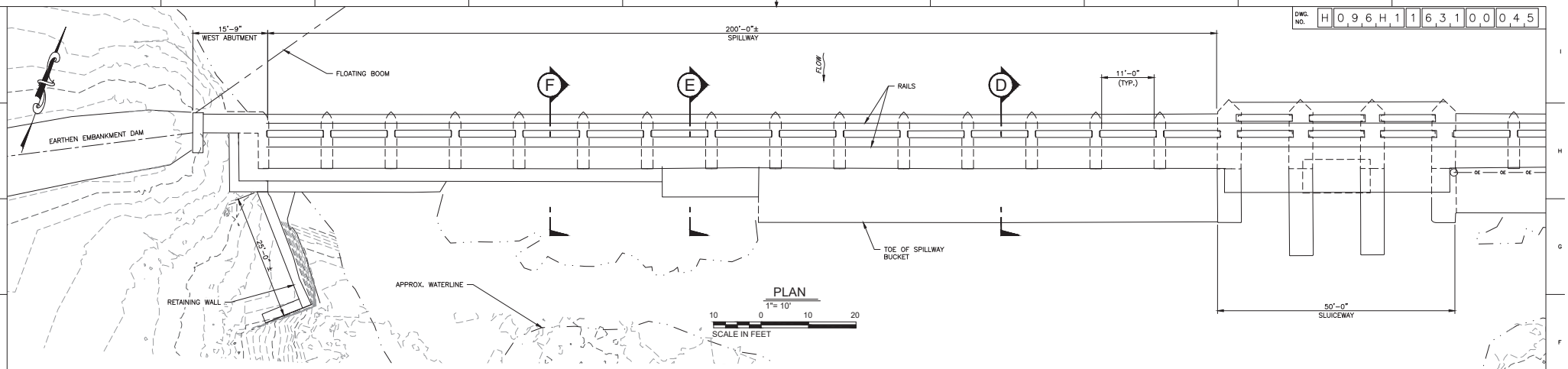
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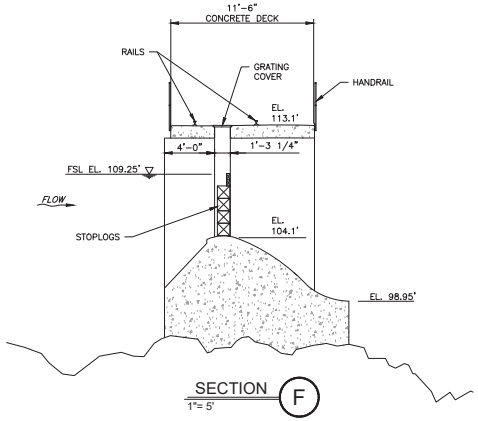
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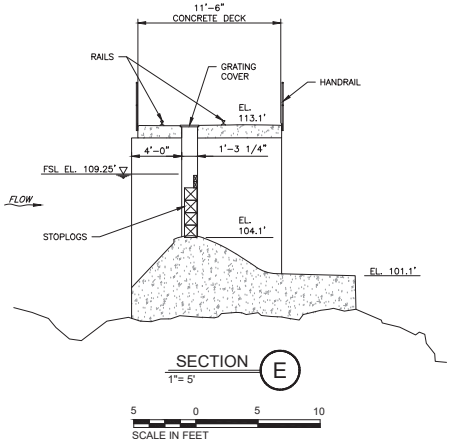
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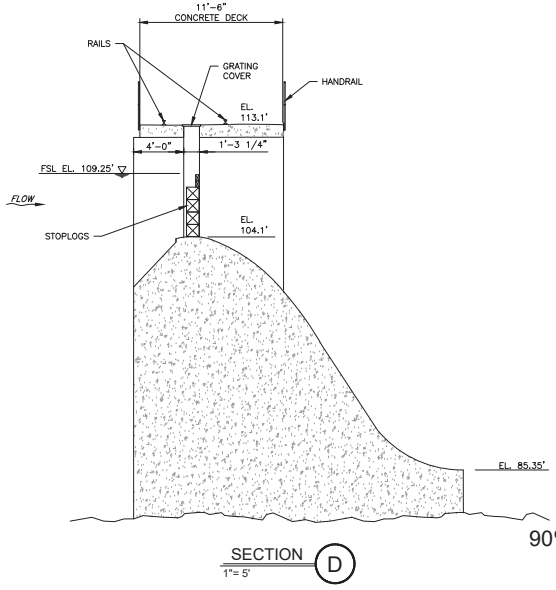
EXISTING CONDITIONS EAST SPILLWAY
PLAN AND SECTION

DWG.NO. H096H1163100044 REV. C









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200-03

DWG. NO. H 0 9 6 H 1 1 6 3 1 0 0 0 4 5

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REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

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MECH	———	CONST	———

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SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
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DATE	2020-12-11
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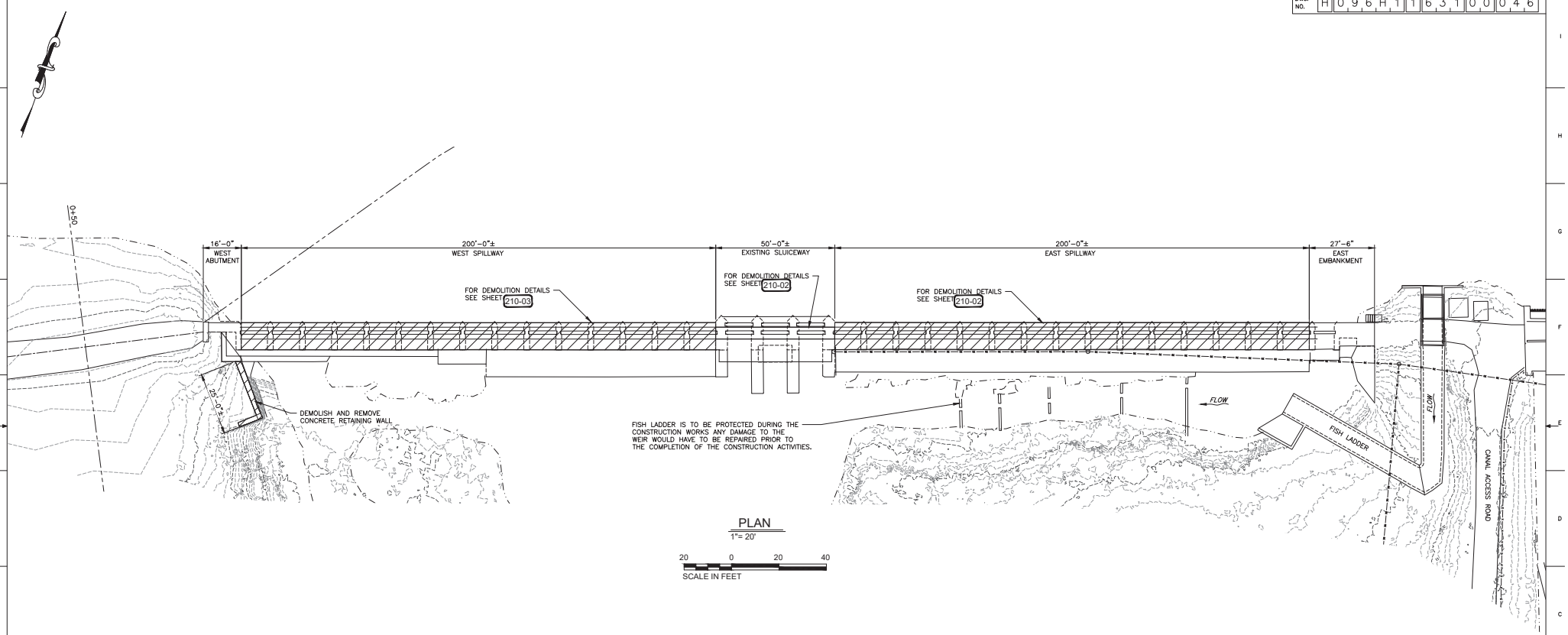
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DAM PLAN AND SECTIONS

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SCALE IN FEET

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210-01

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DEPARTMENTAL APPROVALS

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MECH	———	CONST	———

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SCALE .....
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
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DATE 2020-12-11
W.O. XXXX

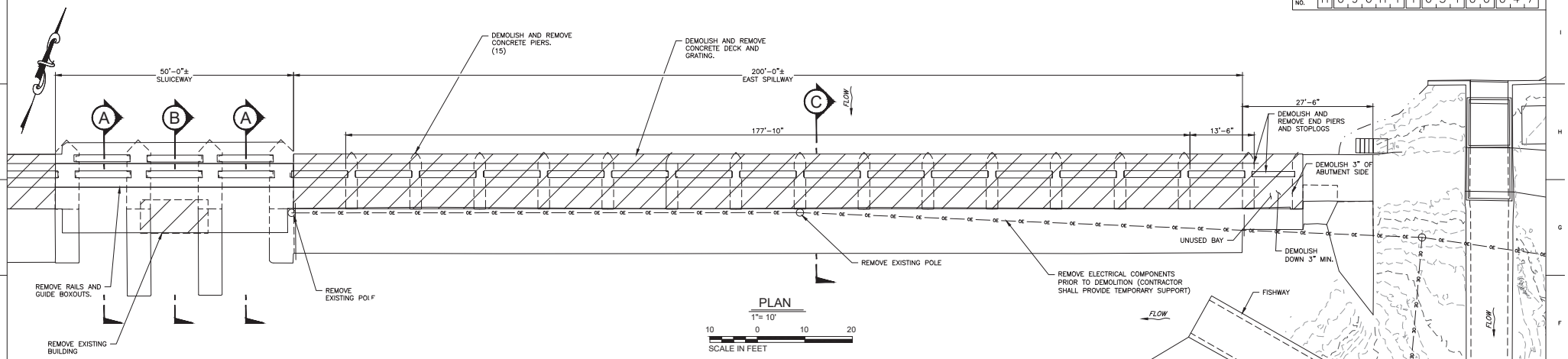
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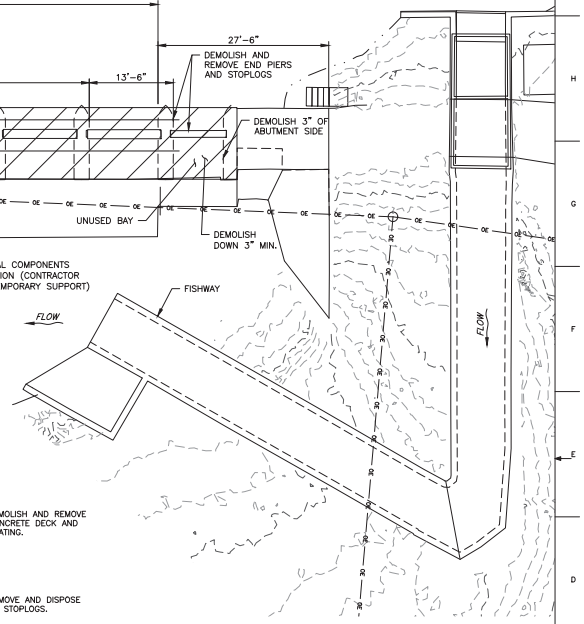
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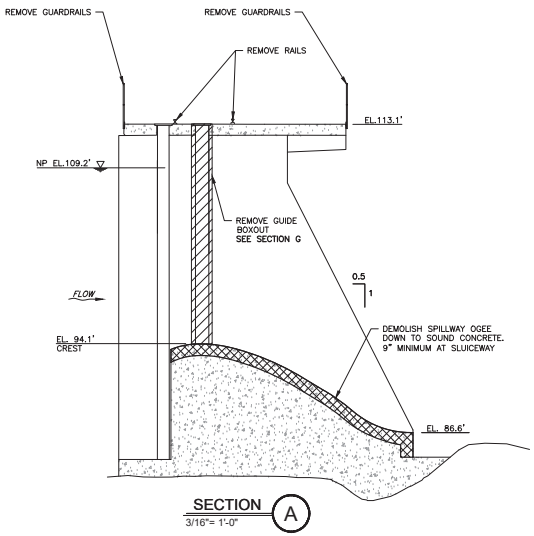
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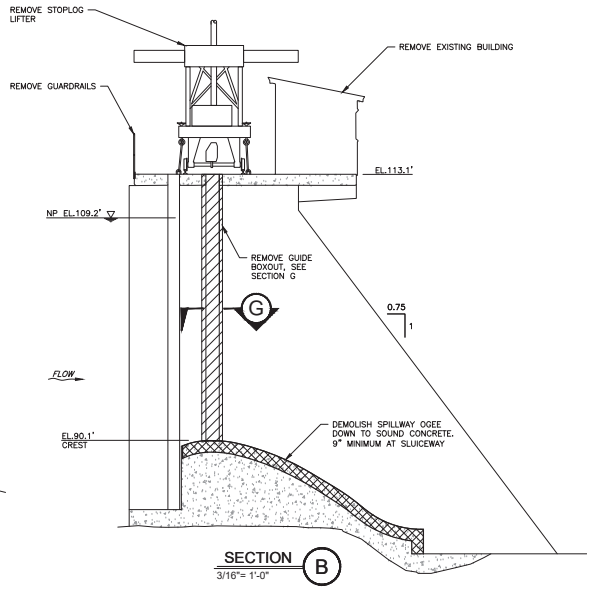


PLAN
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SCALE IN FEET

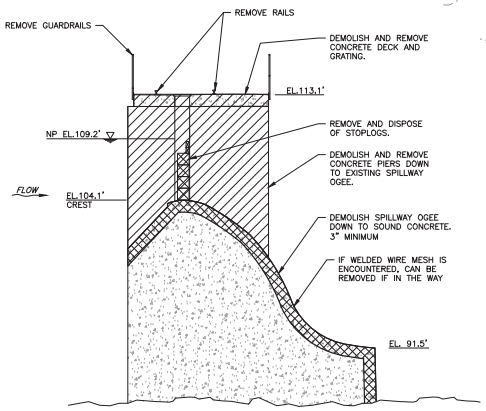




SECTION A
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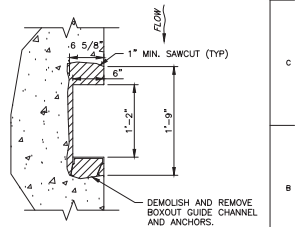


SECTION B
3/16"= 1'-0"



SECTION (TYP EAST SPILLWAY) C
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION (TYP) G
1"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

210-02

Kleinschmidt

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X
RUTH FALLS SPILLWAY AND CONTROL STRUCTURE ELEVATION AND SECTIONS	H	0	9	5	H	1	1	6	7	0	0	0	3	2
REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

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MECH	CONST

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UNITS	IMPERIAL
DESIGNED	CMV
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DATE	2020-12-11
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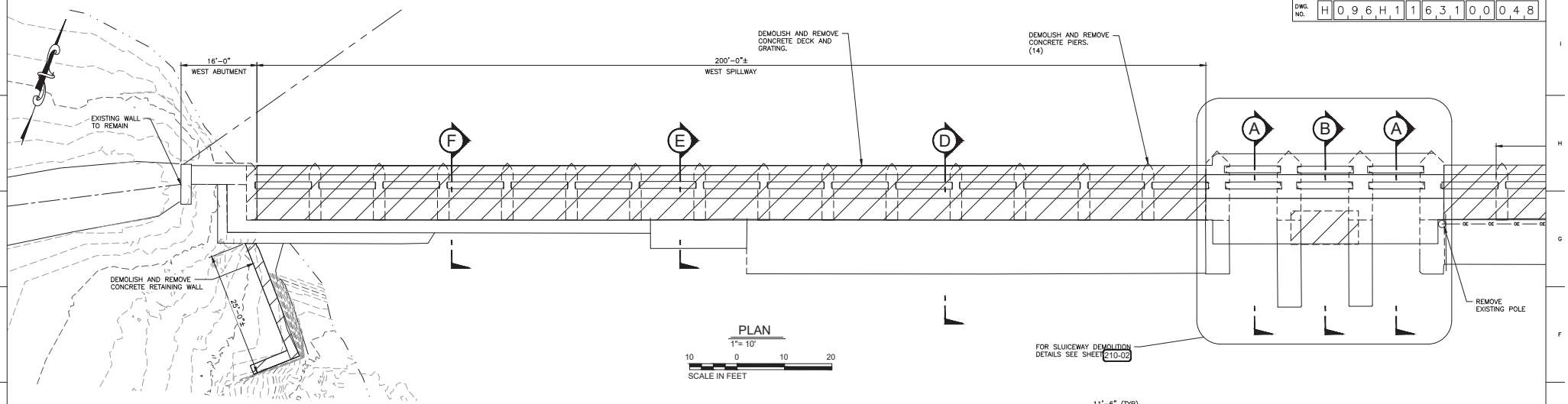
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
EAST SPILLWAY PLAN AND SECTIONS

H096H1163100047 REV. C
DWG.NO.

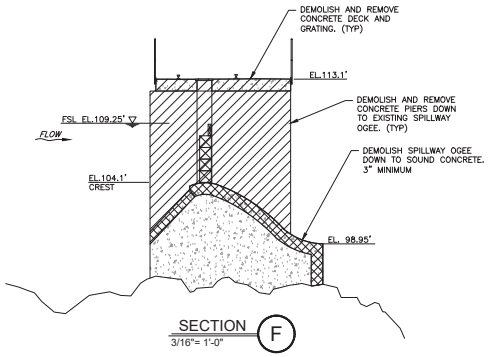
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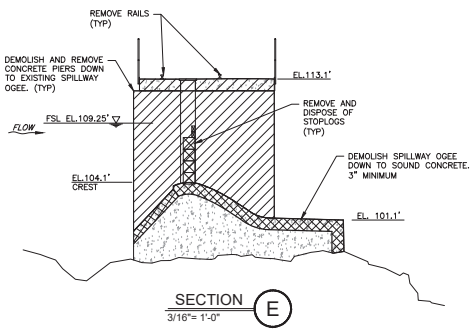
PLAN
1"= 10'

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SCALE IN FEET

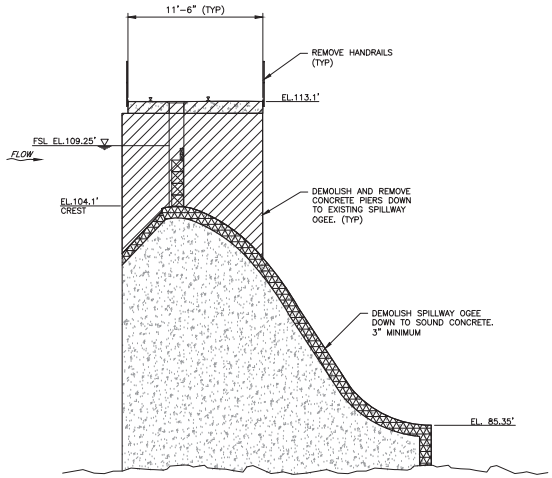


SECTION F
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION E
3/16"= 1'-0"



SECTION D
3/16"= 1'-0"

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210-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

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BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS		
CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE		

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
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DATE	2020-12-11
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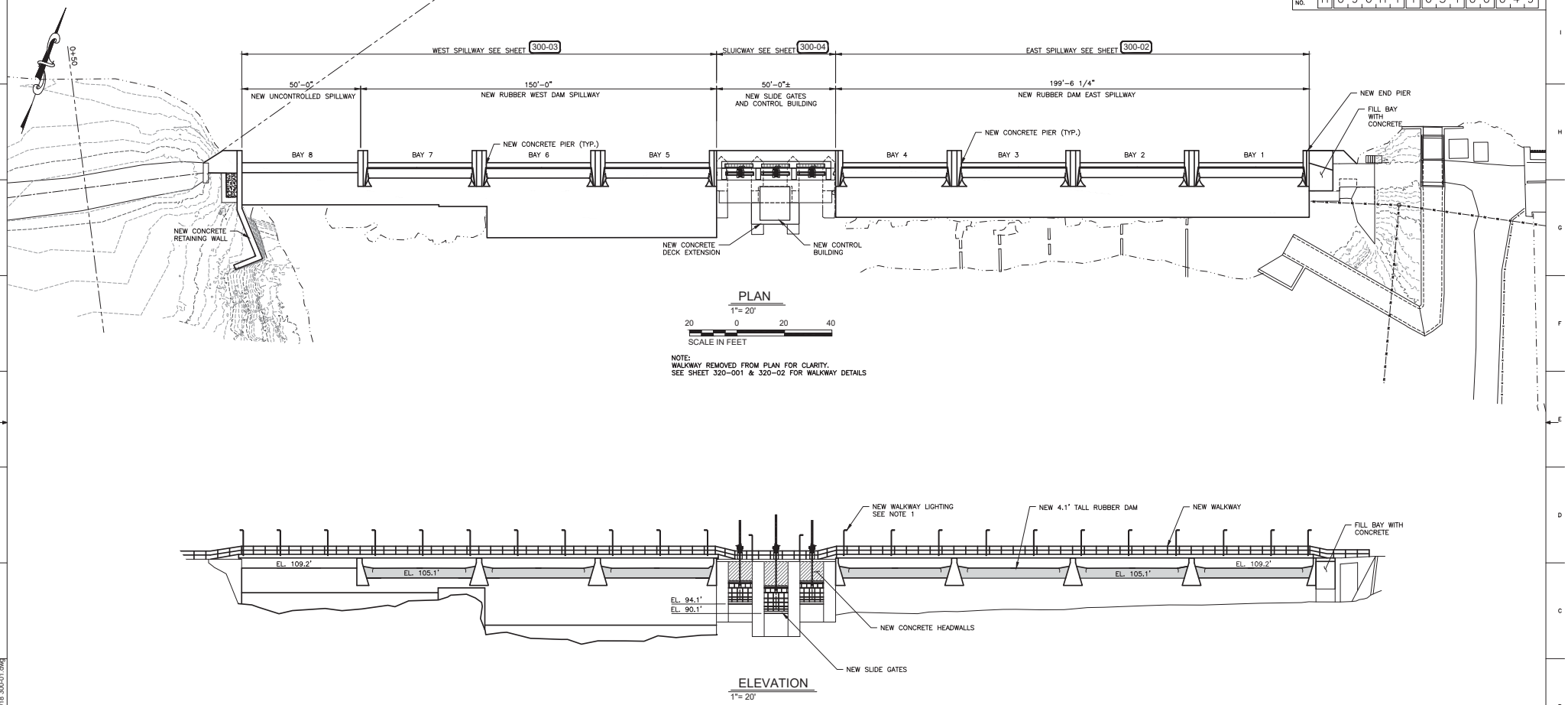
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

TEMPORARY CONDITIONS/DEMO
WEST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100048 REV. C

PRINTED: Dec. 11, 2020 - 9:55 AM
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DWG. NO. H096H1163100049



PLAN
1"= 20'

20 0 20 40
SCALE IN FEET

NOTE:
WALKWAY REMOVED FROM PLAN FOR CLARITY.
SEE SHEET 320-001 & 320-02 FOR WALKWAY DETAILS

ELEVATION
1"= 20'

NOTE:
1. LED LUMINAIRE MOUNTED TO A SWIVEL POLE– 5,300 LUMENS, TYPE 1 OPTIC, MULTIVOLT DRIVER, WARM (3000K) COLOR TEMP. LIGHT TO BE MOUNTED 10' ABOVE WALKWAY AND SPACED AT 20'. WIRING AND CONDUIT RESPONSIBILITY OF CONTRACTOR.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-01

J:\1890\018\Drawings\Working Drawings\1890-018 300-01.dwg
PRINTED: Dec. 9, 2020 - 3:37 PM

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REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST
BY:		DATE:			

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED
DATE

SCALE
UNITS IMPERIAL
DESIGNED CMV
DRAWN ZJA
CHECKED
CHECKED
DATE 2020-12-11
W.O. XXXX

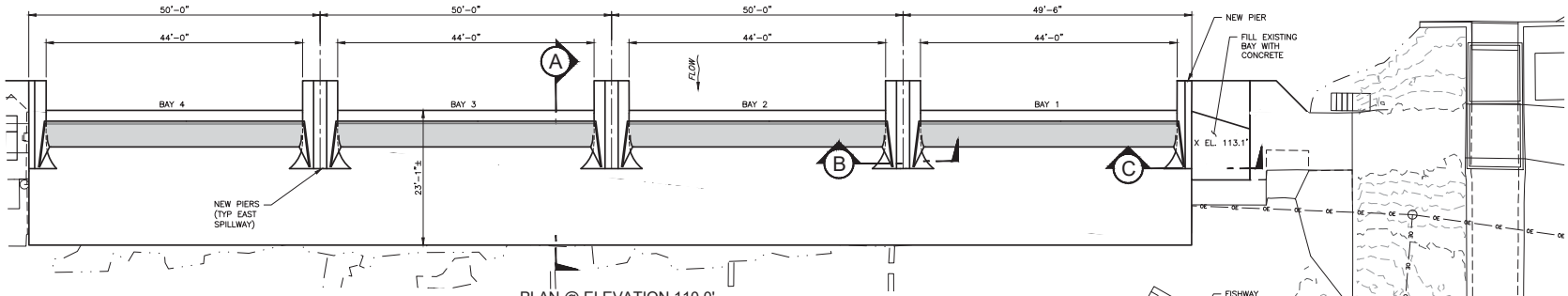
Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

NEW CONDITIONS
DAM PLAN AND ELEVATION

DWG.NO. H096H1163100049 REV. C

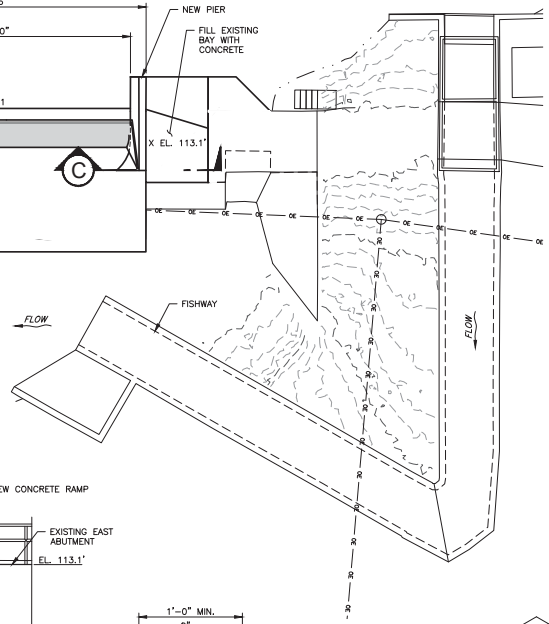
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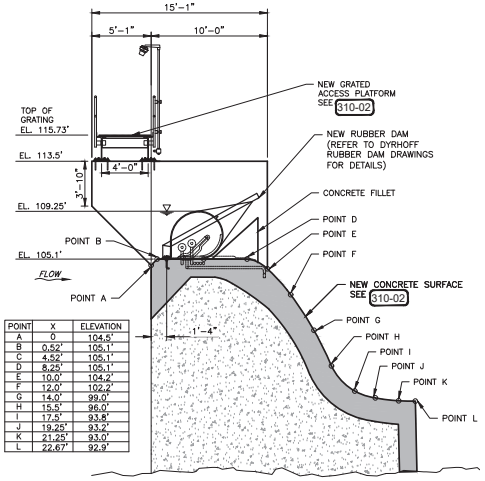


PLAN @ ELEVATION 110.0'

1"= 10'

SCALE IN FEET





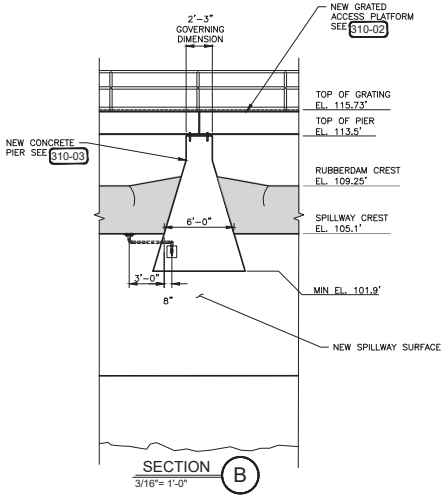
POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	4.52'	105.1'
D	8.25'	105.1'
E	10.0'	104.2'
F	12.0'	102.2'
G	14.0'	99.0'
H	15.5'	96.0'
I	17.5'	93.8'
J	19.25'	93.2'
K	21.25'	93.0'
L	22.67'	92.9'

SECTION A

3/16"= 1'-0"

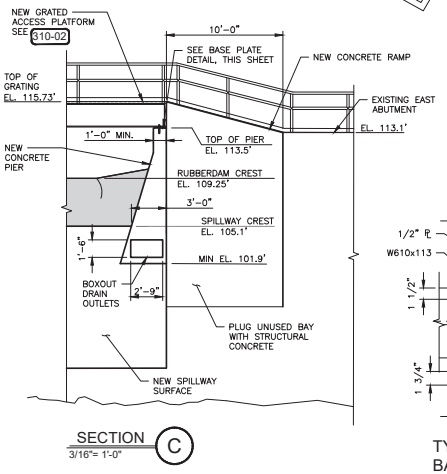
4 0 4 8 12

SCALE IN FEET



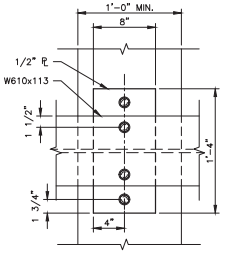
SECTION B

3/16"= 1'-0"



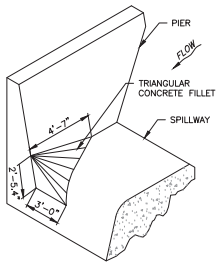
SECTION C

3/16"= 1'-0"



TYPICAL END PIER
BASE PLATE DETAIL

1 1/2"= 1'-0"



TRIANGULAR CONCRETE FILLET DETAIL

N.T.S.

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS		DWG.NO.												

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL _____ E & I _____

MECH _____ CONST _____

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-11

W.O. XXXX

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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

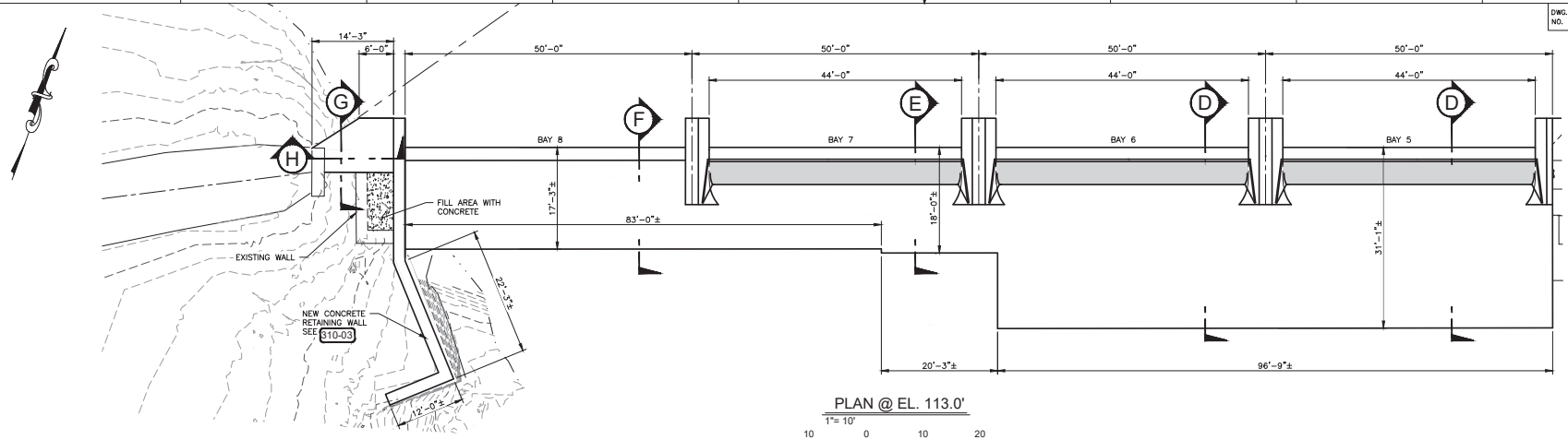
NEW CONDITIONS
EAST SPILLWAY PLAN AND SECTIONS

DWG.NO. H096H1163100050 REV. C

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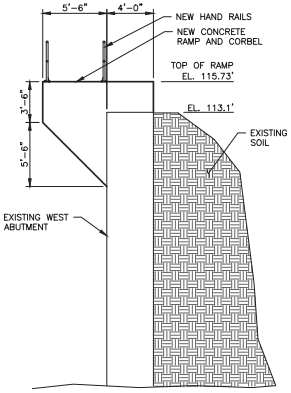
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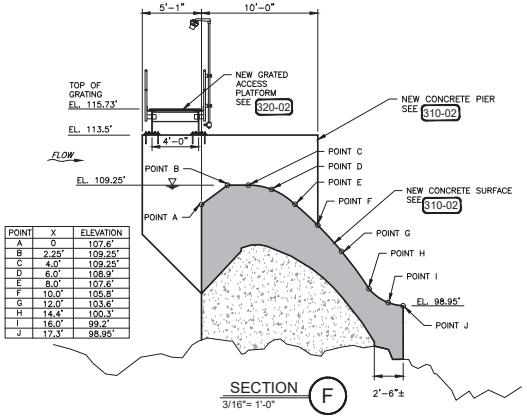


PLAN @ EL. 113.0'
1"= 10'
SCALE IN FEET

NOTE:
WALKWAY REMOVED FROM PLAN FOR CLARITY.
SEE SHEET 320-001 & 320-02 FOR WALKWAY DETAILS

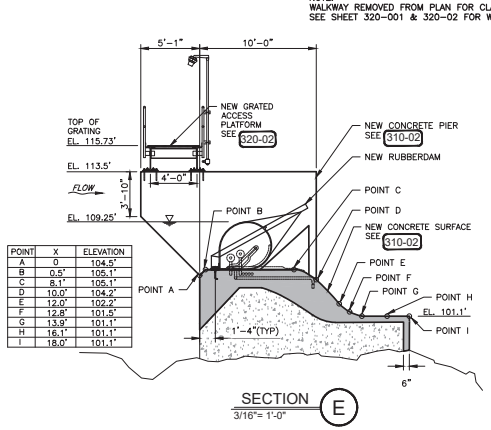


SECTION G
3/16"= 1'-0"



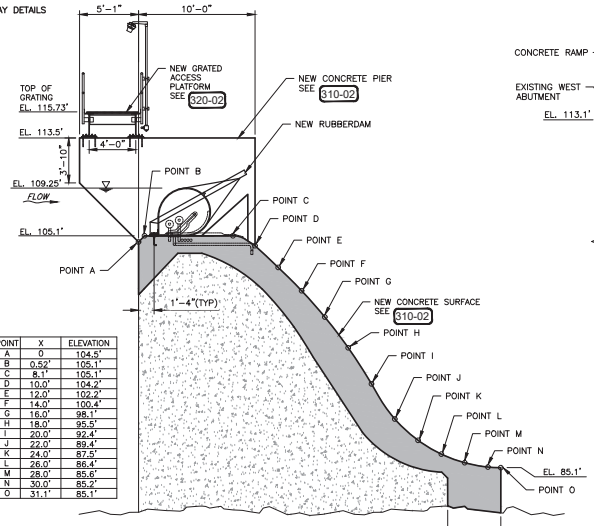
POINT	X	ELEVATION
A	0	107.6'
B	2.25'	109.25'
C	4.0'	109.25'
D	6.0'	108.9'
E	8.0'	107.6'
F	10.0'	105.8'
G	12.0'	103.6'
H	14.4'	100.3'
I	16.0'	99.2'
J	17.3'	98.95'

SECTION F
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.5'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	12.8'	101.5'
G	13.9'	101.1'
H	16.1'	101.1'
I	18.0'	101.1'

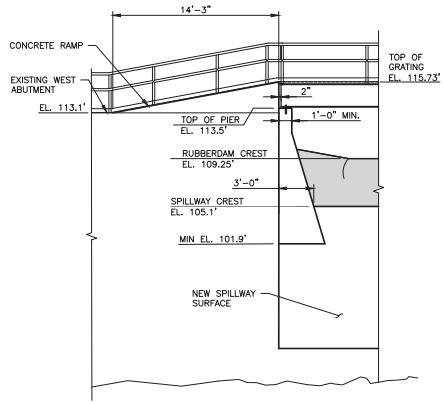
SECTION E
3/16"= 1'-0"



POINT	X	ELEVATION
A	0	104.5'
B	0.52'	105.1'
C	8.1'	105.1'
D	10.0'	104.2'
E	12.0'	102.2'
F	14.0'	100.4'
G	16.0'	98.1'
H	18.0'	95.5'
I	20.0'	92.4'
J	22.0'	89.4'
K	24.0'	87.5'
L	26.0'	86.4'
M	28.0'	85.6'
N	30.0'	85.2'
O	31.1'	85.1'

SECTION D
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET



SECTION H
3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE , ,

SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2020-12-11
W.O.	XXXX

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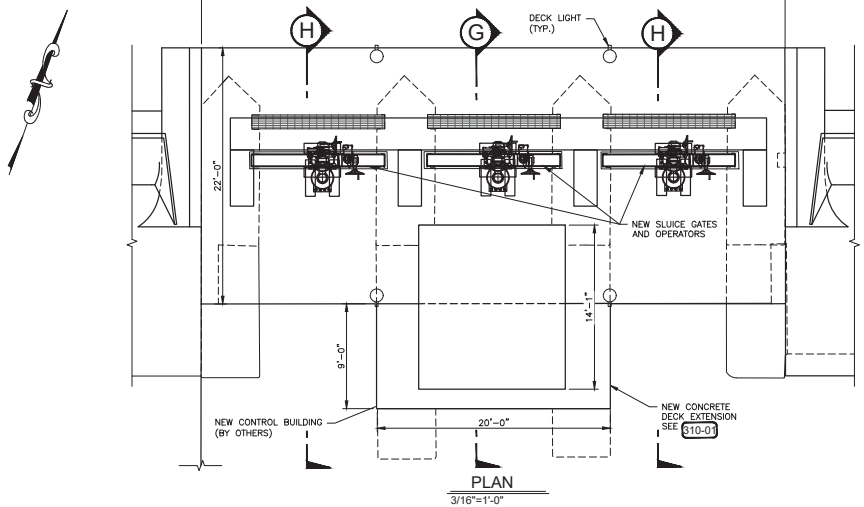
RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
WEST SPILLWAY PLAN AND SECTIONS

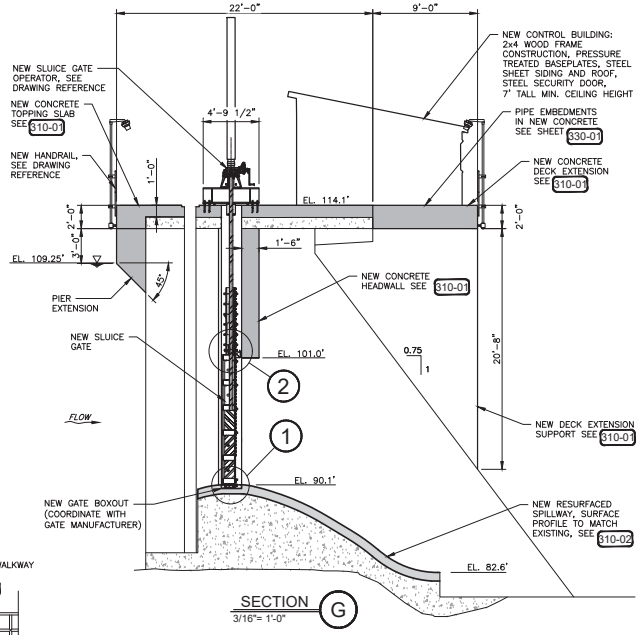
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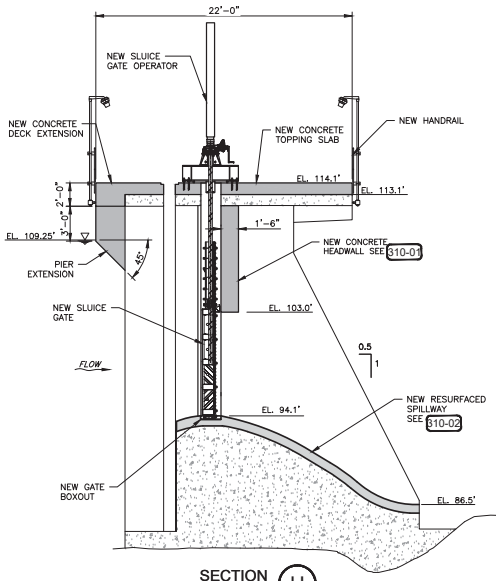
DWG. NO. H096H1163100052



PLAN
3/16"=1'-0"

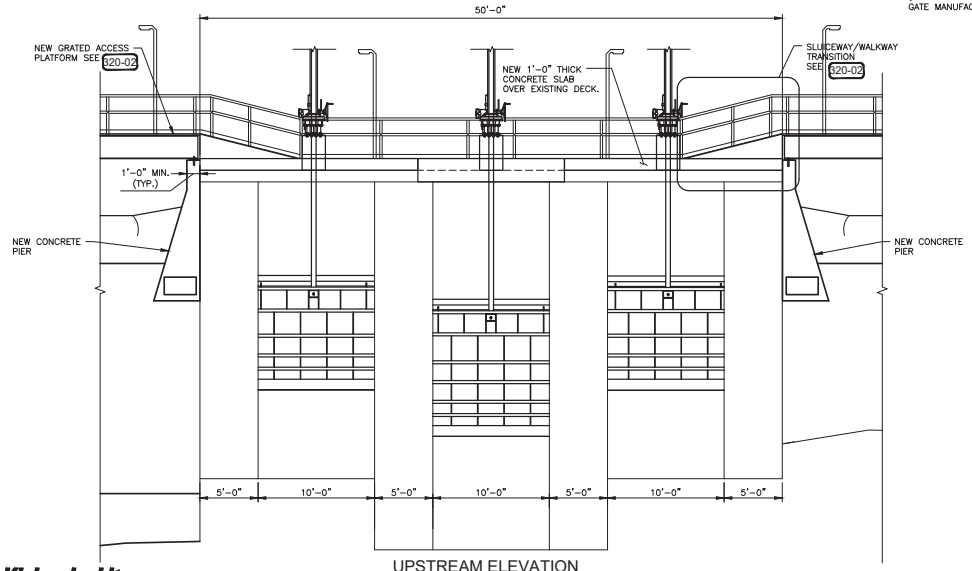


SECTION G
3/16"= 1'-0"

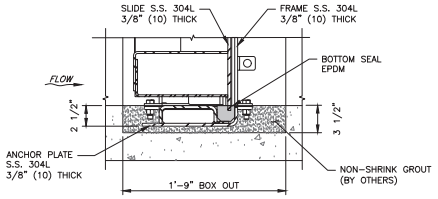


SECTION H
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

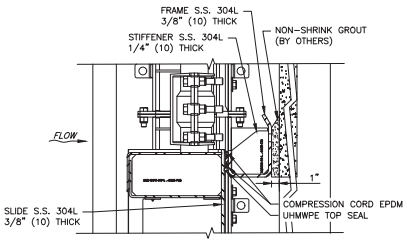


UPSTREAM ELEVATION
3/16"=1'-0"



DETAIL 1
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES



DETAIL 2
1 1/2"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

300-04

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PRINTED: Dec. 9, 2020 - 3:43 PM

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REFERENCE DRAWINGS	DWG.NO.

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL	———	E & I	———
MECH	———	CONST	———

APPROVED

DATE . .

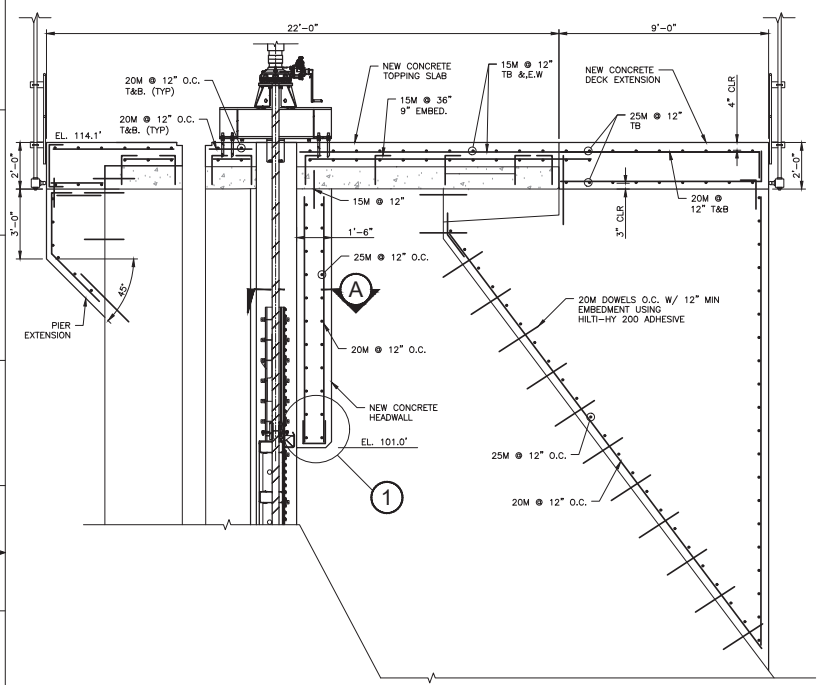
SCALE	
UNITS	IMPERIAL
DESIGNED	CMV
DRAWN	ZJA
CHECKED	— —
CHECKED	— —
DATE	2020-12-11
W.O.	XXXX

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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW CONDITIONS
SLUICEWAY PLAN AND DETAILS

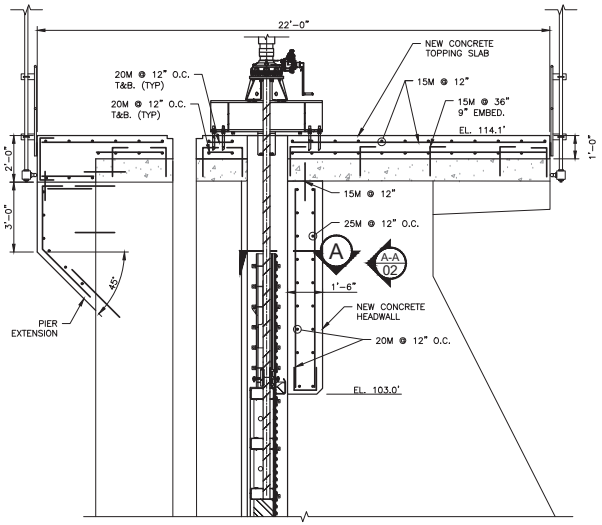
DWG.NO. H096H1163100052 REV. C



INNER SLUICEWAY DETAIL

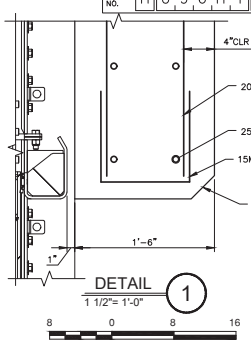
3/8"= 1'-0"

SCALE IN FEET



OUTER SLUICEWAY DETAIL

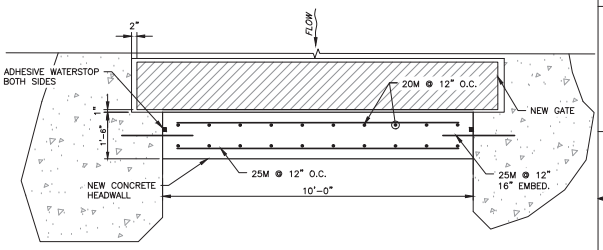
3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

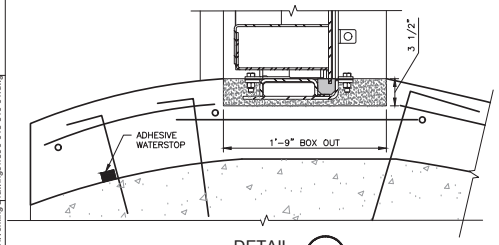
SCALE IN INCHES



SECTION A

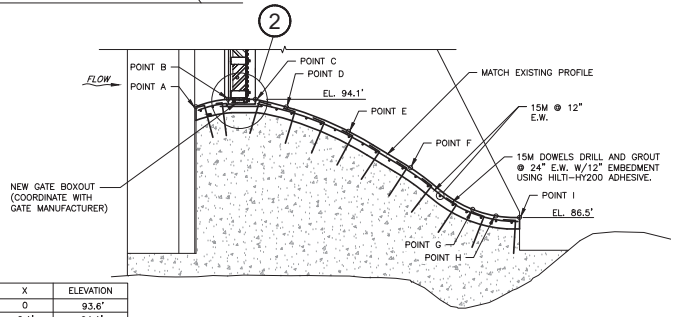
1/2"= 1'-0"

SCALE IN FEET



DETAIL 2

1 1/2"= 1'-0"

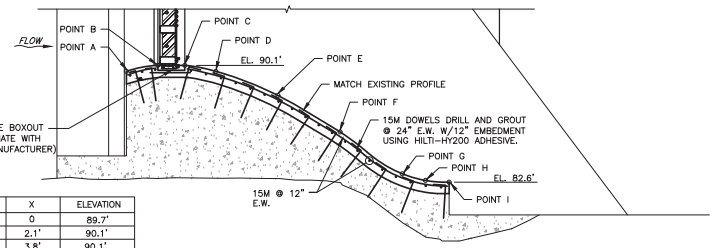


POINT	X	ELEVATION
A	0	93.6'
B	2.1'	94.1'
C	3.8'	94.1'
D	5.8'	93.6'
E	9.8'	92.0'
F	13.8'	89.7'
G	17.8'	87.0'
H	19.3'	86.6'
I	20.8'	86.5'

OUTSIDE SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

SCALE IN FEET



POINT	X	ELEVATION
A	0	89.7'
B	2.1'	90.1'
C	3.8'	90.1'
D	5.8'	89.7'
E	9.8'	88.2'
F	13.8'	85.8'
G	17.8'	83.1'
H	19.3'	82.7'
I	20.8'	82.6'

INNER SLUICEWAY TYPICAL DETAIL

1/4"= 1'-0"

90% REV.1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-01

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PRINTED: Dec. 18, 2020 - 8:42 AM

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
FONTAINE AQUANOX DWG NO. D15542-01-204P2X120107BFE/CW22														
REFERENCE DRAWINGS	DWG.NO.													

SEAL

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-18

W.O. XXXX

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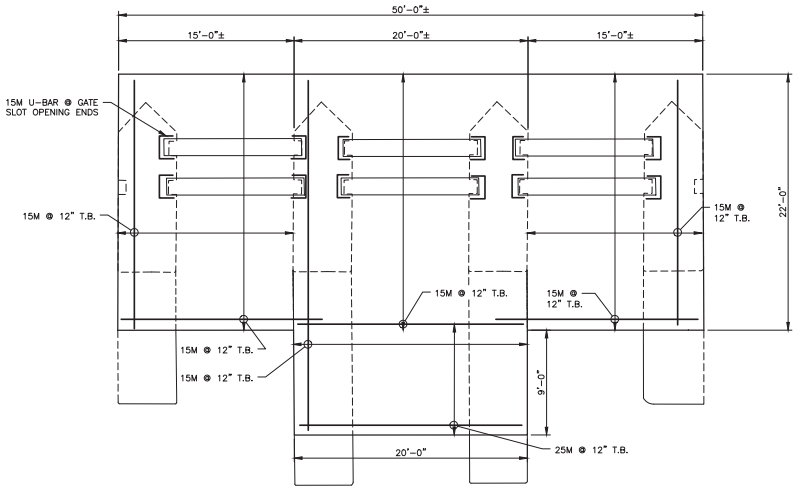
RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 3 REV. C

DWG. NO. H096H1163100054

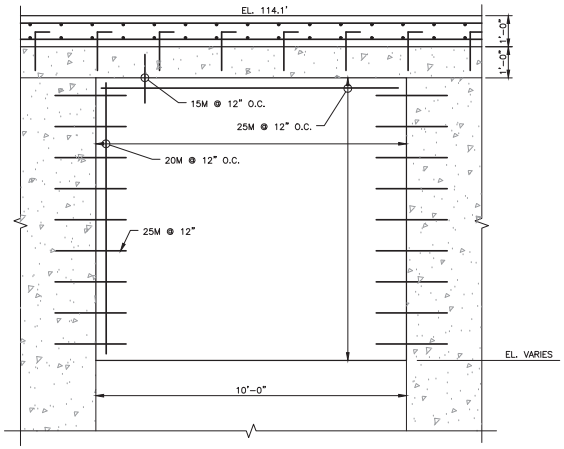


SLUICEWAY DECK REBAR PLAN

3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET

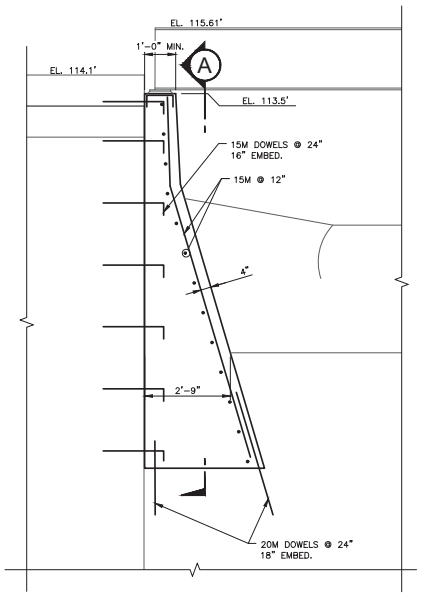


TYPICAL HEADWALL ELEVATION A-A 01

1/2"= 1'-0"

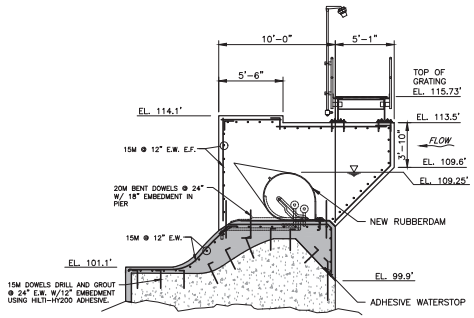
2 0 2 4

SCALE IN FEET



PIER TO SLUICEWAY REBAR DETAIL

1/2"= 1'-0"



SECTION A

3/16"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
NOT FOR CONSTRUCTION

Kleinschmidt

310-02

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X
REFERENCE DRAWINGS	DWG.NO.														

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

DATE , ,

SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED ——

CHECKED ——

DATE 2020-12-18

W.O. XXXX

Nova Scotia POWER An Emera Company energy everywhere.

RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

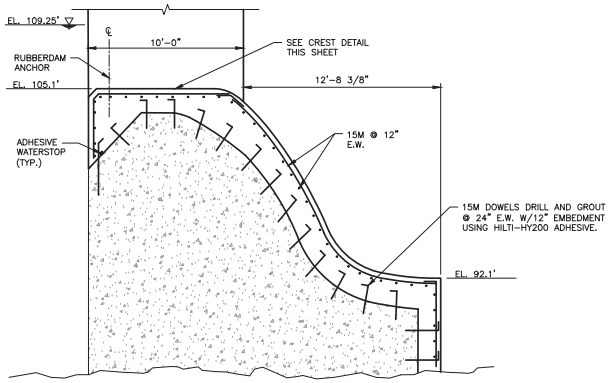
NEW CONCRETE SLUICEWAY HEADWALL AND DECK DETAILS

DWG.NO. H096H1163100054 REV. C

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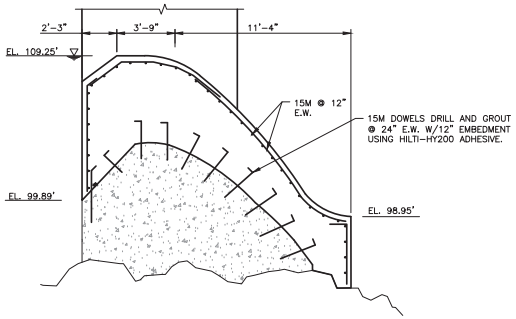
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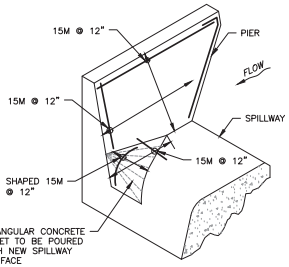
EAST SPILLWAY TYPICAL DETAIL (BAYS 1-4)

1/4"= 1'-0"



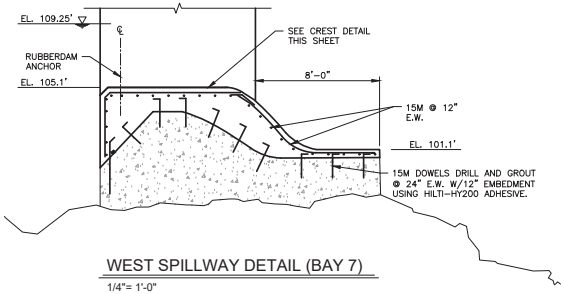
UNCONTROLLED SPILLWAY DETAIL (BAY 8)

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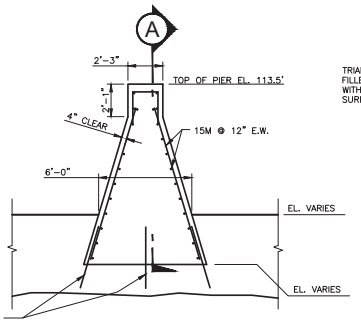
TRIANGULAR CONCRETE FILLET DETAIL

N.T.S.



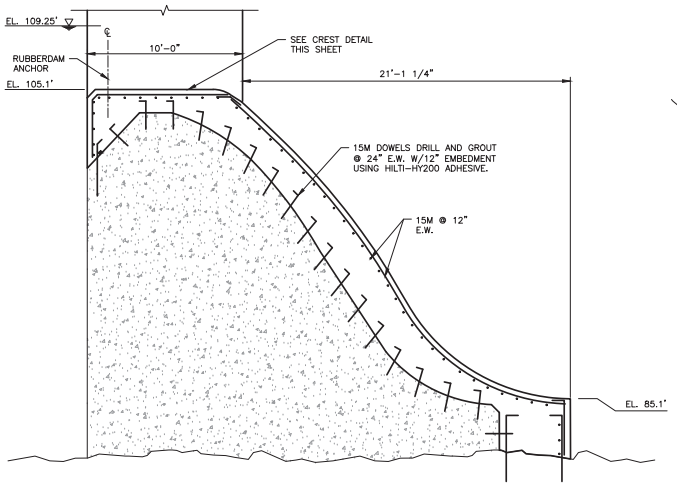
WEST SPILLWAY DETAIL (BAY 7)

1/4"= 1'-0"



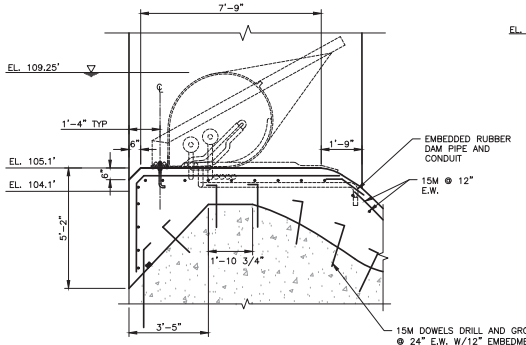
TYPICAL PIER DETAIL

1/4"= 1'-0"



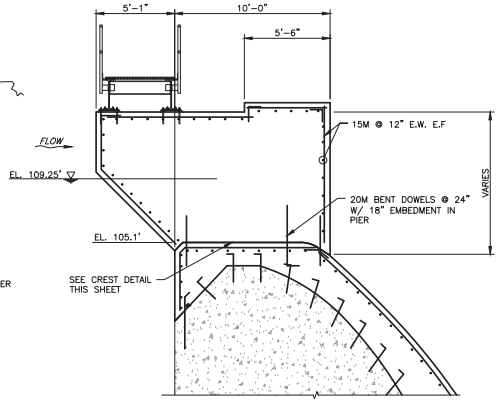
WEST SPILLWAY TYPICAL DETAIL (BAYS 6&5)

1/4"= 1'-0"



RUBBERDAM CREST TYPICAL

3/8"= 1'-0"



TYPICAL PIER SECTION

1/4"= 1'-0"

A 90% REV. 1 REVIEW SUBMITTAL

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310-03

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DATE 2020-12-18

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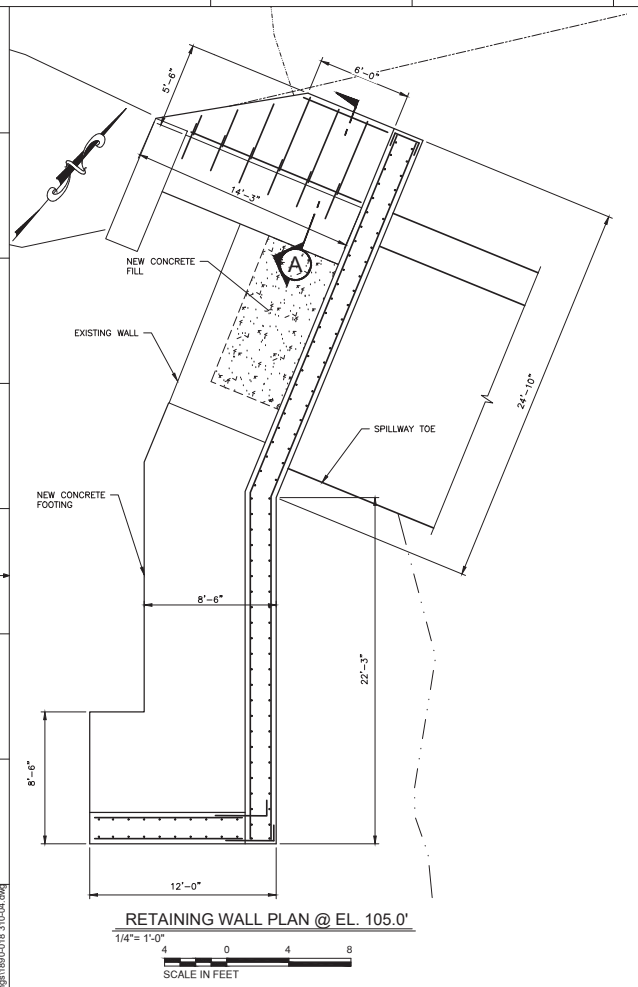
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RUTH FALLS

RUTH FALLS REFURBISHMENT PROJECT

NEW CONCRETE SPILLWAY RESURFACING DETAILS

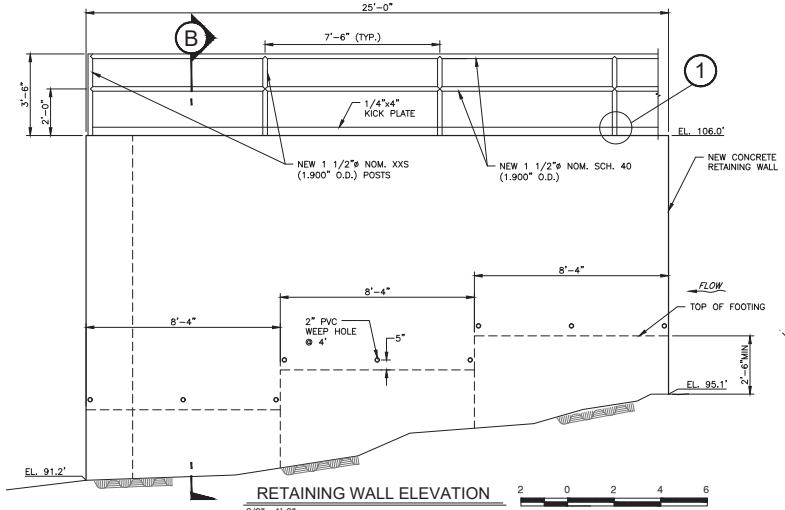
DWG.NO. H096H1163100055 REV. C



RETAINING WALL PLAN @ EL. 105.0'

1/4"= 1'-0"

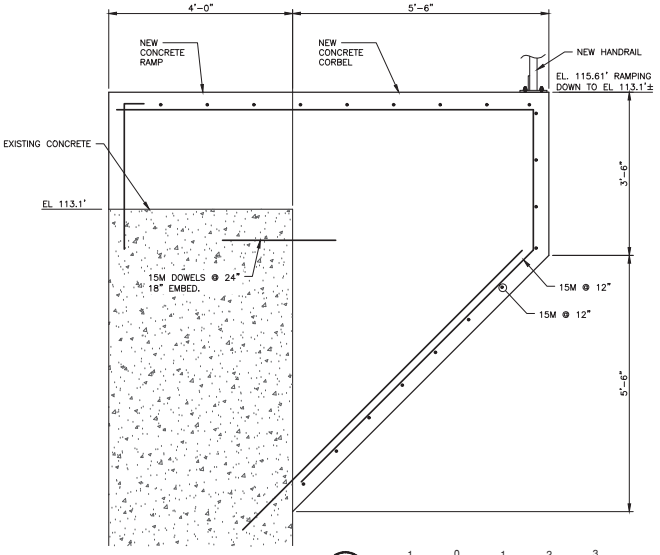
SCALE IN FEET



RETAINING WALL ELEVATION

3/8"= 1'-0"

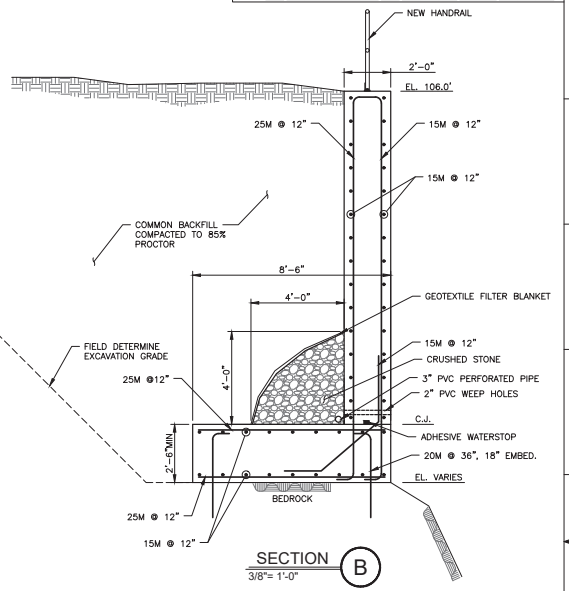
SCALE IN FEET



SECTION A

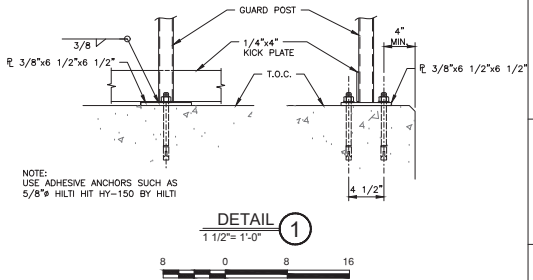
3/4"= 1'-0"

SCALE IN FEET



SECTION B

3/8"= 1'-0"



DETAIL 1

1 1/2"= 1'-0"

SCALE IN INCHES

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310-04

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PRINTED: Dec. 18, 2020 - 8:41 AM

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UNITS IMPERIAL

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DATE 2020-12-18

W.O. XXXX

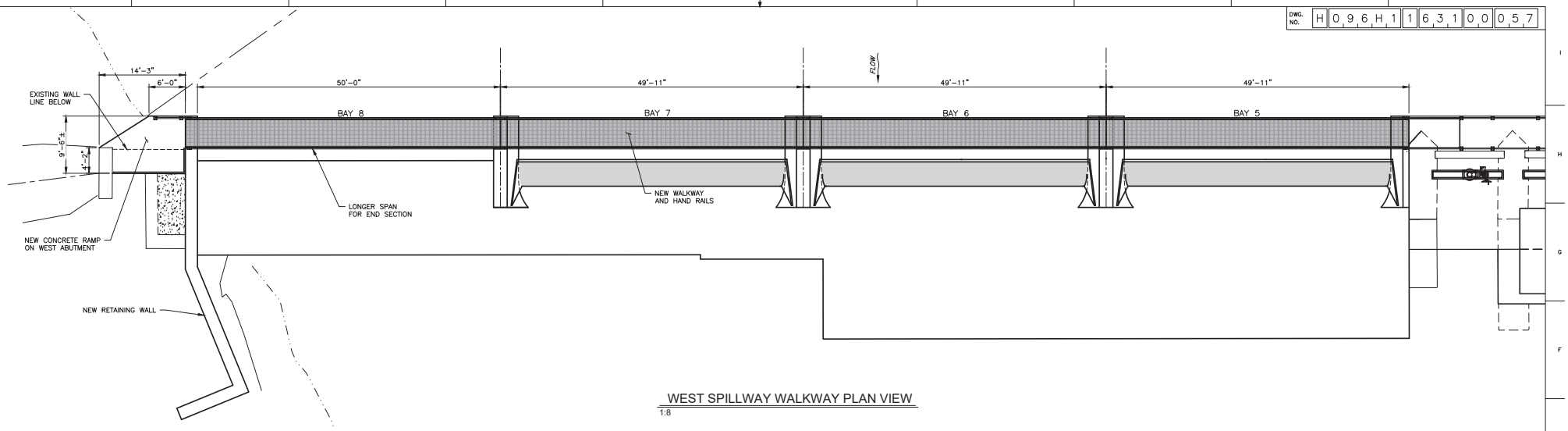
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RUTH FALLS

RUTH FALLS REFURBISHMENT PRJECT

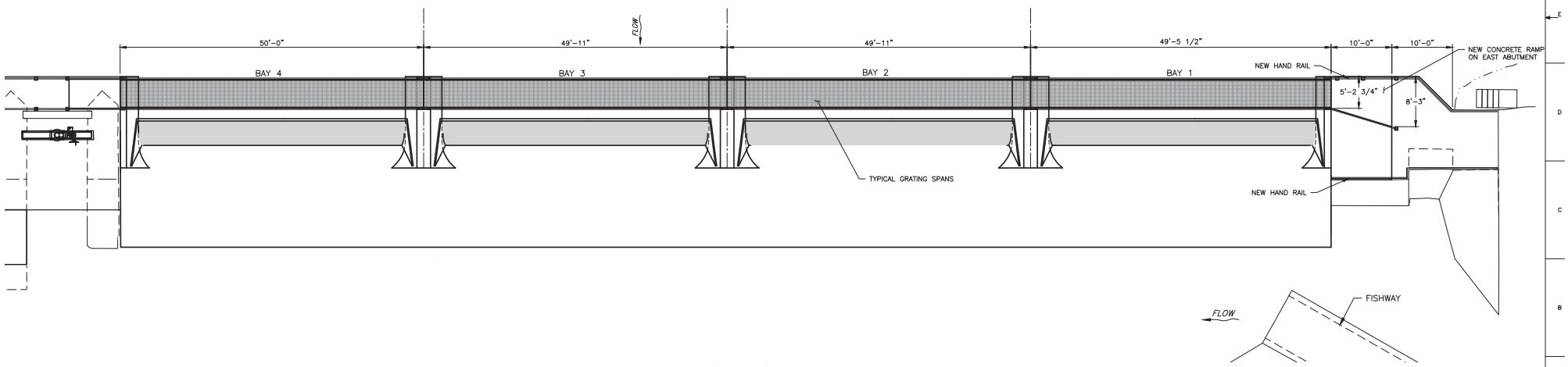
NEW CONCRETE RETAINING WALL AND PIER DETAILS

DWG.NO. H096H1163100056 REV. C



WEST SPILLWAY WALKWAY PLAN VIEW

1:8



EAST SPILLWAY WALKWAY PLAN VIEW

1:8

8 0 8 16

SCALE IN FEET

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320-01

DWG. NO. H096H1163100057

REFERENCE DESCRIPTION

REFERENCE DRAWINGS

DWG.NO.

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BY: _____ DATE: ____-__-__

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DEPARTMENTAL APPROVALS

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MECH ——— CONST ———

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SCALE .....

UNITS IMPERIAL

DESIGNED CMV

DRAWN ZJA

CHECKED __

CHECKED __

DATE 2020-12-11

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RUTH FALLS

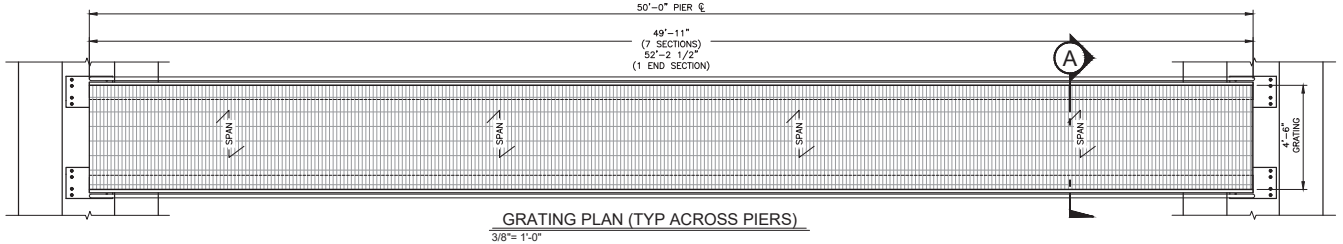
RUTH FALLS REFURBISHMENT PROJECT

NEW STEEL GRATED ACCESS PLATFORM PLAN VIEW

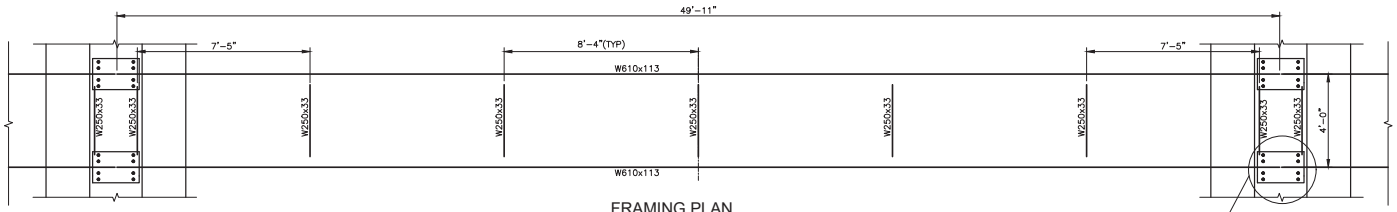
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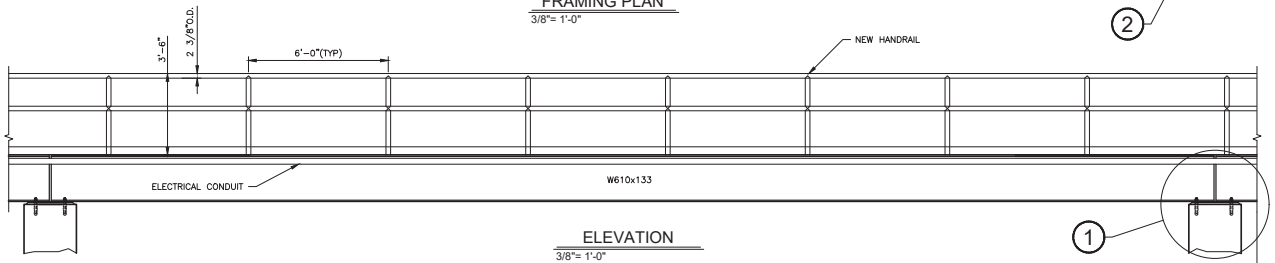
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GRATING PLAN (TYP ACROSS PIERS)
3/8"= 1'-0"

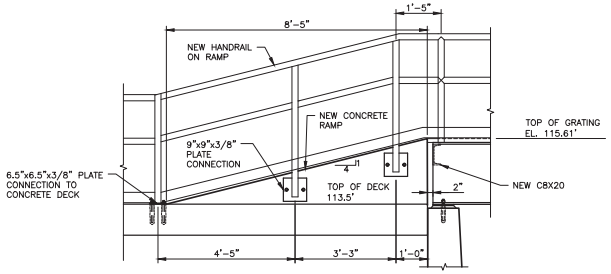


FRAMING PLAN
3/8"= 1'-0"

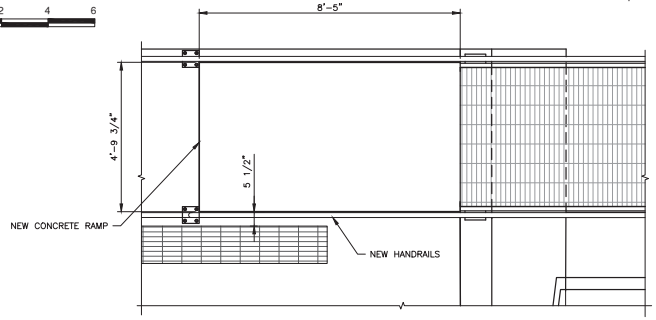


ELEVATION
3/8"= 1'-0"

SCALE IN FEET
2 0 2 4 6

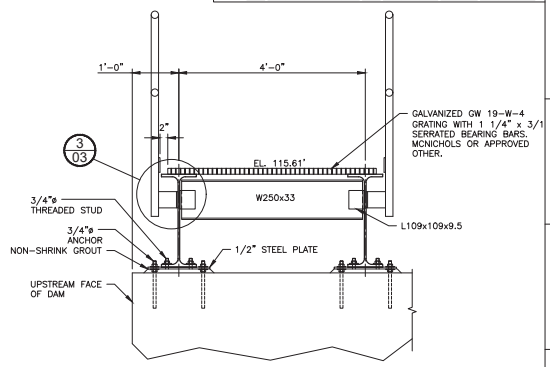


SLUICEWAY/WALKWAY TRANSITION DETAIL
1/2"= 1'-0"

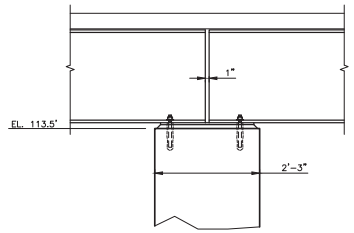


SCALE IN FEET
2 0 2 4

SLUICEWAY/WALKWAY TRANSITION PLAN
1/2"= 1'-0"

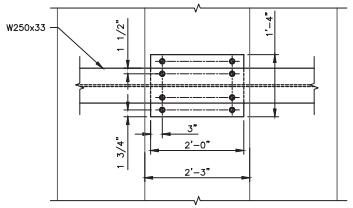


SECTION A
3/4"= 1'-0"



DETAIL 1
3/4"= 1'-0"

SCALE IN FEET
1 0 1 2 3



DETAIL 2
3/4"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
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320-02

Kleinschmidt

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PRINTED: Dec. 9, 2020 - 2:43 P.M.

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BY: _____ DATE: ____-__-__

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MECH	———	CONST	———

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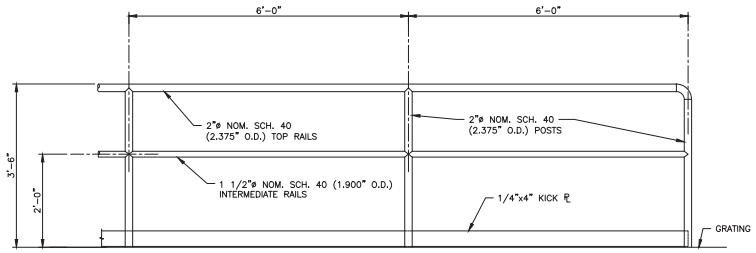
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RUTH FALLS
RUTH FALLS REFURBISHMENT PROJECT

NEW STEEL
GRATED ACCESS PLATFORM

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 5 8 REV. C

DWG. NO. H096H1163100059

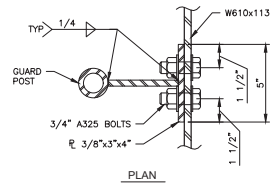


STEEL ACCESS PLATFORM TYPICAL HANDRAIL DETAIL

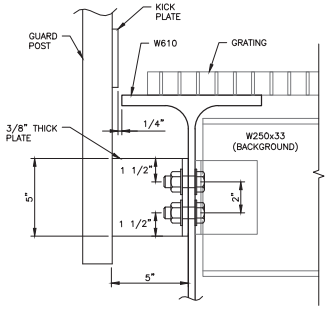
3/4"= 1'-0"

1 0 1 2 3

SCALE IN FEET



PLAN



DETAIL 3/02

3"= 1'-0"

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320-03

REFERENCE DESCRIPTION	A	X	X	X	X	X	X	X	X	X	X	X	X	X
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REFERENCE DRAWINGS	DWG.NO.													

REV	CAD	CIVIL	MECH	E & I	CONST

BY: _____ DATE: ____-__-__

SEAL

DEPARTMENTAL APPROVALS

CIVIL ——— E & I ———

MECH ——— CONST ———

APPROVED

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SCALE .....

UNITS IMPERIAL

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DATE 2020-12-11

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RUTH FALLS

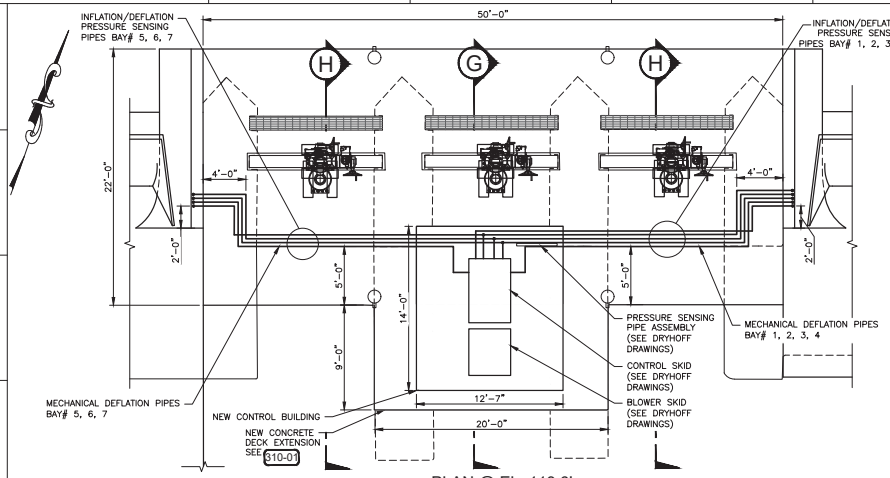
RUTH FALLS REFURBISHMENT PRJECT

NEW STEEL GRATED ACCESS PLATFORM HANDRAIL DETAILS

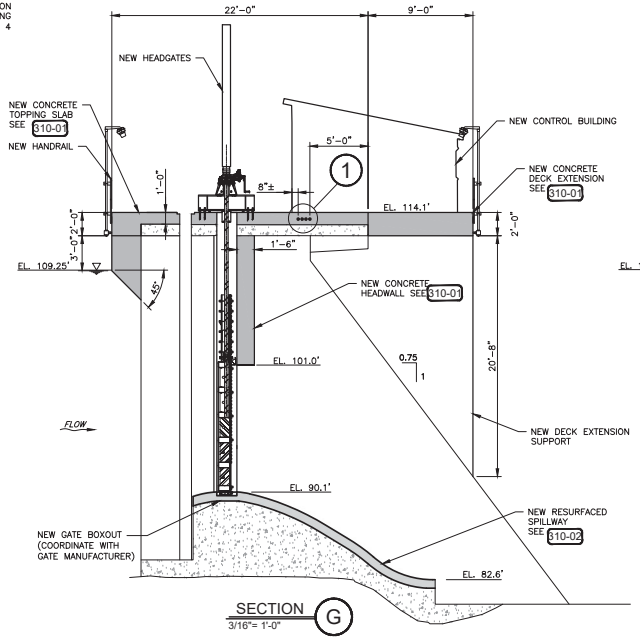
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PRINTED: Dec. 9, 2020 - 3:06 P.M.

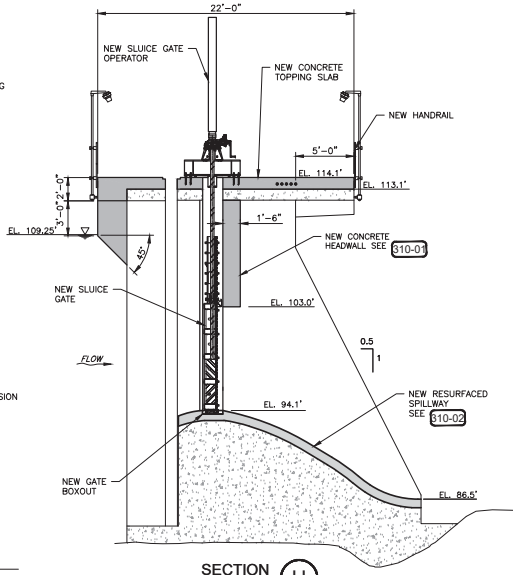
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PLAN @ EL. 113.6'
3/16"=1'-0"

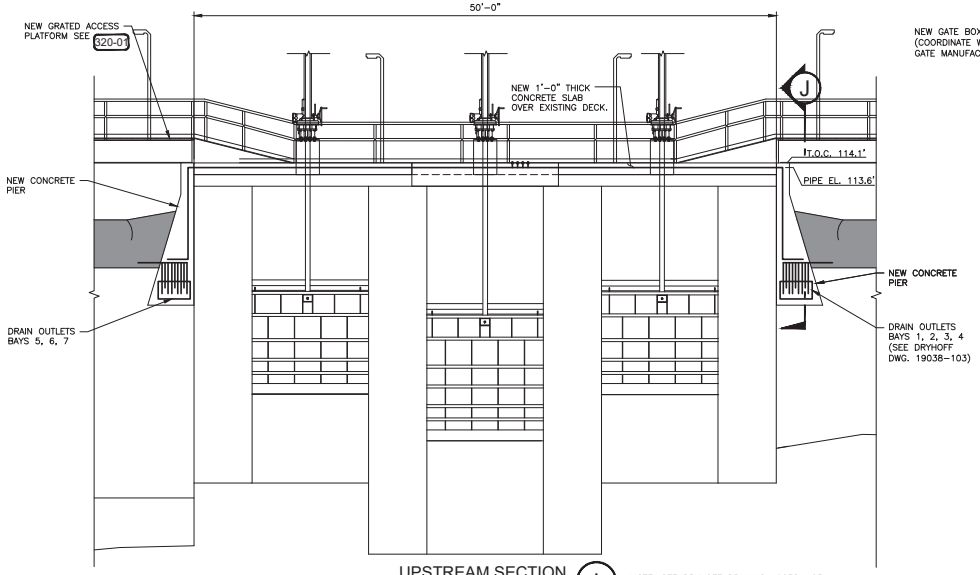


SECTION G
3/16"= 1'-0"



SECTION H
3/16"= 1'-0"

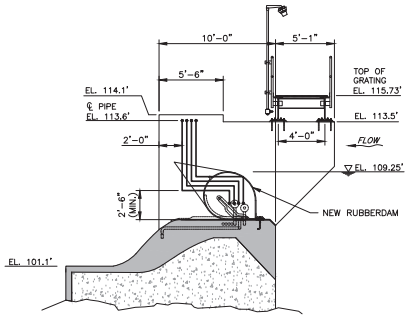
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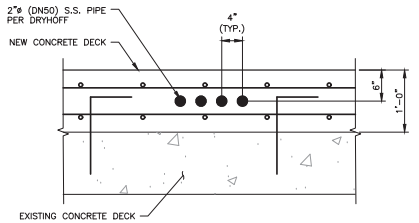
UPSTREAM SECTION
3/16"= 1'-0"

I

NOTE: SEE DRYHOFF DRAWING 19038-103



SECTION J
3/16"= 1'-0"



DETAIL 1
1"= 1'-0"

90% REV. 1 REVIEW SUBMITTAL
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330-01

Kleinschmidt

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PRINTED: Dec. 9, 2020 - 4:06 P.M.

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DRYHOFF DRAWINGS 19038 PACKAGE NOV. 2019														
REFERENCE DRAWINGS	DWG.NO.													

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BY: _____ DATE: ____-__-__

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SCALE .....
UNITS IMPERIAL
DESIGNED CMV
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CHECKED ——
CHECKED ——
DATE 2020-12-11
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RUTH FALLS
RUTH FALLS REFURBISHMENT PRJECT

RUBBER DAM PIPING AT SLUICEWAY

DWG.NO. H 0 9 6 H 1 1 6 3 1 0 0 0 6 0 REV. C

APPENDIX E – Wetland Monitoring Plan

December 14, 2022

Ms. Kailey Osborne
Nova Scotia Power Inc.
1223 Lower Water St.
Halifax, NS B3J 3S8

Dear Ms. Osborne,

Re: Wetland and Wetland Fish Habitat Monitoring Plan
Ruth Falls Reservoir, Sheet Harbour, NS

INTRODUCTION

Nova Scotia Power Inc. (NSPI) is planning to temporarily lower the headpond at the Ruth Falls Reservoir (the Reservoir) within the Sheet Harbour Hydroelectric System to accommodate refurbishments (the Project). Strum Consulting was retained by NSPI to develop a Wetland and Wetland Fish Habitat Monitoring Plan (the Plan) for the Project.

The objective of the Plan is to determine whether the function of wetlands located along the shore that are contiguous with the headpond are impacted as a result of the lowered water levels. Additionally, the Plan will assess the impact on potential fish habitat provided by these wetlands.

The Plan will outline the general principles and methodology by which the wetlands and fish habitat around the Ruth Falls headpond will be monitored, before and after the water level is altered. Baseline wetland monitoring results will also be included for reference.

PROJECT DETAILS

To accommodate refurbishments at the Ruth Falls Reservoir, the water level in the headpond will be dropped from a full supply level of 109.25 ft down to 91 ft. The headpond will remain lowered for a period of approximately 9 months while work is completed on the Reservoir.

Wetlands

Initial wetland delineation was undertaken along the shores of the Reservoir during the *Vegetation Surveys at the Sheet Harbour Hydroelectric System* completed by Jacques Whitford (JW) in 2007 (JW, 2007). As a result of this delineation, 21 wetlands were identified that are contiguous with the headpond (Table 1; see Drawing 1, Attachment A).

Table 1: Wetlands identified at the Ruth Falls Reservoir (Jacques Whitford, 2007)

Wetland ID	Wetland Type
1	Treed shore bog
2	Treed shore bog
3	**Treed shore bog**
4	Shore bog
5	**Shore bog**
6	**Treed shore bog/floating bog**
7	Shore bog
8	Shore bog
9	Shore bog
10	Shore bog
11	Shore bog
12	Shore bog
13	Shore bog
14	Shore bog
15	**Treed shore bog/treed shore swamp**
16	Treed shore bog
17	**Shore bog**
18	Treed shore bog
19	**Shore bog**
20	Shore bog
21	Shore bog

Fish Sampling

Fish species data collected within the Sheet Harbour hydroelectric system was provided to Strum by NSPI; this historical data, including bathymetry information for the Ruth Falls headpond as well as fish and fish habitat assessment information from the Sheet Harbour Hydro System Relicensing Report (Nova Scotia Power, 2018), was used to establish baseline conditions and will assist in developing fish habitat post-construction monitoring assessments.

WETLAND MONITORING

The wetlands, as identified by JW (2007), provided the initial wetland assessment information; Strum has relied on this previously collected data to select and complete a monitoring assessment on six of these identified wetlands. The six wetlands **bolded** in Table 1 (Wetlands 3, 5, 6, 15, 17, and 19) are those selected for monitoring. Criteria for selection considered distribution throughout the reservoir and representation of different (spatial) areas and various wetland types. The criteria also included screening to ensure that hydrological source, landform, and location within a respective catchment area were represented throughout the Reservoir.

Wetland monitoring activities will consist of four baseline assessments (two of which were completed in July and September 2022), one pre-construction assessment, a minimum of one assessment during

drawdown (pending seasonality and timing of construction), and 5 years of post-construction monitoring. Pre-construction monitoring will be completed prior to the headpond being lowered to establish baseline conditions. Post-construction monitoring will begin after refurbishments are concluded and the Reservoir water level has been returned to its pre-construction full supply level. The findings of the monitoring program will allow for an evaluation of the extent of any changes in wetland characteristics and function as a result of the lowered water levels within the headpond.

Methodology

Wetland monitoring will include detailed vegetative, hydrological, and soil monitoring within the six selected wetlands. Each wetland to be monitored was delineated prior to the commencement of monitoring activities to ensure that wetland boundaries are accurate and up to date, and to establish the current biodiversity of the existing habitat.

Vegetative monitoring will entail an assessment of vegetative composition and cover within quadrats along a transect. The linear transect will consist of a series of four 1 m x 1 m quadrats placed 5-10 m apart along the transect route. Percent cover of the herbaceous, shrub/sapling, and tree species within each quadrat will be assessed. The top right corner of each quadrat will be staked to ensure that the selected areas can be replicated for future monitoring events. Additionally, dominant plant species throughout the wetland, as identified along the transect, will be determined for each stratum based on the percentage of vegetative cover. A general assessment will be made to determine overall plant health and note any species that appear to be unhealthy or dying. Vegetative biodiversity will be considered throughout the monitoring timeline to establish whether there is a change in species composition for vegetation plots assessed.

To aid in the extrapolation of data between the wetlands monitored and those that are not, standardized placement of monitoring wells and vegetation plots within wetlands has been conducted. This will ensure consistency throughout the data set, as well as across the different wetland types.

- Monitoring wells were installed halfway between (1) a point on the upland edge of the wetland furthest from open water, and (2) the nearest open water.
- Vegetation plots were positioned between the monitoring well and the water's edge in a line, spaced 5-10 m apart. Where sufficient distance between the monitoring well and the water's edge wasn't available, the plots were positioned towards the upland edge, maintaining the linear distribution.

During initial delineation, soil test pits were incorporated via manual installation (auger, shovel). Indicators of wetland hydrology were noted, including soil saturation, water table level, and standing water. Soil type(s) within each test pit were identified and will be monitored as the wetlands are re-assessed for function during the 5 years post-construction assessments. Subsequent monitoring activities will follow this same approach.

Photographs will be taken of the wetland from a fixed location (identified via GPS) for comparison with future events. All monitoring methodology will be completed during pre-construction and post-construction monitoring events. Initial monitoring events were conducted by a trained biologist and took place within the growing season (June 1 – September 30) to capture the prime growth period for

plants and assess dry season conditions. Subsequent monitoring events will be timed to coincide with previous years' assessment dates to allow data comparisons to be made with previous and future monitoring events. Given the uncertainty of the timing of drawdown, subsequent monitoring events will be timed to best reflect the changing conditions, while also considering the growing season and previously obtained baseline data to accurately assess any changes to vegetative biodiversity.

A description of the monitoring parameters and assessment methodology for wetlands is provided in Table 2, below. All data gathering techniques will be replicated for each subsequent monitoring event.

Table 2: Wetland Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Methods of Assessment
Hydrology	Depth to groundwater will be measured in monitoring wells.
	Standing water depth measurements will be noted within the existing wetland (if applicable).
	Evidence of other positive indicators of hydrology (*e.g.*, drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen sulphide odour in soils, water marks etc.) will be noted.
	An assessment of the general hydrologic condition will be made.
Vegetation	Herbaceous vegetation assessments (as % cover) will be completed within plots along a vegetative transect throughout the wetland. Assessment of the potential changes in composition, species, and health will be evaluated. Photographs will be taken of each individual vegetation plot for comparison with future monitoring events. Any presence of non-native/exotic species will be noted during all surveys, and are addressed specifically in the WESP-AC assessment.
	General assessment of the above variables throughout the wetland will be completed.
	Dominant plant species throughout the wetland will be determined for each stratum based on the percentage of aerial cover. Changes to biodiversity will be monitored over time through identification of species composition.
	Photographs will be taken of the wetland from a fixed location for comparison with future monitoring events.
Soils	Soil type within test pits will be noted and recorded.
	Assessment of potential changes in soil conditions throughout the wetland habitat will be evaluated, including evidence of sedimentation and siltation.

Wetland Functional Assessments (WESP-AC)

WESP-AC was completed during initial baseline pre-construction surveys and will be replicated during the Year 5 post-construction monitoring event to assess whether the function and relative values of the wetlands were changed as a result of the Project.

WETLAND FISH HABITAT MONITORING

Review of Fish Sampling Results

A review of fish sampling conducted by NSPI was completed for all data available prior to the commencement of monitoring. The review involved data compilation of fish species and abundance,

information related to migratory periods (including applicable date ranges and species types observed) and identified species' habitat requirements.

Desktop Fish Habitat Suitability Review

Prior to the commencement of monitoring, a desktop fish habitat suitability review was completed to assess the quality of fish habitat provided by both the Ruth Falls Reservoir and the wetlands contiguous with the Reservoir's shoreline. This review was used to help identify the wetlands that provide valuable fish habitat and inform the selection of wetlands for both wetland monitoring and wetland fish habitat monitoring, and included the following:

- Accessibility to fish
- Provision of fish cover
- Provision of water quality control features
- Potential sources of food and nutrition
- Bathymetry and water depth of the reservoir
- Review of fish sampling results

Based on this assessment, the six wetlands selected were considered most likely to provide a variety of suitable fish habitat for wetland fish habitat monitoring (in addition to meeting the requirements of the wetland monitoring selection criteria).

Assumptions for Fish Habitat Assessments

Fish habitat field surveys are to be modelled after the Ontario Ministry of Natural Resources Procedure (1991) for the Bay of Quinte. Given that the habitat assessments are taking place along the shoreline of a body of (relatively) still water, rather than along a watercourse, the application of flow assessments and fish habitat in streams is less transferable and resources such as the Nova Scotia Fish Habitat Suitability Assessment (NS Adopt-a-stream, 2018), are not as applicable.

Given NSPI's ongoing fish monitoring at the Ruth Falls fish ladder, it is assumed that fish are present in the Reservoir, and that there are fish that use the habitats being surveyed. Therefore, minimizing damage and disruption to fish in sensitive situations, such as breeding, will take priority over the collection of any single data point. If fish breeding evidence is encountered during surveys, those effected data points may be omitted to prevent disturbance during these sensitive periods. NSPI may also want to consider structuring their work schedule around the known breeding periods of any species of conservation interest, including Atlantic salmon (*Salmo salar*).

Wetlands will be monitored for function and fish habitat during the summer months, though they are likely to provide fish habitat year-round. In this instance, the Ordinary High-Water Mark (OHWM) has been defined as the ordinary high-water level within the Reservoir under normal operating conditions. Given that NSPI has some control over water levels, the OHWM is assumed to be the average of the highest operating-condition water levels. This means that water levels during flood conditions in the spring are not considered as the high-water level for the purpose of this assessment. The delineation of fish habitat occurred during initial baseline surveys with consideration given to the OHWM (as

defined herein), further surveys during drawdown and post construction will assess the current conditions at those times and be compared to the baseline conditions.

Methodology for Fish Habitat Field Assessments

The requirements for the baseline and subsequent fish habitat monitoring are described below in detail, including the timing of each of the field and desktop components.

The initial baseline surveys for fish habitat identification and classification were conducted by trained biologists and took place within the growing season on July 4-5, and again on September 6, 2022. The initial baseline surveys were conducted at the six selected wetlands surrounding the Ruth Falls Reservoir. The six wetlands were surveyed for both wetland function and characteristics as well as wetland fish habitat to incorporate the consideration of fish habitat and details associated with water quality. Upon completion of baseline studies, the monitoring schedule will proceed as outlined in the Proposed Schedule and Reporting section of this Plan.

Following the procedure outlined in the Ontario Ministry of Natural Resources (1991) document, transects will be walked from the Open Lake inland, through the Lakeshore and into the backshore for all subsequent monitoring events. This will align with the program that was completed during the baseline studies. General observations will be made, and specific parameters will be assessed for their likelihood to support fish habitat, as seen in Table 3, below.

Along the transects, the portions of each transect to be assessed will be defined as follows:

Open Lake (OL): Open Lake is the area that is completely inundated with water, and can be definitively considered direct fish habitat. There may be any combination of emergent, floating, and submerged vegetation, though the water depth should be no more than 50 cm. The Open Lake area must also be connected to the main water body of the Reservoir to allow fish passage.

Lakeshore (LS): The Lakeshore (also known as the Foreshore) is the area that is generally above the current water level of the lake (Reservoir), but below the highwater line (during flood conditions) on an annual basis. This area might be considered direct fish habitat, though indirect fish habitat should not be considered a requirement. There is wetland vegetation, with the potential for some aquatic vegetation, especially when in proximity to the Open Lake area. The point for the LS assessment should be where there is a transition from standing water to no standing water.

Backshore (BS): The Backshore is the area at least 30 m perpendicular inland to the shore's highwater line and it should not be saturated in water, though it can be wetland or upland. It is not considered fish habitat and should not be accessible to fish.

The parameters to be monitored at each portion of the transect (i.e., OL, LS and BS) are described in Table 3.

Table 3: Wetland Fish Habitat Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Transect Portion to be assessed	Methods of Assessment
Photos	OL, LS, BS	Photos will be taken of the substrate (where applicable), vegetation, surrounding habitat, and any other observations of note.
GPS	OL, LS, BS	GPS waypoints will be taken to accurately map results and track the movement of OL and LS waypoints based on de-watering activities.
Vegetation	OL, LS, BS	Relevant vegetation within a 5 m radius will be recorded, and the relative abundance within each stratum within a 30 m radius will be estimated.
Aquatic vegetation	OL, LS	Any water-bound vegetation species will be noted within a 5 m radius and the relative abundance as a percent cover within a 30 m radius will be estimated.
Water Quality	OL/LS	Standard parameters including pH, conductivity, temperature, and dissolved oxygen will be measured using a YSI Multiparameter meter where open water is present and can be accessed safely. At the Lake Shore area, this may not be possible given differing water levels and vegetation constraints but it will be captured where feasible.
Substrate	OL, LS, BS	Substrate types and relative abundance will be noted, including bedrock, boulders, rubble, cobble, gravel, sand, detritus, and fines/muck/silt.
Water Level/Depth	OL, LS	The depth or level of water compared to the substrate should be measured using a measuring device. The use of a piezometer for continuous measurement may be required in conjunction with, or as a replacement to, any monitoring wells installed within the selected wetlands to be monitored.

Given that the water level will significantly change during drawdown, the transects where the assessment points are taken will remain the same, however, new assessment points will be added at each of the monitoring sites to reflect the changing OL and LS locations. The transect lines will still inform the placement of those points of assessment, however, if safety challenges prevent access to a specific location, the point will be moved to a nearby and comparable safe location, or omitted entirely if accessible and representative habitat is not present. Upon water levels rising to pre-construction levels (or as close as can be expected in post-construction conditions), the original assessment points will be resumed for all post-construction monitoring, to the best ability of the biologist conducting surveys.

Fish habitat will be classified as it is defined in Table 4, for the purpose of determining the extent to which any given habitat might contribute to fish habitat, either directly, indirectly, or not at all.

Table 4: Criteria to determine habitat

Habitat Type	Location(s)	Definition
Direct	Open Lake, Lakeshore (possible)	"…Water frequented by fish…on which fish depend on…to carry out their life processes including spawning grounds and nursery, rearing, food supply, and migration areas" (Federal Fisheries Act, Section 34.1).
Indirect	Lakeshore	Areas where fish might pass, but are not necessarily reliant upon (the areas) for life processes, areas that may be temporarily inundated, temporarily flowing (ephemeral), or where some direct habitats draw important resources from.
Not Fish Habitat*	Backshore, Lakeshore (possible)	Areas not accessible to fish, including upland areas, water that is too warm/cold (species specific). In this instance, Backshore Areas are the primary concern and will be assumed as the standard for "not fish habitat".

*Note that some nearshore environments may also qualify as "not fish habitat" dependent on factors such as vegetation and water quality. This will be further assessed as a component of the wetland and fish habitat monitoring program.

In all cases, the assessment points and transects will be chosen to best represent the surrounding habitats.

Baseline Monitoring Results

Initial baseline monitoring was conducted on July 4-5, and September 6, 2022. All wetlands were accessed via boat over the Reservoir, and each wetland was accessed successfully, as locations provided by the JW (2007) were confirmed. Each wetland was assessed using WESP-AC functional assessment protocols (Attachment B – WESP-AC Forms) and delineated to establish current boundaries. Once this delineation and functional assessment was complete, the installation of monitoring wells and vegetation plots were done according to the methodologies outlined above. One wetland (WL17) was assessed as an island of wetland habitat within the reservoir, and thus had no associated upland habitat directly adjacent, nor any "Back Shore" for the purposes of fish habitat monitoring. Results from the vegetation plots and monitoring wells can be seen in Attachment C – Wetland Monitoring Data.

Detailed information obtained for each of the selected wetlands during initial baseline monitoring assessments can be found in Drawings 2-7, Attachment A.

Wetland delineation and characterization from initial baseline studies agree overall with the JW (2007) study, though the water's edge where the wetlands are contiguous with the Reservoir has changed slightly, given the variable water levels and weather impacts. Wetland types were confirmed, and fish habitat characteristics were assessed.

Wetland Fish Habitat assessment results are included in Attachment D – Fish Habitat Assessment Data. Fish habitat assessments were conducted after delineation to ensure that boundaries could be used to inform the placement of the transect that was travelled for wetland fish habitat assessment.

Given constraints surrounding accessibility, water quality measurements were only collected at LS locations for each of the wetlands surveyed.
As outlined above, each wetland (aside from WL17 – an island) had a distinctly observable upland edge where "Back Shore" measurements were collected. Significant forestry impacts exist on many of the properties that surround the reservoir, though there is generally a riparian buffer separating the water's edge from those heavily forested areas. Details on habitat for each wetland is outlined in Table 5, as a combination of both initial baseline surveys and general observations.

Table 5: Wetland Fish Habitat - Baseline Observations

Wetland	Open Lake	Lakeshore	Backshore
Wetland 3	Permanently flooded with abundant large woody debris and moderate floating and emergent vegetation. No fish observed, though rocky (primarily rubble) substrate suggests positive attributes to fish habitat. Quite shallow – 25 m offshore there are emergent boulders. Direct fish habitat.	Some overhanging vegetation. Shoreline is quite distinct, though there is slightly more emergent vegetation. Under normal operating conditions should be considered Indirect Fish Habitat.	Spruce dominated forest with clear signs of previous forestry management present. No evidence of watercourses or significant surface flow nearby.
Wetland 5	Permanently flooded with some rocky and woody debris. Substrate slopes away from the wetland edge quite quickly to deep water. Direct fish habitat is present in shaded areas closer to the shoreline, both adjacent to the wetland and further along the shore. Direct fish habitat.	Ephemeral brook flowing along the southeast boundary of the wetland providing cooler water inputs from the forested area upstream for Indirect Fish Habitat.	Young to moderate aged coniferous forest present in all nearby upland, except along lakeshore.
Wetland 6	Plenty of submerged and emergent woody debris and boulders, as well as moderate emergent vegetation. Fish observed. Direct fish habitat.	A poorly defined channel flows out of the wetland near the location of water quality measurements, but no flow was present during baseline monitoring events. Rocky substrate (rubble) with significant silt on top. Indirect fish habitat.	Young-mid aged softwood dominated forest. Appears to have been previously impacted by forestry operations.
Wetland 15	Appears to be permanently flooded with very little vegetation or emergent debris. Appears to drop-off to deeper water quite quickly. Direct fish habitat.	Small ephemeral outflow with boulders and overhanging vegetation present at location of water quality measurements, though the ground level of the wetland is significantly higher than water levels. Indirect fish habitat	Clearcut present approximately 25 m inshore from wetland/upland edge. No signs of waterflow over land, though some small ditches of water are present due to forestry impacts.

Wetland	Open Lake	Lakeshore	Backshore
Wetland 17	Quite shallow all around the wetland (an island), with abundant emergent and aquatic vegetation. Fairly rocky substrate, though some silt on top as well. No deep water for ~5 m in all directions surrounding the wetland. Direct fish habitat.	Shoreline habitats varied from rocky and muddy to fully vegetated. Vegetation remains consistent across the land/water boundary. Indirect fish habitat	No Backshore present. It is suspected that the entire wetland could flood during highwater conditions outside of the flood season.
Wetland 19	Permanently flooded with gravel and sand substrate present on the east side of the wetland, fish observed, and clear signs of Direct Fish Habitat. West side of wetland bordering on small cove has muck/mud substrate and is very shallow providing poor fish habitat.	No clear inflow/outflow present, with the western border of the wetland being contiguous with the open water, while the eastern border having a proper border. Indirect fish habitat on all on sides.	Backshore is young softwood with relatively few undergrowth species. No signs of waterflow overland, nor signs of flooding at any time.

All instances included passage through the Open Water by boat, where observations on habitat and substrate were made. Backshore conditions (where available) included similar species distributions throughout the Reservoir, though the impacts of forestry on those habitats is well established.

During future monitoring events, the locations of water quality measurements (Lakeshore during baseline monitoring), Open Water, and Lakeshore are likely to change, sometimes in a significant way. Pre-construction and post-construction monitoring locations are expected to remain consistent, as outlined above, although during construction there is anticipated to be differing amounts of change at each wetland, considering their positions within the Reservoir. These differences will be noted and aid in the comparison of fish habitat quality and abundance between baseline, during construction, and post-construction conditions.

With fish being observed at both WL6 and WL19, as well as the confirmed presence of fish crossing the dam and spillway at the south end of the Reservoir, it is understood that under current conditions, each of the wetlands monitored provides some level of fish habitat, as well as indirect benefits to fish habitat.

PROPOSED SCHEDULE AND REPORTING

Annual post-construction monitoring reports will be submitted to Nova Scotia Environment and Climate Change (NSECC) for the five years of post-construction monitoring. Vegetation results shall be provided in a cumulative table to allow for inter-annual comparison of data. Table 6 outlines the monitoring and reporting schedule for the Wetland Monitoring Program, while Table 7 outlines the monitoring and reporting schedule for the Wetland Fish Habitat Monitoring Program.

Table6: Monitoring and Reporting Schedule for Wetland Monitoring

Monitoring Event		Wetland and Wetland Fish Habitat Monitoring	WESP-AC	Reporting Submission to NSECC
Pre-construction	Baseline	✓	✓	
During Construction		✓		Memo
Post-construction	Year 1	✓		✓
	Year 2	✓		✓
	Year 3	✓		✓
	Year 4	✓		✓
	Year 5	✓	✓	✓

Information collected from post-construction monitoring events will be compared with the baseline data collected during the pre-construction monitoring events and previous years' monitoring events to evaluate post-construction vegetation (e.g., wetland and vegetation present, invasion of exotic species, success of any re-vegetation, etc.), hydrology, and soils. After Year 5, potential long-term impacts to the wetlands will be assessed, a follow up WESP-AC program will be completed, and required consultation with NSECC will take place.

Table 7: Monitoring and Reporting Schedule for Wetland Fish Habitat Monitoring

Monitoring Event		Fish Habitat Transect Monitoring	Desktop Review of Fish Data	Reporting Submission to NSECC & DFO
Baseline		✓	✓	✓
Pre-construction	1 week before drawdown	✓	✓	✓
During Construction*	1 week after drawdown	✓	✓	✓
	End of growing season during drawdown/construction	✓	✓	✓
Post Construction*	1 week after water level is restored	✓	✓	✓
	Year 1	✓	✓	✓
	Year 2	✓	✓	✓
	Year 3	✓	✓	✓
	Year 4	✓	✓	✓
	Year 5	✓	✓	✓

*Monitoring may be limited depending on the time of year when construction is to be completed, *i.e.,* if construction is completed in January, the first post-construction survey will not be completed before the growing season begins in June.

Information during post-construction monitoring will be used to inform reports submitted to NSECC and Fisheries and Oceans Canada (DFO) on an annual basis, while further consultation with each respective governing body may be required after the post-construction monitoring is completed.

CLOSURE

Thank you for the opportunity to develop this Wetland and Wetland Fish Habitat Monitoring Plan. If you have any questions, please contact us.

Thank you,

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Environmental Scientist
adoane@strum.com

Natasha Myers, BSc., EP, PMP
Senior Environmental Scientist
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REFERENCES

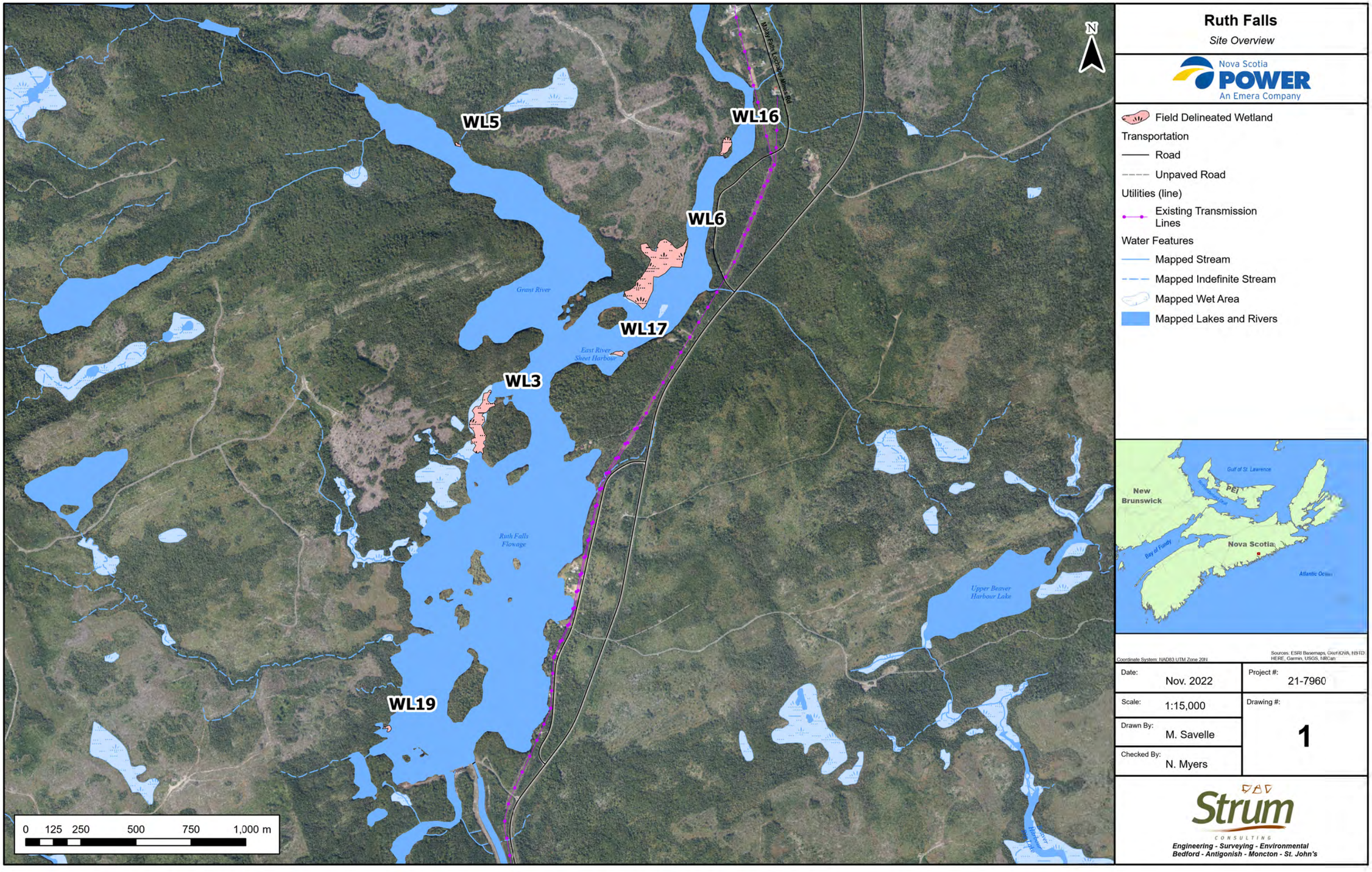
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ATTACHMENT A
DRAWINGS



Ruth Falls

Site Overview

Nova Scotia POWER
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- Field Delineated Wetland

Transportation
- Road
- Unpaved Road

Utilities (line)
- Existing Transmission Lines

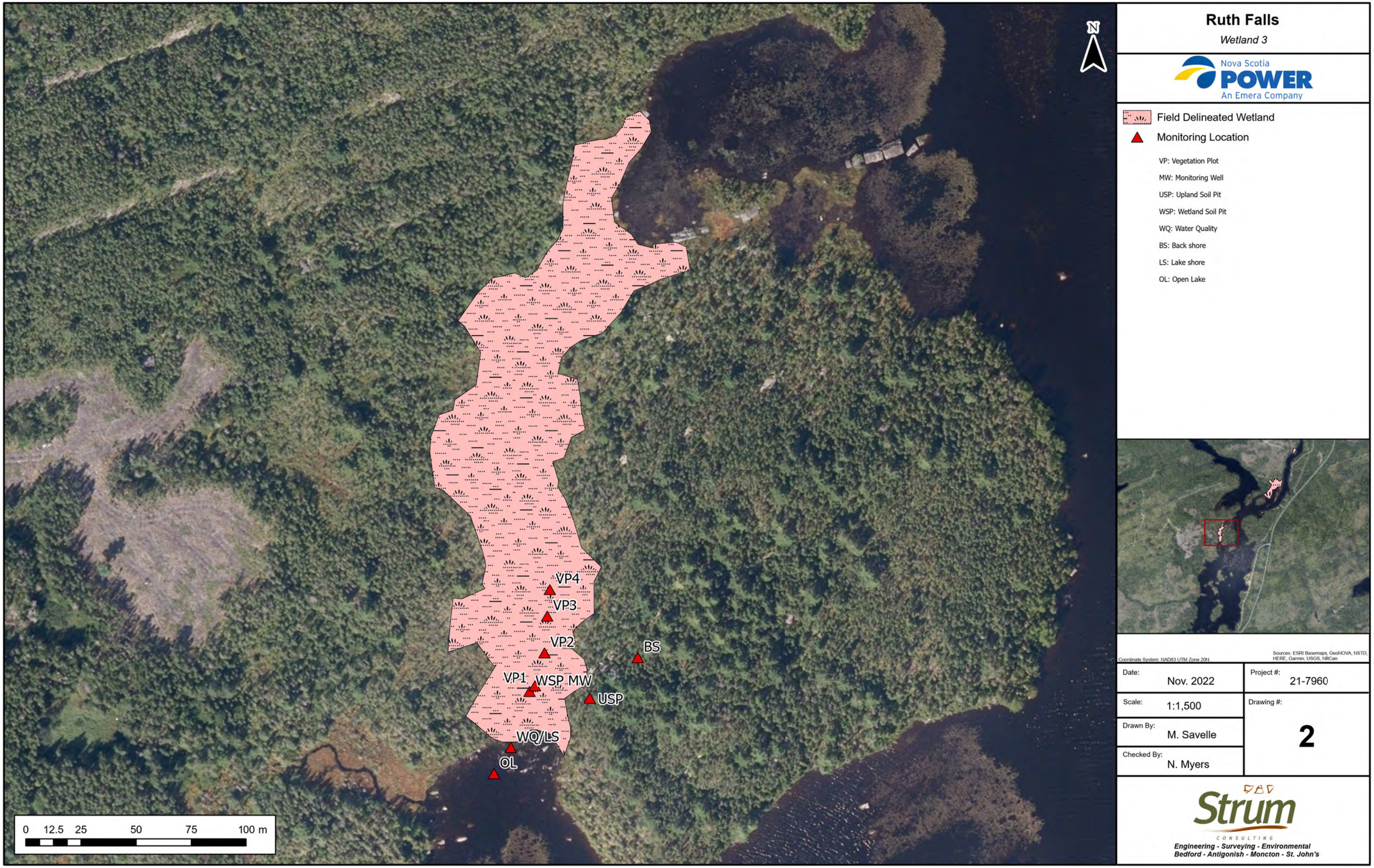
Water Features
- Mapped Stream
- Mapped Indefinite Stream
- Mapped Wet Area
- Mapped Lakes and Rivers

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoEYE, INSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:15,000	Drawing #: 1
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 3

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:1,500	Drawing #: 2
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 5

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot

MW: Monitoring Well

USP: Upland Soil Pit

WSP: Wetland Soil Pit

WQ: Water Quality

BS: Back shore

LS: Lake shore

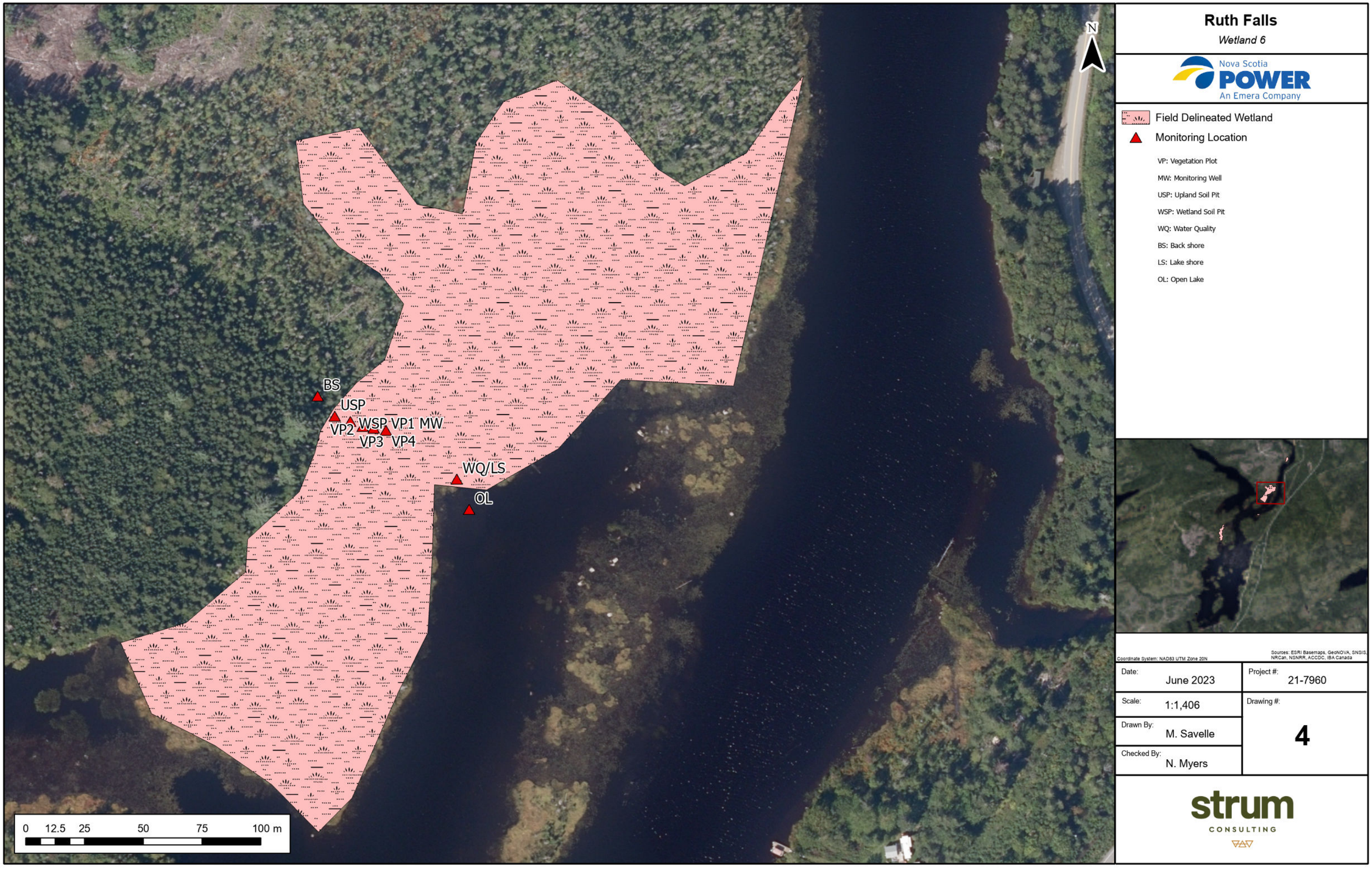
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, SNSIS, NRCan, NSNRR, ACCDC, IBA Canada

Date: June 2023	Project #: 21-7960
Scale: 1:500	Drawing #: 3
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 6

Nova Scotia POWER
An Emera Company

Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot

MW: Monitoring Well

USP: Upland Soil Pit

WSP: Wetland Soil Pit

WQ: Water Quality

BS: Back shore

LS: Lake shore

OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, SNSIS, NRCan, NSNRR, ACCDC, IBA Canada

Date: June 2023	Project #: 21-7960
Scale: 1:1,406	Drawing #: 4
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 16

Nova Scotia POWER
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Field Delineated Wetland

Monitoring Location

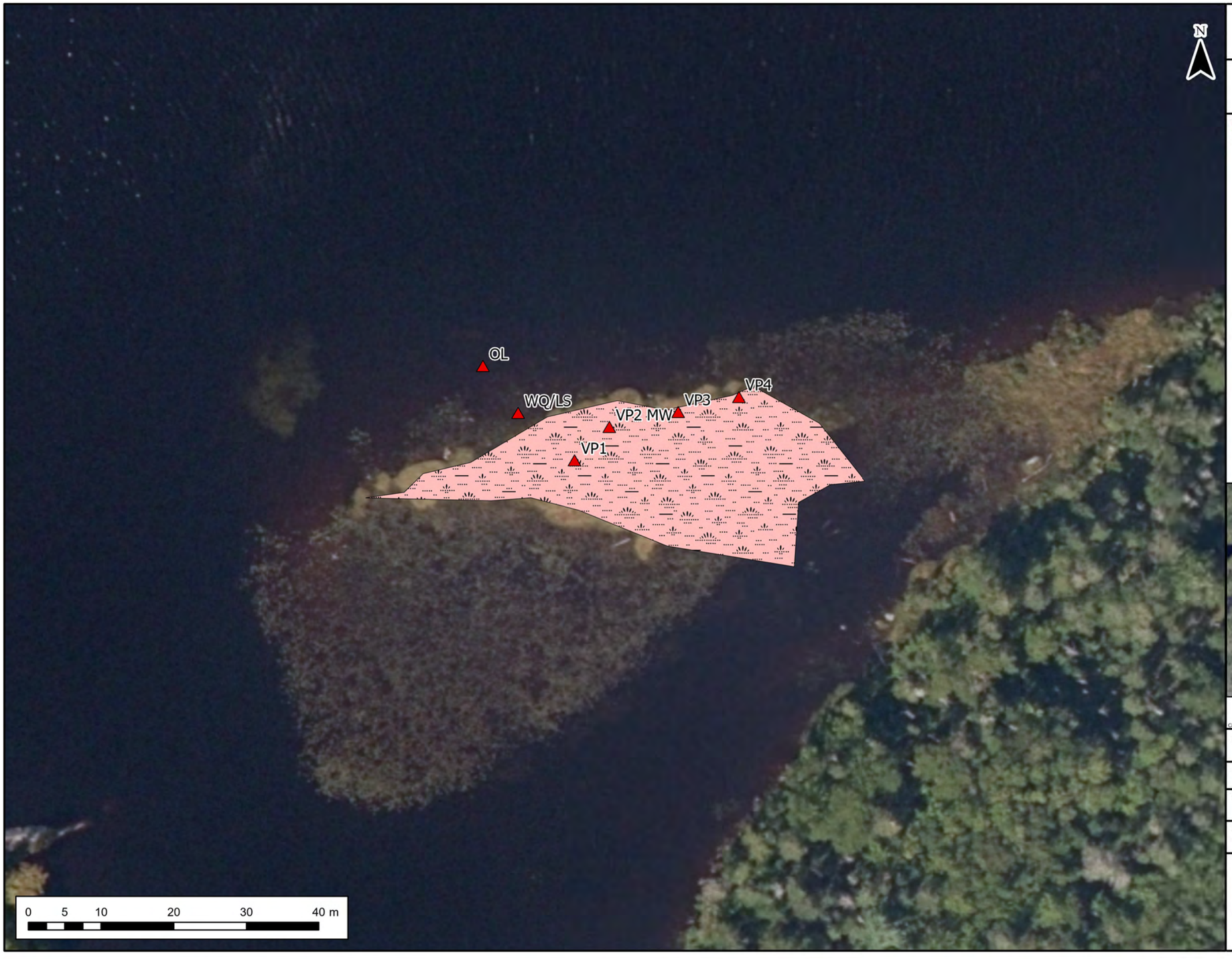
VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, SNSIS, NRCan, NSNRR, ACCDC, IBA Canada

Date: June 2023	Project #: 21-7960
Scale: 1:500	Drawing #: 5
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 17

Nova Scotia POWER
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Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake



Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 6
Drawn By: M. Savelle	
Checked By: N. Myers	

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Ruth Falls

Wetland 19

Nova Scotia POWER
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Field Delineated Wetland

Monitoring Location

VP: Vegetation Plot
MW: Monitoring Well
USP: Upland Soil Pit
WSP: Wetland Soil Pit
WQ: Water Quality
BS: Back shore
LS: Lake shore
OL: Open Lake

Coordinate System: NAD83 UTM Zone 20N

Sources: ESRI Basemaps, GeoNOVA, NSTD, HERE, Garmin, USGS, NRCan

Date: Nov. 2022	Project #: 21-7960
Scale: 1:500	Drawing #: 7
Drawn By: M. Savelle	
Checked By: N. Myers	

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ATTACHMENT B
WESP-AC FORMS

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 3
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.96946
Longitude (decimal degrees):	-62.49768
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	1.35 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	1.35 ha
What percent (approx.) of the **wetland** were you able to visit?	100%
What percent (approx.) of the **AA** were you able to visit?	100%
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL3	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	1	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

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31	OF5	Distance to Large Vegetated Tract	The minimum distance from the **edge** of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) **larger than 375 hectares** (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of **paved** roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and **not** separated.	1	
35			50-500 m, but separated by those features.	0	
36			0.5 - 5 km, and **not** separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the **5-km** radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured **along** the maintained road nearest the AA, the distance to the nearest **population center** is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

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56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	0	
62			>500 m.	1	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	1	
75			1 -2 km.	0	
76			2-5 km.	0	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

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92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

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145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	5-Jul-22		Site Identifier: Ruth Falls WL 3	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	1	
14			A2.	0	
15			B1.	0	
16			B2.	0	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	1	
19			deciduous trees taller than 3 m.	1	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	3	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> **30-70%.** Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	0	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	1	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	0	
85			100-1000 sq. m.	1	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	1	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.		
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	1	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	0	
243			2-5%.	1	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	1	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	1	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	0	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL 3**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	2
			Sum=	7
			Stressor subscore=	0.58

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	0
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	2
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	3
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	3
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	8
			Stressor subscore=	0.67

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL3

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.96946 & -62.49768

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	7.98	Higher	7.86	Higher	7.90	3.48
Stream Flow Support (SFS)	1.60	Moderate	2.55	Moderate	1.29	1.70
Water Cooling (WC)	10.00	Higher	0.00	Lower	6.67	0.00
Sediment Retention & Stabilisation (SR)	4.30	Moderate	3.12	Moderate	5.56	1.53
Phosphorus Retention (PR)	2.09	Lower	2.77	Higher	5.05	2.15
Nitrate Removal & Retention (NR)	10.00	Higher	5.14	Moderate	10.00	5.14
Carbon Sequestration (CS)	4.69	Moderate			7.42	
Organic Nutrient Export (OE)	8.86	Higher			5.79	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.88	Higher	0.77	Lower	5.89	1.66
Amphibian & Turtle Habitat (AM)	2.22	Lower	4.20	Moderate	4.29	5.22
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	6.51	Moderate	10.00	Higher	5.67	10.00
Pollinator Habitat (POL)	7.48	Moderate	6.67	Moderate	6.20	6.67
Native Plant Habitat (PH)	5.82	Moderate	6.18	Moderate	6.22	6.18
Public Use & Recognition (PU)			2.60	Moderate		2.08
Wetland Sensitivity (Sens)			8.89	Higher		4.71
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			9.42	Higher		4.70
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	7.98	Higher	7.86	Higher	7.90	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	7.64	Higher	4.41	Moderate	8.50	4.04
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	8.29	Higher	1.83	Lower	5.79	1.41
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.33	Lower	2.52	Moderate	2.57	3.13
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.04	Higher	8.81	Higher	6.13	8.81
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			9.16	Higher		4.71

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	62.68937601	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	33.64974214	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	15.16699195	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.362856423	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	62.02430846	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 5
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.981186°
Longitude (decimal degrees):	-62.499067°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.031765
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	0.031765
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL5	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	0	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	1	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the **center** of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	0	
62			>500 m.	1	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to **blank** if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is **larger than 8 hectares** during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest **tidal water** body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	

	A	B	C	D	E
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.15	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	

	A	B	C	D	E
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

	A	B	C	D	E
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands. Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL5	Investigator: Darcy Kavanagh & Angus Doane	
2	Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia. DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	1	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	0	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11			*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*		
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	1	
15			B1.	0	
16			B2.	0	
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		Deciduous shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the tree/shrubs is <95% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM

	A	B	C	D	E
18			coniferous trees (may include tamarack) taller than 3 m.	2	the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
19			deciduous trees taller than 3 m.	1	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	1	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do not comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark ALL the types that comprise >5% of the woody canopy cover in the AA or >5% of the wooded areas (if any) along its upland edge (perimeter). The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	1	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation taller than 1 m nor the vegetation shorter than that comprise >70% of the vegetated part of the AA. They each comprise 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (diameter >20 cm) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces longer than 2 m and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	

	A	B	C	D	E
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of open water that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and SKIP to F41 (Floating Algae & Duckweed).	0	Open water is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is open (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and SKIP to F41 (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	

	A	B	C	D	E
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's water edge length that is nearly flat (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage of the emergent vegetation cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		Emergent vegetation is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. SKIP to F38.	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of emergent vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and SKIP to F42.(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of dead wood and undercut banks is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore by water depths >1 m on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the least permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where surface water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by most of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into herbaceous vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into herbaceous vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into tree trunks and/or shrub stems but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly indirect path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	1	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			Evident from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			Likely based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	1	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	1	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL5**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL5

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.981186° & -62.499067°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	9.12	Higher	7.88	Higher	8.75	3.49
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	10.00	Higher	0.00	Lower	6.67	0.00
Sediment Retention & Stabilisation (SR)	6.44	Moderate	3.02	Moderate	7.22	1.48
Phosphorus Retention (PR)	1.85	Lower	3.04	Higher	4.91	2.36
Nitrate Removal & Retention (NR)	10.00	Higher	5.56	Moderate	10.00	5.56
Carbon Sequestration (CS)	6.58	Higher			8.31	
Organic Nutrient Export (OE)	5.34	Moderate			3.49	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	5.88	Higher	0.23	Lower	5.89	1.37
Amphibian & Turtle Habitat (AM)	0.44	Lower	3.88	Moderate	3.36	4.95
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	5.59	Moderate	10.00	Higher	4.86	10.00
Pollinator Habitat (POL)	6.61	Moderate	6.67	Moderate	5.48	6.67
Native Plant Habitat (PH)	3.44	Lower	5.67	Moderate	5.28	5.67
Public Use & Recognition (PU)			2.60	Moderate		2.08
Wetland Sensitivity (Sens)			7.71	Higher		4.37
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			8.41	Higher		4.22
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	9.12	Higher	7.88	Higher	8.75	3.49
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.11	Higher	4.71	Moderate	8.80	4.34
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.65	Higher	0.16	Lower	5.34	0.91
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	0.27	Lower	2.33	Moderate	2.01	2.97
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	5.91	Moderate	8.72	Higher	5.34	8.72
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			8.06	Higher		4.29

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	71.88945608	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	38.22502401	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	1.193241535	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	0.617343402	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	51.55843686	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	WESP-AC version 2
Site Name:	Ruth Falls Wetland 6
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.975436°
Longitude (decimal degrees):	-62.487924°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	3.35 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	3.35 ha
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL6	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.				
3	**#**	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	1	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	

	A	B	C	D	E
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to **blank** if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is **larger than 8 hectares** during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest **tidal water** body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. **This will be true for most** assessments done with WESP-AC.	0	
92	OF17	Flood Damage from **Non-tidal** Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do **not** show Flood Zone or Flood Risk areas (**or no such mapping has been done locally**) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is **no infrastructure** vulnerable to river flooding unrelated to tidal storm surges.	0	

	A	B	C	D	E
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	

	A	B	C	D	E
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]

	A	B	C	D	E
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL6	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	2	
19			deciduous trees taller than 3 m.	2	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>each comprise</u> 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	1	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	0	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	0	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	1	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter **>10 cm**, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	0	
71			Intermediate.	1	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	1	
81			Shallow Peat or organic <40 cm deep.	0	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	0	
103			50-95% of the vegetated area.	1	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	1	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL6**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL6

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.975436° & -62.487924°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	9.29	Higher	7.86	Higher	8.88	3.48
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	6.44	Moderate	2.17	Moderate	7.22	1.06
Phosphorus Retention (PR)	1.59	Lower	1.88	Moderate	4.74	1.46
Nitrate Removal & Retention (NR)	10.00	Higher	5.00	Moderate	10.00	5.00
Carbon Sequestration (CS)	6.42	Higher			8.24	
Organic Nutrient Export (OE)	5.30	Moderate			3.47	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	7.88	Higher	1.03	Lower	6.71	1.80
Amphibian & Turtle Habitat (AM)	2.42	Lower	4.49	Moderate	4.39	5.46
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.34	Moderate	10.00	Higher	6.39	10.00
Pollinator Habitat (POL)	7.31	Moderate	6.67	Moderate	6.06	6.67
Native Plant Habitat (PH)	5.32	Moderate	6.37	Moderate	6.02	6.37
Public Use & Recognition (PU)			2.69	Moderate		2.14
Wetland Sensitivity (Sens)			9.23	Higher		4.80
Wetland Ecological Condition (EC)			8.26	Higher		9.17
Wetland Stressors (STR) (higher score means more stress)			8.26	Higher		4.15
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	9.29	Higher	7.86	Higher	8.88	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.06	Higher	4.01	Moderate	8.77	3.75
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.59	Higher	0.68	Lower	4.63	1.20
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.45	Lower	2.69	Moderate	2.64	3.28
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	7.00	Higher	8.84	Higher	6.27	8.84
WETLAND CONDITION (EC)			8.26	Higher		9.17
WETLAND RISK (average of Sensitivity & Stressors)			8.74	Higher		4.47

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	72.99984688	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	32.28886351	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	3.821786962	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.916235569	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	61.84993183	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 15
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 4th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.981144
Longitude (decimal degrees):	-62.483722°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.271124 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	100
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL15	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	1	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the **edge** of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) **larger than 375 hectares** (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of **paved** roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and **not** separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and **not** separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the **5-km** radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured **along** the maintained road nearest the AA, the distance to the nearest **population center** is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

	A	B	C	D	E
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.15	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	1	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	0	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	1	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	0	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]

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146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to **blank**.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to **blank** (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank** (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank**.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to **blank**.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to **blank**.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 4, 2022		Site Identifier: Ruth Falls WL15	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	0	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	1	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	1	
14			A2.	1	
15			B1.	0	
16			B2.	0	

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17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	1	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	4	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	3	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	1	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. They <u>each comprise</u> 30-70%. Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	

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57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	1	
81			Shallow Peat or organic <40 cm deep.	0	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	1	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	0	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	1	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	1	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	0	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	1	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	1	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	1	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	1	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	1	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	1	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	1	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	1	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	1	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	1	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	1	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	1	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	1	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	1	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	1	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]		
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	1	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]		
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]		
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	1	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	0	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	1	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	0	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	0	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	0	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	1	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	0	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
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Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL15**	**Date: July 4, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	0
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	0
			Sum=	3
			Stressor subscore=	0.25

		Data
S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	
Erosion from construction, in-channel machinery in the CA.	1
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	3
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	0
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	5
			Stressor subscore=	0.42

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL15

Date: July 4, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.981144 & -62.483722°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	6.22	Moderate	7.88	Higher	6.58	3.49
Stream Flow Support (SFS)	1.03	Lower	0.00	Lower	0.83	0.00
Water Cooling (WC)	5.00	Moderate	0.00	Lower	3.33	0.00
Sediment Retention & Stabilisation (SR)	10.00	Higher	1.80	Moderate	10.00	0.88
Phosphorus Retention (PR)	3.64	Moderate	2.14	Moderate	6.02	1.67
Nitrate Removal & Retention (NR)	10.00	Higher	10.00	Higher	10.00	10.00
Carbon Sequestration (CS)	3.60	Moderate			6.90	
Organic Nutrient Export (OE)	5.91	Moderate			3.86	
Anadromous Fish Habitat (FA)	4.13	Higher	2.71	Moderate	2.71	1.72
Resident Fish Habitat (FR)	5.10	Moderate	2.75	Moderate	2.77	1.72
Aquatic Invertebrate Habitat (INV)	7.52	Higher	7.08	Higher	6.56	5.06
Amphibian & Turtle Habitat (AM)	5.13	Moderate	7.18	Higher	5.81	7.67
Waterbird Feeding Habitat (WBF)	8.65	Higher	10.00	Higher	6.59	10.00
Waterbird Nesting Habitat (WBN)	8.33	Higher	10.00	Higher	6.04	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	7.39	Moderate	10.00	Higher	6.43	10.00
Pollinator Habitat (POL)	7.64	Moderate	6.67	Moderate	6.33	6.67
Native Plant Habitat (PH)	3.23	Lower	6.48	Moderate	5.19	6.48
Public Use & Recognition (PU)			1.47	Moderate		1.31
Wetland Sensitivity (Sens)			10.00	Higher		5.14
Wetland Ecological Condition (EC)			3.04	Lower		6.67
Wetland Stressors (STR) (higher score means more stress)			5.56	Moderate		2.85
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	6.22	Moderate	7.88	Higher	6.58	3.49
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.41	Higher	7.32	Higher	9.12	7.09
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	6.20	Higher	4.72	Moderate	5.11	3.37
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	7.46	Higher	8.26	Higher	5.69	8.11
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.86	Higher	8.86	Higher	6.21	8.86
WETLAND CONDITION (EC)			3.04	Lower		6.67
WETLAND RISK (average of Sensitivity & Stressors)			7.78	Higher		4.00

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	48.9801358	Moderate
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	61.55144868	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	29.24667855	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	61.64799552	Moderate
HABITAT SUPERGROUP - TRANSITION HABITAT	60.79392506	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	WESP-AC version 2
Site Name:	Ruth Falls Wetland 17
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.972398°
Longitude (decimal degrees):	-62.489619°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.083111 ha
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL17	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	1	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	0	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the edge of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) larger than 375 hectares (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of paved roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and not separated.	0	
35			50-500 m, but separated by those features.	1	
36			0.5 - 5 km, and not separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	0	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the 5-km radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured along the maintained road nearest the AA, the distance to the nearest population center is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	1	
55			>5 km.	0	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	0	
75			1 -2 km.	0	
76			2-5 km.	1	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	1	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

	A	B	C	D	E
92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

	A	B	C	D	E
118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

	A	B	C	D	E
145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL17	Investigator: Darcy Kavanagh & Angus Doane	
2	Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia. DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	0	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	0	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	0	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	0	
27			those species together do **not** comprise > 50% of such cover.	1	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They** <u>**each comprise**</u> **30-70%.** Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	0	
61			50-95% of the vegetated part of the AA.	1	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	1	
75			Intermediate (1 - 10% of vegetated part of the AA).	0	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	0	
92			50-95% of the vegetated part of the AA.	1	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	0	
97			25-50% of the herbaceous part of the AA.	1	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	0	
103			50-95% of the vegetated area.	1	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	1	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	0	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	1	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	1	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	1	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	1	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	1	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	1	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	1	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	1	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	1	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	1	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	1	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	1	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	1	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	1	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	1	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	1	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	1	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	0	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	1	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	1	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	1	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]	5.5	
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]	20	
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]	50	
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	0	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	1	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	1	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	0	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	0	
276			25-50%.	0	
277			>50%.	1	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	1	
306			>500 m. away, or no information.	0	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
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Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL17**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	3
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	3
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	2
			Sum=	9
			Stressor subscore=	0.75

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	1
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	1
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	1
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	1
			Sum=	3
			Stressor subscore=	0.33

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	1
Fertilizers applied to lawns, ag lands, or other areas in the CA.	1
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	1
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	1
			Sum=	3
			Stressor subscore=	0.33

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	1
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	1
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL17

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.972398° & -62.489619°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	2.11	Lower	7.86	Higher	3.52	3.48
Stream Flow Support (SFS)	6.28	Higher	4.77	Moderate	5.06	3.17
Water Cooling (WC)	5.29	Higher	6.88	Higher	3.53	3.73
Sediment Retention & Stabilisation (SR)	4.87	Moderate	9.79	Higher	5.99	4.79
Phosphorus Retention (PR)	3.90	Moderate	9.11	Higher	6.18	7.08
Nitrate Removal & Retention (NR)	1.77	Lower	10.00	Higher	4.05	10.00
Carbon Sequestration (CS)	4.09	Moderate			7.13	
Organic Nutrient Export (OE)	9.02	Higher			5.90	
Anadromous Fish Habitat (FA)	7.15	Higher	3.46	Moderate	4.68	2.20
Resident Fish Habitat (FR)	7.50	Higher	3.36	Moderate	4.07	2.10
Aquatic Invertebrate Habitat (INV)	6.14	Higher	6.57	Higher	6.00	4.78
Amphibian & Turtle Habitat (AM)	6.05	Moderate	4.53	Moderate	6.29	5.49
Waterbird Feeding Habitat (WBF)	8.51	Higher	10.00	Higher	6.48	10.00
Waterbird Nesting Habitat (WBN)	9.88	Higher	10.00	Higher	7.16	10.00
Songbird, Raptor, & Mammal Habitat (SBM)	0.00	Lower	0.00	Lower	0.00	0.00
Pollinator Habitat (POL)	0.00	Lower	0.00	Lower	0.00	0.00
Native Plant Habitat (PH)	6.37	Higher	0.00	Lower	6.44	0.00
Public Use & Recognition (PU)			3.52	Moderate		2.71
Wetland Sensitivity (Sens)			3.92	Lower		3.29
Wetland Ecological Condition (EC)			6.52	Higher		8.33
Wetland Stressors (STR) (higher score means more stress)			10.00	Higher		5.46
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	2.11	Lower	7.86	Higher	3.52	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	4.26	Moderate	9.82	Higher	6.49	8.65
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	7.85	Higher	6.48	Moderate	5.56	4.34
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	8.85	Higher	8.14	Higher	6.45	7.98
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	4.25	Moderate	0.00	Lower	4.29	0.00
WETLAND CONDITION (EC)			6.52	Higher		8.33
WETLAND RISK (average of Sensitivity & Stressors)			6.96	Higher		4.37

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	16.54837478	Low
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	41.82872928	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	50.87397482	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	71.97293334	High
HABITAT SUPERGROUP - TRANSITION HABITAT	0	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

Cover Page: Basic Description of Assessment	**WESP-AC version 2**
Site Name:	Ruth Falls Wetland 19
Investigator Name:	Darcy Kavanagh & Angus Doane
Date of Field Assessment:	July 5th, 2022
Nearest Town:	Sheet Harbour
Latitude (decimal degrees):	44.957041°
Longitude (decimal degrees):	-62.502964°
Is a map based on a formal on-site wetland delineation available?	Yes
Approximate size of the Assessment Area (AA, in hectares):	0.056483
AA as percent of entire wetland (approx.). Attach sketch map if AA is smaller than the entire contiguous wetland.	
What percent (approx.) of the **wetland** were you able to visit?	100
What percent (approx.) of the **AA** were you able to visit?	100
Were you able to ask the site owner/manager about any of the questions?	No
Indicate here if you intentionally surveyed for rare plants, calciphile plants, or rare animals:	Yes
Have you attended a WESP-AC training session? If so, indicate approximate month & year.	No
How many wetlands have you assessed previously using WESP-AC? (approx.)	50+
Comments about the site or this WESP-AC assessment (attach extra page if desired):	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL19	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form OF (Office). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia wetlands only.** DIRECTIONS: Conduct an assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answering many of the questions below will require using these online map viewers: **Google Earth Pro**: https://www.google.com/earth/download/gep/agree.html **Provincial Landscape Viewer**: https://nsgi.novascotia.ca/plv/ For most wetlands, completing this office data form will require 1-2 hours. For a list of functions to which each question pertains, see bracketed abbreviations in the Definitions/Explanations column. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	#	Indicators	Condition Choices	Data	Definitions/Explanations
4	OF1	Province	Mark the province in which the AA is located by changing the 0 in the column next to it to a "1". Mark only one.		This determines to which province's calibration wetlands the raw score of any wetland is normalised. In the function and benefits models, it also triggers the automatic exclusion of indicators for which no spatial data exists in a particular province.
5			New Brunswick	0	
6			Nova Scotia	1	
7			Prince Edward Island	0	
8			Newfoundland-Labrador	0	
9	OF2	Ponded Area Within 1 km.	The area of **surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		**"Adjacent"** means not separated from the AA by a wide expanse (>50 m) of upland (including roads >50 m wide). Include ponded areas likely to be hidden by wetland vegetation. If surface water extends beyond 1 km, include only the part within 1 km. Do not include tidal areas. Measure the area from aerial imagery using Google Earth Pro (click on Ruler icon in toolbar, then Polygon in pop-up menu). [PH, SBM, WBN]
10			<0.01 hectare (about 10 m x 10 m).	0	
11			0.01 - 0.1 hectare.	0	
12			0.1 - 1 hectare.	0	
13			1 to 10 hectares.	0	
14			10 to 100 hectares.	0	
15			>100 hectares.	1	
16	OF3	Ponded Water & Wetland Within 1 km.	The area of **wetlands and surface water** ponded during most of the growing season that is both (1) in or adjacent to the AA and (2) within 1 km is:		See definition of adjacent in OF2. If the AA's wetland vegetation extends beyond 1 km, include only the part within 1 km. "Ponded" means not flowing in rivers or streams. [Sens, WBF]
17			<0.01 hectare (about 10 m x 10 m).	0	
18			0.01 - 0.1 hectare.	0	
19			0.1 - 1 hectare.	0	
20			1 to 10 hectares.	0	
21			10 to 100 hectares.	0	
22			>100 hectares.	1	
23	OF4	Size of Largest Nearby Vegetated Tract or Corridor	The largest vegetated patch or corridor that includes the AA's vegetation plus all **adjacent** upland vegetation that is not lawn, row crops, heavily grazed lands, conifer plantation is:		See definition of adjacent in OF2. Use Google Earth Pro's polygon ruler (as described above). Exclude conifer plantations only if it is obvious that trees were planted in rows. [AM, PH, SBM, Sens]
24			<0.01 hectare (about 10 m x 10 m).	0	
25			0.01 - 0.1 hectare.	0	
26			0.1 - 1 hectare.	0	
27			1 to 10 hectares.	0	
28			10 to 100 hectares.	0	
29			100 to 1000 hectares.	0	
30			>1000 hectares. [*This is nearly always the answer in relatively undeveloped landscapes.*]	1	

	A	B	C	D	E
31	OF5	Distance to Large Vegetated Tract	The minimum distance from the **edge** of the AA to the edge of the closest *vegetated land* (but excluding row crops, lawn, conifer plantation) **larger than 375 hectares** (about 2 km on a side), is:		To measure distance, use Google Earth Pro (Ruler > Line tool). The 375-ha criterion is from the Fundy Model Forest Project. [AM, PH, POL, SBM, Sens]
32			<50 m, and not separated from the 375-ha vegetated area by any width of **paved** roads, stretches of open water, row crops, bare ground, lawn, or impervious surface. Or the AA itself contains >375 ha of vegetation. [This is often the answer in relatively undeveloped landscapes.]	0	
33			<50 m, but completely separated from the 375-ha vegetated area by those features, and AA does not contain >375 ha of vegetation.	0	
34			50-500 m, and **not** separated.	1	
35			50-500 m, but separated by those features.	0	
36			0.5 - 5 km, and **not** separated.	0	
37			0.5 - 5 km, but separated by those features.	0	
38			None of the above (the closest patches or corridors which are that large are >5 km away).	0	
39	OF6	Herbaceous Uniqueness	The AA's vegetation cover is >10% herbaceous* but uplands within 5 km have <10% herbaceous cover. If so, enter "3" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 1 km have <10% herbaceous cover. If so enter "2" and continue to OF7. If not, consider: The AA's vegetation cover is >10% herbaceous* but uplands within 100 m of the wetland edge have <10% herbaceous cover. If so, enter "1". [* NOTE: Exclude lawns, row crops, heavily grazed lands, forest, shrublands. Include moss as well as grasslike plants in this use of "herbaceous vegetation"]	0	For this question only, consider moss to be herbaceous vegetation. Determine the score by viewing aerial imagery in Google Earth after successively drawing or estimating the boundaries of the buffers of 5 km, 1 km, and 100 m radius focused on the center of the AA. Circles of specified radius can be drawn in Google Earth Pro by clicking on the Ruler icon, then Circle in the pop-up menu. [AMv, PHv, POLv, SBMv, WBFv, WBNv]
40	OF7	Woody Uniqueness	The AA's vegetation cover is >10% woody* but uplands within 5 km have <10% woody cover. If so, enter "3" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 1 km have <10% woody cover. If so enter "2" and continue to OF8. If not, consider: The AA's vegetation is >10% woody* but uplands within 100 m of the wetland edge have <10% woody cover. If so, enter "1" [* NOTE: woody cover = trees & shrubs taller than 1 m.]	2	See above. Do not consider conifer plantations to be forest if it is obvious that trees were planted in rows. [AMv, PHv, POLv, SBMv]
41	OF8	Local Vegetated Cover Percentage	Draw a 5-km radius circle measured from the center of the AA. Ignoring all permanent water in the circle, the percent of the remaining area that is wooded or unmanaged herbaceous vegetation (NOT lawn, row crops, bare or heavily grazed land, clearcuts, or conifer plantations) is:		In Google Earth, draw the 5 km buffer and then estimate land cover percentages, or do GIS analysis of an appropriate land cover layer. [AM, PH, POL, SBM, Sens]
42			<5% of the land.	0	
43			5 to 20% of the land.	0	
44			20 to 60% of the land.	1	
45			60 to 90% of the land.	0	
46			>90% of the land. SKIP to OF10.	0	
47	OF9	Type of Land Cover Alteration	Within the **5-km** radius circle, and ignoring all permanent water, the land area that is bare or non-perennial cover is mostly:		[AM, SBM]
48			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
49			Bare pervious surface, e.g., lawn, recent (<5 yrs ago) clearcut, dirt or gravel road, cropland, landslide, conifer plantation.	1	
50	OF10	Distance by Road to Nearest Population Center	Measured **along** the maintained road nearest the AA, the distance to the nearest **population center** is:		"Population center" means a settled area with more than about 5 regularly- inhabited structures per square kilometer. In Google Earth Pro, click on the Ruler icon, then Path, and draw and measure the route. [FAv, FRv, NRv, PH, PU, SBM, WBFv]
51			<100 m.	0	
52			100 - 500 m.	0	
53			0.5- 1 km.	0	
54			1 - 5 km.	0	
55			>5 km.	1	

	A	B	C	D	E
56	OF11	Distance to Nearest Maintained Road	From the center of the AA, the distance to the nearest maintained public road (dirt or paved) is:		Determine this by viewing aerial imagery in Google Earth Pro and measuring with the Ruler>Line tool. [AM, FAv, FRv, NRv, PH, PU, SBM, STR, WBN]
57			<10 m.	0	
58			10 - 25 m.	0	
59			25 - 50 m.	0	
60			50 - 100 m.	0	
61			100 - 500 m.	1	
62			>500 m.	0	
63	OF12	Wildlife Access	Draw a circle of radius of 5 km from the center of the AA. If mammals and amphibians can move from the center of the AA to ALL other separate wetlands and ponds located within the circle without being forced to cross pavement (any width), lawns, bare ground, and/or marine waters, mark 1= yes can move to all, 0= no. Change to blank if there are no other wetlands within 5 km.	0	Draw the 5 km circle in Google Earth Pro using the Circle tool and search for roads and wetlands within it, being alert for roads hidden under forest canopy. [AM, SBM, STR]
64	OF13	Distance to Ponded Water	The distance from the AA center to the closest (but separate) ponded water body visible in GoogleEarth imagery is:		In Google Earth Pro, zoom in closely to examine the surrounding landscape for ponds, lakes, and wetlands that appear to be permanently flooded. [AM, PH, SBM, Sens, WBF, WBN]
65			<50 m, and not separated by any width of paved roads, stretches of open water, row crops, lawn, bare ground, or impervious surface.	0	
66			<50 m, but completely separated by those features.	0	
67			50-500 m, and not separated.	0	
68			50-500 m, but separated by those features.	0	
69			0.5 - 1 km, and not separated.	0	
70			0.5 - 1 km, but separated by those features.	0	
71			None of the above (the closest patches or corridors that large are >1 km away).	1	
72	OF14	Distance to Large Ponded Water	The distance from the AA center to the closest (but separate) non-tidal body of water that is ponded during most of the year and is larger than 8 hectares during most of a normal year is:		Determine this by viewing aerial imagery in Google Earth. [Sens, WBF, WBN]
73			<100 m.	0	
74			100 m - 1 km.	1	
75			1 -2 km.	0	
76			2-5 km.	0	
77			5-10 km.	0	
78			>10 km.	0	
79	OF15	Tidal Proximity	The distance from the AA edge to the closest tidal water body (regardless of its salinity) is:		In Google Earth, measure the distance to the ocean (including Bay of Fundy) or tidal river, whichever is closer. If you need to see how far upriver a river is tidal, see the KMZ file provided with this calculator for NS (NS Headtide). Points shown in those files are only an approximation, so local information if available may be preferable. [FA, WBF]
80			<100 m.	0	
81			100 m - 1 km.	0	
82			1 - 5 km.	0	
83			5-10 km.	1	
84			10-40 km.	0	
85			>40 km.	0	
86	OF16	Upland Edge Contact	Select one:		[NR, SBM, Sens]
87			The AA has no upland edge (or upland is <1% of perimeter). The AA is entirely surrounded by (& contiguous with) other wetlands or water.	0	
88			1-25% of the AA's perimeter abuts upland (including filled areas). The rest adjoins other wetlands or water that is mostly wider than the AA.	1	
89			25-50% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
90			50-75% of the AA's perimeter abuts upland. The rest adjoins other wetlands or water that is mostly wider than the AA.	0	
91			More than 75% of the AA's perimeter abuts upland. Any remainder adjoins other wetlands or water that is mostly wider than the AA. This will be true for most assessments done with WESP-AC.	0	

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92	OF17	Flood Damage from Non-tidal Waters	Within 5 km downstream or downslope of the AA (select first true choice):		Contact local authories to determine if such maps exist. Where available, LiDAR imagery can provide finer elevational resolution useful for flood modeling. [WSv]
93			Maps show Flood Zone or Flood Risk areas and there appears to be infrastructure vulnerable to river flooding not caused by tidal storm surges.	0	
94			Maps show Flood Zone or Flood Risk areas, but infrastructure is absent or is not vulnerable to floods from a non-tidal river. In some cases levees, upriver dams, or other measures may partly limit damage or risk from smaller events.	0	
95			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there appears to be infrastructure vulnerable to river flooding unrelated to tidal storm surges.	1	
96			Maps do not show Flood Zone or Flood Risk areas (or no such mapping has been done locally) and there is no infrastructure vulnerable to river flooding unrelated to tidal storm surges.	0	
97	OF18	Relative Elevation in Watershed	In Google Earth, enable the Terrain layer (lower left menu) and open the NS_Watersheds Secondary KMZ file that accompanies this calculator. Then determine the AA's approximate elevation (bottom right, NOT the "eye alt"). Then move cursor around to determine the watershed's maximum and minimum elevation. Divide the AA's elevation by the (max-min).	0.14	[FA, NR, Sens, SFSv, WCv, WSv]
98	OF19	Water Quality Sensitive Watershed or Area	The AA is in a Protected Water Supply area (Designated Water Supply Area, Natural Watershed Municipal Surface Water Supply Area, or Municipal Water Supply Area) according to the provided KMZ overlay ("NS Protected Water Supply Areas"). Enter 1= yes, 0= no.	0	If an ACCDC report is available for this AA, it also may contain such information. [NRv]
99	OF20	Degraded Water Upstream	Sampling indicates a problem with concentrations of metals, hydrocarbons, nutrients, or other substances (excluding bacteria, acidic water, high temperatures) being present at levels harmful to aquatic life or humans, and:		May use existing data, or sample those waters as part of this wetland assessment. "Harmful" should be evaluated with regard to current federal or provincial water quality standards. [AM, FA, FR, NRv, PRv, SRv, STR, WBF, WBN]
100			The condition is present within the AA.	0	
101			The condition is present in waters within 1 km that flow into the AA, but has not been documented in the AA itself.	0	
102			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
103			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
104	OF21	Degraded Water Downstream	The problem described above is downslope from the AA, and:		May use existing data, or monitor waters as part of this wetland assessment. [NRv, PRv, SRv]
105			The condition is present within 1 km downslope and connected to the AA by a channel.	0	
106			The condition is present within 5 km downslope and connected to the AA by a channel, or within 1 km but not connected to the AA by a channel.	0	
107			Sampling during both low water periods and times with high runoff (storms, snowmelt) indicates no problems in either the AA or inflowing waters.	0	
108			Data are insufficient (no or inadequate sampling within 1 km, or condition exists only at >1 km upstream). This is the situation for nearly all wetlands in this region.	1	
109	OF22	Wetland as a % of Its Contributing Area (Catchment)	From a topographic map and field observations, estimate the approximate boundaries of the catchment (CA) of the entire wetland of which the AA may be only a part. Then adjust those boundaries if necessary based on your field observations of the surrounding terrain, and/or by using procedures described in the Manual. Divide the area of the wetland (not just the AA) by the approximate area of its catchment excluding the area of the wetland itself. When doing the calculation, if ponded water is adjacent to the wetland, include that in the wetland's area. The result is:		Topographic maps may be viewed online at the National Atlas of Canada (Toporama): http://atlas.gc.ca/toporama/en/index.html [NR, PR, Sens, SR, WS]
110			<0.01, or catchment size unknown due to stormwater pipes that collect water from an indeterminate area.	0	
111			0.01 to 0.1.	1	
112			0.1 to 1.	0	
113			>1 (wetland is larger than its catchment (e.g., wetland with flat surrounding terrain and no inlet, or is entirely isolated by dikes, or is a raised bog).	0	
114	OF23	Unvegetated Surface in the Contributing Area	The proportion of the AA's contributing area (measured to no more than 1000 m upslope) that is comprised of buildings, roads, parking lots, other pavement, exposed bedrock, landslides, and other mostly-bare surface is about :		[FA, INV, NRv, PRv, SRv, STR, WCv, WSv]
115			<10%.	0	
116			10 to 25%.	1	
117			>25%.	0	

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118	OF24	Transport From Upslope	A relatively large proportion of the precipitation that falls farther upslope in the CA reaches this wetland quickly as runoff (surface water), as indicated by the following: (a) input channel is present, (b) input channels have been straightened, (c) upslope wetlands have been ditched extensively, (d) land cover is mostly non-forest, (e) CA slopes are steep, and/or (f) most CA soils are shallow (bedrock near surface) and/or have high runoff coefficients. This statement is:		[NRv, PRv, SRv, WSv]
119			Mostly true.	0	
120			Somewhat true.	0	
121			Mostly untrue.	1	
122	OF25	Aspect	The overland flow direction of most surface water (in streams, rivers, or runoff) that enters the AA is:		[AM, NR, SFS, WC, WS]
123			Northward (N, NE). north-facing contributing area.	0	
124			Southward (S, SW). south-facing contributing area.	0	
125			Other (E, SE, W, NW), or no detectable uphill slope or input channel (flat).	1	
126	OF26	Internal Flow Distance (Path Length)	The horizontal flow distance from the wetland's inlet to outlet is:		Identify inlets and outlets, if any, from topographic maps (use elevations to determine which are inlets and which are outlets) and augment by field inspection. With the Provincial Landscape Viewer, select Nova Scotia Topo as the Basemap. Also enable the layer Forestry>WAM Predicted Flow. Then measure the inlet-outlet distance. [NR, OE, PR, SR, WS]
127			<10 m.	0	
128			10 - 50 m.	0	
129			50 - 100 m.	0	
130			100 - 1000 m.	0	
131			1- 2 km.	0	
132			>2 km, or wetland lacks an inlet and outlet.	1	
133	OF27	Growing Degree Days	In Google Earth, open the KMZ file that accompanies this calculator, called NS_GrowingDegreeDays. Place your cursor over the AA and left-click. From the pop-up window, enter the GRIDCODE number in the next column.	1773	This layer was provided by Dr. Dan McKenney of the Canadian Forest Service [AM, CS, FR, INV, NR, OE, PH, PR, Sens, SR, WBF, WCv, WS]
134	OF28	Fish Access or Use	According to agency biologists and/or your own observations, the AA. [M*ark just the first choice that is true.]* :		Regarding the last choice, if uncertain if an AA is fishless, consider the possibility its waters have been stocked. [AM, FA, FR, INV, WBF, WBN]
135			Is known to support rearing and/or spawning by Atlantic salmon or other anadromous species or eels. Go to Provincial Landscape Viewer>Wildlife>Significant Habitat>Species at Risk. Contact local fishery biologists, review the ACCDC report, and visit these websites: http://www.salmonatlas.com/atlanticsalmon/canada-east/index.1.html http://atlanticsalmonfederation.org/rivers/introduction.html	1	
136			Has not been documented to support Atlantic salmon rearing and/or spawning, but is connected to nearby waters likely to contain Atlantic salmon or other anadromous species or eels and is probably accessed by those during some conditions.	0	
137			Is probably is not accessed by any anadromous fish species but is known or likely to have other fish at least seasonally.	0	
138			Is known or likely to be fishless (e.g., too small, dry, and/or not accessible even temporarily, and not stocked).	0	
139	OF29	Species of Conservation Concern	Within the past 10 years, in the AA (or in its adjoining waters or wetland), qualified observers have documented *[mark all applicable*]:		Request information from ACCDC and/or conduct your own survey at an appropriate season using an approved protocol. For birds, also check eBird.org. NOTE for NS: If your WESP-AC is being completed for a Wetland Alteration Application to NS-ECC, your ACCDC results and any taxon-specific survey results must be submitted along with your WESP-AC results, and application. [AMv, EC, PHv, POLv, SBMv, Sens, WBFv, WBNv]
140			Presence of one or more of the plant species listed in the Plants_Rare worksheet of the accompanying SuppInfo file, or the AA is within a mapped Atlantic Coastal Plain Flora Buffer (go to Provincial Landscape Viewer> Wildlife> Special Management Practice Zones).	0	
141			Presence of one or more of the amphibian or reptile species (AM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
142			Presence of one or more of the waterbird species (WBF, WBN) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file.	0	
143			Presence of one or more of the nesting songbird or raptor species (SBM) of conservation concern as listed in the Wildlife_Rare worksheet of the accompanying SuppInfo file, during their nesting season (May-July for most species).	0	
144			None of the above, or no data.	1	

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145	OF30	Important Bird Area (IBA)	In Google Earth, open the KMZ file that accompanies this calculator, called IBAs_Canada. The AA is all or part of an officially designated IBA. Enter 1= yes, 0= no.	0	The source of this layer, which should be checked periodically for updates, is: http://www.ibacanada.com/mapviewer.jsp?lang=EN [SBMv, WBFv, WBNv]
146	OF31	Black Duck Nesting Area	In Google Earth, open the KMZ file that accompanies this calculator, called BlackDuck. Adjust its alignment and opacity. Determine the predicted density (pairs per 25 sq. km) of nesting American Black Duck in the AA's vicinity: <10 (enter 0), 10-20 (enter 1), 20-30 (enter 2), >30 (enter 3). If outside of region shown in map, change to blank.	1	This was provided by Dr. David Leske. [WBNv]
147	OF32	Wintering Deer or Moose Concentration Areas	If AA is on private land with no information, change to blank (not 0). Otherwise: With the Provincial Landscape Viewer, for Wintering Moose, go to Wildlife> Significant Habitat. For Mainland Moose Concentration Areas, go to Wildlife> Special Management Practice Zones. Enter: yes= 1, no= 0.	0	[SBM]
148	OF33	Other Conservation Designation	The AA is all or part of an area designated by government, First Nations, or the Nature Conservancy of Canada (NCC) for its exceptional ecological features or highly intact natural conditions. With Provincial Landscape Viewer, see Protected Areas. Enter: yes= 1, no= 0. If uncertain, consult NCC and agencies for more recent information.	0	See: https://novascotia.ca/parksandprotectedareas/plan/interactive-map/ [PU]
149	OF34	Conservation Investment	The AA is part of or contiguous to a wetland on which public or private organizational funds were spent to preserve, create, restore, or enhance the wetland (excluding mitigation wetlands). Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank (not 0).	0	[PU]
150	OF35	Mitigation Investment	The AA is all or part of a mitigation site used explicitly to offset impacts elsewhere. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
151	OF36	Sustained Scientific Use	Plants, animals, or water in the AA have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public. Or the AA is part of an area that has been designated by an agency or institution as a benchmark, reference, or status-trends monitoring area. Ask the property owner. Enter: yes= 1, no= 0. If no information, change to blank.		[PU]
152	OF37	Calcareous Region	The AA is NOT in a subregion that has been heavily exposed to acid precipitation. Enter "1" if true (green or yellow in map in Appendix A of the Manual). Enter "0" if false. If no information, change to blank.	1	[AM, FA, FR, INV, PH]
153	OF38	Ownership	Select the ONE ownership that covers the most of the AA. In Google Earth, open KMZ file called NS_Crownlands.Use more recent information if available.		"Private lands" may include those owned or leased by non-governmental organizations, e.g., charitable conservation land trusts, DUC, TNC. [PU, STR]
154			New timber harvest, roads, mineral extraction, and intensive summer recreation (e.g., off-road vehicles) are permanently prohibited. Includes many publicly-owned Protected Lands, and private lands under long-term (30+ year) legal agreements to maintain nearly-unaltered conditions.	0	
155			Ownership is public (e.g., municipal, Crown Reservations/Notations) but some or all of the above activities are allowed.	0	
156			Ownership is private but public access is allowed, and/or a shorter-term conservation easement (whether renewable or not) is in place.	0	
157			Ownership is private and owner does not allow access, or access permission unknown, and not a conservation easement.	1	

	A	B	C	D	E
1	Date: July 5, 2022		Site Identifier: Ruth Falls WL19	Investigator: Darcy Kavanagh & Angus Doane	
2	**Form F (Field). Non-tidal Wetland Data Form. WESP-AC version 2 for Nova Scotia.** DIRECTIONS: Walk for no less than 10 minutes from the wetland edge towards its core, in the part of the AA that is proposed for alteration. If no alteration is proposed, walk in a portion that appears to be most representative of the wetland overall. Walk only where it is safe and legal to do so. Conduct the assessment only after reading the accompanying Manual and the Explanations column of the data form. In the Data column, change the 0 (false) to a 1 (true) for the best choice, or for multiple choices where allowed and so indicated. Answer these questions primarily based on your onsite observations and interpretations. Do not write in shaded parts of this data form. Answering some questions accurately may require conferring with the landowner or other knowledgable persons, and/or reviewing aerial imagery. For most wetlands, completing this field data form will require 1-2 hours on a site. For a list of functions to which each question pertains, see the accompanying Interpretations form. For detailed descriptions of each WESP-AC model, see Appendix B of the accompanying Manual. Codes for functions and values are: WS= Water Storage & Delay, SFS= Stream Flow Support, WC= Water Cooling, SR= Sediment Retention & Stabilisation, PR= Phosphorus Retention, NR= Nitrate Removal, CS= Carbon Sequestration, OE= Organic Nutrient Export, INV= Invertebrate Habitat, FA= Anadromous Fish Habitat, FR= Resident Fish Habitat, AM= Amphibian & Reptile Habitat, WBF= Feeding Waterbird Habitat, WBN= Nesting Waterbird Habitat, SBM= Songbird, Raptor, & Mammal Habitat, POL= Pollinator Habitat, PH= Native Plant Habitat, PU= Public Use & Recognition, EC= Ecological Condition, Sen= Wetland Sensitivity, STR= Stressors.			
3	**#**	**Indicators**	**Condition Choices**	**Data**	**Definitions/Explanations**
4	F1	Wetland Type	Follow the key below and mark the ONE row that best describes MOST of the vegetated part of the AA:		Ericaceous shrubs are ones in the heather family (Ericaceae). Most have leathery evergreen leaves. They include rhododendron, azalea, swamp laurel, leatherleaf, Labrador tea, and others. Most require acidic soil. Although not in the family Ericaceae, sweetgale (*Myrica gale*) should be counted also. [AM, CS, FA, FR, INV, NR, OE, PH, Sens, SFS, WBF, WBN]
5			A. Moss and/or lichen cover more than 25% of the ground. Often dominated by ericaceous shrubs (e.g., Labrador tea) or other acid-tolerant plants (e.g., bog cranberry, pitcher plant, sundew, orchids). Substrate is mostly undecomposed peat. Choose between A1 and A2 and mark the choice with a 1 in their adjoining column. Otherwise go to B below.		
6			A1. Surface water is usually absent or, if present, pH is typically <4.5 and conductivity is usually <100 µS/cm (<64 ppm TDS). Trees are absent or nearly so. Sedge cover usually sparse or absent but cottongrass and/or lichen cover may be extensive, as well as cloudberry, lingonberry, sheep laurel, and a sedge (*Carex rariflor* a). Wetland surface and surrounding landscape are seldom sloping and wetland often is domed (convex). Inlet and outlet channels are usually absent. If known, pH of peat is <4.0.	0	
7			A2. Not A1. Surface water, if present, has pH typically >4.5 and conductivity is usually >100 µS/cm (>64 ppm TDS). Sedge cover is usually extensive, and/or tree and tall shrub cover is extensive. Sometimes at toe of slope or edge of water body. An exit channel is usually present. Wetter than A1 and peat depth may be shallower (<2 m).	1	
8			B. Moss and/or lichen cover less than 25% of the ground. Soil is mineral or decomposed organic (muck). Choose between B1 and B2 and mark the choice with a 1 in their adjoining column:		
9			B1. Trees and shrubs taller than 1 m comprise more than 25% of the vegetated cover. Surface water is mostly absent or inundates the vegetation only seasonally (e.g., vernal pools or floodplain).	0	
10			B2. Not B1. Tree & tall shrubs comprise less than than 25% of the vegetated cover. Vegetation is mostly herbaceous, e.g., cattail, bulrush, burreed, pond lily, horsetail. Surface water may be extensive and fluctuates seasonally, being either persistent or drying up partly or entirely.	0	
11	*Reminder : For all questions, the AA should include all persistent waters in ponds smaller than 8 hectares (~283 m on a side) that are adjacent to the AA. The AA should also include part of the water area of adjacent ponded water larger than 8 ha and adjacent rivers wider than 20 m. Specifically, the AA should include the open water part adjacent to wetland vegetation and equal in width to the average width of that vegetated zone. Throughout this data form, " adjacent " is used synonymously with abutting, adjoining, bordering, contiguous -- and means no upland (manmade or natural) completely separates the described features along their directly shared edge. Features joined only by a channel are not necessarily considered to be adjacent -- a large portion of their edges must match. The features do not have to be hydrologically connected in order to be considered adjacent.*			
12	F2	Wetland Types - Adjoining or Subordinate	If the AA is smaller than 1 ha, mark all other types that occupy more than 1% of the vegetated AA. If the AA is larger than 1 ha, mark all other types which are within or adjacent to the AA and occupy more than 1 ha, as visible from the AA or as interpreted from aerial imagery. Do not mark again the type marked in F1.		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, INV, SBM, WBF]
13			A1.	0	
14			A2.	0	
15			B1.	0	
16			B2.	1	

	A	B	C	D	E
17	F3	Woody Height & Form Diversity	Following EACH row below, indicate with a number code the percentage of the living vegetation in the AA which is occupied by that feature (6 if >95%, 5 if 75-95%, 4 if 50-75%, 3 if 25-50%, 2 if 5-25%, 1 if <5%, 0 if none). If the vegetated part of the AA is largely herbaceous (non-woody) vegetation, these percentages should not sum to 100%.		**Deciduous** shrubs in this region usually include buttonbush, Labrador tea, bayberry (*Morella*), huckleberry, cranberry, cloudberry, sweetgale, alder, willow, birch, ash, dogwood, and a few others. If you assigned a code of 3 or higher to any of the first four choices and the ground cover beneath the trees/shrubs is <25% moss, then question F1 might be "B1". [CS, INV, NR, PH, POL, SBM, Sens]
18			coniferous trees (may include tamarack) taller than 3 m.	0	
19			deciduous trees taller than 3 m.	0	
20			coniferous or ericaceous shrubs or trees 1-3 m tall not directly below the canopy of trees.	3	
21			deciduous shrubs or trees 1-3 m tall not directly below the canopy of trees.	2	
22			coniferous or ericaceous shrubs <1 m tall not directly below the canopy of taller vegetation.	5	
23			deciduous shrubs or trees <1 m tall (e.g., deciduous seedlings) not directly below the canopy of taller vegetation.	2	
24	*Note : If none of top 4 rows in F3 was marked 2 or greater , SKIP to F9 (N fixers).*				
25	F4	Dominance of Most Abundant Shrub Species	Determine which two woody plant species comprise the greatest portion of the low (<3 m) woody cover . Then choose one:		[PH, POL, SBM, Sens]
26			those species together comprise > 50% of such cover.	1	
27			those species together do **not** comprise > 50% of such cover.	0	
28	F5	Woody Diameter Classes	Mark **ALL** the types that comprise >5% **of the woody canopy** cover **in the AA** or >5% of the **wooded areas** (if any) along its **upland edge (perimeter).** The edge should include only the trees whose canopies extend into the AA.		Estimate the diameters at chest height. If small-diameter trees are overtopped (shaded) by larger ones, visualise a "subcanopy" at the average height of the smaller-dbh trees, to serve as a basis for the minimum 5% canopy requirement in this question. The trees and shrubs need not be wetland species. [AM, CS, POL, SBM, Sens, WBN]
29			coniferous, 1-9 cm diameter and >1 m tall.	1	
30			broad-leaved deciduous 1-9 cm diameter and >1 m tall.	1	
31			coniferous, 10-19 cm diameter.	1	
32			broad-leaved deciduous 10-19 cm diameter.	0	
33			coniferous, 20-40 cm diameter.	0	
34			broad-leaved deciduous 20-40 cm diameter.	0	
35			coniferous, >40 cm diameter.	0	
36			broad-leaved deciduous >40 cm diameter.	0	
37	F6	Height Class Interspersion	Follow the key below and mark the ONE row that best describes MOST of the AA:		[AM, INV, NR, PH, SBM, Sens]
38			A. Neither the vegetation **taller** than 1 m nor the vegetation **shorter** than that comprise >70% of the vegetated part of the AA. **They <u>each</u> comprise 30-70%.** Choose between A1 and A2 and mark the choice with a 1 in the adjoining column. Otherwise go to B below.		
39			A1. The two height classes are mostly scattered and intermixed throughout the AA.	0	
40			A2. Not A1. The two height classes are mostly in separate zones or bands, or in proportionately large clumps.	0	
41			B. Either the vegetation shorter than 1 m comprises >70% of the vegetated part of the AA, or the vegetation taller than that does. One size class might even be totally absent. Choose between B1 and B2 and mark the choice with a 1 in the adjoining column:		
42			B1. The less prevalent height class is mostly scattered and intermixed within the prevalent one.	1	
43			B2. Not B1. The less prevalent height class is mostly located apart from the prevalent one, in separate zones or clumps, or is completely absent.	0	
44	F7	Large Snags (Dead Standing Trees)	The number of large snags (**diameter >20 cm**) in the AA plus adjacent upland area within 10 m of the wetland edge is:		Snags are dead standing trees that often (not always) lack bark and foliage. Include only ones that are at least 2 m tall. [POL, SBM, WBN]
45			None, or fewer than 8/ hectare which exceed this diameter.	1	
46			Several (>8/hectare) and a pond, lake, or slow-flowing water wider than 10 m is within 1 km.	0	
47			Several (>8/hectare) but above not true.	0	
48	F8	Downed Wood	The number of downed wood pieces **longer than 2 m** and with diameter >10 cm, and not persistently submerged, is:		Exclude temporary "burn piles." [AM, INV, POL, SBM]
49			Few or none that meet these criteria.	1	
50			Several (>5 if AA is >5 hectares, less for smaller AAs) meet these criteria.	0	
51	F9	N Fixers	The percentage of the AA's vegetated cover that contains nitrogen-fixing plants (e.g., alder, sweetgale, clover, lupine, alfalfa, other legumes) is:		Do not include N-fixing algae or lichens. [FA, FR, INV, NRv, OE, PH, SBM, Sens]
52			<1% or none.	0	
53			1-25% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
54			25-50% of the vegetated cover, in the AA or along its water edge (whichever has more).	1	
55			50-75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	
56			>75% of the vegetated cover, in the AA or along its water edge (whichever has more).	0	

	A	B	C	D	E
57	F10	Sphagnum Moss Extent	The cover of Sphagnum moss (or any moss that forms a dense cushion many centimeters thick), including the moss obscured by taller sedges and other plants rooted in it, is:		Exclude moss growing on trees and rocks. [CS, PH]
58			<5% of the vegetated part of the AA.	0	
59			5-25% of the vegetated part of the AA.	0	
60			25-50% of the vegetated part of the AA.	1	
61			50-95% of the vegetated part of the AA.	0	
62			>95% of the vegetated part of the AA.	0	
63	F11	% Bare Ground & Thatch	Consider the parts of the AA that lack surface water at the driest time of the growing season. Viewed from directly above the ground layer, the predominant condition in those areas at that time is:		Thatch is dead plant material (stems, leaves) resting on the ground surface. Bare ground that is present under a tree or shrub canopy should be counted. Boulders count as bare ground. Wetlands with mineral soils and that are heavily shaded or are dominated by annual plant species tend to have more extensive areas that are bare during the early growing season. [AM, EC, INV, NR, OE, POL, PR, SBM, Sens]
64			Little or no (<5%) *bare ground* is visible between erect stems or under canopy anywhere in the vegetated AA. Ground is extensively blanketed by dense thatch, moss, lichens, graminoids with great stem densities, or plants with ground-hugging foliage.	1	
65			Slightly bare ground (5-20% bare between plants) is visible in places, but those areas comprise less than 5% of the unflooded parts of the AA.	0	
66			Much bare ground (20-50% bare between plants) is visible in places, and those areas comprise more than 5% of the unflooded parts of the AA.	0	
67			Other conditions.	0	
68			Not applicable. Surface water (either open or obscured by emergent plants) covers all of the AA all the time.	0	
69	F12	Ground Irregularity	Imagine the AA without any living vegetation. Excluding the portion of the AA that is always under water, the number of hummocks, small pits, raised mounds, animal burrows, ruts, gullies, natural levees, microdepressions, and other areas of peat or mineral soil that are raised or depressed >10 cm compared to most of the area within a few meters surrounding them is:		The depressions may be of human or natural origin. [AM, EC, INV, NR, PH, POL, PR, SBM, SR, WS]
70			Few or none (minimal microtopography; <1% of the land has such features, or entire AA is always water-covered).	1	
71			Intermediate.	0	
72			Several (extensive micro-topography).	0	
73	F13	Upland Inclusions	Within the AA, inclusions of upland are:		[AM, NR, SBM]
74			Few or none.	0	
75			Intermediate (1 - 10% of vegetated part of the AA).	1	
76			Many (e.g., wetland-upland "mosaic", >10% of the vegetated AA).		
77	F14	Soil Texture	In parts of the AA that lack persistent water, the texture of soil in the uppermost layer is mostly: [*To determine this, use a trowel to check in at least 3 widely spaced locations, and use the soil texture key (in Appendix A of the Manual).]*		[CS, NR, OE, PH, PR, Sens, SFS, WS]
78			Loamy: soils that may contain a little fine grit and do not make a "ribbon" longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
79			Fines: includes silt, clay, silt, soils that make a ribbon longer than 2 cm when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
80			Deep Peat, to 40 cm depth or greater.	0	
81			Shallow Peat or organic <40 cm deep.	1	
82			Coarse: includes sand, loamy sand, gravel, cobble, soils that do not make a ribbon when moistened, rolled, squeezed, and extended between thumb and forefinger.	0	
83	F15	Shorebird Feeding Habitats	During any 2 consecutive weeks of the growing season, the extent of mudflats, bare unshaded saturated areas not covered by thatch, and unshaded waters shallower than 6 cm is: [Include also any area that is adjacent to the AA.]		This addresses needs of many but not all migratory sandpipers, plovers, and related species. [WBF]
84			None, or <100 sq. m.	1	
85			100-1000 sq. m.	0	
86			1000 – 10,000 sq. m.	0	
87			>10,000 sq. m.	0	
88	F16	Herbaceous % of Vegetated Wetland	In aerial ("ducks eye") view, the maximum annual cover of herbaceous vegetation (all non-woody plants except moss) is:		[AM, WBF, WBN]
89			<5% of the vegetated part of the AA or <0.01 hectare (whichever is less). Mark "1" here and SKIP to F20 (Invasive Plant Cover).	0	
90			5-25% of the vegetated part of the AA.	0	
91			25-50% of the vegetated part of the AA.	1	
92			50-95% of the vegetated part of the AA.	0	
93			>95% of the vegetated part of the AA.	0	

	A	B	C	D	E
94	F17	Forb Cover	Within parts of the AA having herbaceous cover (excluding SAV), the areal cover of forbs reaches an annual maximum of:		Forbs are flowering plants. Do not include grasses, sedges, cattail, other graminoids, ferns, horsetails, or others that lack showy flowers. [POL]
95			<5% of the herbaceous part of the AA.	0	
96			5-25% of the herbaceous part of the AA.	1	
97			25-50% of the herbaceous part of the AA.	0	
98			50-95% of the herbaceous part of the AA.	0	
99			>95% of the herbaceous part of the AA.	0	
100	F18	Sedge Cover	Sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) occupy:		[CS]
101			<5% of the vegetated area, or none.	0	
102			5-50% of the vegetated area.	1	
103			50-95% of the vegetated area.	0	
104			>95% of the vegetated area.	0	
105	F19	Dominance of Most Abundant Herbaceous Species	Determine which two herbaceous species comprise the greatest portion of the herbaceous cover (excluding mosses and floating-leaved aquatic plants). Then choose one of the following:		For this question, include ferns as well as graminoids and forbs. [EC, INV, PH, POL, Sens]
106			those species together comprise > 50% of the areal cover of herbaceous plants at any time during the year.	0	
107			those species together do not comprise > 50% of the areal cover of herbaceous plants at any time during the year.	1	
108	F20	Invasive Plant Cover	How extensive is the cover of invasive plant species in the AA? For species, see Plants_invasive worksheet in the accompanying SuppInfo file.		[EC, PH, POL, Sens]
109			invasive species appear to be absent in the AA, or are present only in trace amount (a few individuals).	1	
110			invasive species are present in more than trace amounts, but comprise <5% of herbaceous cover (or woody cover, if the invasives are woody).	0	
111			invasive species comprise 5-20% of the herb cover (or woody cover, if the invasives are woody).	0	
112			invasive species comprise 20-50% of the herb cover (or woody cover, if the invasives are woody).	0	
113			invasive species comprise >50% of the herb cover (or woody cover, if the invasives are woody).	0	
114	F21	Invasive Cover Along Upland Edge	Along the wetland-upland boundary, the percent of the upland edge (within 3 m upslope from the wetland) that is occupied by invasive plant species is:		If a plant cannot be identified to species (e.g., winter conditions) but its genus contains an exotic species, assume the unidentified plant to also be exotic. If vegetation is so senesced that exotic species cannot be identified, answer "none". [PH, STR]
115			none of the upland edge (invasives apparently absent), or AA has no upland edge.	1	
116			some (but <5%) of the upland edge.	0	
117			5-50% of the upland edge.	0	
118			most (>50%) of the upland edge.	0	
119	F22	Fringe Wetland	During most of the year, open water within or adjacent to the vegetated part of the wetland is much wider than the maximum width of the vegetated zone within the wetland. Enter "1" if true, "0" if false.	1	[WBF, WBN, WCv]
120	F23	Lacustrine Wetland	The vegetated part of the AA is within or adjacent to a body of non-tidal standing open water whose size exceeds 8 hectares during most of a normal year.	1	[FR, PR, PU, WBF, WBN]
121	F24	% of AA Without Surface Water	The percentage of the AA that never contains surface water during an average year (that is, except perhaps for a few hours after snowmelt or rainstorms), but which is still a wetland, is:		1 hectare is 10,000 sq. m or about 2.5 acres. It could have dimensions of 100 m by 100 m, 1000 m by 10 m, or similar. [AM, FA, FR, INV, NR, PH, PR, SBM, Sens, SRv, WBF, WBN, WC]
122			<1% . In other words, all or nearly all of the AA is covered by water permanently or at least seasonally.	0	
123			1-25% of the AA, or <1% but >0.01 ha never contains surface water.	0	
124			25-50% of the AA never contains surface water.	0	
125			50-75% of the AA never contains surface water.	0	
126			75-99% of the AA never contains surface water, OR >99% and there is at least one persistently ponded water body larger than 1 ha in the AA.	0	
127			99-100%. AND there is no persistently ponded water body larger than 1 ha within the AA. Enter "1" and SKIP to F42 (Channel Connection).	1	

	A	B	C	D	E
128	F25	% of AA with Persistent Surface Water	Identify the parts of the AA that still contain surface water (flowing or ponded, open or hidden beneath vegetation) even during the driest times of a normal year, i.e., when the AA's surface water is at its lowest annual level. At that time, the percentage of the AA that still contains surface water is:		If you are unable to determine the condition at the driest time of year, ask the land owner or neighbors about it if possible. Indicators of persistence may include fish, some dragonflies, beaver, and muskrat. [AM, CS, FA, FR, INV, NR, POL, PR, SBM, WBF, WBN]
129			None. The AA dries up completely (no water in channels either) or never has surface water during most years. SKIP to F27.	0	
130			1-20% of the AA.	0	
131			20-50% of the AA.	0	
132			50-95% of the AA.	0	
133			>95% of the AA. True for many fringe wetlands.	0	
134	F26	% of Summertime Water that Is Shaded	At mid-day during the warmest time of year, the area of surface water within the AA that is shaded by vegetation and other features that are within the AA at that time is:		[FA, WC]
135			<5% of the water is shaded, or no surface water is present then.	0	
136			5-25% of the water is shaded.	0	
137			25-50% of the water is shaded.	0	
138			50-75% of the water is shaded.	0	
139			>75% of the water is shaded.	0	
140	F27	% of AA that is Flooded Only Seasonally	The percentage of the AA's area that is between the annual high water and the annual low water (surface water) is:		Flood marks (algal mats, adventitious roots, debris lines, ice scour, etc.) are often evident when not fully inundated. Also, such areas often have a larger proportion of upland and annual (vs. perennial) plant species. In riverine systems, the extent of this zone can be estimated by multiplying by 2 the bankful height and visualising where that would intercept the land along the river. [CS, FA, INV, NR, OE, PH, SR, WBF, WBN, WS]
141			None, or <0.01 hectare and <1% of the AA. SKIP to F29.	0	
142			1-20% of the AA, or <1% but >0.01 ha.	0	
143			20-50% of the AA.	0	
144			50-95% of the AA.	0	
145			>95% of the AA.	0	
146	F28	Annual Water Fluctuation Range	The annual fluctuation in surface water level within most of the parts of the AA that contain surface water at least temporarily is:		Look for flood marks (see above). Because the annual range of water levels is difficult to estimate without multiple visits, consider asking the land owner or neighbors about it. [AM, CS, INV, NR, OE, PH, PR, SR, WBN, WS]
147			<10 cm change (stable or nearly so).	0	
148			10 cm - 50 cm change.	0	
149			0.5 - 1 m change.	0	
150			1-2 m change.	0	
151			>2 m change.	0	
152	Is the AA plus adjacent ponded water smaller than 0.01 hectare (about 10m x 10m, or 1m x 100 m)? If so, enter "1" in column D and SKIP TO F42 (Connection).			0	
153	F29	Predominant Depth Class	During most of the time when surface water is present during the growing season, its depth, averaged over the entire inundated part of the AA, is:		If a boat is unavailable, estimate this by considering wetland size and local topography. Or if timing and safety allow, depths may be measured by drilling through winter ice.This question is asking about the spatial median depth that occurs during most of that time, even if inundation is only seasonal or temporary. If inundation in most but not all of the wetland is brief, the answer will be based on the depth of the most persistently inundated part of the wetland. Include surface water in channels and ditches as well as ponded areas. [CS, FA, FR, INV, OE, PH, PR, Sens, SFS, SR, WBF, WBN, WC]
154			<10 cm deep (but >0).	0	
155			10 - 50 cm deep.	0	
156			0.5 - 1 m deep.	0	
157			1 - 2 m deep.	0	
158			>2 m deep. True for many fringe wetlands.	0	
159	F30	Depth Classes - Evenness of Proportions	When present, surface water in most of the AA usually consists of (select one):		Estimate these proportions by considering the gradient and microtopography of the site. [FR, INV, WBF, WBN]
160			One depth class that comprises >90% of the AA's inundated area (use the classes in the question above).	0	
161			One depth class that comprises 50-90% of the AA's inundated area.	0	
162			Neither of above. There are 3 or more depth classes and none occupy >50%.	0	
163	F31	% of Water That Is Ponded (not Flowing)	During most times when surface water is present, the percentage that is (1) ponded (stagnant, or flows so slowly that fine sediment is not held in suspension) AND (2) is likely to be deeper than 0.5 m in some places, is:		Nearly all wetlands with surface water have some ponded water. [AM, CS, INV, NR, OE, PR, Sens, SR, WBF, WBN, WC, WS]
164			<5% of the water, or it occupies <100 sq.m cumulatively. Nearly all the surface water is flowing. SKIP to F34.	0	
165			5-30% of the water.	0	
166			30-70% of the water.	0	
167			70-95% of the water.	0	
168			>95% of the water.	0	

	A	B	C	D	E
169	F32	Ponded Open Water - Minimum Size	During most of the growing season, the largest patch of **open water** that is ponded and is in or bordering the AA is >0.01 hectare (about 10 m by 10 m) and mostly deeper than 0.5 m. If true enter "1" and continue, If false, enter "0" and **SKIP to F41** (Floating Algae & Duckweed).	0	**Open water** is not obscured by vegetation in aerial ("duck's eye") view. It includes vegetation floating on the water surface or entirely submersed beneath it.
170	F33	% of Ponded Water that is Open	In ducks-eye aerial view, the percentage of the ponded water that is **open** (lacking emergent vegetation during most of the growing season, and unhidden by a forest or shrub canopy) is:		[AM, CS, FA, FR, INV, NR, OE, PR, SR, WBF, WBN, WC]
171			None, or <1% of the AA and largest pool occupies <0.01 hectares. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
172			1-4% of the ponded water. Enter "1" and **SKIP to F41** (Floating Algae & Duckweed).	0	
173			5-30% of the ponded water.	0	
174			30-70% of the ponded water.	0	
175			70-99% of the ponded water.	0	
176			100% of the ponded water.	0	
177	F34	Width of Vegetated Zone within Wetland	At the time during the growing season when the AA's water level is lowest, the average width of vegetated area in the AA that separates adjoining uplands from open water within the AA is:		"Vegetated area" does not include underwater or floating-leaved plants, i.e., aquatic bed. Width may include wooded riparian areas if they have wetland soil or plant indicators. [AM, CS, NR, OE, PH, PR, SBM, Sens, SR, WBN]
178			<1 m.	0	
179			1 - 9 m.	0	
180			10 - 29 m.	0	
181			30 - 49 m.	0	
182			50 - 100 m.	0	
183			> 100 m, or open water is absent at that time.	0	
184	F35	Flat Shoreline Extent	During most of the part of the growing season when water is present, the percentage of the AA's **water edge** length that is **nearly flat** (a slope less than about 5% measured within 5 m landward of the water) is:		If several isolated pools are present in early summer, estimate the percent of their collective shorelines that has such a gentle slope. [SR, WBN]
185			<1% of the water edge.	0	
186			1-25% of the water edge.	0	
187			25-50% of the water edge.	0	
188			50-75% of the water edge.	0	
189			>75% of the water edge.	0	
190	F36	Robust Emergents	The percentage **of the emergent vegetation** cover in the AA that is cattail (*Typha* spp.), common reed (*Phragmites*), or tall (>1m) bulrush is:		**Emergent vegetation** is herbaceous plants whose stems are partly above and partly below the water surface during most of the time water is present. [WBN]
191			<1% of the emergent vegetation, or emergent vegetation is absent. **SKIP to F38.**	0	
192			1-25% of the emergent vegetation.	0	
193			25-75% of the emergent vegetation.	0	
194			>75%, of the emergent vegetation.	0	
195	F37	Interspersion of Emergents & Open Water	During most of the part of the growing season when water is present, the spatial pattern of **emergent** vegetation within the water is mostly:		[AM, FA, FR, INV, NR, OE, PH, PR, SBM, SR, WBF, WBN]
196			Scattered. More than 30% of such vegetation forms small islands or corridors surrounded by water.	0	
197			Intermediate.	0	
198			Clumped. More than 70% of such vegetation is in bands along the wetland perimeter or is clumped at one or a few sides of the surface water area.	0	
199	F38	Persistent Deepwater Area	If the deepest patch of surface water (flowing or ponded) in or directly adjacent to the AA is mostly deeper than 0.5 m for >2 weeks during the growing season, enter "1" and continue. If not, enter "0" and **SKIP to F42.**(Connection).	0	
200	F39	Non-vegetated Aquatic Cover	During most of the growing season and in waters deeper than 0.5 m, the cover for fish, aquatic invertebrates, and/or amphibians that is provided NOT by living vegetation, but by accumulations of **dead wood and undercut banks** is:		For this question, consider only the wood that is at or above the water surface. Estimates of underwater wood based only on observations from terrestrial viewpoints are unreliable so should not be attempted. [AM, FA, FR, INV]
201			Little or none.	0	
202			Intermediate.	0	
203			Extensive.	0	
204	F40	Isolated Island	The AA contains (or is part of) an island or beaver lodge within a lake, pond, or river, and is isolated from the shore **by water depths >1 m** on all sides during an average June. The island may be solid, or it may be a floating vegetation mat that is sufficiently large and dense to support a waterbird nest.	0	[WBN]
205	F41	Floating Algae & Duckweed	At some time of the year, mats of algae and/or duckweed are likely to cover >50% of the AA's otherwise-unshaded water surface, or blanket >50% of the underwater substrate. If true, enter "1" in next column. If untrue or uncertain, enter "0".	0	[EC, PR, WBF]

	A	B	C	D	E
206	F42	Channel Connection & Outflow Duration	The most persistent surface water connection (outlet channel or pipe, ditch, or overbank water exchange) between the AA and a downslope stream network is: [Note: If the AA represents only part of a wetland, answer this according to whichever is the **least** permanent surface connection: the one between the AA and the rest of the wetland, or the surface connection between the wetland and the downslope stream network.]		Consider the connection regardless of whether the surface water is frozen. The "downslope stream network" could consist of ditches, rivers, ponds, or lakes which eventually connect to the ocean. If this cannot be determined while visiting the AA, consult topographic maps perhaps by viewing these online with Toporama (http://atlas.nrcan.gc.ca/toporama/en/index.html) [CS, FA, FR, NR, OE, PR, Sens, SFS, SR, WCv, WS]
207			Persistent (surface water flows out for >9 months/year).	0	
208			Seasonal (surface water flows out for 14 days to 9 months/year, not necessarily consecutive).	0	
209			Temporary (surface water flows out for <14 days, not necessarily consecutive).	0	
210			None -- but maps show a stream network downslope from the AA and within a distance that is less than the AA's length. SKIP to F47 (pH Measurement).	0	
211			No surface water flows out of the wetland except possibly during extreme events (<once per 10 years). Or, water flows only into a wetland, ditch, or lake that lacks an outlet. SKIP to F47 (pH Measurement).	1	
212	F43	Outflow Confinement	During major runoff events, in the places where **surface** water exits the AA or connected waters nearby, the water:		"Major runoff events" would include biennial high water caused by storms and/or rapid snowmelt. [CS, NR, OE, PR, Sens, SR, STR, WS]
213			Mostly passes through a pipe, culvert, narrowly breached dike, berm, beaver dam, or other partial obstruction (other than natural topography) that does not appear to drain the wetland artificially during most of the growing season.	0	
214			Leaves through natural exits (channels or diffuse outflow), not mainly through artificial or temporary features.	0	
215			Is exported more quickly than usual due to ditches or pipes within the AA or connected to its outlet, or within 10 m of the AA's edge, which drain the wetland artificially, or water is pumped out of the AA.	0	
216	F44	Tributary Channel	At least once annually, surface water from a tributary channel that is >100 m long moves into the AA. Or, surface water from a larger permanent water body adjacent to the AA spills into the AA. If it enters only via a pipe, that pipe must be fed by a mapped stream or lake further upslope. If no, SKIP to F47 (pH Measurement).	0	If inlet tributaries cannot be searched for due to inaccessibility of part of the AA, follow suggestions in F42 above. [NRv, PH, PRv, SRv]
217	F45	Input Water Temperature	Based on lack of shade, water source characteristics, or actual temperature measurements, the inflow is likely to be warmer than surface water in the AA during part of most years. Enter 1= yes, 0= no.	0	[WCv]
218	F46	Throughflow Resistance	During its travel through the AA at the time of peak annual flow, water arriving in channels: [select only the ONE encountered by **most** of the incoming water].		[FA, FR, INV, NR, OE, PR, SR, WS]
219			Does not bump into many plant stems as it travels through the AA. Nearly all the water continues to travel in unvegetated (often incised) channels that have minimal contact with wetland vegetation, or through a zone of open water such as an instream pond or lake.	0	
220			Bumps into **herbaceous** vegetation but mostly remains in fairly straight channels.	0	
221			Bumps into **herbaceous** vegetation and mostly spreads throughout, or is in widely meandering, multi-branched, or braided channels.	0	
222			Bumps into **tree trunks and/or shrub stems** but mostly remains in fairly straight channels.	0	
223			Bumps into tree trunks and/or shrub stems and follows a fairly **indirect** path from entrance to exit (meandering, multi-branched, or braided).	0	
224	F47	pH Measurement	The pH in most of the AA's surface water:		Preferably, measure this in larger areas of ponded surface water within the AA, or in streams that have passed through (not along) most of the AA. Unless surface water is completely absent, do not dig holes or make depressions in peat in order to provide water for this measurement. Avoid measuring near roads or in puddles formed only by recent rain. [AM, FA, FR, NR, WBF, PH, PR, Sens, WBF, WBN]
225			Was measured, and is: [*enter the reading in the column to the right.*]	5.4	
226			Was not measured but surface water is present and is darkly tea-coloured. Or if no surface water, then mosses and plants that indicate peatland (e.g., Labrador tea) are prevalent. Enter "1".	0	
227			Neither of above. Enter "1".	0	
228	F48	TDS and/or Conductivity	The TDS (total dissolved solids) or conductivity off the AA's surface water is: (select the first true row with information):		See above for measurement guidance. [FR, INV, NRv, PH, PRv, Sens]
229			TDS is: [*Enter the reading in ppm or mg/L in the column to the right, if measured, or answer next row.*]	20	
230			Conductivity is [*Enter the reading in µS/cm in the column to the right.*]	40	
231			Was not measured, but plants that indicate saline conditions cover much of the vegetated AA. Enter "1".	0	
232			Neither of above	0	
233	F49	Beaver Probability	Use of the AA by beaver during the past 5 years is (select most applicable ONE):		[FA, FR, PH, SBM, Sens, WBF, WBN]
234			**Evident** from direct observation or presence of gnawed limbs, dams, tracks, dens, lodges, or extensive stands of water-killed trees (snags).	0	
235			**Likely** based on known occurrence in the region and proximity to suitable habitat, which may include: (a) a persistent freshwater wetland, pond, or lake, or a perennial low or mid-gradient (<10%) channel, and (b) a corridor or multiple stands of hardwood trees and shrubs in vegetated areas near surface water.	1	
236			Unlikely because site characteristics above are deficient, and/or this is a settled area or other area where beaver are routinely removed.	0	

	A	B	C	D	E
237	F50	Groundwater Strength of Evidence	Select first applicable choice:		Adhere to these criteria strictly -- do not use personal judgment based on fen conditions, pH, or other evidence. Consult topographic maps to detect breaks in slope described here. Rust deposits associated with groundwater seeps may be most noticeable as orange discoloration in ice formations along streams during early winter. [AM, CS, FA, FR, INV, NR, OE, PH, PRv, SFS, WC, WS]
238			Springs are known to be present within the AA, or if groundwater levels have been monitored, that has demonstrated that groundwater primarily discharges to the wetland for longer periods during the year than periods when the wetland recharges the groundwater.	0	
239			Most of the AA has a slope of >5%, or is very close to the base of a natural slope longer than 100 and much steeper than the slope of the AA, AND the pH of surface water, if known, is >5.5.	0	
240			Neither of above is true, although some groundwater may discharge to or flow through the AA. Or groundwater influx is unknown.	1	
241	F51	Internal Gradient	The gradient along most of the flow path within the AA is:		This is not the same as the shoreline slope. It is the elevational difference between the AA's inlet and outlet, divided by the flow-distance between them and converted to percent. If available, use a clinometer to measure this. Free clinometer apps can be downloaded to smartphones. If the wetland is large (longer than ~1 km), this may be estimated using Google Earth to determine the minimum and maximum elevation within the AA, then dividing by length and multiplying by 100. [CS, NR, OE, PR, SR, WBF, WBN, WS]
242			<2% or the AA has no surface water outlet (not even seasonally).	1	
243			2-5%.	0	
244			6-10%.	0	
245			>10%.	0	
246	Note for the next three questions: If the AA lacks an upland edge, evaluate based on the AA's entire perimeter, and moving outward into whatever areas are adjacent. In many situations, these questions are best answered by measuring from aerial images.				
247	F52	Vegetated Buffer as % of Perimeter	Within a zone extending 30 m laterally from the AA's edge with upland and/or other wetlands, the percentage that contains perennial vegetation cover (except lawns, row crops, heavily grazed land, conifer plantations) is:		[AM, FA, FR, INV, NRv, PH, POL, PRv, SBM, Sens, SRv, STR, WBN]
248			<5%.	0	
249			5 to 30%.	0	
250			30 to 60%.	0	
251			60 to 90%.	0	
252			>90%, or all the area within 30 m of the AA edge is other wetlands. SKIP to F55.	1	
253	F53	Type of Cover in Buffer	Within 30 m upslope of where the wetland transitions to upland, the upland land cover that is NOT perennial vegetation is mostly (mark ONE):		[AM, FA, INV, NRv, PH, POL, SBM, STR, WBN]
254			Impervious surface, e.g., paved road, parking lot, building, exposed rock.	0	
255			Bare or nearly bare pervious surface or managed vegetation, e.g., lawn, row crops, unpaved road, dike, landslide.	1	
256	F54	Buffer Slope	The steepest and/or most disturbed part of the upland area that is within 30 m of the wetland and occupies >10% of that upland area has a percent slope of:		[NRv, PRv, Sens, SRv]
257			<1% (flat -- almost no noticeable slope) or all the area within 30 m of the AA edge is other wetlands.	0	
258			2-5%.	1	
259			5-30%.	0	
260			>30%.	0	
261	F55	Cliffs or Steep Banks	In the AA or within 100 m, there are elevated terrestrial features such as cliffs, talus slopes, stream banks, or excavated pits (but not riprap) that extend at least 2 m nearly vertically, are unvegetated, and potentially contain crevices or other substrate suitable for nesting or den areas. Enter 1 (yes) or 0 (no).	0	Do not include upturned trees as potential den sites. [POL, SBM]
262	F56	New or Expanded Wetland	Human actions within or adjacent to the AA have persistently expanded a naturally occurring wetland or created a wetland where there previously was none (e.g., by excavation, impoundment):		Determine this using historical aerial photography, old maps, soil maps, or permit files as available [CS, NR, OE, PH, Sens]
263			No.	0	
264			Yes, and created or expanded 20 - 100 years ago.	1	
265			Yes, and created or expanded 3-20 years ago.	0	
266			Yes, and created or expanded within last 3 years.	0	
267			Yes, but time of origin or expansion unknown.	0	
268			Unknown if new or expanded within 20 years or not.	0	
269	F57	Burn History	More than 1% of the AA's previously vegetated area:		Look for charred soil or stumps (in multiple widely-spaced locations) or ask landowner. [CS, PH, STR]
270			Burned within past 5 years.	0	
271			Burned 6-10 years ago.	0	
272			Burned 11-30 years ago.	0	
273			Burned >30 years ago, or no evidence of a burn and no data.	1	

	A	B	C	D	E
274	F58	Visibility	The maximum percentage of the wetland that is visible from the best vantage point on public roads, public parking lots, public buildings, or public maintained trails that intersect, adjoin, or are within 100 m of the AA (select one) is:		[PU, STR, WBFv]
275			<25%.	1	
276			25-50%.	0	
277			>50%.	0	
278	F59	Non-consumptive Uses - Actual or Potential	Assuming access permission was granted, select ALL statements that are true of the AA as it currently exists:		[PU, STR]
279			For an average person, walking is physically possible in (not just near) >5% of the AA during most of the growing season, e.g., free of deep water and dense shrub thickets.	0	
280			Maintained roads, parking areas, or foot-trails are within 10 m of the AA, or the AA can be accessed part of the year by boats arriving via contiguous waters.	0	
281			Within or near the AA, there is an interpretive center, trails with interpretive signs or brochures, and/or regular guided interpretive tours.	0	
282	F60	Unvisited Core Area	The percentage of the AA almost never visited by humans during an average growing season probably comprises: *[Note: Only include the part actually walked or driven (not simply viewed from) with a vehicle or boat. Do not include visitors on trails outside of the AA unless more than half the wetland is visible from the trails and they are within 30 m of the wetland edge. In that case include only the area occupied by the trail.]*		[AM, FAv, FRv, PH, PU, SBM, STR, WBF, WBN]
283			<5% and no inhabited building is within 100 m of the AA.	0	
284			<5% and inhabited building is within 100 m of the AA.	0	
285			5-50% and no inhabited building is within 100 m of the AA.	0	
286			5-50% and inhabited building is within 100 m of the AA.	0	
287			50-95%, with or without inhabited building nearby.	0	
288			>95% of the AA with or without inhabited building nearby.	1	
289	F61	Frequently Visited Area	The part of the AA visited by humans almost daily for several weeks during an average growing season probably comprises: *[See note above.]*		[AM, PH, PU, SBM, STR, WBF, WBN]
290			<5%. If F60 was answered ">95%" (mostly never visited), SKIP to F64.	1	
291			5-50%.	0	
292			50-95%.	0	
293			>95% of the AA.	0	
294	F62	BMP - Soils	Boardwalks, paved trails, fences or other infrastructure and/or well-enforced regulations appear to effectively prevent visitors from walking on soil within nearly all of the AA when the soil is unfrozen. Enter "1" if true.	0	[PH, PU]
295	F63	BMP - Wildlife Protection	Fences, observation blinds, platforms, paved trails, exclusion periods, and/or well-enforced prohibitions on motorised boats, off-leash pets, and off road vehicles appear to effectively exclude or divert visitors and their pets from the AA at critical times in order to minimize disturbance of wildlife (except during hunting seasons). Enter "1" if true.	0	[AM, PU, WBF, WBN]
296	F64	Consumptive Uses (Provisioning Services)	Recent evidence was found within the AA of the following potentially-sustainable consumptive uses. Select ALL that apply.		[FAv, FRv, WBFv]
297			Low-impact commercial timber harvest (e.g., selective thinning).	0	
298			Commercial or traditional-use harvesting of native plants, their fruits, or mushrooms.	0	
299			Waterfowl hunting.	0	
300			Fishing.	0	
301			Trapping of furbearers.	0	
302			None of the above.	1	
303	F65	Domestic Wells	The closest wells or water bodies that currently provide drinking water are:		[NRv]
304			Within 0-100 m. of the AA.	0	
305			100-500 m. away.	0	
306			>500 m. away, or no information.	1	
307	F66	Calcareous Fen	The AA is, or is part of, a calcareous fen. See the Plants_Calcar worksheet in the accompanying SuppInfo file for list of plant indicators (calciphiles). Enter 1 If more than two Strong or more than five Moderate calciphile species are present; otherwise enter 0, but if not able to identify those and no information, change to blank.		[PH, PR]
308					

Investigator: Darcy Kavanagh & Angus Doane	**Site Identifier: Ruth Falls WL19**	**Date: July 5, 2022**

Stressor (S) Data Form for Non-Tidal Wetlands. WESP-AC for Nova Scotia version 2.

		Data
S1	**Aberrant Timing of Water Inputs**	
	In the last column, place a check mark next to any item that is likely to have caused the timing of water inputs (but not necessarily their volume) to shift by hours, days, or weeks, becoming either more muted (smaller or less frequent peaks spread over longer times, more temporal homogeneity of flow or water levels) or more flashy (larger or more frequent spikes but over shorter times). [FA, FR, INV, PH, STR]	
	Stormwater from impervious surfaces that drains directly to the wetland.	
	Water subsidies from wastewater effluent, septic system leakage, snow storage areas, or irrigation.	
	Regular removal of surface or groundwater for irrigation or other consumptive use.	
	Flow regulation in tributaries or water level regulation in adjoining water body, or other control structure at water entry points that regulates inflow to the wetland.	
	A dam, dike, levee, weir, berm, or fill -- within or downgradient from the wetland -- that interferes with surface or subsurface flow in/out of the AA (e.g., road fill, wellpads, pipelines).	1
	Excavation within the wetland, e.g., dugout, artificial pond, dead-end ditch.	
	Artificial drains or ditches in or near the wetland.	
	Accelerated downcutting or channelization of an adjacent or internal channel (incised below the historical water table level).	
	Logging within the wetland.	
	Subsidence or compaction of the wetland's substrate as a result of machinery, livestock, fire, drainage, or off road vehicles.	
	Straightening, ditching, dredging, and/or lining of tributary channels.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items had no measurable effect on the timing of water conditions in any part of the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Spatial extent of timing shift within the wetland:	>95% of wetland.	5-95% of wetland.	<5% of wetland.	2
When most of the timing shift began:	<3 yrs ago.	3-9 yrs ago.	10-100 yrs ago.	1
Score the following 2 rows only if the altered inputs began within past 10 years, and only for the part of the wetland that experiences those.				
Input timing now vs. previously:	Shift of weeks.	Shift of days.	Shift of hours or minutes.	2
Flashiness or muting:	Became very flashy or controlled.	Intermediate.	Became mildly flashy or controlled.	1
			Sum=	6
			Stressor subscore=	0.50

S2	**Accelerated Inputs of Contaminants and/or Salts**	
	In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of contaminants or salts to the AA. [AM, FA, PH, POL, STR]	
	Stormwater or wastewater effluent (including failing septic systems), landfills, industrial facilities.	
	Metals & chemical wastes from mining, shooting ranges, snow storage areas, oil/ gas extraction, other sources (download many locations from National Pollutant Release Inventory and view KMZ overlay in Google Earth. https://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=B85A1846-1	
	Road salt.	
	Spraying of pesticides, as applied to lawns, croplands, roadsides, or other areas in the CA.	
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly higher levels of contaminants and/or salts, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.	

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Usual toxicity of most toxic contaminants:	Industrial effluent, mining waste, unmanaged landfill.	Cropland, managed landfill, pipeline or transmission rights-of-way.	Low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S3

Accelerated Inputs of Nutrients

In the last column, place a check mark next to any item -- occurring in either the wetland or its CA -- that is likely to have accelerated the inputs of nutrients to the wetland. [NRv, PRv, STR]

Stormwater or wastewater effluent (including failing septic systems), landfills.	
Fertilizers applied to lawns, ag lands, or other areas in the CA.	
Livestock, dogs.	
Artificial drainage of upslope lands.	

If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not cumulatively expose the AA to significantly more nutrients, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Type of loading:	High density of unmaintained septic, some types of industrial sources.	Moderate density septic, cropland, secondary wastewater treatment plant.	Livestock, pets, low density residential.	0
Frequency & duration of input:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	0
AA proximity to main sources (actual or potential):	0 - 15 m.	15-100 m. or in groundwater.	In more distant part of contributing area.	0
			Sum=	0
			Stressor subscore=	0.00

S4

Excessive Sediment Loading *from Contributing Area*

In the last column, place a check mark next to any item present in the CA that is likely to have elevated the load of waterborne or windborne sediment reaching the wetland from its CA. [FA, FR, INV, PH, SRv, STR]

Erosion from plowed fields, fill, timber harvest, dirt roads, vegetation clearing, fires.	1
Erosion from construction, in-channel machinery in the CA.	
Erosion from off-road vehicles in the CA.	1
Erosion from livestock or foot traffic in the CA.	
Stormwater or wastewater effluent.	
Sediment from road sanding, gravel mining, other mining, oil/ gas extraction.	
Accelerated channel downcutting or headcutting of tributaries due to altered land use.	
Other human-related disturbances within the CA.	1

If any items were checked above, then for each row of the table below, assign points (3, 2, or 1 as shown in header) in the last column. However, if you believe the checked items did not cumulatively add significantly more sediment or suspended solids to the AA, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.

	Severe (3 points)	Medium (2 points)	Mild (1 point)	
Erosion in CA:	Extensive evidence, high intensity.*	Potentially (based on high-intensity* land use) or scattered evidence.	Potentially (based on low-intensity* land use) with little or no direct evidence.	1
Recentness of significant soil disturbance in the CA:	Current & ongoing.	1-12 months ago.	>1 yr ago.	1
Duration of sediment inputs to the wetland:	Frequent and year-round.	Frequent but mostly seasonal.	Infrequent & during high runoff events mainly.	1
AA proximity to actual or potential sources:	0 - 15 m.	15-100 m.	In more distant part of contributing area.	1
* high-intensity= extensive off-road vehicle use, plowing, grading, excavation, erosion with or without veg removal; low-intensity= veg removal only with little or no apparent erosion or disturbance of soil or sediment.			Sum=	4
			Stressor subscore=	0.33

S5	**Soil or Sediment Alteration *Within the Assessment Area***				
	In the last column, place a check mark next to any item present in the wetland that is likely to have compacted, eroded, or otherwise altered the wetland's soil. Consider only items occurring within past 100 years or since wetland was created or restored (whichever is less). [CS, INV, NR, PH, SR, STR]				
	Compaction from machinery, off-road vehicles, livestock, or mountain bikes, especially during wetter periods.				
	Leveling or other grading not to the natural contour.				
	Tillage, plowing (but excluding disking for enhancement of native plants).				
	Fill or riprap, excluding small amounts of upland soils containing organic amendments (compost, etc.) or small amounts of topsoil imported from another wetland.				
	Excavation.				
	Ditch cleaning or dredging in or adjacent to the wetland.				
	Boat traffic in or adjacent to the wetland and sufficient to cause shore erosion or stir bottom sediments.				
	Artificial water level or flow manipulations sufficient to cause erosion or stir bottom sediments.				
	If any items were checked above, then for each row of the table below, assign points. However, if you believe the checked items did not measurably alter the soil structure and/or topography, then leave the "0's" for the scores in the following rows. To estimate effects, contrast the current condition with the condition if the checked items never occurred or were no longer present.				
		Severe (3 points)	Medium (2 points)	Mild (1 point)	
	Spatial extent of altered soil:	>95% of wetland or >95% of its upland edge (if any).	5-95% of wetland or 5-95% of its upland edge (if any).	<5% of wetland and <5% of its upland edge (if any).	0
	Recentness of significant soil alteration in wetland:	Current & ongoing.	1-12 months ago.	>1 yr ago.	0
	Duration:	Long-lasting, minimal veg recovery.	Long-lasting but mostly revegetated.	Short-term, revegetated, not intense.	0
	Timing of soil alteration:	Frequent and year-round.	Frequent but mostly seasonal.	Mainly during one-time or scattered events.	0
				Sum=	0
				Stressor subscore=	0.00

Assessment Area (AA) Results:

Wetland ID: Ruth Falls WL19

Date: July 5, 2022

Observer: Darcy Kavanagh & Angus Doane

Latitude & Longitude (decimal degrees): 44.957041° & -62.502964°

Scores will appear below after data are entered in worksheets OF, F, and S. See Manual for definitions and descriptions of how scores were computed.

Wetland Functions or Other Attributes:	Function Score (Normalised)	Function Rating	Benefits Score (Normalised)	Benefits Rating	Function Score (raw)	Benefits Score (raw)
Water Storage & Delay (WS)	8.62	Higher	7.86	Higher	8.38	3.48
Stream Flow Support (SFS)	0.00	Lower	0.00	Lower	0.00	0.00
Water Cooling (WC)	0.00	Lower	0.00	Lower	0.00	0.00
Sediment Retention & Stabilisation (SR)	5.73	Moderate	2.04	Moderate	6.67	1.00
Phosphorus Retention (PR)	3.04	Moderate	1.50	Moderate	5.65	1.17
Nitrate Removal & Retention (NR)	10.00	Higher	5.00	Moderate	10.00	5.00
Carbon Sequestration (CS)	6.47	Higher			8.26	
Organic Nutrient Export (OE)	7.44	Moderate			4.87	
Anadromous Fish Habitat (FA)	0.00	Lower	0.00	Lower	0.00	0.00
Resident Fish Habitat (FR)	0.00	Lower	0.00	Lower	0.00	0.00
Aquatic Invertebrate Habitat (INV)	6.20	Higher	0.74	Lower	6.02	1.64
Amphibian & Turtle Habitat (AM)	2.27	Lower	4.15	Moderate	4.31	5.18
Waterbird Feeding Habitat (WBF)	0.00	Lower	0.00	Lower	0.00	0.00
Waterbird Nesting Habitat (WBN)	0.00	Lower	0.00	Lower	0.00	0.00
Songbird, Raptor, & Mammal Habitat (SBM)	6.36	Moderate	10.00	Higher	5.54	10.00
Pollinator Habitat (POL)	6.27	Moderate	6.67	Moderate	5.20	6.67
Native Plant Habitat (PH)	6.07	Moderate	5.80	Moderate	6.32	5.80
Public Use & Recognition (PU)			2.69	Moderate		2.14
Wetland Sensitivity (Sens)			8.38	Higher		4.56
Wetland Ecological Condition (EC)			6.52	Higher		8.33
Wetland Stressors (STR) (higher score means more stress)			7.91	Higher		3.98
Summary Ratings for Grouped Functions:						
HYDROLOGIC Group (WS)	8.62	Higher	7.86	Higher	8.38	3.48
WATER QUALITY SUPPORT Group (max+avg/2 of SR, PR, NR, CS)	8.15	Higher	3.92	Moderate	8.82	3.69
AQUATIC SUPPORT Group (max+avg/2 of SFS, INV, OE, WC)	5.43	Moderate	0.49	Lower	4.37	1.09
AQUATIC HABITAT Group (max+avg/2 of FA, FR, AM, WBF, WBN)	1.36	Lower	2.49	Moderate	2.59	3.11
TRANSITION HABITAT Group (max+avg/2 of SBM, PH, POL)	6.30	Moderate	8.74	Higher	6.01	8.74
WETLAND CONDITION (EC)			6.52	Higher		8.33
WETLAND RISK (average of Sensitivity & Stressors)			8.14	Higher		4.27

NOTE: A score of 0 does not mean the function or benefit is absent from the wetland. It means only that this wetland has a capacity that is equal or less than the lowest-scoring one, for that function or benefit, from among all the NS calibration wetlands that were assessed previously.

Function-Benefit Product (FBP)	FBP SCORE	FBP SCORE CATEGORY
SUPPORT SUPERGROUP - HYDROLOGIC	67.73492558	High
SUPPORT SUPERGROUP - WATER QUALITY SUPPORT	31.9930733	Low
SUPPORT SUPERGROUP - AQUATIC SUPPORT	2.671992164	Low
HABITAT SUPERGROUP - AQUATIC HABITAT	3.390130046	Low
HABITAT SUPERGROUP - TRANSITION HABITAT	55.07618538	Low

Habitat Rule Satisfied?	NO
Support Rule Satisfied?	NO
Habitat/Support Hybrid Rule Satisfied?	NO
CONCLUSION:	**Site is not a WSS**

ATTACHMENT C
WETLAND MONITORING DATA

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

Table 1A. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 3

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	2	35	
Soil Type			
Depleted Below Dark Surface (A11)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Eriophorum virginicum*	Tawny Cotton-Grass		30	
	Glyceria striata	Fowl Manna Grass	20		
	Carex spp.	Carex	50		
	Rhynchospora spp.	Beaksedge		25	
	Sarracenia purpurea	Pitcher Plant	10	10	
	Drosera rotundifolia	Round-leaved Sundew	15	15	
	Vaccinium oxycoccus	Bog Cranberry	10	20	
	Carex stipata	Awlfruit Sedge		30	
Shrubs	*Alnus incana*	Grey Alder		5	
	Spiraea alba	Meadowsweet	10		
	Chamaedaphne calyculata	Leatherleaf	40	40	
	Ilex mucronata	Mountain Holly	5	5	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Sarracenia purpurea	Pitcher Plant	15	25	
Osmunda cinnamomea	Cinnamon Fern	30	30	
Drosera rotundifolia	Round-leaved Sundew	15	15	
Carex spp.	Carex	40		
Maianthemum canadense	False Lily of the Valley	40		
Vaccinium oxycoccus	Bog Cranberry	10	25	
Eriophorum virginicum	Tawny Cotton-Grass		30	
Solidago spp.	Goldenrod		10	
Oclemena nemoralis	Bog Aster		10	
Calamagrostis canadensis	Blue Joint		15	
Carex magellanica	Boreal Bog Sedge		10	
Smilacina trifolia	Three-leaved false Solomon's seal		30	
Chamaedaphne calyculata	Leatherleaf	30	30	
Myrica gale	Sweetgale	15	15	
Ledum groenlandicum	Labrador tea	15	15	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Osmunda cinnamomea*	Cinnamon Fern	25	25	
	Sarracenia purpurea	Pitcher Plant	10		
	Maianthemum canadense	False Lily of the Valley	40		
	Vaccinium oxycoccus	Bog Cranberry	15	15	
	Carex stipata	Awlfruit Sedge		25	
	Oclemena nemoralis	Bog Aster		15	
	Drosera rotundifolia	Round-leaved Sundew		15	
	Vaccinium oxycoccus	Bog Cranberry		15	
	Smilacina trifolia	Three-leaved false Solomon's seal	10	30	
	Carex spp.	Carex	40		
	Eriophorum virginicum	Tawny Cotton-Grass		25	
Shrubs	*Myrica gale*	Sweetgale	30		
	Chamaedaphne calyculata	Leatherleaf	35		
	Kalmia angustifolia	Lambkill	25		
	Ilex mucronata	Mountain Holly		15	
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Sarracenia purpurea	Pitcher Plant	10	20	
Drosera rotundifolia	Round-leaved Sundew	15	15	
Carex spp.	Carex	20		
Maianthemum canadense	False Lily of the Valley	20		
Eriophorum virginicum	Tawny Cotton-Grass		15	
Smilacina trifolia	Three-leaved false Solomon's seal		30	
Rhynchospora spp.	Beaksedge		15	
Vaccinium oxycoccus	Bog Cranberry	10	20	
Platanthera psycodes	Lesser Purple Fringed Orchid	5		
Ledum groenlandicum	Labrador tea	15	25	
Chamaedaphne calyculata	Leatherleaf	25	30	
Kalmia angustifolia	Lambkill	15	15	
Ilex mucronata	Mountain Holly	5	10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1B. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 5

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	N	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	Y	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	4	27	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)

Monitoring Date	Baseline (July 2022)	Baseline (September 2022)	
Preceeding 5 Day Precipitation* (mm)	2	2	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Coptis trifolia*	Goldthread	30	40	
	Cornus canadensis	Bunchberry	10	15	
	Vaccinium angustifolium	Lowbush Blueberry	5		
	Carex trisperma	Three seeded sedge	25		
	Vaccinium oxycoccus	Bog Cranberry	40	40	
	Carex spp.	Carex	30		
	Oclemena nemoralis	Bog Aster	5		
	Ajuga reptans	Bugleweed		15	
	Carex trisperma	Three seeded sedge		40	
	Linnaea borealis	Twinflower		15	
Shrubs					
Trees	*Abies balsamea*	Balsam Fir	15	25	

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Coptis trifolia	Goldthread	10	20	
Cornus canadensis	Bunchberry	10	20	
Sarracenia purpurea	Pitcher Plant	15	25	
Oclemena nemoralis	Bog Aster	5	20	
Iris versicolor	Norther Blue Flag	5	5	
Linnaea borealis	Twinflower	10	25	
Carex spp.	Carex	30		
Carex trisperma	Three seeded sedge		40	
Ilex mucronata	Mountain Holly	10	15	
Myrica gale	Sweetgale	30	30	
Spiraea alba	White Meadowsweet	10	15	
Acer rubrum	Red Maple	5	5	

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Calamagrostis canadensis*	Blue Joint	10	40	
	Solidago rugosa	Rough Goldenrod	5		
	Rubus pubescens	Dwarf Red Blackberry	20		
	Vaccinium oxycoccus	Bog Cranberry	15	40	
	Oclemena nemoralis	Bog Aster		15	
	Rubus hispidus	Swamp Dewberry			
Shrubs	*Viburnum nudum*	Wild Raisin		30	
	Spiraea tomentosa	Steeplebush		15	
	Chamaedaphne calyculata	Leatherleaf	20	25	
Trees	*Picea rubens*	Red Spruce	5		

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex grayi	Gray's Sedge	10		
Chamaedaphne calyculata	Leatherleaf	50		
Sarracenia purpurea	Pitcher Plant	10	10	
Solidago rugosa	Rough Goldenrod	5		
Drosera rotundifolia	Round-leaved Sundew	2	10	
Oclemena nemoralis	Bog Aster		25	
Carex trisperma	Three seeded sedge	20	35	
Myrica gale	Sweetgale	5		
Chamaedaphne calyculata	Leatherleaf		75	
Iris versicolor	Norther Blue Flag		20	
Ledum groenlandicum	Labrador tea		10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1C. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 6

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	3	0	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Smilacina trifolia*	Three-leaved false Solomon's seal	30	25	
	Carex spp.	Carex	15		
	Grass spp.	Grass	20		
	Calla spp.	Calla	10	15	
	Dulichium arundinaceum	Three-way Sedge		25	
	Sarracenia purpurea	Pitcher Plant		5	
	Carex trisperma	Three seeded sedge		20	
	Carex magellanica ssp. irrigua	Boreal Bog Sedge		15	
	Vaccinium oxycoccus	Bog Cranberry		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	35	35	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Symphyotrichum puniceum	Swamp Aster	30		
Calamagrostis canadensis	Blue Joint	25	25	
Sarracenia purpurea	Pitcher Plant	10	20	
Carex spp.	Carex	15		
Grass spp.	Grass	20		
Drosera rotundifolia	Round-leaved Sundew		10	
Thelypteris palustris	Marsh Fern	25	30	
Oclemena nemoralis	Bog Aster		30	
Eriophorum virginicum	Tawny Cotton-Grass		20	
Rhynchospora spp.	Beaksedge		20	
Dulichium arundinaceum	Three-way Sedge		35	
Alnus incana	Grey Alder	25	25	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	40		
	Grass spp.	Grass	10		
	Drosera rotundifolia	Round-leaved Sundew	5		
	Vaccinium oxycoccus	Bog Cranberry	15	15	
	Rhynchospora spp.	Beaksedge		40	
	Dulichium arundinaceum	Three-way Sedge		15	
	Sarracenia purpurea	Pitcher Plant		15	
	Carex trisperma	Three seeded sedge		30	
	Carex sparganioides	Bur Reed Sedge		10	
	Eriophorum virginicum	Tawny Cotton-Grass		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	30	30	
	Ledum groenlandicum	Labrador tea	10	10	
	Ilex mucronata	Mountain Holly		10	
	Myrica gale	Sweetgale	10		
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Osmunda cinnamomea	Cinnamon Fern	5	20	
Drosera rotundifolia	Round-leaved Sundew	5	15	
Smilacina trifolia	Three-leaved false Solomon's seal	10		
Vaccinium oxycoccus	Bog Cranberry	5		
Carex spp.	Carex	60		
Rhynchospora spp.	Beaksedge		60	
Eriophorum virginicum	Tawny Cotton-Grass		35	
Dulichium arundinaceum	Three-way Sedge		15	
Sarracenia purpurea	Pitcher Plant		15	
Calamagrostis canadensis	Blue Joint		10	
Ledum groenlandicum	Labrador tea	10	20	
Chamaedaphne calyculata	Leatherleaf	30	20	
Kalmia angustifolia	Lambkill		10	
Picea mariana	Black Spruce	5	10	None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1D. Ruth Falls Reservoir - Wetland Monitoring Results *Project # 21-7960*

Wetland 15

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	Y	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	2	6	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	20		
	Oclemena nemoralis	Bog Aster	5	10	
	Dulichium arundinaceum	Three-way Sedge		40	
	Drosera rotundifolia	Round-leaved Sundew		10	
	Vaccinium oxycoccus	Bog Cranberry		10	
	Carex trisperma	Three seeded sedge		20	
Shrubs	*Myrica gale*	Sweetgale	60	25	
	Chamaedaphne calyculata	Leatherleaf		60	
	Viburnum nudum	Wild Raisin		25	
Trees	*Viburnum nudum*	Wild Raisin		25	

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex trisperma	Three seeded sedge	50		
Vaccinium oxycoccus	Bog Cranberry	10		
Osmunda cinnamomea	Cinnamon Fern	15	25	
Eriophorum virginicum	Tawny Cotton-Grass		15	
Drosera rotundifolia	Round-leaved Sundew		10	
Myrica gale	Sweetgale	30	40	
Chamaedaphne calyculata	Leatherleaf	5	25	
Ledum groenlandicum	Labrador tea		20	
Ilex mucronata	Mountain Holly		5	
Picea mariana	Black Spruce	10	10	
Acer rubrum	Red Maple	20		

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Cornus canadensis*	Bunchberry	5	25	
	Carex trisperma	Three seeded sedge	10		
	Vaccinium oxycoccus	Bog Cranberry	5	15	
	Carex trisperma	Three seeded sedge		20	
	Osmunda cinnamomea	Cinnamon Fern	15	20	
	Eriophorum virginicum	Tawny Cotton-Grass		20	
Shrubs	*Ledum groenlandicum*	Labrador tea	5	20	
	Myrica gale	Sweetgale	60	40	
	Chamaedaphne calyculata	Leatherleaf		25	
	Ilex mucronata	Mountain Holly		5	
Trees	*Picea mariana*	Black Spruce	25	30	

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Thelypteris palustris	Marsh Fern	15		
Carex trisperma	Three seeded sedge	15	20	
Calamagrostis canadensis	Blue Joint		15	
Oclemena nemoralis	Bog Aster	5	5	
Osmunda cinnamomea	Cinnamon Fern		20	
Cornus canadensis	Bunchberry	10	20	
Vaccinium oxycoccus	Bog Cranberry		20	
Myrica gale	Sweetgale	50	50	
Acer rubrum	Red Maple	40	20	
Picea mariana	Black Spruce		5	
Ledum groenlandicum	Labrador tea	5	10	
Chamaedaphne calyculata	Leatherleaf		20	
Ilex mucronata	Mountain Holly	5		
Ilex mucronata	Mountain Holly		10	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1E. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 17

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	N	N	
Drainage patterns	N	Y	
Water marks	N	N	
Depth to Water (cm)	5	10	
Soil Type			
Histosol (A1)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)

Monitoring Date	Baseline (July 2022)	Baseline (September 2022)	Notes
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex lupulina*	Hop Sedge	60	60	
	Drosera rotundifolia	Round-leaved Sundew	15	25	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	30	40	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex lupulina	Hop Sedge	60	75	
Zantedeschia aethiopica	Calla Lily	10		
Drosera rotundifolia	Round-leaved Sundew	10	15	
Chamaedaphne calyculata	Leatherleaf	20	30	
Alnus incana	Grey Alder	20	20	
Picea mariana	Black Spruce	30	30	
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex lupulina*	Hop Sedge	60	60	
	Zantedeschia aethiopica	Calla Lily	10		
	Drosera rotundifolia	Round-leaved Sundew	15	15	
	Vaccinium oxycoccus	Bog Cranberry	10	20	
	Carex oligosperma	Few-seeded Sedge		15	
Shrubs	*Chamaedaphne calyculata*	Leatherleaf	25	25	
	Picea mariana	Black Spruce	15	25	
Trees					None noted

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex lupulina	Hop Sedge	40	40	
Zantedeschia aethiopica	Calla Lily	5		
Drosera rotundifolia	Round-leaved Sundew	15		
Grass spp.	Grass	15		
Carex sparganioides	Bur Reed Sedge		25	
Carex oligosperma	Few-seeded Sedge		15	
Chamaedaphne calyculata	Leatherleaf	20	35	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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Table 1F. Ruth Falls Reservoir - Wetland Monitoring Results

Project # 21-7960

Wetland 19

HYDROLOGICAL INDICATORS	Baseline (July 2022) Y/N	Baseline (September 2022) Y/N	Notes
Surface water	N	Y	
Surface saturation	Y	Y	
Dry season water table (<30cm)	N	N	
Water stained leaves	Y	N	
Drainage patterns	N	Y	
Water marks	N	N	
Monitoring Well			
Depth to Water (cm)	9	3	September Note: Well cracked off.
Soil Type			
Histosol (A1), Depleted Below Dark Surface (A11)			

HYDROLOGICAL OBSERVATIONS (POST ALTERATION)			
Monitoring Date	**Baseline (July 2022)**	**Baseline (September 2022)**	**Notes**
Preceeding 5 Day Precipitation* (mm)	2	0	
Preceeding 24 hr Precipitation* (mm)	0	0	

VEGETATION PLOT 1

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Carex spp.*	Carex	30	15	
	Eriophorum virginicum	Tawny Cotton-Grass		25	
	Carex trisperma	Three seeded sedge			
Shrubs	*Ledum groenlandicum*	Labrador tea	40	60	
	Myrica gale	Sweetgale	60	40	
	Chamaedaphne calyculata	Leatherleaf	25	25	
Trees					None noted

VEGETATION PLOT 2

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Vaccinium oxycoccus	Bog Cranberry	15	25	
Carex spp.	Carex	15		
Calla spp.	Calla	15		
Drosera rotundifolia	Round-leaved Sundew	15		
Eriophorum virginicum	Tawny Cotton-Grass		15	
Myrica gale	Sweetgale	20	60	
Chamaedaphne calyculata	Leatherleaf	40	15	
Larix laricina	Tamarack	25		
				None noted

VEGETATION PLOT 3

Stratum	Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Herbs	*Oclemena nemoralis*	Bog Aster	15	25	
	Vaccinium angustifolium	Lowbush Blueberry	5		
	Calla spp.	Calla	15		
	Carex spp.	Carex	25		
	Osmunda cinnamomea	Cinnamon Fern		10	
	Eriophorum virginicum	Tawny Cotton-Grass		15	
Shrubs	*Ledum groenlandicum*	Labrador tea	10	10	
	Myrica gale	Sweetgale	80	60	
	Picea mariana	Black Spruce	25	20	
	Vaccinium angustifolium	Lowbush Blueberry		15	
	Ilex mucronata	Mountain Holly	10		
Trees	*Picea mariana*	Black Spruce	25	25	

VEGETATION PLOT 4

Scientific Name	Common Name	Baseline (July 2022) %	Baseline (September 2022) %	Notes
Carex spp.	Carex	25		
Calla spp.	Calla	15		
Oclemena nemoralis	Bog Aster	10	40	
Carex diandra	Lesser Tussock-Sedge		25	
Rhododendron canadense	Rhodora	25	25	
Myrica gale	Sweetgale	30	30	
Chamaedaphne calyculata	Leatherleaf	25		
Picea mariana	Black Spruce	40	40	
				None noted

*Data obtained from nearest weather station, located in Sheet Harbour, NS

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ATTACHMENT D
FISH HABITAT ASSESSMENT DATA

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 3		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	11:00	13:00
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	23
Water Temperature (degC)	23.5	22.0
pH	5.10	5.40
Conductivity (mS/m)	0.04	0.005
TDS (mg/L)	20	20
DO (%)	85	80.6
DO (mg/L)	7.6	7.75
Average Depth (m)	0.6	0.30
Hydroperiod (Flooded (semi) Permanently?)	Permanently flooded	Permanently flooded
Connectivity to Lake	Inflow	Inflow
Deep Open Water Present Nearby?	Yes	Shallow Open Water
Macrophyte (% cover)	Med (10-50%)	Med (10-50%)
Substrate(s)	Muck	Rubble
Turbidity (or other water characteristisc)	Slightly Cloudy	Slightly Cloudy
Vegetation/Debris Cover/Shade	Trace	None
Probability of Fish Presence	Med	Med
Notes	Plenty of submerged logs and rocks. Lots of macrophytic veg. Mucky substrate, plenty of brownish detritus.	Macrophytes and woody debris provide decent cover for fish, though water is warm. Edge of Lake. Silt on rocks. Excess woody debris.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 5		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	13:15	12:23
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	26	22
Water Temperature (degC)	21	15.5
pH	4.93	5.09
Conductivity (mS/m)	0.09	0.04
TDS (mg/L)	30	40
DO (%)	93.9	80.6
DO (mg/L)	9.05	7.05
Average Depth (m)	0.5	0.10
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Inflow	Throughflow
Deep Open Water Present Nearby?	Shallow Open Water	Shallow Open Water
Macrophyte (% cover)	Low (<10%)	Low(<10%)
Substrate(s)	Muck:25%, Gravel:50%, Rubble:25%	Gravel and Rubble
Turbidity (or other water characteristisc)	Slightly Cloudy	Clear
Vegetation/Debris Cover/Shade	Trace	Abundant
Probability of Fish Presence	High	Med
Notes	Small stream/trickle inflow at southeast end of WL (appears to be spring fed). Fish seen off weltand edge. No signs of fish habitat upstream/upland. Extensive cover/shade near inflow, primarily open/unshaded elsewhere.	No flow in stream, though area is well shaded with clear water.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 6		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	15:30	11:30
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	20
Water Temperature (degC)	28	21.3
pH	4.89	5.26
Conductivity (mS/m)	0.05	0.07
TDS (mg/L)	30	30
DO (%)	77	23.1
DO (mg/L)	5.7	2.19
Average Depth (m)	0.5	0.2
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Semi-permanently Flooded
Connectivity to Lake	Inflow	Outflow
Deep Open Water Present Nearby?	Shallow Open Water	No
Macrophyte (% cover)	Low (<10%)	Low(<10%)
Substrate(s)	Muck and Rubble	Muck and Gravel
Turbidity (or other water characteristisc)	Slightly Cloudy	Cloudy
Vegetation/Debris Cover/Shade	None	None
Probability of Fish Presence	High	Low
Notes	Juvenile American Eels spotted durring delineation. Very little shadded water, some areas "in-land" that could be accessible to fish seasonally.	High amount of metals suspended on water surface. Area appears to be poor habitat if at all. Water is stagnant.

Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 15		
	4-Jul-22	**6-Sep-22**
Weather	Sun	Sun/Cloud
Time	12:15	11:00
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	24	20
Water Temperature (degC)	22.8	20.9
pH	5.4	6.12
Conductivity (mS/m)	0.21	0.05
TDS (mg/L)	30	160
DO (%)	93	93.7
DO (mg/L)	7.51	8.43
Average Depth (m)	0.5	
Hydroperiod (Flooded (semi) Permanently?)	Semi-permanently Flooded	Permanently Flooded
Connectivity to Lake	Inflow	Throughflow
Deep Open Water Present Nearby?	Shallow Open Water	Shallow Open Water
Macrophyte (% cover)	Med(10-50%)	Low(<10%)
Substrate(s)	Muck	Rubble
Turbidity (or other water characteristisc)	Clear	Slightly Cloudy
Vegetation/Debris Cover/Shade	None	Trace
Probability of Fish Presence	High	Med
Notes	Dead trees/snags in water.	Lake edge near outflow of watland. Some lily pads present. Woody debris.

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Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 17		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	9:36	10:41
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	20	19
Water Temperature (degC)	21.7	20.3
pH	5.45	7.39
Conductivity (mS/m)	0.05	0.72
TDS (mg/L)	20	40
DO (%)	97.2	80.7
DO (mg/L)	9.03	7.27
Average Depth (m)	0.5	0.5
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Thoughflow	Throughflow
Deep Open Water Present Nearby?	Yes	Shallow Open Water
Macrophyte (% cover)	High(>50%)	Med(10-50%)
Substrate(s)	Muck	Gravel and Silt
Turbidity (or other water characteristisc)	Slightly Cloudy	Slightly Cloudy
Vegetation/Debris Cover/Shade	Trace	None
Probability of Fish Presence	High	Med
Notes	Entire island is wetland. Lily pads all around the perimeter. "Sheltered" coves along island edge. Seems like great fish nursery area.	Lake Edge.

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Wetland Fish Habitat Monitoring Results *Project # 21-7960*

WETLAND 19		
	5-Jul-22	**6-Sep-22**
Weather	Sun	Overcast
Time	12:15	13:45
Locations Surveyed (OL, LS, BS)	All	All
Air Temperature (degC)	26	22
Water Temperature (degC)	25.5	23.5
pH	5.36	5.67
Conductivity (mS/m)	0.04	0.04
TDS (mg/L)	20	30
DO (%)	103.0	105.8
DO (mg/L)	8.42	8.76
Average Depth (m)	0.5	0.40
Hydroperiod (Flooded (semi) Permanently?)	Permanently Flooded	Permanently Flooded
Connectivity to Lake	Throughflow	Lake Edge
Deep Open Water Present Nearby?	Shallow Open Water	Yes 5m
Macrophyte (% cover)	Low(<10%)	Low(<10%)
Substrate(s)	Gravel	Gravel and Rubble
Turbidity (or other water characteristisc)	Clear	Clear
Vegetation/Debris Cover/Shade	Moderate	Trace on NW side
Probability of Fish Presence	High	High
Notes	Fish observed at lake side pt. Wetland is a peninsula, open water side has excellent habitat. Cove side has mostly muck substrate with some debris/emergent veg.	

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APPENDIX F – Hydraulic Modeling Report



Ruth Falls Dam Refurbishment

3D Modelling and Fish Passage Assessment

Nova Scotia POWER
An Emera Company

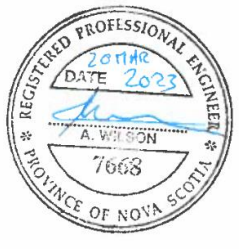
FINAL REPORT ver.2

CBCL

Project 221107.00 • 20th March 2023

2	FINAL REPORT ver.2	A Wilson / M Browne	20-Mar-2023	Y Zhang / C Jardine
1	FINAL REPORT	A Wilson / M Browne	13-Mar-2023	Y Zhang / C Jardine
0	DRAFT REPORT	A Wilson / M Browne	22-Feb-2023	Y Zhang / C Jardine
Rev.	Issue	Reviewed By:	Date	Issued By:

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Appendices

A FIGURE 1
B THAUMAS CONSULTANTS REPORT

1 HYDROTECHNICAL ASSESSMENT

1.1 Background

This report addresses the request made by Nova Scotia Power (NSP) by email on the 8th February, 2022, and following discussions. An excerpt is presented below to present the requested scope of work:

We have determined a need for 3D hydraulic modeling to be completed at the Ruth Falls dam for the purpose of assessing post-refurbishment downstream conditions. The main refurbishments include the installation of vertical lift gates in the center section of the dam which will replace the existing stop log bay. Another big change includes the installation of a new rubber dam. We are looking to know how changes in flow releases from the vertical lift gates (and rubber dam) could impact the downstream area – specifically the entrance conditions to the fish ladder.

The following information was discussed with NSP and was used to support the assessment:

- *Historic operation of the gates at the former structure*
- *Proposed operation of the gates at the proposed structure*
- *Flow measurements and discharge curves available at the gates*
- *Maintenance flow schedules during the year*
- *Fishway release flow schedules during the year*
- *Geometry of the proposed structure (IFC drawings)*
- *Bathymetry of the tailrace, from several site surveys*

1.2 Flow Assessment

Spill flow data was available from 2015 to 2022. The full timeseries of the spill flow data is presented below in Figure 1:

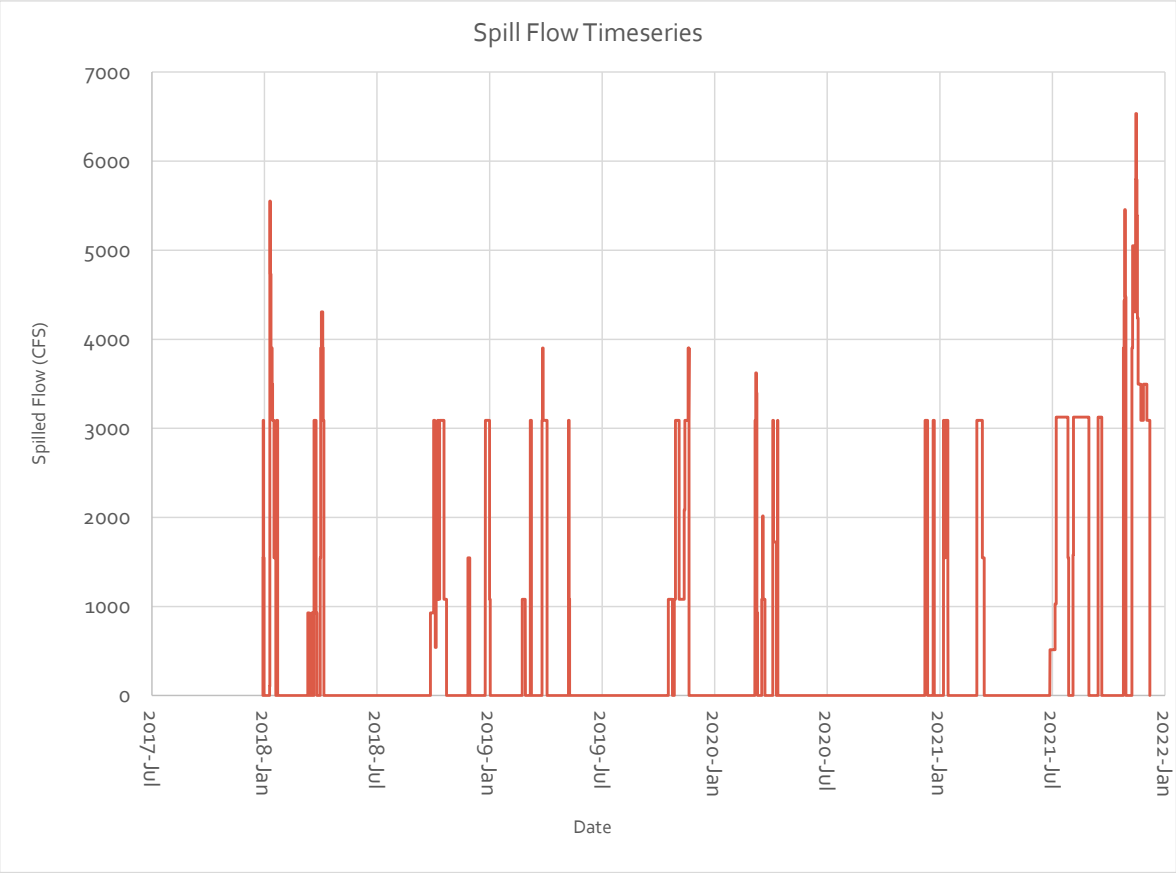


Figure 1: Spill flow Timeseries from 2015 to 2022 at the Ruth Falls Dam

As shown on the figure, spills are rather infrequent at this site. Spills increased in 2021 and 2022 due to construction activity at the dam, which has resulted in more frequent spills than would typically be seen at the site. Those years were therefore removed from the data to allow the assessment to be more representative of typical conditions. The results were also separated into seasonal time spans, to provide seasonal data that would be representative of fish migration windows. The following months were used to represent the various seasons:

Spring: May, June, July

Summer: August, September

Fall: October, November

Winter: December, January, February, March, April

Figure 2 shows the results of the flow duration curve analysis, presented as days during which the flows would be present during the various seasons.

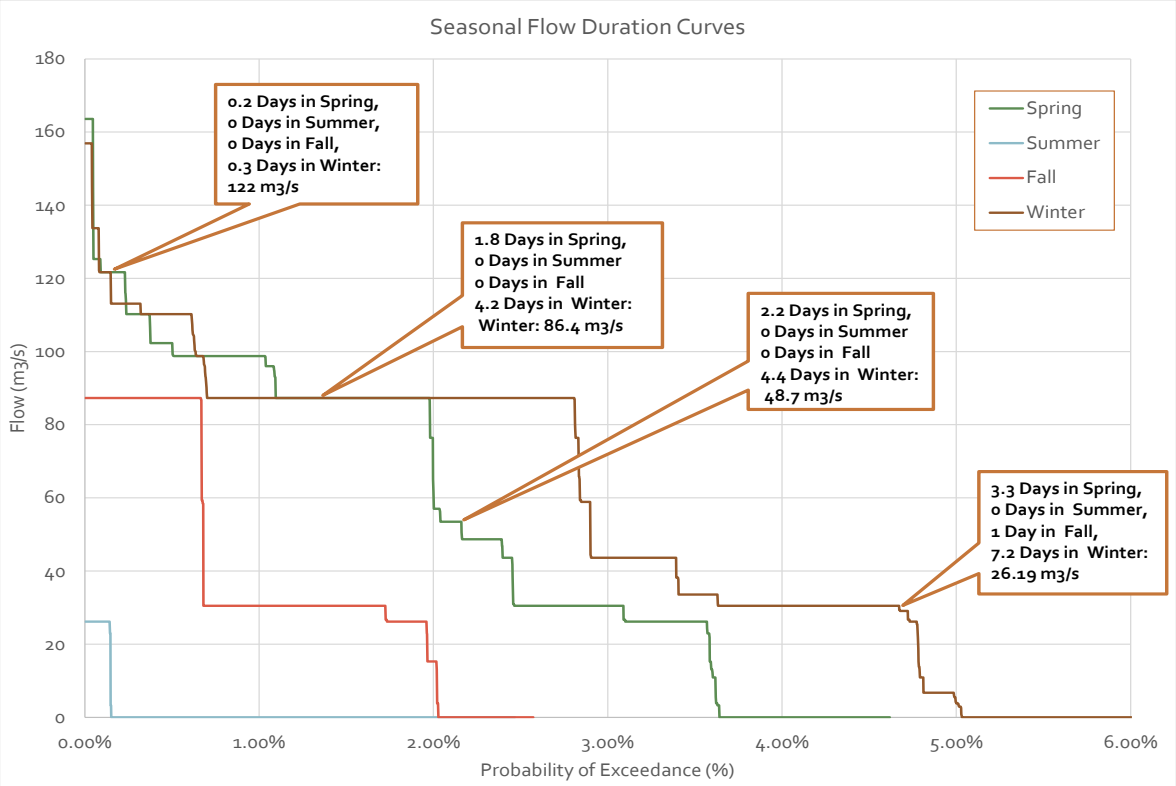


Figure 2: Seasonal Flow Duration Curves at Ruth Falls

Typically, the spills are released fairly evenly between the 3 gates, so the flow scenarios used in model include the 4 flows identified in Figure 2, all released evenly through the 3 gates.

The current structure has leakage through the stop logs, as well as through the existing gate frames. NSP measured the flows downstream of the dam, and obtained a value of 100.2 cfs. Part of this flow is from the fishway (6 cfs) and part of it is from the louvres pipe outflow (29 cfs), leaving 65 cfs as leakage through the structure. From the modelling results (see below) and the interpretation of those results for fish passage (see Thaumas Consultants report), the current flows are estimated to provide suitable conditions for fish passage in the natural river channel downstream of the dam. Higher flows produce higher velocities, especially at the rock sills, which leave no area of low velocity in the river for the passage of fish. Therefore, it was concluded that providing 65 cfs from the gates in the proposed conditions would result in the optimal conditions for fish passage.

Nevertheless, the attraction flows and existing weir configurations were not optimal for fish passage, so the weirs downstream of the fishway were re-configured in the model to improve both attraction flows and velocities for fish passage. The following steps were taken following the various model tests:

1. Existing weir configurations and louvres outflow configurations were modelled and resulted in poor attraction flows (see Figure 3)
2. The louvres outflow was moved to the last fishway to attempt to improve attraction flows towards the most downstream fish passage weir, which resulted in an improvement in attraction flows, but still no suitable passage through the weirs
3. The fish passage weirs were redesigned with the intent of providing approximately 20 cm drops, and a flow of 35 cfs, by also moving the louvres outflow beside the outlet of the fishway. The new weirs were sized to provide 23 cm drops at each pool, with a sufficient distance between the weir, and the last weir was rotated to point at 45 degrees downstream, the opening being on the south side of the weir. A rock diversion weir was also tested to evaluate its use in orienting the gate flows away from the weir attraction flows. The results of this are seen in Figure 4.
4. The same scenario was tested, but without the rock diversion just downstream of the gate (see Figure 5). It was found that with or without the rock diversion, flows from the gates would create back currents towards the last weir, disrupting the attraction flows.
5. The last weir was modified to have its notch on the north (dam) side, to join with the circulating flows from the gates. To achieve this, one weir had to be removed from the set, to maintain the alternating configuration of the notches. This is shown in Figure 6. The results show an improvement, but the strong currents circulating from the gate flows still disrupt the attraction flows.
6. The distribution of flows from the various gates was tested, to produce a more even guiding flow towards the fish passage weir, and minimize the current flowing back upstream. A range of distributions were tested, and the optimal configuration was achieved with a flow distribution of 20 cfs from the west gate, 40cfs from the centre gate, and 5 cfs from the east gate. The flow is highest from the centre gate because the centre gate ogee spillway is lower than the others. The velocity of the water is therefore much reduced, and the flow released enters the river at a lower elevation, where its energy is significantly more dissipated. It is noted that in practice, as the flows and velocity patterns at the gates and downstream may be slightly different than in the model, it is expected that some field verification and gate adjustment will be needed once the dam is completed, to obtain the desired fish passage goals. The gate settings may therefore be different than noted here, while still delivering a total of 65cfs. The results for this scenario are shown the figures S1-1 to S7-13.

For the last geometric configuration (point 5 above), results are shown below for a range of flow scenarios. These include the following:

- S1: 6 cfs from the fishway, 29 cfs from the louvres outfall, 65 cfs from the gates

- S2: 6 cfs from the fishway, 29 cfs from the louvres outfall, 165 cfs from the gates
- S3: 6 cfs from the fishway, 29 cfs from the louvres outfall, 925 cfs from the gates
- S4: 6 cfs from the fishway, 29 cfs from the louvres outfall, 1720 cfs from the gates
- S5: 6 cfs from the fishway, 29 cfs from the louvres outfall, 3051 cfs from the gates
- S6: 6 cfs from the fishway, 29 cfs from the louvres outfall, 4308 cfs from the gates
- S7: 6 cfs from the fishway, 29 cfs from the louvres outfall, 0 cfs from the gates

It is noted that the flow values in cfs for scenarios 3 to 7 correspond to the 4 spill flow values shown in Figure 2 above.

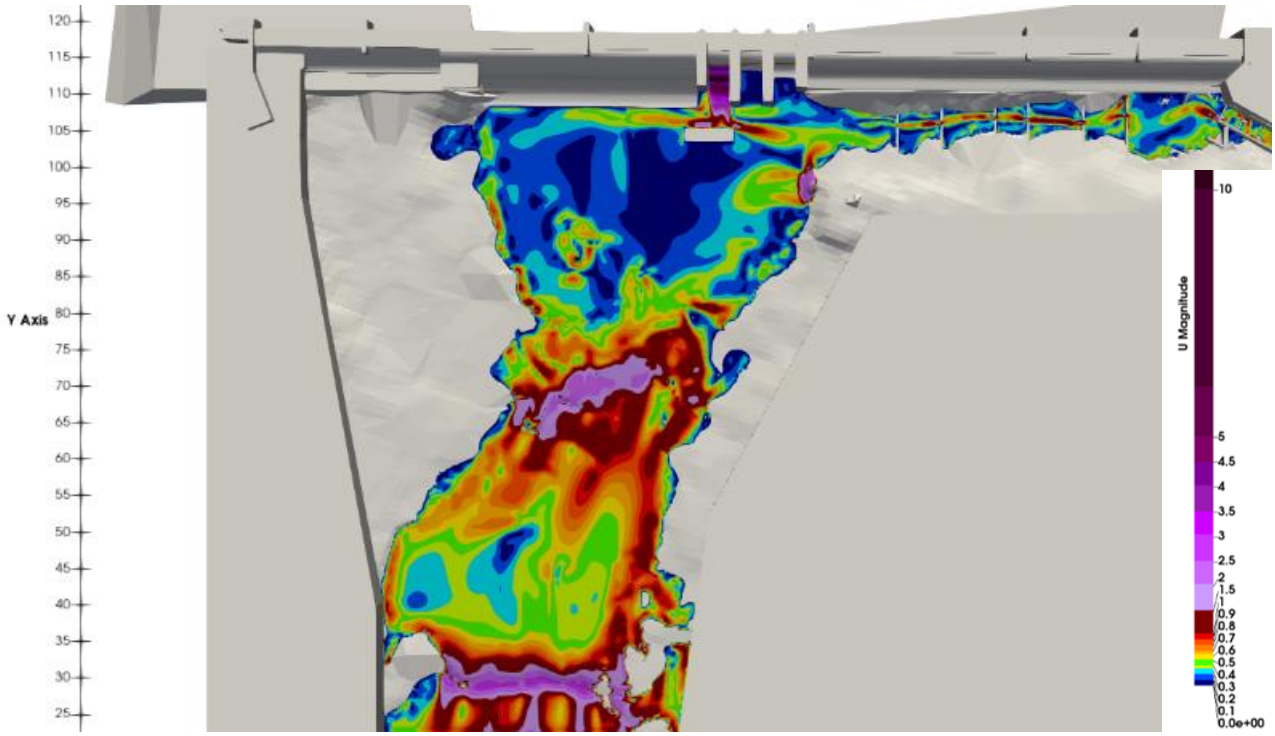


Figure 3: Existing Weir and louvres outflow configuration

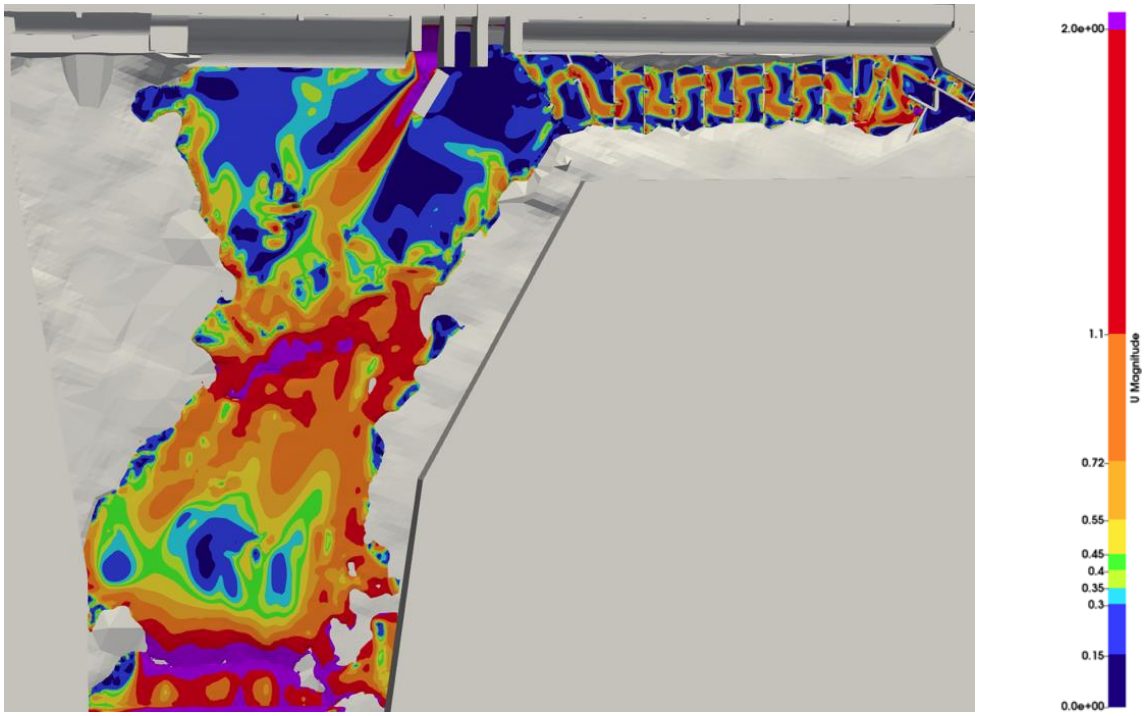


Figure 4: re-Designed Weir and louvres outflow configuration – with Rock Diversion

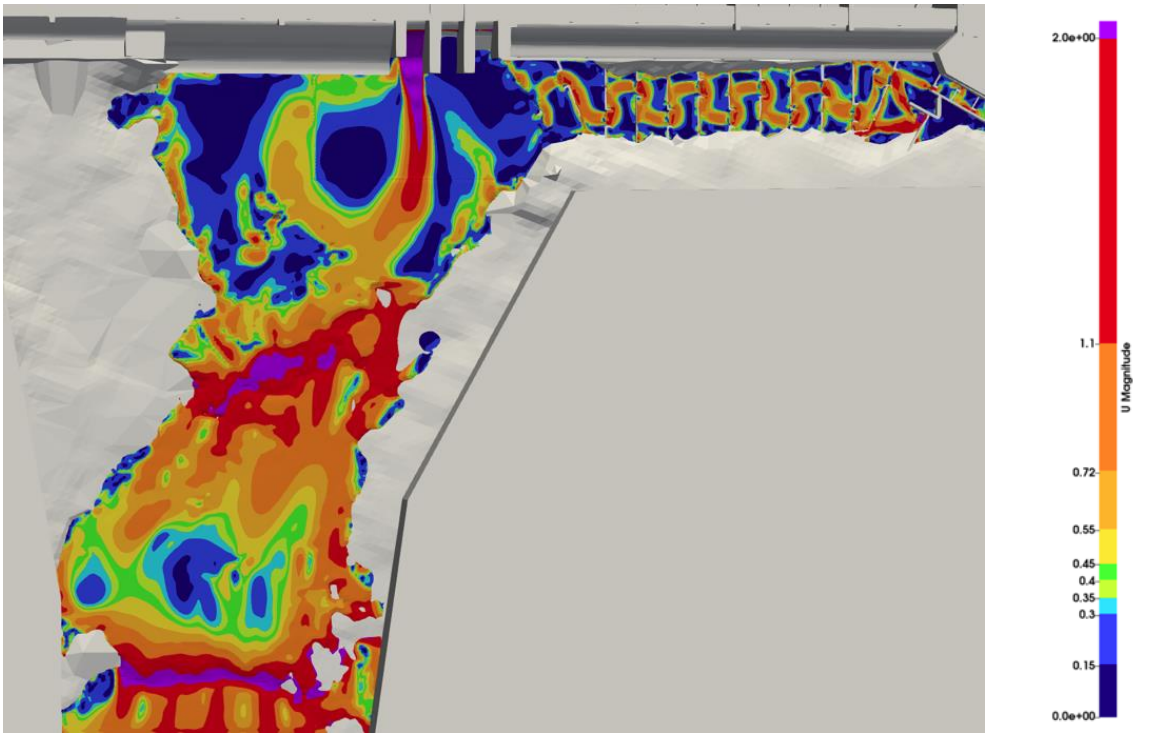


Figure 5: re-Designed Weir and louvres outflow configuration – No Rock Diversion

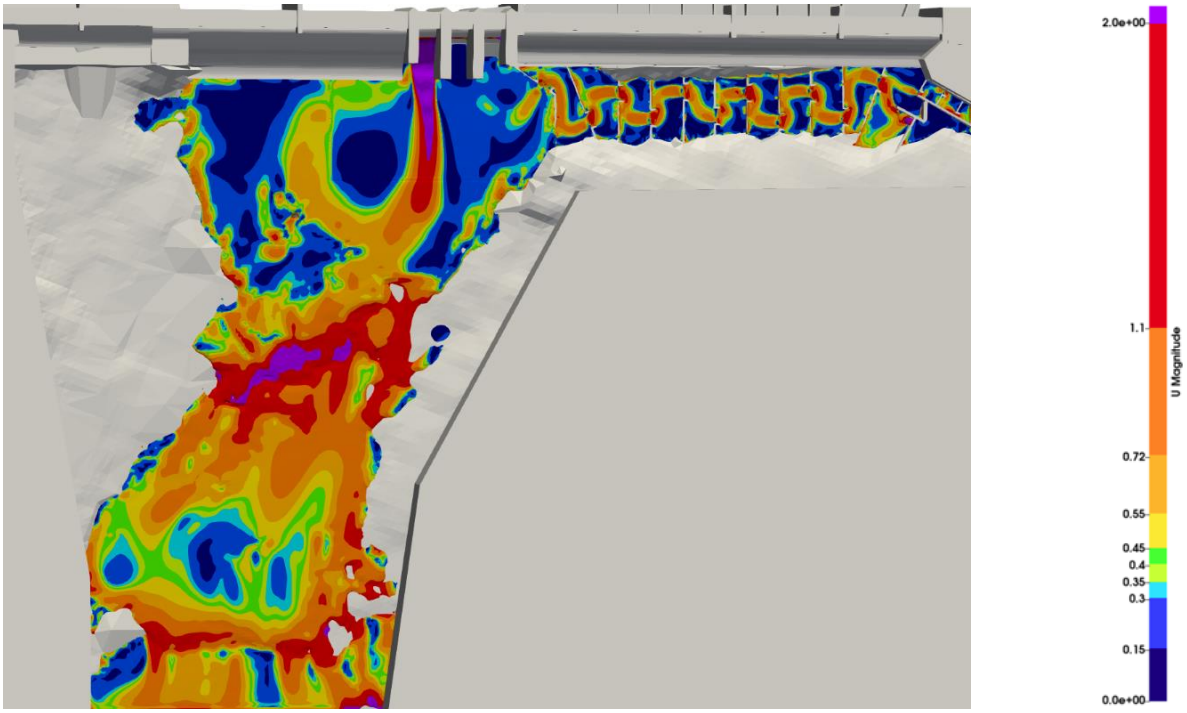


Figure 6: re-Designed Weir and louvres outflow configuration- last weir on Dam Side

1.3 3D CFD Modelling

Once the details of the geometry were fully available and completely understood, a geometric model of the proposed structure (fully constructed), together with the fishway and downstream channel was assembled in Civil3D. The extent of the modelled downstream channel was defined based on expected turbulence patterns, to make sure that the extents of the downstream influence of the fishway flows and attraction flows are included. This is important since the fish need to be able to sense the attraction flows and be guided to the fishway. Once the geometric model was completed in Civil3D, it was be exported to the 3D modelling software.

The modelling software used is OpenFoam, which has the highest recognition for Computational Fluid Dynamics (CFD) modelling in the scientific community. It was developed at Imperial College, London, is open source, and is supported by a community of users that provide technical support and additional tools to the model. CBCL has several years of experience working with this model and has developed workflows from model assembly to data extraction.

Once the geometry was set up in the model, the water levels and flows at the boundaries were set up. These were set depending on the various flow scenarios described above. The results of the modelling then allows the interpretation of fish passage quality for each species during the entire year.

1.4 Modelling Results

Each scenario (S1 to S7) contains 13 figures. Both plan views of the velocity magnitude, as well as cross-sections at regular intervals, with velocity vectors, are shown in panoramic views.

- **Figure 1 to Figure 3**: present the plan view of the water surface, mid-surface, as well as the view taken from the bottom to show the velocities along the bottom.
- **Figure 4 to Figure 8**: panoramic views of entire study domain and close-up views for the fishway area and the river channel; the vectors have a uniform length and are not scaled by velocities. Vectors are coloured by velocity magnitude.
- **Figure 9 to Figure 13**: focus on the bottom velocities (from the geometry bottom to 0.2m above it); vectors are generated only for a depth of 0.2m from the bottom and the vectors have a uniform length and are coloured by velocity magnitude.

The colour scale has been adjusted based on Bob Rutherford's request to show details from 0 to 2m/s, and only one colour for all velocities above 2m/s. The intervals between the cross sections are given in the titles for each figure.

1. Model Results of Scenario S1 with 65 cfs from the gates

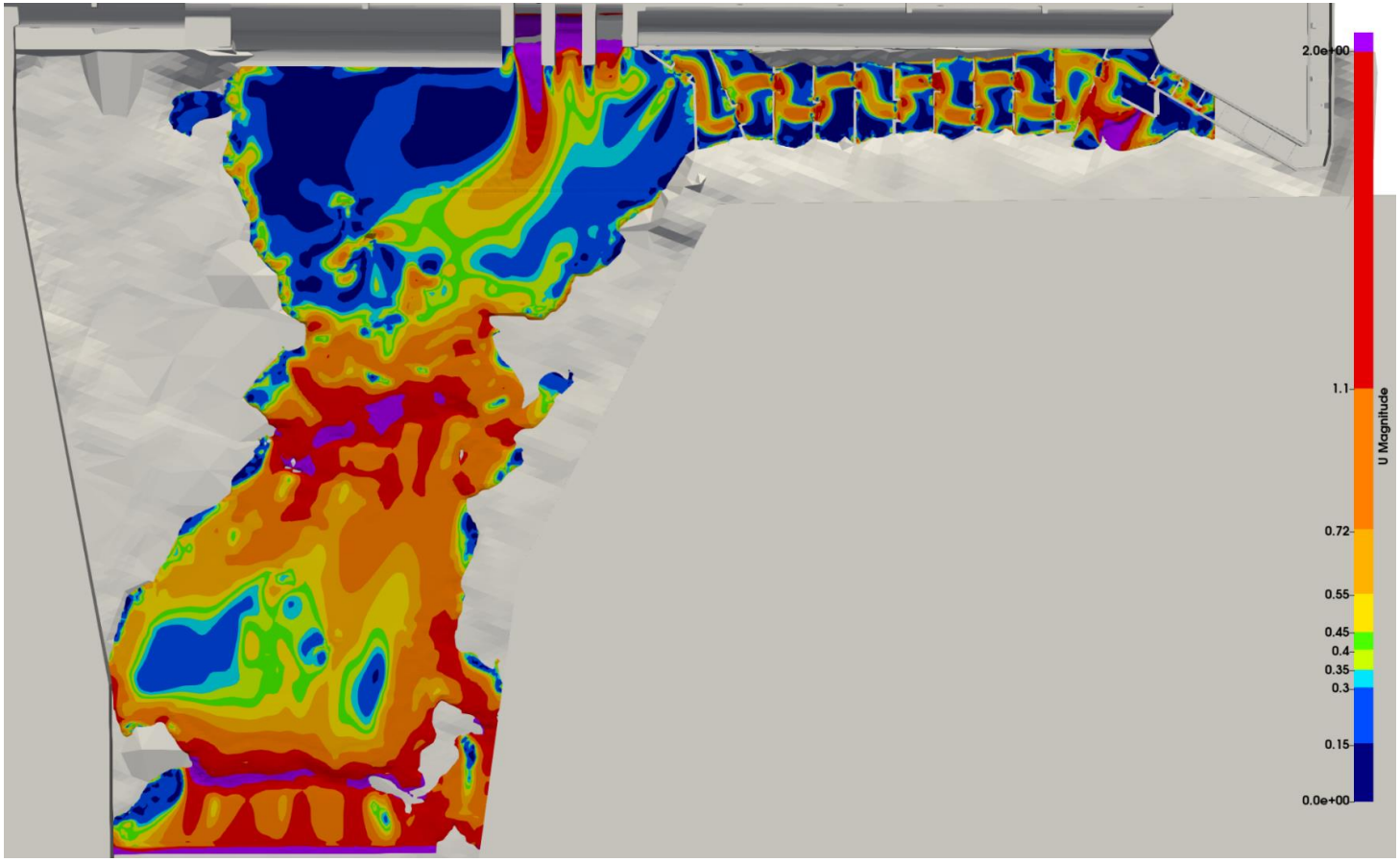


Figure S1-1: Plan view of the Water Surface Velocities

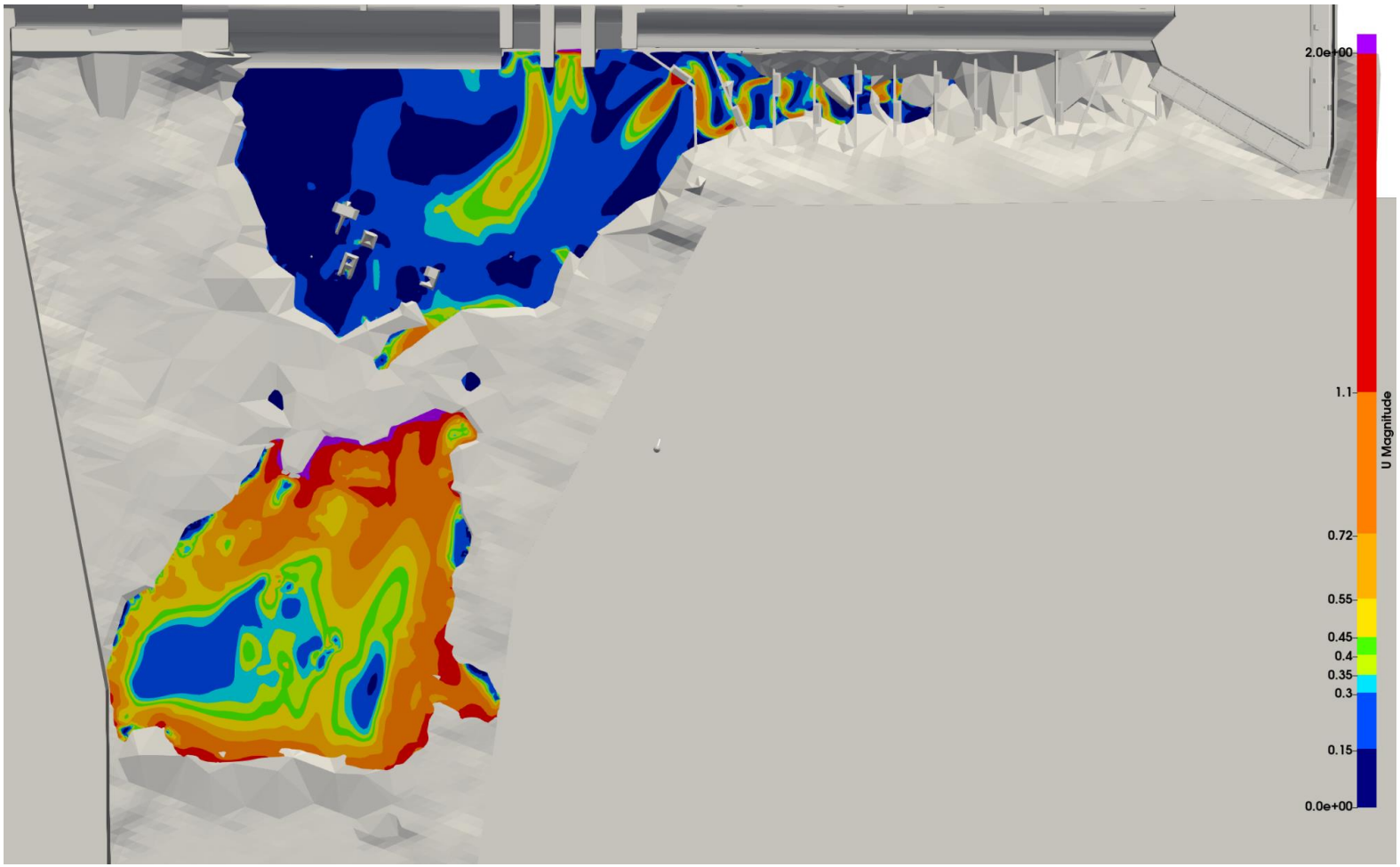


Figure S1-2: Plan view of the Mid-Surface Velocities

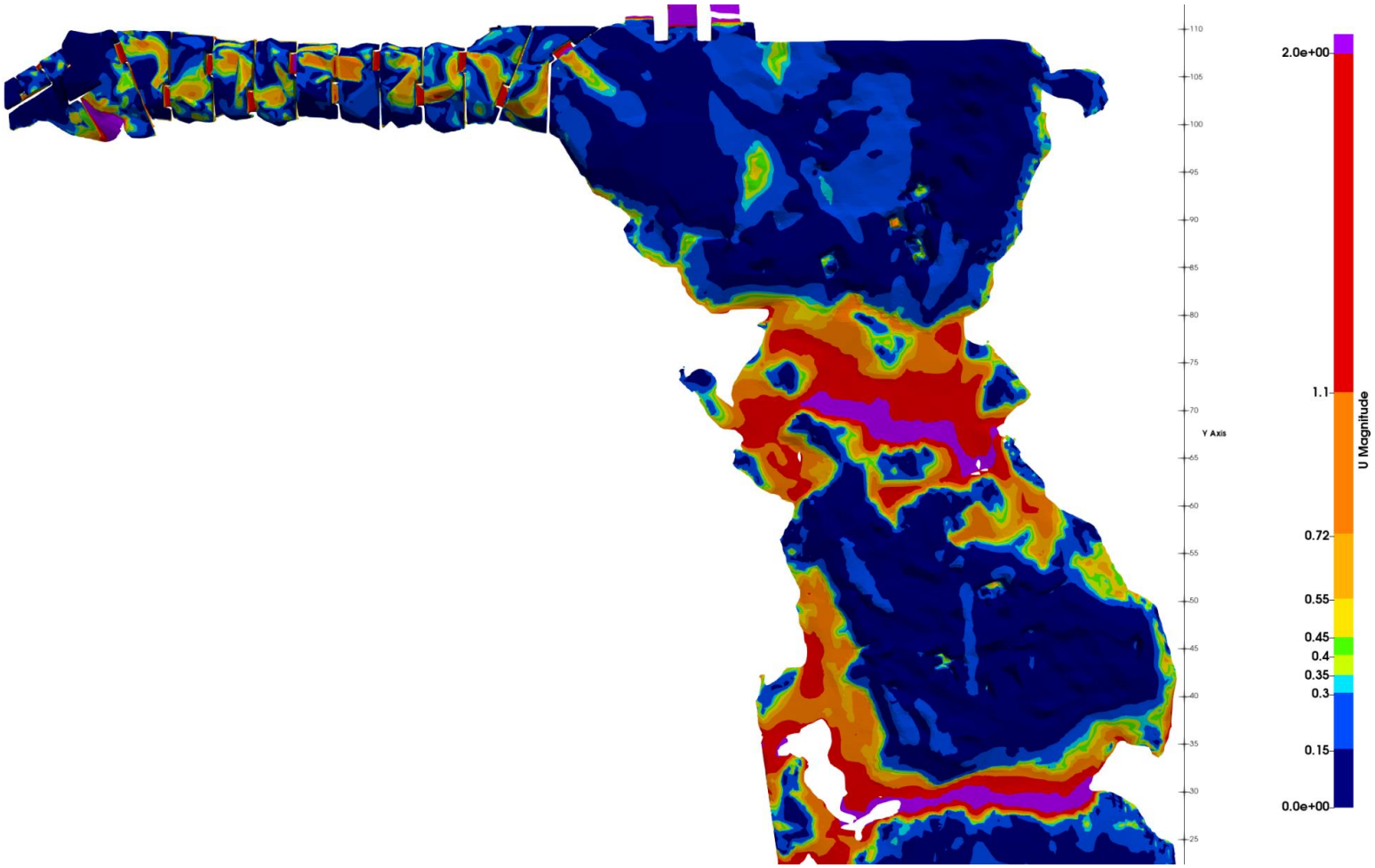


Figure S1-3: View of the Bottom Velocities

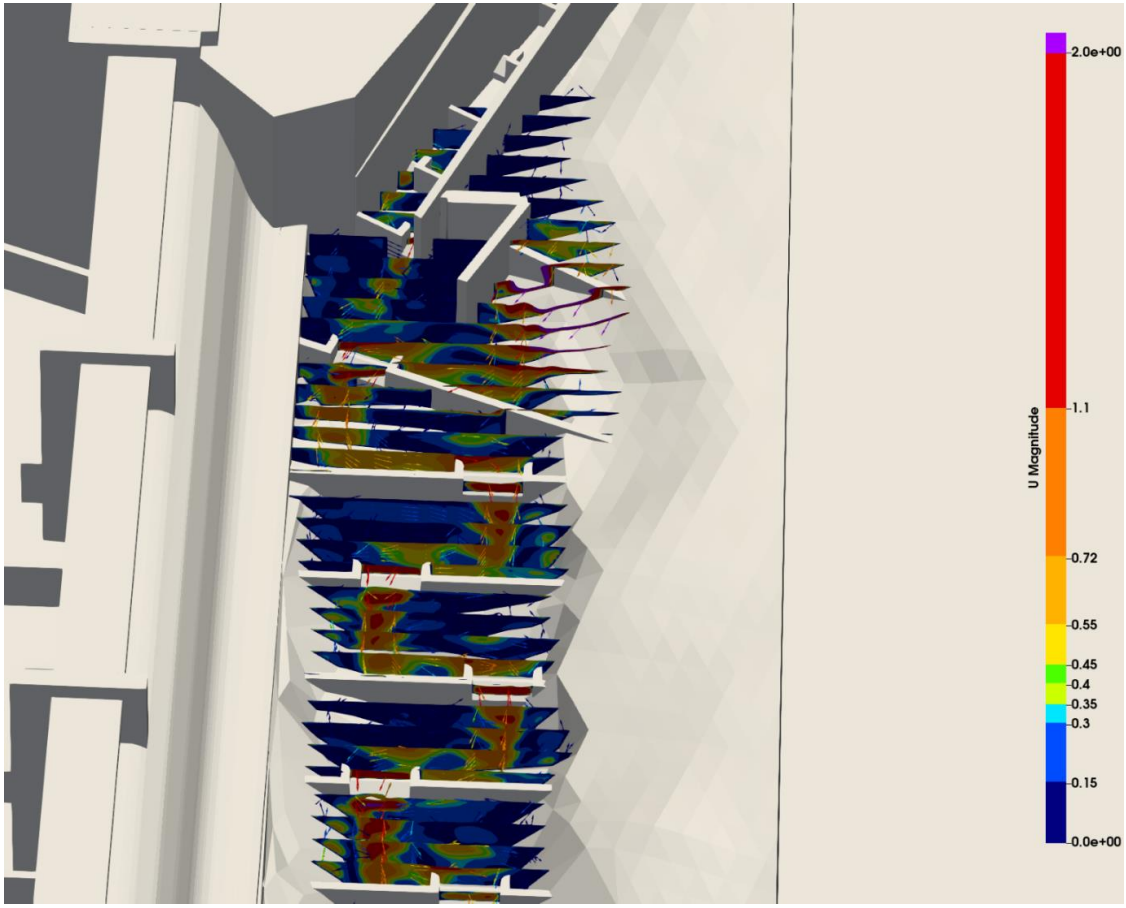


Figure S1-4: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

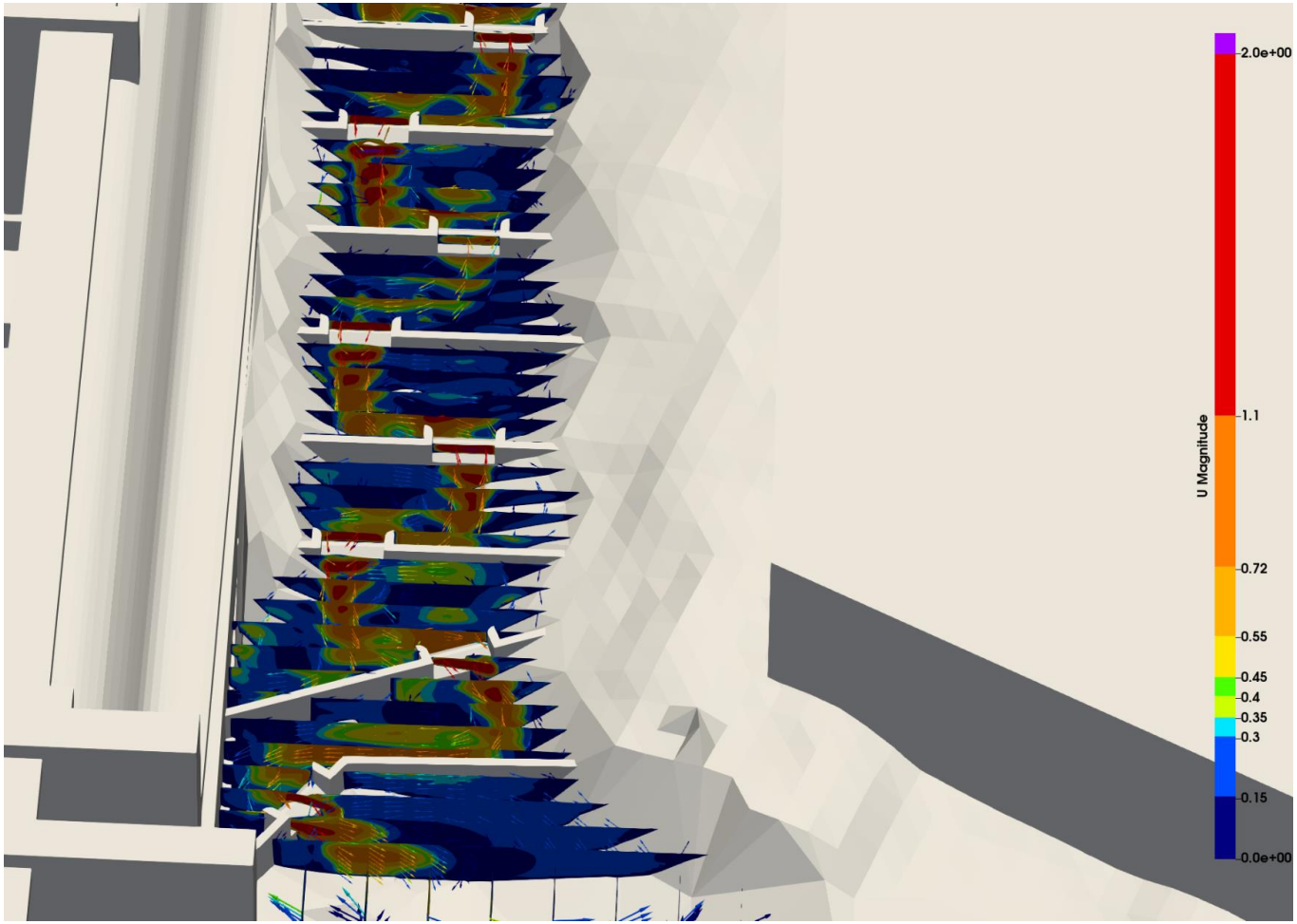


Figure S1-5: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

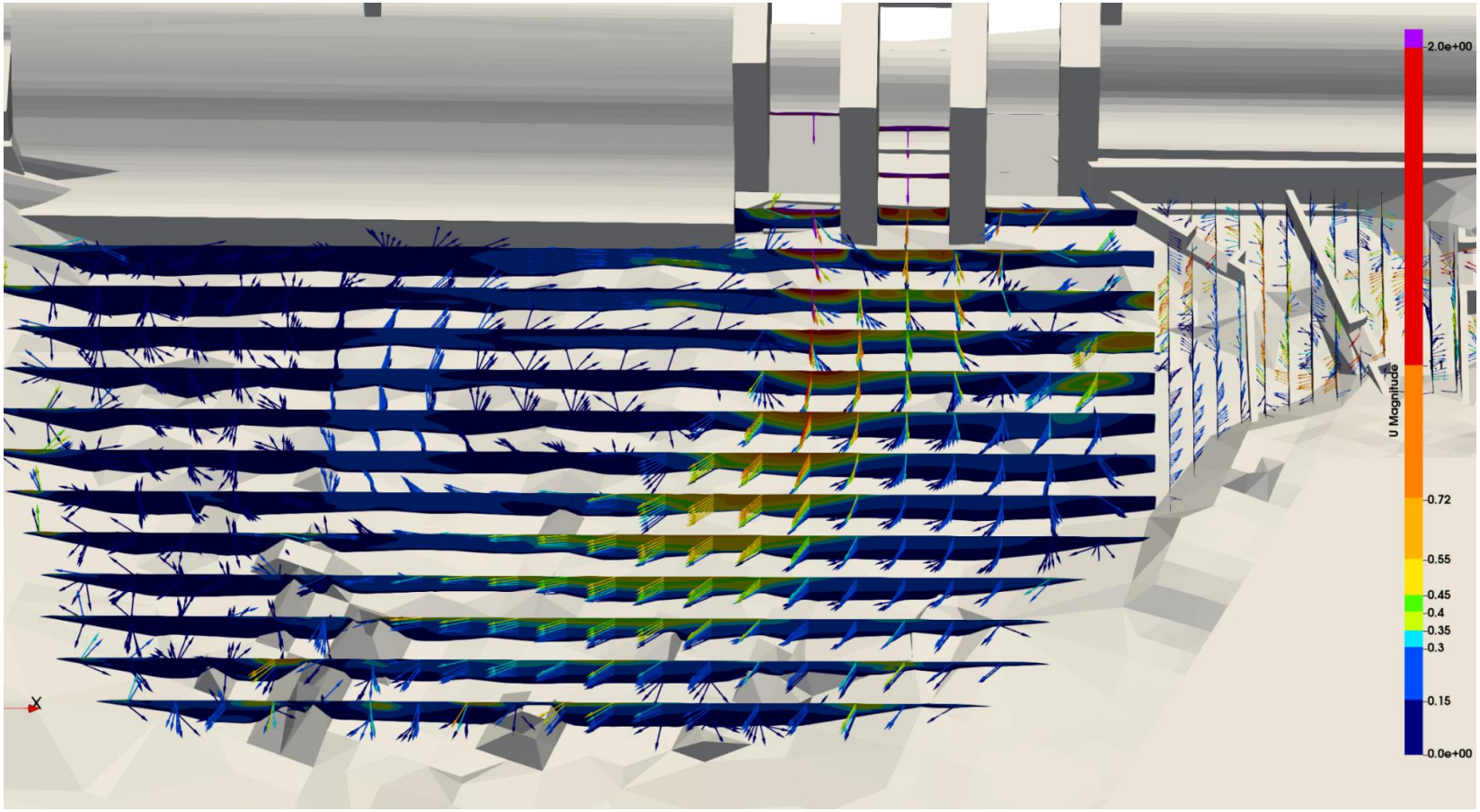


Figure S1-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

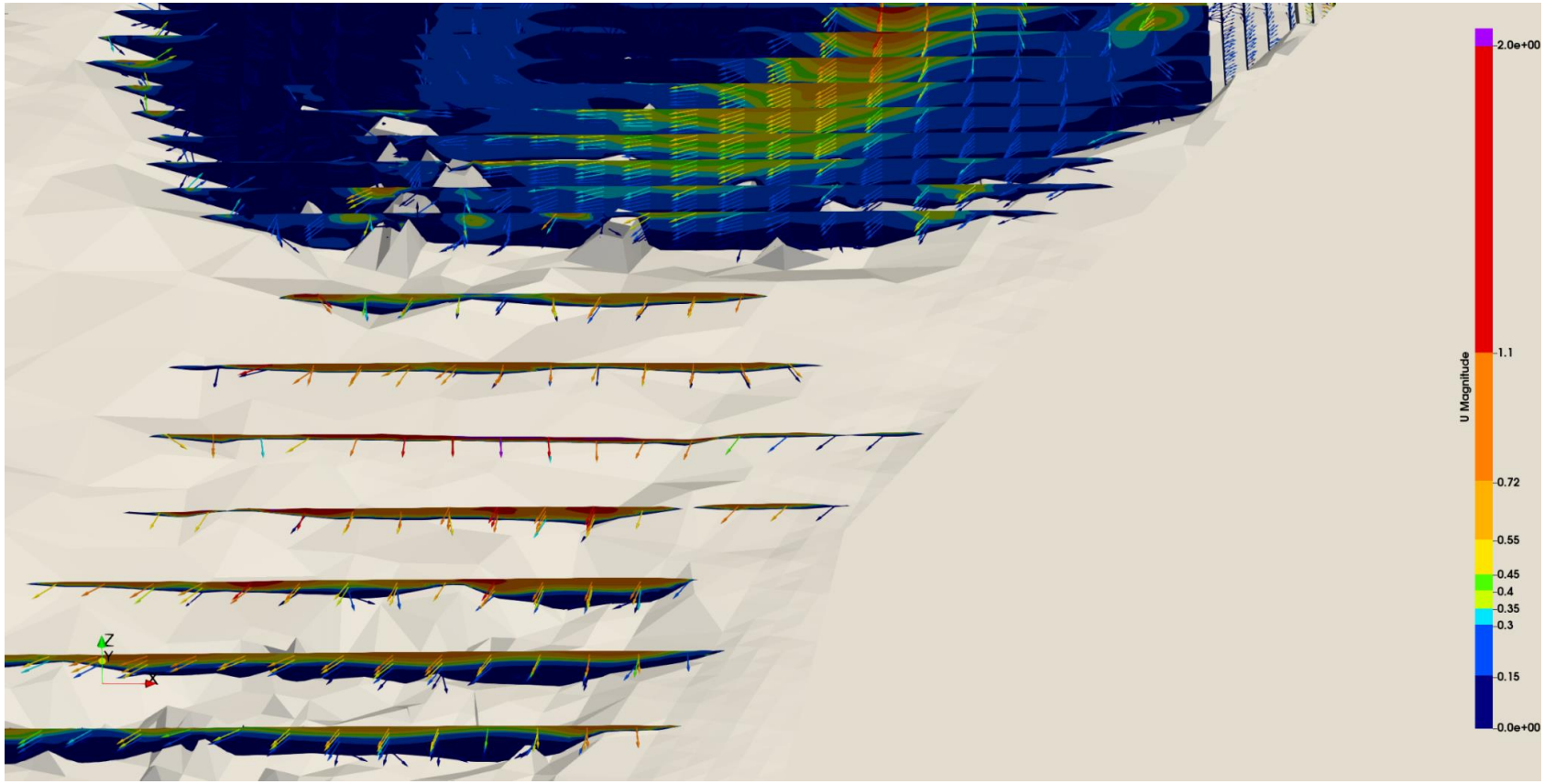


Figure S1-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction



Figure S1-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

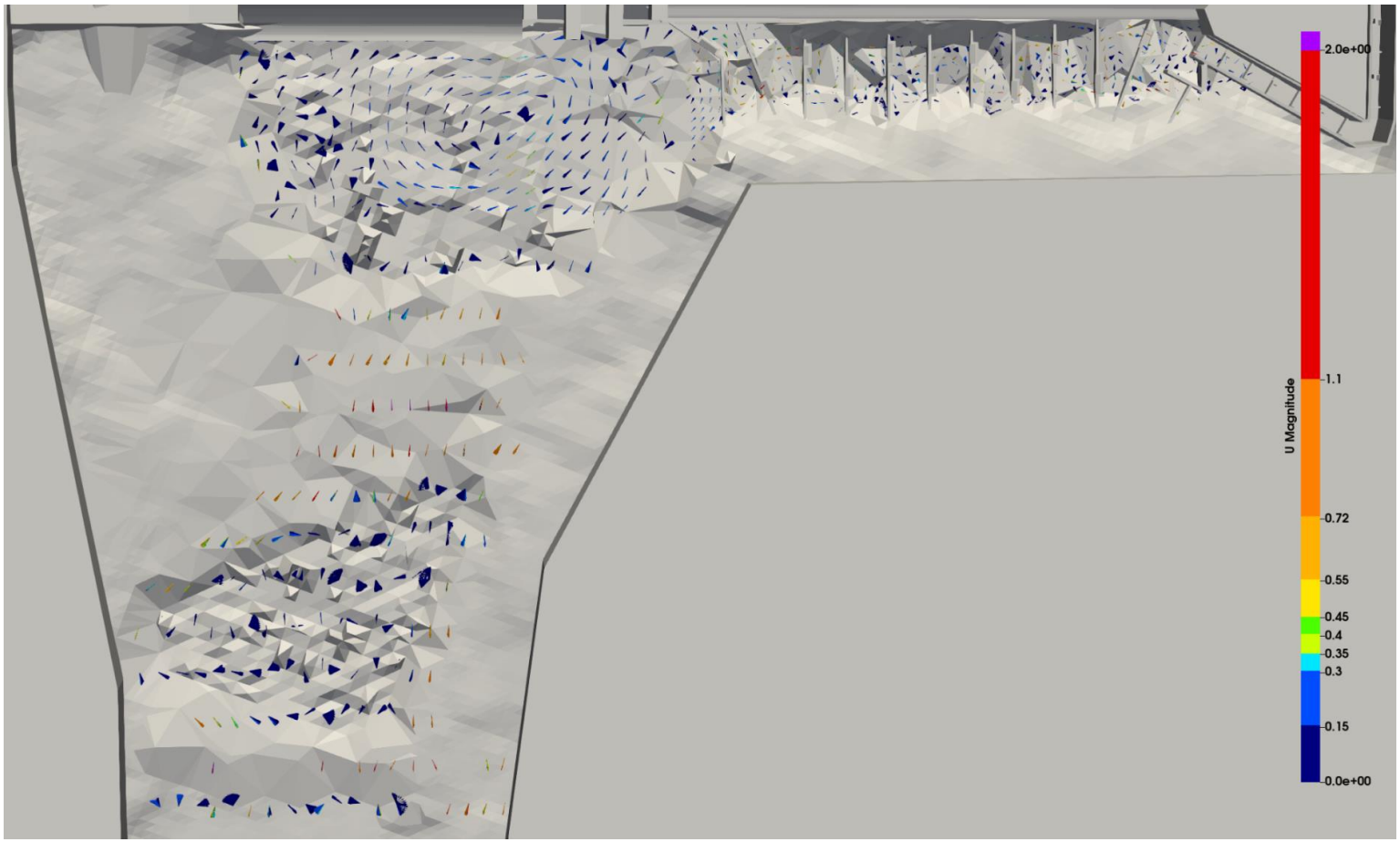


Figure S1-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

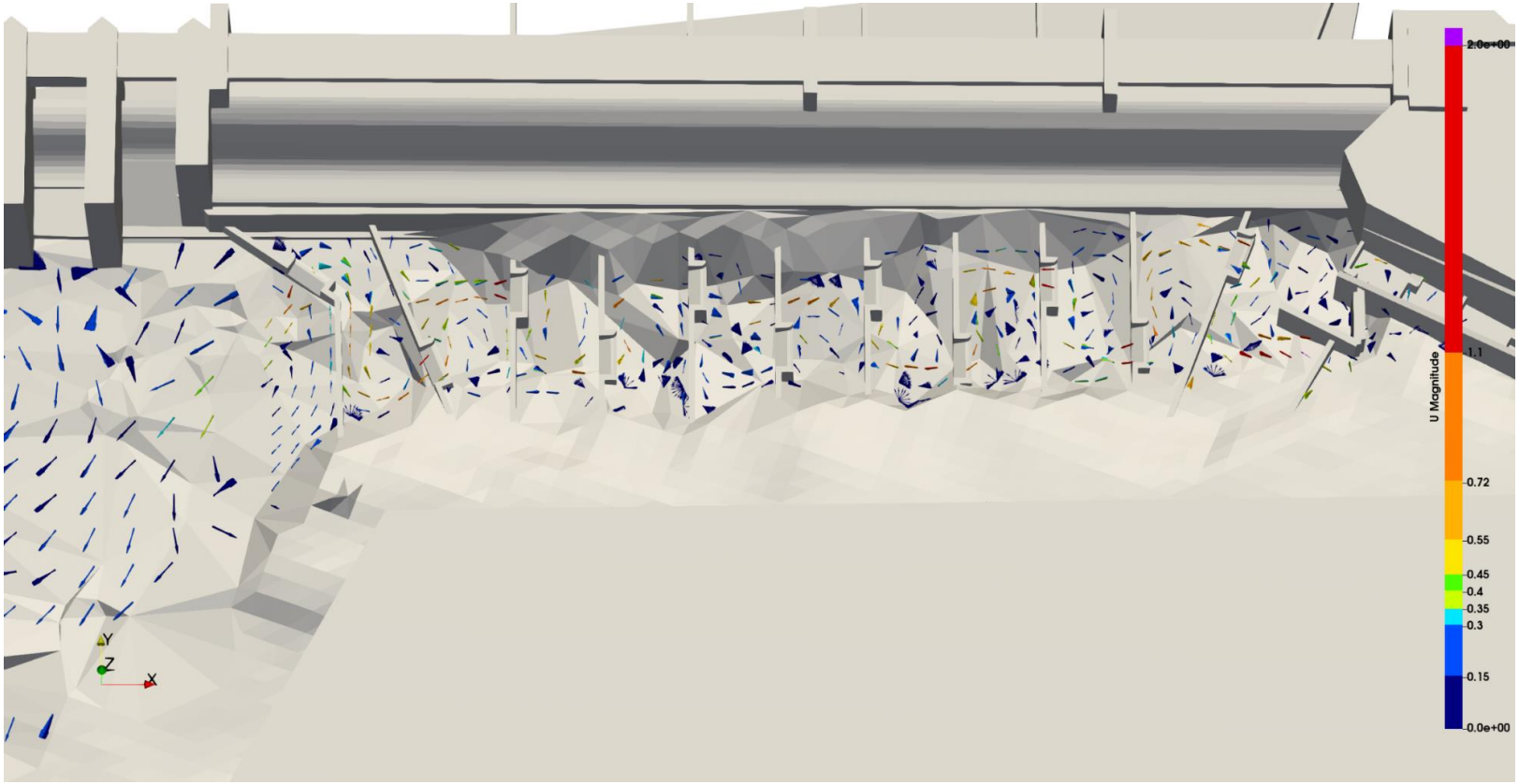


Figure S1-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

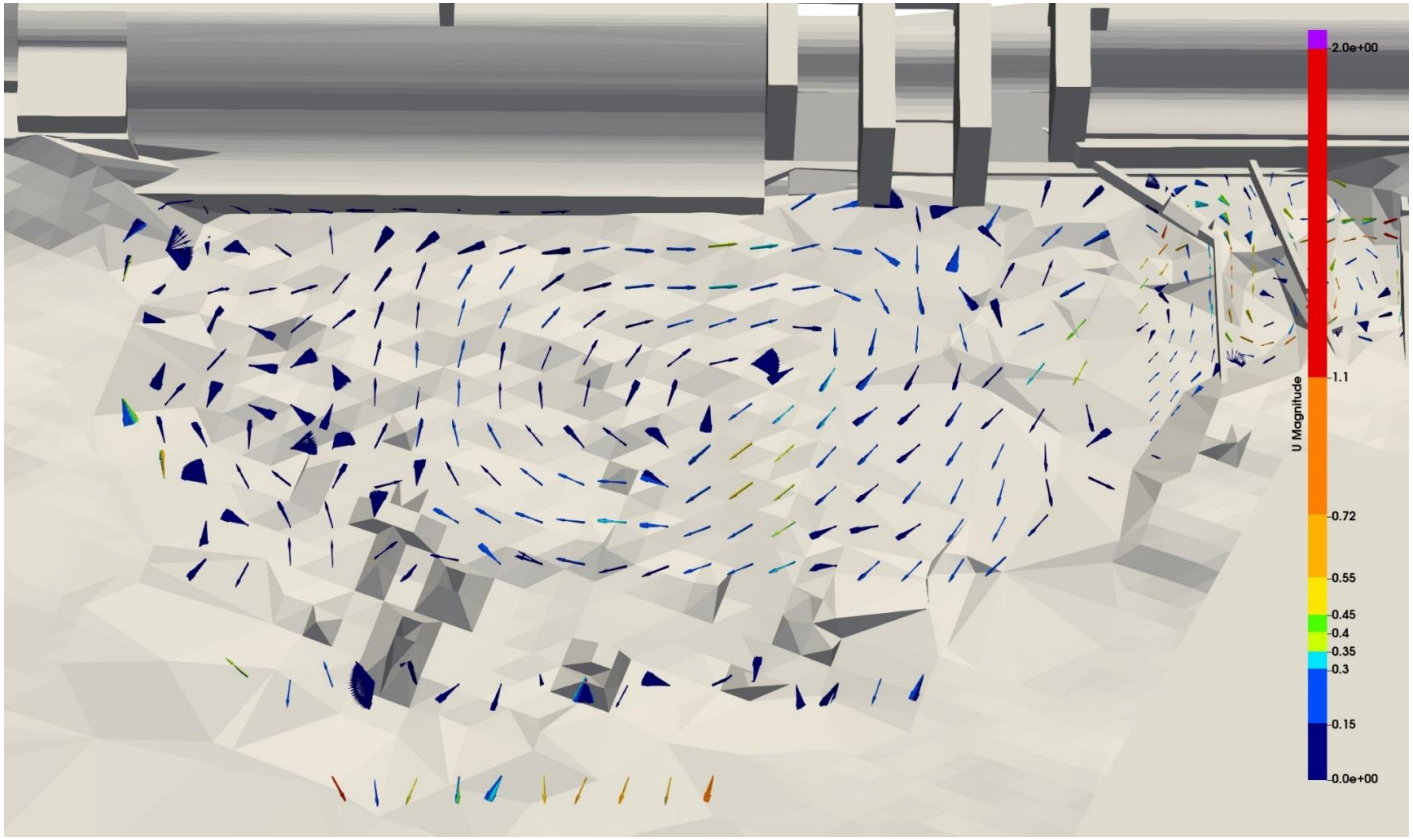


Figure S1-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

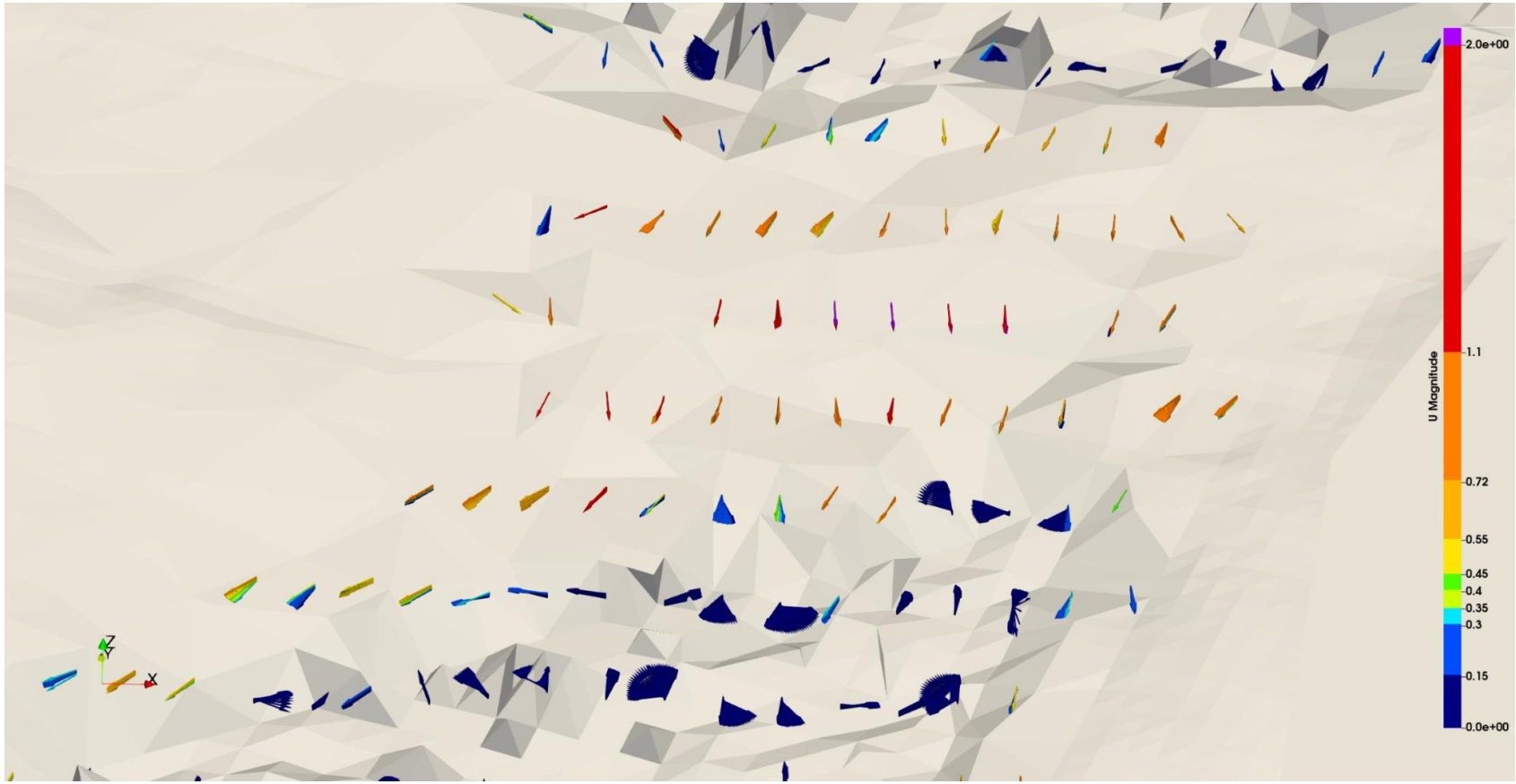


Figure S1-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

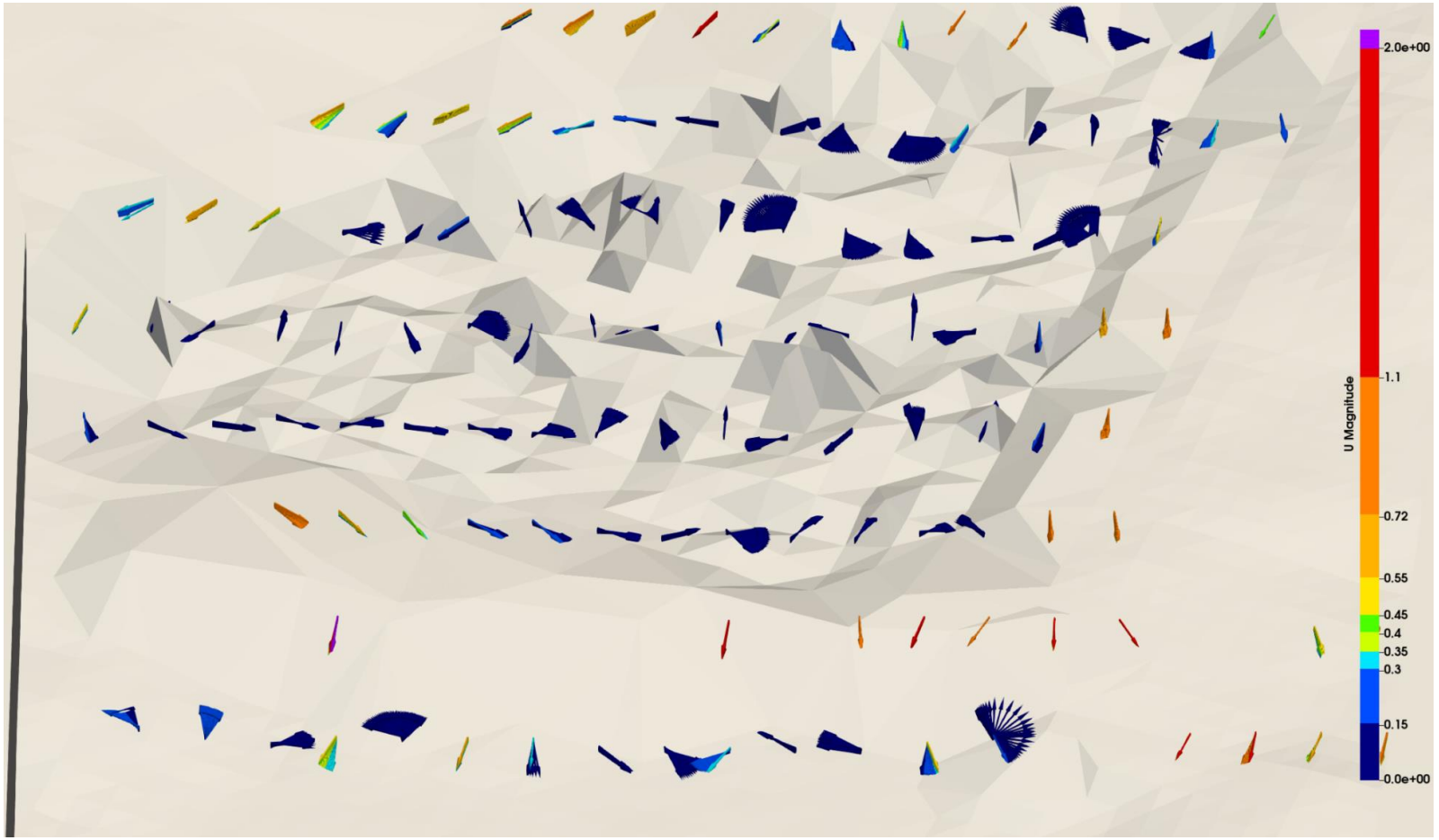


Figure S1-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

2. Model Results of Scenario S2 with 165 cfs from the gates

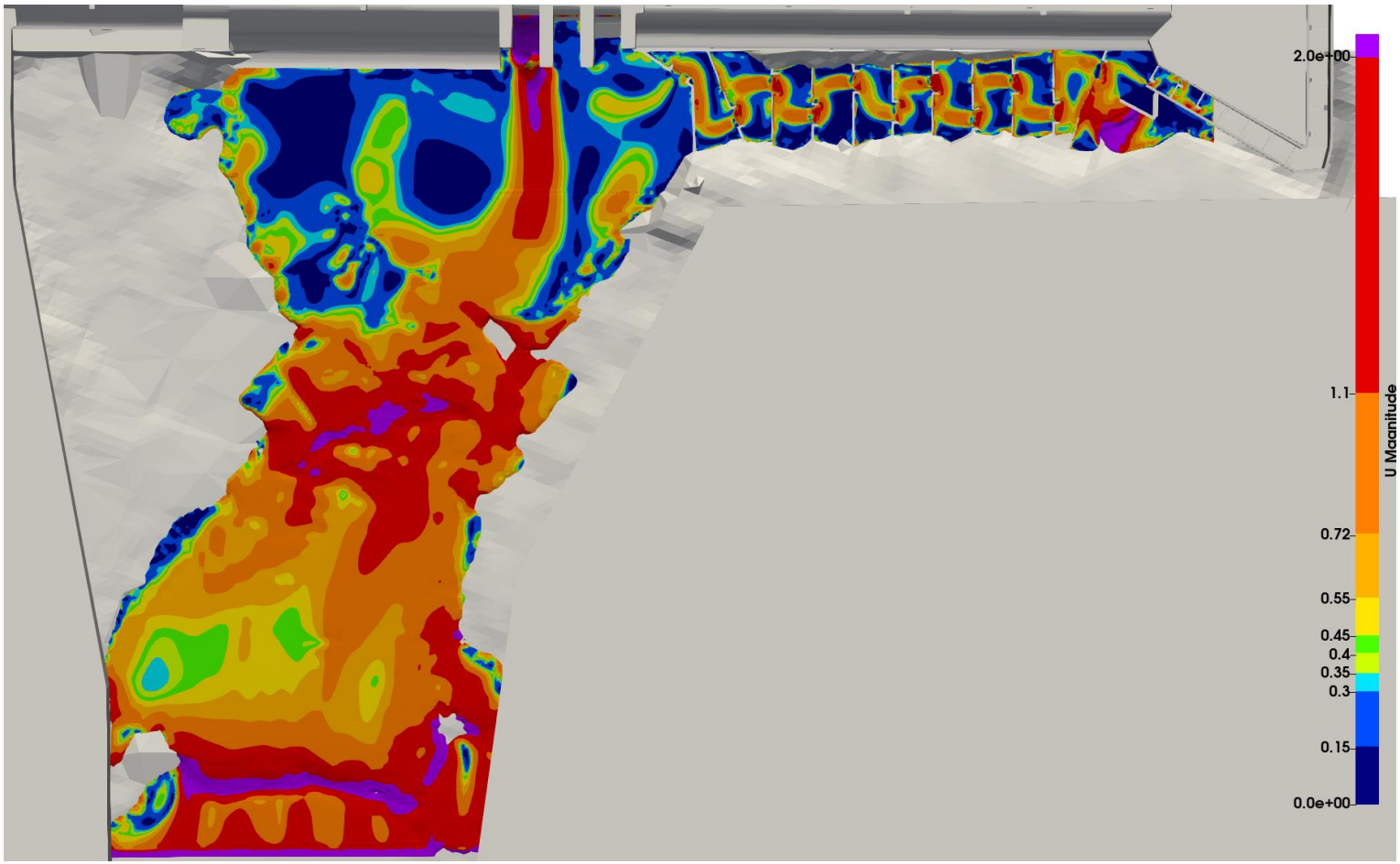


Figure S2-1: Plan view of the Water Surface Velocities

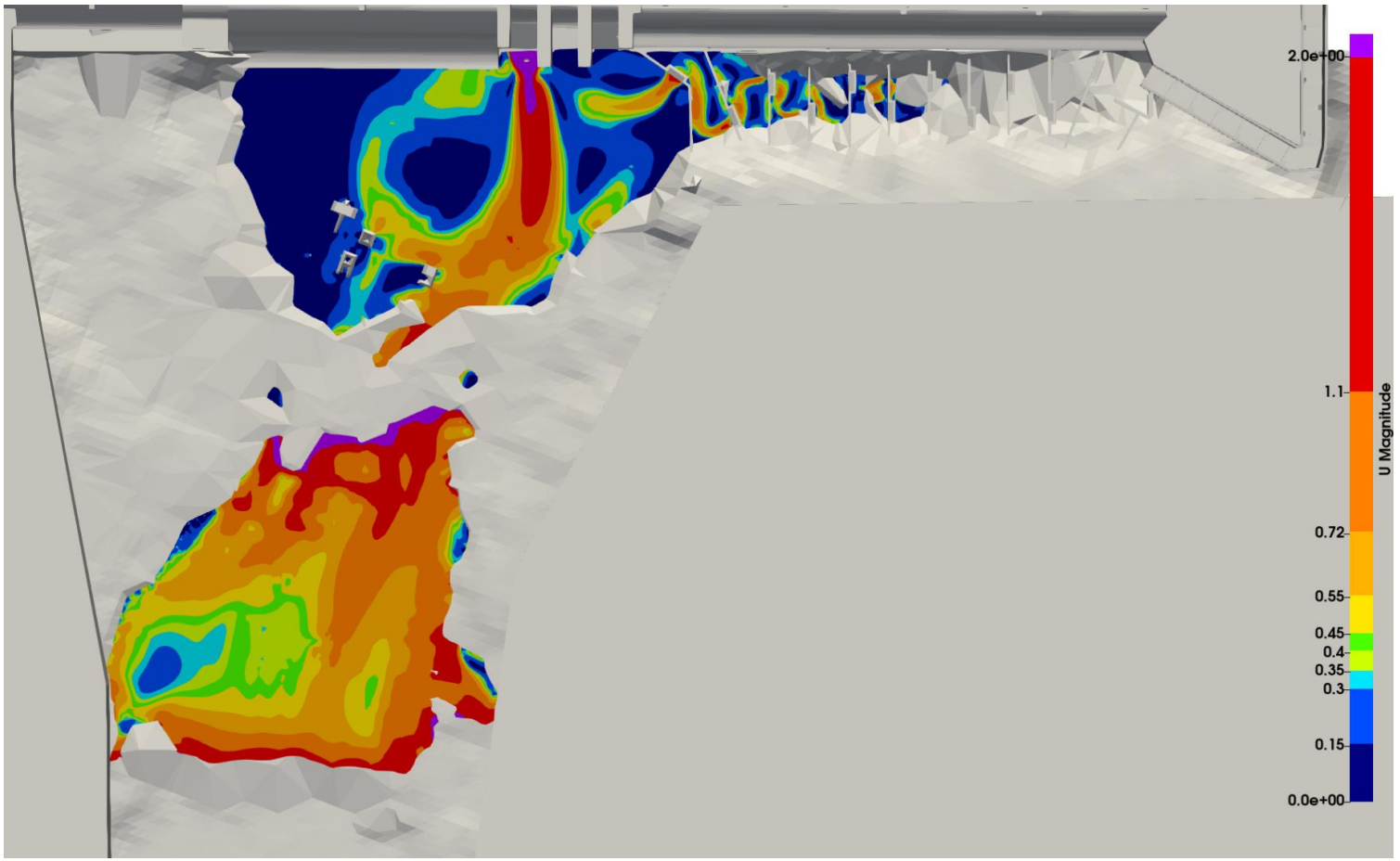


Figure S2-2: Plan view of the Mid-Surface Velocities

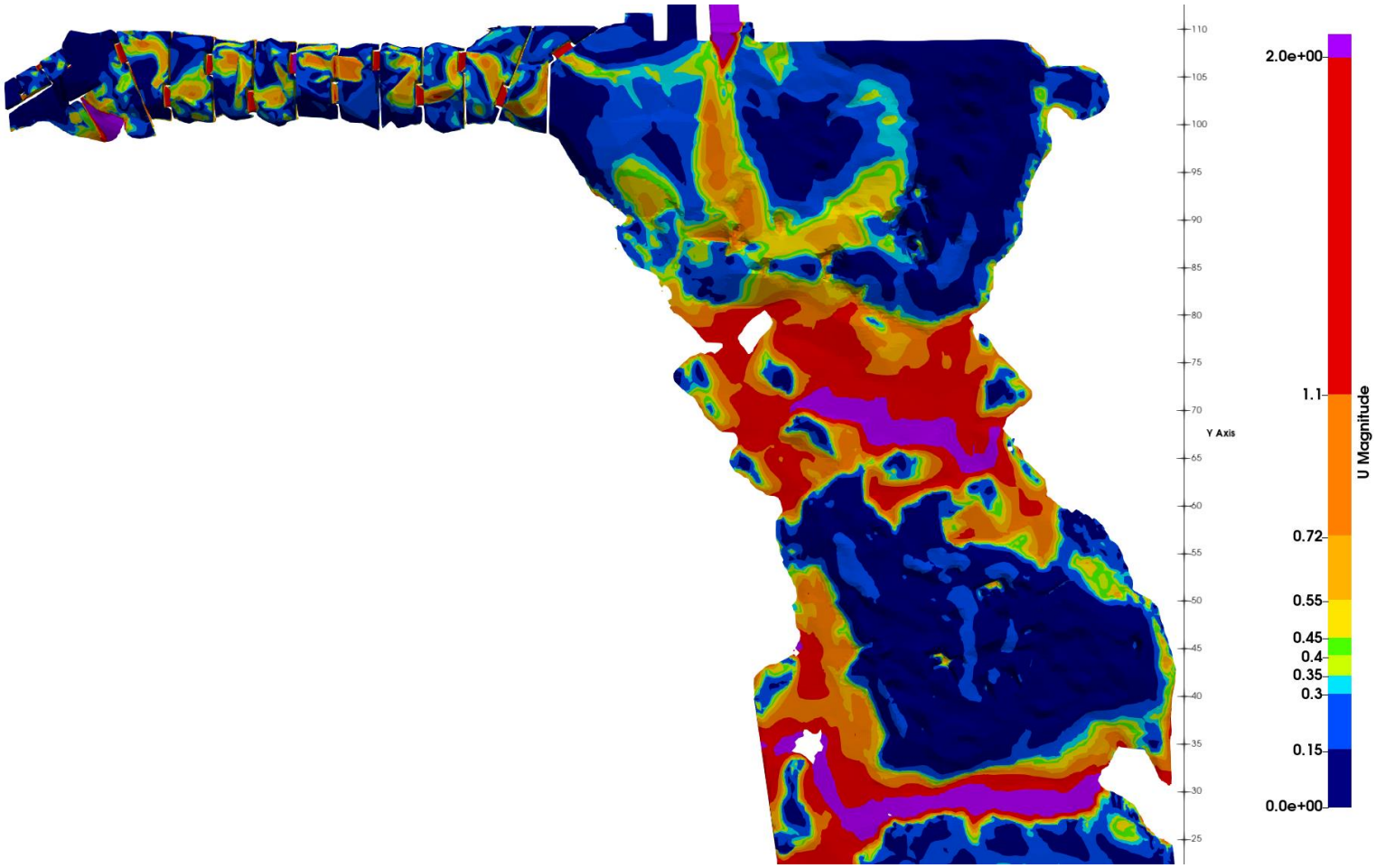


Figure S2-3: View of the Bottom Velocities

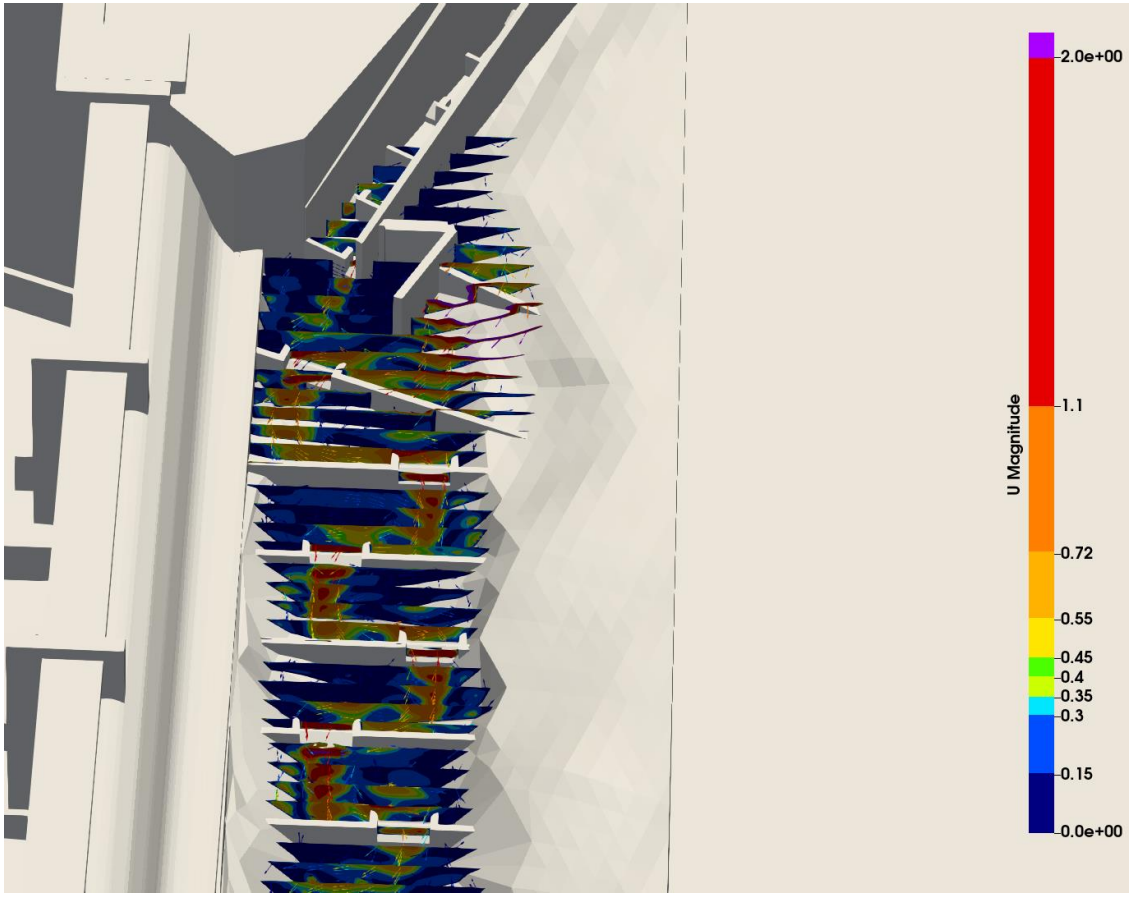


Figure S2-4: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

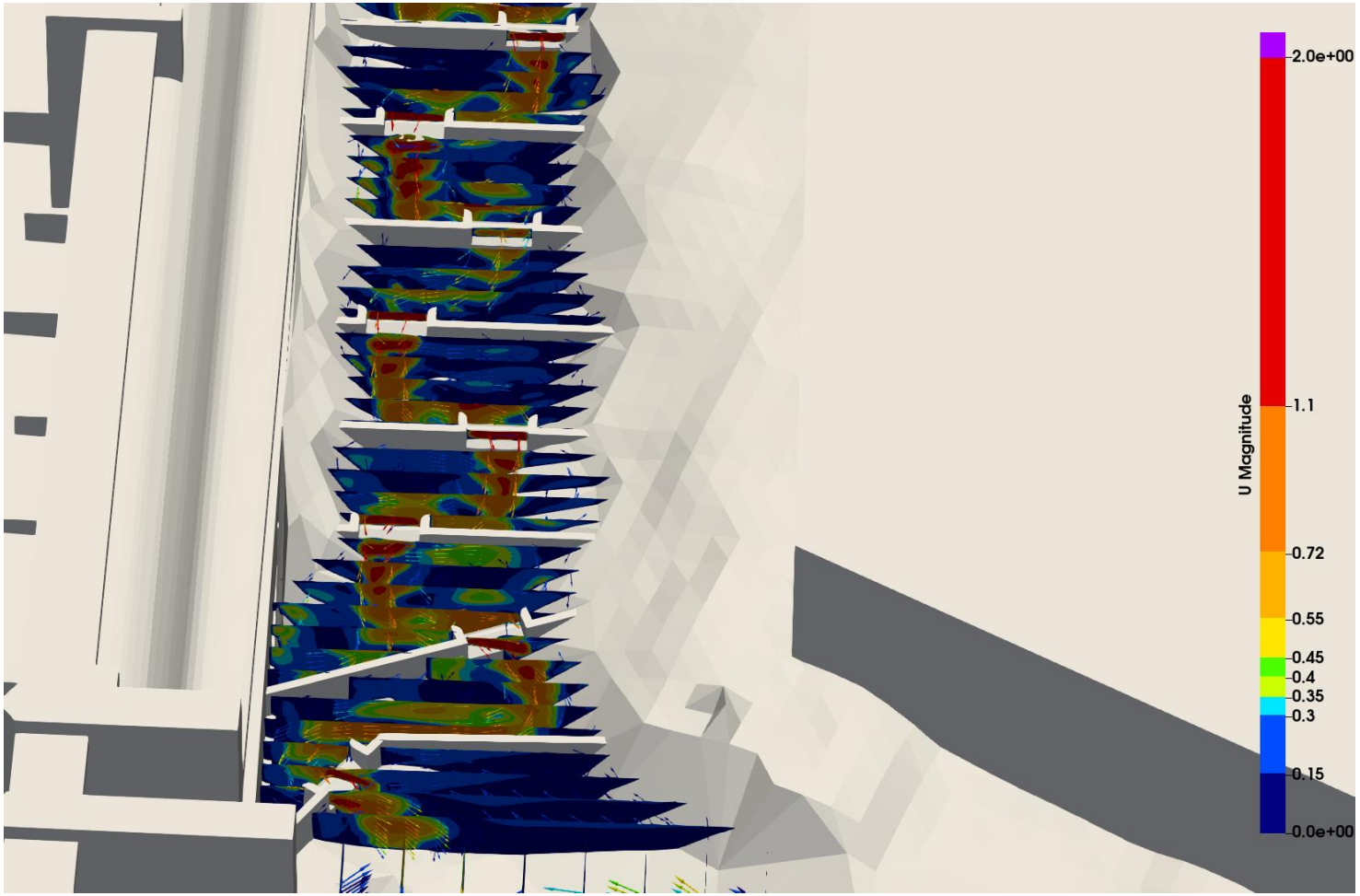


Figure S2-5: Close up view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

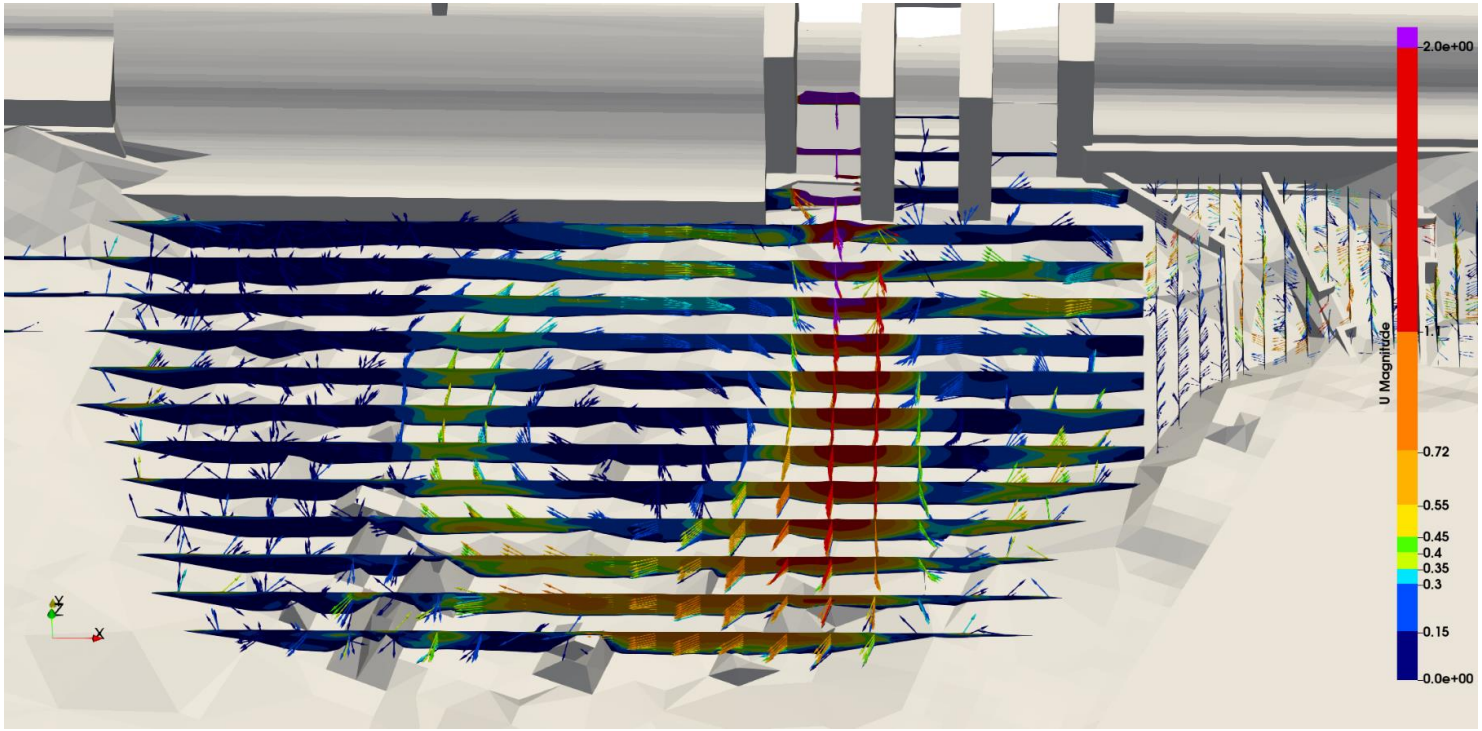


Figure S2-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

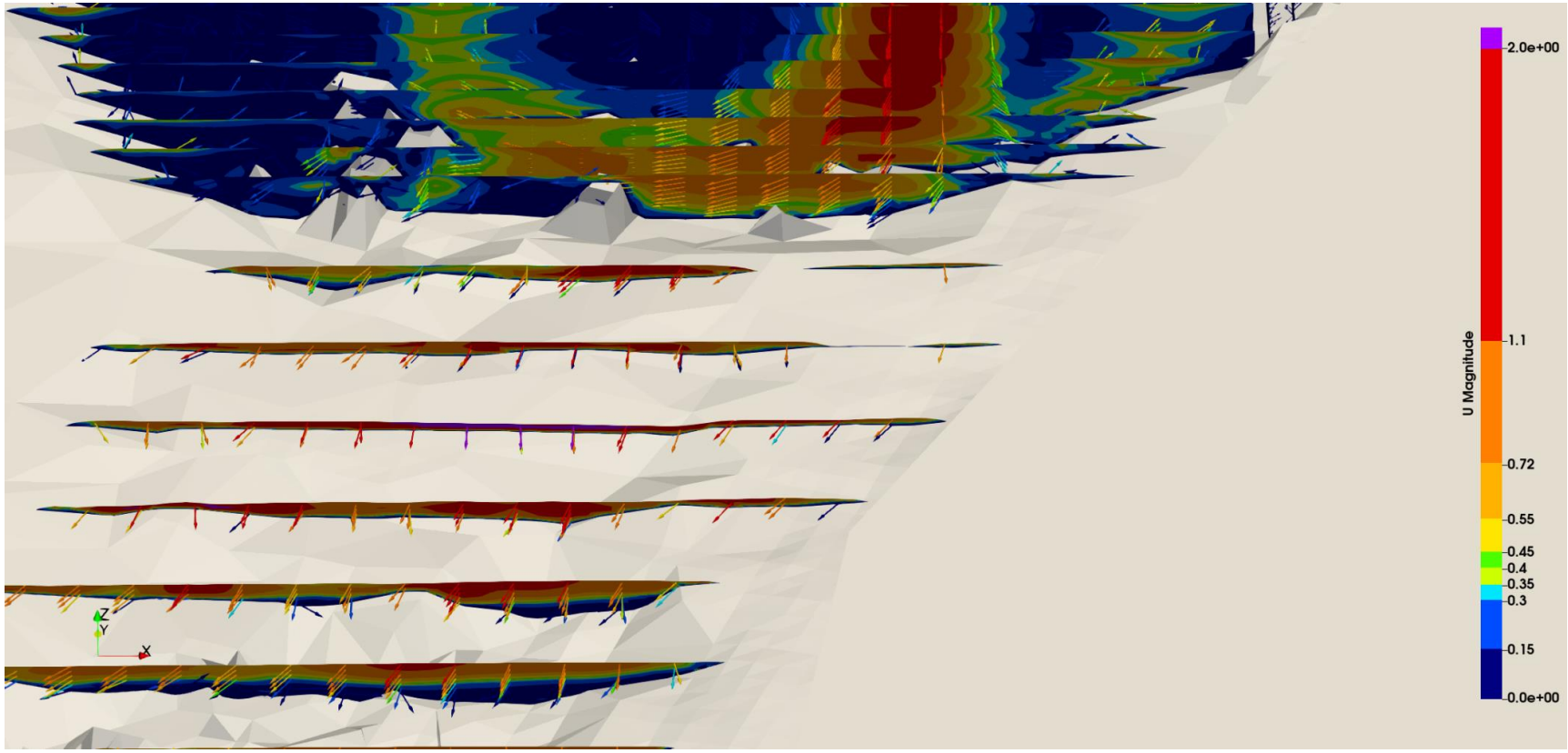


Figure S2-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

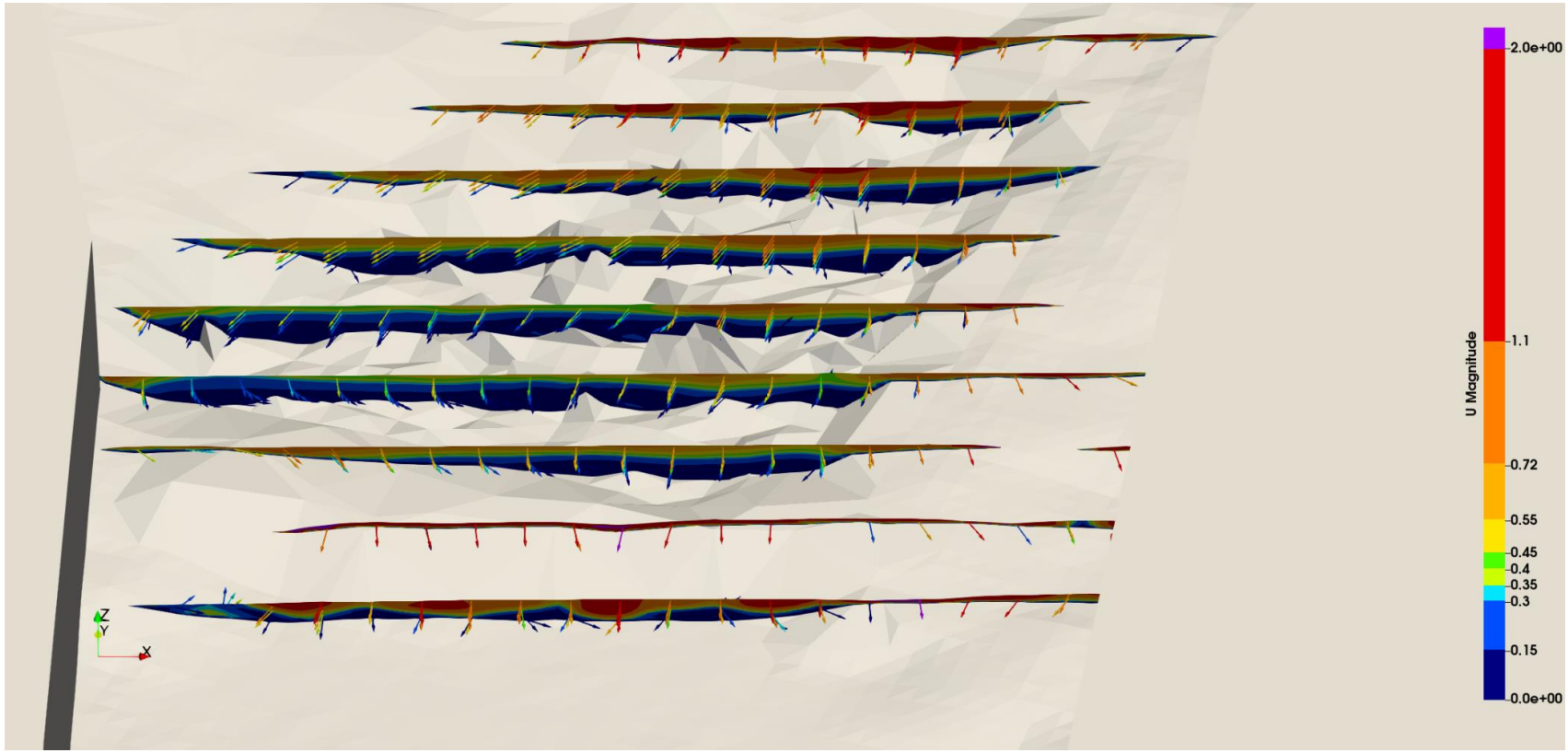


Figure S2-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

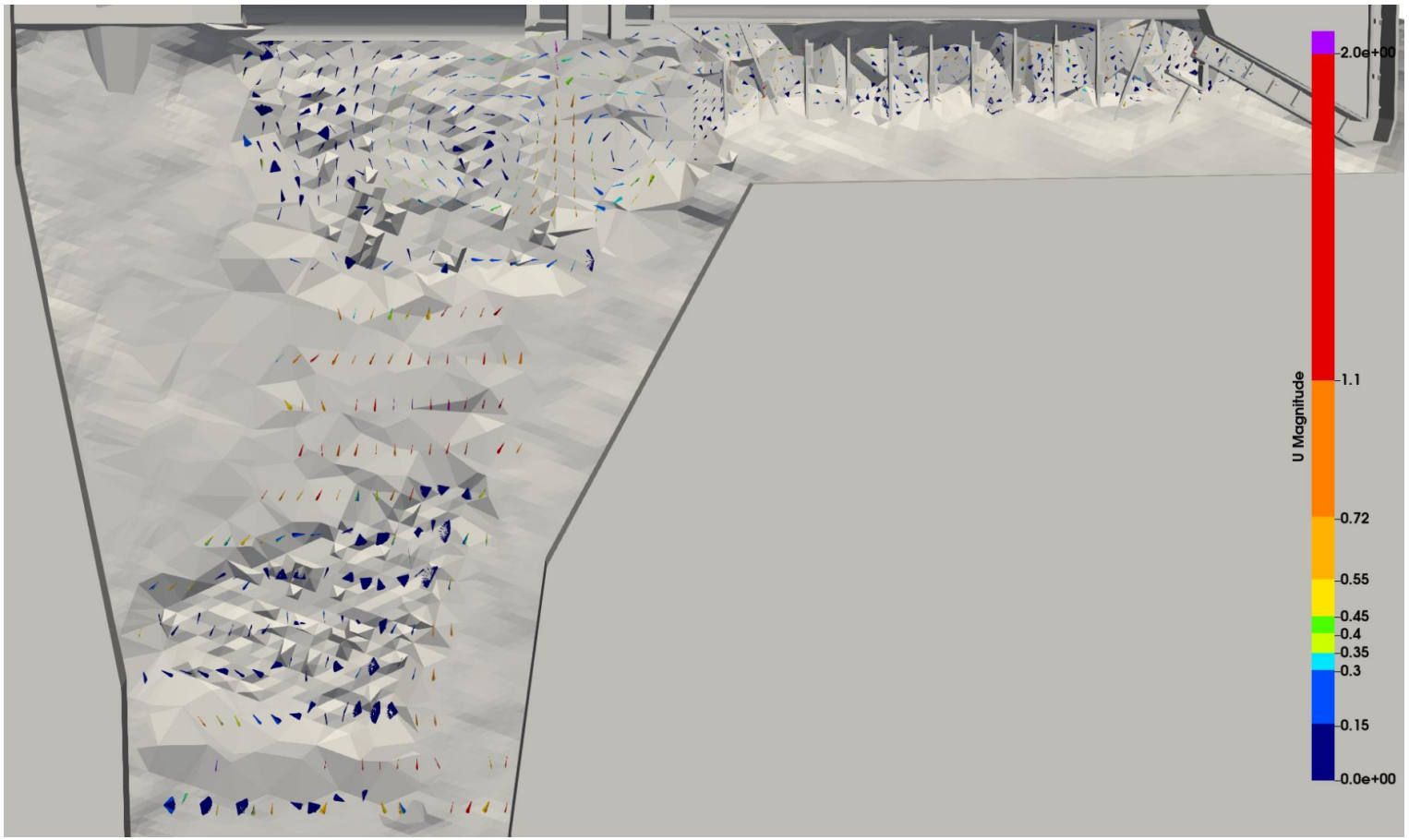


Figure S2-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

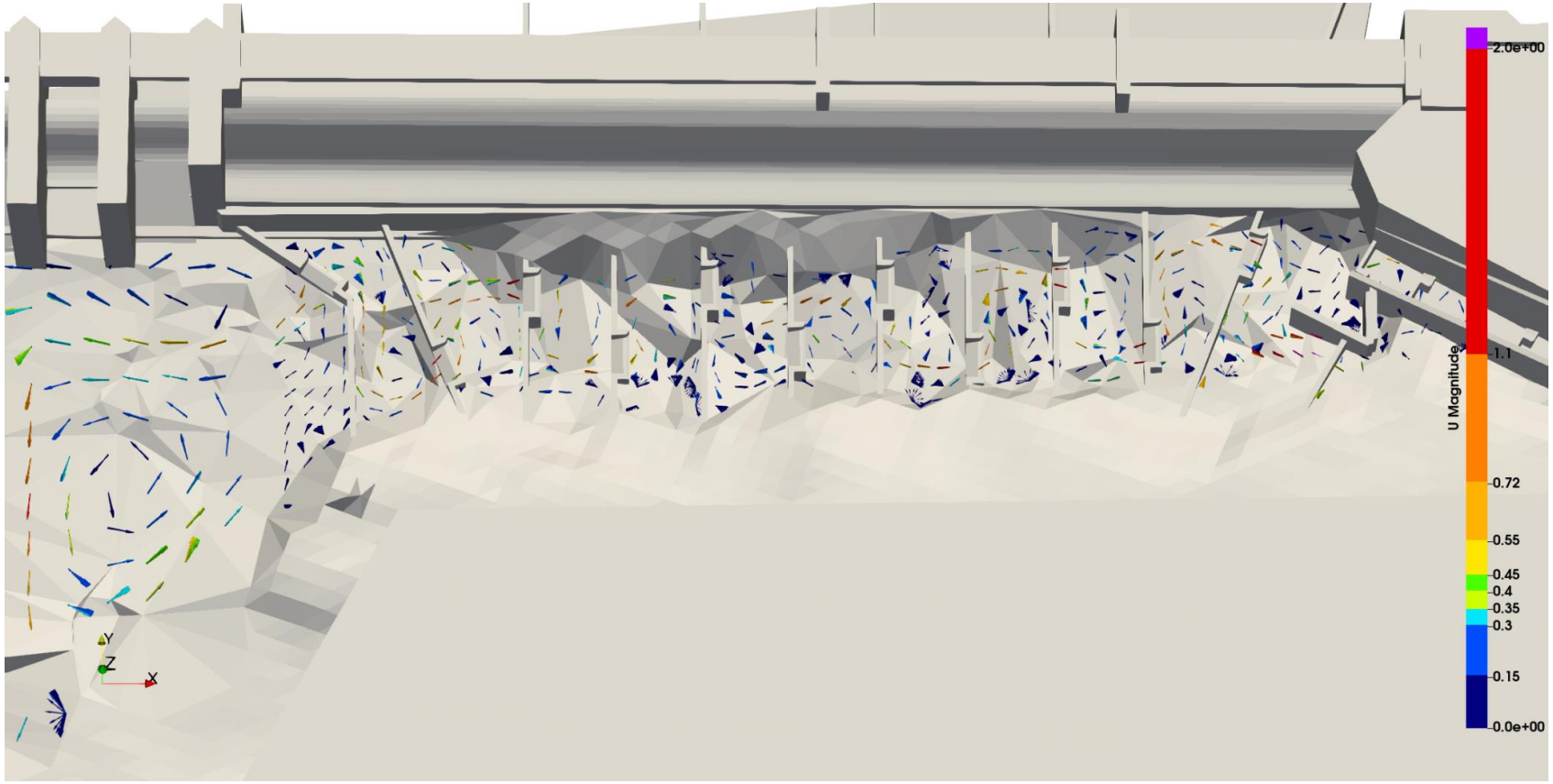


Figure S2-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

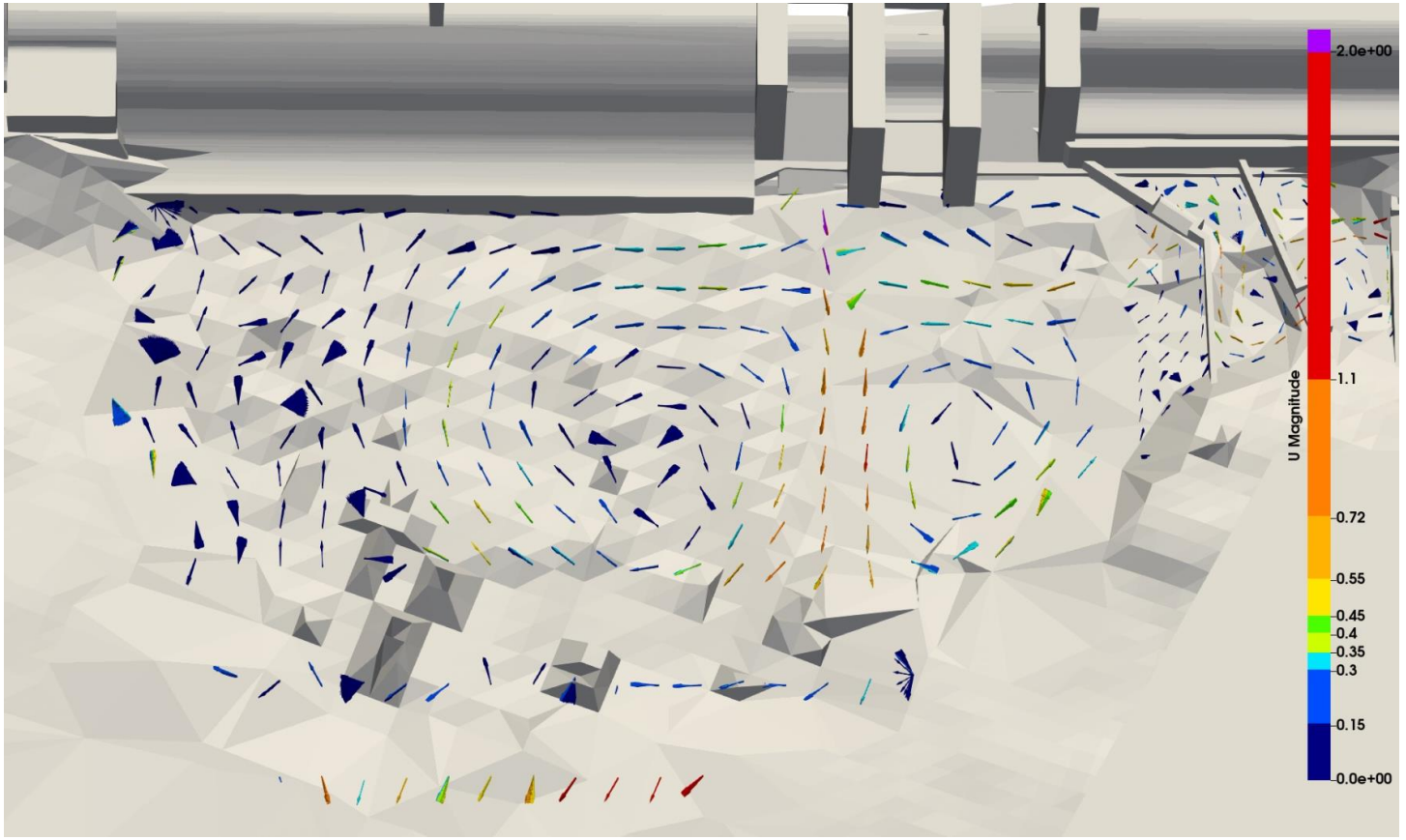


Figure S2-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

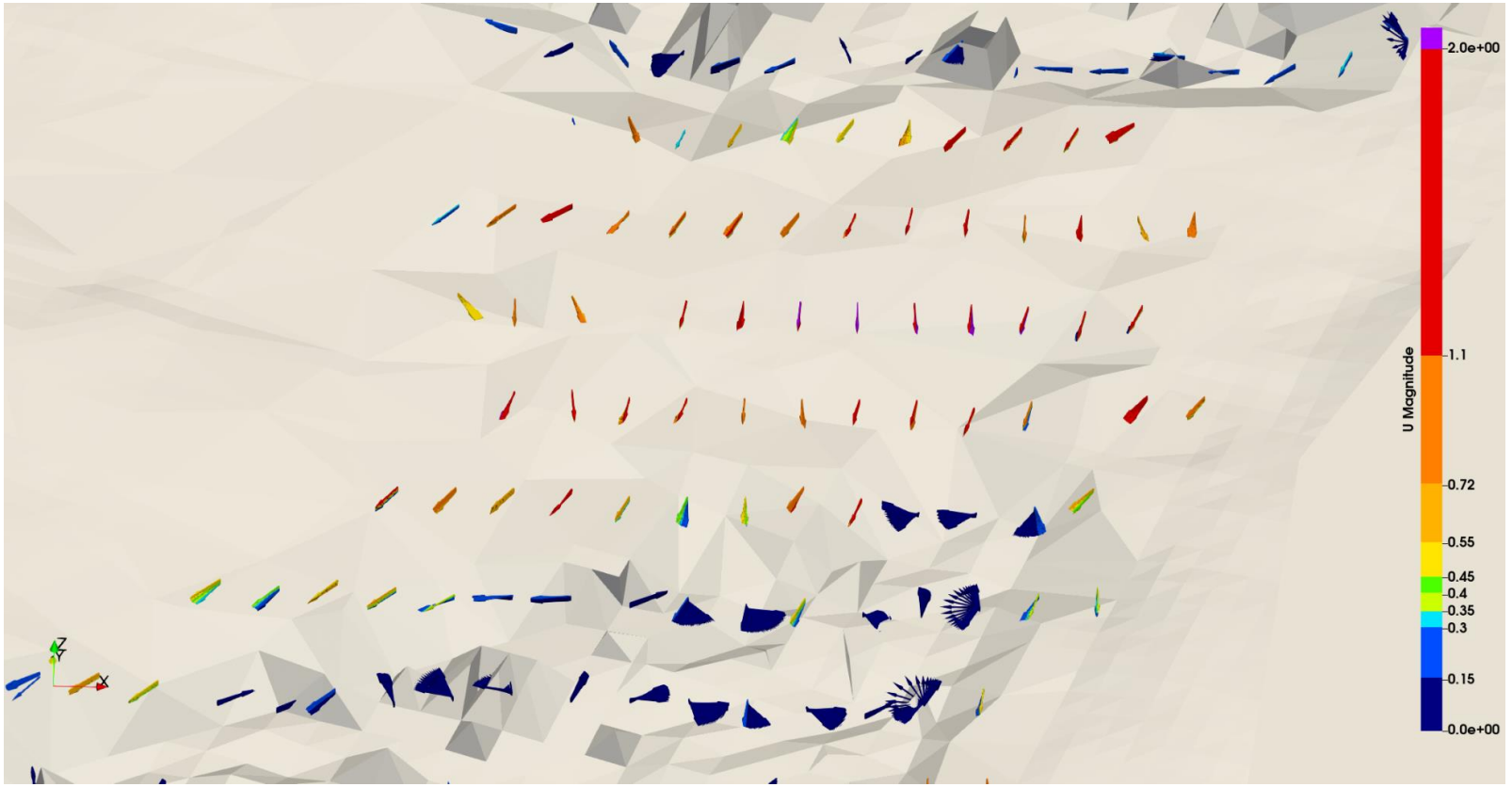


Figure S2-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

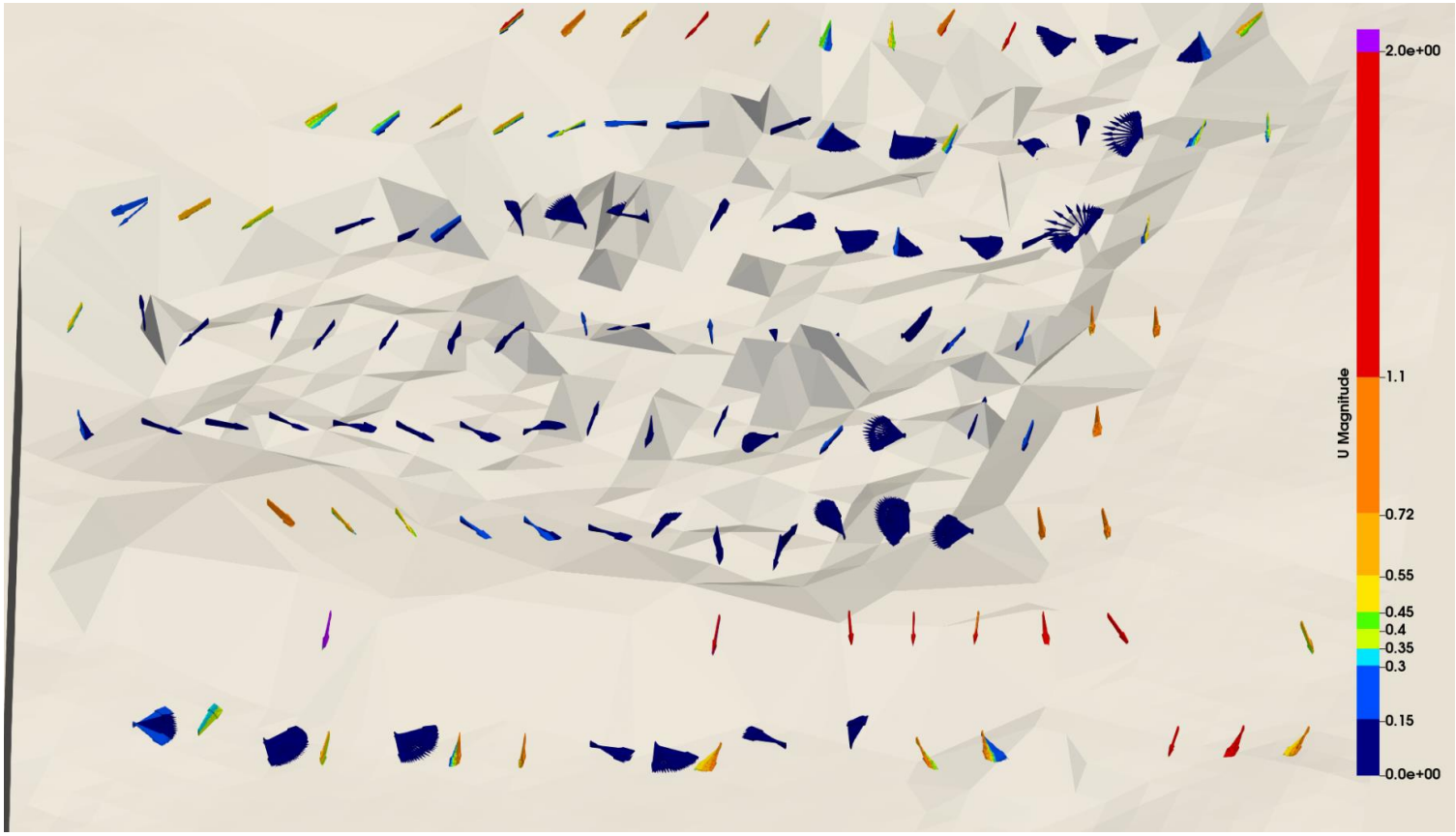


Figure S2-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

3. Model Results of Scenario S3 with 925 cfs from the gates

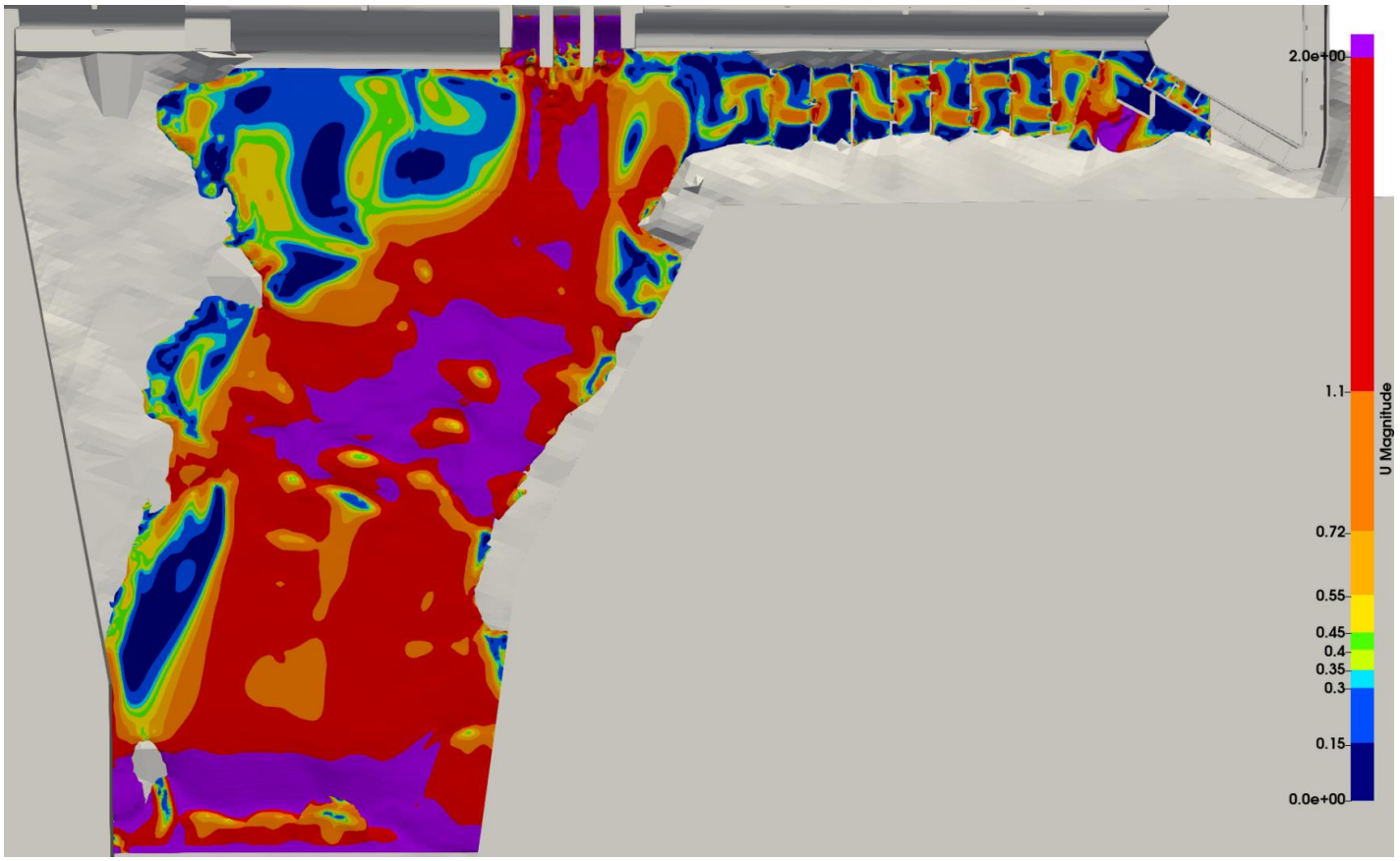


Figure S3-1: Plan view of the Water Surface Velocities

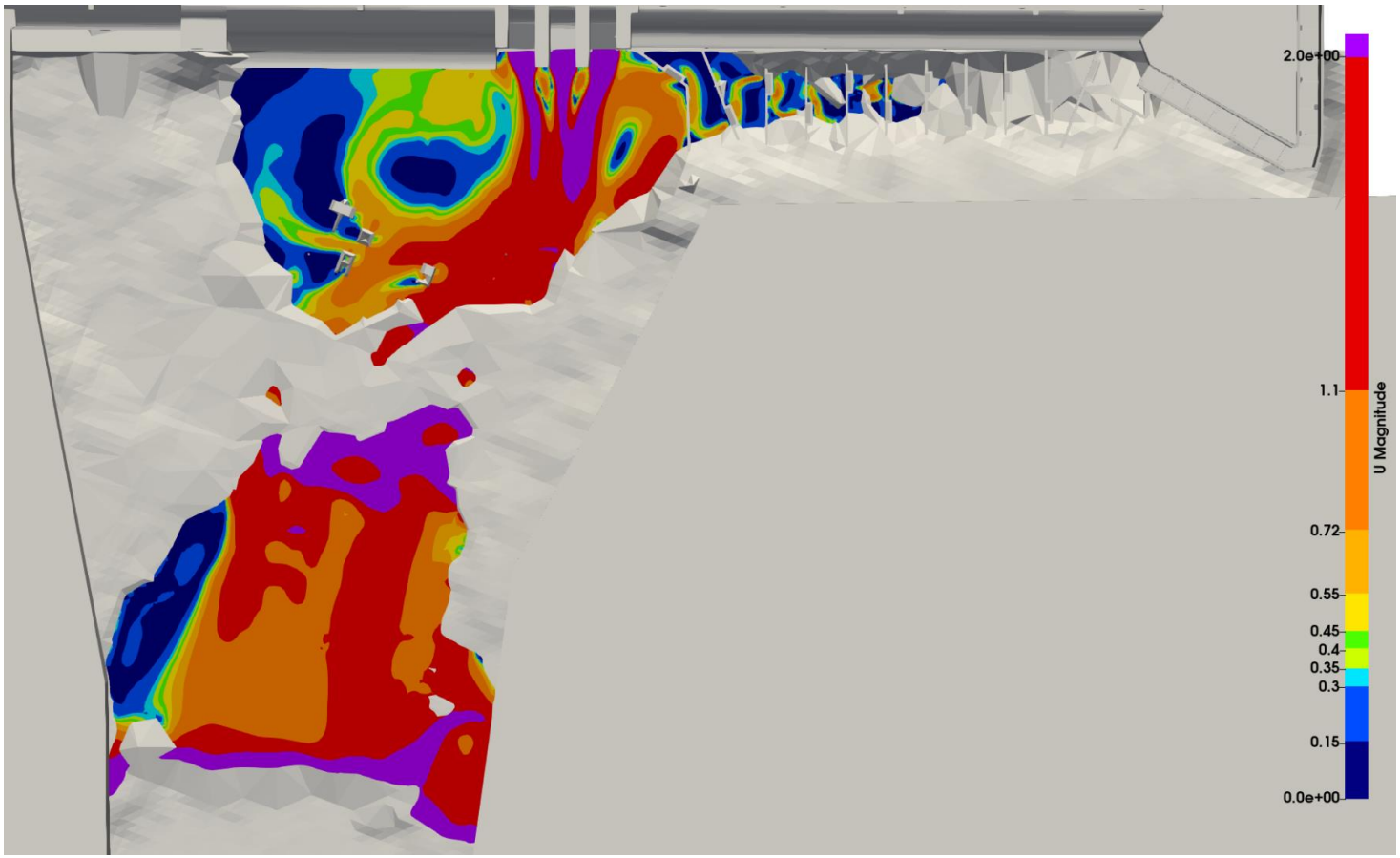


Figure S3-2: Plan view of the Mid-Surface Velocities

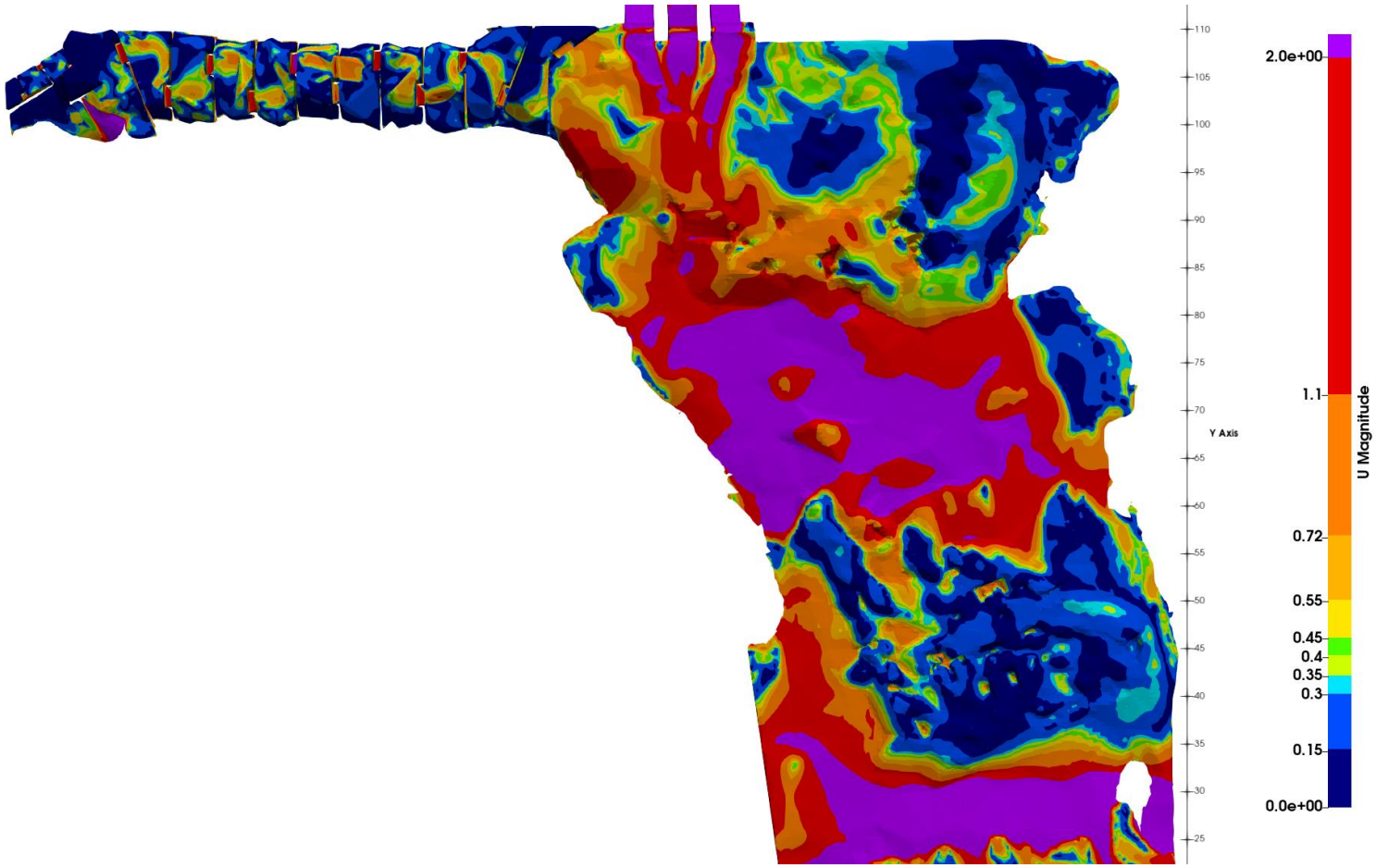


Figure S3-3: View of the Bottom Velocities

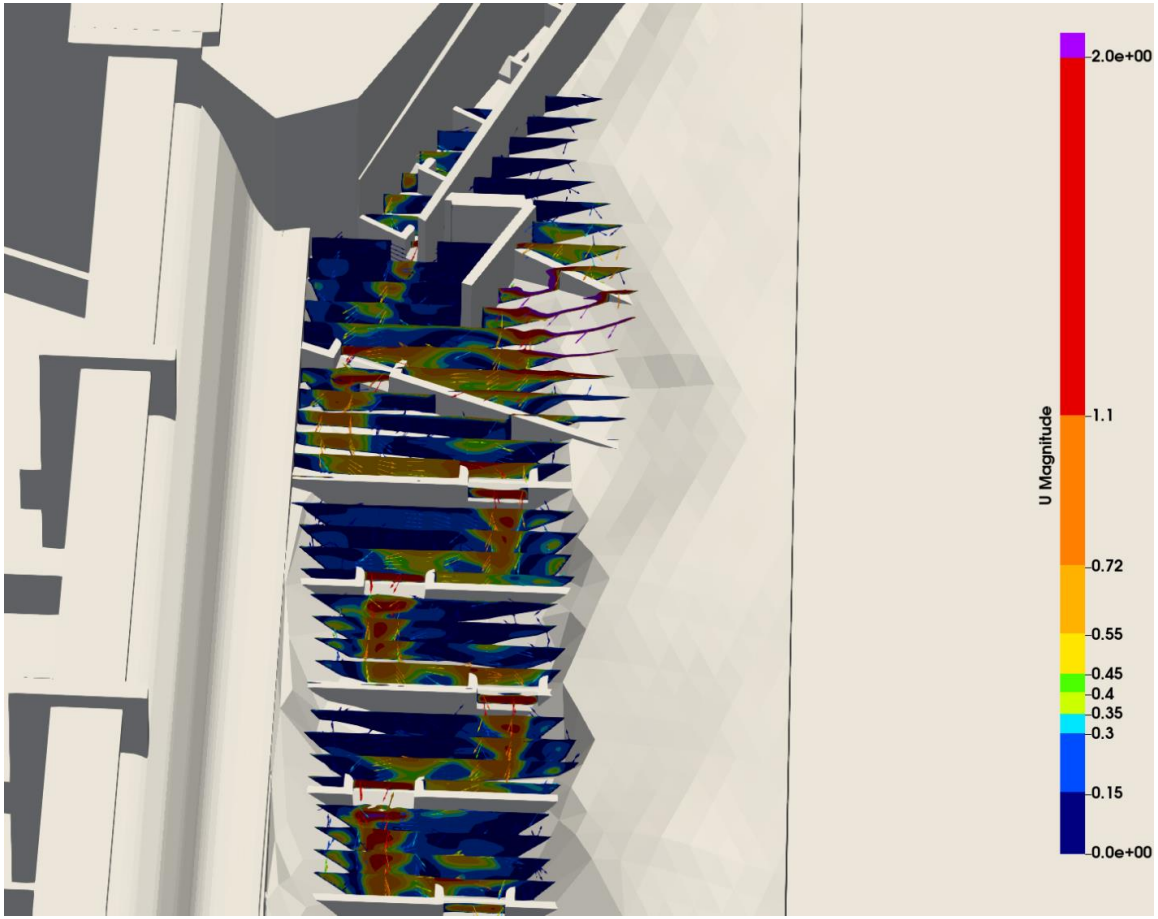


Figure S3-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

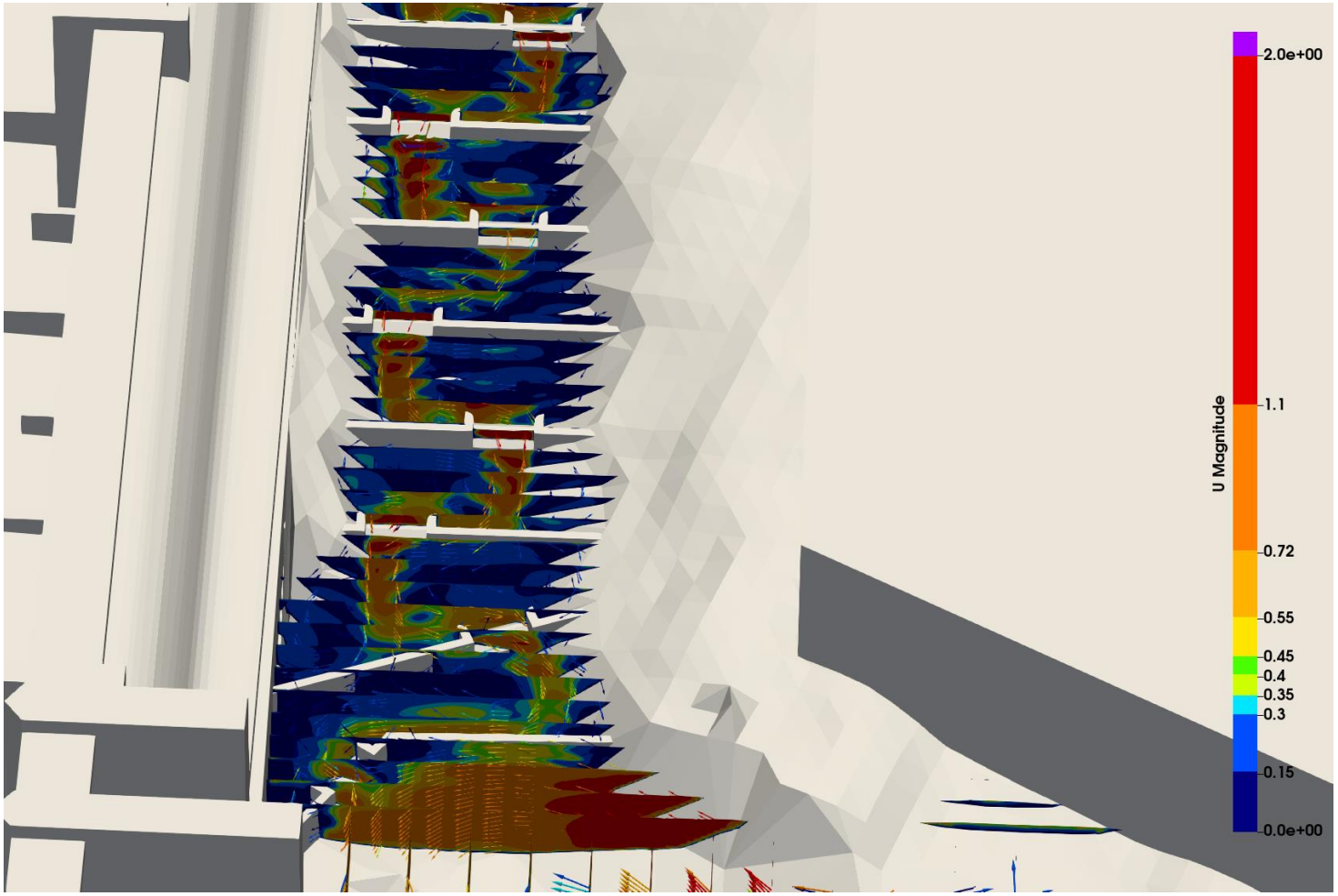


Figure S3-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

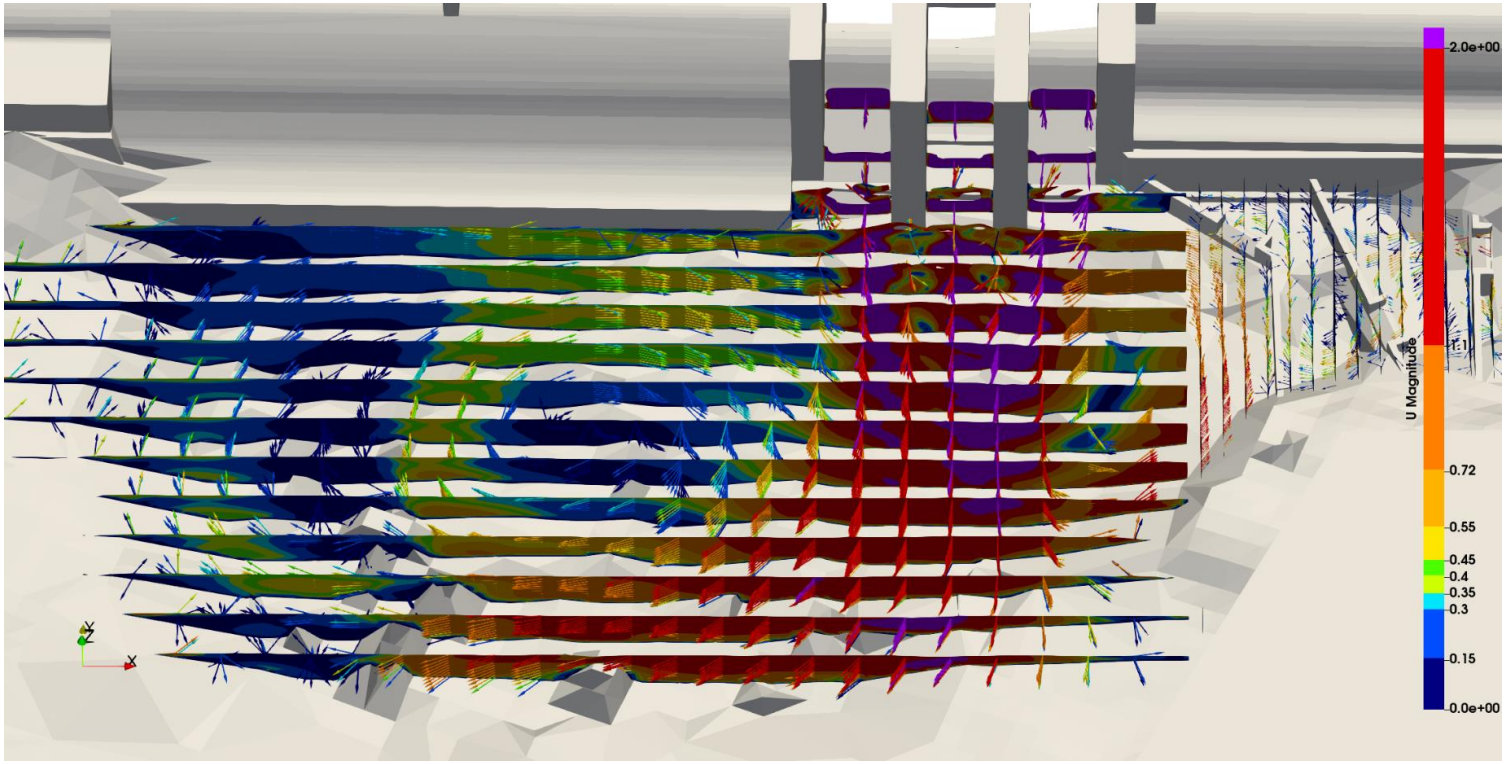


Figure S3-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

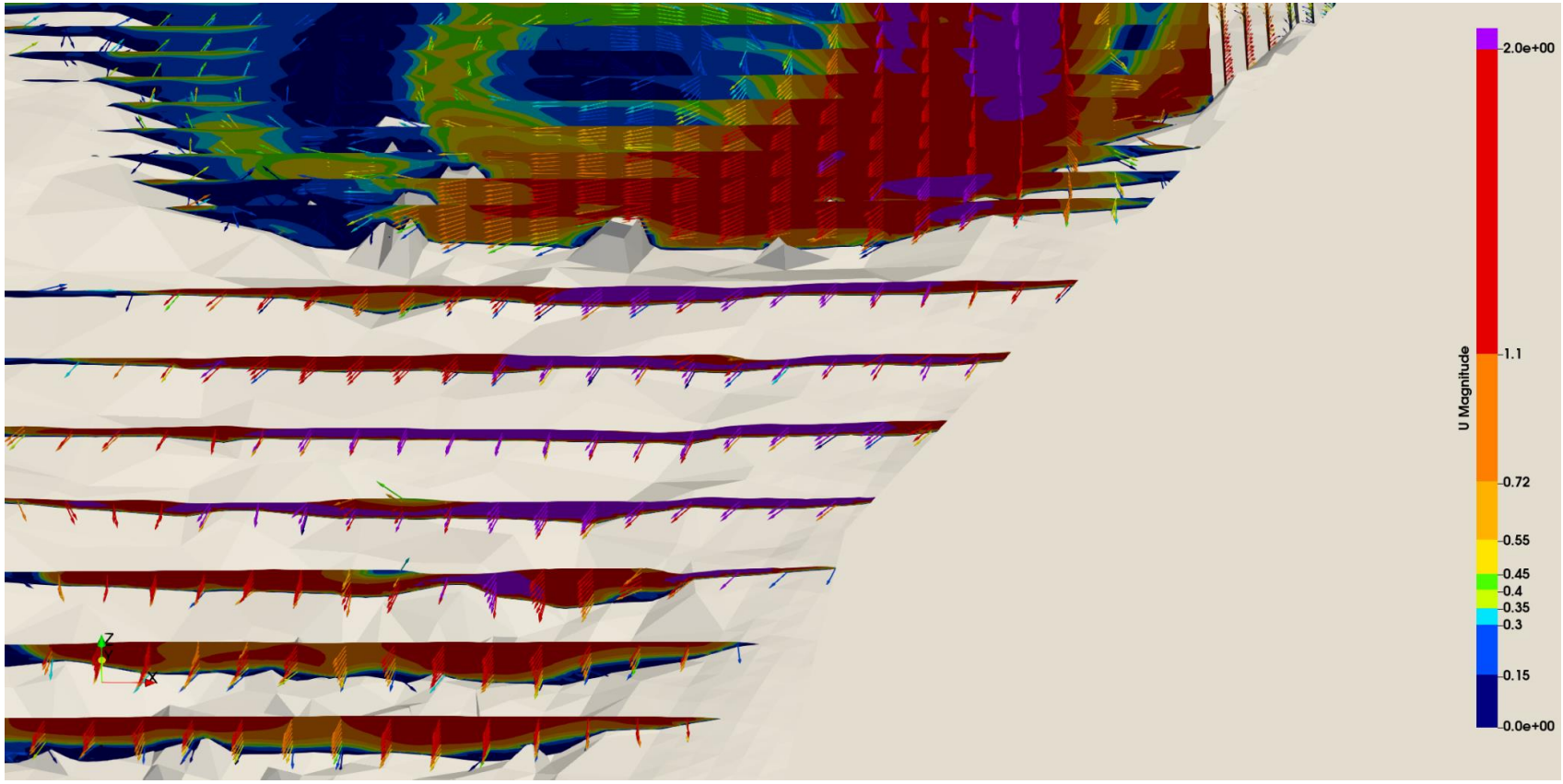


Figure S3-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

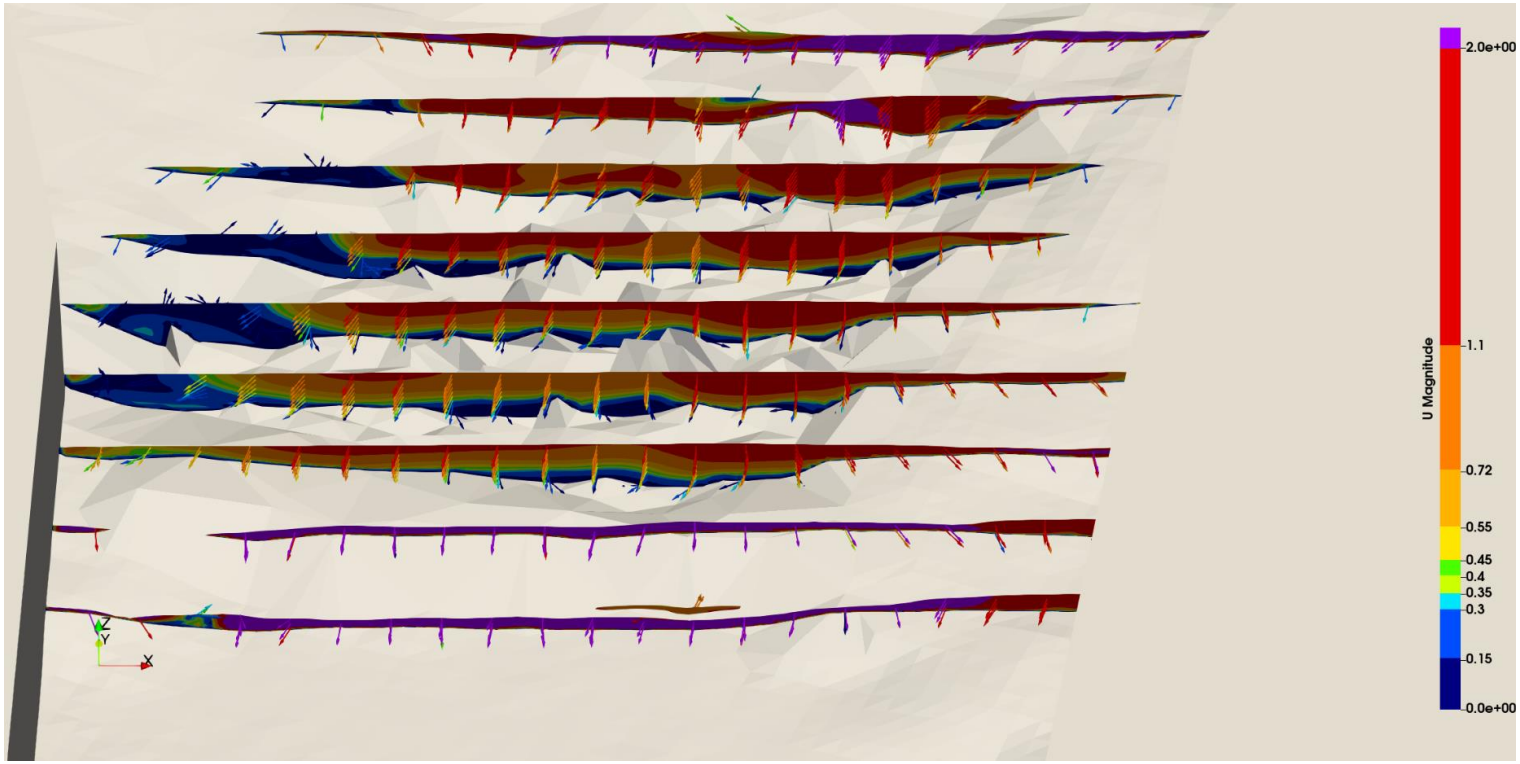


Figure S3-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

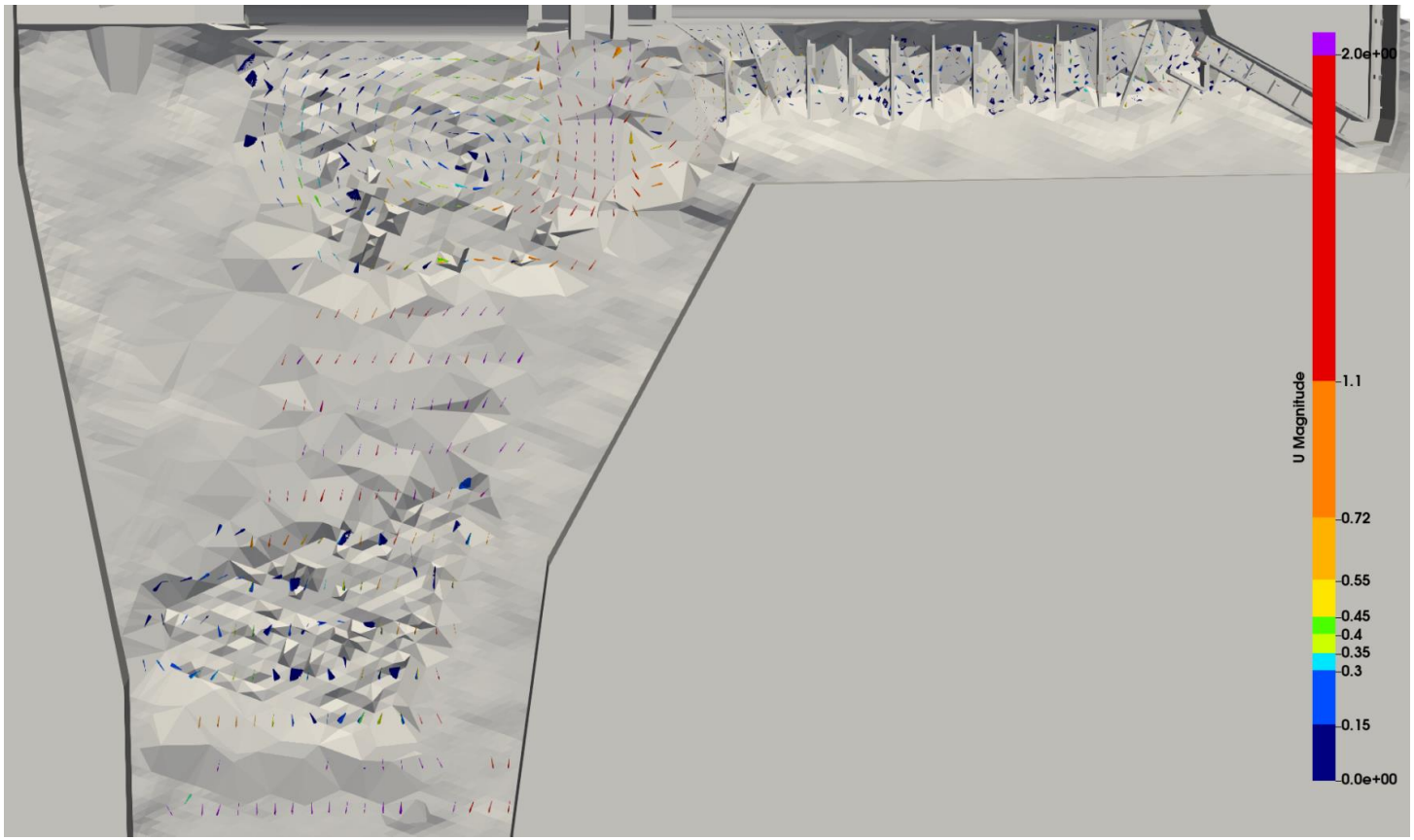


Figure S3-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

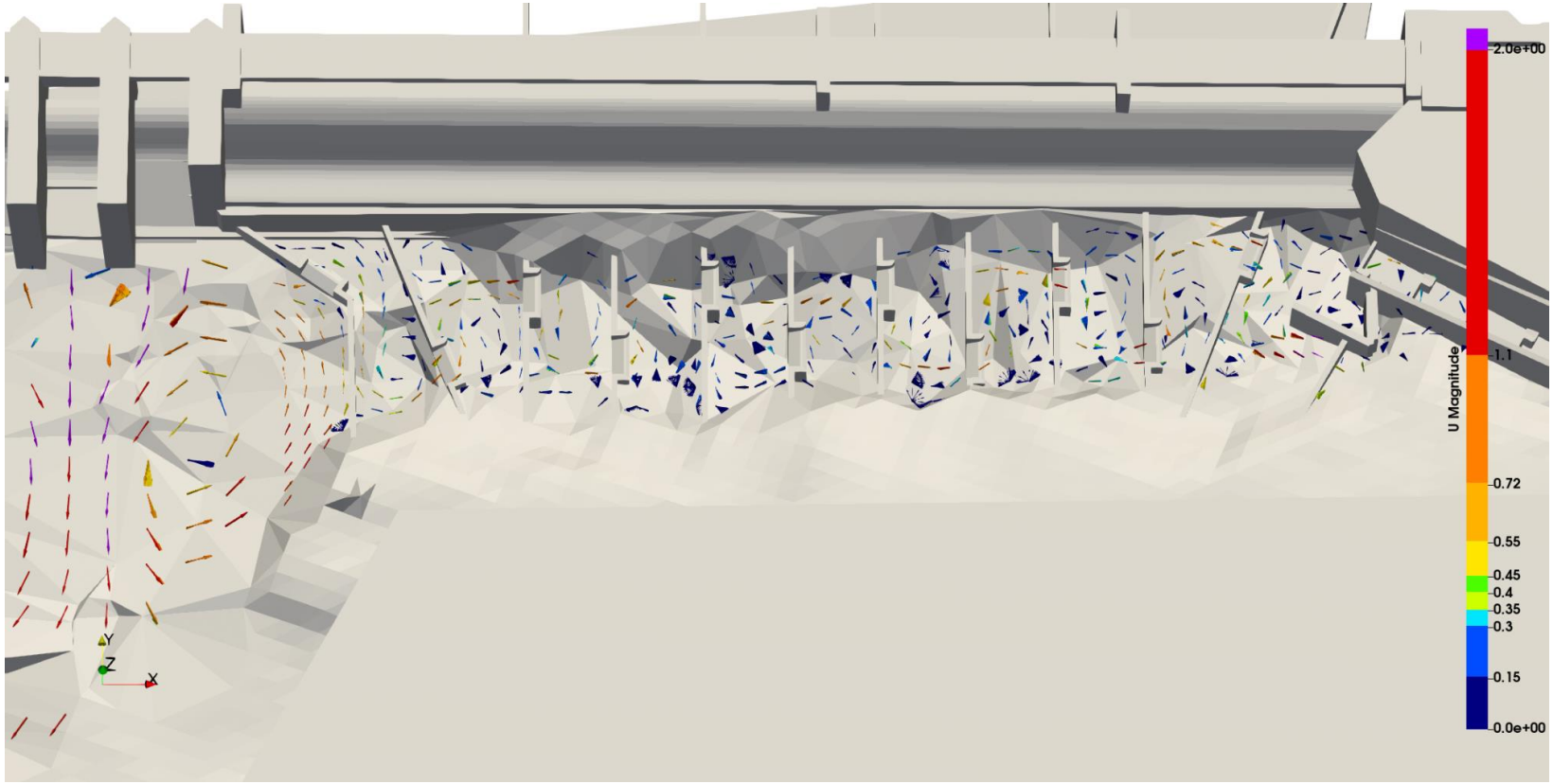


Figure S3-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

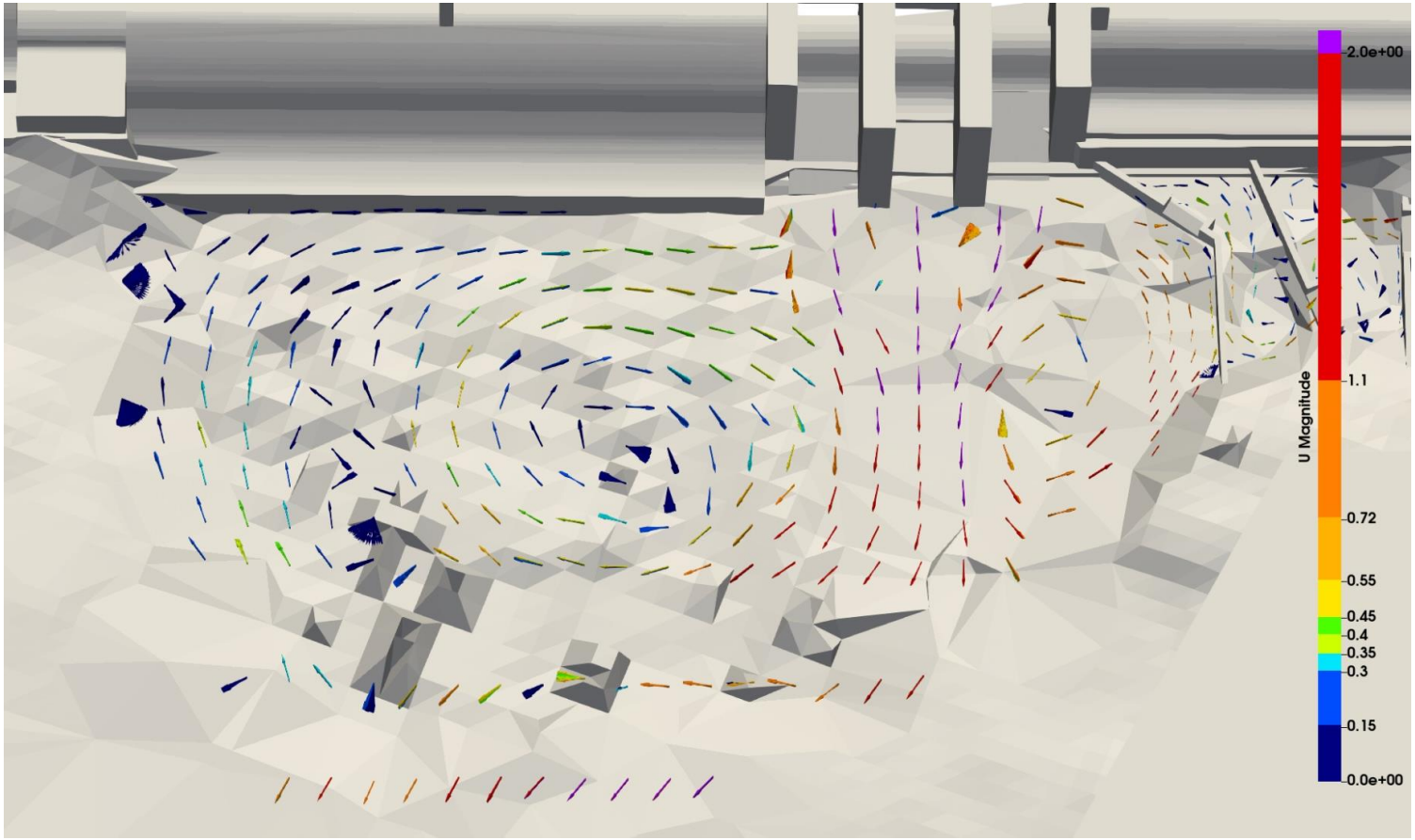


Figure S3-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

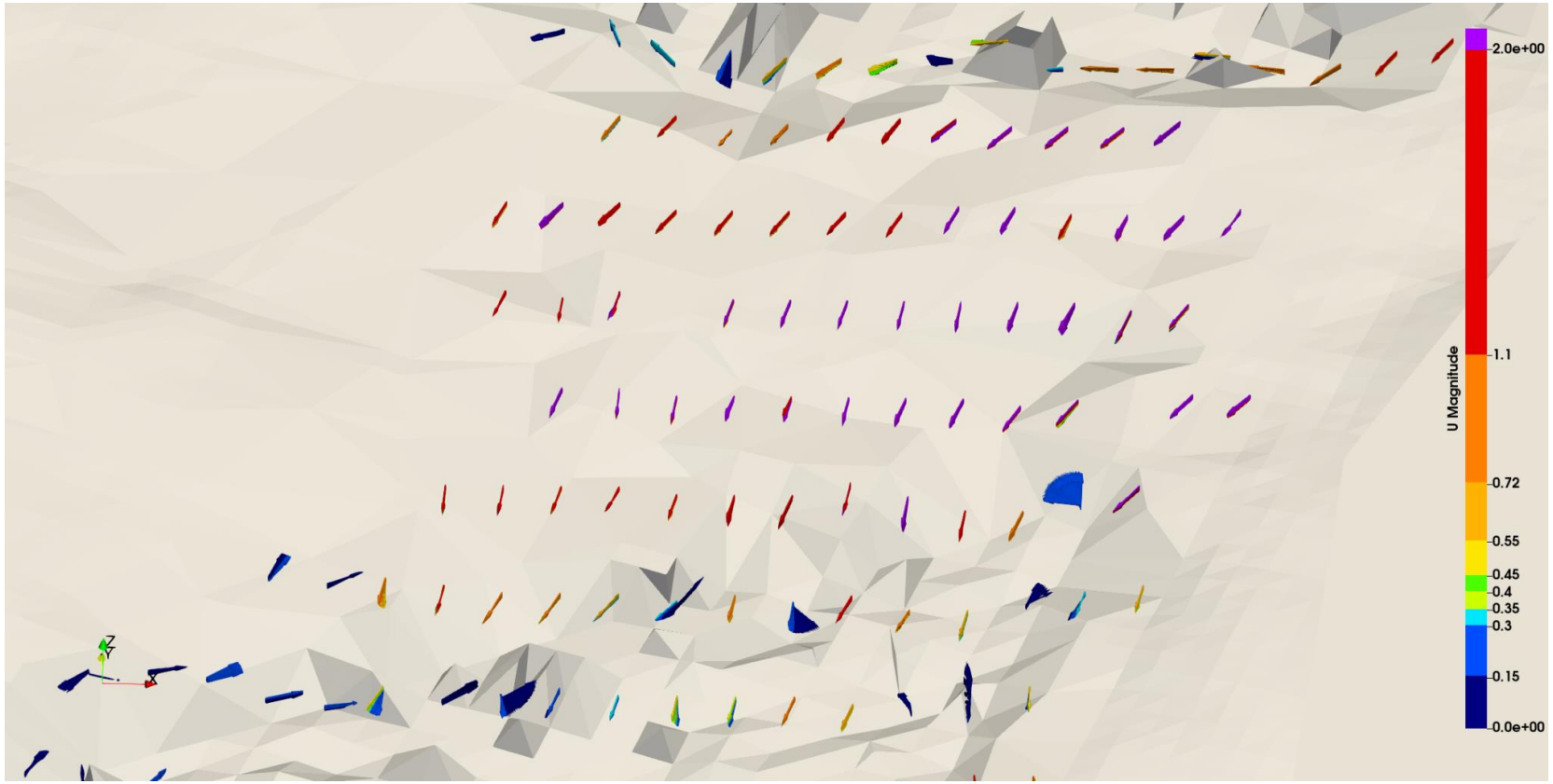


Figure S3-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

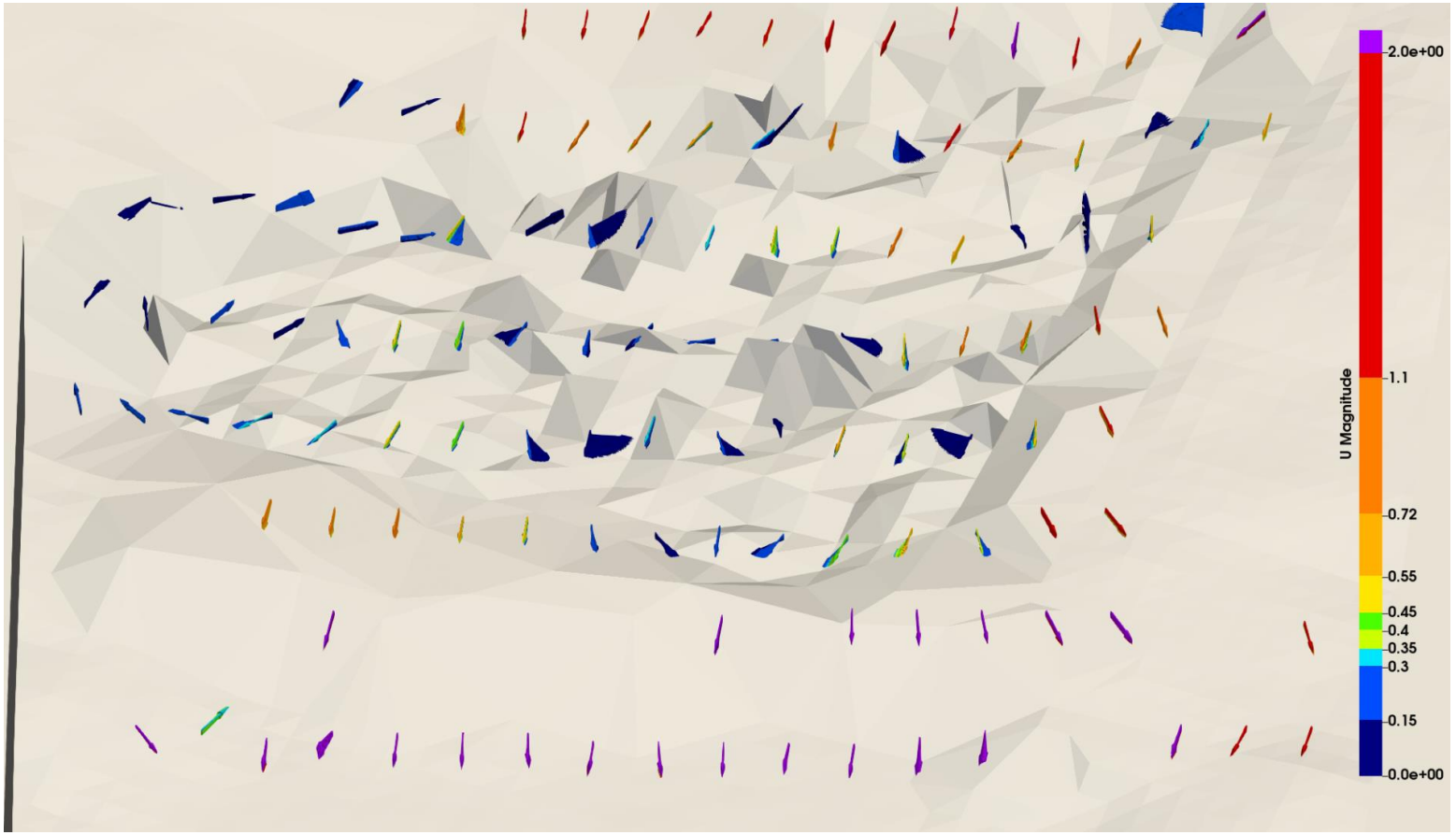


Figure S3-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

4. Model Results of Scenario S4 with 1720 cfs from the gates

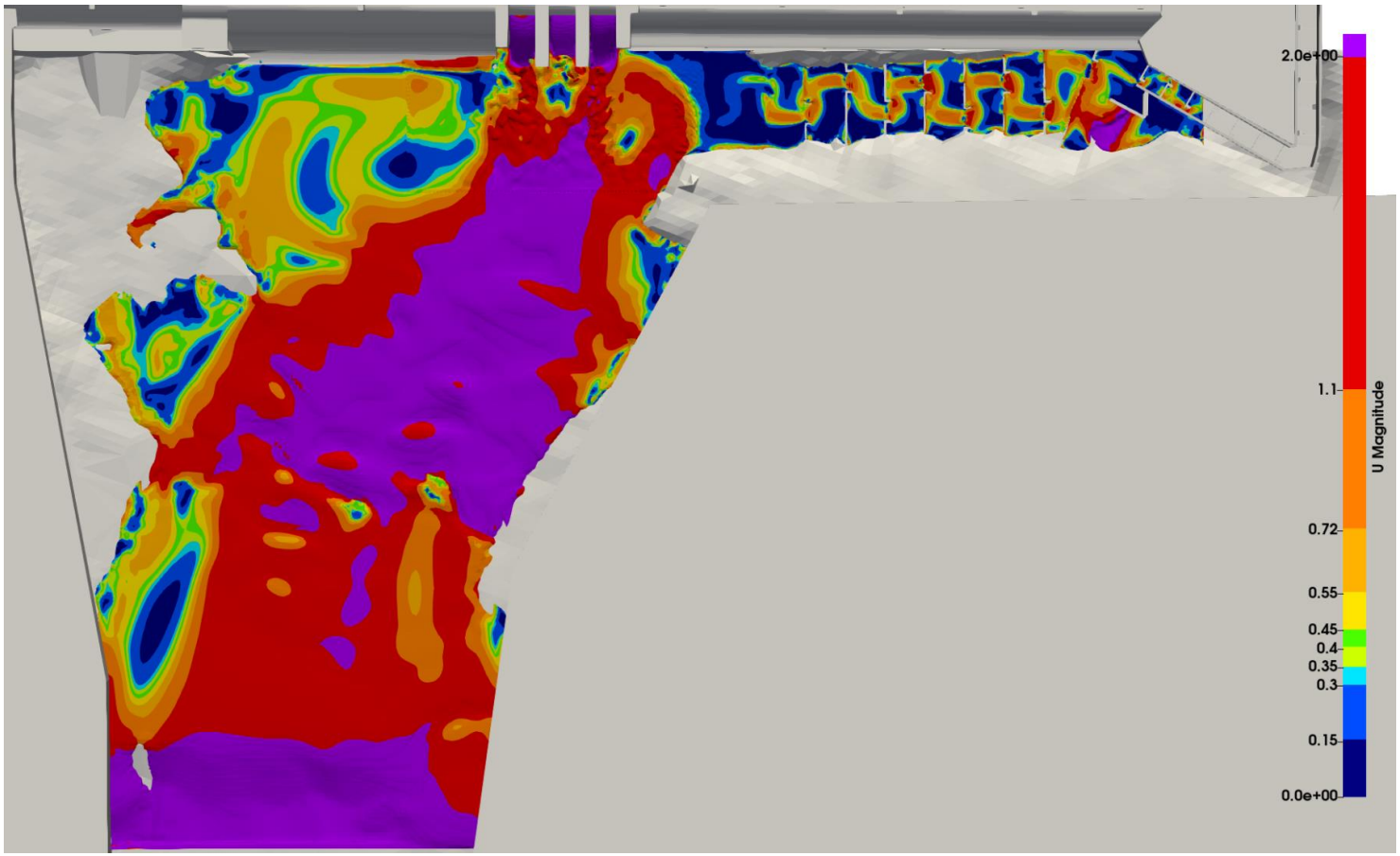


Figure S4-1: Plan view of the Water Surface Velocities

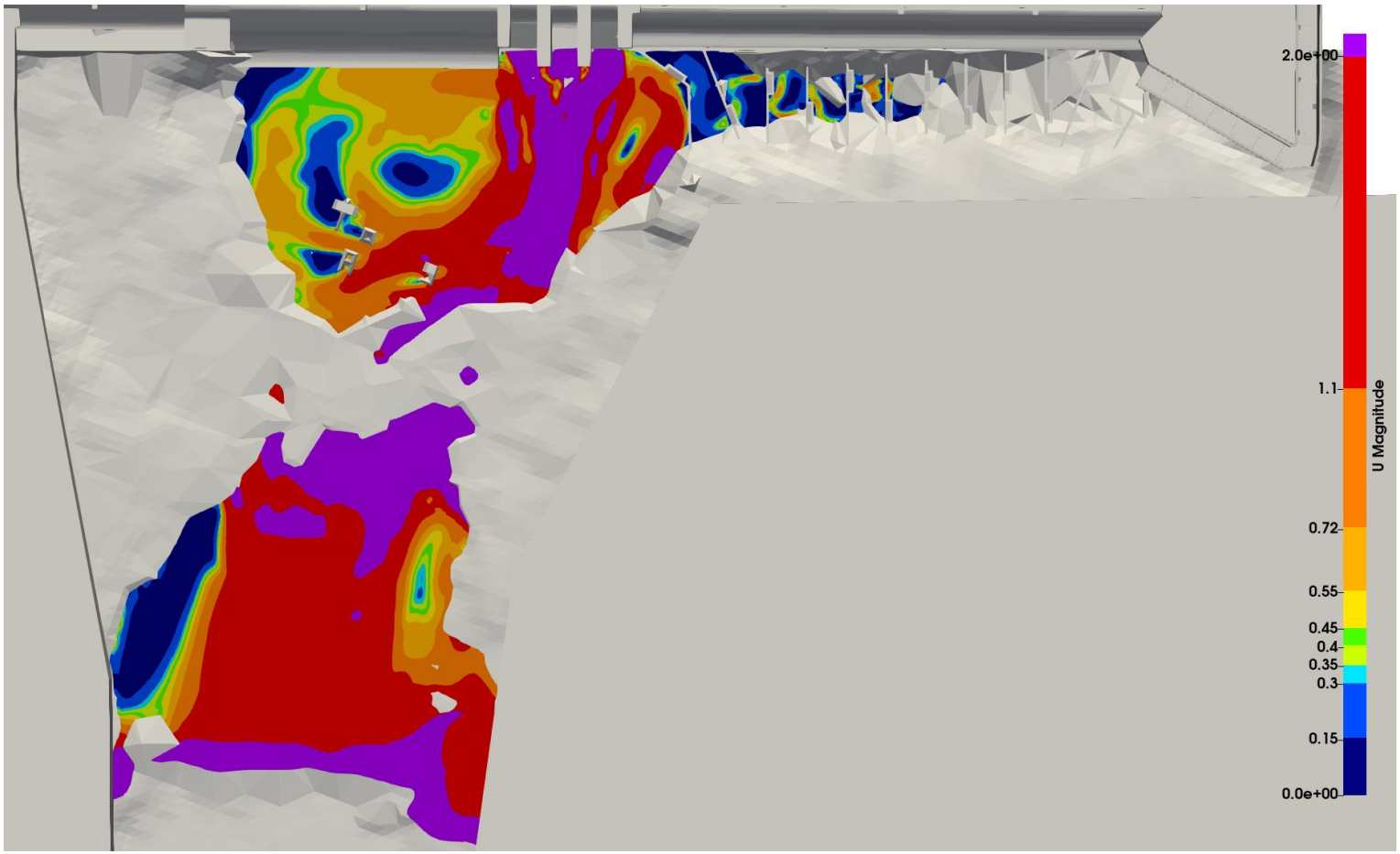


Figure S4-2: Plan view of the Mid-Surface Velocities

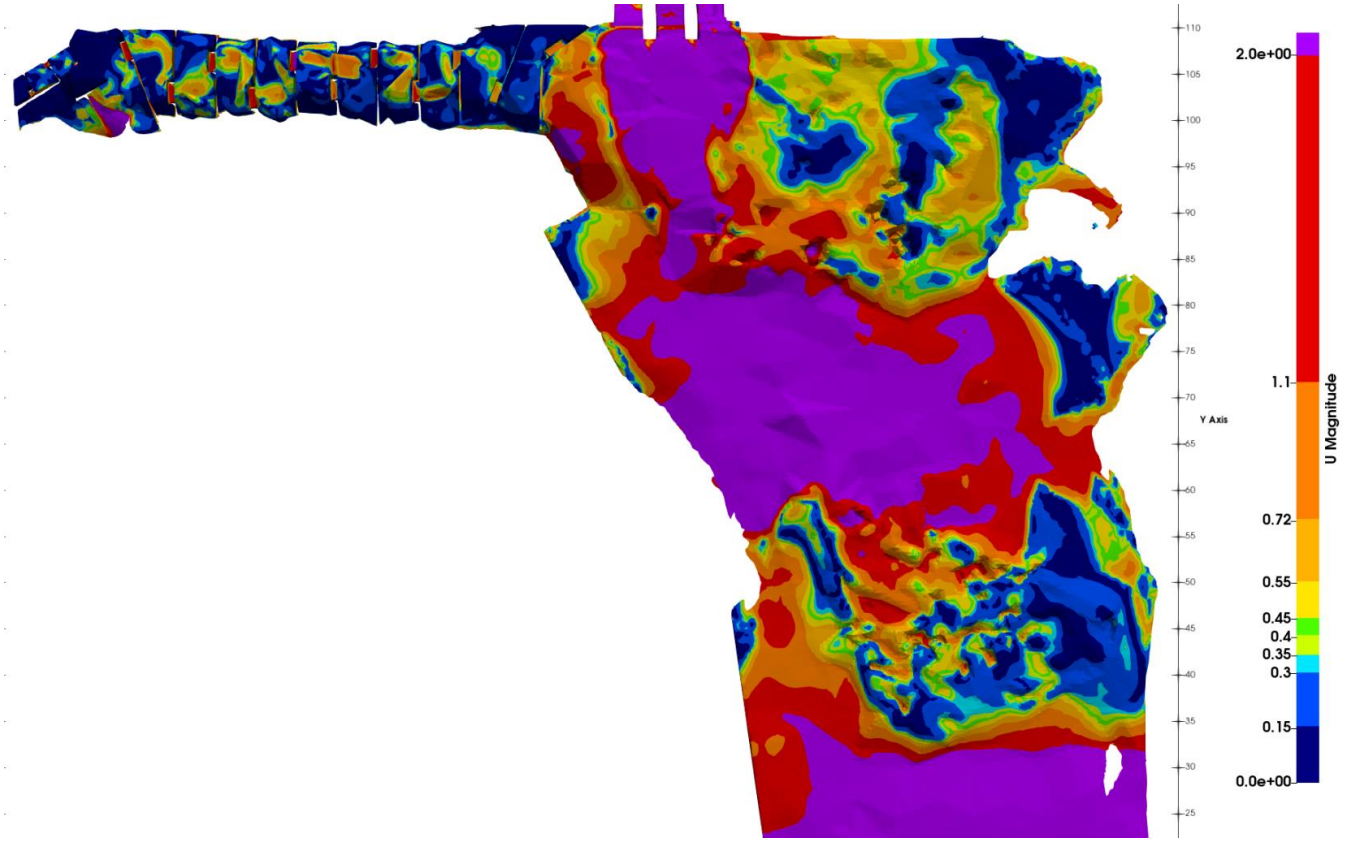


Figure S4-3: View of the Bottom Velocities

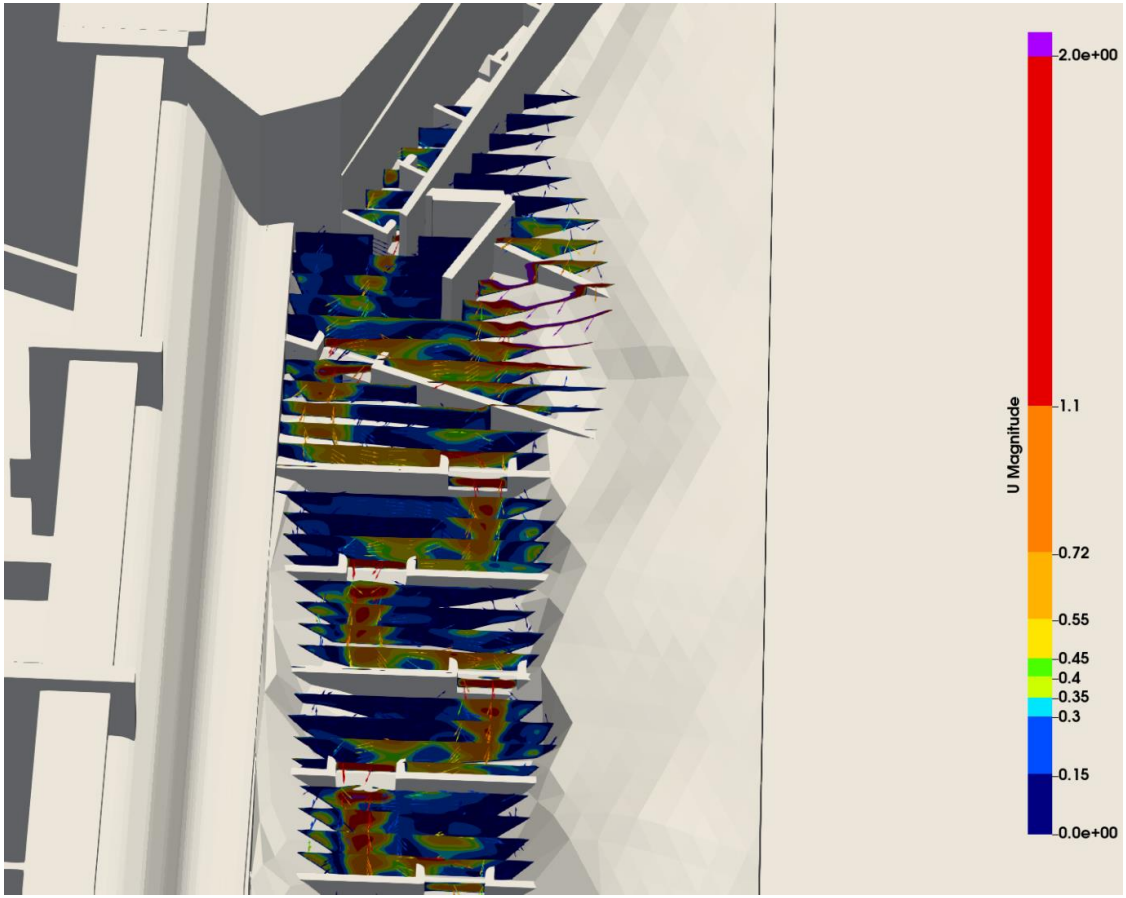


Figure S4-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

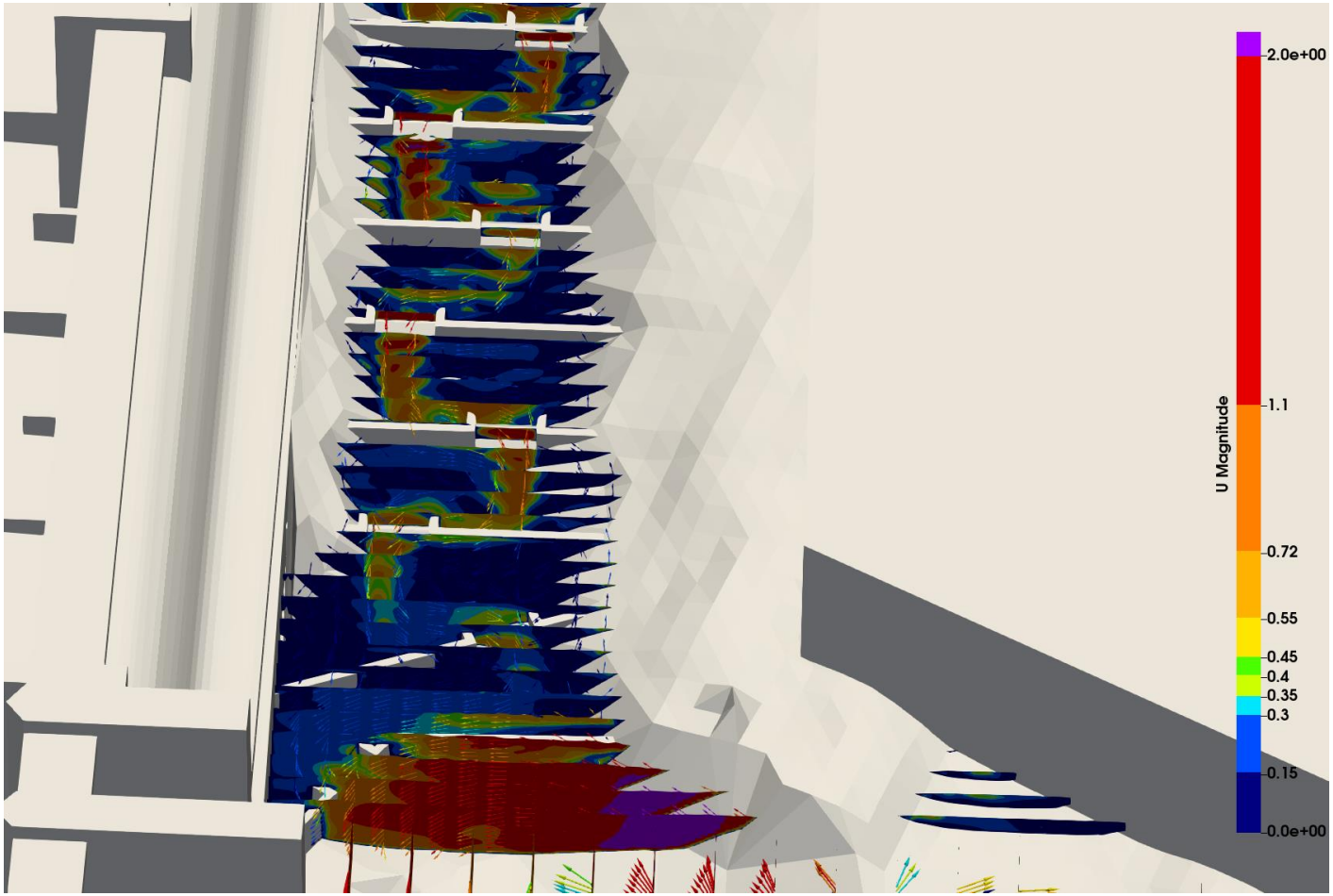


Figure S4-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

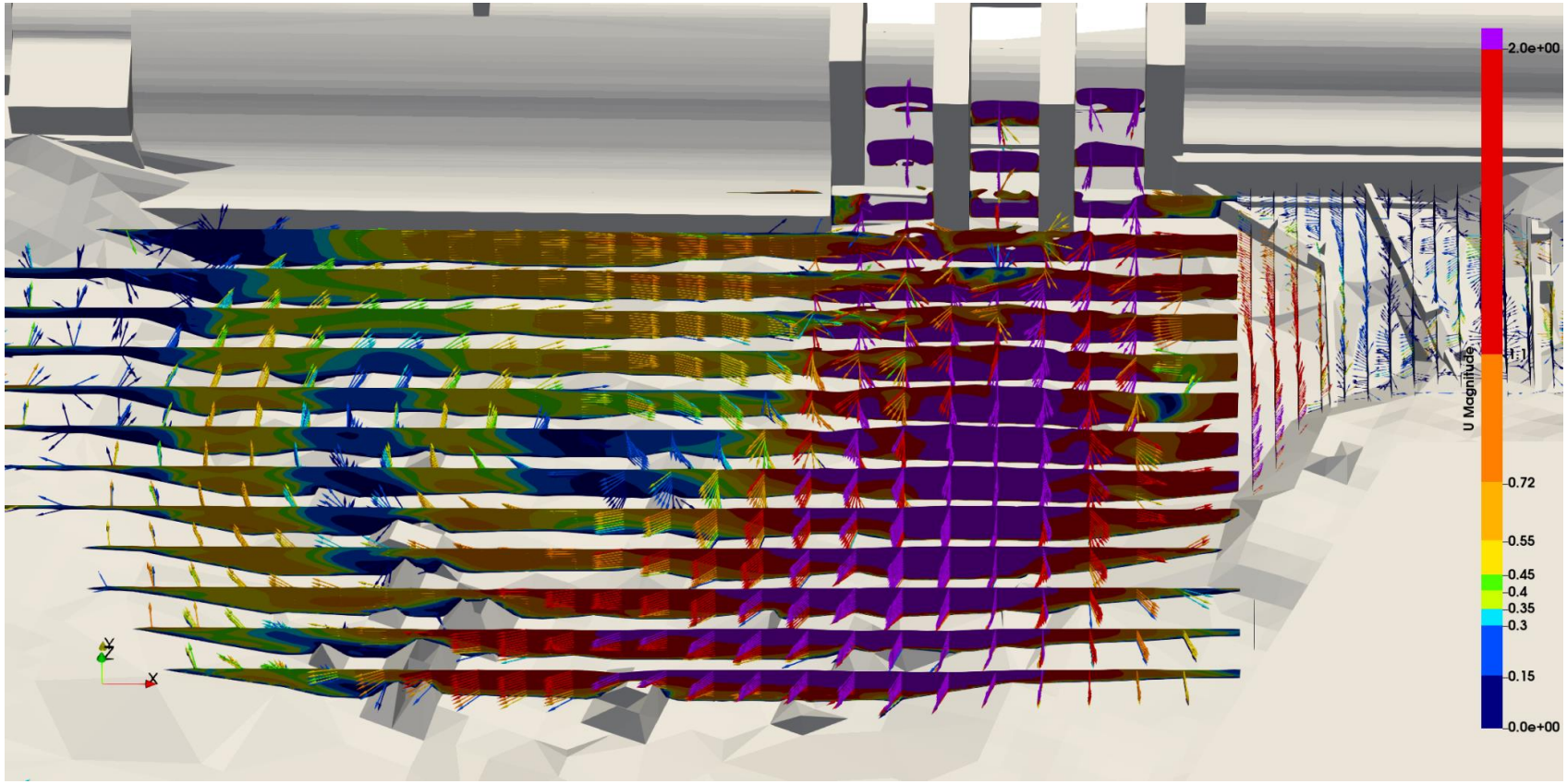


Figure S4-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

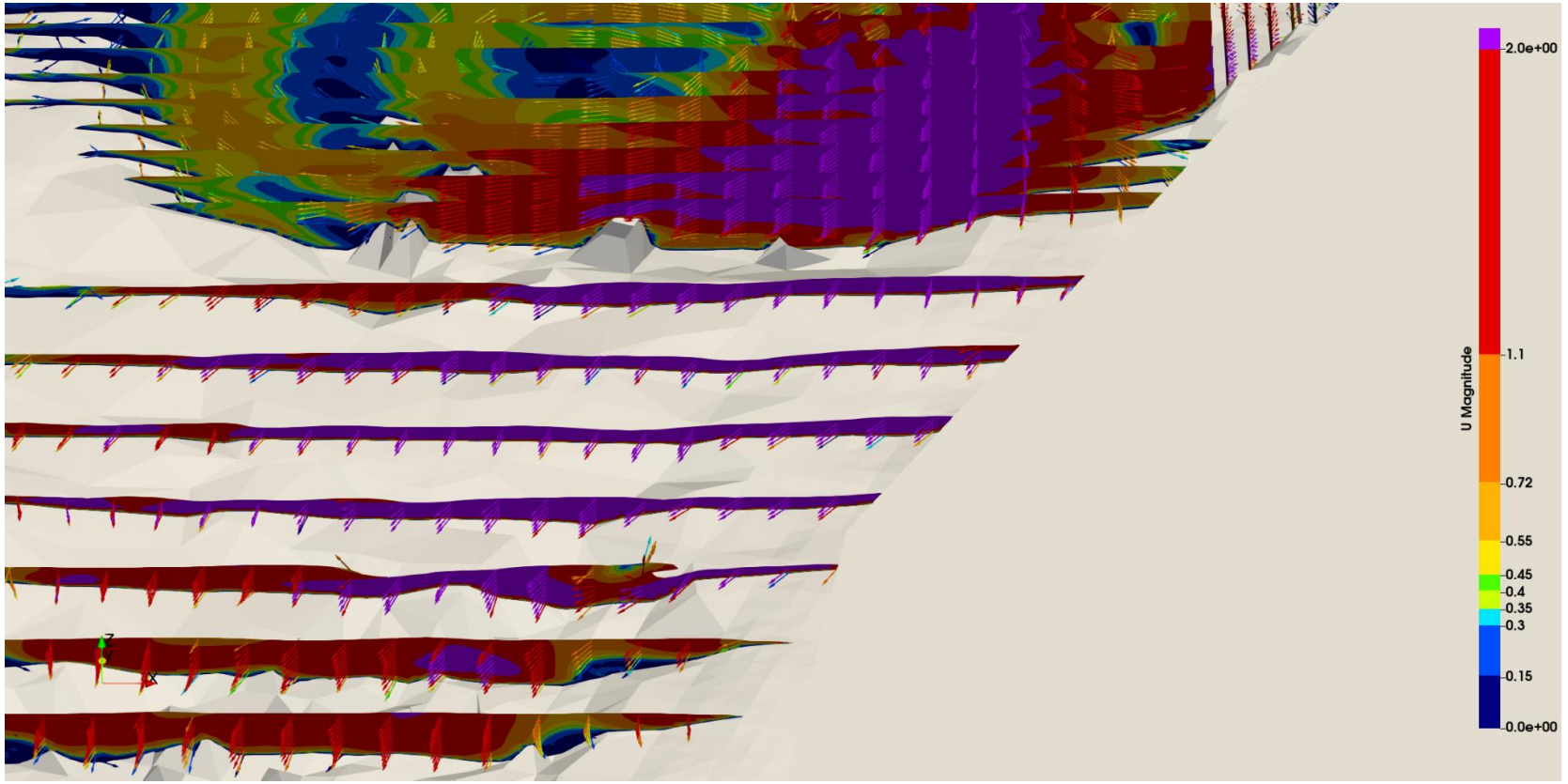


Figure S4-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

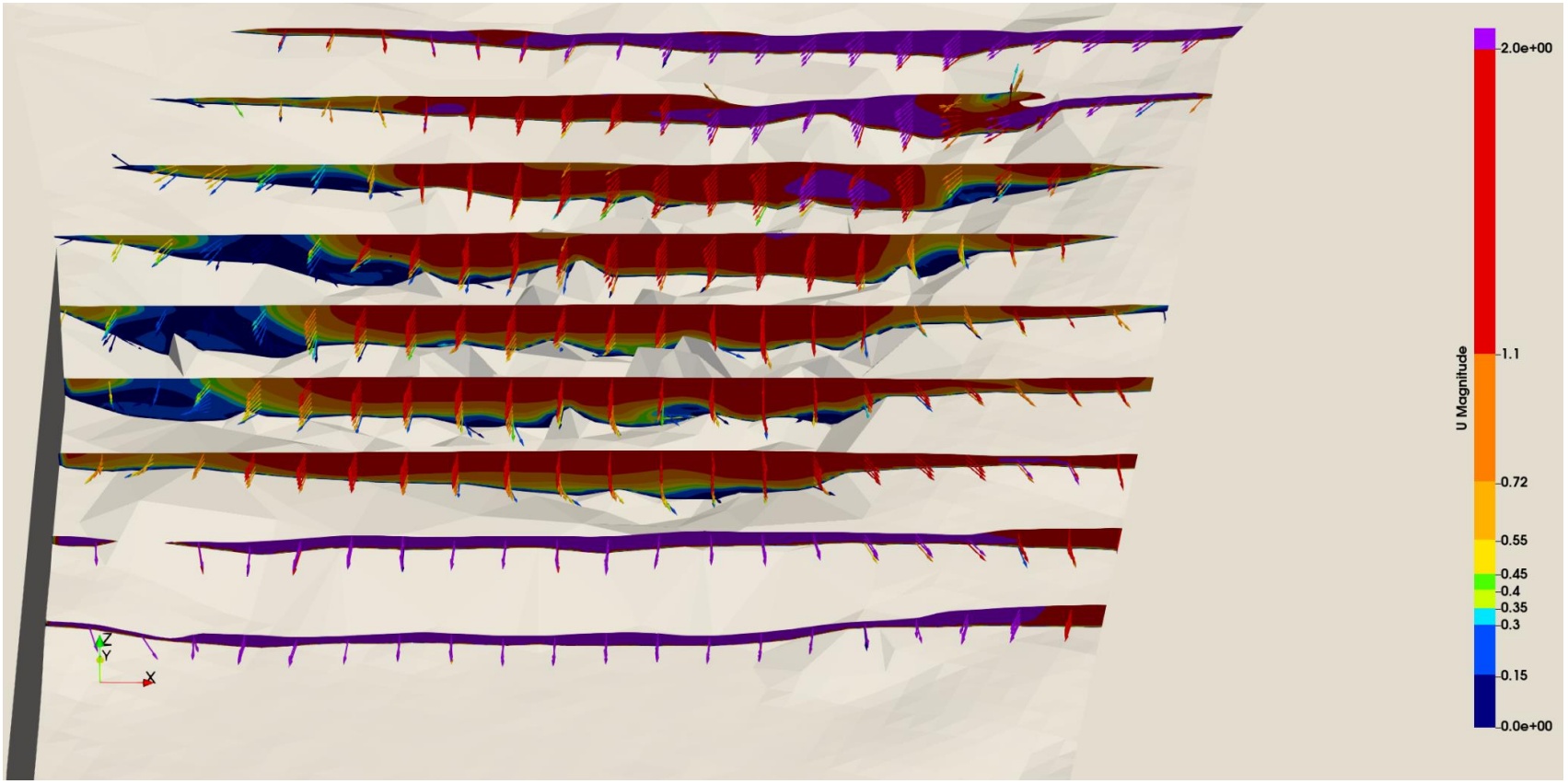


Figure S4-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

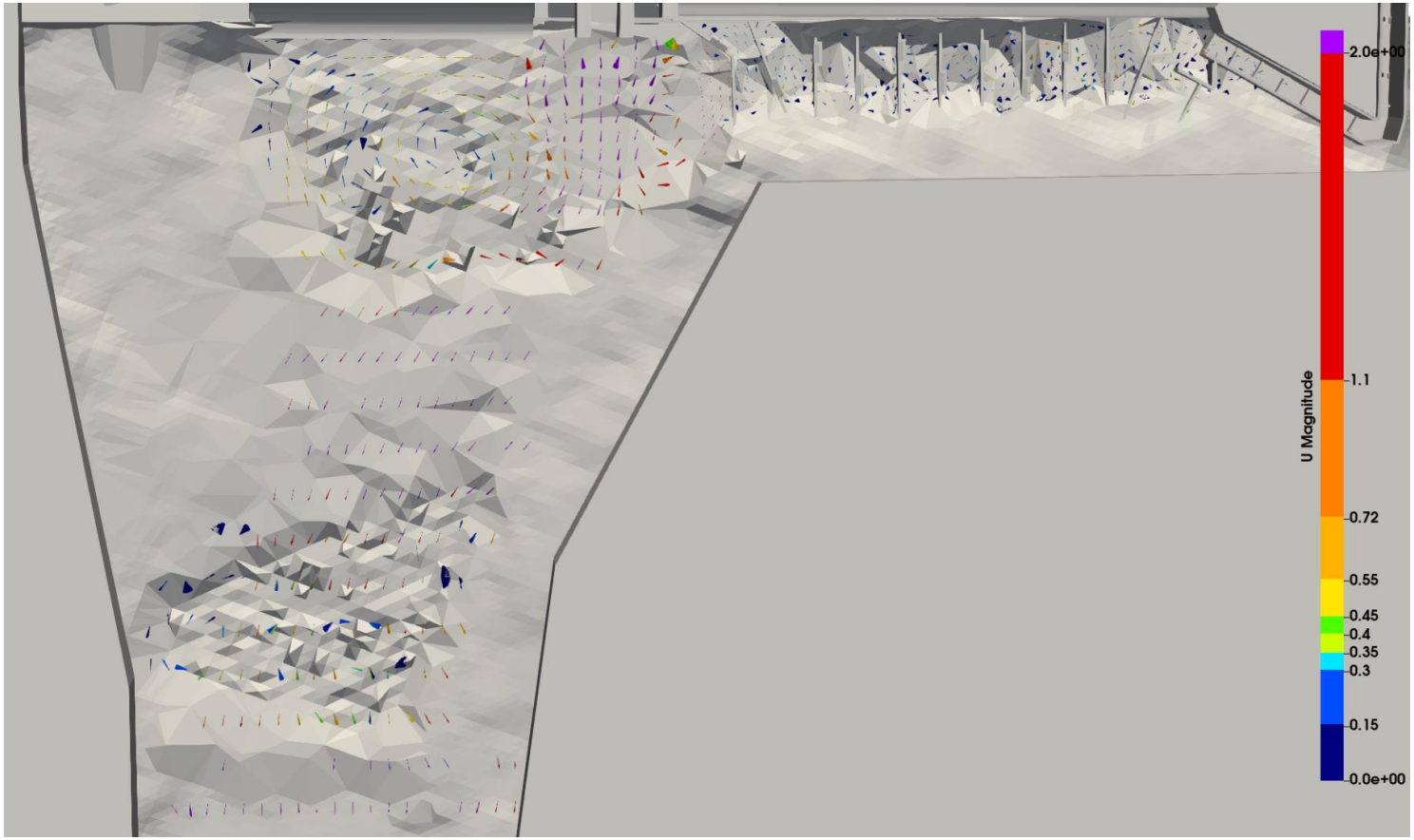


Figure S4-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

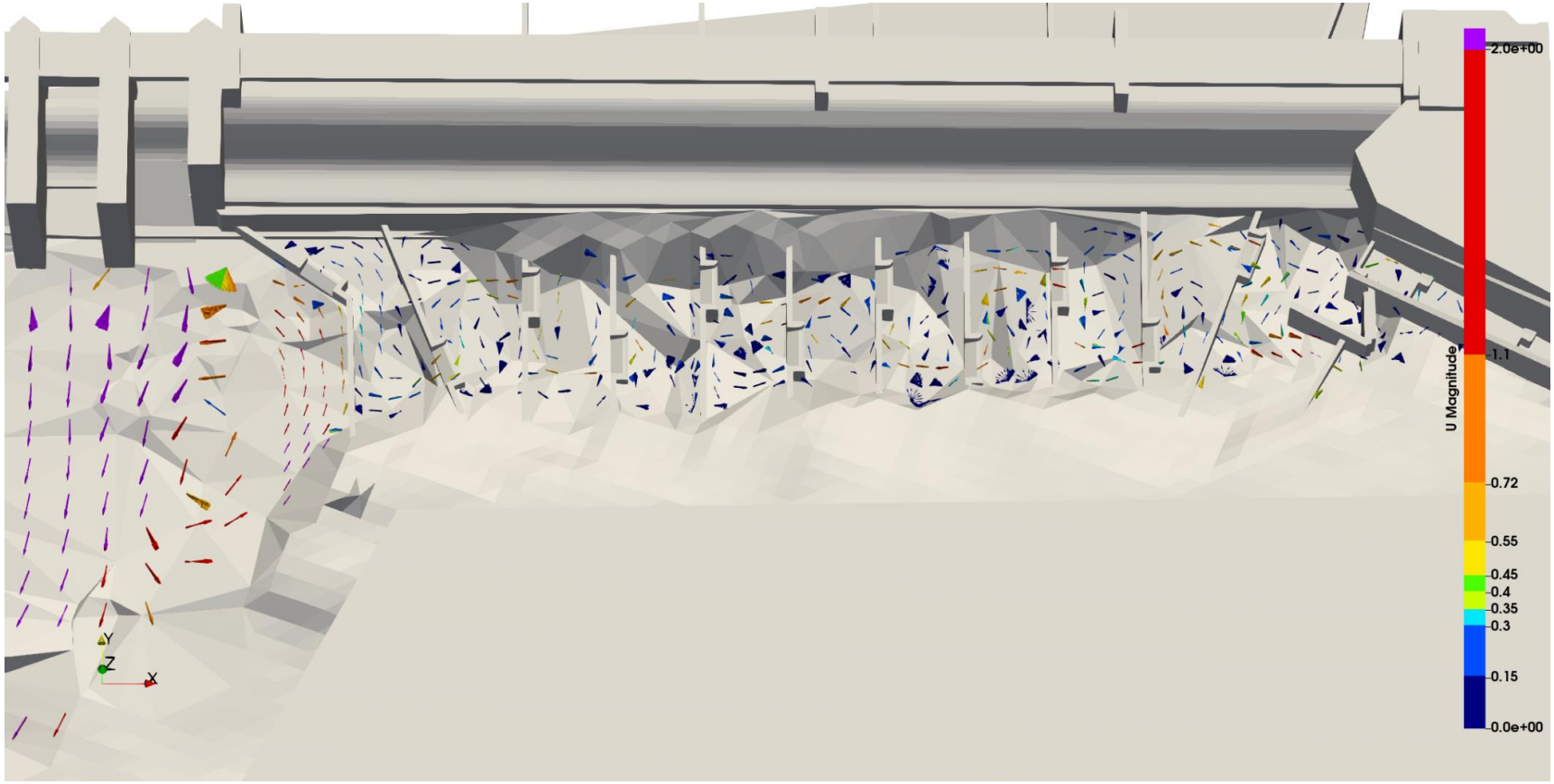


Figure S4-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

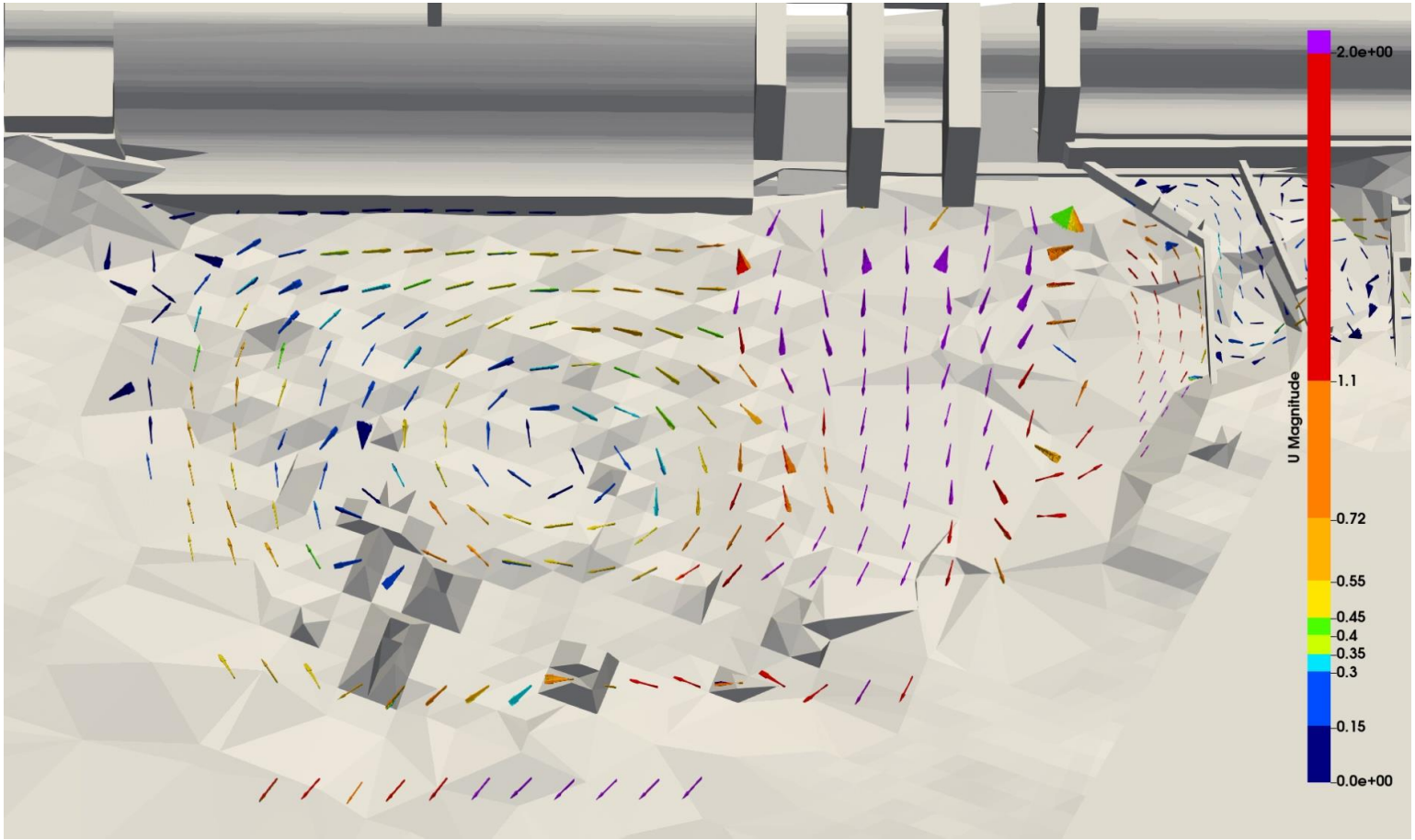


Figure S4-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

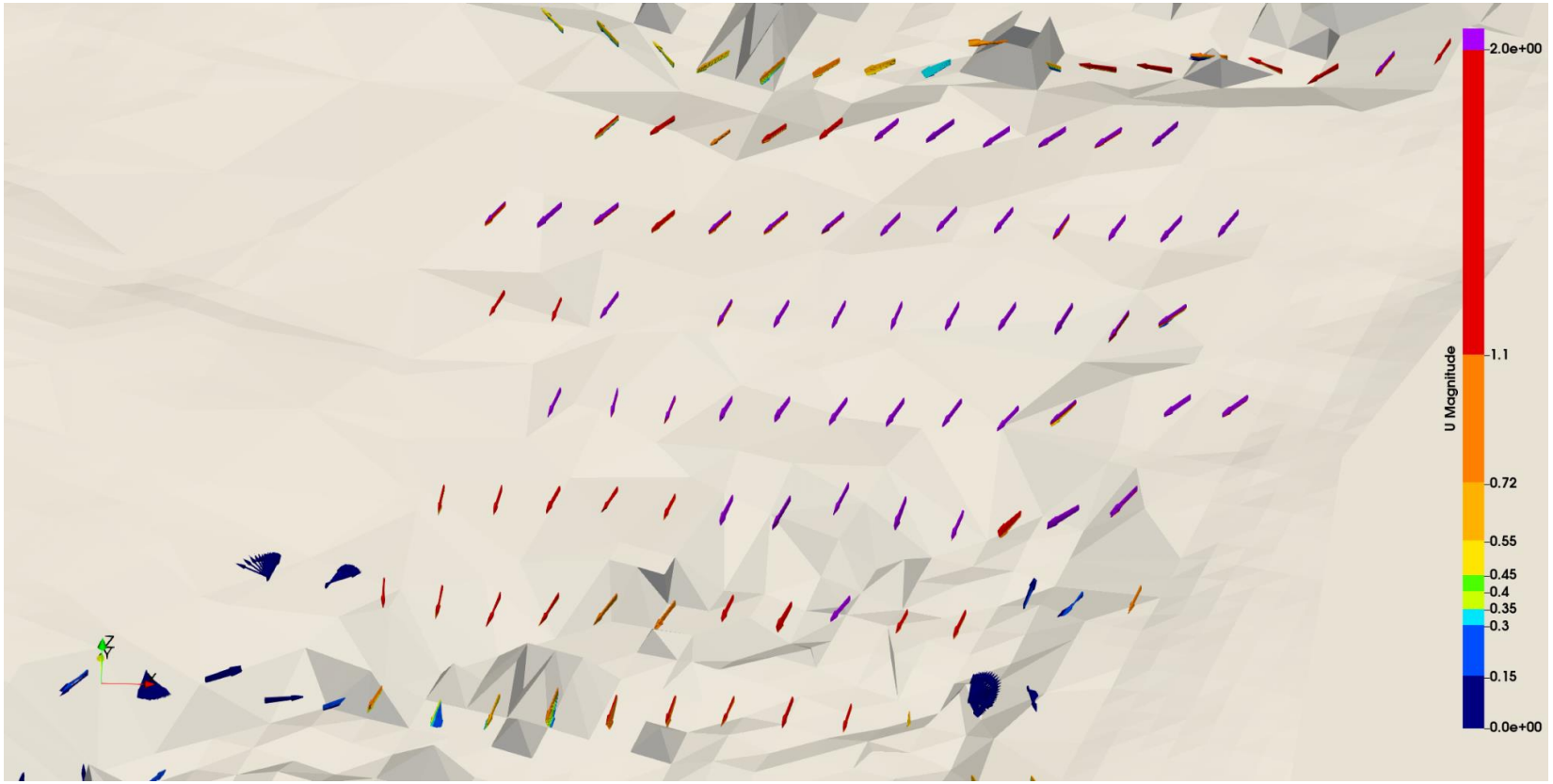


Figure S4-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

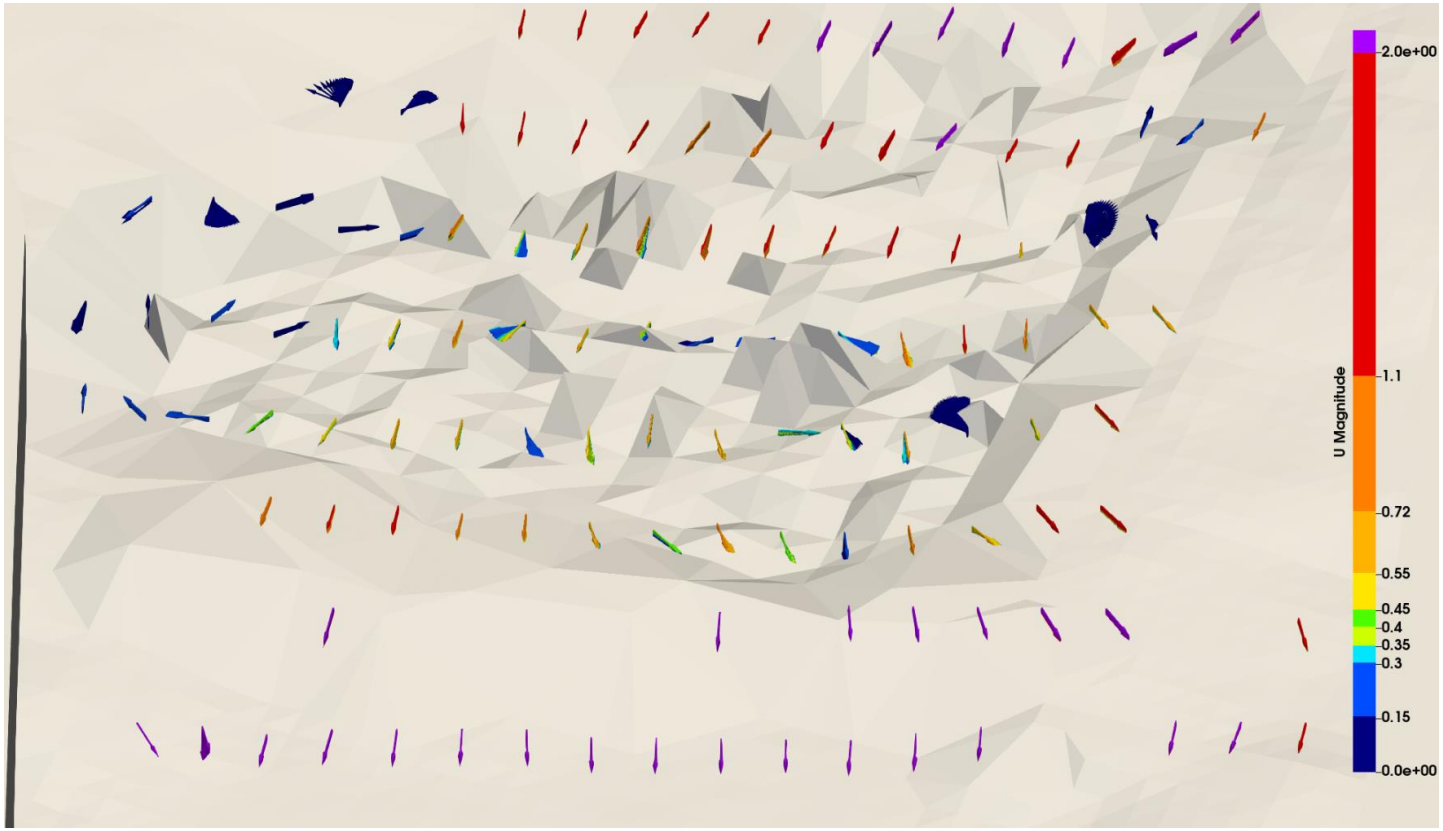


Figure S4-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

5. Model Results of Scenario S5 with 3051 cfs from the gates

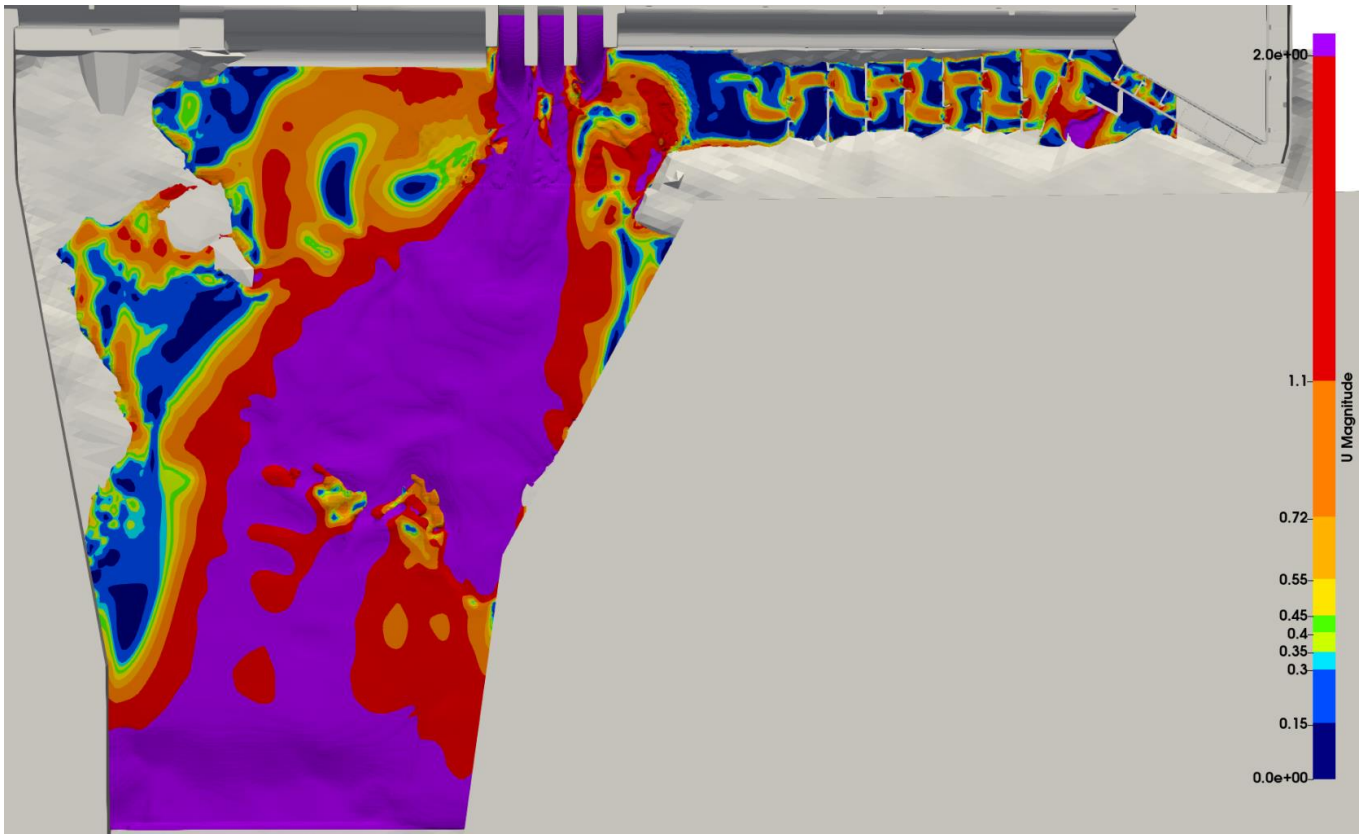


Figure S5-1: Plan view of the Water Surface Velocities

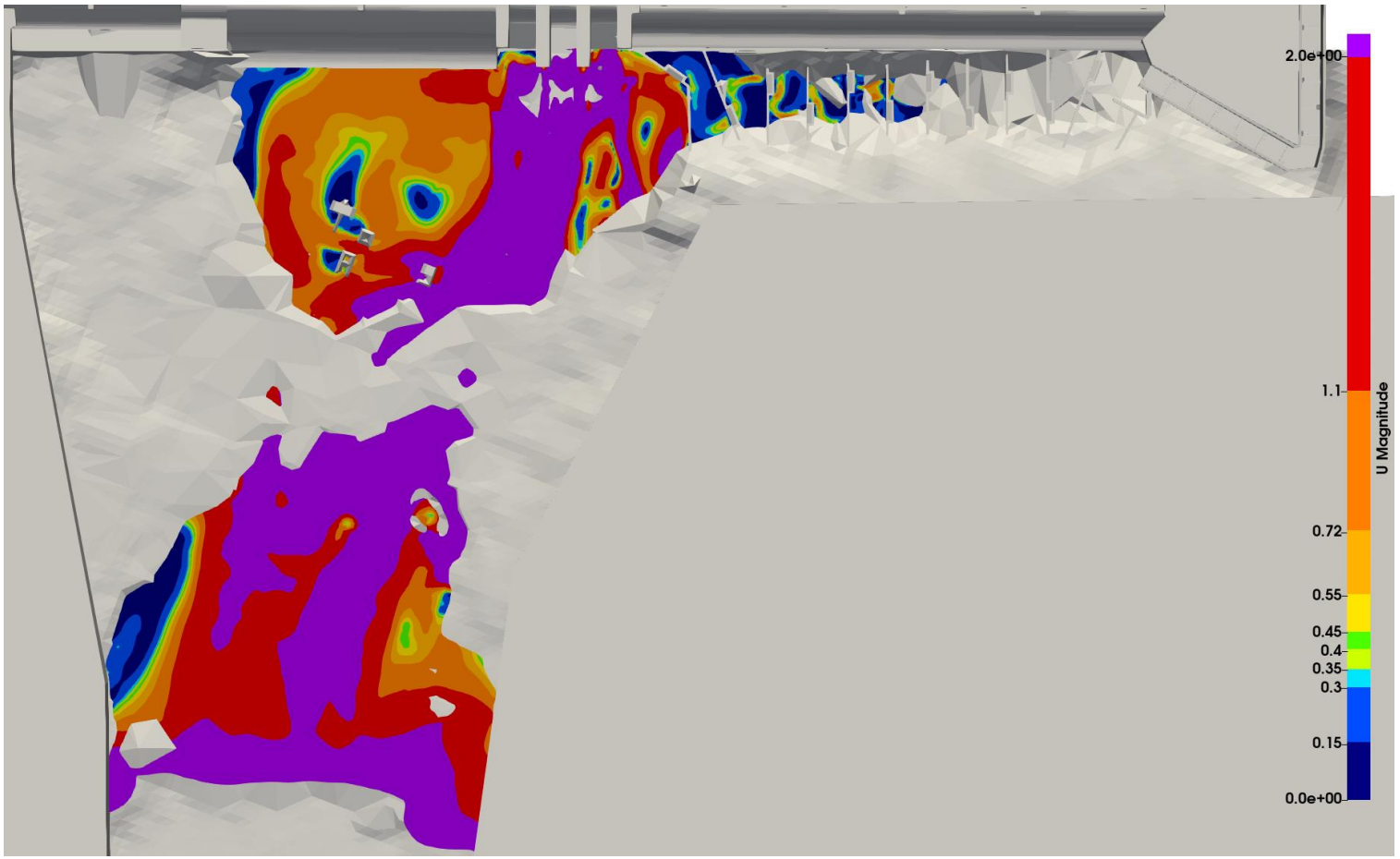


Figure S5-2: Plan view of the Mid-Surface Velocities

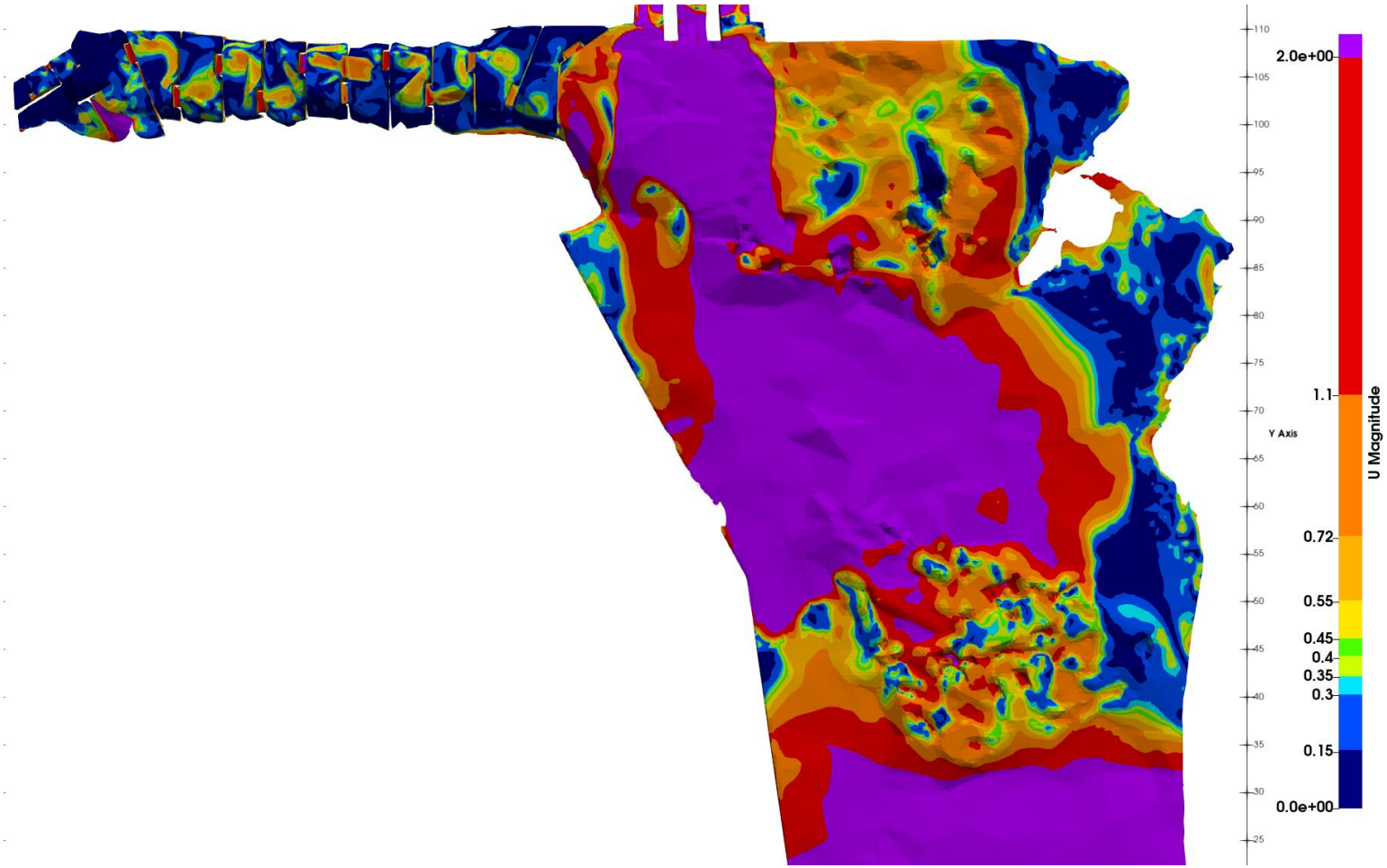


Figure S5-3: View of the Bottom Velocities

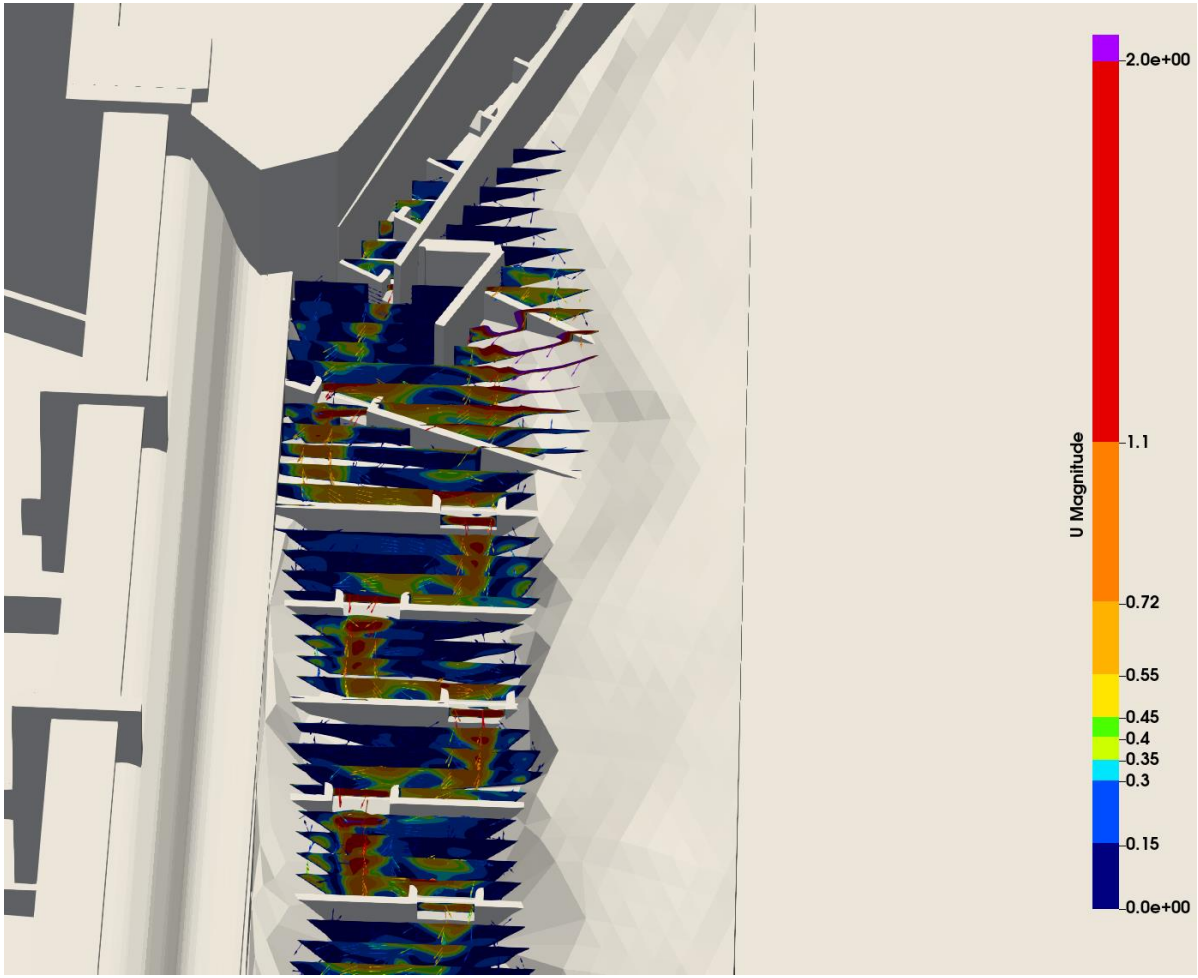


Figure S5-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

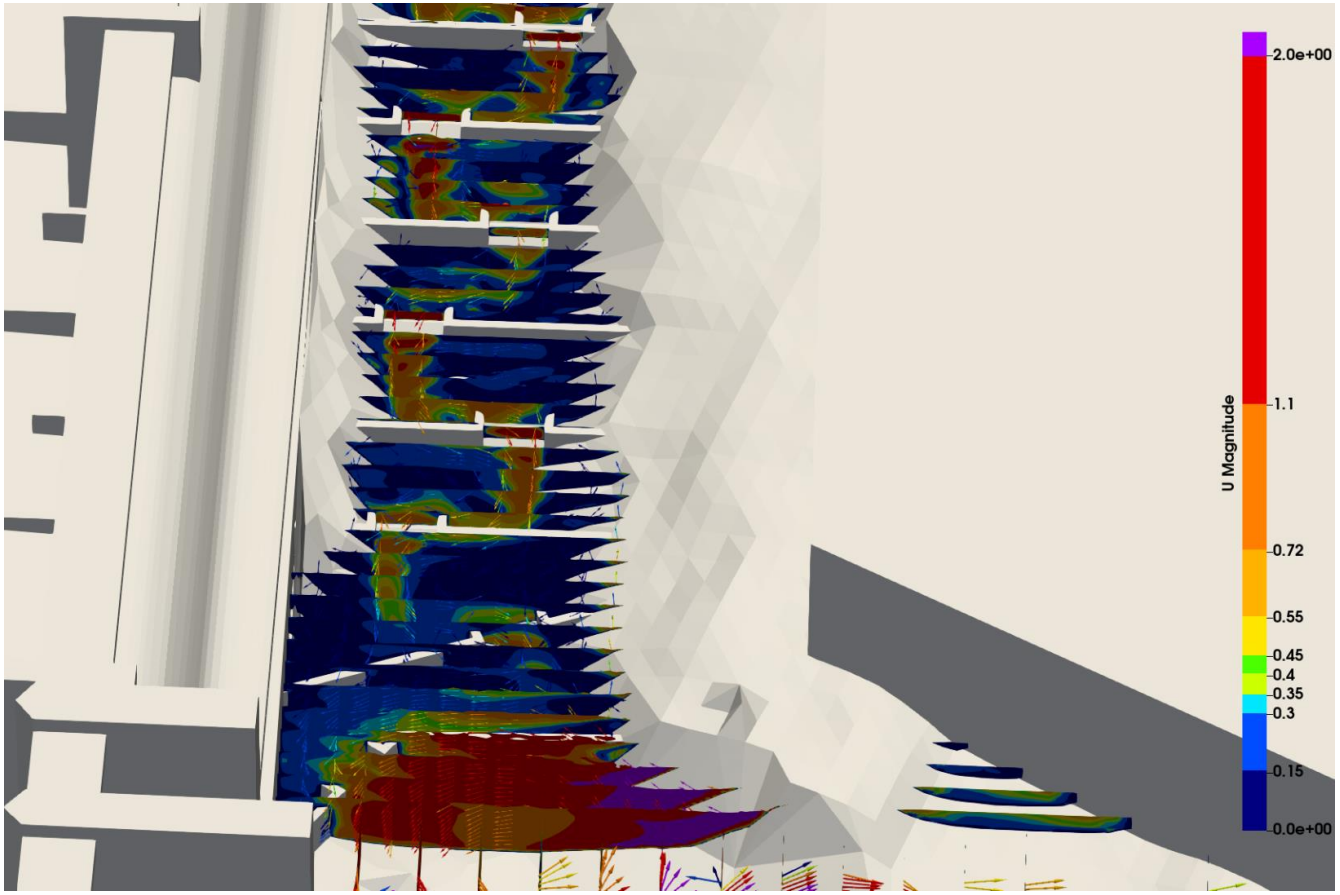


Figure S5-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

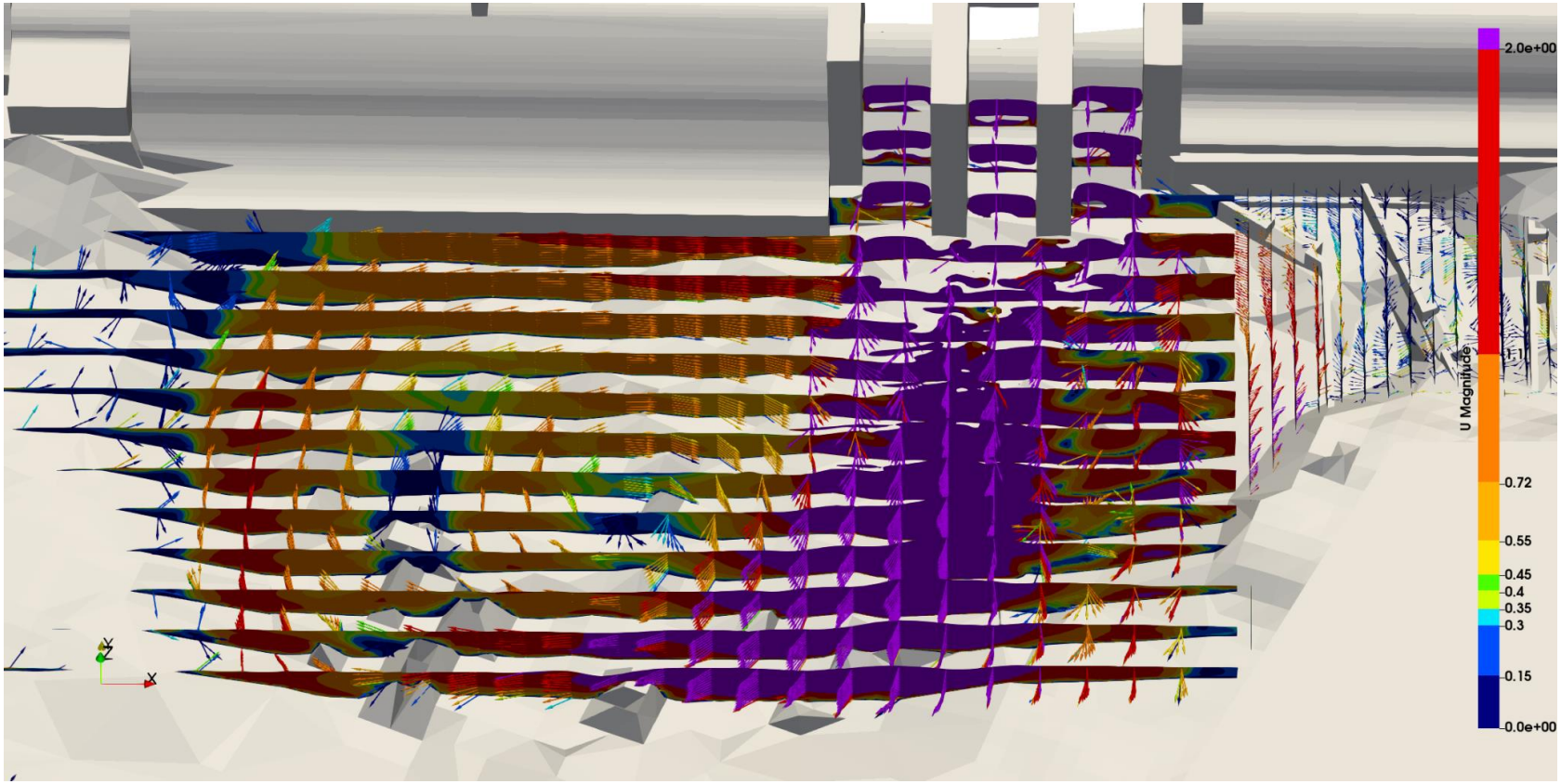


Figure S5-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

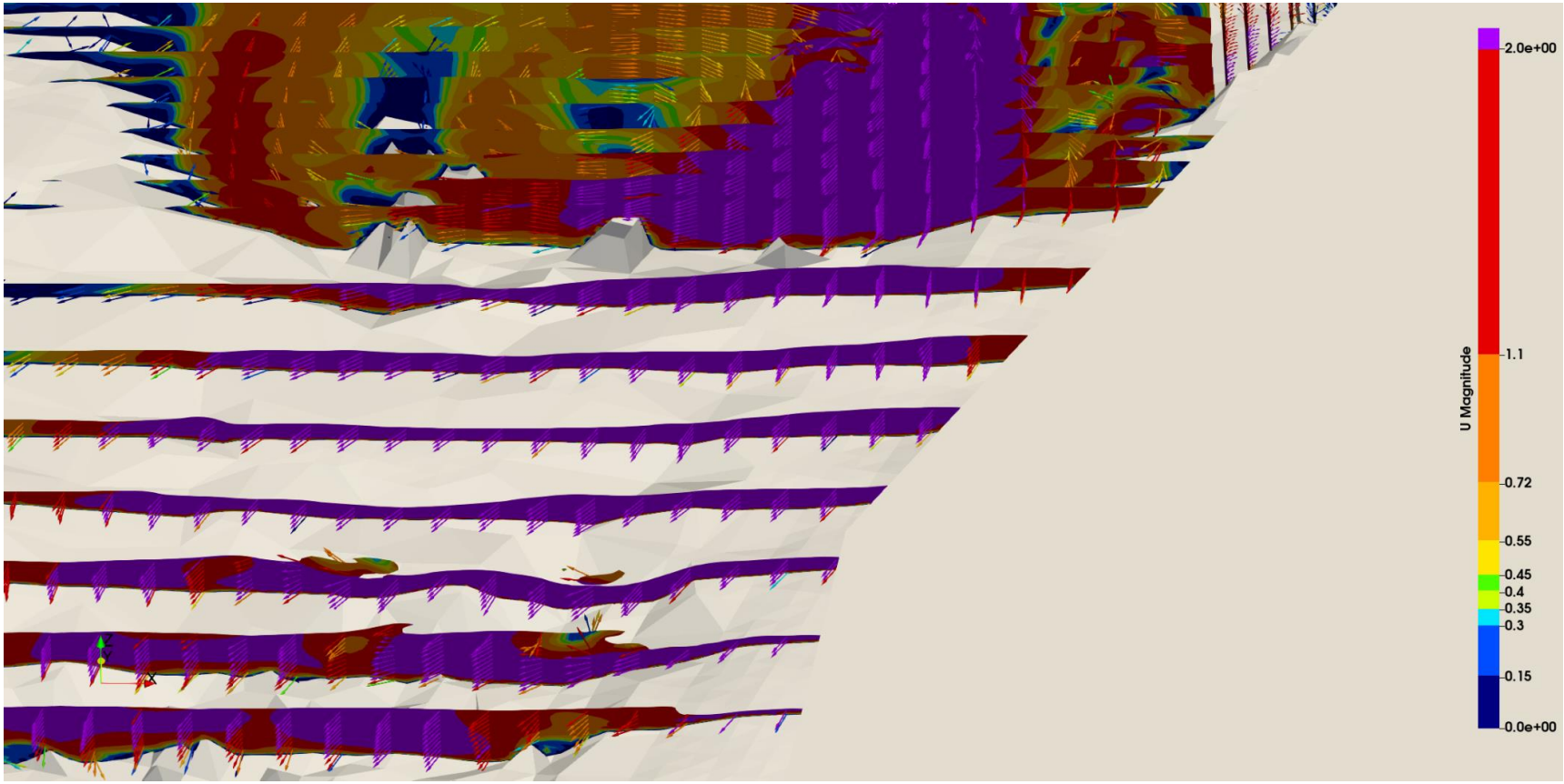


Figure S5-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

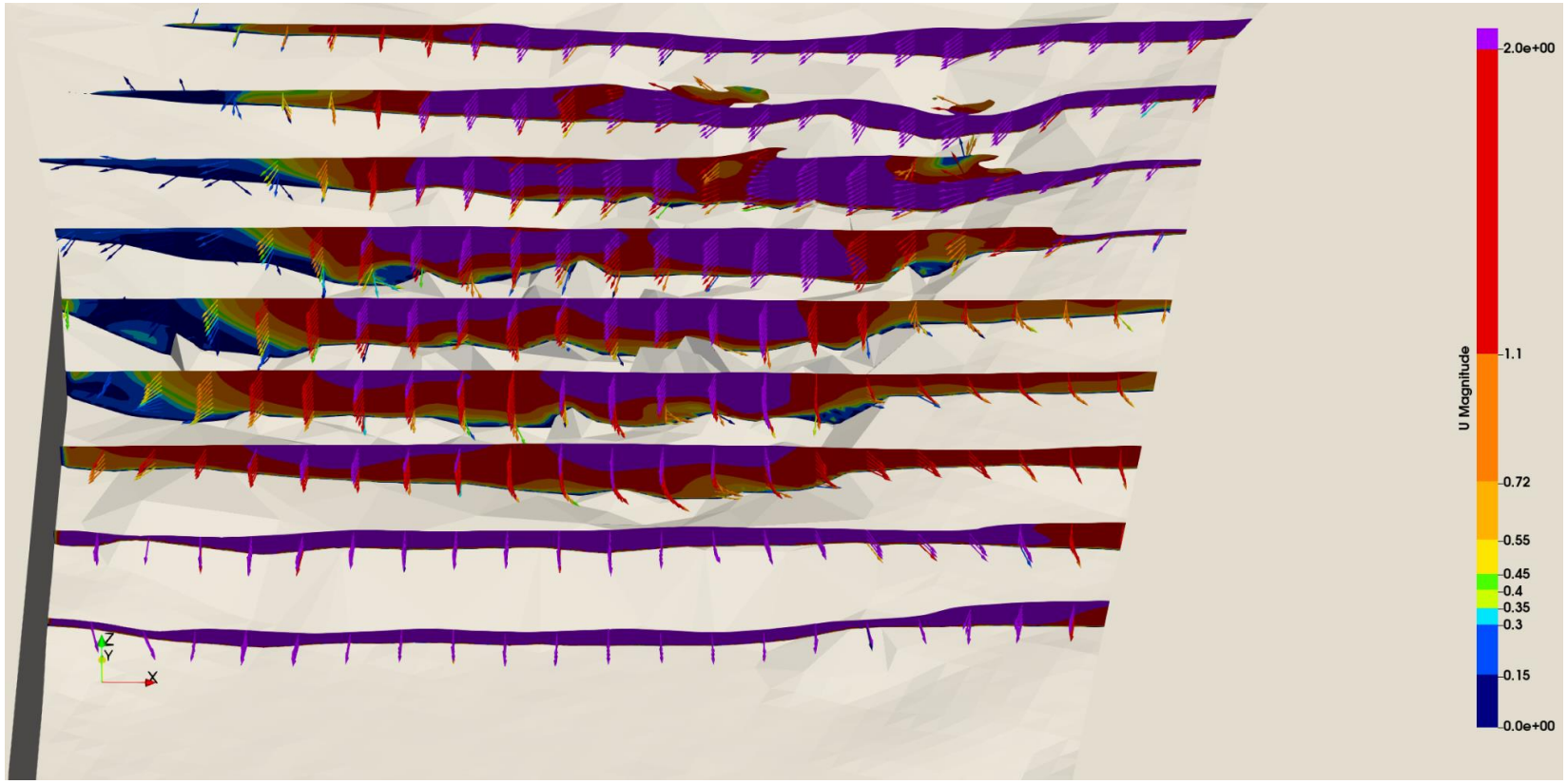


Figure S5-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

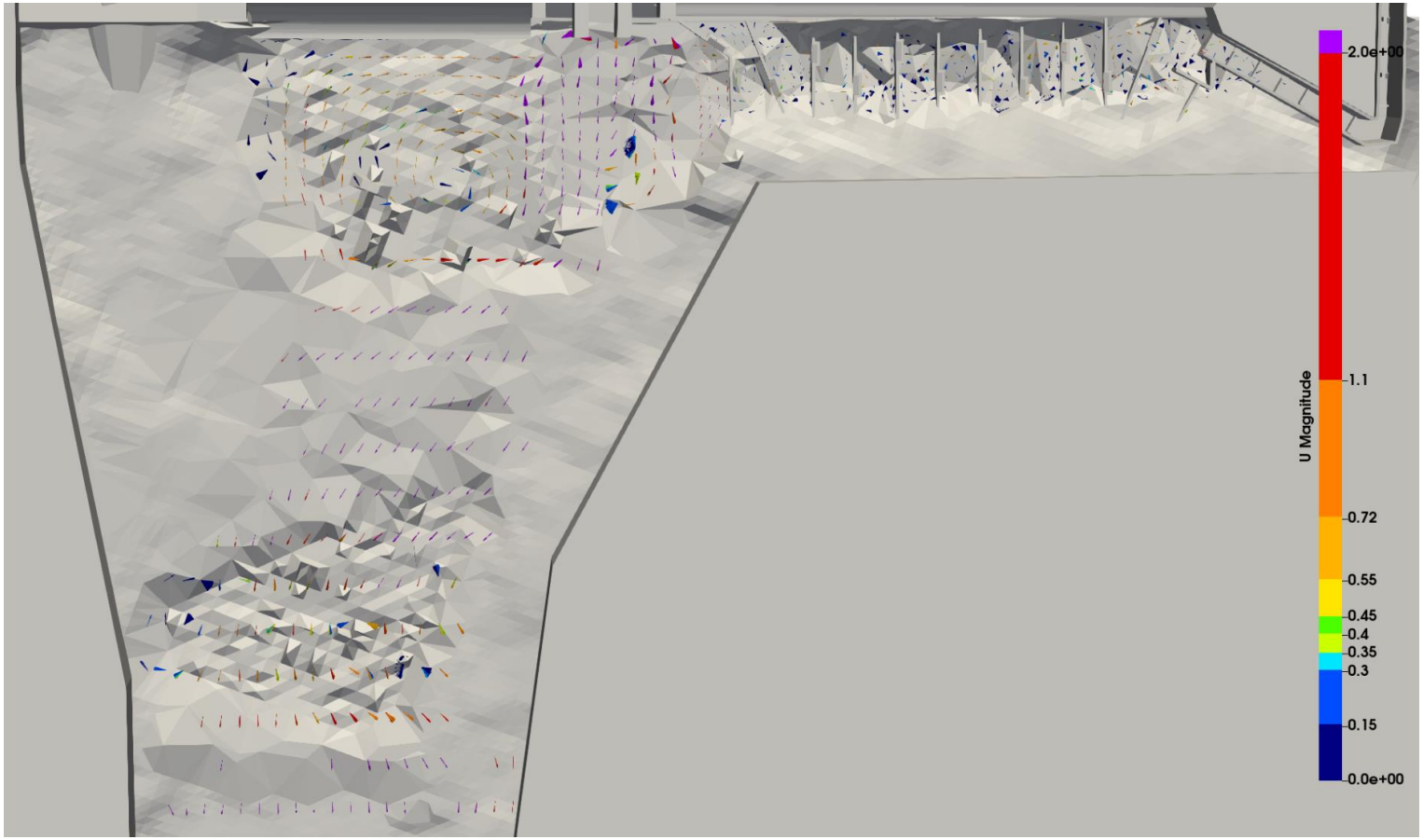


Figure S5-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

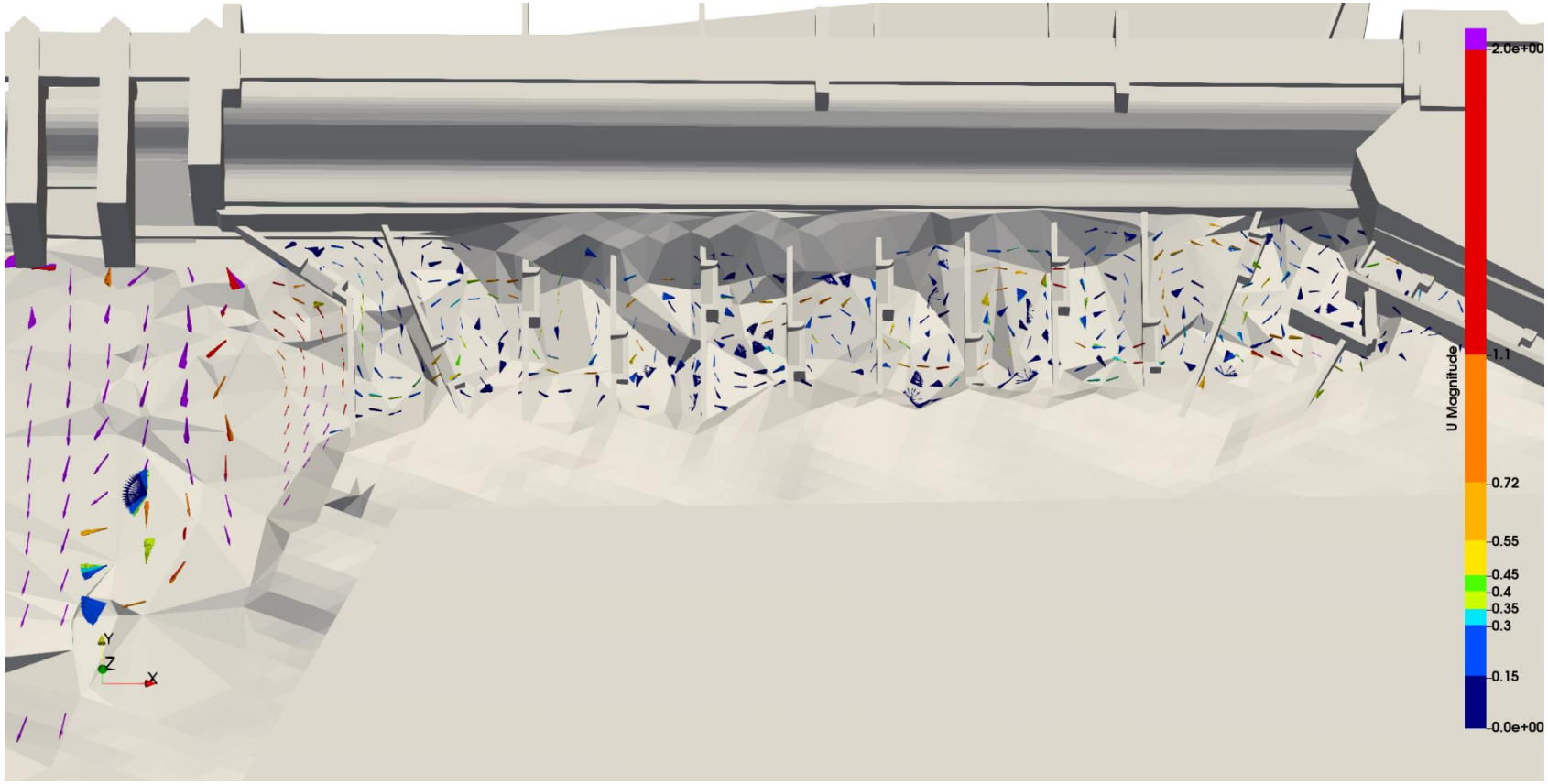


Figure S5-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

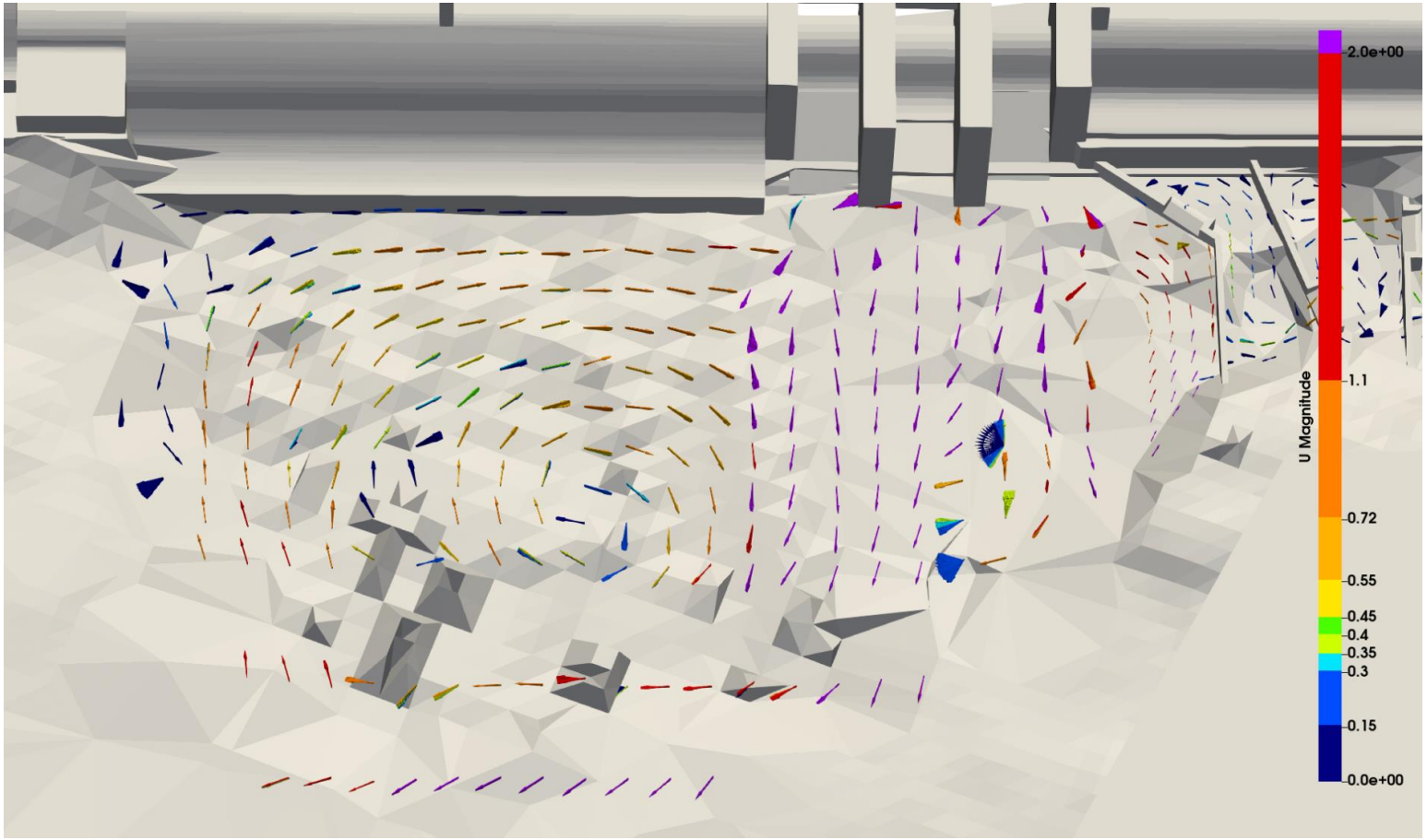


Figure S5-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

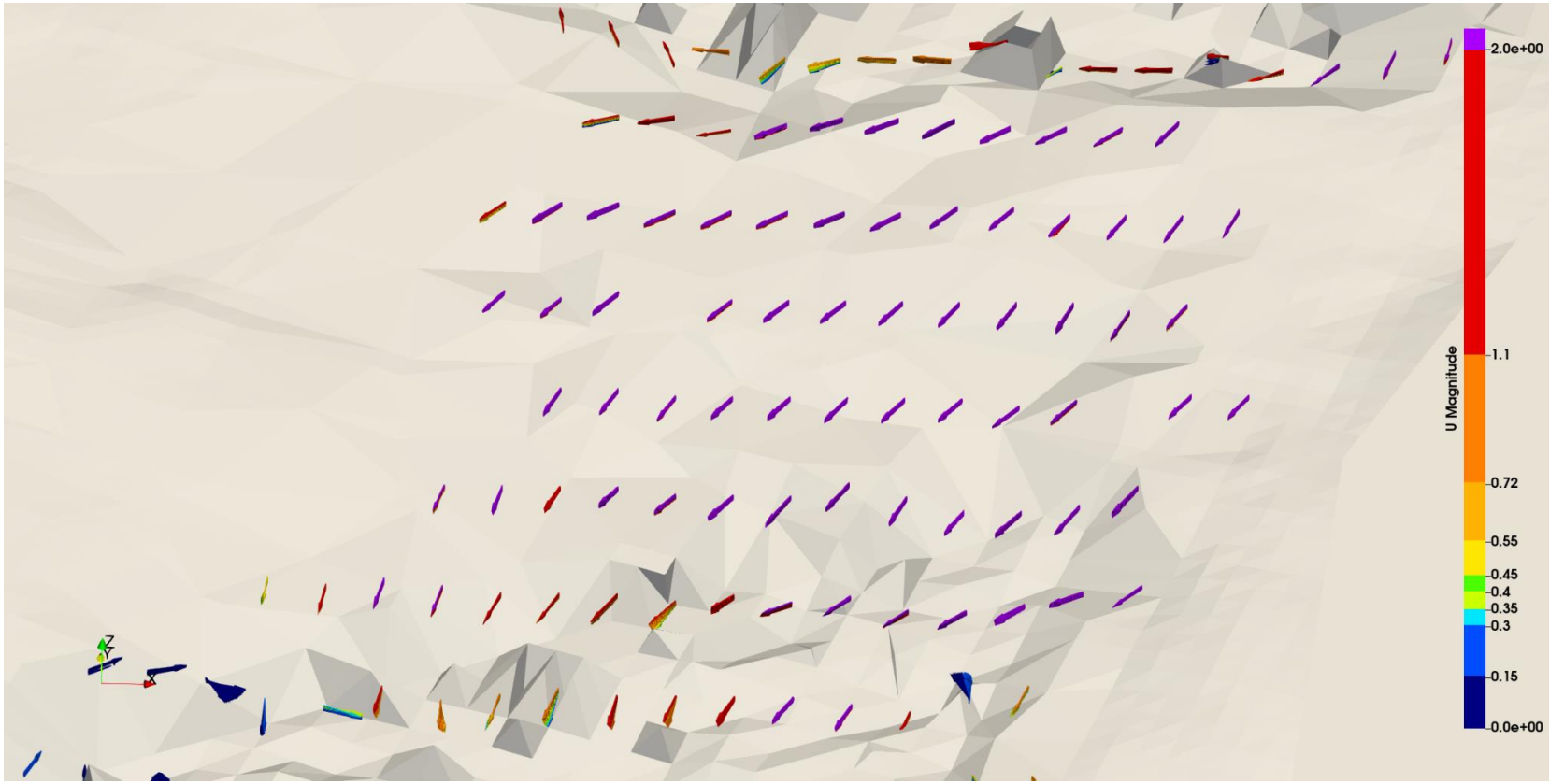


Figure S5-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

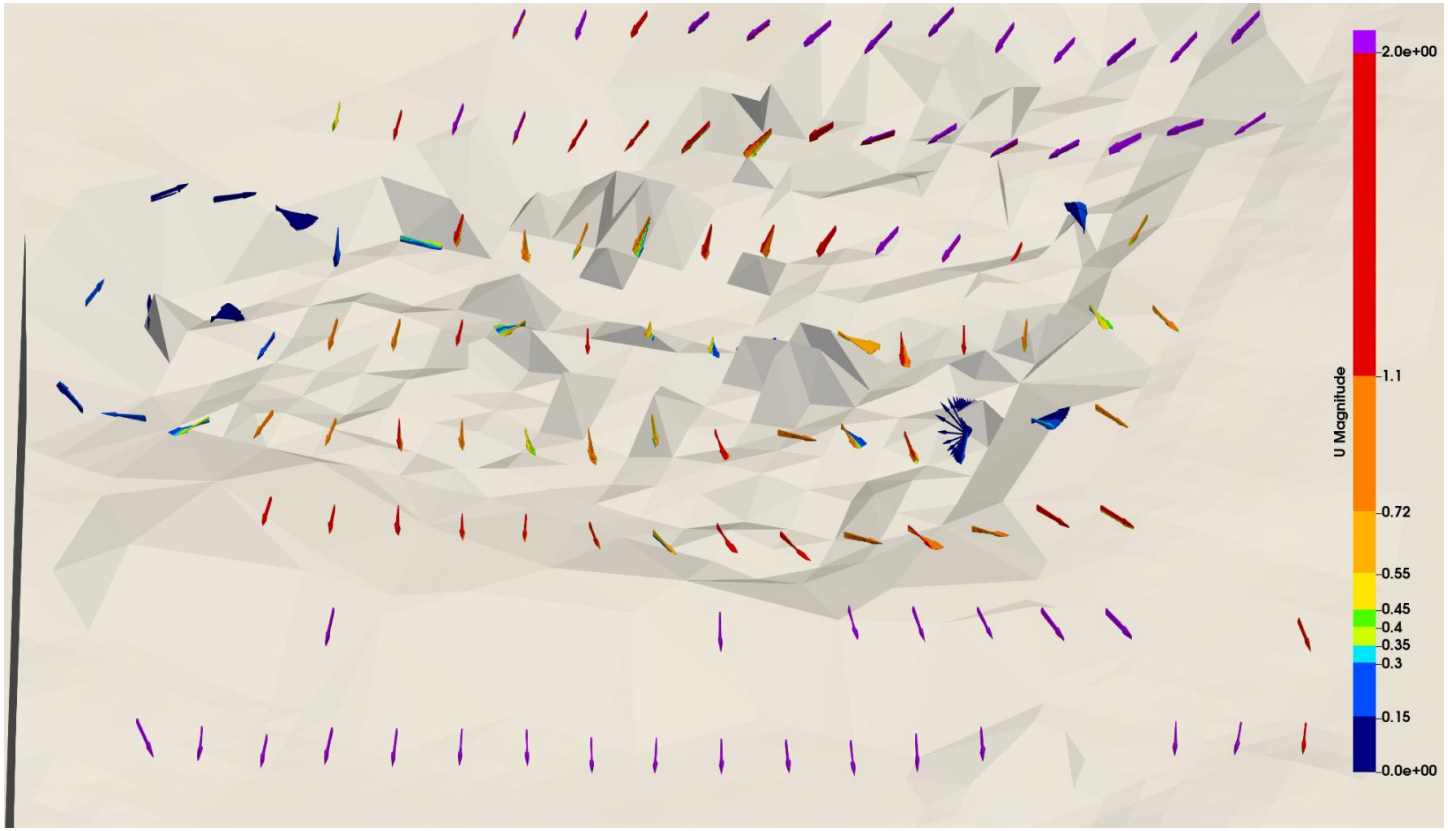


Figure S5-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

6. Model Results of Scenario S6 with 4308 cfs from the gates

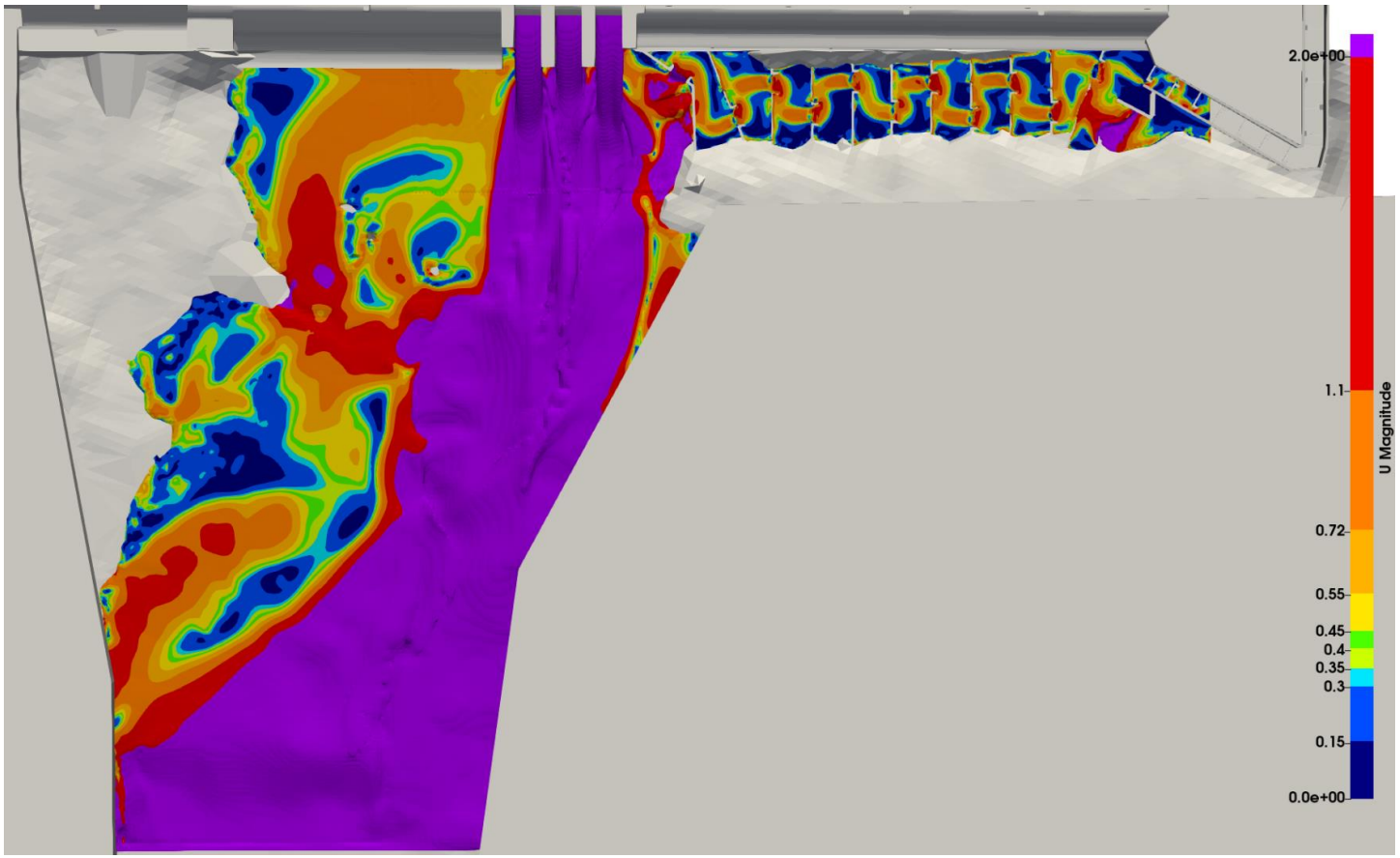


Figure S6-1: Plan view of the Water Surface Velocities

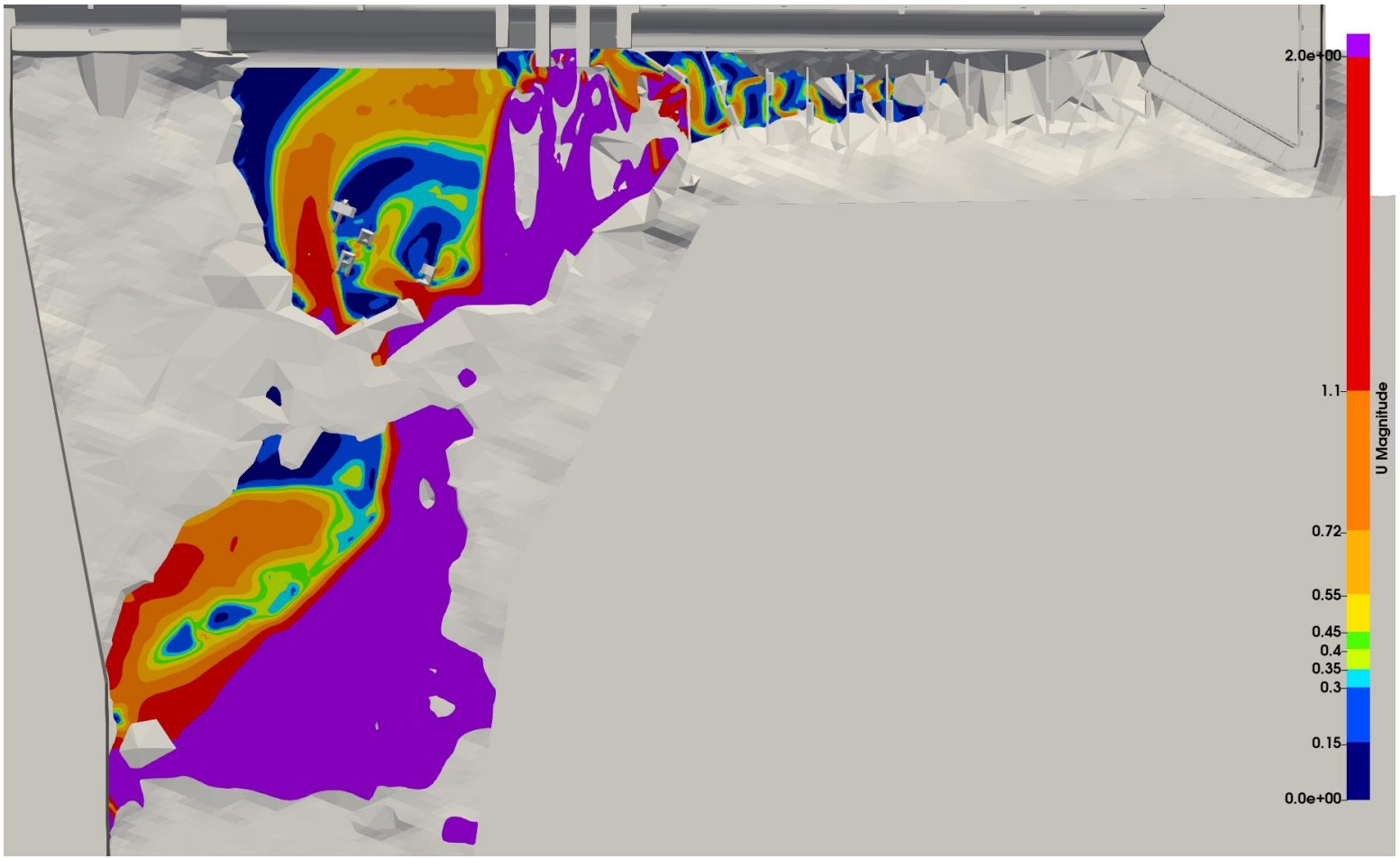


Figure S6-2: Plan view of the Mid-Surface Velocities

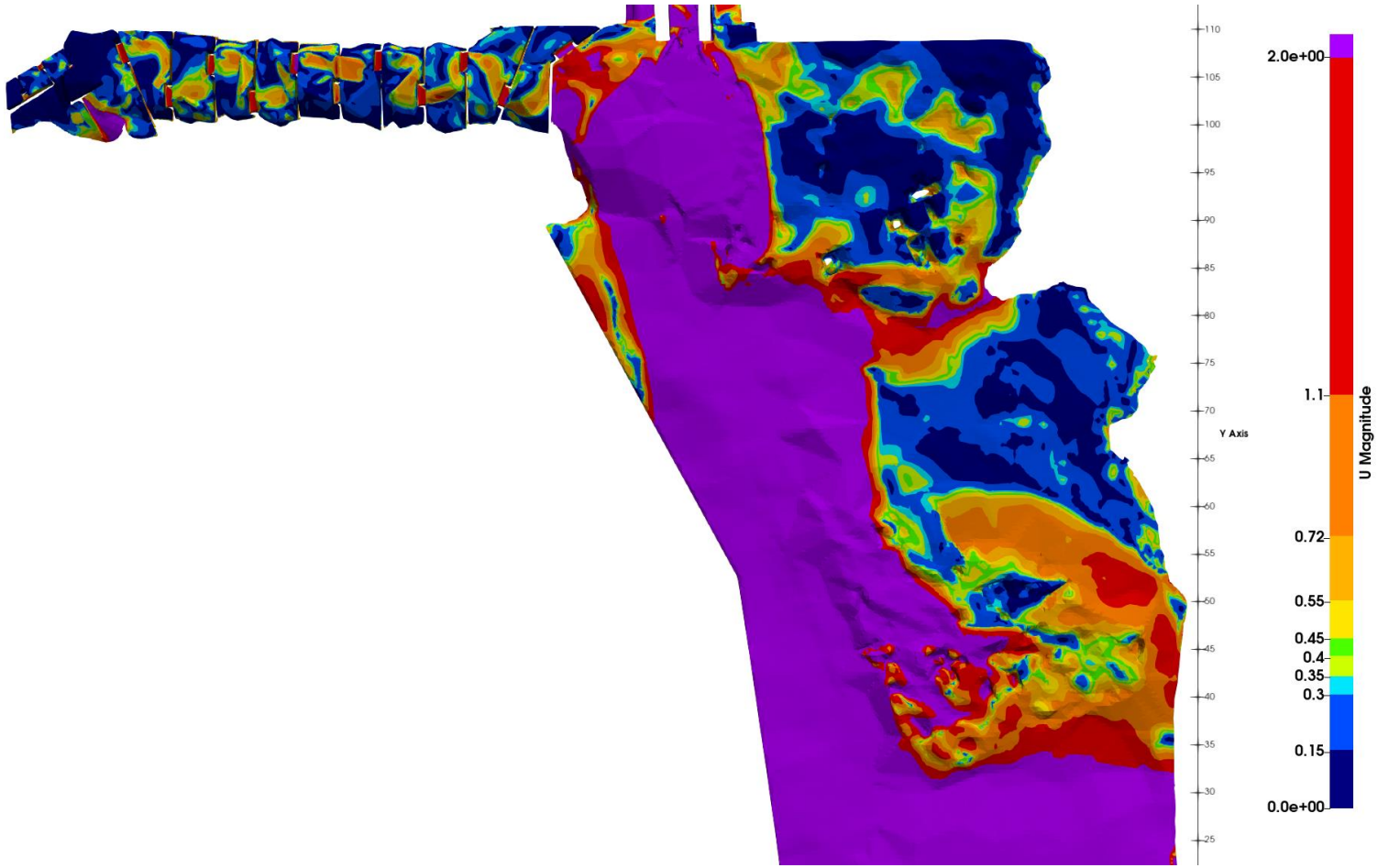


Figure S6-3: View of the Bottom Velocities

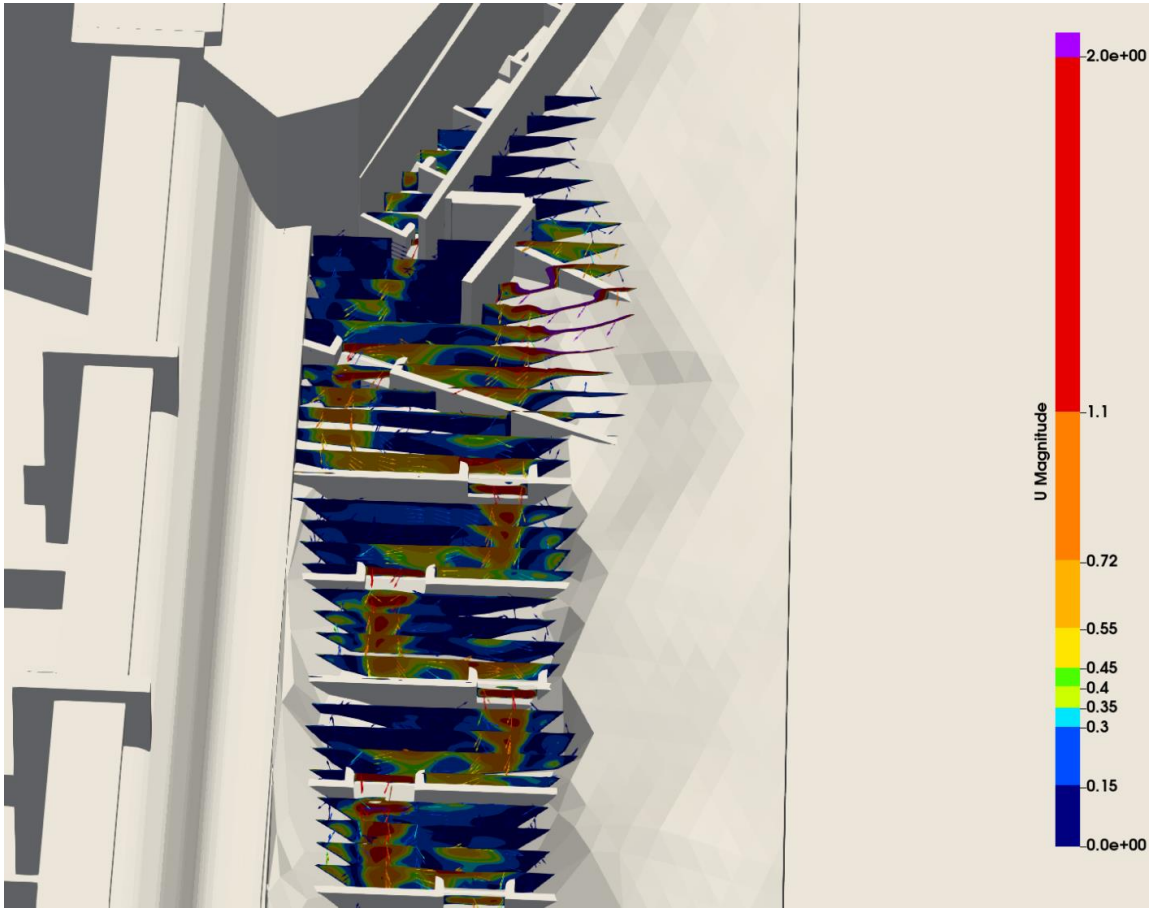


Figure S6-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

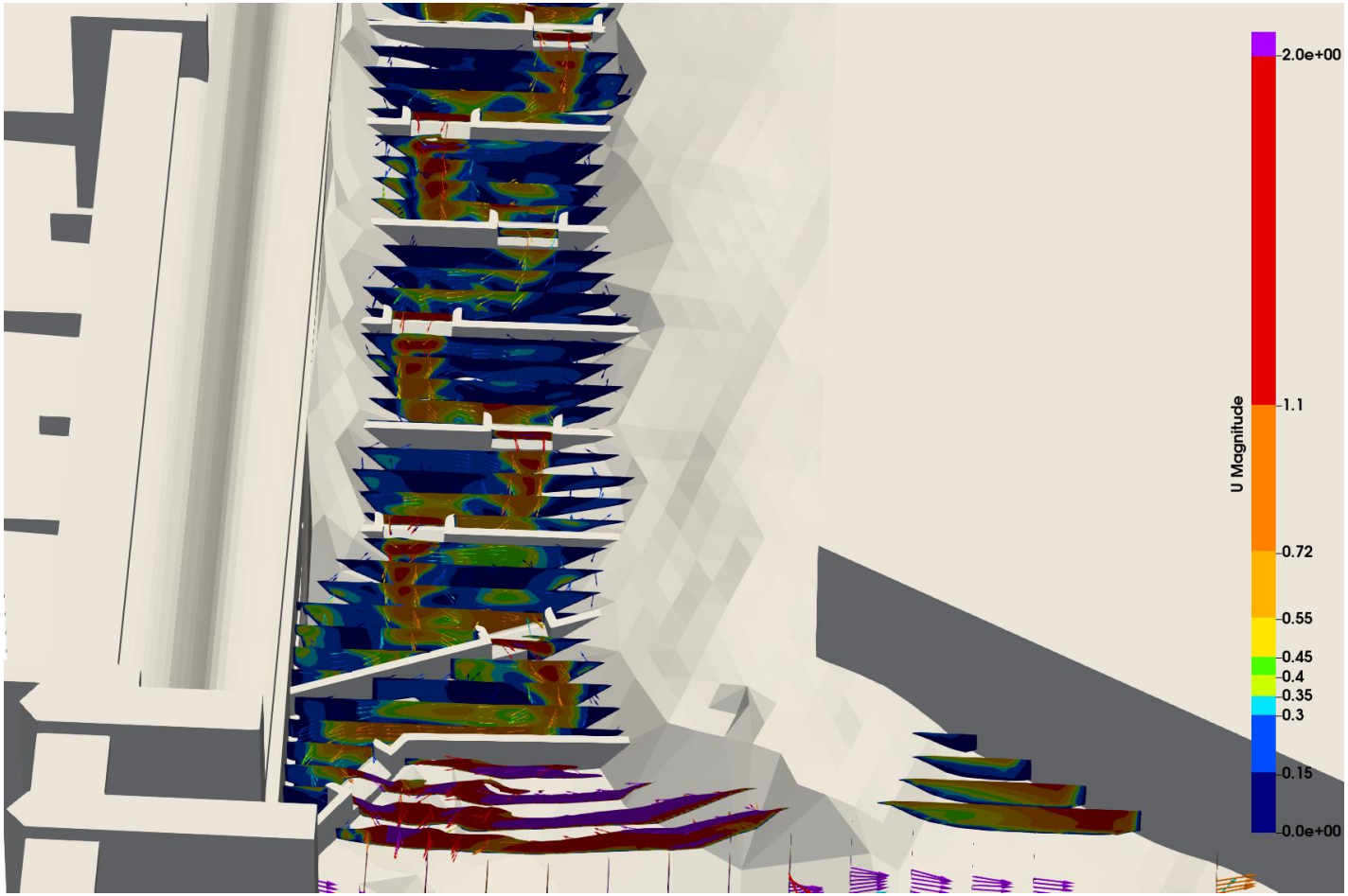


Figure S6-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

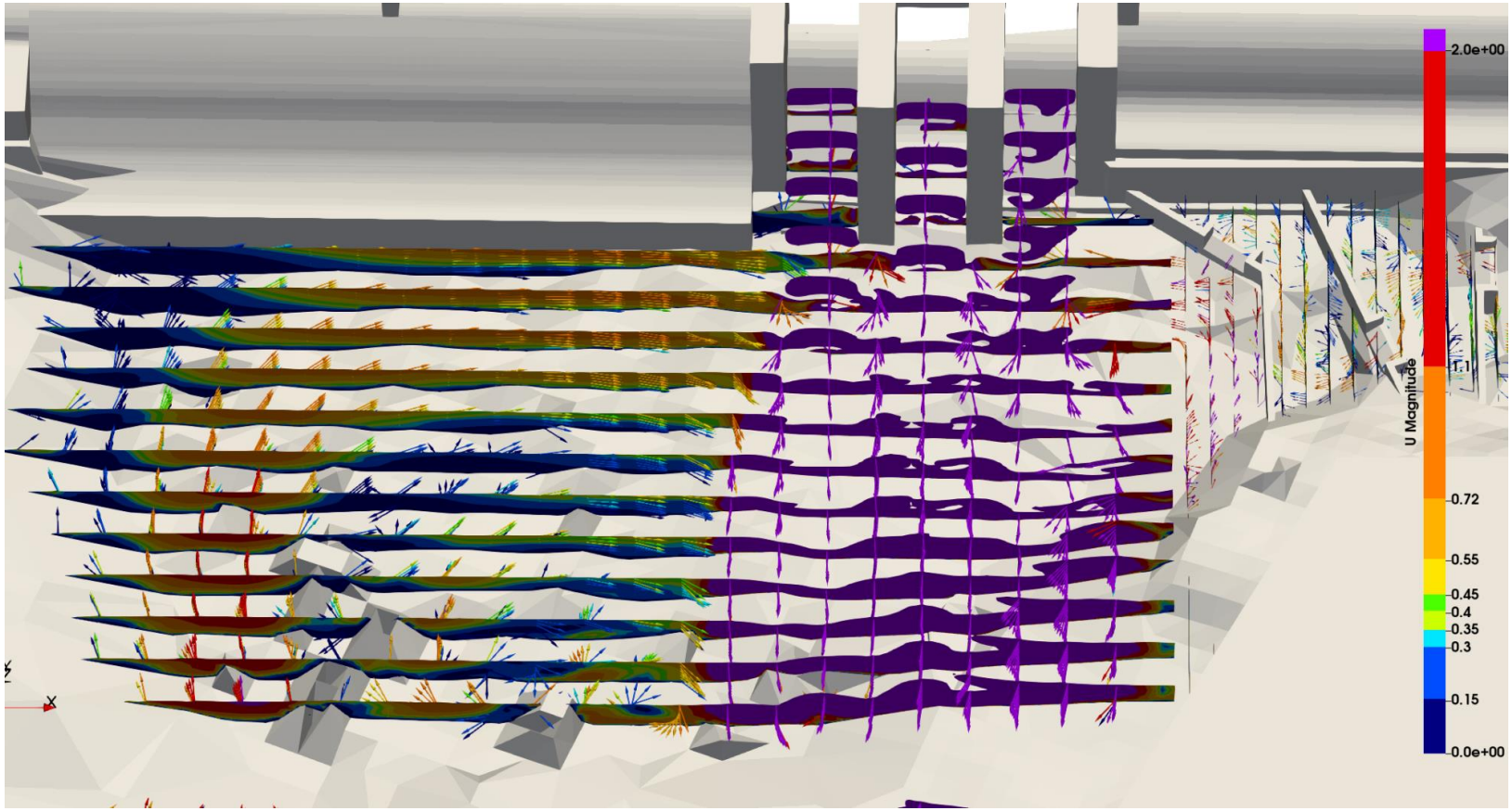


Figure S6-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

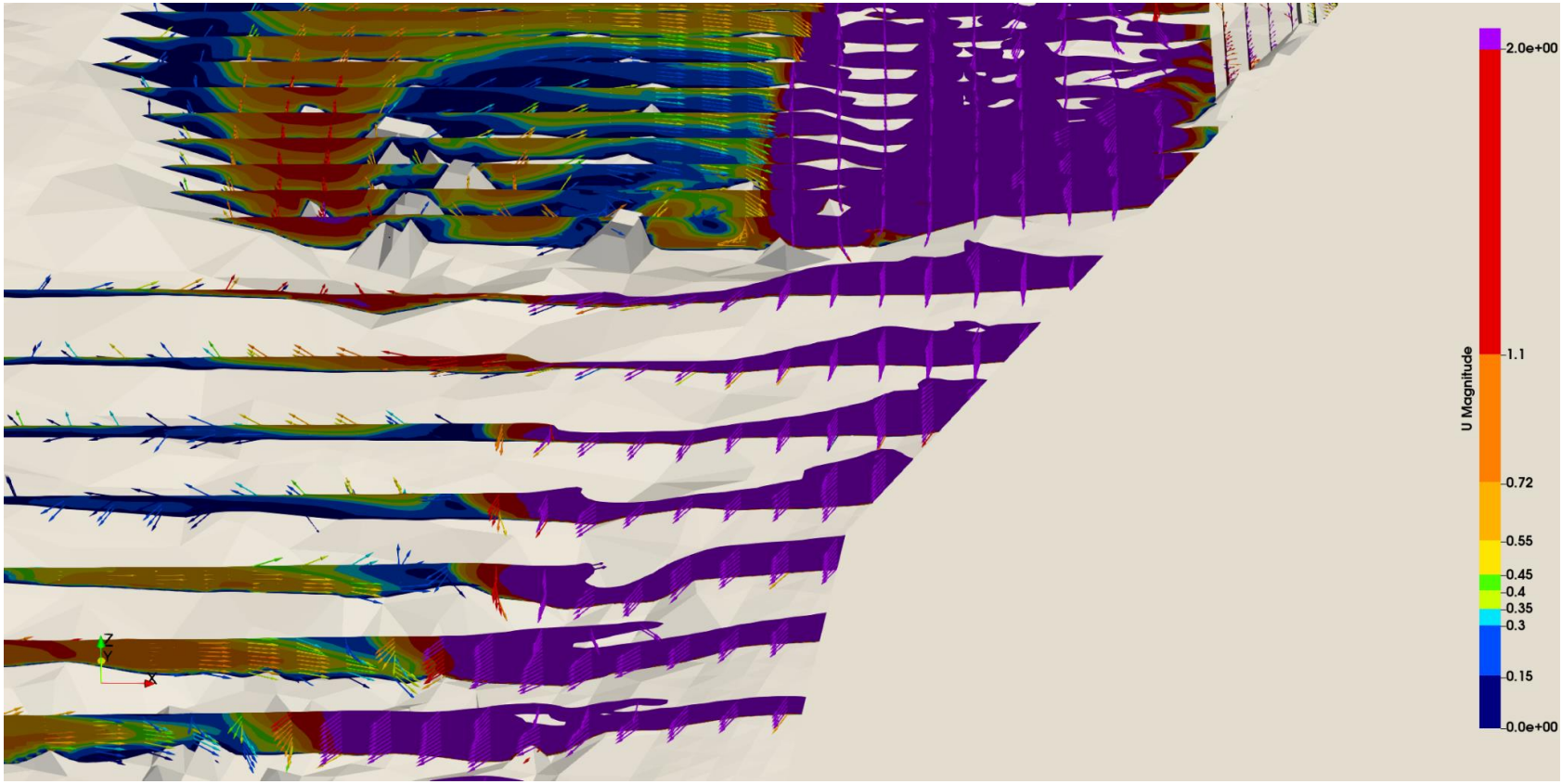


Figure S6-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

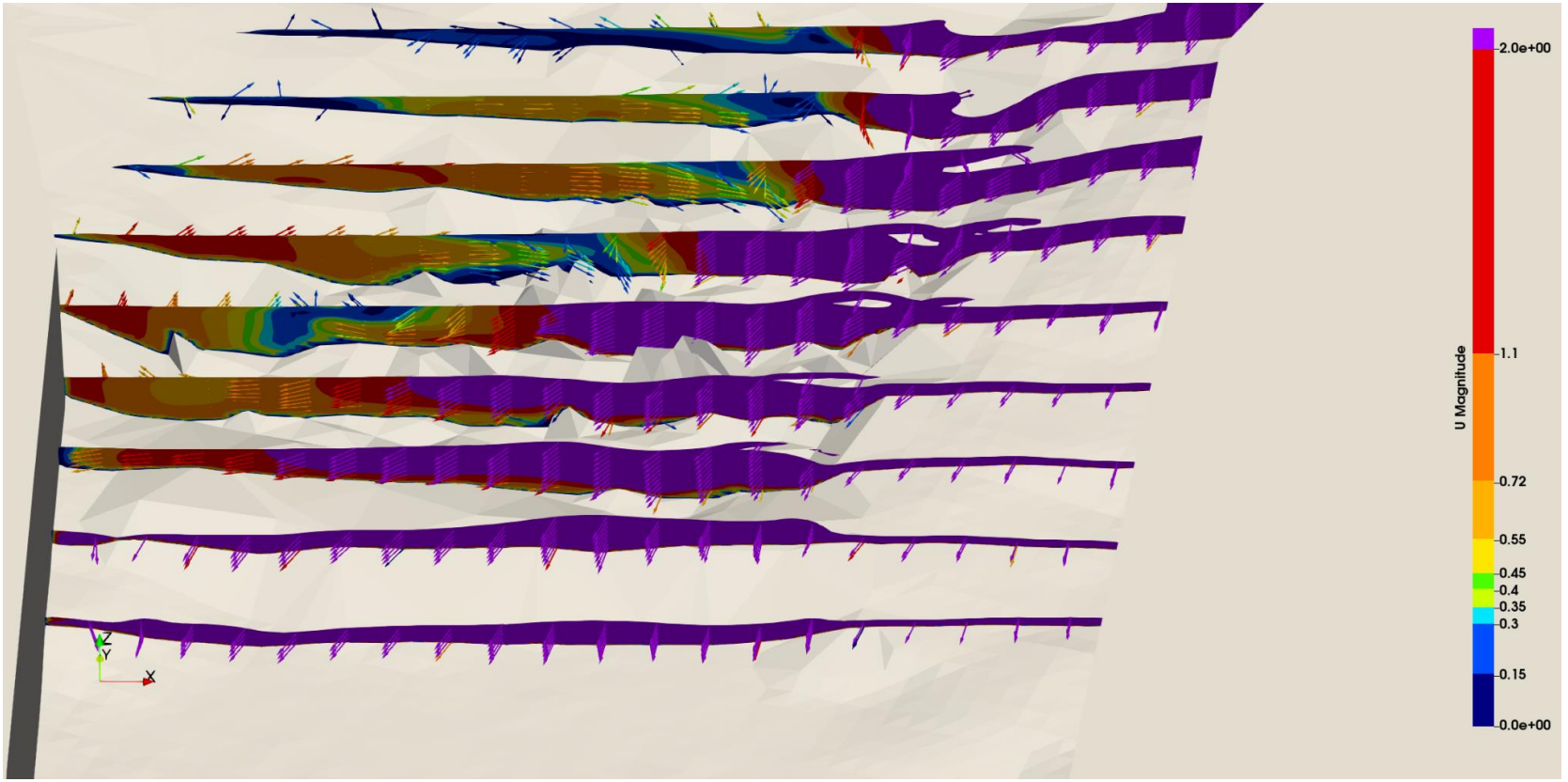


Figure S6-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

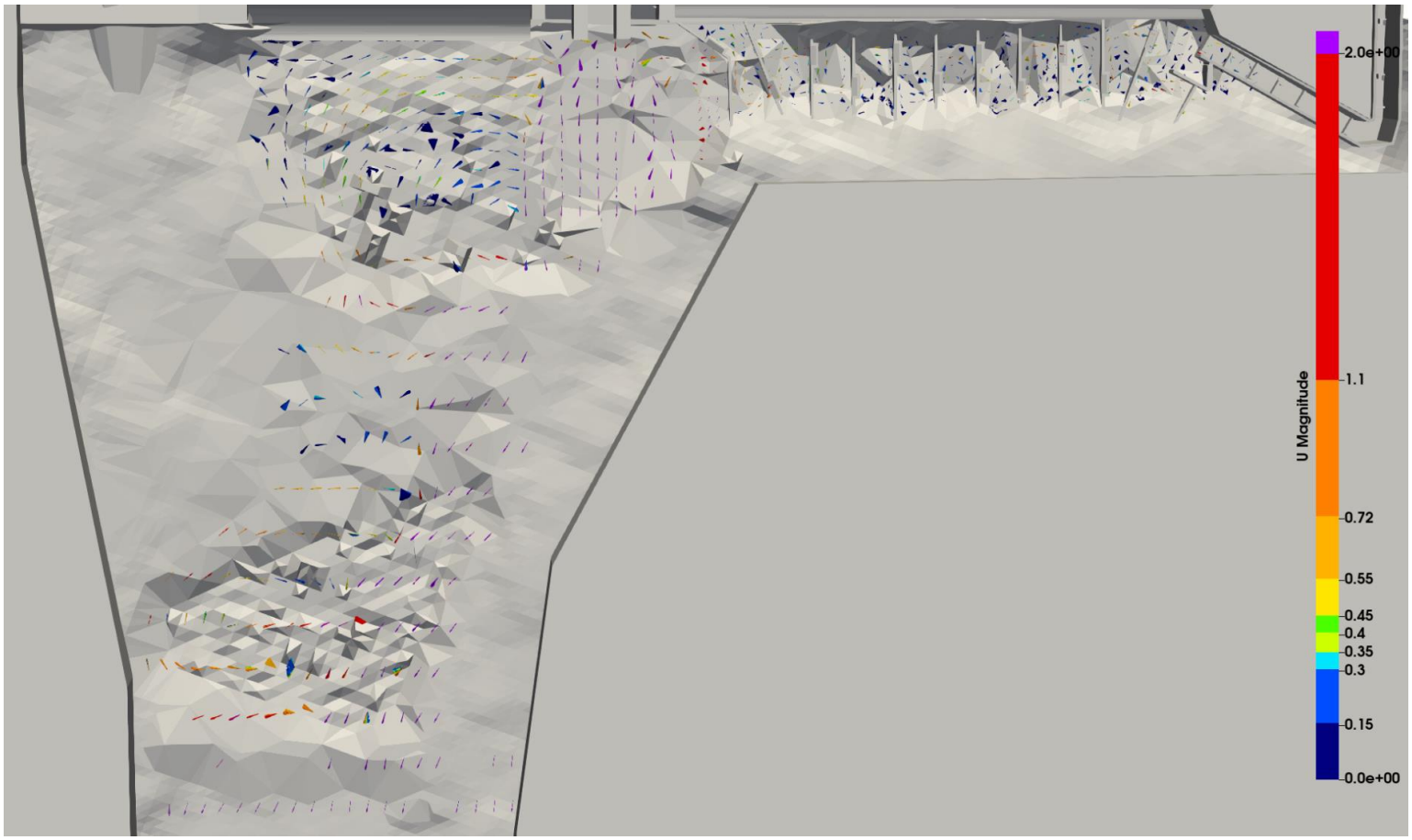


Figure S6-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

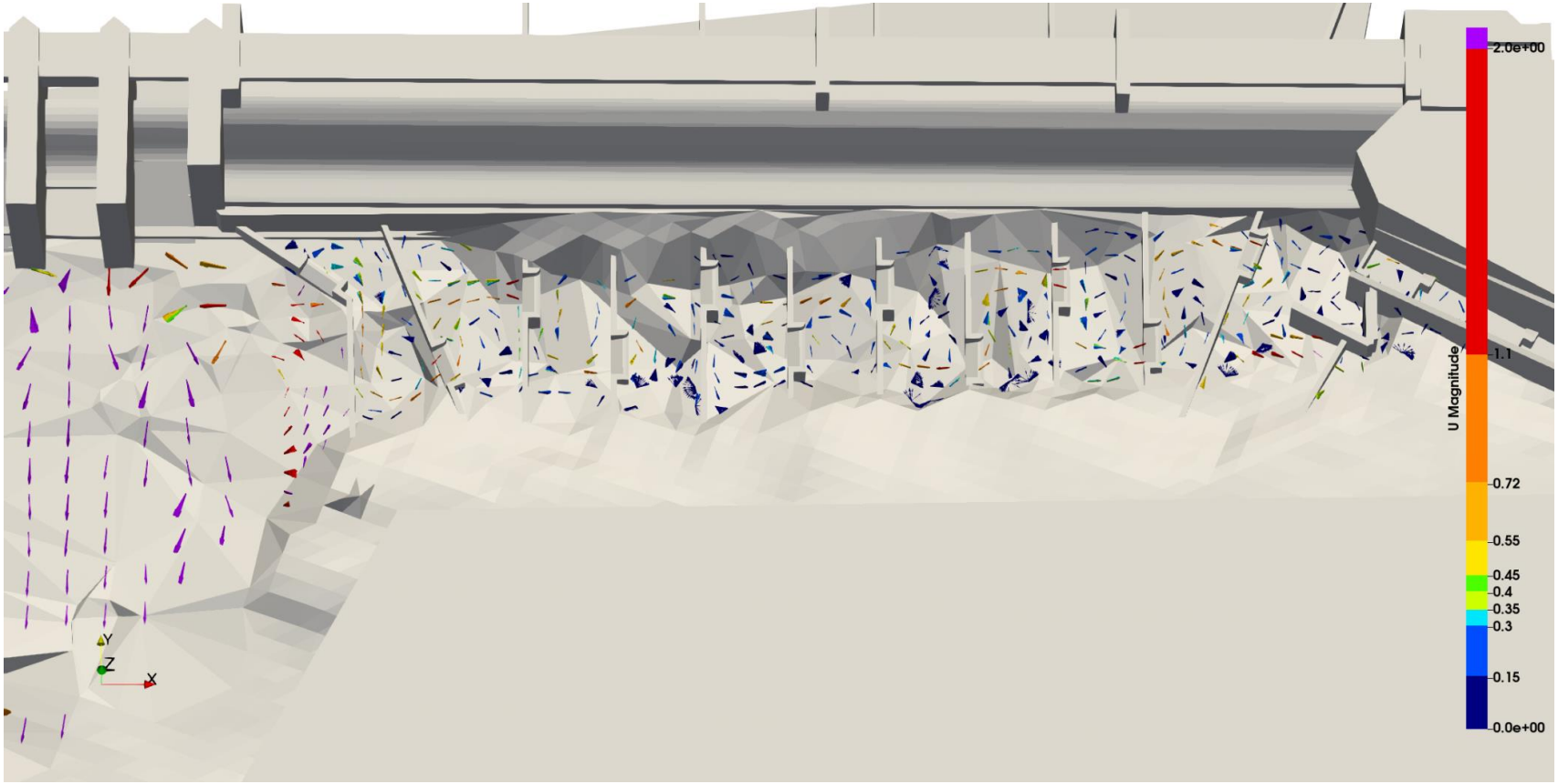


Figure S6-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

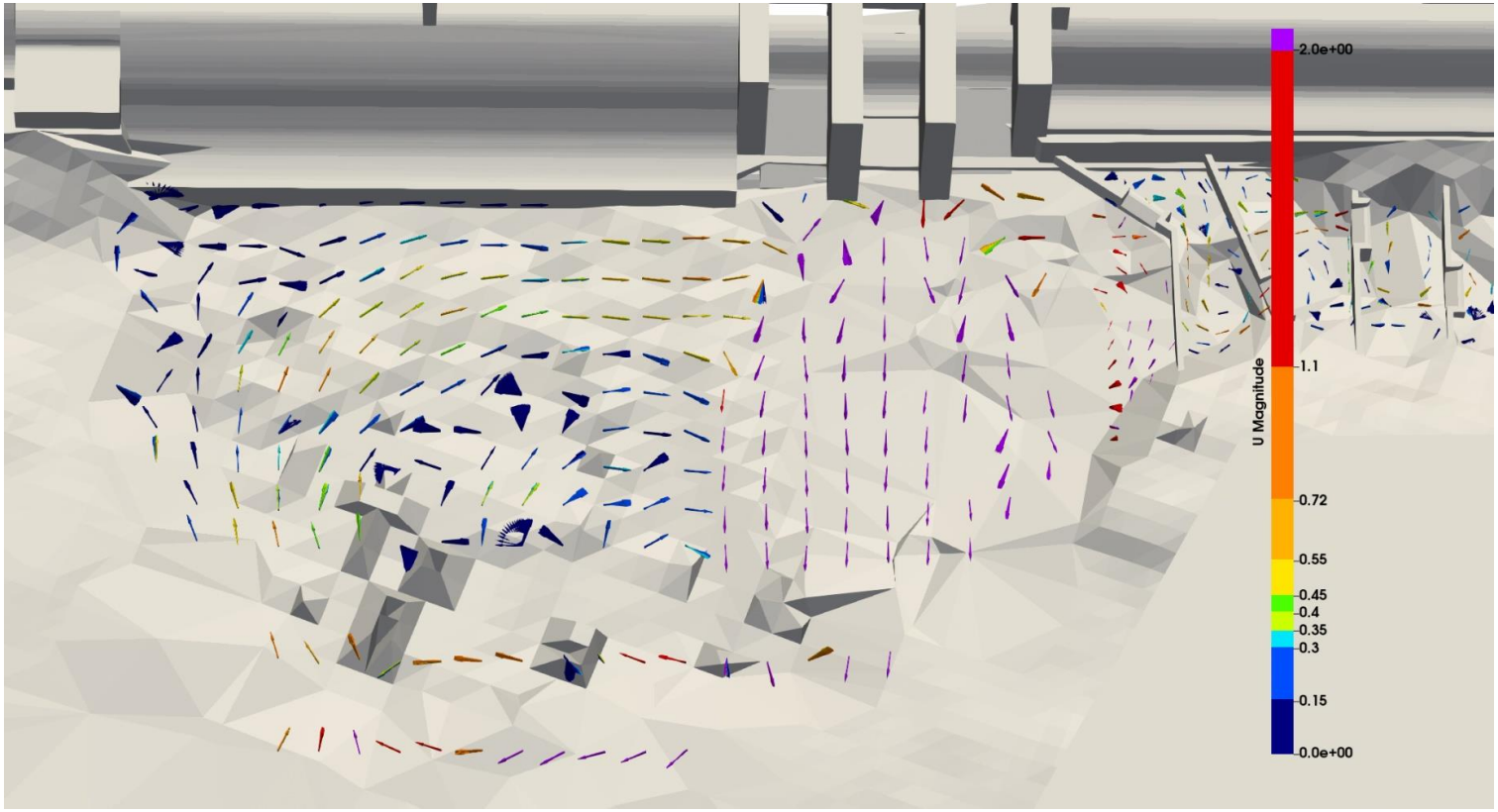


Figure S6-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

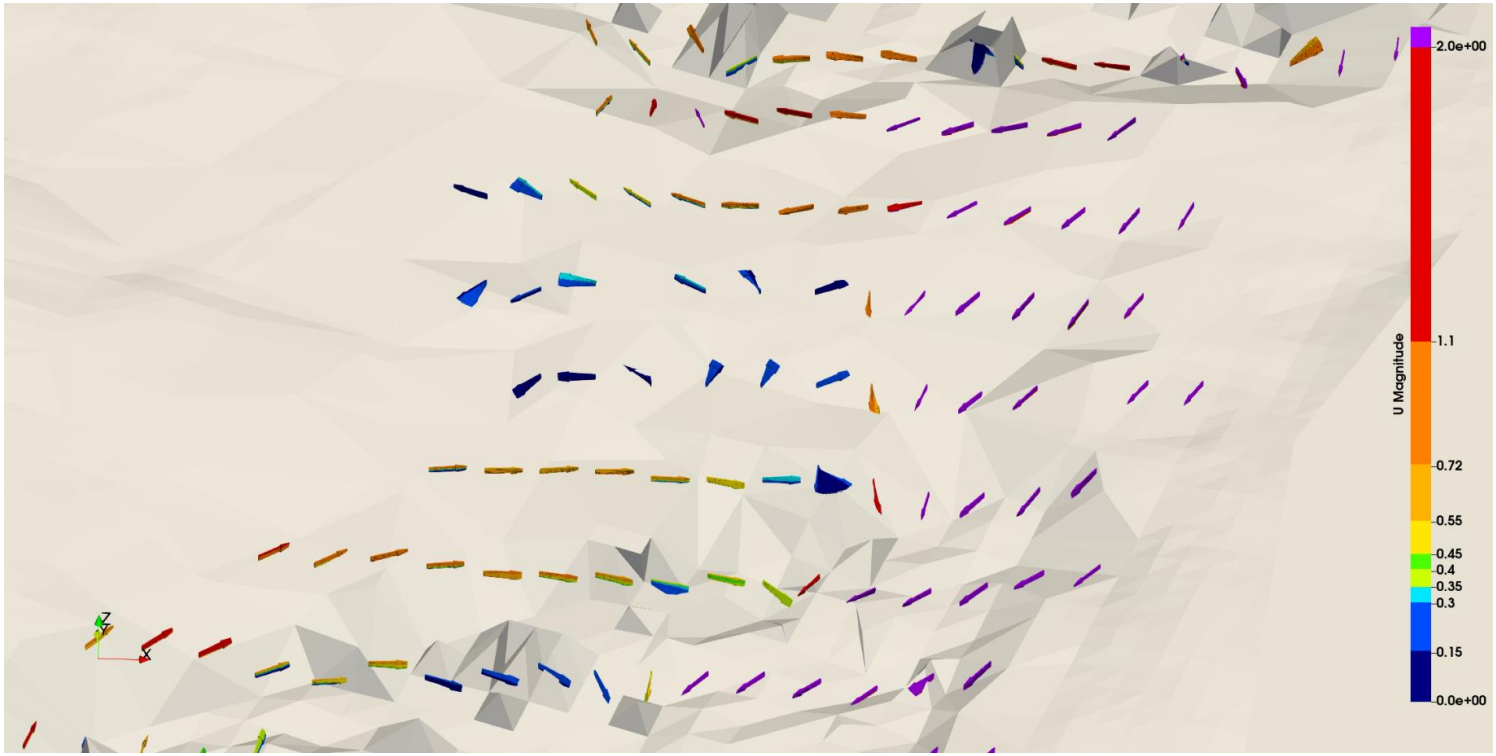


Figure S6-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

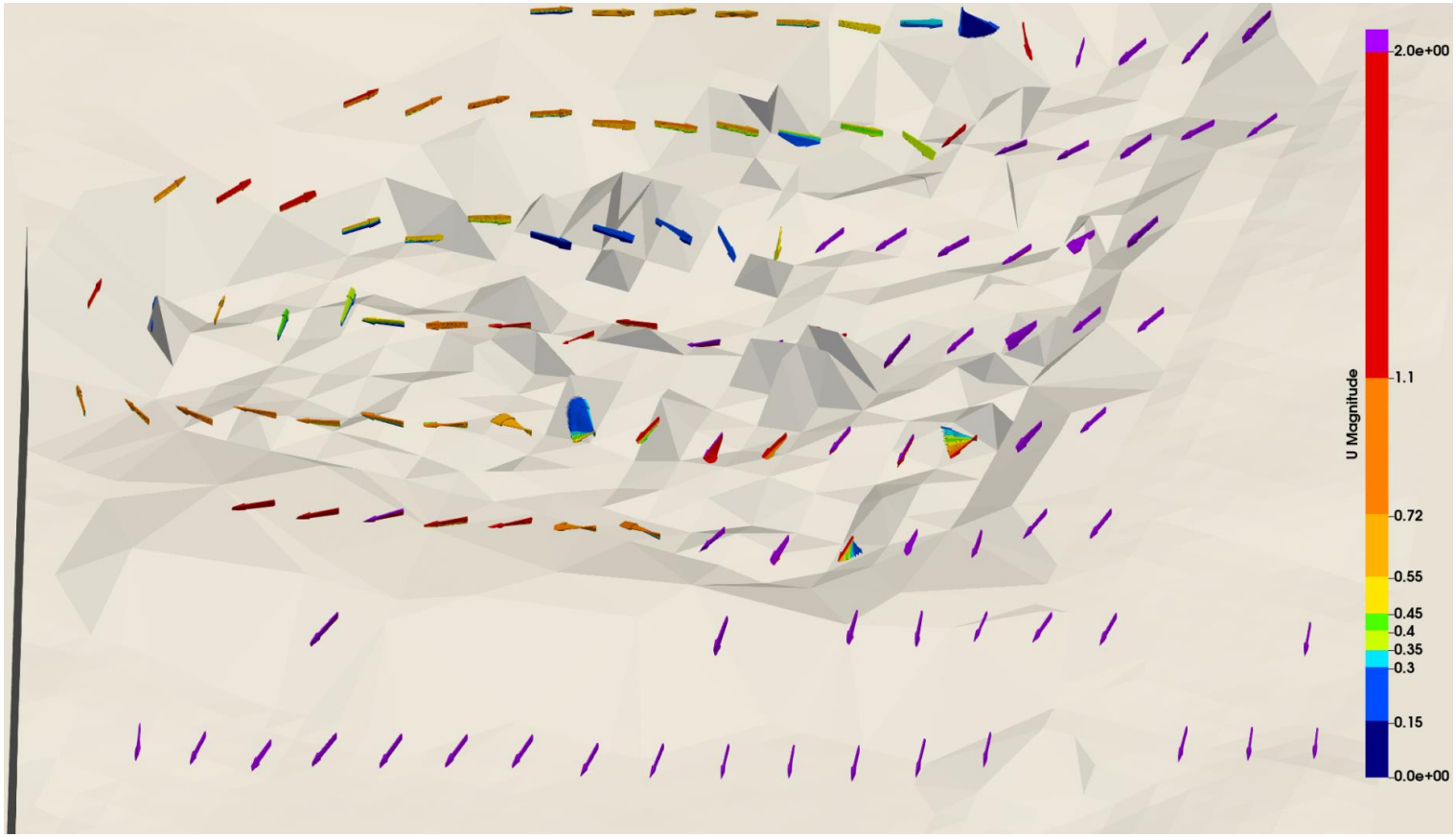


Figure S6-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

7. Model Results of Scenario S7 with 0 cfs from the gates

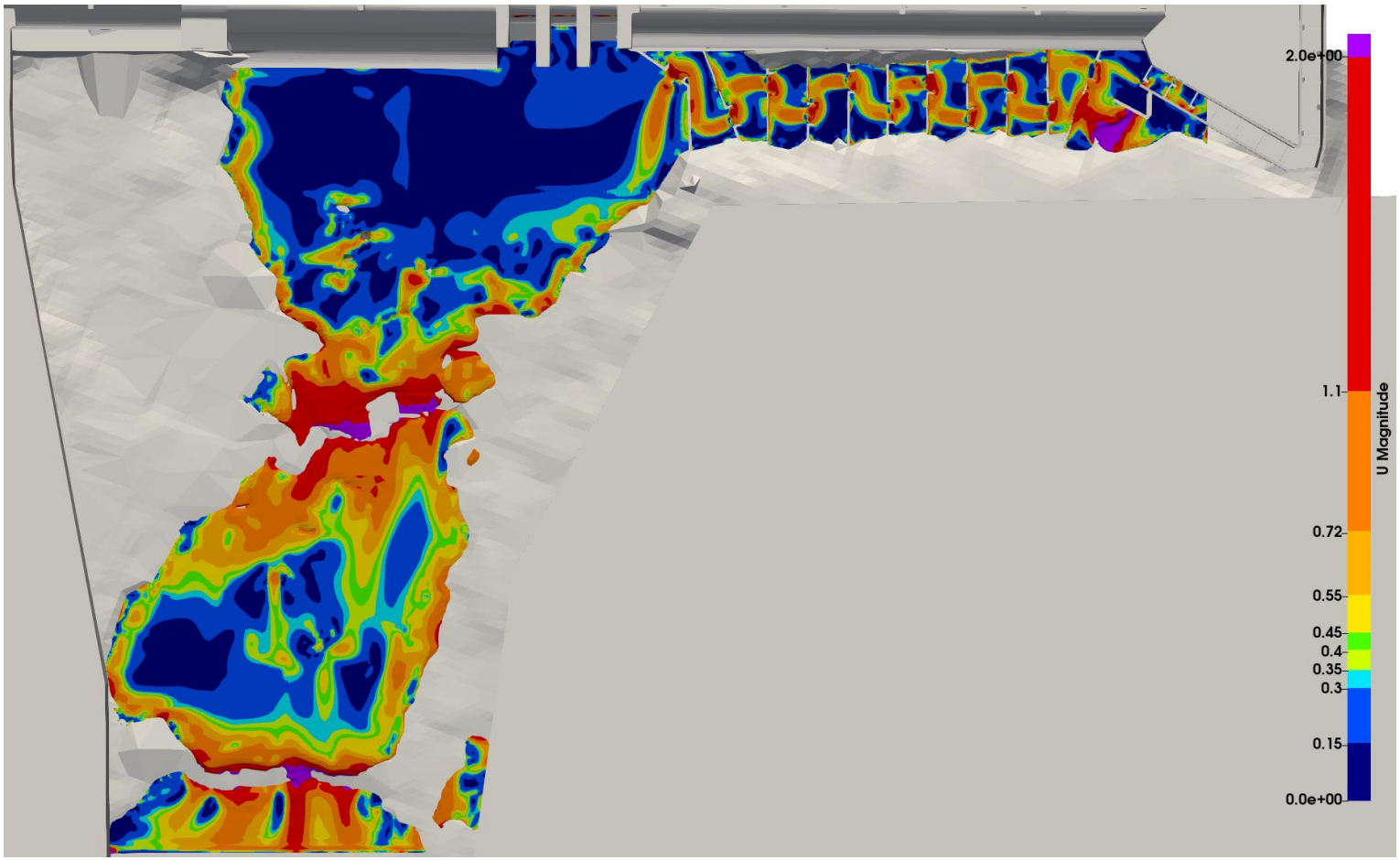


Figure S7-1: Plan view of the Water Surface Velocities

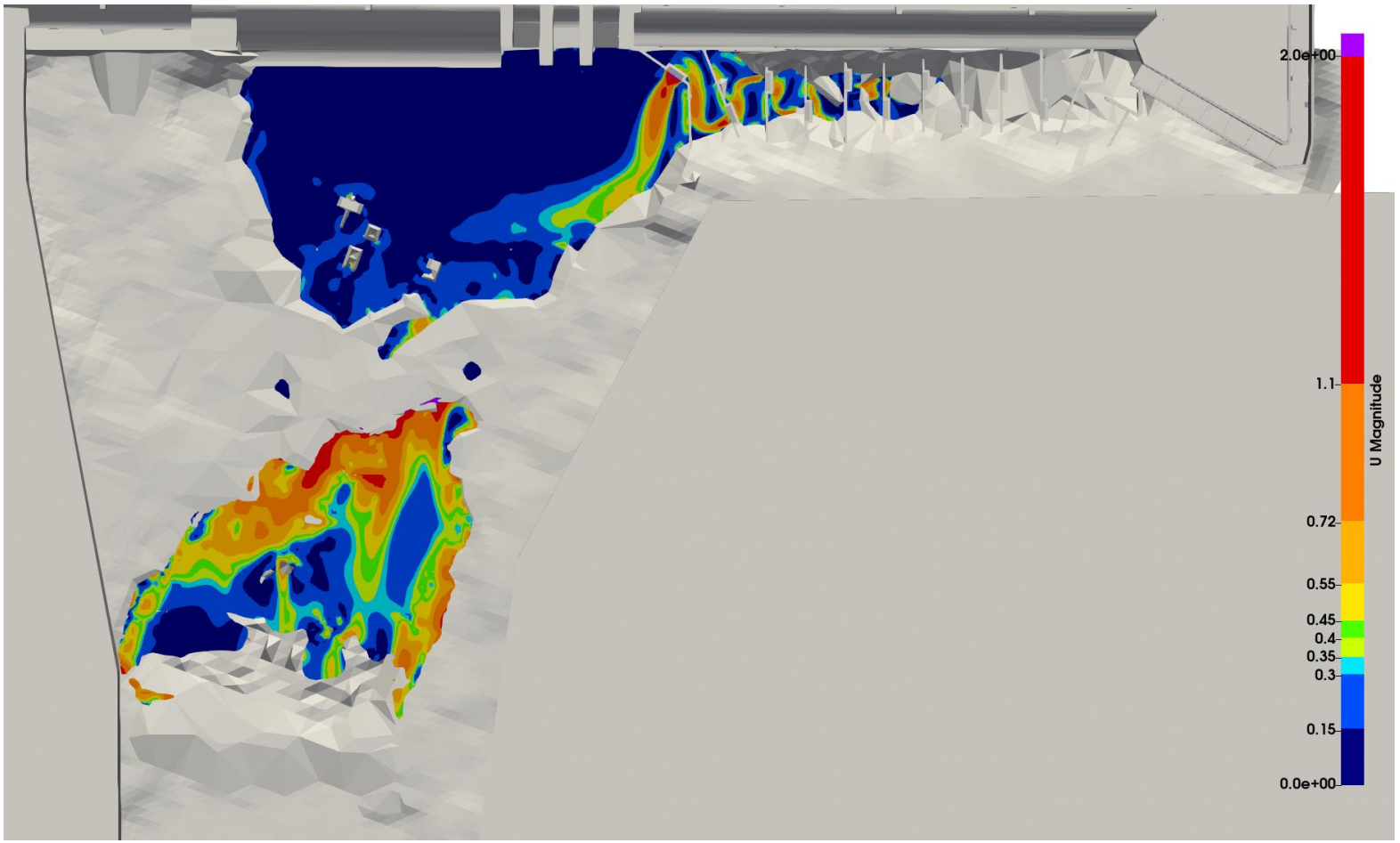


Figure S7-2: Plan view of the Mid-Surface Velocities

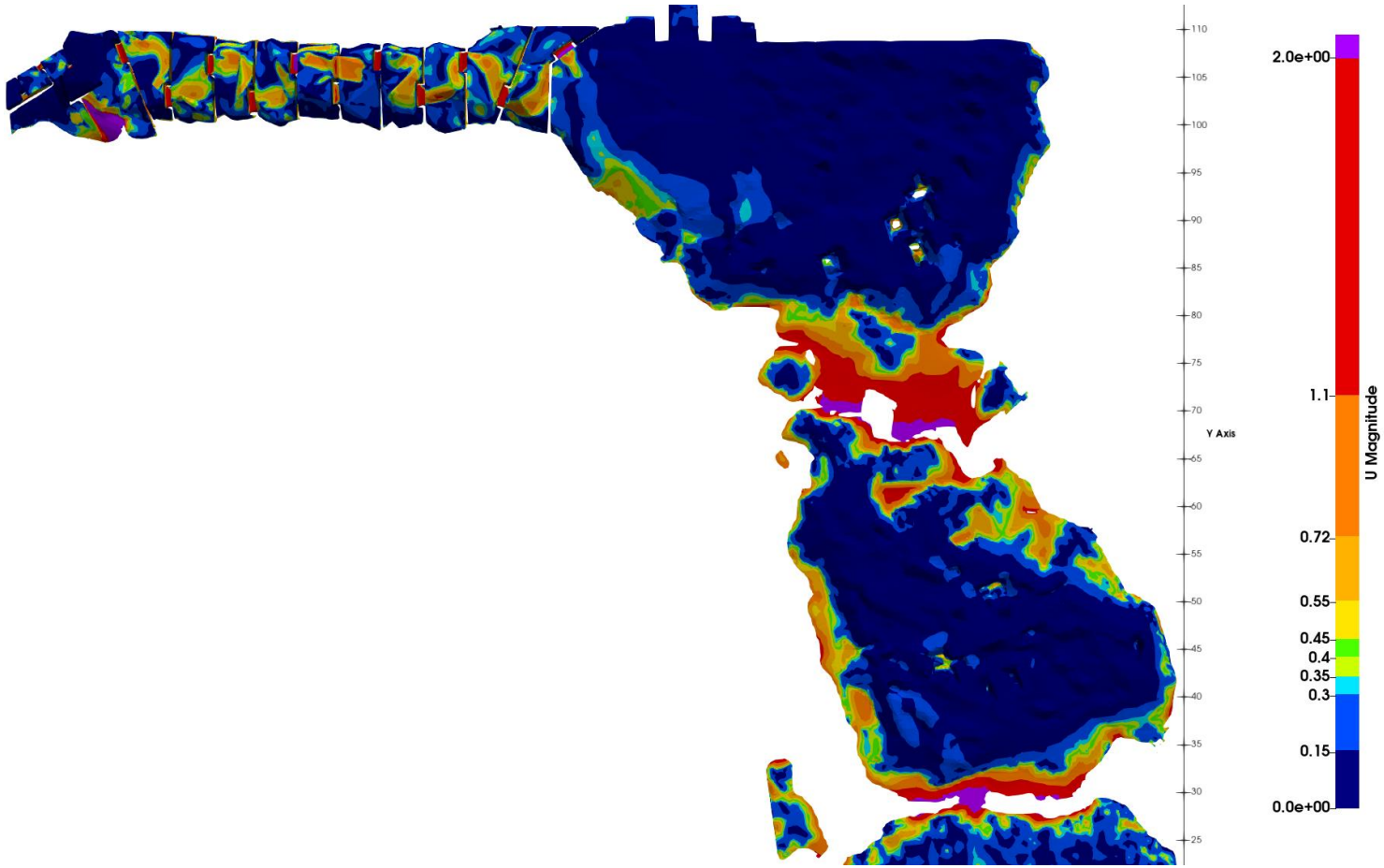


Figure S7-3: View of the Bottom Velocities

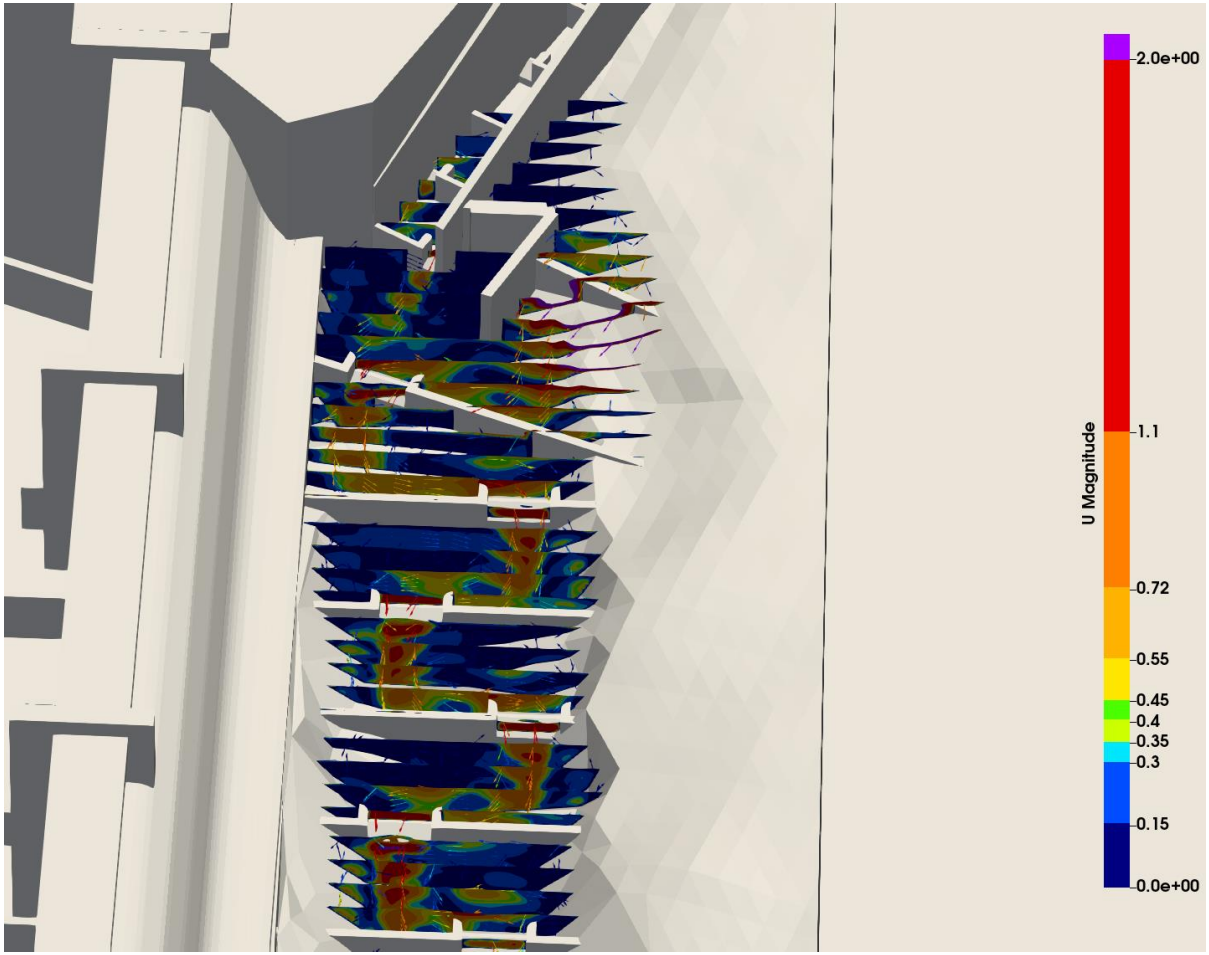


Figure S7-4: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

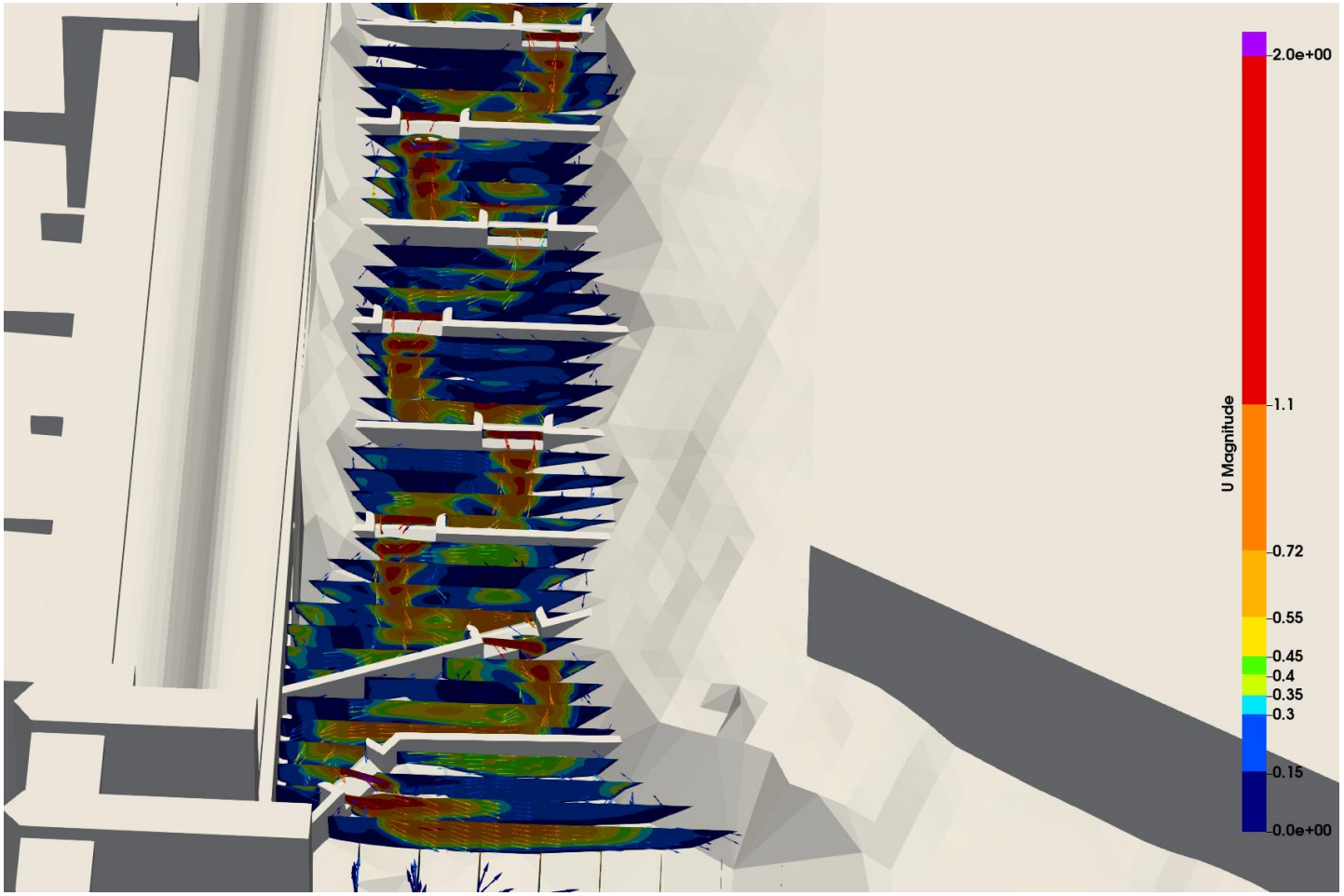


Figure S7-5: Zoom-in view of velocity vectors in the fishway area at an interval of 1m in both x and y directions

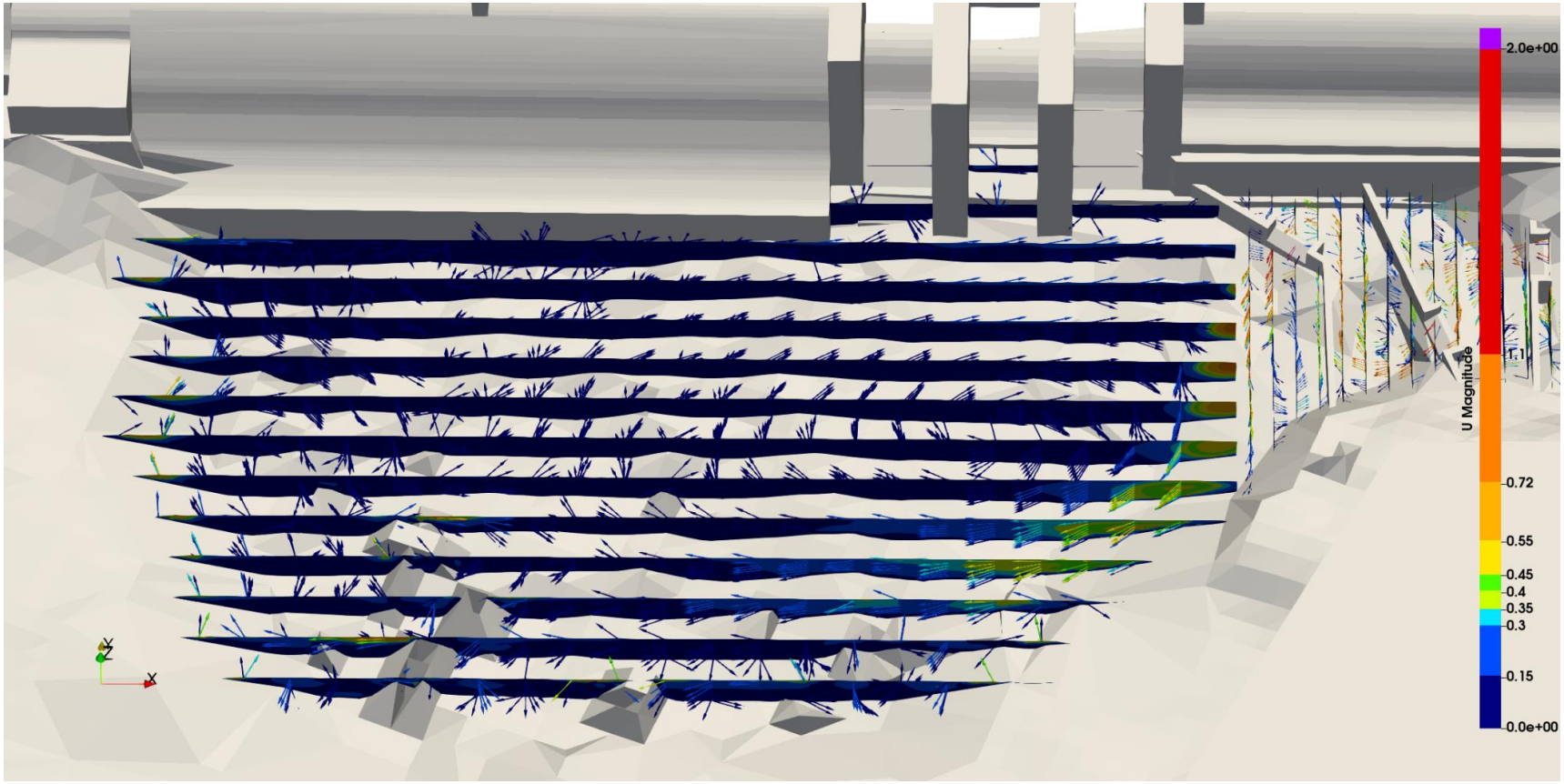


Figure S7-6: View of velocity vectors downstream of the gates at an interval of 1m/2m in the x direction and 2m/5m in the y direction

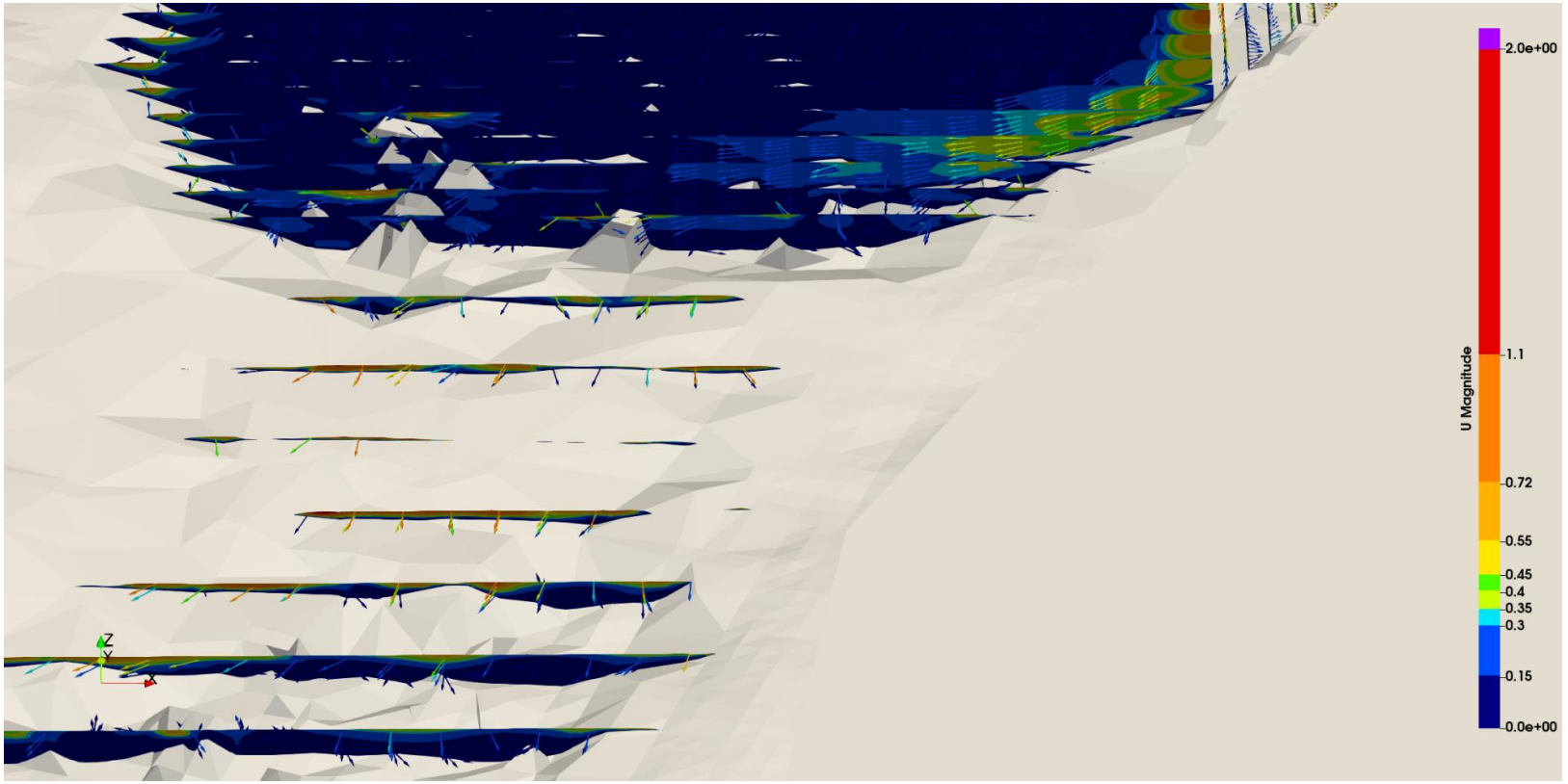


Figure S7-7: View of velocity vectors in the middle of the channel at an interval of 2m in the x direction and 2m/5m in the y direction

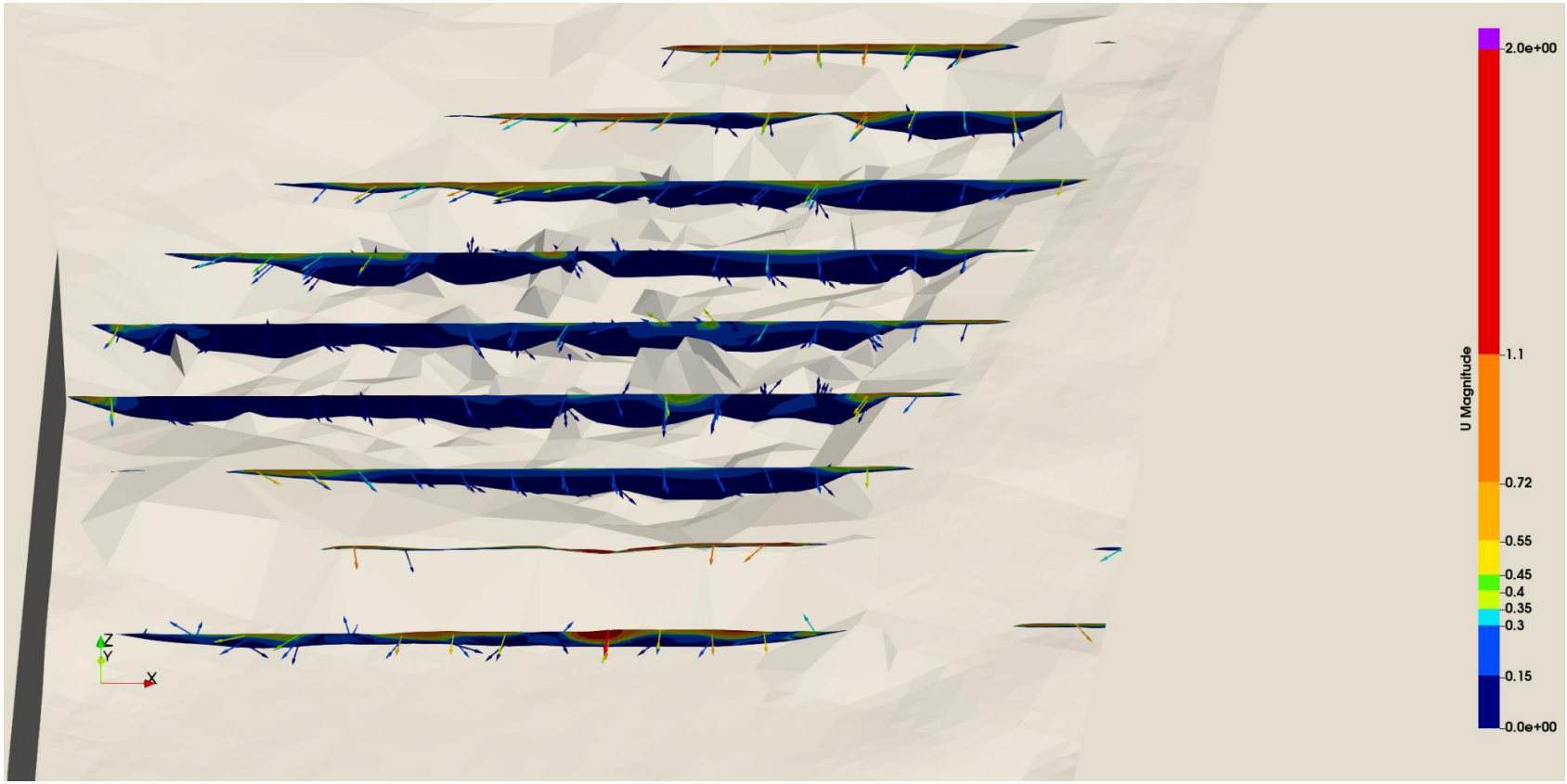


Figure S7-8: View of velocity vectors near the end of the channel at an interval of 2m in the x direction and 5m in the y direction

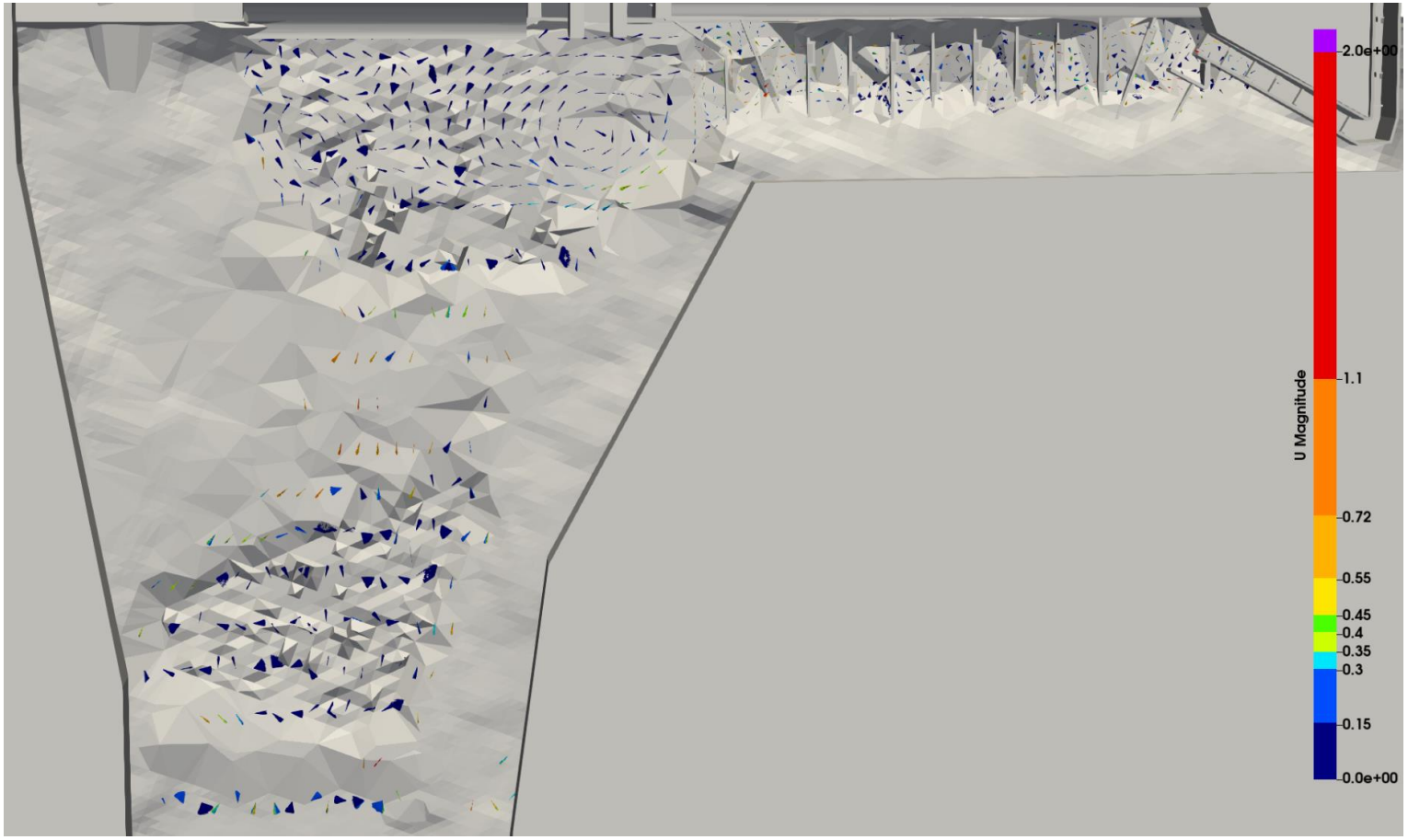


Figure S7-9: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 1m/2m/5m in the y direction (from the geometry bottom to 0.2m above it; vectors are at uniform length) – entire domain

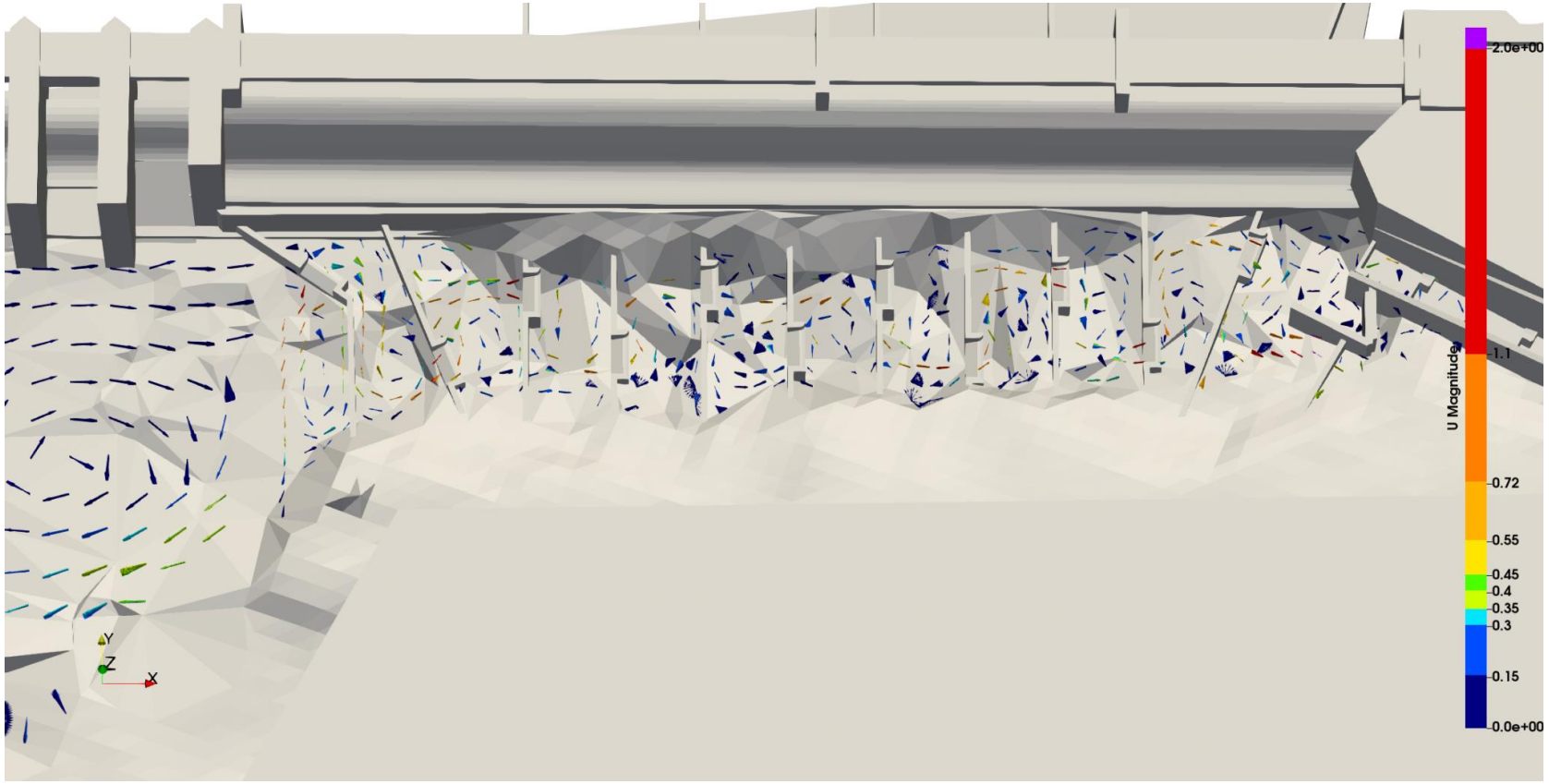


Figure S7-10: Plan view for velocities at the bottom area at an interval of 1m in both x and y directions (from the geometry bottom to 0.2m above it; vectors are at uniform length) – fishway

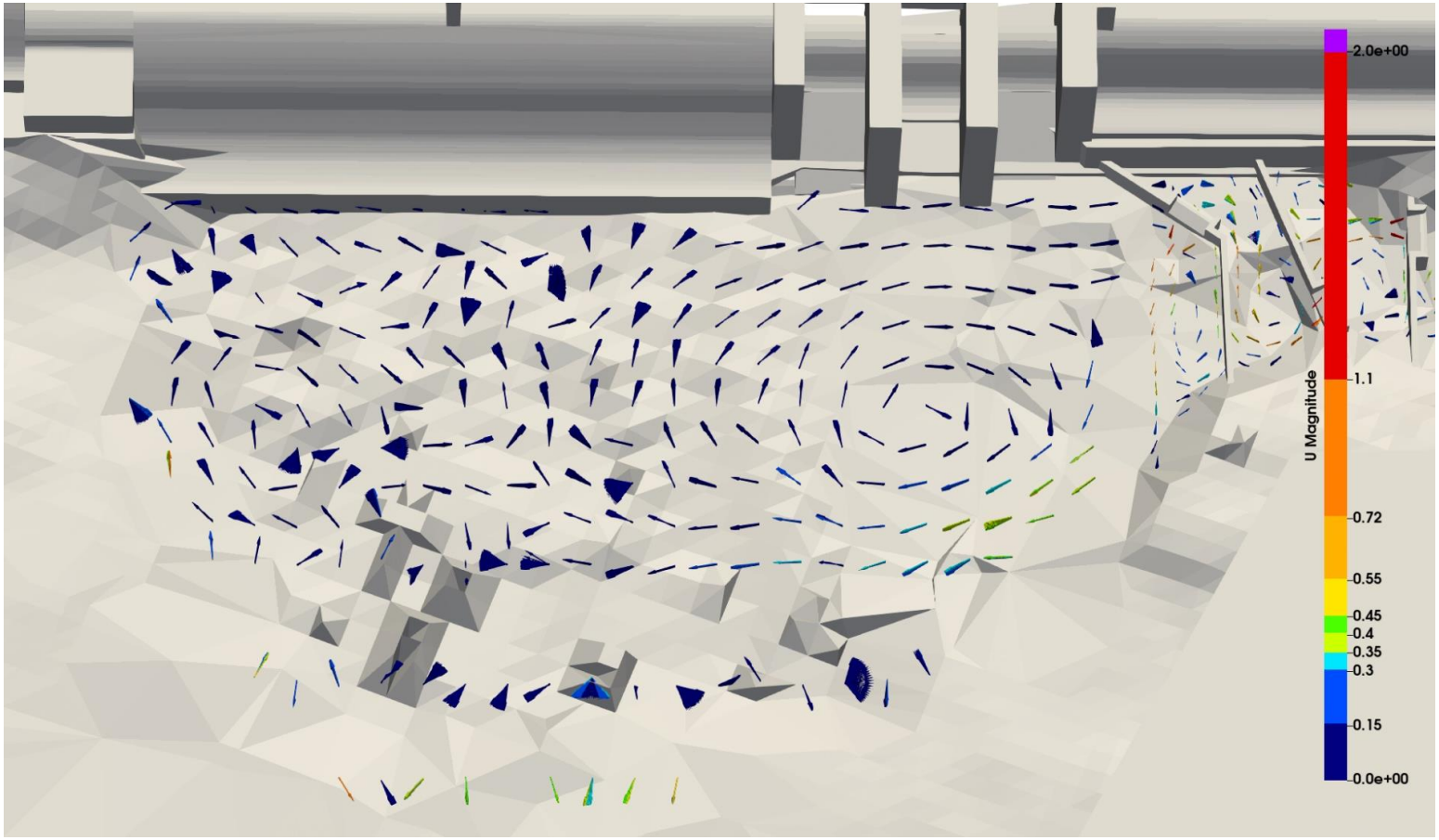


Figure S7-11: Plan view for velocities at the bottom area at an interval of 1m/2m in the x direction and 2m in the y direction (from the geometry bottom to 0.2m above it; vectors at uniform length) – downstream of the gates

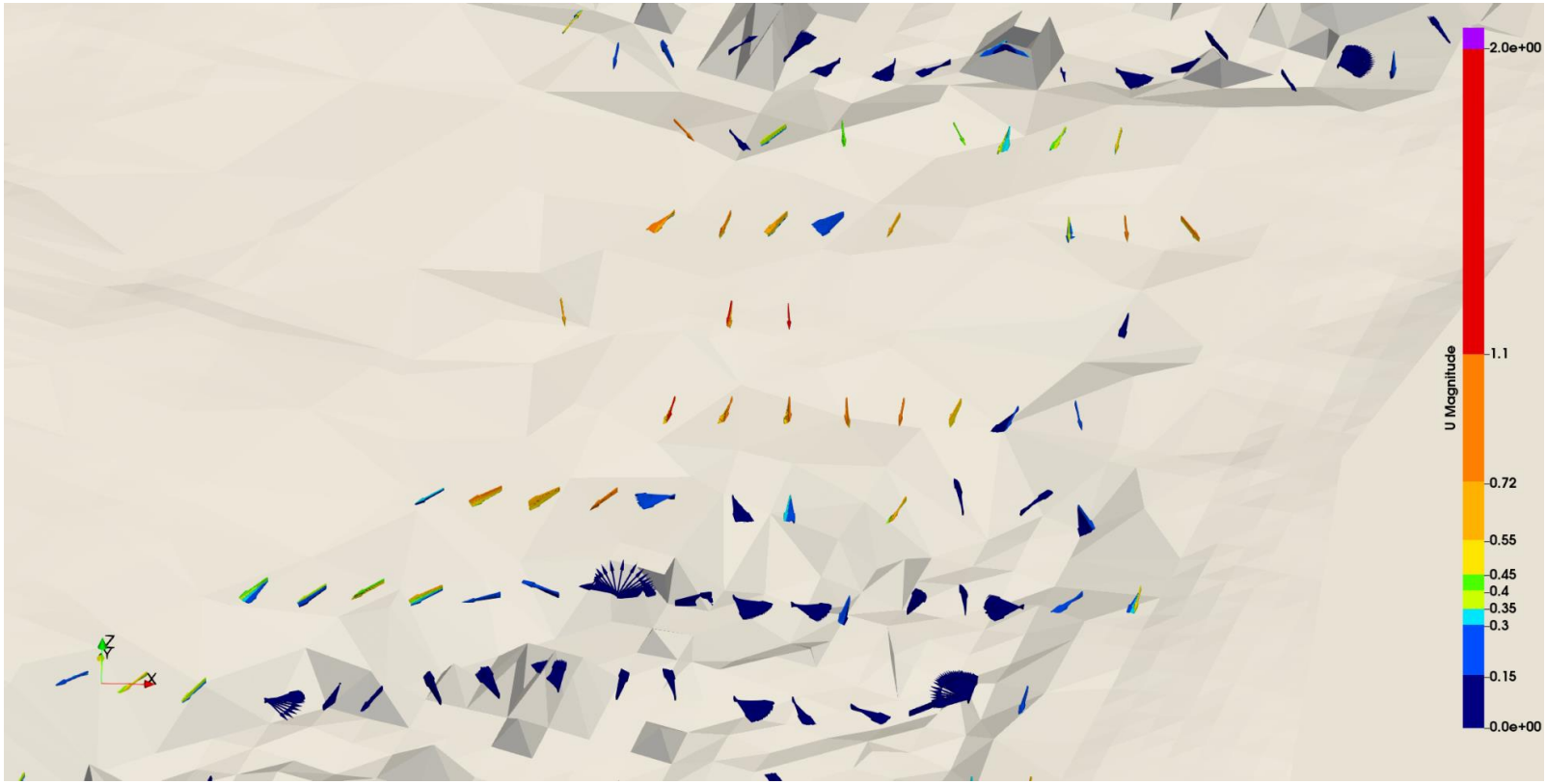


Figure S7-12: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – middle of the channel

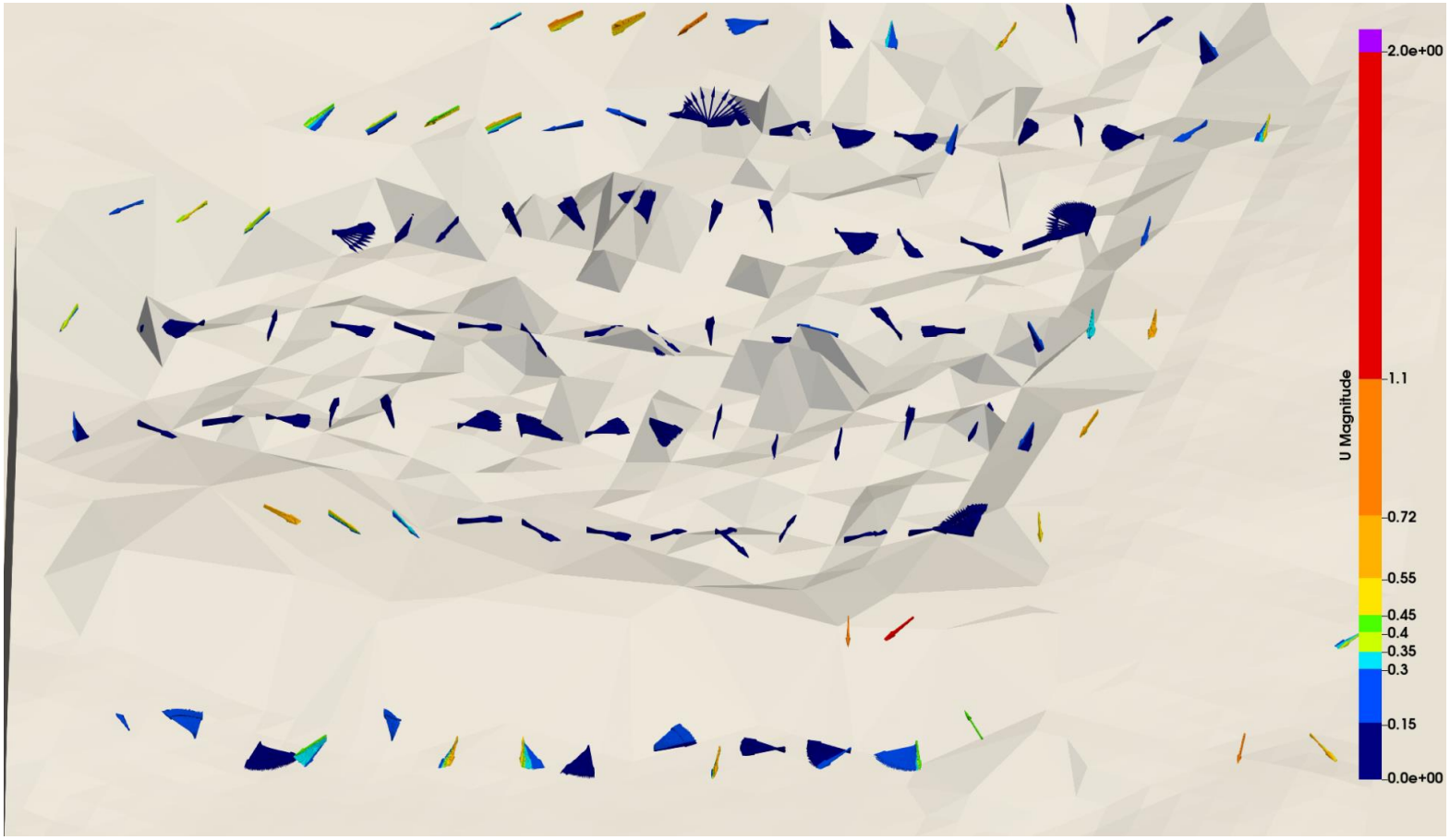


Figure S7-13: Plan view for velocities at the bottom area at an interval of 2m in the x direction and 5m in the y directions (from the geometry bottom to 0.2m above it; vectors at uniform length) – near the end of the channel

2 Ruth Falls Dam – River Fish Passage Modelling: Summary of Thaumas Environmental Consultants Ltd. Report

2.1 Introduction

Nova Scotia Power (NSP) has requested that CBCL Limited (CBCL) conduct 3D Computational Fluid Dynamics (CFD) hydraulic modelling (3D modelling) for the post-refurbished downstream conditions and proposed changes at the Ruth Falls Dam in Sheet Harbour, Nova Scotia (Appendix A: Figure 1). The main refurbishments and changes that were modelled by CBCL and evaluated by Thaumas Environmental Consultants Ltd (Thaumas) are shown in Table 1 and Appendix A: Figure 1).

Table 1: Proposed Refurbishments and Changes to the Ruth Falls Dam and Explanations

#	Proposed Refurbishment / Change	Explanation
1	Replacement of the existing stop log bay with three vertical lift gates in the center of the dam and the flows distributed between the gates.	The current stop logs are leaking and are difficult to adjust to maintain the headpond within a narrow depth range.
2	Installation of a new rubber dam.	Large inflatable rubber cylinders will be replacing the existing stoplog sections, on top of the concrete spillway of the refurbished dam, to replace the existing stop logs and stop all leakage.
3	Eleven new fish passage weirs in the fishway channel section at the toe of the dam.	The existing seven fishway weir configuration has varying drops and pool sizes and does not provide adequate fish passage. The weirs will be replaced with 23 cm drops and notches sized to accommodate the louvre flow for additional fishway attraction flow.

#	Proposed Refurbishment / Change	Explanation
4	Fishway entrance	The notch in the entrance weir is located to the dam side of the fishway channel and aligned to direct its flow along the edge of the gate flows.
5	Louvres flow and bypass pipe relocated	The louvre flow will be relocated to the upper end of the fishway channel to provide additional attraction flow to the fishway.
6	Removal of rock flow diversion at gate three	A rock outcrop in front of gate three will be removed so the flow is directed down river vs. along the toe of the dam.
7	Riverbed bathymetry was flattened in the model just below the fishway and the three spill gates	To remove flow obstructions along the bottom, which disrupt favourable velocity patterns for fish passage.

The modelling was requested to determine if the proposed changes to the refurbished dam would affect fish passage in the river, at the entrance to the fishway, and in the lower channel section of the fishway. At the request of NSP, CBCL performed the CFD 3D modelling with the OpenFoam[1] modelling software. Thaumas evaluated and reviewed the computer modelling for fish passage and provided a report entitled, "Ruth Falls Dam – River Fish Passage Modelling". The following sections are a high-level summary of the Thaumas report and the full Thaumas report is provided in Appendix B.

2.2 Literature and Background Review

Thaumas conducted a background review of the current operating conditions, fish passage facilities at Ruth Falls, and fish swimming abilities and behaviour for the species present at the site. Thaumas found that the Ruth Falls concrete fishway currently passes fish well, based on the modelling and observations, and does not need any modification. Currently, the normal operating conditions of the dam provide approximately 100 cubic feet per second (cfs) of flow to the river below the dam. The licence requirements for the facility requires a minimum fishway flow of 6 cfs, and a minimum louvre flow of 29 cfs. These flows are supplemented by the stoplog leakage providing an additional flow of 65 cfs, for an approximate total flow of 100 cfs. The results of the fish passage background review indicated that these current flow requirements allow satisfactory upstream passage of most fish species; however, the depth over the river's rock sills would need additional flow to provide a water depth of at least 38 cm on the river's rock sills for multi-sea year Salmon passage.

The current operating licence also requires 10 or more supplemental flows from June 15 to July 15 and September 26 to November 30 of greater than 50 cfs overnight for a minimum of 12 hours, and nightly when Atlantic Salmon are present. The location of this release

[1] Open-source Field Operation and Manipulation is a 3D Computational Fluid Dynamics model.

must be immediately below the dam. The supplemental flow events are intended to complement significant high flow events (i.e., ≥ 24 mm of rain in 24 hours) and to attract Atlantic Salmon to migrate upstream to the fish ladder by providing migration flow depth over the river's rock sills.

As part of the literature review, Thaumas evaluated the swimming speeds, swimming endurance, orientation to flows, and behaviours of the fish species found at the site that want to migrate past the dam. The species assessed cover the full range of swimming abilities of all fish species present and include:

- Gaspereau (Alewife and Blueback Herring)
- Brook Trout (20 cm Total Length (TL))
- Atlantic Salmon (Salmon Grilse[2], multi-sea-year Salmon)
- American Eels (Elver 6 cm TL, yellow 20 cm TL, yellow 60 cm TL)

A summary of migration times and cues, size range and the assessed sizes is provided in Table 2. Lake species found in the reservoir that do not need to migrate past the dam to complete their life cycles were not specifically evaluated but their abilities fall within the range of the assessed species (i.e., Yellow Perch, Brown Bullhead, White Sucker, Golden Shiner, and Lake Chub).

Table 2: Migration Times and Cues and Size of Selected Fish Species

Selected Species	Migration Times/Needs Past the Dam	Migration Requirements Assessed	Typical Size Range (cm)	Assessed Size (cm)
Gaspereau	March until Fall, upstream Spring Run: Mid-April to Late June; downstream till fall	- temperature - flow velocity - water depth - orientation to flows - behaviour - swimming ability & endurance	20-35	25
Brook Trout	Year Round & Fall spawning	- flow - temperature - water depth - orientation to flows - behaviour - swimming ability & endurance	20-55	20
Atlantic Salmon - Grilse	Spring, Summer, and Fall	- river migration - velocity - temperature	45-60	50

[2] Salmon that have only been to sea for one year

Selected Species	Migration Times/Needs Past the Dam	Migration Requirements Assessed	Typical Size Range (cm)	Assessed Size (cm)
		- water depth - behaviour - swimming ability & endurance		
Atlantic Salmon – Multi-Sea-Year	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	75-105	100[3]
American Eel Elvers	Mid-March - June	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	6	6
American Eel Yellow 20 cm	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	20	20
American Eel Yellow 60 cm	Spring, Summer, and Fall	- river migration - velocity - temperature - water depth - behaviour - swimming ability & endurance	60	60

[3] Larger size was assessed to ensure larger salmon can pass.

2.3 Proposed Scenarios Based on 3D Model Results

Using the OpenFOAM model results, Thaumas, evaluated the routes the fish are anticipated to select in the river below the dam based on their swimming abilities and endurance, required water depth, flow direction, and behaviour to plot routes they could use against the river flow velocities and depths before having to rest. Scenarios were evaluated to find the optimal conditions between the interaction of the fishway attraction flow and the gate flow, to attract the fish to the fishway entrance. The revised lower channel section of the fishway, with its new 11 weirs, the louvre flows of 35 cfs, and the upper concrete fishway section, was also assessed. Seven different flow scenarios from the gates (Scenarios 1-7) (Table 3) were assessed. Details of each flow scenario can be found in the detailed report (Section 3D model results; Appendix B). Under all scenarios the fishway flow and louvre flows remain consistent at the minimum required flow. Changes in flows arise from the gates or the required supplementary flows released from the gates[4]. The supplementary flow events were not modelled during the evaluation. Thaumas considered fish passage downstream of the gates to be occurring mainly within the Scenarios 1 and 2. Since the current operating licence requires supplementary flows of 50 cfs, flow events under Scenario 1 would be approximately 150 cfs in total during those events, which would fall in between Scenario 1 at 100 cfs and Scenario 2 at 200 cfs, which as stated above are the flows where fish passage occurs.

Table 3: Flows Scenarios Evaluated and Considered for Fish Passage

Scenario	Fishway Min Flow (cfs)	Louvre Min Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow* (cfs)	Total Flow (cfs)
Current Scenario (for comparison)	6	29	65	50	100-150**
Fishway	6	29	n/a	n/a	35
Scenario 1	6	29	65	n/a	100
Scenario 2	6	29	165	n/a	200
Scenario 3	6	29	925	n/a	960
Scenario 4	6	29	1720	n/a	1755
Scenario 5	6	29	3051	n/a	3086
Scenario 6	6	29	4308	n/a	4343

[4] Proposed Supplementary flows can be defined as 10 or more supplementary flows of 50 cfs that occur from June 15 to July 15 and September 26 to November 30.

Scenario	Fishway Min Flow (cfs)	Louvre Min Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow* (cfs)	Total Flow (cfs)
Scenario 7	6	29	0	n/a	35
Required Supplementary Flow (not modelled but considered)	6	29	65	50	150

Table Notes:
n/a = not applicable
* Supplementary flows can be defined as 10 or more supplementary flows of >50 cfs that occur from June 15 to July 15 and September 26 to November 30 and each night when salmon are detected.
**150 cfs would only occur during supplementary flows.

2.4 Fish Passage Routes Based on 3D Modelling

The swimming ability and water depth requirements, plus a behaviour evaluation for each of the listed species and size classes, was used to evaluate fish passage routes in the river approaches to the dam and the lower channel fishway section for all the modelled flow scenarios using the details in the 3D model.

The Fish Protection Tools for Swim Distance, Velocity, and Water Depths were used to calculate the swim distance and percentage of fish that could physically pass in each scenario through various routes in the river below the dam. The percent potential passage categories based on swimming ability included the following:

- 97.5% - Always pass fish and will sustain fish populations.
- 87.5% - Acceptable fish passage and will sustain fish populations.
- 50% - Satisfactory fish passage, may not be enough passage to sustain the population for some species.
- 12.5% - Poor fish passage, will not sustain fish populations.
- 2.5% - Unlikely passage, will not sustain fish populations.

When the swim distance, based on velocities encountered before access to a resting area, fell between categories, the lower percent category was used. The potential estimated percent passage of the selected fish species is based on the model results for the best route evaluated for fish passage (see Table 4).

Table 4: Estimated % ability of the selected fish species to pass through the river section modeled to the fishway entrance based on the best routes found in the Evaluated Model Scenarios

Scenario	Gaspereau	Brook Trout*	Grilse Salmon	Multi-Sea-Year Salmon	American Eel - Elver	American Eel – Yellow 20 cm	American Eel – Yellow 60 cm
New Lower Section of the Fishway	97.5%	97.5%	97.5%	97.5%	< 2.5%	97.5%	97.5%
Eel Pass	n/a	n/a	n/a	n/a	97%	97%	n/a
Scenario 1	97.5%	50%	87.5%	97.5%	< 2.5%	12.5%	87.5%
Scenario 2	50%	12.5%	50%	97.5%	< 2.5%	< 2.5%	12.5%
Scenario 3	None	None	12.5%	50%	None	None	None
Scenario 4	None	None	None	None	None	None	None
Scenario 5	None	None	None	None	None	None	None
Scenario 6	None	None	None	None	None	None	None
Scenario 7	None	None	None	None	None	None	None

Table Notes:
*Based on 20cm TL trout, the % passage for larger sea run trout may be higher but was not evaluated.
n/a = not applicable

2.5 Proposed Scenario

Based on the evaluation of the OpenFOAM model results, Scenario 1, with 6 cfs from the upper fishway and 29 cfs from the louvres (combining to provide 35cfs at the fishway entrance), and an additional 65cfs from the gates, provides the best conditions for upstream fish passage in the river up to the dam and the best attraction to the fishway entrance for all modelled species.

This scenario provides the best passage for Eels compared to the other proposed scenarios. Elvers are shown as having poor passage in all scenarios due to the scale of the bathymetry and flow modelling for these very small eels, that require only a very shallow flow. It is expected that the elvers and very young yellow stage eels will preform much better at moving up the river than the modelling shows, as they move between rocks on the bottom and along the shallow low velocity flows along the bank.

The pool and weir fishway will pass the larger eels but the velocities and distances in the notches exceed the passage ability of the elvers and smaller eels. For this reason, the addition of an Eel pass is proposed for American Eels to provide passage past the dam for

all upstream migrating age classes of eels. The best location for an American Eel pass is depicted on Figure 1 in Appendix A.

This scenario provides a minimum passage depth over the river's rock sills for the multi-sea-year Salmon so it is likely they will choose not to pass until the water level is deeper during the supplemental flow releases. Under Scenario 1, the 10 or more nighttime supplemental flow releases from June 15 to July 15 and September 26 to November 30, of 50 cfs, as currently provided under the licence, are required and are best released from the three gates. The number and timing of the supplemental flows provides the attraction and water depths over the river's rock sills the Salmon need, while still providing passage for the other species during the day and on the other nights.

Table 5: Proposed Scenario Based on Estimated Fish Passage of Selected Fish Species

Scenario	Fishway Flow (cfs)	Louvre Outflow (cfs)	Gate Flow (cfs)	Supplementary Flow (cfs) (≥10 Events)	Total Flow (cfs)
Scenario 1 with Eel Pass	6	29	65	50	100-150*

Table Notes: *150 cfs would only occur during supplementary flows.

2.6 Closure

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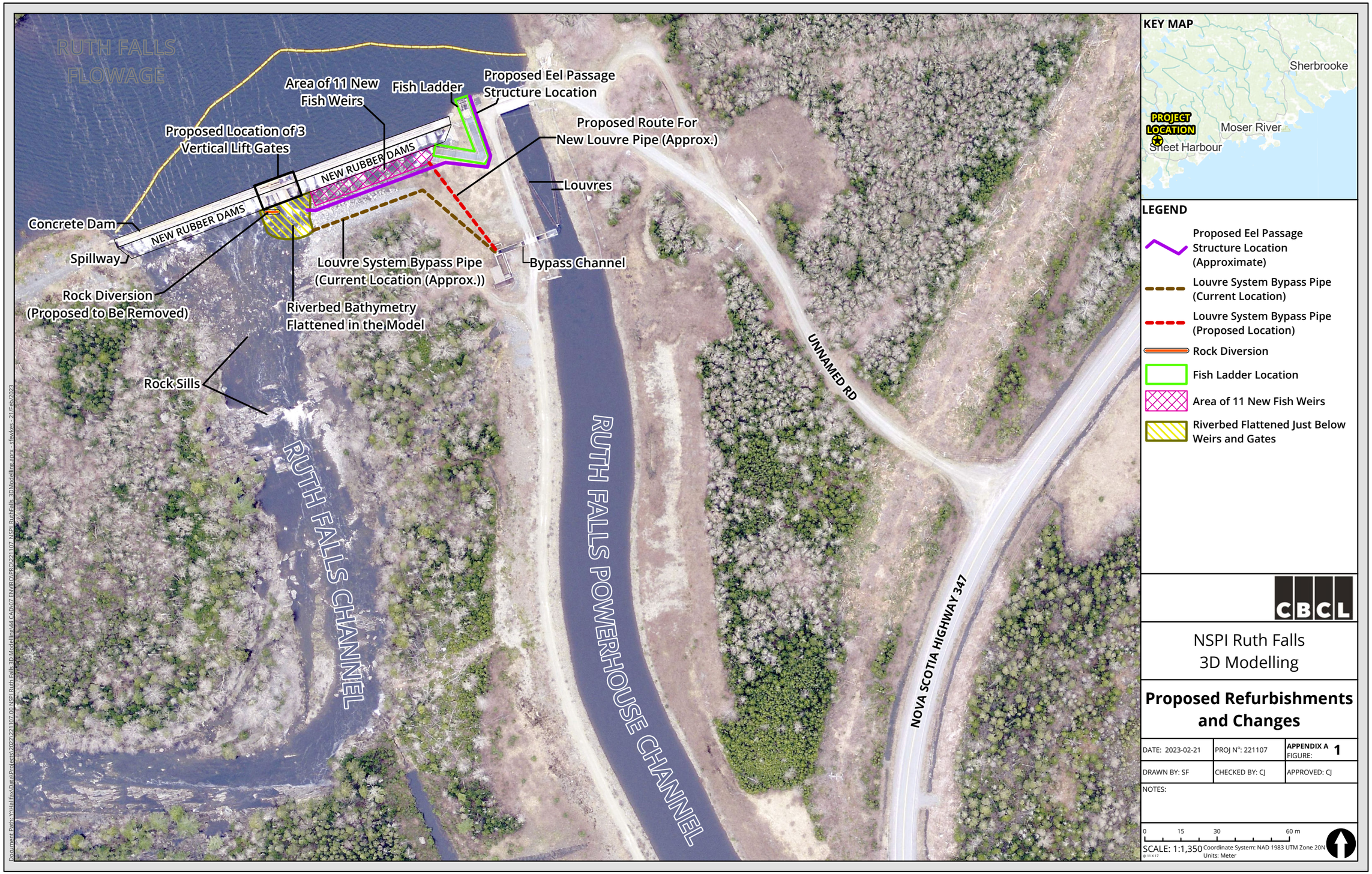
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APPENDIX A

Figure 1


RUTH FALLS FLOWAGE
Area of 11 New Fish Weirs
Fish Ladder
Proposed Eel Passage Structure Location
Proposed Location of 3 Vertical Lift Gates
NEW RUBBER DAMS
NEW RUBBER DAMS
Proposed Route For New Louvre Pipe (Approx.)
Louvres
Concrete Dam
Spillway
Rock Diversion (Proposed to Be Removed)
Louvre System Bypass Pipe (Current Location (Approx.))
Bypass Channel
Riverbed Bathymetry Flattened in the Model
Rock Sills
UNNAMED RD
RUTH FALLS CHANNEL
RUTH FALLS POWERHOUSE CHANNEL
NOVA SCOTIA HIGHWAY 347
KEY MAP
Sherbrooke
PROJECT LOCATION
Moser River
Sheet Harbour
LEGEND
Proposed Eel Passage Structure Location (Approximate)
Louvre System Bypass Pipe (Current Location)
Louvre System Bypass Pipe (Proposed Location)
Rock Diversion
Fish Ladder Location
Area of 11 New Fish Weirs
Riverbed Flattened Just Below Weirs and Gates
CBCL
NSPI Ruth Falls 3D Modelling
Proposed Refurbishments and Changes
DATE: 2023-02-21
PROJ N°: 221107
APPENDIX A FIGURE: 1
DRAWN BY: SF
CHECKED BY: CJ
APPROVED: CJ
NOTES:
0 15 30 60 m
SCALE: 1:1,350 @ 11 x 17
Coordinate System: NAD 1983 UTM Zone 20N
Units: Meter
Document Path: X:\Halifax\Data\Projects\2022\221107.00 NSPI Ruth Falls 3D Modelling\mxd\CAD\07 ENVIRO\PRO\221107 NSPI RuthFalls 3DModelling.aprx - sfewkes - 21/Feb/2023

APPENDIX B

Thaumas Consultants Report

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Ruth Falls Dam – River Fish Passage Modeling

THAUMAS ENVIRONMENTAL CONSULTANTS FEBUARY 10, 2023

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Introduction

Nova Scotia Power Inc has requested 3D hydraulic modeling to be completed at the Ruth Falls dam East River Sheet Harbour for the purpose of assessing post-refurbishment downstream river flow conditions. The main refurbishments to the dam include the installation of vertical lift gates in the center section of the dam which will replace the existing stoplog bays. The change also includes the installation of a new rubber dam along the other stoplog spillways. The modeling is to assess how changes in flow releases from the vertical lift gates and rubber dam would impact fish passage in the river area downstream of the dam and specifically the entrance conditions to the fish ladder. The lower section of the fish ladder is changed to improve fish passage and operate effectively with the changes in the refurbished dam (Thaumas 2023 a, b, c) and these new fishway conditions have also been modeled.

The 3D modeling has been done by CBCL and the results provided in their memo dated January 27th, 2023, titled "NSPI Ruth Falls 3D Modelling Model Results with new fish passage weirs pointing south-west, louvres flow relocated, with no rock flow diversion and bathymetry flattened just below weirs and gates, and flows distributed between the 3 main gates." The model results were also provided in electronic format for further fish passage route computer analysis.

The fish route plots are drawn on plots provided in this CBCL memo.

Ruth Falls Fish Passage Background

Fishway Layout and Operation

The Ruth Falls concrete fishway passes fish well based on the modeling and observations and does not need any modifications. Measurements taken showed some pools had a slightly larger drop than others, but this is due to either plugged drain holes or materials built up in the pool, is well within the proper operating range of depth, and this will be fixed when the fishway is dewatered. The notch width is 1.75 ft, with a typical water depth of 1ft over the crest of the notches. The pool size is 8 ft wide by 10 ft long with a sloping floor, containing a water depth of 2 ft at the upstream end and 3 ft at the downstream end. There is a range of velocities in the notches with the maximum velocity of 1.2m/sec (3.9 ft/sec). The EDF in the pools is 1.8 (ft-lb/s-ft3) and the fishway flow is 6 cfs Velocities are lower at the bottom and especially in the corners of the notch as the water level in the pool below backs the water level up to the crest of the weir for a combination plunging and streaming flow which is better for fish passage. This notch design is very good for fish passage and the operating depth range at or a few inches above 1 ft must be maintained.

Current flow requirements

The current fishway and flows were modeled with the minimum depth over the concrete fishway notches of 1 ft, the minimum fishway flow of 6 cfs, the minimum louvre flow of 29 cfs, and the stoplog leakage and spill of 65 cfs. Some of the stoplog leakage increases the flow in the lower fishway channel section but the amount is not known and was included in the gate release as the new dam will not have any leakage along this part of the dam.

From June 15 to July 15 and September 26 to November 30 there are weekly supplemental flow events when the Ruth Falls headpond elevation is at 33.3 m (109.4ft). These supplemental flow events are scheduled to complement significant inflow events, where a significant inflow event is defined as greater than or equal to 24 mm of rain in a 24-hour period, as measured at the Malay Falls office where a rain gauge is maintained and checked on weekdays. A total of 10 or more supplemental flow events are to occur within these dates. A supplemental flow event is defined as release of water exceeding 50 cfs immediately downstream from the discharge point for a minimum of 12 hours released overnight. These flows are intended to attract salmon out of the tide and to migrate upstream. These supplementary flows are not modeled and would fall between the modeled current flows of a minimum of 6cfs from the fishway, 29 cfs from the louvre outfall, 65cfs from the gates for a total of 100cfs and the modeled flows of 200cfs.

Refurbished Dam Layout and Operation

The plans for the dam refurbishment were used to identify where there will be fish passage issues, where changes may need to be made to the flow requirements and flow patterns to provide good fish passage following the refurbishment.

Changes to the flow pattern

The current fishway flow does not provide significant attraction flows on it own. The stoplog leakage along the fishway channel at the toe of the dam does not add enough flow to significantly improve attraction, and this leakage equivalent can not be provided through the new rubber dam spills. The design of the fishway channel that runs along the toe of the dam was designed for salmon but does not meet the proper design criteria even for them with inline small size notches, pools with various lengths, widths, and depths, plus flow over the lower weirs even in low flow, and excessive pool turbulence when additional flow is added from the spillways to provide entrance attraction. This section of the fishway is poor, so a redesign is needed with additional flow.

The fishway channel weirs will be replaced by 11 new weirs that will handle the fishway flows plus the louvre flows. This provides a good flow of (35cfs) at the fishway entrance to attract fish under various gate releases (Thaumas 2023 a).

The gate flows are released at different depths with the two outside gates releasing at the river surface water level, parallel to the surface, so there are high velocities across the surface in the river but not at depth. The center gate releases deeper in the river and affects velocities right to the bottom where the salmon, trout, and eels swim and at mid water where the migrating gaspereau swim in this depth of water. This flow energy dissipates quickly in the deeper water vs the other two gates that show high velocities across the surface.

To provide a consistent downstream flow and minimize the back eddies, especially in front of the fishway, the flow has been distributed between the three gates. Various combinations were modeled, and the best was 20 cfs from the west gate, 40 cfs from the deeper center gate, and 5

cfs from the east gate closest to the fishway. The rock in front of the west gate will be removed and the bathymetry in front of the fishway has been smoothed.

This combination of flows will need to be checked when operational to get the best balance of flows from the gates as the bathymetry in the area is not very detailed so the model only gives a good indication of the flows and velocities but may not be giving the best combination of gate flows.

The fish passage migration routes are predicted based on the swimming abilities, distance against the velocity, behaviour, and required water depth for Gaspereau, Brook trout, Salmon grilse, multi-sea-year Salmon, and American eels. These species requirements span the upstream passage requirements for all the species that need to migrate up past the dam to complete their life cycle.

The fishway operation is the same under all scenarios. It is only the gate flows that change.

Fish Swimming Performance Background

Loss of habitat connectivity due to built structures is among the greatest threats to freshwater fish populations. Re-establishing river connectivity through fishways can be an effective and cost-efficient method of enhancing the watershed's productivity, but many are unsuccessful due to flow patterns in the tailrace, location of the fishway entrance, poor attraction flows without suitable velocities, and within the fishway due to excessive turbulence due to low pool volumes, high velocities and low water depths in the notches, and poor notch design, that are not suitable for migration and resting for all the species that require passage.

A good understanding of swimming performance and behavioural response to hydraulic conditions for all the species present is needed to assess fish passage and migration conditions in the following locations: the river below to determine where the fish will approach the dam, near the dam face for fish searching for the fishway, and in the immediate area around the fishway entrance for attraction and entrance conditions.

Ideally a fishway including the entrance attraction flow in the river should allow fish to continue their upstream and downstream migration with no delay, added risk of predation, or extra energy expenditure compared to the natural migratory route, and without reducing fitness due to stress, disease, or injury (Castro-Santos, 2009). Evaluation of fish pass effectiveness is largely dependent on determining attraction, for example the percent of migrating fish in the dam tailrace that are able to find the fishway entrance without delay, the proportion of fish that approach the fishway and enter, and the proportion of the fish which successfully ascend/descend and the related efficiencies and length of delay (Castro-Santos, 2009; Bunt, 2012).

It has long been recognised that the success of mitigation measures to maintain freshwater connectivity are dependent on a good understanding of fish swimming ability (Brett, 1964). Water velocities exceeding the capability of the individual species and related fish size will prevent passage, therefore this is the main ecological metric accounted for in fishway design

(Clay, 1995). Fishway length, slope, dimensions of pools, water depths, weir, the design of slots and orifices, and the frequency and size of resting pools all have to be determined based on the resultant water velocity and depth and the ability of fish to move upstream (Clay, 1995; USFWS, 2019). Perhaps most importantly, the fishway entrance and its attraction flow must be located properly with a strong enough flow to be detected by fish within the dam tailrace without excluding weak swimming species (Weaver, 1963).

Literature Background

Despite a long history of research into fish swimming abilities (Katopodis & Williams, The development of fish passage research in a historical context, 2012), fishway attraction and passage efficiencies remain highly variable (Bunt, 2012; Noonan, 2012). As swimming ability depends on fish species and life stage (Katopodis & Gervais, 2012), where there has been historically a bias towards designing fish passes for strong swimming salmonids on their spawning migration, which has been widely blamed for low efficiencies for other species and life stages (Petts, 1989; Mallen-Cooper, 2007; Katopodis and Williams, 2012; Foulds and Lucas, 2013).

The widespread swim chamber methodologies used to quantify swimming ability have also come under recent criticism. Several studies have shown that data obtained in swim chambers can underestimate swimming ability and result in conservative fishway and migration flow velocities, which can be a problem for upstream passage route determination and attraction to fishway entrances. These studies are also limited by the size of fish studied and the water temperature, so swimming ability is often extrapolated from younger life stages but seldom reflect the temperature effects both positive and negative. Oxygen levels in the water are also critical but not reported in most the swimming tests. Also, fish muscle function is related to water temperature (Brett and Glass 1973; Bernatchez 1985) which has a strong influence on both swimming ability and fish behaviour which are not fully accounted for in these studies. (Plaut, 2001; Peake, 2004a; Peake and Farrell, 2006; Tudorache *et al.*, 2011; Castro-Santos and Haro, 2006). It has also been shown that the habitat the fish is reared in, fast flowing stream vs a lake or pond, affects their swimming ability and endurance (Jones P. E. 2020).

Basing designs on swimming ability alone has resulted in a lack of consideration of a fish's behavioural response to the hydraulic conditions they experience, which may improve, prevent, limit, or delay passage (Castro- Santos and Haro, 2008; Castro-Santos, T. (2005; Enders *et al.*, 2017; Rice *et al.*, 2010; Williams *et al.*, 2012). Fish behaviour including preferred migration velocities they swim against and swimming depth; orientation to the bed and banks; and the use of currents and turbulence patterns they use to ride upstream reducing energy expenditure while for some species, maintaining a preferred ground speed, all need to be considered but not well studied if at all for the species present at this site.

The Biology of Fish Swimming Abilities

Fish swimming behaviour uses different speeds that have been classified into four modes based on the muscles activated and the relationship between speed and endurance. The four modes are sprint, burst, prolonged and sustained swimming (Beamish, 1978; Nelson *et al*., 2002).

Sustained speed (also known as continuous or cruising) can be maintained for long periods, primarily using energy derived from aerobic processes to power red muscles (Brett *et al*., 1958), and is used for holding, resting, and routine movements. Water velocities in structures and rivers below a fish's maximum sustained speed are passable regardless of the distance covered. This is often recommended for very long culverts, fishway pools, at the approach to fish screens, and for resting areas (Peake *et al.*, 1997). During laboratory tests a time limit of 200 minutes (recommended by Brett, 1967) is often used in endurance tests, after which time it is assumed, fish are swimming at sustained speeds. However, 60, 100, and 120-minute-long trials are also common (McDonald *et al*., 1998).

Prolonged swimming uses both aerobic and anaerobic processes to power red and white muscle fibres, with an increasing contribution from the white muscle at higher velocities. Prolonged speeds are those resulting in fatigue following a swimming duration between 20 seconds to 200 minutes (Brett, 1964). These intermediate speeds are regularly used during ascent of fishways and culverts (Bunt *et al.*, 1999). Swimming at prolonged speeds is also reflected in a gait change for many fish species, whereby more white muscle fibres are used, and anaerobic processes must be increased (Peake and Farrell, 2004). The prolonged speed that fish can swim at decreases rapidly as the time increases, so the velocity that fish must swim against and the time to make it through the river flows or fishway before reaching a resting area, must both be considered. Also, the condition of the fish, how fatigued they are approaching the fishway, and the availability and size of resting areas upon exiting must be considered.

Burst swimming is powered by anaerobic metabolic processes and contraction of white muscle fibres. This high-speed swimming can only be maintained for a short time before a rest period is required for glycogen resynthesis and removal of muscle lactate (Wilson and Egginton, 1994). Burst speeds are usually defined as speeds that result in fatigue within 20 seconds (Beamish, 1978). Short duration, high swimming speeds are essential for predator escape, prey capture and passage through short velocity barriers. Passage success at sluices, pool and weir, vertical slot, and orifice fishways is determined by burst swimming ability (Russon *et al.*, 2011).

Sprint swimming refers to very high speeds that are maintained for only 1 to 5 seconds (Nelson *et al*., 2002, Castro-Santos, 2005). Sprint speed can be used for very short high velocity sites but is normally just used for predator escape and is not recommended for fish migration design, even in very short sections of flow.

Prolonged, burst, and sprint swim speeds can be combined with a glide behaviour. A burst swim speed in a high velocity flow so that the fish is moving faster than its usual ground speed can be followed by a glide, where they continue upstream, but their ground speed slows until the next burst and glide movement. This is used in turbulent flows, in streams with a stepped pool structure, or in baffled fishways where the velocity is high at a baffle and lower or even moving upstream above it.

Critical swimming speed (U_{crit}) is a special category of prolonged swimming first introduced by Brett (1964). The protocol is carried out on fish enclosed in a swim tunnel respirometer, during which the fish are forced to swim against a particular water velocity for a set time interval. Water velocity (and therefore swimming speed) is then increased by a set increment until the individual fails to swim for an entire time interval. Critical swimming speed is calculated as the sum of the ultimate velocity attained and a fraction of the velocity increment proportional to the time spent swimming at the final velocity relative to the full-time interval (Hammer 1995). Although U_{crit} has often been used to estimate maximum sustained speed, it has also been defined as the highest swimming speed that a fish can maintain for a period equal in magnitude to the time interval used in the test (Peake et al. 1997c). Time intervals as low as 2 min, and as high as 60 min are used in these trials, although values greater than 20 min are most common. Critical swimming speed separates the sustained and prolonged performance swim speeds, and it is therefore considered the best available metric for establishing water velocity criteria for fish passage.

The time limits commonly applied to define swimming modes during performance studies (i.e., sprint < 5 sec, burst < 20 sec, prolonged > 20 sec and < 200 sec, sustained > 200 min;) are somewhat arbitrary values. The transitions do not occur at discrete time intervals and are variable between species. Some species move seamlessly between the different modes while others show definite changes in swim speed and gait.

As swimming speed increases the energy derived from anaerobic processes increases. The use of anaerobic energy stores leads to physiological effects, which must be reversed following exercise, through increased oxygen consumption (known as postexercise oxygen consumption). The anaerobic cost of swimming can therefore be studied by evaluating EPOC (excess post-exercise oxygen consumption) and the time needed for oxygen consumption to return to resting levels (Peake and Farrell, 2004). This recovery time after fatigue can be one or more hours (Lee *et al*., 2003; Reidy *et al*., 1995), therefore, fish swimming endurance at a test velocity can also depend on previous exercise intensity (Jain and Farrell, 2003). The migration conditions in the river below the dam needs to be considered as the fish approach the dam, the time spent searching for the fishway entrance, and where they have been able to find suitable resting areas to rest and recover from this exercise before using the fishway.

Water velocities exceeding the fish swimming capability will prevent passage, therefore it is the main ecological metric accounted for in fish pass design guidance (Clay, 1995, FAO and DVWK, 2002). Also, the attraction flow must be strong enough to be detected by fish within the barrier's tailrace flows without excluding weak swimming species (Weaver, 1963). However, other factors such as water temperature, fish condition including both how well fed they are and if they have been recently fatigued, body condition, age, behaviour with respect to the reason for migration such as spawning, feeding, or habitat selection, and physical parameters such as the orientation to velocities, shoreline, substrate, swimming depth, reaction to turbulence both positive and negative, tidal levels, current patterns, and light conditions all are important factors affecting fish swimming ability and behaviour.

Fish Swimming Behavior

Fish have five swim behaviours they use to try to maintain their ground speed while migrating upstream. The five modes can be combined so that the fish use the least effort possible.

Mode one is to swim against a preferred migration velocity that is, for example, approximately 1 to 1.5 body lengths per second for gaspereau, which would be 0.30 m/sec to 0.4 m/sec. This is a velocity range used by most species but varies a bit from species to species. It is a bit higher for the larger salmonids, and slower for most benthic species and smaller species.

Mode two is to use upstream currents along the side of faster flows, both swimming and riding up on them to maintain a preferred ground speed. If the flow is faster than their preferred ground speed, they tend to turn and face into the current instead of riding on it. This is an issue in back eddy flows and in downstream passage locations.

Mode three is to use the vortices, which are small clockwise and counter-clockwise eddies found along both sides of a faster flow moving through slower flowing water. In Karman Gate (Liao 2017) swim behaviour, fish swim along vortices of approximately 1 to 1.5 body lengths, using the side of the vortices that are headed upstream to make upstream migration easier, but they will use smaller and larger horizontal vortices as well. Fish can be seen swimming in these circulation patterns along the side of faster currents.

Mode four is maintaining their preferred ground speed and adjusting their swimming speed along the route as the currents change. To do this they will use sustained, prolonged, burst and glide, burst, and even sprint speeds if needed, but anything more than low prolonged speed, normally used for migration, shortens the distance they can swim before resting.

Mode five is to school. In this mode they create their own turbulence to aid in swimming. The lead fish keep changing but they are still orienting to the flow and physical parameters.

For mode one, when fish are swimming against a constant velocity, a maximum distance needed between resting areas can be estimated. The estimate is conservative as all the other modes save energy and allow the fish to swim further before resting. Fish can switch easily between modes and combine modes as the conditions along the route change. The swim ability modeling has been conservative.

As fish are migrating upstream or downstream, they orient to physical features, such as the banks, the bottom, the water surface, as well as light intensity and direction using sight and adjusting to currents or turbulence using the lateral line. They also orient to chemical cues such as water temperature, salinity, acidity, and the chemical ion makeup that distinguishes individual rivers due to the geology and recent land use using their olfactory and lateral line senses.

Schooling Behavior

Schools of fish adjust in numbers of fish and shape, both in width and depth, to match conditions. This often puts fish deeper and shallower than the depths noted below. The schools are a predator avoidance technique as well as for swimming assistance, so they can be very large and come in a continuous stream when the fish numbers are high. As an example, early and late in the migration run the numbers are small and the upstream movement for gaspereau occurs in the early morning and at dusk in otherwise ideal route conditions (Alcott 2021). Schools at this time can be as small as 3 or 4 fish. When they are running strong, the highest rate of passage or greatest numbers of fish are migrating in the afternoon to early evening. The fishing weirs use the gaspereau's orientation to the physical stream profile and flows to guide them to the dipping station location (Peake 2008) using a guide wall, which is a simulated diagonal riffle creating shallower and faster flow that the fish avoid and lead along to the upstream end. Individual species behaviours will be noted below.

Passage Depth

The next thing to consider is the depth the fish are swimming at, as the flow velocity and patterns change with depth and fish also need a minimum depth for safe passage, which for most fish is a minimum of 1/3 the body length, although a water depth of two body depths is often recommended. Alewife, for example, move up and down in the water column with the light level. Typically, in deep water, if they are not crowded, they swim with their dorsal fins at the secchi disc depth (the point where a white object disappears), which changes with the light level. So, they will be deeper in the sunlight and shallower in the early morning, evening, and at night. In shallow water they swim at mid water. Other species such as trout and salmon orient to the bottom in shallow water and eels always orient to the bottom no matter what the depth is, in rivers, lakes, and estuaries. This behaviour is likely due to a combination of a need for cover from predators and the light level to see for orientation. However, they will all make short term movements into other water depths.

All species, if they are crowded by a migration restriction, such as approaching an obstruction like a dam, can fill the water column. If there are not suitable holding or resting areas providing enough space for each fish, some will fall back. Also, in a crowded environment fish have trouble orienting to flows as they are blocked by other fish. This over crowding often happens in fishway pools where they are trying to rest or orient to the flows, or when there is a change in light levels, all creating a passage barrier which should be avoided.

Upstream and downstream fish passage routes are complex to plot as the fish behaviour and response to conditions is variable, but general routes and bounds can be established.

Fish Swimming Speeds and Behaviours by Species

Based on the available literature and fish swim speed models, criteria have been developed to guide the assessment of fish passage in the river and the lower fishway. The fish size selected is the mean size of the smallest spawning adults and the velocity and endurance are set for the fish's ability to successfully pass 97.5% of the time for a fish of this size. This means excellent passage potential for larger individuals and lower passage potential for the smallest individuals in a population.

Gaspereau

This group includes Alewife and Blueback Herring. Adult Alewife are usually 25-35 cm, and Blueback Herring are often 20 cm (Scott & Scott, 1988). They are present in the tide from late March until Fall. They begin running into the river mid to late April, when river water temperatures are above 9°C, and end in late June (Jessop 2003). They are expected to run at dawn and dusk in the early and late run times and peak in the late afternoon early evening during the main run, but it can be any time of the day (Alcott 2021). Timing is mainly driven by water temperature. They use visual and lateral line cues to orient upstream in water with all velocities less than 0.30 m/sec and in turbulent or back eddy flows.

For their size gaspereau are better swimmers for short distances than the salmonids but do have issues with currents hitting them from the side that the salmonids don't, something we must watch for where the currents come a right angle, or the side turbulence/circulation pattern velocity is high. The model does not show these small circulation patterns but clearly shows the flows from the fishway and gates. While they can swim a bit faster than salmonids of the same size, they have less endurance so the distance they can swim against a current is less.

Table 1: Swimming Speeds by Time for 250 mm gaspereau in m/sec (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 + seconds
97.5	3.19	1.82	0.723	0.614	0.465	0.299
87.5	3.49	2.00	0.792	0.673	0.529	0.327
50.0	3.97	2.27	0.901	0.765	0.579	0.332

Brook trout

Sea trout that overwintered in the estuary will follow eels, and gaspereau into the river on feeding runs and will go back and forth following the food supply, staying in the estuary when the river temperature is >20°C. There is a spawning run in the fall following the fall rains with spawning in mid October to mid November depending on flows and water temperatures. They can move from the estuary to freshwater several times a year and may stay in the freshwater. Adults range in size from 20cm to 55cm, with a mean length of 35 cm (MacMillan & Madden, 2007).

Table 2: Swimming Speeds by Time for 350 mm Trout in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.64	1.20	0.672	0.608	0.511	0.388
87.5	2.22	1.57	0.883	0.789	0.671	0.510
50.0	3.27	2.31	1.300	1.18	0.988	0.751

There are also resident Brook trout that are generally smaller and may also need to pass upstream at the dam for spawning or feeding runs. The criteria for the smaller resident trout are the same as for the generally larger sea run Brook trout but this assessment focuses on the smaller trout averaging 20 cm in length.

The length assessed for swimming capabilities was 200 mm. Trout rest in velocities of < 0.2 m/sec and hold in velocities of 0.2 - 0.3 m/sec (Tudorache 2011). Their preferred migration velocity is 0.3 to 0.4 m/sec, which 20 cm long trout can swim against for 16 m (Katopodis 2016).

Table 3: Swimming Speeds by Time for 200 mm long Trout in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.19	0.843	0.474	0.428	0.360	0.274
87.5	1.57	1.11	0.623	0.563	0.473	0.359
50.0	2.31	1.63	0.917	0.828	0.697	0.529

Atlantic salmon

Salmon may come out of the tide at any time of the year if the water is under 20°C and there is a good flow. There are spring, summer, and fall runs, with the latter being the spawning run. They wait in the tide until water temperatures are generally between 9°C and 20°C and flows are high enough to provide a water depth > 2 body depths in shallow reaches of the river. Normally they will move upstream at dawn and dusk, but it can be at any time of day. Spawning runs can continue till freeze up or late December.

Salmon use freshwater cues to migrate upstream and strongly orient to the flow. Salmon will need velocities under 0.2 m/sec for resting and can hold oriented to the flow in velocities of 0.2 – 0.4 m/sec.

Salmon are strong swimmers and can go long distances between resting areas. The ability of Atlantic salmon to swim for long distances against relatively strong currents, makes it easy for them to go up the fishways. It also gives them an advantage navigating the eddies and fast flows present in the tailwater. They have a good chance of navigating the currents, finding the fishway, and swimming up it before needing to rest.

Grilse

Atlantic salmon Grilse range in size from 450 mm to 600 mm in length and 500 mm was used for assessment. They have a preferred migration velocity 0.4 to 0.5 m/sec, which they can swim against for 110 m (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016).

Table 4: Swimming Speeds by Time for 500 mm Salmon Grilse in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	2.11	1.49	0.84	0.759	0.639	0.458
87.5	2.78	1.96	1.10	0.998	0.839	0.637
50.0	4.09	2.89	1.63	1.47	1.24	0.938

Atlantic salmon multi sea year

The larger multi sea year Atlantic salmon are 850 mm to 1050 mm long (Reid 2012). The length assessed for swimming ability was 1000 mm. They have a preferred migration velocity of 0.4 - 0.55 m/sec, which they can swim against for 340 m (Katopodis 2016).

Sufficient water depth over the bedrock sills in this river is an issue for multi-year Salmon at Ruth Falls, especially in the lower flows.

Table 5: Swimming Speeds by Time for 1000 mm Salmon Grilse in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	3.26	2.30	1.30	1.17	0.985	0.78
87.5	4.29	3.03	1.70	1.54	1.29	0.983
50.0	6.30	4.46	2.51	2.27	1.90	1.45

American Eels

American eels live in both the estuary and the freshwater. Access to the freshwater is needed as most of the females develop in freshwater habitats. Some of the eels will move in and out of the estuary several times during their life.

The eel tiles that are proposed to be used contain two different sizes of pegs. The smaller pegs have a space of 17.5 mm between them and will pass elver and yellow stage eels up to 25 cm long. The larger pegs have a space of 29.6 mm between them and can accommodate eels up to around 44 cm long, based on a body depth to length ratio of 0.068 cm (Berry & Escott Ltd., 2020). The larger eels are capable of swimming up through the main fishway.

Yellow stage eels and silver stage eels and lamprey require downstream passage. They travel on the bottom with occasional movements up the water column.

American eel elvers 60 mm long

Elvers will begin their upstream migration in mid March. They will use the eel pass. They have a swimming ability of 0.11 m/sec for 60 sec, which results in very short distances between resting areas. They tend to use upstream currents along the edges of rivers to aid passage.

Table 6: Swimming Speeds by Time for 60 mm long American Eel Elvers in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.367	0.221	0.0948	0.0817	0.0634	0.0423
87.5	0.456	0.274	0.118	0.102	0.0787	0.0526
50.0	0.621	0.373	0.160	0.138	0.107	0.0716

Yellow stage American eel (200 mm)

Yellow stage American eels do not move around until water temperatures are above 12°C. The eel pass has a section suitable for the passage of yellow stage eels under 45 cm long. 20 cm long eels have swimming speeds of 0.35 m/sec for 60 sec and they travel very short distances at a time.

Table 7: Swimming Speeds by Time for200 mm long Yellow Stage American Eels in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.836	0.503	0.216	0.186	0.144	0.0964
87.5	1.04	0.625	0.268	0.231	0.179	0.120
50.0	1.41	0.850	0.365	0.315	0.244	0.163

Yellow stage American eel (600 mm)

These eels will be too big for the eel pass, but they do have a strong swimming ability 0.87 m/sec for 60 sec and modeling shows they can pass though the fishway near the bottom surface or along the edge of the notches. They prefer to travel short distances at a time which would be limiting. They also use the drain hole orifices at the bottom of the baffles.

Table 8:Swimming Speeds by Time for 600 mm long Yellow Stage American Eels in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.77	1.07	0.457	0.394	0.306	0.204
87.5	2.2	1.32	0.568	0.490	0.380	0.254
50.0	3.0	1.80	0.774	0.667	0.517	0.345

Lake Species

The following species were found in the reservoir above the dam and do not need to pass to complete their lifecycles.

Yellow Perch

Yellow perch are freshwater fish but may be found in brackish water up to 10 ppt. they use a wide range of habitats from large lakes to ponds to slow moving sections of rivers or the upper estuaries. They are most abundant in open water of lakes with moderate amount of vegetation.

They spawn in the spring in from mid April to early May along the shallow shoreline of lakes or in the tributaries. They live up to 9 years and are 200 mm to 300 mm when caught by angers (Scott & Crossman, 1973).

Brown Bullhead

The Brown bullhead is a freshwater fish that lives in lakes and ponds but may venture into brackish water. They spawn in late spring or early summer in shallow water along the shoreline of lakes and ponds. Most adults are between 250 mm to 300 mm long (Scott & Crossman, 1973).

White Sucker

White suckers generally live in warm, shallow lakes and tributary rivers of larger lakes. They are bottom feeders and have been known to live for up to 15 years, reaching sexual maturity at age 5-8. In the spring, they begin migrating to spawn when daily water temperatures stay above 10°C. They often move out of the lake to spawn in tributary streams with shallow water and gravel bottoms, but they sometimes spawn on the lake margins. They move off the spawning

grounds 10-14 days later. The young begin to migrate into the lake about a month after spawning beginning when they are around 15 mm in length (Scott & Crossman, 1973).

The sizes of White suckers are difficult to determine as they grow at different rates depending on sex and location. A 200 mm average size was used for the assessment which is typical of the spawners seen on the eastern shore.

White suckers do not need to pass by the dam to complete their lifecycle, but they are strong enough swimmers that they should be able to get up the fishway if they choose to or accidentally go down the downstream bypass.

Table 9: Swimming Speeds by Time for 200 mm long White Sucker in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	1.19	0.843	0.474	0.428	0.360	0.274
87.5	1.57	1.11	0.623	0.563	0.473	0.359
50.0	2.31	1.63	0.917	0.828	0.697	0.529

Minnow Species

Minnow species do not need to pass the dam to complete their lifecycle. Both minnow species identified were found in the reservoir above the dam and will spawn on the margins of the lake.

Golden Shiner

The Golden shiner, (*Notemigonus crysoleucas)*, has an average length of 76 – 127 mm and has a golden colouration. It is a lake fish, and moves in schools in weedy, shallow areas. Spawning occurs when water temperatures reach 20°C over filamentous algae or aquatic vegetation (Scott & Crossman, 1973).

Lake Chub

Lake chub (Couesius plumbeus) are a freshwater fish found in lakes, ponds, and streams. They move from the lakes to streams in early spring to spawn usually in April. They are a large minnow that can reach 150mm in length and even larger if they have been in brackish water. Average length of an adult is 10 cm (Scott & Crossman, 1973).

Table 10: Swimming Speeds by Time for a 100 mm long minnow in m/sec (Katopodis & Gervais, Ecohydraulic analysis of fish fatigue data, 2012; Di Rocco, 2020)

Percent passage	Sprint speed 5 seconds	Burst speed 20 seconds	Prolonged speed 200 seconds	Prolonged speed 300 seconds	Prolonged speed 600 seconds	Sustained speed 1800 seconds
97.5	0.773	0.546	0.307	0.278	0.234	0.177

87.5	1.02	0.718	0.404	0.365	0.307	0.233
50.0	1.49	1.06	0.594	0.537	0.452	0.343

Summary of Passage Metrics for all Species

Figure 1: Swim distance vs. water velocity for the species present shows how far each of the species requiring passage below the dam can swim over a range of water velocities (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020). For this graph average fish sizes were used and swim distances are those at which 97.5% of fish of that size will be able to achieve.

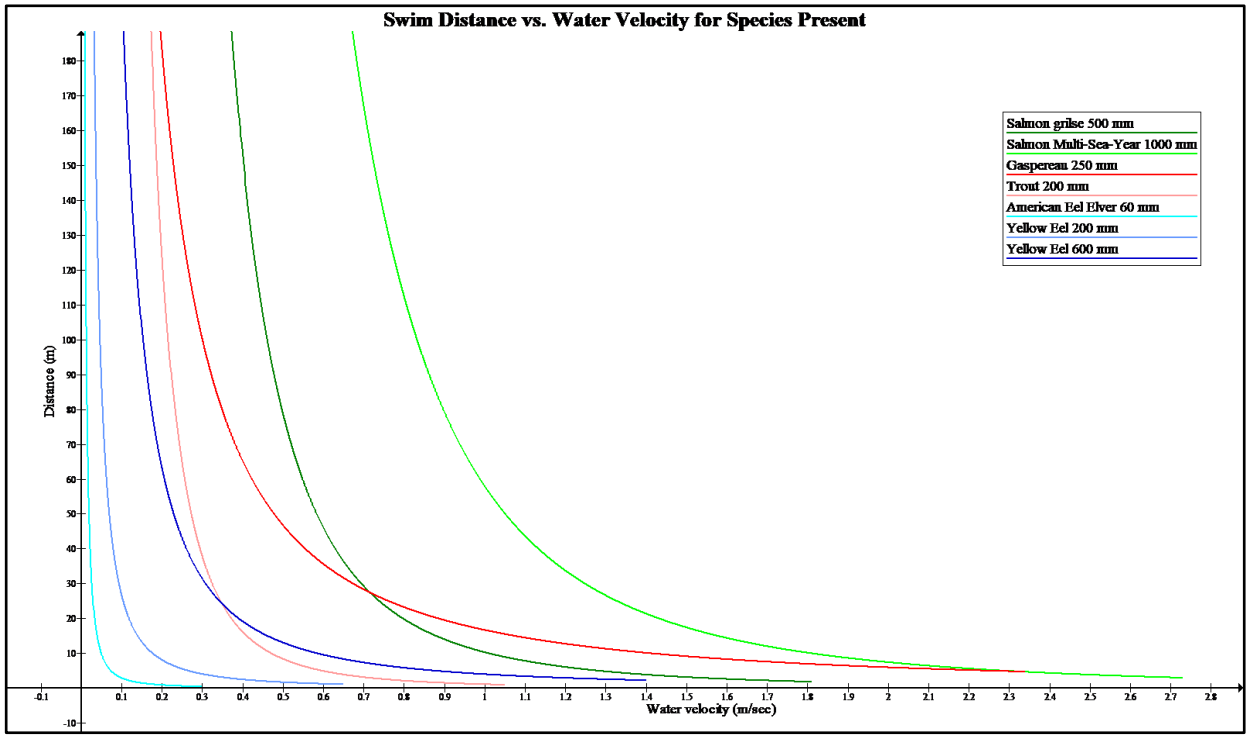


Figure 1: Swim distance vs. water velocity for the species present at 97.5% passage

Table *11* shows the same information for swim distance vs. velocity as in written form above, with categories for distances matching those from the modeling. The table also shows the body depth of the fish and the minimum depth required for passage, based on the largest of each species. The body depth is taken from US Fish Passage Engineering Design Criteria (2019), but the minimum passage depth was taken as 1/3 of the length of the largest fish size to accommodate extended dorsal and ventral fins. Eels are the exception to this, as they have a small body depth for their length. Ideally, the eels would have three times the body depth for safe, comfortable passage (US Fish and Wildlife Service, 2019).

Table 11: Distance before resting for each modeling category at 97.5% passage (Katopodis & R. Gervais, Fish swimming performance database and analyses, 2016; Di Rocco, 2020)

Species	Gaspereau	Trout	Salmon Grilse	Salmon Multi-Sea-Year	American Eel Elver	Yellow Stage American Eel	Yellow Stage American Eel
Average Size (cm)	25	20	50	100	6	20	60
max size (cm)	35	55	60	105	7	45	100
Max body depth (cm)	8	14	13	23	0.5	3	7
Depth required for passage (cm)	12	18	20	35	0.5	3	7
Velocity range (m/sec)	Distance before resting (m)						
0 – 0.15	Resting	Resting	Resting	Resting	1 – 3	15 – 30	Resting
0.15 – 0.3	Holding oriented to flow	Holding oriented to flow	Holding oriented to flow	Holding oriented to flow	< 1	5 – 15	30 – 100
0.3 – 0.35	80 – 100	25 - 40	225 – 355	>620	No passage	3 – 5	25 – 30
0.35 – 0.4	65 – 80	15 – 25	150 – 225	>620	No passage	3	20 – 25
0.4 – 0.45	55 – 65	10 – 15	110 – 150	>620	No passage	2	15 – 20
0.45 – 0.55	40 – 55	6 – 10	60 – 110	340 – 620	No passage	1	10 – 15
0.55 – 0.72	25 – 40	3 – 6	25 – 60	155 – 340	No passage	< 1	7 – 10
0.72 – 1.1	15 – 25	< 3	10 - 25	45 – 155	No passage	No passage	3 – 7
1.1 - 2	5 – 15	No passage	1.5 - 10	7 – 45	No passage	No passage	No passage
>2	Limited passage	No passage	No passage	Limited passage	No passage	No passage	No passage

3D model results

NSPI requested 3D hydraulic modeling to be completed at the Ruth Falls dam for the purpose of assessing post dam refurbishment downstream flow patterns and velocities as they relate to fish passage. The main refurbishments include the installation of vertical lift gates in the center 3 gate section of the dam which will replace the existing stoplog bays and the installation of new rubber dams along the spillways adjacent to the lower section of the fishway that runs along the toe of the dam. The changes will affect the fishway operation and entrance conditions including the river routes to the fishway for migrating fish.

The diagram of velocities 20 cm from the bottom was used to display the fish migration routes below the dam, as this route best represents the velocities that fish will be traveling though. These velocities are most representative of the mid water velocities that gaspereau will be swimming through and they are the velocities that trout and salmon will be moving through along the bottom. Eels will be traveling directly on the bottom and will find areas with slower moving water as they have a small body depth so can move between cobbles and small boulders on the bottom.

All the fish swimming abilities and behaviours described above have been taken into consideration in determining the migration routes.

Fish migration routes were determined directly from the computer model using all the available models to get a detailed picture of the routes. This included point depths, velocities, and flow direction along the routes. These detailed 3D assessments were transposed on the diagrams.

There are two shallow bedrock sills that fish must pass over to get to the area below the dam. These sills have shallow fast flows that present passage problems for weaker swimming fish, especially as the flows increase below the dam. The first sill is located at around 30 m on the Y Axis of the diagrams and the second sill is located between 65 m and 75 m. Generally, the river flows are very shallow and fast over the sills and become faster as the flow increases. Depth in the dark blue areas is up to 1 m deep and the depth over the rock outcrop sills is shallow except for the one channel near the left bank (looking downstream) which is used by most fish for migration due to both a suitable depth and a passable velocity. The most downstream rock sill shown in the plots may have better passage opportunities than it appears because the velocities and depth here may not be correct since the model's bathymetry is cut off on both banks and the lower end of all models does not have the effect of the downstream bathymetry backwater effect. Further downstream in the river there are several other bedrock sills. Passage over these sills is unknown, so the percentage of fish attempting passage from the mouth of the river that reach the dam is unknown.

The Fish Protection Tools Swim Distance and Velocity tool was used to calculate distances and percentage of fish that have the ability pass along certain routes (Di Rocco, 2020; Katopodis C. a., 2016). The estimates are given in levels for 97.5%, 87.5%, 50%, 12.5%, and 2.5% passage. When swim distance was between levels, the lower passage percentage was used. Passage rates are very conservative, as fish may use other swim modes to decrease energy expenditure, or they may find small eddies behind and between boulders.

The Fishway Flows

The upper, concrete section of the fishway has been designed to operate with 1 ft of water over the crests of the notches with the water level in the pool below equal to the elevation of the notch crest. The velocity in the notches ranges from 1.0 ft/sec (0.3 m/sec) at the bottom up to 4 ft/sec (1.2 m/sec) at mid to surface depth. These velocities are passable by all the species needing to pass using burst or sprint speed over this short distance. Part of the reason for the lower velocities at the bottom is that the water level in the pool below the notch is backed up to at least the level of the notch crest above it when operating with at least 1 ft of water depth. When the notch depth is higher the velocities at the bottom decrease as the notch is further backwatered.

The flow depth in the channel portion of the fishway is now designed to carry 35 cfs at a depth of 1 ft and 9 inches in the notches, backwatered by 1 ft, for drops of 9 inches. This provides easier passage for fish, with a range of velocities in the notches from 1 ft/sec to 6 ft/sec (0.3 – 1.8 m/sec). The pools have good resting areas and a range of velocities for migration.

Fishway attraction velocities extend from the surface to the bottom in the range most fish seek for upstream migration and this is combined with a strong flow along the side of the gate flows to orient fish toward the fishway.



Figure 2: Fishway and entrance area velocities

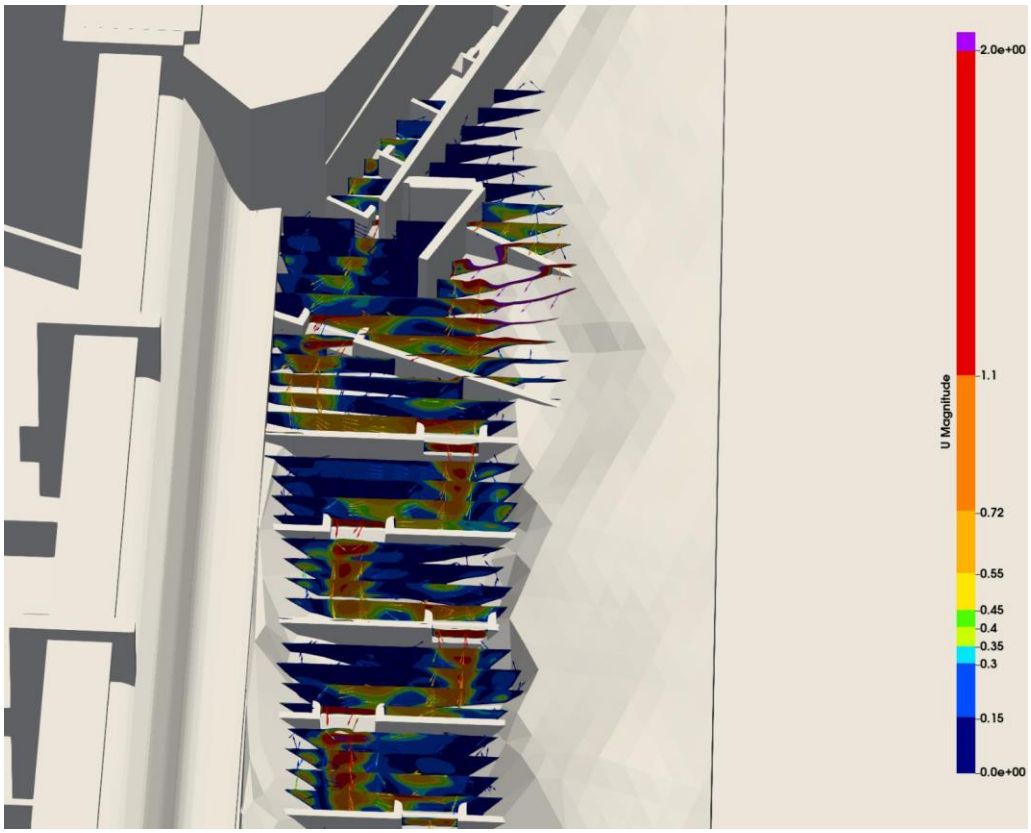


Figure 3: Cross section view of the fishway flows

The velocities in the notches of the concrete fishway are shown in Figures 4 and 5. The maximum velocity shows in the red but is just a maximum of 1.2 m/sec. In the pools, faded out in these screen shots you see the resting areas in the blue and a current through the pool for the fish to follow notch to notch. These velocities are within the swimming ability of all the migratory species with the exception of the smallest eels.

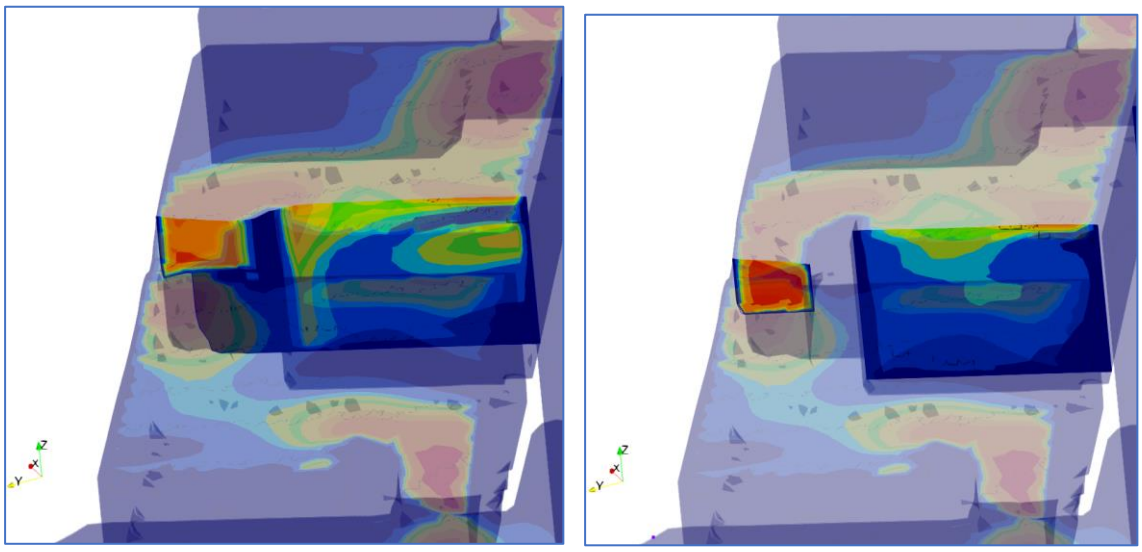


Figure 4: Velocity at top of notch (left); velocity at 23 cm down (right) showing the max notch velocity.

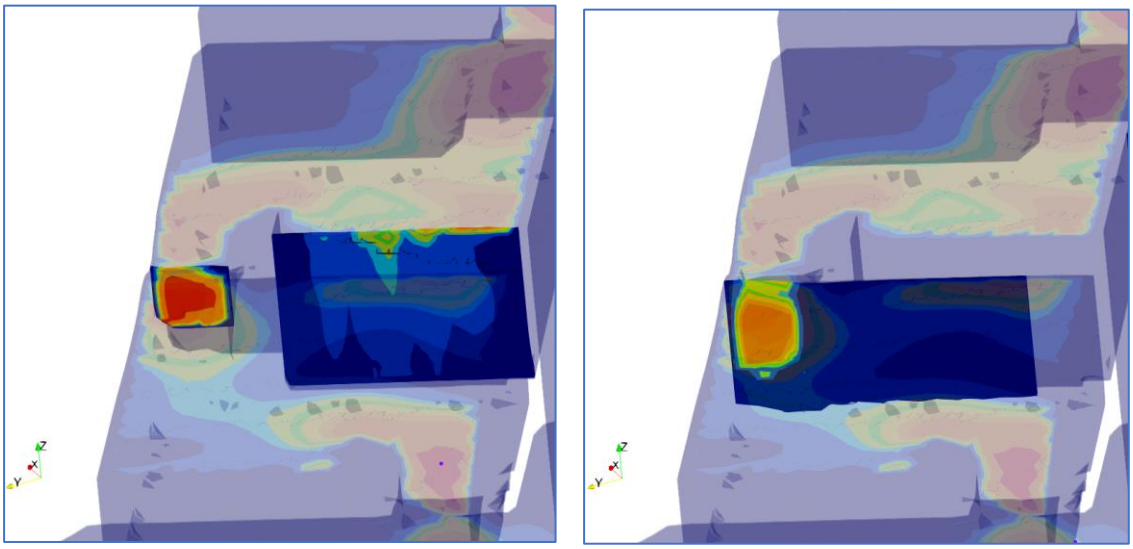


Figure 5: Velocity 46 cm down in notch (left); velocity as notch enters the pool (right)

The velocities in the notches of the channel fishway, shown in Figure 6, with a flow of 35 cfs have a similar pattern to the other fishway but with velocities in the cross sections mid way along the notch range from 1.8 m/sec in the center to 0.8 m/sec along the sides and bottom. Providing good fish passage for all the migratory species except the smallest eels. There are large resting areas and a flow pattern through the pools that has migration velocities.

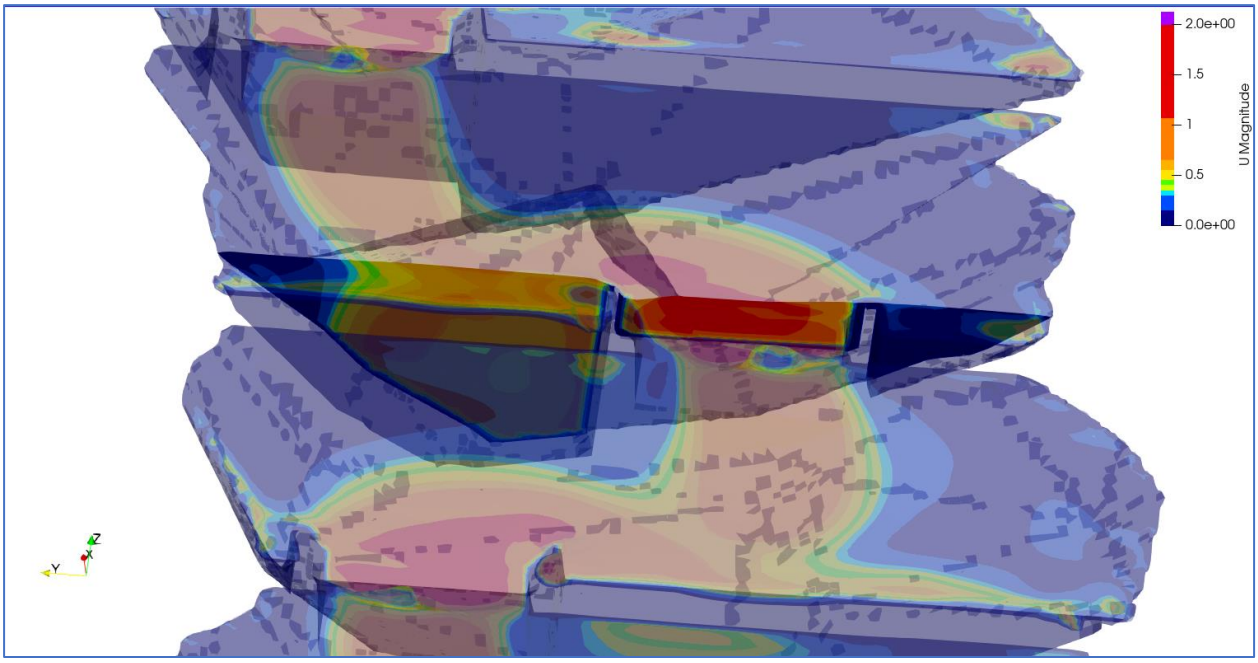


Figure 6 The velocities in the notches of the channel fishway section with 35 cfs flow.

S1: 6 cfs from the fishway, 29 cfs from the louvres outfall, 65 cfs from the gates

This flow scenario has the best passage for gaspereau, trout, grilse, and eels, but has barely enough water depth for the larger salmon.

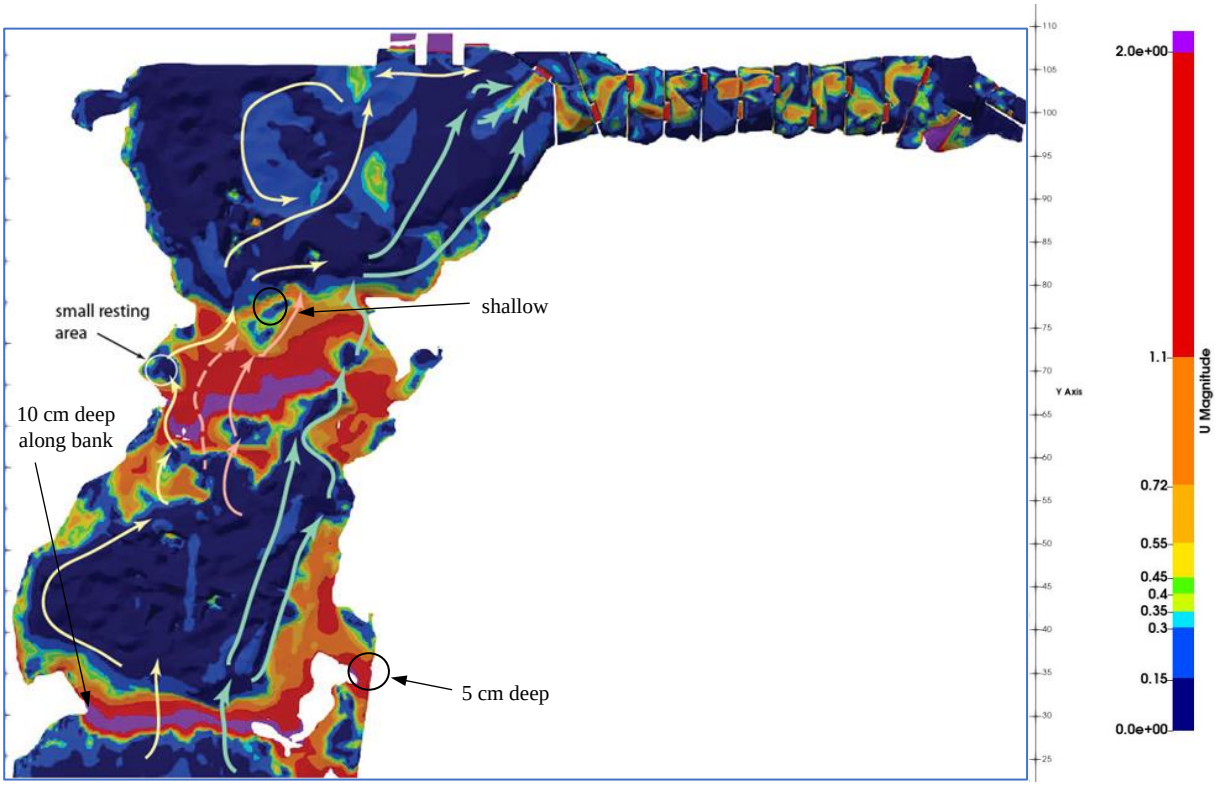


Figure 7: S1 routes for gaspereau, trout, and grilse on velocities 0.2 m from the bottom

Gaspereau

The route marked with green arrows follows the main thalweg of the river and will be the most used route for gaspereau as it is the easiest. Using this route fish can avoid velocities greater than 2 m/sec over the first sill by traveling through the deepest channel, where the water is around 30 cm deep, and the velocities are the slowest at depth in this cross-section. Since the distance to get over the sill is less than 5 m 97.5% of gaspereau should make it over. Then they can rest before attempting to go over the second sill, which has lower velocities, under 1.1 m/sec, but the distance fish must swim before resting is much longer, around 20 m. This is within the swimming ability of gaspereau.

The yellow route is the next best route, but limited numbers of gaspereau will be able to use it due to the small size of the resting area on the right bank. Using this resting area, the fish won't have to go more than 10 m in dark orange and reds, which is well within the swimming abilities for the distance involved of 97.5% of gaspereau. Once the resting area fills up fish may fall back.

The route marked with orange arrows is at the edge of how far gaspereau can go without resting. There is 20 m of fast water, with velocities ranging from 0.55 m/sec – 2.0 m/s. Only the strongest fish will choose this route, passing 50% of 250 mm gaspereau. Some may fall back and choose another route.

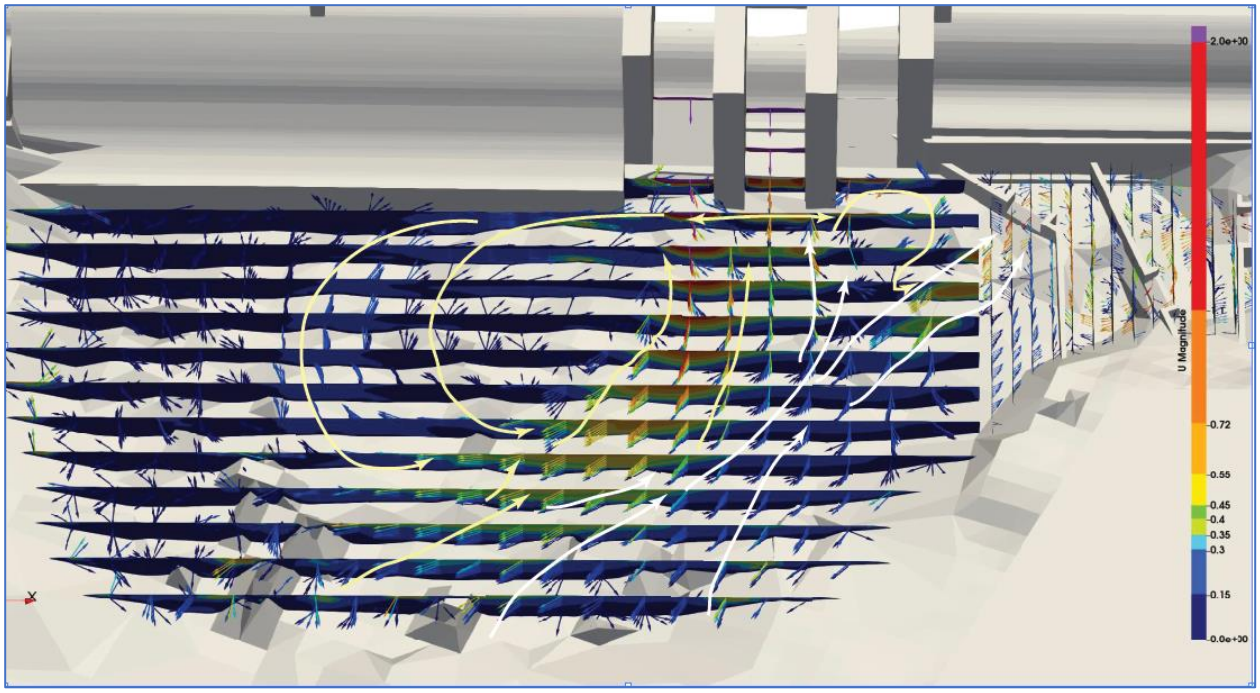


Figure 8: A close up of the routes for gaspereau below the dam with cross-sections spaced at 5 m

It is expected that the gaspereau will gather in the resting areas below the dam for some time to rest before seeking the fishway to move further upstream. The velocities just below the dam are well within swimming abilities of gaspereau and they can choose their preferred velocity to follow. Those on the left bank will easily find the fishway, as the new fishway entrance has good attraction velocities throughout the water column. Those on the right bank side of the main flow will have to look around for a bit and eventually will cross under the main flow to find the fishway or will not have to go too far downstream to be able to cross the surface flow, as velocities near the streambed are well within swimming abilities. The main migration route is in white. The yellow areas the fish will be delayed looking for the fishway.

Trout

Trout are much smaller than the salmon so have a weaker swimming ability. They will have a hard time getting through the fast flows on the bedrock sills. About 50% of 200 mm trout will be able to pass through the green route, 12.5% through the yellow route, and 2.5% through the orange route. Larger Sea Trout will have better passage success. The main route is the white arrows in fig 9 with delays if they take the other routes as they have to search for the fishway.

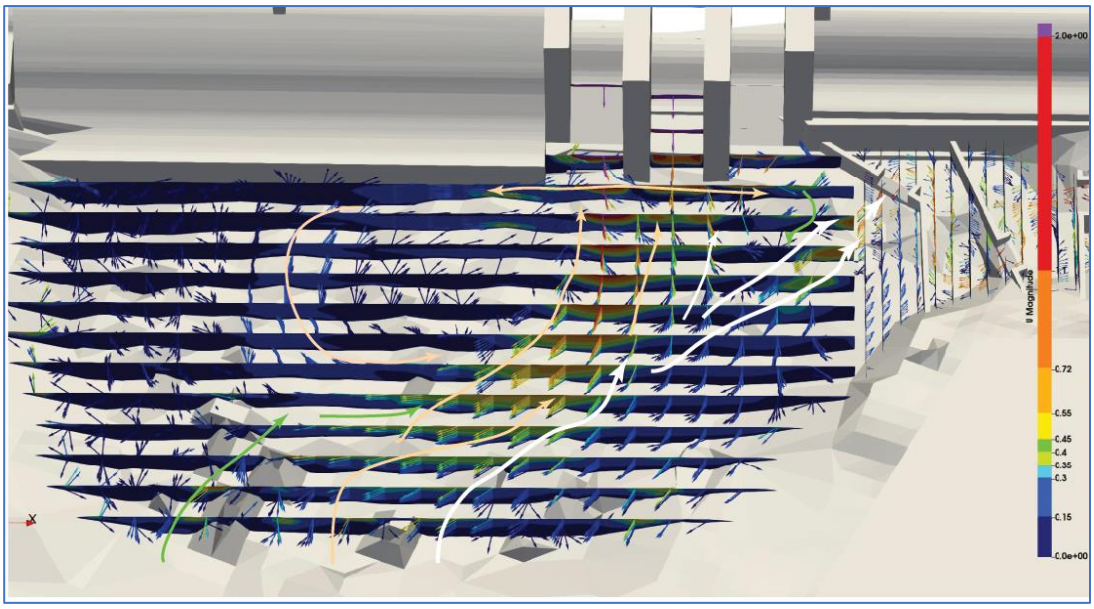


Figure 9: A close up of the routes for trout below the dam with cross-sections spaced at 5 m

Salmon Grilse

Grilse will follow the same routes as gaspereau, the green route will have 87.5% passage, the yellow route will have 50% passage, and the orange line will have 50% passage.

Multi-sea-year-salmon

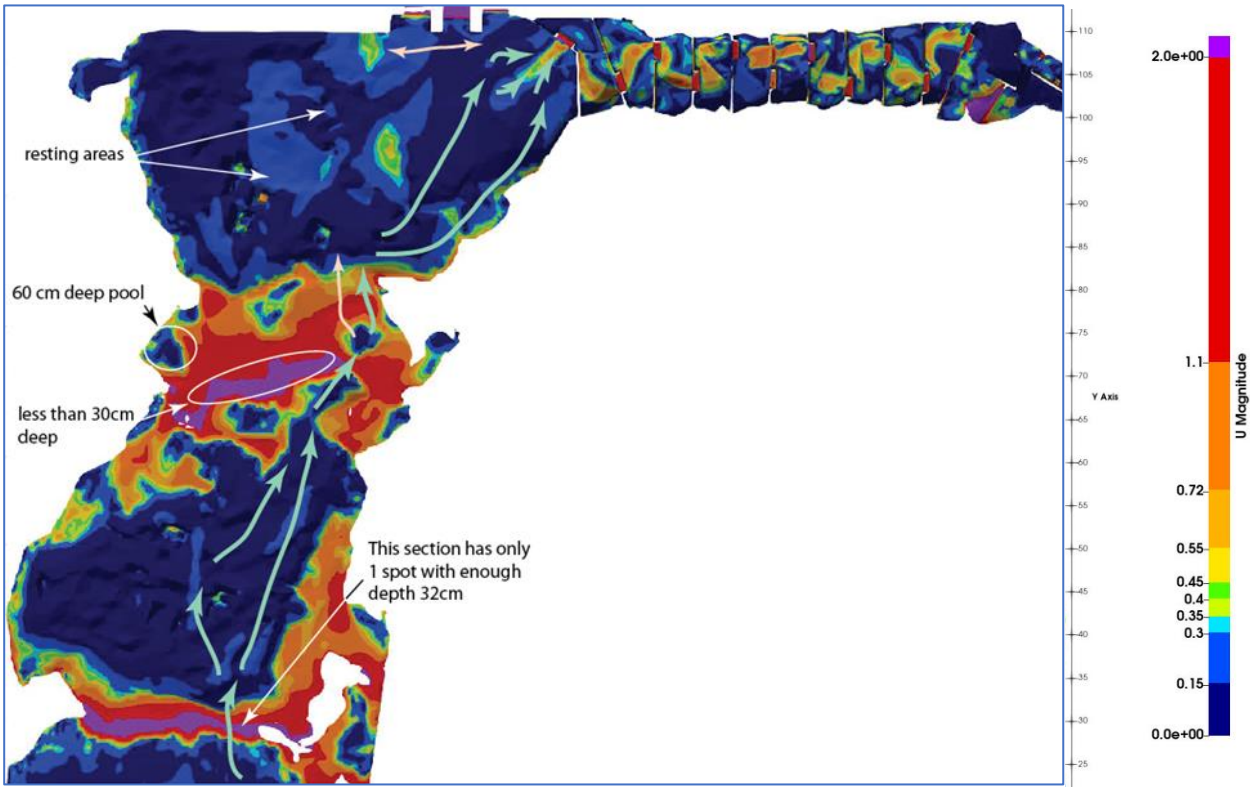


Figure 10:S1 routes for multi-sea-year salmon on velocities 0.2 m from the bottom

The route through the deeper main channel is the only one with enough depth for multi-sea-year salmon to pass. This route has areas with a minimum depth as low as 32 cm. They are strong swimmers and will not have any issues with water velocities on this route.

In the pool below the dam, both lines here are well within swimming abilities of salmon. Those on the left bank will easily find the fishway. Those on the right bank side of the main flow will have to look around for a bit and eventually will cross the main flow to find the fishway. At these flows Salmon will not have to go too far downstream to be able to cross the flow, as velocities near the streambed are well within their swimming abilities.

American eel

Elvers

Elvers can only navigate in the dark blue and medium blue colors (<0.3 m/sec). Velocities over the bedrock sills are too high for them to navigate.

Yellow stage eels

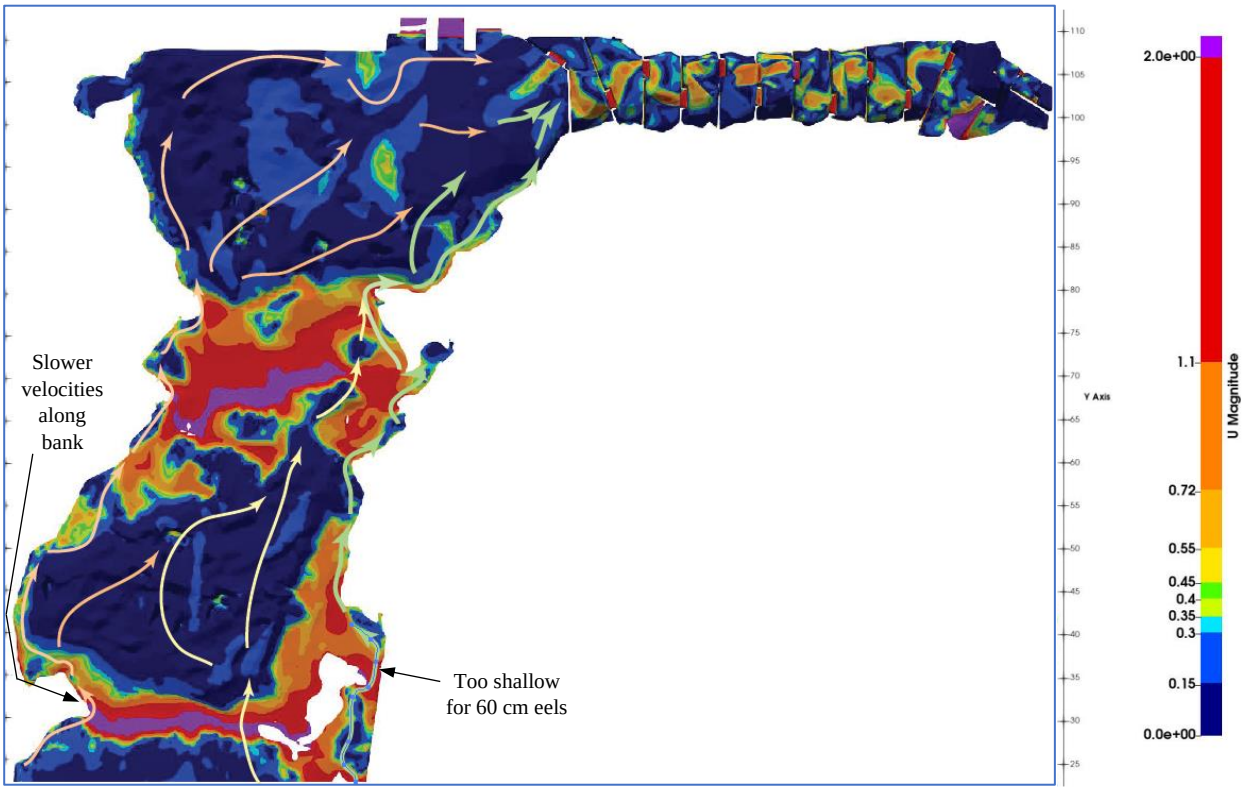


Figure 11: S1 routes for yellow stage eels shown on velocities 0.2 m from the bottom.

The yellow stage eels will be oriented to the bottom. They can navigate comfortably in the blue colors and can't go more than a few meters in higher velocities, so eels will struggle with the high velocities over the two sills but will find large resting areas in between and at the base of the dam to recover. For 97.5% passage they can't navigate in the dark orange, red, and purple colors. The passage rates derived from the model for 20 cm long eels would be very low, varying form 2.5% - 12.5% passage for the different routes, while passage for 60 cm eels would be close to 90%. Actual passage rates may be higher as eels can use small eddies between and behind boulders and large cobble for resting that are not shown within the level of detail of the model.

The orange route that goes up the right bank (looking downstream) from the dam and uses the low velocity water on the river margins, that are mostly under 0.3 m/sec. The eels will need to navigate through some faster water getting around the edge of the first bedrock sill. There is 4.5 m of fast water on the edge of the sill in the dark orange to red coloring, providing passage for the strongest 12.5% of 20 cm eels and 87.5% of 60 cm eels. This route along the right bank margin has around 10 cm of water in it at the shallowest of places, giving enough depth for both sizes of eels. There is a large resting area after the first sill where eels can spread out and rest before continuing along the right bank margins in low velocity water. At the point where the stream narrows near the large pool at the base of the dam there is another short area with higher velocities. In this area the eels can continue along the side and will need to swim through 1.5 m of water with velocities in the light to dark orange range. This short section will pass 87.5% of 20 cm eels and 97.5% of 60 cm eels.

There is a large resting area on the right side of the spill flows where eels can gather before heading towards the fishway. The velocities on the bottom are low, so eels will be able to pass under the spill flow towards the fishway. Eels over 10 cm will be able to go up the main fishway, but eels up to 50 cm long may choose to use the eel pass.

The yellow route goes through the thalweg. Using the deepest area over the first sill lowers the distance that the eels must travel through the fast moving water to 4 m. Velocities over the sill are up to 1.7 m/sec, which is too fast for most 20 cm eels. Passage over this sill will be 2.5% for 20 cm eels and 50% for 60 cm eels. Once eels are over the sill there is a large slow area for resting, where the eels will follow upstream along the bottom. There is some fast water again going over the second sill. Here, there is a deeper channel where the eels will be traveling that stays over 30 cm deep with slower velocities on the bottom. In deeper areas there is a good depth of slow moving water with a velocity under 0.15 m/sec, but in areas where the channel is shallower than 50 cm eels may experience higher velocities of up to 1.1 m/sec for up to 5 m. This section will pass 2.5% of 20 cm eels and 87.5% of 60 cm eels.

The green route follows along the margins of the left bank, looking downstream. One section, about 10 m up along the route is only 4 cm deep so 20 cm eels will fit but 60 cm eels would be partially out of water. In this route eels must swim 5 m through velocities between 0.7 m/sec and 2 m/sec, passing 12.5% of 20 cm eels and 87.5% of 60 cm eels. The route continues along the left bank margins. There are a few places larger eels may have to come further into the main flow velocity to get enough depth. They may have to enter velocities in the range of 0.45 m/sec - 0.72 m/sec for a few meters at a time. The larger yellow stage eels should be able to handle these velocities. There is a narrow area before the large pool at the base of the dam with velocities in between 0.7 m/sec and 2 m/sec along the left bank margin. This area will pass 12.5% of 20 cm eels and 87.5% of 60 cm eels.

From there eels will enter a large resting area and will be able to follow the flow to the fishway.

S2: 6 cfs from the fishway, 29 cfs from the louvre outfall, 165 cfs from the gates

This scenario has worse passage for gaspereau, trout, grilse, and eels, due to higher velocities, but better passage for multi-sea-year salmon, as the water depth increases.

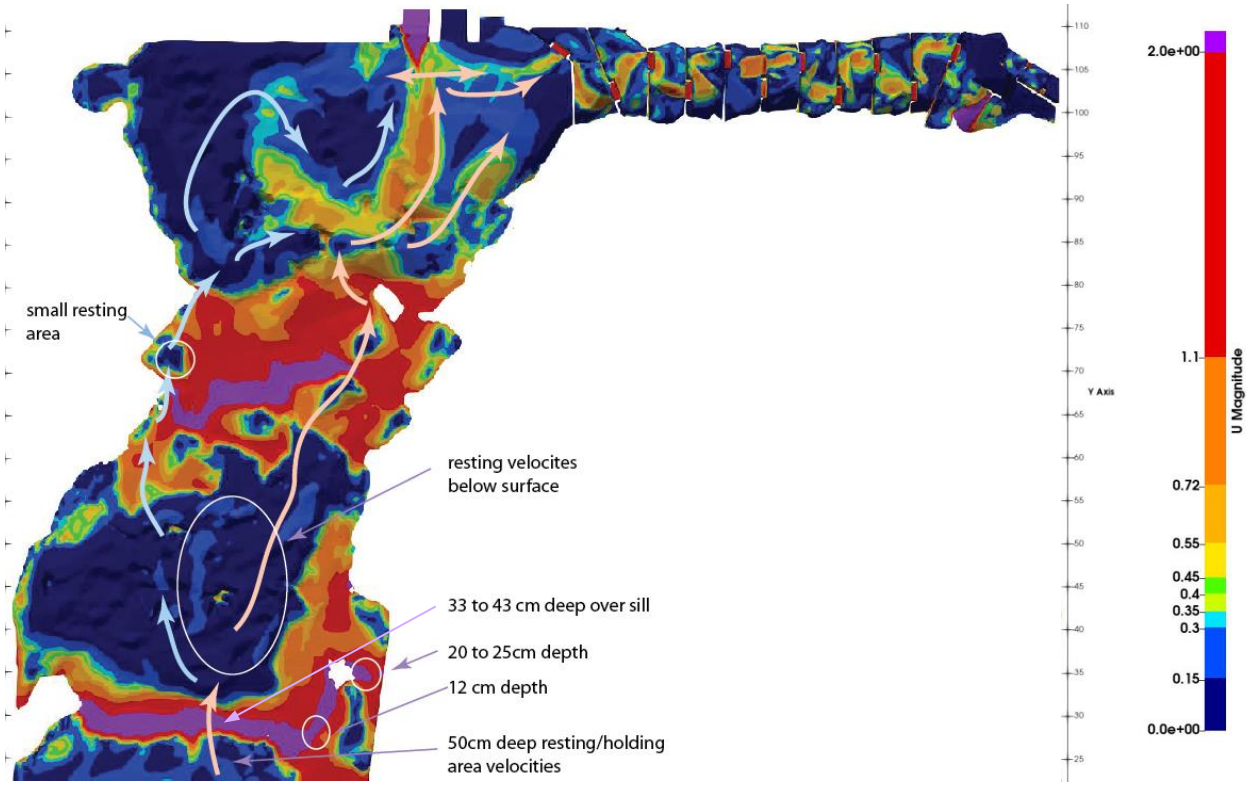


Figure 12: S2 routes for gaspereau, trout, and grilse on velocities 0.2 m from the bottom

Gaspereau

Using the orange route gaspereau will have 12.5% passage overall. Over the first sill there is 5.5 m where the gaspereau must pass through velocities of up to 2.5 m/sec. 87.5% can pass over the first sill. Then they enter resting velocities present under the surface flows where they can recover. Over the second sill there are 35 m of fast velocities, mostly under 1.1 m/sec but with a short section with velocities up to 1.5 m/sec, that the gaspereau must pass through, giving 12.5% passage, due to the length of the section.

Using the blue route gaspereau will have 50% passage, but the size of the resting pool will limit the numbers that can use the route. After passing over the first sill, the gaspereau can rest and then head towards the right bank, looking downstream. They must pass through water velocities in the 0.55 m/sec – 1.1 m/sec range for 10 m, then pass through 7 m of water at velocities up to 1.5 m/sec, before reaching a small resting pool. From the resting pool it is another 10 m through velocities of up to 1.1 m/sec before the fish reach a larger resting area. This route will have 50% passage if there is room to rest in the small pool and 2.5% passage once the pool fills up.

There are other routes around the first sill, but none that offer better then 12.5% passage.

Trout

20 cm Trout will have poor overall passage in these flows. Using either route the passage will be 12.5%. On the blue route, once the resting pool is full of fish the passage will be reduced and will be 2.5%.

Salmon Grilse

Grilse will have around 50% passage using either route. They will not need to use the resting pool on the right bank.

Multi-sea-year salmon

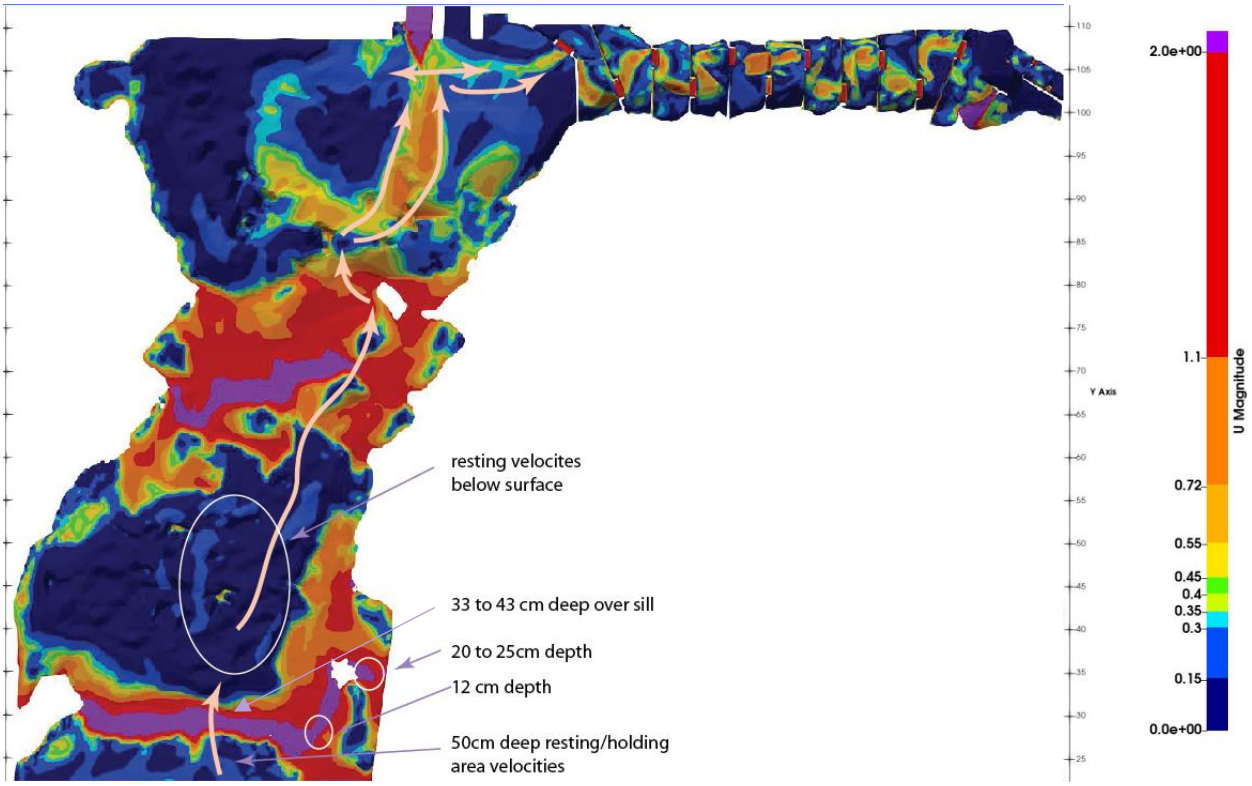


Figure 13: S2 routes for multi-sea-year salmon on velocities 0.2 m from the bottom

There is enough depth in the main channel for multi-sea-year salmon, with 45 cm over the first sill in the thalweg. The velocities going over the first sill are less than 2.5 m/sec. Multi-sea-year salmon are strong swimmers and should be able to overcome these velocities since the distance is only 4.5 m in the high velocities. The salmon can rest after going over the high velocities at the first sill. Then they will continue 35 m through mainly dark orange with a short section of red to the resting areas below the dam. 97.5% of multi-sea-year salmon should be able to swim against these velocities.

American eel

Elvers

The water velocities over the sills are too fast for elvers. Any passage will be along the very edge in shallow areas or back eddies.

Yellow stage eels

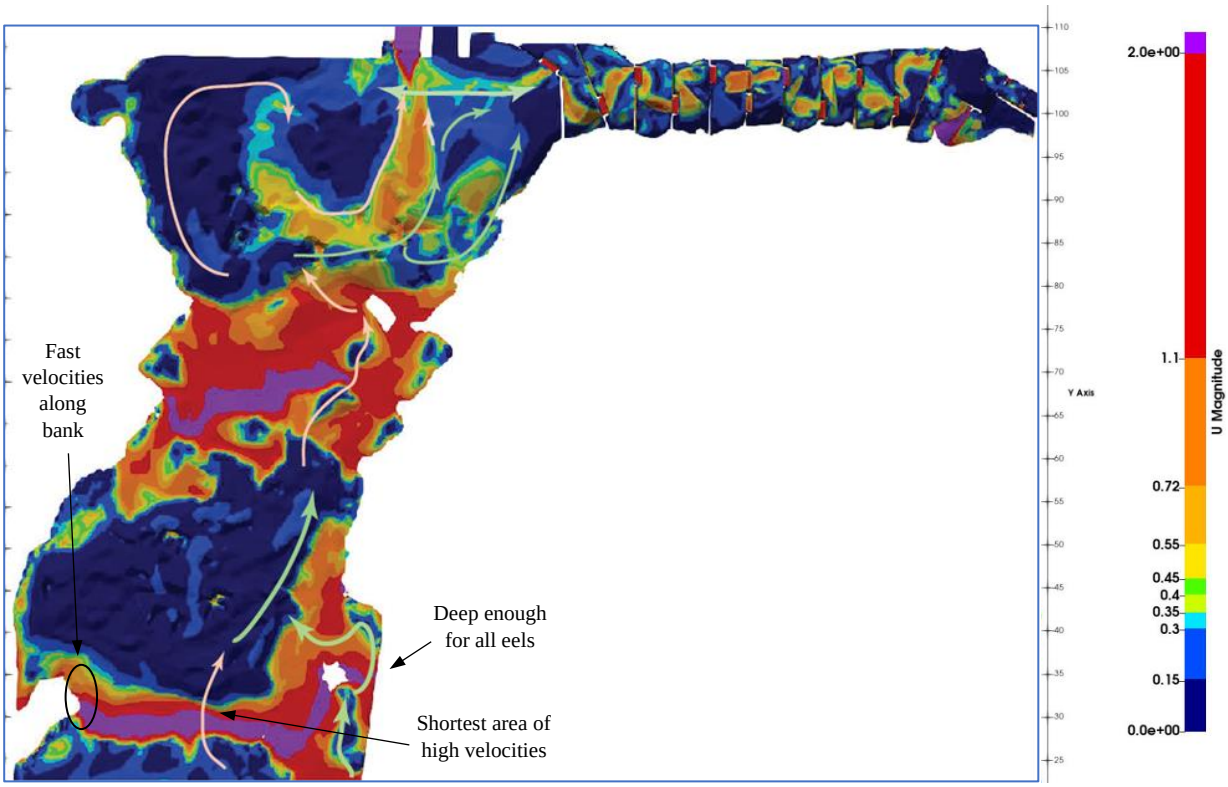


Figure 14: S2 routes for yellow stage eels on velocities 0.2 m from the bottom

Some yellow stage eels will be able to navigate up to the fishway with 165 cfs of spill, but there are areas of fast velocity that will prevent the majority from being able to get past. The velocities will prevent the smaller 20 cm long eels from getting up, but a small number of larger eels will be able to get up. Both routes will pass 12.5% of 60 cm yellow stage eels.

S3: 6 cfs from the fishway, 29 cfs from the louvre outfall, 925 cfs from the gates

At these flows the resting areas in the middle of the channel are almost gone, but there are some eddies with resting velocities that form on the right bank, looking downstream, for fish that are strong enough swimmers to make it over the first sill. Velocities over the first sill are too high for gaspereau, trout, and eels. There will be limited passage for Salmon.

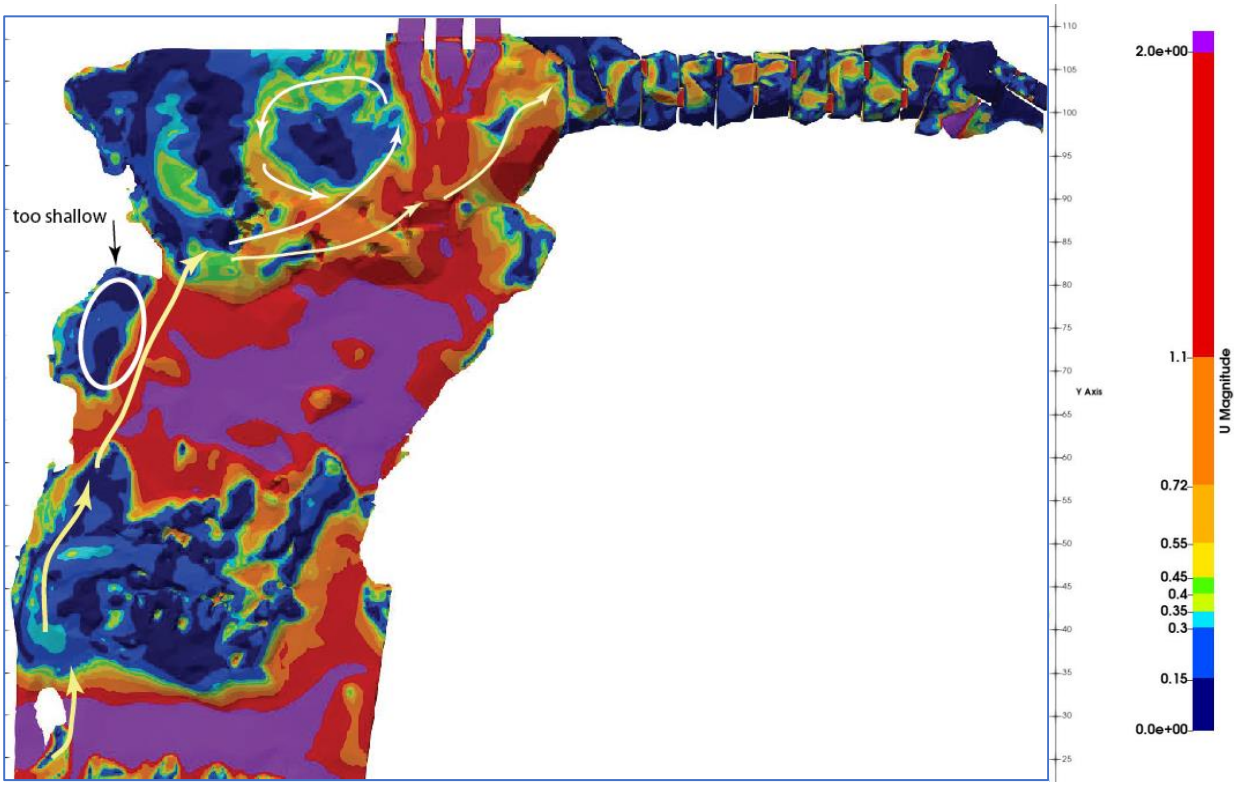


Figure 15: S3 routes for salmon on velocities 0.2 m from the bottom

Salmon Grilse

Grilse will have 12.5% passage.

multi-sea-year Salmon

Multi-Sea-Year salmon will have 50% passage to the dam. Over the first sill fish must pass through water with velocities up to 2.5 m/sec for 20 m in the model, but with unknown distance from the downstream resting areas this may be limiting. Over the second sill fish must pass 30 m of water in velocities up to 2 m/sec which should be passable if they rest between the sills.

S4: 6 cfs from the fishway, 29 cfs from the louvres outfall, 1720 cfs from the gates

Velocities are too high for passage.

S5: 6 cfs from the fishway, 29 cfs from the louvres outfall, 3051 cfs from the gates

Velocities are too high for passage.

S6: 6 cfs from the fishway, 29 cfs from the louvres outfall, 4308 cfs from the gates

Velocities are too high for passage.

S7: 6 cfs from the fishway, 29 cfs from the louvres outfall, 0 cfs from the gates

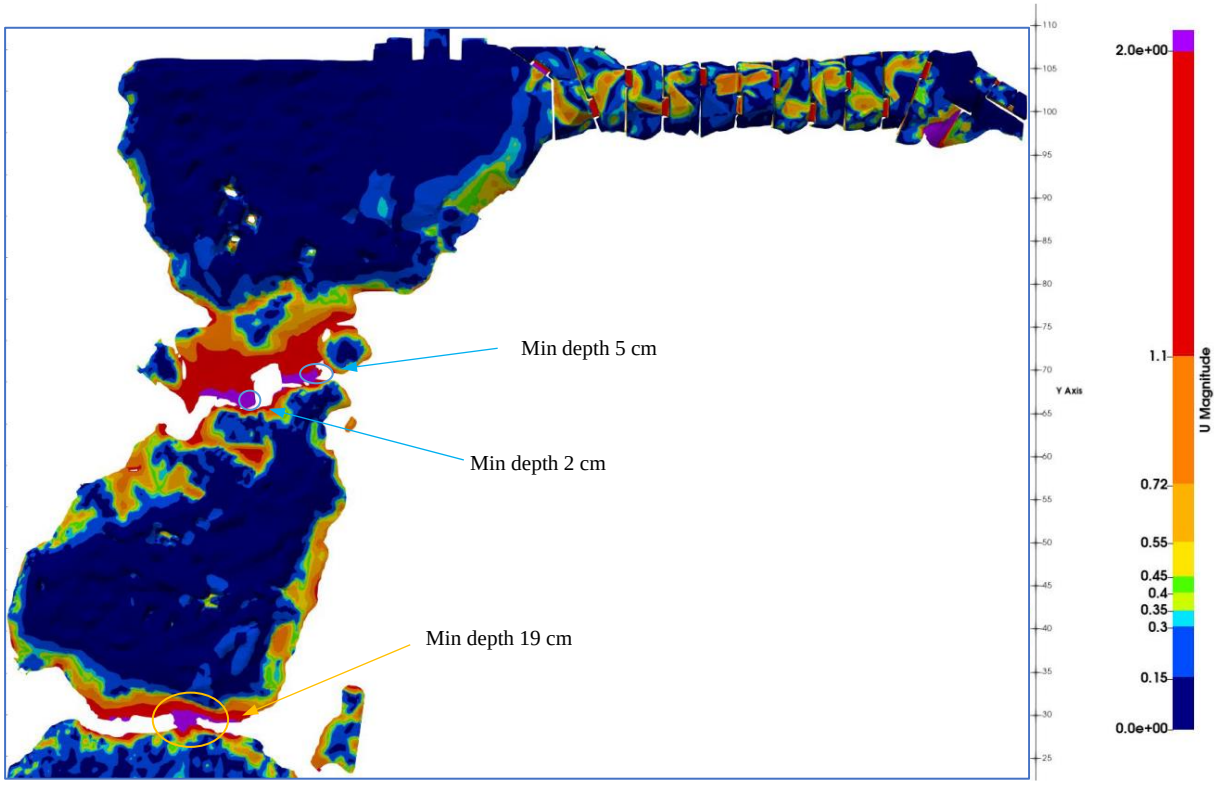


Figure 16: S7 velocities 0.2 m from the bottom

There is no passage in this scenario. The deepest area for passage over the second sill is only 5 cm deep, which is too shallow for gaspereau, trout, salmon, and larger yellow eels. Elvers and smaller yellow stage eels would have enough depth to pass, but the velocities over the sills are too high.

Conclusion

The fishways and eel pass will provide good passage for the fish that make it up the river to the dam. Attraction flow to the fishway is good with a volume of 35 cfs of attraction flow against a gate flow of 65 cfs in the first scenario, which is normal operations. The addition of 50 cfs supplementary flows as required should provide enough depth of water over the sills for all salmon as the flows are just slightly to shallow for the multi sea year salmon without these additional flows. The duration of the supplementary flows at 12 hours each is good as it allows for better passage of the other species in between. Care should be taken in using this flow all the time when salmon are present as it would limit the passage of other species.

The fishway /louvre flow of 35 cfs is not sufficient to provide fish passage in the river below the dam. This has not been an issue due to the leakage of at least 65 cfs from the stoplogs. However, the new dam will not have this leakage so the 65 cfs should be provided to the river through the gates on an ongoing basis.





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APPENDIX G – Fish Passage Assessment

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To: Kailey Osborne, BMgmt, EP
Environmental Scientist
Nova Scotia Power

January 31, 2023

Re: Ruth Falls Fish Passage Assessment

Introduction

Nova Scotia Power (NSPI) has requested an assessment of the existing downstream and upstream passage and a concept design be developed for changes needed to improve passage and to work with the proposed refurbished dam at Ruth Falls. The detailed engineering drawings will follow based on the recommendations of this concept design and review by NSPI and the regulatory government departments. This report gives an overview of the upstream fish passage and modifications and refers to the more detailed reports for the downstream passage louver upgrade, upstream fishway passage and eel pass, and the in-river fish passage routes and related issues.

Upstream passage

The fishway at Ruth Falls dam is a pool and weir fishway with two distinct sections.

The upper section is a concrete fishway with 1 ft drops between pools, the pools are 8 ft wide by 10 ft long, each pool is 2 ft deep at the top end and 3 ft deep and the downstream end with a sloping floor. There is a fish trap in the top pool then six pools down to a large corner resting pool that turns the fishway approximately 135 degrees to the right followed by 6 more pools for an overall drop of 13ft. The notches are 3 ft 3inches wide and against the outside wall in an alternating pattern. The top inside corner of the notch is curved on a 6-inch radius. The notch crest has a 4inch flat area at the upper end dropping on a 2H:1V slope over 2 ft for a drop of 1ft. Running with 1ft of water at the crest of the notches, the water level in the pools below is at the crest of the notch above. The fishway is required to be run at 12 inches of flow over the crest of the notches. Water flow is approximately 5.56cfs with this type of notch with the 1ft depth in the notch with the sloping backwatered apron verses the 6cfs that would be the flow from a sharp crested weir. So, some small variation of the flow above the 1ft depth is acceptable.

This upper section is a concrete fishway connects to a **channel fishway** section running along the toe of the dam that is cut into bedrock with concrete weirs across the channel each taking a portion of the head drop to the river. The drop through this section is 8.35ft with nominal river

level and the drop is taken up on 7 weirs. The first weir is located approximately 35 ft downstream of the concrete fishway then the weirs are spaced at 20, 25, 15, 25, 20, and 20ft apart. These fishway channel weirs currently have various drops on the weirs ranging from 1.63 ft to 1.17 ft and notches 1.75 wide and 1.67 deep. The three lower weirs have a 1V:2H sloping floor in the notch, the upper 4 weirs have level floors in their notches. Under the 5.6cfs fishway flow these notches run full. These weirs do get additional flow from the leakage through the stoplog sections in the adjacent spillway, but the amount is not known. From observations this leakage backs the water up on the lower notches so the flow is over the weirs but has no effect on the uppermost notch. The upper weir does not properly back the water up on the notch in the entrance to the concrete fishway which should be higher up to the notch crest height.

From June 15 to July 15 and September 26 to November 30 there are weekly supplemental flow events of 50cfs are released immediately downstream from the discharge point for a minimum of 12 hours released overnight, when Ruth Falls headpond elevation is at 33.3m (109.4ft). These supplemental flow events are scheduled to complement natural significant inflow events, where a significant inflow event is defined as greater than or equal to 24mm of rain in a 24-hour period, as measured at the Malay Falls office where a rain gauge is maintained and checked on weekdays. A total of 10 or more supplemental flow events are to occur within these dates. These flows are intended to attract salmon out of the tide and to migrate upstream. When salmon have been caught in the fishway trap these flows are to continue nightly. This flow of a total river flow of 150cfs has not been modeled.

When the new dam is built there will be no leakage or additional flow available for this channel section of the fishway.

Pool and Wier fishway design background

Pool-and-weir fishways are very sensitive to water level fluctuations at both the upstream and downstream ends.

In these fishways, low tailwater levels will result in a high drop out the entrance notch increasing velocities and reducing or eliminating the backwatering of the notch which is important for fish passage. High tailwater levels will lead to drowning of the fishway entrance and, consequently, poor fish attraction flows with low velocities. The entrances are often supplied with additional attraction flow, and this aids entrance attraction flow conditions during fluctuating water levels.

Changes in the upstream water level affects the turbulence conditions in the fishway pools. High water levels increase flows through the fishway reducing or eliminating fish resting areas due to turbulence in the pools limiting fish passage. A very low upstream water level will result in low discharges and very shallow or no water depths in the notches passable by the fish. The water surface in the pool below the notch should be equal or above the crest of the notch. With low flows, shallower depths in the notches than designed for, drops the pool water surface below the crest of the notch making fish passage more difficult. Water depth should also be at least 1/3 the

body length of the fish requiring passage. So, the 1ft depth is the minimum for multi-sea year salmon.

It is very important that the fishways operate with the flows and drops between pools they were designed for with very little water level fluctuation. Any fluctuation should be above the design water depth for the notches.

Fishways at most NSPI sites are designed as what has been termed "salmon" fishways as historically the fishways were designed only for anadromous salmon on their spawning migration as this was the focus in the Department of Fisheries and Oceans (DFO) and was the Salmon section of the Science Branch the fishway engineers were in who developed the designs and provided the federal *Fisheries Act* approval. That is the case for this fishway. What makes them "salmon "fishways is the turbulence in the pools which is created as the notch flow velocity dissipates the energy of the drop as it reaches the pool bottom, upwells on the downstream weir, turning back and across the pool upwelling on the side opposite the upstream notch then down the next notch. So, the drop between pools, the volume of flow, and pool size length, width and depth that make up the water volume in the pool are important when looking at passing species and age classes other than the upstream migration of salmon spawners. The various species deal with the turbulence in the pools differently and most require more frequent resting areas than the salmon. Salmon also arrived in relatively small numbers, moved though the fishway quickly not needing to rest in these relatively short fishways in Nova Scotia. Gaspereau are at the other extreme arriving in large numbers and requiring resting areas while passing through these fishways. Crowding in the pools is also an issue that can slow down or even stop passage so the fishway has to take the numbers of fish at a given time into the design consideration.

This basic "salmon" design was then copied with some minor modifications to dimensions for other salmonid species, gaspereau, and in a few cases smelt. This was done by designing the fishways to operate with a lower drop between pools generally 8 to 9 inches for gaspereau and 6 inches for smelt while maintaining the 8ft wide x10ft long x 2 to 3 ft deep pools. These lower drops between pools lowered the velocity some in the notches while still backwatering the notches, but mainly by reducing the flow volume so there was less energy to dissipate resulting in less turbulence in the pools and in turn more resting areas. The flow volume can be reduced by narrowing the notches where the pool turbulence is too high, which also allows for them to be backwatered more improving passage. The burst or sprint swim speeds for the short distance through the notches are greater than the velocities with the one-foot drop between pools for all migratory species but the gaspereau and smelt do not have the endurance the salmon have, so need those resting areas in the pools provided by the lower flow volume into the same pool size. The same is true for the smaller and weaker swimming fish species. It is that greater energy dissipation in the pools for the volume of water dropping into the pool that makes the distinction between fishway types. The lower drops still maintained the notch design including having the pool water surface level at least equal to the notch crest but work better for all fish species if backwatered preferably by a minimum of 2 inches or 20% of the notch depth above the crest. This design feature changes the flow in the notch from a fully plunging flow if there was no

backwater on the notch slope, to one that is a combination of plunging and streaming flow. This improves passage for all species. It also introduces the flow deeper in the pool below and that increases the energy dissipation resulting in lower turbulence and velocity in the pools and more resting area.

The Ruth Falls upper concrete fishway

At Ruth Falls the water elevation in the pool below the notch is designed to be at the level of the notch crest when there is a 1ft deep flow in the notch. This is the proper operational water depth for this fishway and is acceptable for the passage of all the major species.

This concrete fishway should be operated with a 1ft of flow depth or slightly above through the notches to meet the design criteria. If it is observed during monitoring that the pools do not provide enough resting area for the number of weaker swimming fish present then the notches can be narrowed from the wall side to reduce the fishway flow while maintaining the notch depth and pool volume there by reducing the pool turbulence providing more resting are for gaspereau, smelt, suckers etc. while keeping the notch operating within parameters. The modeling of the fishway and the operation with 1 ft water depth in the notches, and observations of the flow patterns, confirm the turbulence in the pools is good providing resting areas and needs no adjustment with the expected numbers of fish.

The lower fishway channel and entrance

The current attraction to the fishway entrance is poor with the louver flow at a minimum of 29cfs coming out at right angles to the river flow and the water from the spillway aligned with the river flow boxing in the 5.6 cfs fishway flow. This is causing the fish to collect either downstream of the louver flow or on the right side of the gate flow missing the flow from the fishway. It is not known what the current flow is out of the channel section of the fishway is as in addition to the 5.6cfs of the concrete fishway flow it collects additional flow from the stop log spillways along its right side. When the fishway is run at 1 ft deep and a flow of 5.6cfs plus the leakage and additional supplemental flow of 50cfs it is more competitive with the other flows but still boxed in. This large supplemental flow overtopping the weirs creates very turbulent pools between the weirs and is particularly bad at the narrow weirs with shorter, shallower pools. With the new dam these additional flows, both the stoplog leakage and the supplemental 50cfs flow, will be eliminated from this part of the fishway and relocated to the spill gates.

Eel passage past the dam is possible as indicated by the population upstream but they must pass through the existing fishways to get upstream. This is limited to the larger eels that can swim through the fishway velocities.

Changes to provide improved fish passage at the refurbished dam

To provide attraction flow from the fishway and eliminate the larger flow from the louvers, just downstream of the fishway entrance, the louver flow will be realigned to the top of the fishway channel as described within the downstream passage report. This will provide a combined

fishway minimum flow of 5.6cfs with a minimum louver flow of 29cfs for a total at least 34.6 as attraction flow at the fishway's river entrance. To properly accommodate this flow in the fishway channel, the 7 existing weirs are to be replaced by 11 new weirs each with a 0.75 water drop, 11ft wide by 1.75 deep notches with sloping on at 2H:1V, backwaterd over the crests of the notches by 1ft. Pools between the weirs will be at least 4ft deep with the notches are running at 1.75 depth over the crest of the notches, and a weir width of 25 ft bank to bank. The modeling of the flow pattern and velocities in the pools and notches has shown that this design will provide easy passage though this section of the fishway for the fish including resting areas in each pool.

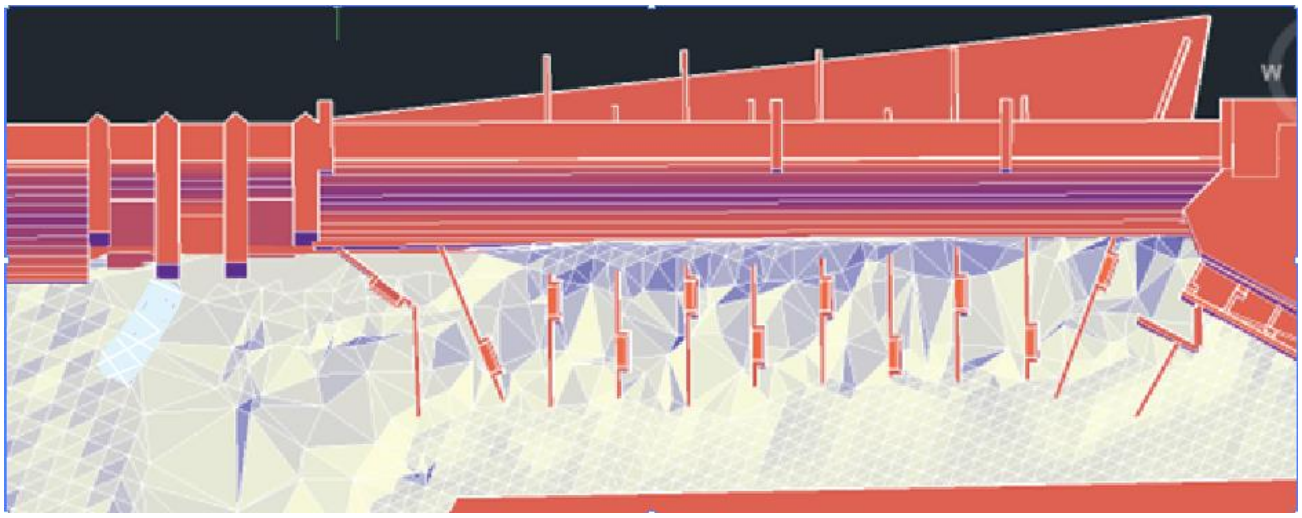


Figure 1: The layout of the 11 channel fishway weirs

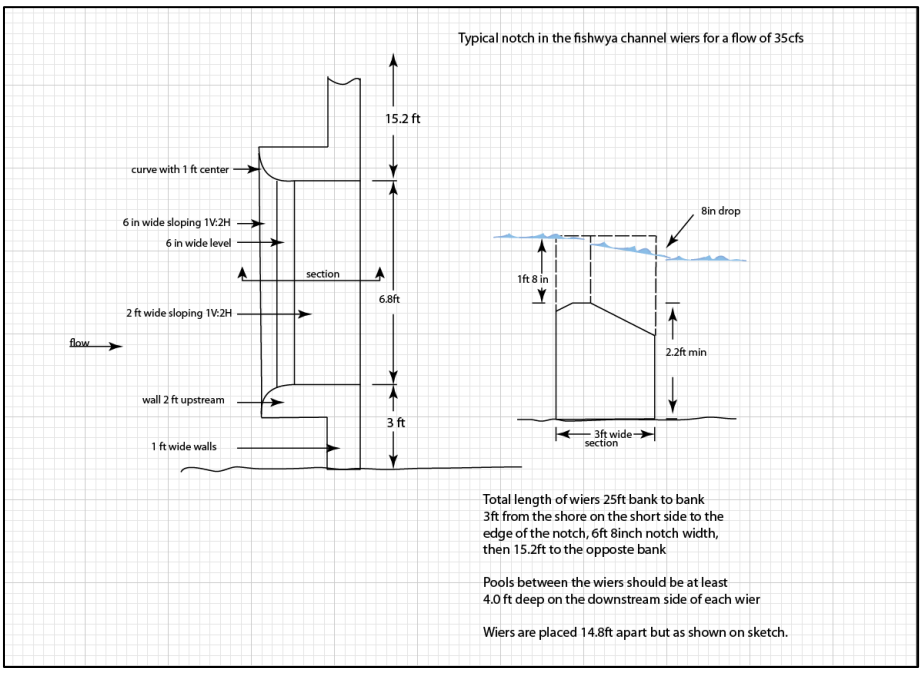


Figure 2: Design details of the notches in the channel fishway weirs

It is preferable to have the fishway entrance flow at least 10% to 15 % of the river flow, if possible, to attract the fish. The upper concrete fishway flow of 5.6cfs provides 16% of the combined fishway and louver flow in a small area where the two flows meet at the top of the fishway channel with its new baffles. At the entrance to the fishway at the river the percentage will vary depending on the flow from the gates but at the minimum flow of 65cfs from the gates the fishway flow will be up to 39% of the total flow. During higher river flows they could go as high as 390 cfs and still meet the 10% criteria.

Additional fish passage for eels

One species that cannot use the fishway effectively are the smaller American eels. Having the louver flow moved to the fishway as attraction flow, the river flow currents will lead the majority of the eels to the downstream corner of the lowest fishway notch. The upstream eel pass entrance is to be located at the downstream corner of the fishway entrance. See eel pass report for more details.

Eels tend to be smaller near the tide and Ruth Falls is close to the tide, so designs have to accommodate the 0+ year class. There are some challenging natural sections for these young eels in the river below the dam but there are likely locations along the bottom or along the shore they can use for migration over these natural sections particularly under low flows. For this reason, an eel pass is designed to provide this passage for the smaller eels. The lower channel fishway with its drowned weirs and the concrete fishway when the weirs are backwatered with 1 ft of flow allow eels larger than 15cm long to use their burst speed over the notches along the bottom and especially in the bottom corners of the notches where the velocity is lower. Passage is also available through the 3-inch diameter drain hole in each weir. Details regarding the eel pass are outlined within the upstream eel passage report.

Downstream passage

The diadromous fish need to come back down past the dam at some point in their life cycle and resident species may choose to migrate down seeking suitable habitat. Some may come back down through the fishway or exit through the gate flows, but it is expected most will follow the power cannel flow and be led through the louvers. The louvers are currently of the best designs used to date for downstream passage but there are a few improvements that can be made at this site. Eels travel along the bottom and do not guide well with currents at louvers so a solid wall fitting tight to the bottom is needed guide them to the exit. Bottom outlets are best for eels, or they need to be led up to the surface outlet. To do this a slated ramp is to be installed to lead them up. See the louver report for eel behaviour and design requirements for downstream passage.

For all fish the velocity into the louver exit is good but below their burst speeds. Then they reach a series of partial barrier stop log sections that they have to go up and over. As a partial barrier these sections will cause many of the fish to return back upstream. To prevent movement back up and out of the louvers a trap funnel will be installed, and the stop log sections will become

orifices vs the overflow weirs in the concrete transition channel. This will ensure quick passage through a barrier free transition channel to the louver outflow pipe. See the downstream passage louver report for more details.

Louve pipe outlet is designed to discharge into pool sized to dissipate the energy from the head drop through the piped section and then the vertical drop into the top pool of the channel fishway section. The pipe can come down from the end of the louver system's concrete transition channel on a 3% slope which leaves a 6.45ft drop into the 4ft deep pool. This stays within the USFW guideline for safe downstream passage.

Summary

This completes the full loop of fish passage from the upstream river passage routes, the fishway sections and the downstream louver system discharging between the two fishway sections to provide good attraction flow to the fishway at the river.

Figure 3 provides a diagram of the location of the proposed changes. To the left of the figure and running along the toe of the spillway with its rubber dams are the series of 11 new fishway weirs in the fishway channel. These weirs are designed to have velocities and water depths for passage for all species and to carry both the concrete fishway flow and the louver flow. Above that is the existing concrete fishway which meets design standards for a good fishway. Running alongside of these fishway sections, as a blue line in Figure 3, is an eel pass for the smaller life stages of eel. This eel pass is a design that is commonly used in Europe and around the world. This completes the upstream passage. Downstream passage is through the fishway and gates but primarily through the louvers in the power canal. The louvers with their solid wall along the bottom, guide ramp to the outlet, and swimming depth passage through the transition channel to the outlet pipe removes the existing partial barriers to downstream passage for all species. They then complete the journey down the lower portion of the fishway to the river.

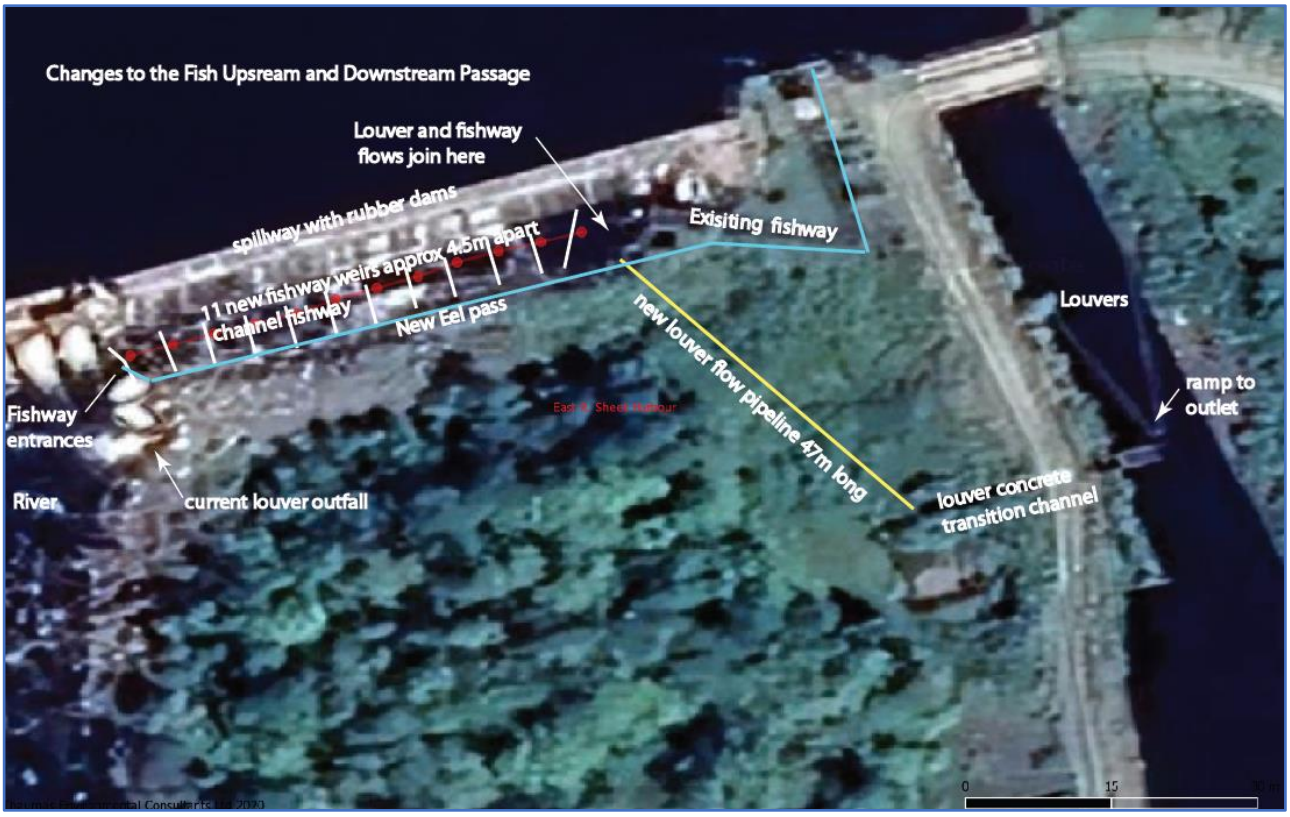


Figure 3: The overall layout of the fish passage facilities

Conclusion

Fish passage that meets or exceeds modern fish passage criteria will be provided for all species that need to migrate past the Ruth Falls dam to complete the life cycle with a few modifications to the existing fish passage facilities.

The new dam will eliminate the spill along the lower channel portion of the fishway and this required changes to be made to provide good attraction flow to the fishway entrance at the river. To provide this attraction flow the louver flow carrying the fish downstream will be diverted into the top of the channel section of the fishway. The existing 7 weirs with various head drops and notch designs will be replaced by 11 weirs with large, drowned notches to carry the additional flow without over topping. This will provide good passage for all the required fish species.

The additional eel pass will provide the latest eel pass design for upstream passage of elvers and small yellow stage eels.

The downstream passage already has a set of well-designed louvers, but the efficiency has been compromised for the benthic species, eels and suckers, by raising the outlet 5 ft above the bottom. A sloping ramp to lead the fish up to the outlet combined with walls along the bottom of

the louvers will greatly improve efficiency. The passage was further hindered by stoplog overflow weirs in the outlet transition channel combined with the slower bottom and mid water velocities the fish could swim against to return to the power canal. These have been replaced by a trap funnel to limit fish from returning upstream and orifice openings in the stop logs to remove these barriers and maintain the velocity through to the pipe. Returning the fish through the pipe diversion shortens the length and the overall drop brings this flow in halfway up the fishway. Taking the fish down the fishway will help those returning to find the fishway entrance.



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APPENDIX H – Louvre Assessment

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January 31, 2023

Re: Concept Design Report -Downstream Passage of Silver Stage Eels at Ruth Falls Dam – Draft

1. Introduction

Nova Scotia Power Inc (NSPI) requested a condition assessment of the louver system which forms a part of the fish diversion structure at the upstream end (entrance) of the power canal at Ruth Falls Dam. NSPI also requested a concept design of improvements to the louver system to increase it effectiveness in bypassing silver stage American Eels (*Anguilla rostrata*).

2. Site Visit

On May 31, 2022, Thaumas Environmental and Wood Canada Limited (Wood) visited the fish diversion louvers at the entrance to the Ruth Falls power canal in Sheet Harbour, NS. The purpose of the site visit was to determine the current configuration of the louvers and the overall fish management infrastructure at the site. It was also an opportunity to understand how the louvers are currently functioning, and to assess what opportunities there are for improving downstream American silver eel (*Anguilla rostrata*) passage at the site. A second visit to assess the condition of the louvers for damage to the louvers and attachment to the bottom was not done as the headpond was not drawn down as originally planned in 2022. It is noted we do not know what the condition of the louvers were during the 2009/ 2010 eel passage study conducted by NSPI. Another site visit was undertaken on October 20th, 2022, to check the flow volume through the louvers and to take a second look at the overall configuration.

3. History of the Fish Diversion Louvers

The louvers were originally installed in 1966 as a downstream bypass and counting facility for the passage of Atlantic salmon smolts. The louvers have been modified several times since then to improve smolt passage based on studies on smolt behaviour and passage rates from 1967 to 1971. In 2005 Nova Scotia Power contracted Alden Research Laboratory, Inc. to assess the louvers and provide an Engineering and Biological Assessment Ruth Falls Fish Deflection Facility, authored by Gregory Allen (Allen 2005).

Major changes were undertaken during the rebuild of the louver bypass exit and monitoring shed operations based on Nova Scotia Power plans dated in 2006.

Initially the louvers had a bottom outlet pipe. However, it was found that the migrating salmon smolts were concentrated in the upper 4.5 ft of the water column so the louver exit / bypass entrance was changed to provide a surface outlet that used less water and improved surface velocities and attraction for the smolt. The bottom outlet pipe was reportedly filled with concrete as part of that modification.

The powerhouse intake canal is located adjacent to the dam's east abutment. The louver facility is located about 75 ft downstream of the canal entrance. The intake canal was reconstructed and widened in 2000 downstream of the louvers to improve the conveyance capacity of the canal to the powerhouse to its original design flow rate. The original intake canal where the louvers are located is approximately 42 ft wide at the top bank, a bottom width of 14 ft, and bank slopes at 1:1 (H:V). Downstream of the louvers the canal widens to a top width of approximately 100 ft and a 25 ft bottom width. The louvers are shown in Figure1.



Figure 1: Looking downstream at the louvers May 31, 2022

4. Description of the Louvers

As shown in Figures 2 and 3, the louvers are arranged in a V pattern across the intake canal and consist of steel bars orientated perpendicular to the flow. Each leg of the V is approximately 50 ft long and orientated 12 degrees to the approach flow with a fish bypass located downstream at the vertex. As shown in Figure 4, the louver bars are 2 inches apart and extend from the bottom of the canal to a top walkway deck at elevation 114.0 ft. Every sixth bar (12 inches) has a flow straightener extending from the bar in an arc that forces flow to exit the louvers parallel to the

canal. The fish bypass is located at the vertex of the louver V array. As previously noted, the original bypass entrance design extended the full depth of the intake canal. Testing conducted in the late 1960's suggested optimizing the entrance design by blocking off the lower 5 ft creating a surface bypass and increasing the bypass velocity. The bypass entrance is 18 inches wide with an invert at El. 104.0 ft. (Allen et al 2005). The 2006 modifications built a new bypass entrance with the bottom 5ft closed off by a concrete block that supports a metal bypass with 18-inch-wide vertical opening curving 90 degrees and widening to 6 ft wide and 4 ft deep into a concrete channel. The operating water depth in the channel is 2 ft at 29 cfs minimum flow. This channel incudes the diversion to the monitoring shed and ends with the inlet to a 32-inch diameter pipe that carries the flow to the river where it drops into the river just downstream of the fishway entrance and at right angles to the spill gates.



Figure 2: Looking upstream at the louvers May 31,2022

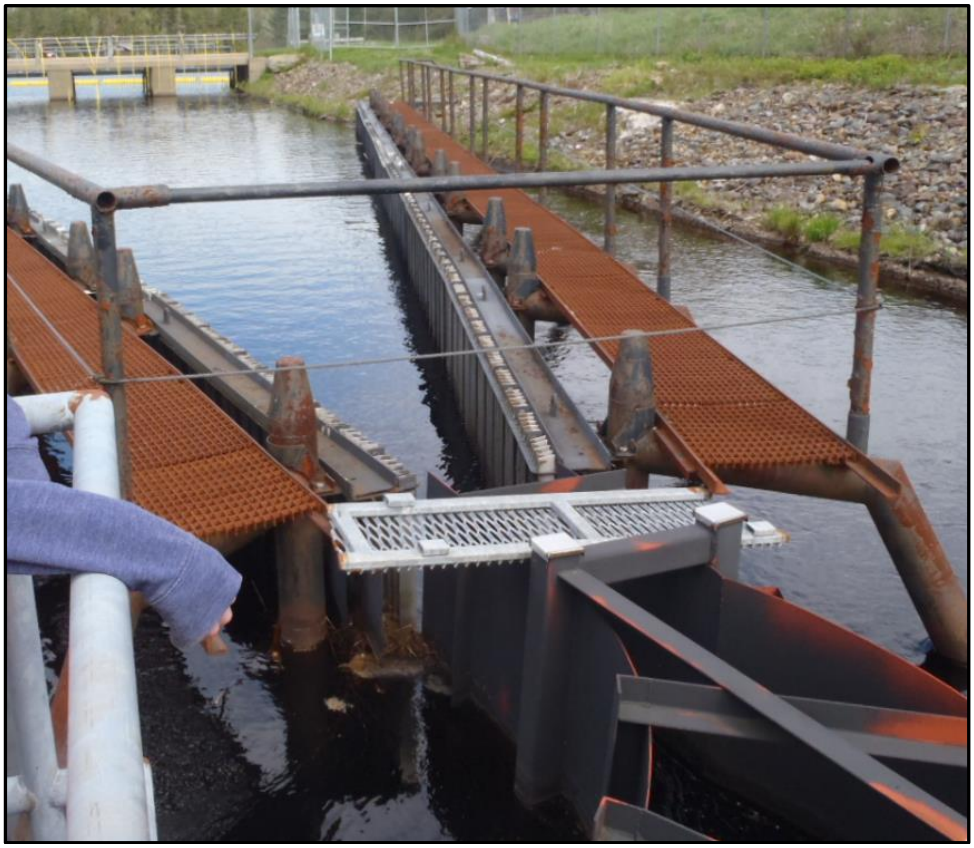


Figure 3: Looking at the louver /Bypass connection gap May 31, 2022

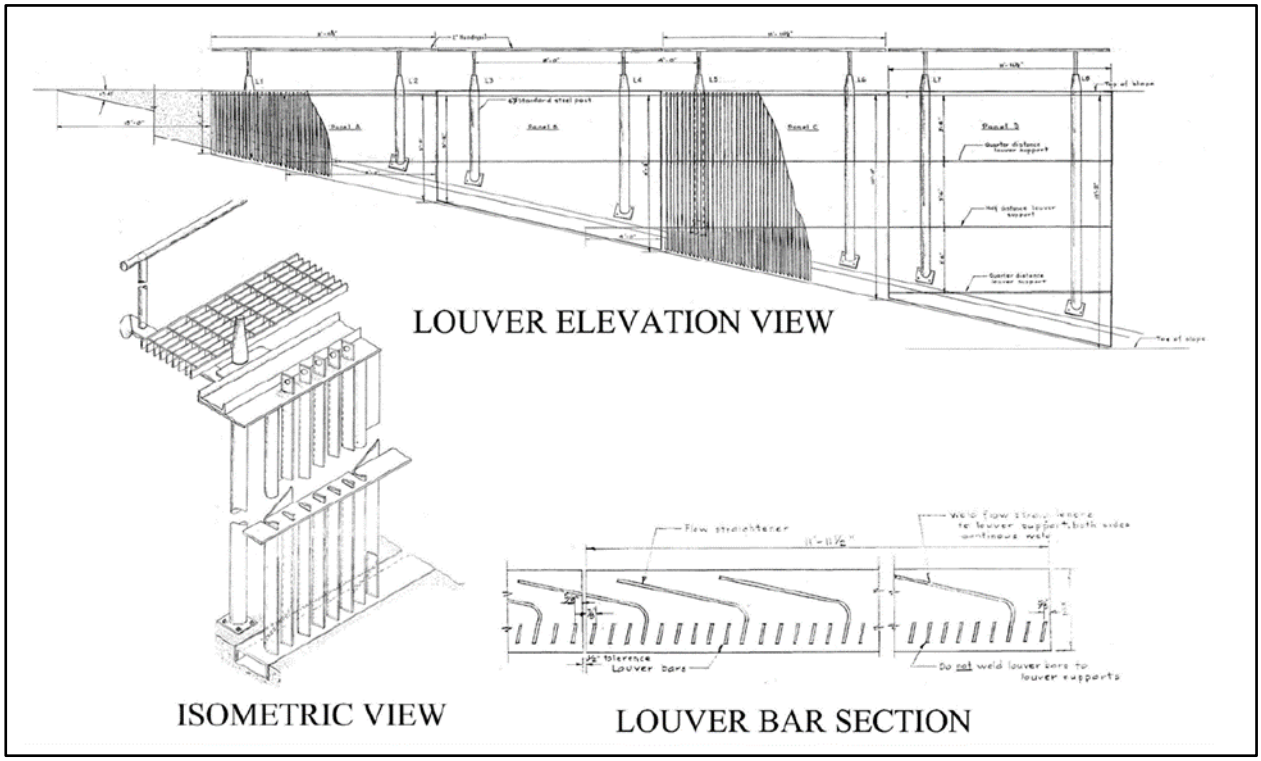


Figure 4: DFO Louver design from Ducharme 1972

Louvers can be very effective at guiding all fish including eels to a bypass if properly designed (Beck 2020) and modeling conducted at the Alden Research Laboratory (Allen 2005). Guiding angle is very important and (Amaral 2003) found a 15-degree angle to the flow was better than a 45-degree angle. In Ruth Falls the angle is even better at 12 degrees to the flow. The effectiveness for most species was very high when the flow velocities were good, and they are at Ruth Falls (Allen 2005) so eel fish guidance efficiency (FGE) should be in the 90% range.

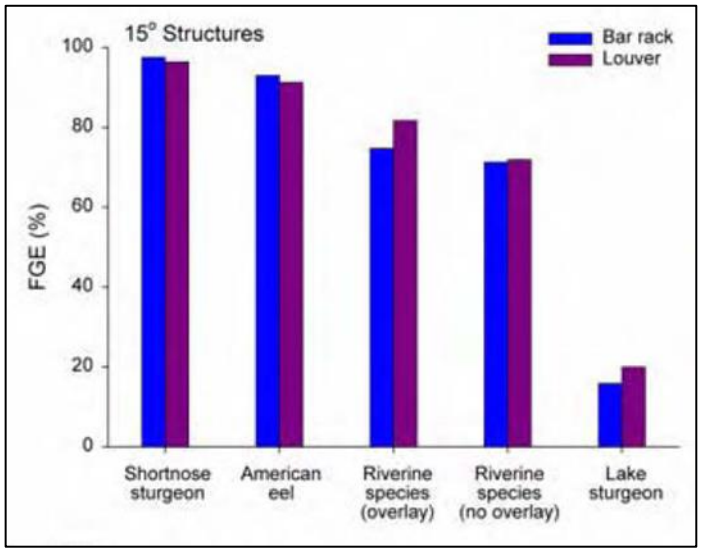


Figure 5: from Amaral 2003

The one thing that is missing at Ruth Falls that they found added efficiency for eel guidance is a barrier along the bottom (termed overlay). Figure 6 shows the difference they found with and without the barrier along the bottom.

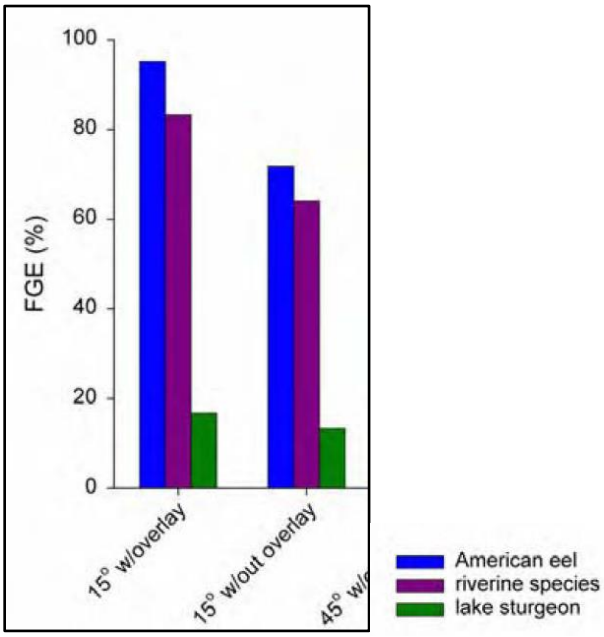


Figure 6: from Amaral 2003

So, since the basic design is good we need to look at how it is working and how it can be upgraded to work better.

5. American Eel (*Anguilla rostrata*) Silver Stage Downstream Passage

With the recent focus on the American eel, NSPI has been asked to review potential options for improving the effectiveness of the louvers to bypass downstream migrating silver stage American eels.

NSPI studies in 2010 indicated that of 30 acoustic tagged silver stage eels released above the headpond, all reached the dam, 21 (70%) were detected in the power canal downstream of the louvers, of those 8 were detected down river, and another 9 detected downstream either used the louver bypass, the fishway, or the spillway, for survival of 56.7%. There is no information on the detection efficiency of the receivers in the river below the powerhouse and this is especially important as the assumption of mortality rates is not sound if the detection rate was low as those not detected were assumed to be mortalities. This river section likely required two recorders in this channel on opposite sides to get a high detection rate. The observed results for the louvers efficiency are poor as 21 of 30 were below the louvers in the power canal at one point in their migration.

Eels are known to actively search for a downstream passage route near the bottom of the water column in forebays of structures such as hydropower stations and navigate by following the walls and bed of the headpond or power canal until the reach a barrier then they venture higher in the water column looking for a way downstream (Piper 2015) (Brown 2009) (Haro 2000). Consequently, bypass location will influence the ability of eels to find the bypass entrance. Flow is one of the main drivers for the downstream spawning migration and thus providing an attractive flow at the entrance to the bypass increases the likelihood of eels successfully locating the entrance and subsequently entering. However, they do not necessarily follow the greatest flow past a dam (Piper 2015). Understanding the swimming capabilities and behaviour of emigrating eels at a particular site is essential to ensure that they enter the bypass eventually encounter water velocities that exceed their burst swimming speed, hence preventing them from swimming upstream against bypass flow or a restriction that prevents them from moving back upstream (Baker 2019). The louvers at Ruth Falls provide the attraction flow velocities and the bypass velocities at their burst swimming ability without any sudden acceleration, and so just meets requirements for eel downstream passage based on the Alden modeling (Allen et al 2005) and supported by velocity readings taken during the October 2022 site visit and modeled for the bypass entrance. However, the bypass channel then widens, and velocities change to levels that would allow them to move back upstream. The drops over the stop logs that control the flow in the upper part of the concrete bypass channel are approximately 4 inches which allows the eels to move back upstream and out of the bypass. These 6 stop log weirs are 21 inches high with 4 inches of water over them in a 6 ft wide concrete channel leading to the pipe that carries the flow to the river. They create a series of partial barriers for eels traveling on the bottom which would lead them to use search behaviour that could result in an upstream movement back out of the bypass. Also, the flow velocity over the weirs in the channel is well within the eel swimming ability so they could move upstream back into the louvers in the power canal.

Silver eels travel on the bottom of the watercourse with occasional movements up in the water column. They tend to spend considerable time migrating near the bottom and are often insensitive to velocity changes until they encounter an obstruction, e.g., a physical guidance or exclusion device. Deep bypasses tend to be more effective than surface bypasses for downstream migrant eels (Gosset et al. 2005) (Russon et al. 2010). Movements up in the water column are common at dams and in lakes where the bottom velocities are low and do not provide an indication of downstream direction. These movements do allow some of the eels to find surface bypasses, spill over spillways, or spill under gates but can also attract them to leakage from stoplog sections.

The current design of the louvers, extending to the bottom of the power canal and with the vast majority of the flow past the dam through the canal, provides good attraction and velocities along the bottom (1 to 2 ft/sec). The physical visual behavioural barrier and the water turbulence along the louvers should be effectively leading the eels to the bypass. Full-depth guidance structures like this one can potentially guide all fish species regardless of migration depth (Linnansaari 2017). Louvers are behavioural devices, so it is critical that fish efficiently enter the bypass and do not delay or hold at any partial barrier. However, the surface outlet is 5 ft above the bottom so the eels would tend to collect at the bottom until individuals chose to move up in the water column or numbers build up so those at the top come in contact with the bypass opening and flow. With this dead-end bottom passage causing crowding, many would move back upstream or just to the sides and find their way through the louvers or seek other ways downstream through the fishway or via the spill. As previously noted, this behavior aligns with the findings of NSPI's acoustic tagging study and staff observations with 70% of the eels in the power canal below the louvers while large numbers appear in a mass at the louver vertex. Passage would have been better for the eels with the original bottom outlet, this would not be as good for the fish swimming up in the water column like the target salmon smolts.

Extensive laboratory studies were conducted by EPRI to determine if louver arrays could be employed to guide various riverine fishes and the catadromous American eel (EPRI 2001). The louvers at Ruth Falls meet or exceed the best configurations studied except they found better results if an inclined plane was used to bring eels and benthic species of fish to the surface outlet and a solid wall is placed along the sides at the bottom 1 ft of the louvers. It is also unclear what the bypass-to-louver approach velocity ratio is currently. The ratio should be 1.5 or slightly greater. The current flow through the bypass is 32cfs as set by 4inch high stoplogs so there is a slight change above and below this number as logs are removed or added with headpond fluctuation. Velocity in the bypass notch is calculated to be in the 5.0 to 6.0 ft / second range. We do not have direct measurement of the velocity along the louvers, but the Alden report (Allen et al 2005) set it at 3.1 to 3.4ft/sec depending on generation levels. This gives a ratio of 1.6 to 1.78 which is very good. The United States Bureau of Reclamation (USBR 2006) gives a general design value of 1.1−1.5 for louver bypass systems for all fish species and these louvers meet that guide without acceleration that would cause the fish to avoid passage. This velocity drops when the fish enter the concrete channel with 4 to 4.5 ft /sec with a 4 inch drop over the stoplogs and no bottom flow which acts as a barrier at each of six stoplog sections.

To ensure silver stage eel downstream passage, particular attention needs to be paid to the velocity along the face of the louvers near the bottom of the canal to get it in the right range that will lead the eels to the outlet. We have not been able to check this and are relying on

the Alden modeling (Allen et al 2005) that indicates the velocities are good for guiding the eels to the bypass both at the bottom and along the louvers. Observations made by the NSPI staff have seen large numbers of eels at the bypass entrance, so the louvers are effective at leading them to this location.

The louvers need to be checked along the bottom to see if there are any gaps in the louvers at or near the bottom that the eels may have been passing through in the earlier study. This could not be checked as the headpond was not drawn down this past summer but can be checked and repaired during dam construction.

There needs to be a design change to lead the eels to the existing surface outlet.

There are several modifications required to improve passage efficiency.

5.1 Lead the Eels to the Surface Outlet and Remove All Barriers Delaying Passage.

The surface outlet is just 5 ft above the bottom but for eels traveling on the bottom, in fact usually in close contact with the bottom, this becomes a barrier and causes the eels to begin a search behaviour to find a way past the barrier at the bottom. They would search for an opening with a current to follow. This behaviour would also include rising to find the bypass outlet, but this would involve a significant delay and the search behaviour would include movement through the louvers. Since the eels orient to the bottom, and they need to find the outlet quickly, providing a bottom structure to follow up to the bypass opening simulates the natural outlet from a lake or pond providing an easy to find the downstream route reducing the crowding.

The design shown in Figures 7 and 8 are for a proposed sloping ramp on a 15-degree slope up to the bypass with 1.5ft high sides of the ramp (Amaral 2003) to prevent the eels from moving to and through the louvers as the numbers build up in the narrowing exit area. The ramp is made of (steel or HDPE) plates 10 inches wide on an additional 15-degree slope (30-degrees to the horizontal) overlapping so that there is just a 2-inch opening between them (a 7-inch spacing along the ramp). This meets the best configuration for slope and openings tested by EPRI (EPRI 2001). Similar ramps are used at Garvin's Falls Project and Holyoke Dam louvers in New England. This ramp could be solid but using the angled plate will allow any fish that find themselves under the ramp to move up and follow the ramp to the louver outlet.

To rise the 5 ft, the ramp will extend out into the louvers by 18.66 ft with an upstream end width of 9.5ft and a width at the bypass entrance of 1.5ft. Migrating eels will follow up the ramp which will appear to them to be a solid bottom. The velocities along the ramp will be ideal for downstream passage. If fish that go through the louvers and return ending up under the ramp, they will be able to come up through the openings. There is no loss of habitat with this design and debris build up is not an issue vs fine mesh excluding screening.

A 1ft to 1.5 ft high solid barrier along the full length of the louvers, where the existing louvers meets the bottom of the canal, is needed to guide eels and benthic fish following the bottom to the vortex and the ramp.

There is currently a gap along the sides where the louvers meet the bypass as seen in Figure 3. It is not known if this extends to the bottom but needs to be closed as it is large enough to allow eel

passage as well as other species at a critical point where the water is accelerating and there is a change in the structure.

There is also a gap where the louvers meet the shoreline as can be seen in Figure 1 and these should be blocked off.

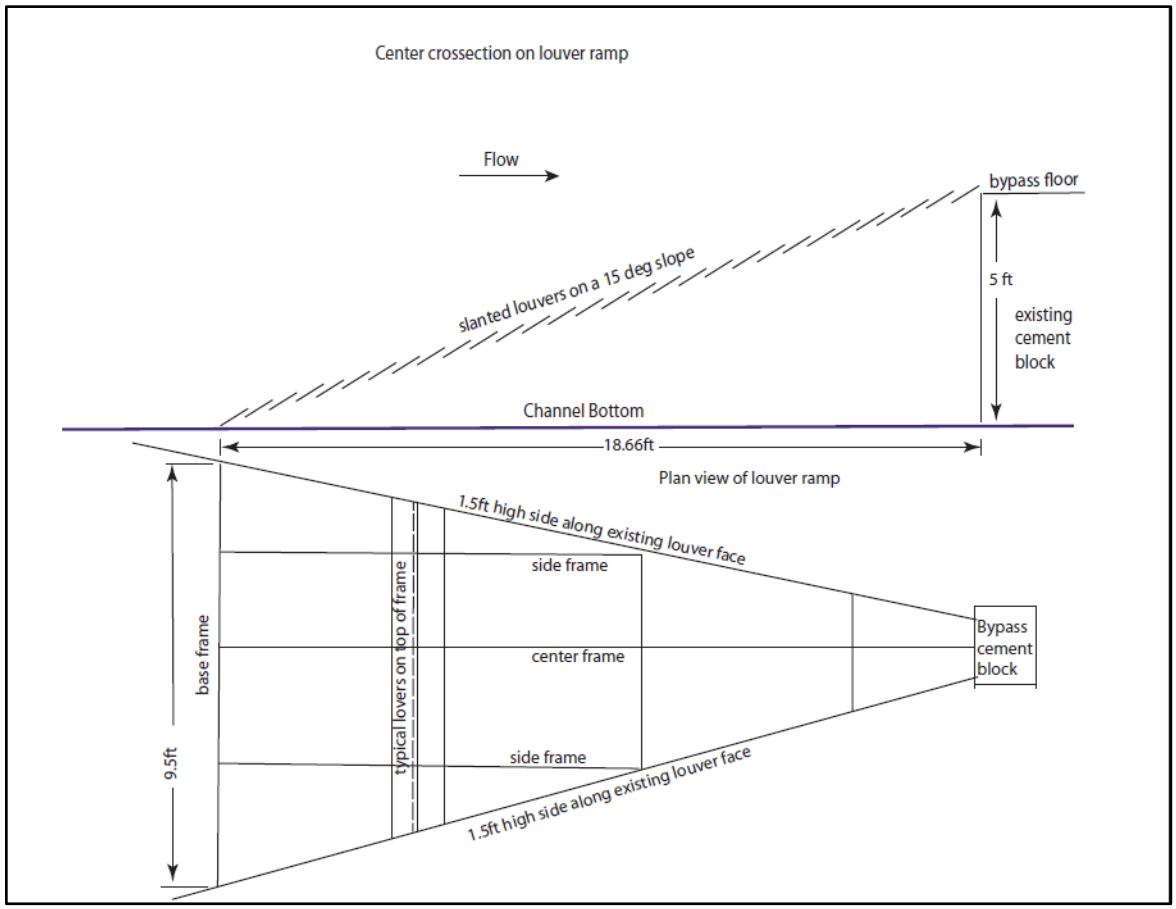


Figure 7: Longitudinal cross section (top) and plan view (bottom)

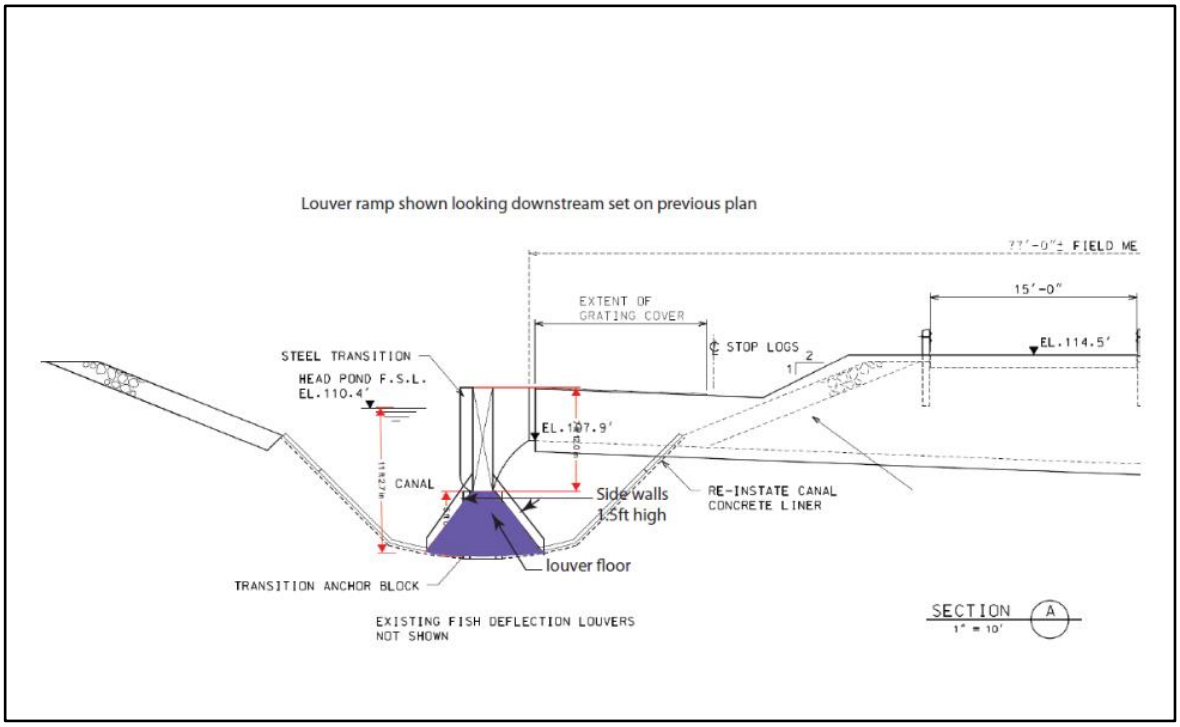


Figure 8: End View Looking Downstream

5.2 Keep the Fish in the Bypass Channel and Improve Downstream Passage

In the concrete channel, it is proposed that a trap funnel be installed at the most upstream stop log guide. This funnel would narrow the opening to 1.25ft and lead the eels and fish up 1ft to create a trap preventing them from easily returning upstream as shown in Figure 9. Then each of the 6 stop log sections that currently present partial barriers to all species will be modified to have a bottom orifice to carry the majority of the flow with an opening of 1 ft high by 3.32 ft wide as shown in Figure 10. The orifices will provide good downstream passage at the bottom for all species and eliminate the series of resting pool areas currently in place that slow eel and all other species migration and encourage them to find another way downstream.

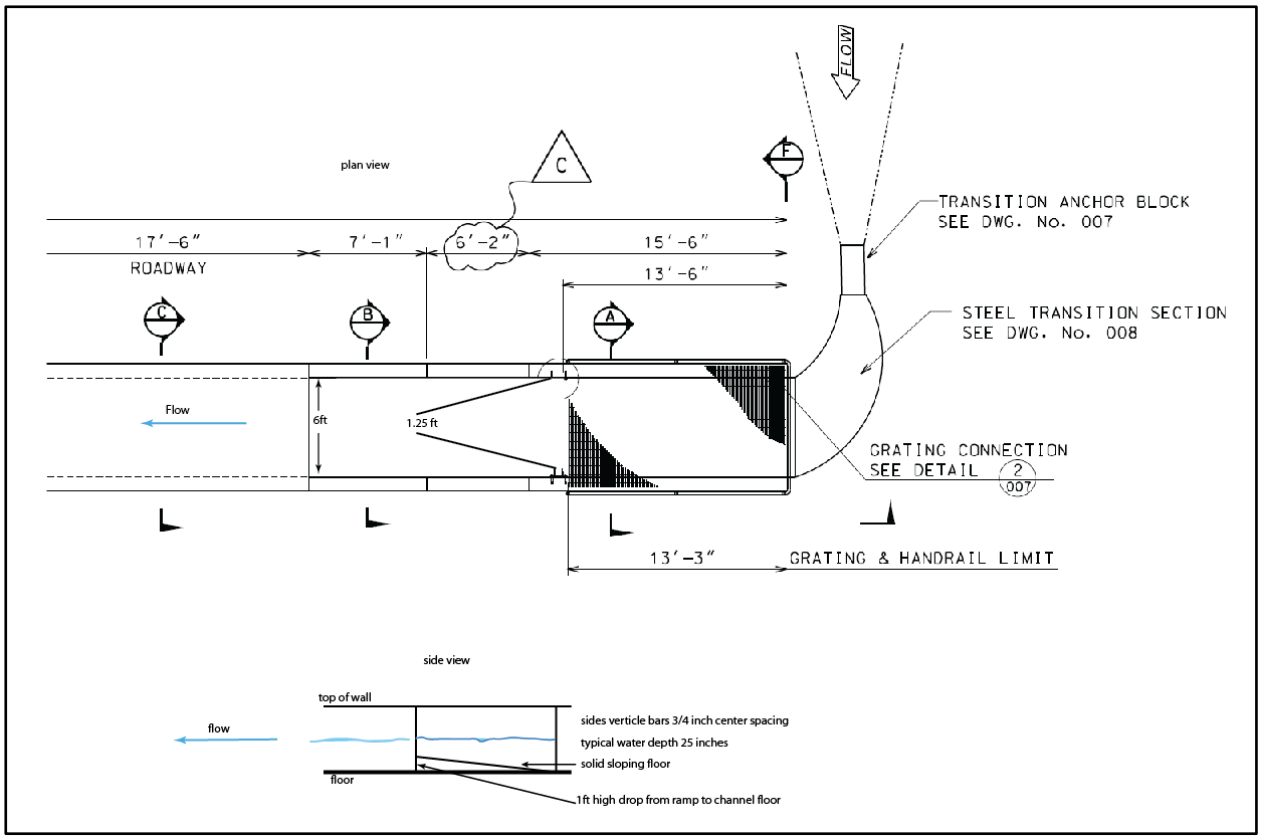


Figure 9: Trap funnel in the bypass concrete channel

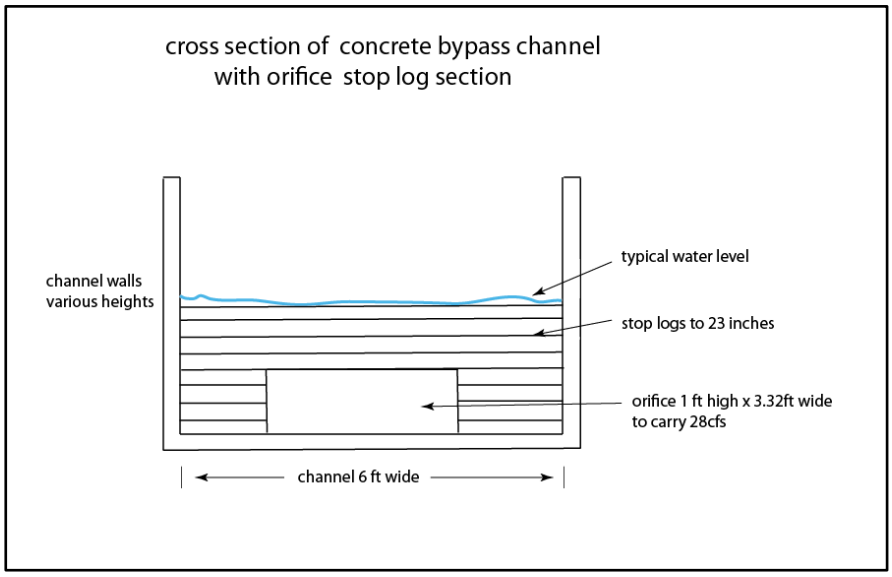


Figure 10: Typical stop log section with orifice

5.3 The Transition from the Bypass Channel to the Pipe

The next problem location is where the cement channel connects to the pipe to the river. This is a very turbulent pool as the flow drops over the stop logs down to a bottom the outlet pipe. To reduce this turbulence and possible harm to the fish, the orifice in the stoplog section entrance to

this pool will lower the drop and a surface mounted slide gate will be installed so that the flow to the pipe can be adjusted to back up water partially filling this pool and dissipating the energy in the flow. The slide gate will allow for adjustment to the water depth in the pool and allow for any future changes in louver water flow. The pipe will need an air vent to balance the pressures in the pipe.

5.4
The louver pipe is to be realigned to enter the fishway between the upper section, the concrete fishway, and the lower section, the channel fishway that enters the river. This is to provide additional attraction flow to the fishway entrance replacing the stoplog leakage currently entering the lower channel fishway section which will no longer be available with the new dam. This louver flow will discharge into the pool between the two fishway sections. The pipe will be realigned to come down from the end of the louver concrete channel on a 3% slope toward the fishway which will leave a 6.45ft drop into the 4ft deep pool just to the left of the counting bypass holding area at the downstream end of the concrete fishway. This overall drop from the 32-inch diameter pipe with the design flows stays within the USFW guideline for safe downstream passage.

6. Conclusions
    1) The installation of a ramp and bottom walls along the louver will greatly improve entrance conditions for eel and other benthic species traveling along the bottom. This option would provide passage for yellow stage eels throughout the year, silver stage eels in the fall, as well as all other species or individual fish that may be swimming deeper than the bypass inlet during downstream habitat migration or seasonal spawning movements. The Alden Research Laboratory modeled flow conditions at this site, with this addition, will provide good downstream passage for the silver stage American eels and all fish species.

    2) It is important that the louver bypass entrance is designed to keep the fish from returning upstream once they enter, so either velocities have to be above their burst/sprint swimming speeds or as proposed a trap funnel to prevent most upstream movement and bottom orifices in the stop logs to provide quick downstream migration.

        The flow in the bypass entrance is just at the sprint speed of the large eels and most species. It could be adjusted by removing stop logs at the second set of stop logs to increase the flow to ensure velocities are high enough to prevent a return upstream, but this would increase the acceleration of the flow above 1m/sec/m guideline for downstream passage at the bypass entrance and the fish would startle and go back upstream. This would also require at least 40cfs which will increase velocities in the fishway channel, where the louver flow is needed for attraction water to the upstream fishway and create velocities and turbulence at those weirs that would not be good for good passage of upstream migrating fish.

        So, stoplogs with orifices will provide the required flow at or just above the minimum of 29cfs and the orifices will provide rapid downstream movement rather than the surface overflow partial barriers.

3) The bypass pipe outfall drop to the river and plunge pool as currently operating meets the drop and depth requirements to ensure it is safe for the eels and all other species and life stages. When it is realigned to the top of the fishway channel the drop to the plunge pool and this pool's water depth exceed the USFW criteria for drops of all species and age classes at the site.

4) We were not able to conduct a condition assessment of the louver system to see if there were damaged louvers or other openings along the bottom that would allow eels to pass through rather than leading along the louvers. Such a condition assessment and repairs will be carried out when the channel is dewatered for the dam construction. A solid wall along this bottom will correct any potential issue of louvers damaged at the bottom but all bent or otherwise damage louvers must be repaired.

5) Additional eel passage monitoring studies are recommended following the modifications suggested above. When these studies are done it is suggested that some eels be released in the channel downstream of the power canal trash racks and some above to determine the effect of the trash racks on passage and calculated louver efficiency. There are suggestions in the literature (Piper 2015) that a portion of the migrating eels would be deterred by the trash racks and seek other ways downstream. Receivers should also be placed in the fishway as the bars on the trap allow for eels to pass downstream and by any gate openings to see if they are using other routes. The current dam has leakage and some spill from stop log sections high on the dam that may have provided an attraction and possible downstream passage for eels. The new dam will have minimal leakage, but it will have bottom outlets in the spill gates that will be very attractive to the eels for downstream passage being both a concentrated flow and at the bottom. This route and the fishway should monitor for downstream passage in future studies.

6) The louvers are the best downstream passage design to guide fish to a surface outlet. There are some weaknesses in the current design for benthic species like the eels and the retaining fish in the bypass channel. The modifications proposed here will correct these weaknesses. The modifications will greatly improve eel downstream passage and passage for all other species as well bringing the system up to new standards.



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APPENDIX I – Upstream Eel Passage

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To: Kailey Osborne, BMgmt, EP
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Nova Scotia Power

January 31, 2023

Re: Concept Design Report - Upstream Eel Passage at the Proposed Refurbished Dam at Ruth Falls

1. Introduction

NSPI requested a concept design be developed for upstream eel passage at the proposed refurbished dam at Ruth Falls. This is an update of the November 2020 report.

2. Eel Behaviour

American eel (Anguilla rostrata) elvers migrate upstream from the ocean in the spring and can continue until fall. The older yellow eels may move repeatedly, irregularly, or seasonally, between freshwater and marine habitat and may continue to move upstream for several years after entering freshwater (Jessop, B.M., 2003). They tend to swim along the bottom but do swim up into the water column occasionally. They have average swimming ability but have strong burst or sprint swimming speeds (Langdon, S.A., 2000). Small eels can climb wet surfaces if they are rough or covered with algae or moss and do pass through some technical fishways particularly pool and weir design where there is a skim of water over algae or moss-covered weirs. They normally move at night but can be seen at any time-of-day swimming short distance of a few meters at a time through the higher velocities to resting areas and congregating in very low velocity areas. Eels start migration behaviours at temperatures above 10^0 C. Therefore, the eel pass will need to operate whenever the water temperatures are at or above 10^0 C to accommodate these movements. (Haro, A. 2013) (Shepard, S.L. 2015)

3. Modern Eel Passes

Generally, technical upstream fishways, such as fish ladders and fish lifts, are ineffective at passing juvenile eels. Therefore, specialized eel pass structures are required to provide a path for them over the dam (Vowles,2015) (Padgett 2020). Larger eels can use typical pool and weir fishways of the design currently in place at Ruth Falls and are often found living in them.

Modern eel passes consist of linear metal, plastic, or wooden channels lined with climbing substrate, and equipped with a pumped water flow and, in some cases, additional attraction water. Eels utilize the wetted substrate to propel themselves up the ramp. In this case, a metal enclosed box similar to that shown in figure 3 is used to protect the eels from predators and keep the pass dark. The entrance is uncovered to allow entrance between high and low tail water levels expected for durations of more than a couple of days at a time so neither short term extreme water levels need to be accommodated.

4. Eel Pass at Ruth Falls

4.1 General

A modern eel pass will be an effective option for upstream passage of eels at the re-constructed Ruth Falls dam. The location of the eel pass entrance at Ruth Falls is dependent on the flow patterns along the bottom below the refurbished dam under the various spill flow regimes.

4.2 Flow Conditions

Hydraulic modeling was used to identify flow patterns, velocities, and depths, downstream of the dam that support fish passage (including eels) under various flow scenarios. The results of this flow modelling have been used to determine the best location for the eel pass entrance which must be located at the most upstream point that the elvers and young yellow stage eels can reach. (Solomon, D. J. 2004) (Watz J. 2019)

The modeling shows the eels will have the ability to move along both banks and along the bottom, across the whole river where the uneven bottom creates low velocities and resting areas every few meters. These areas are coloured blue on Figure 1. There was a general bathymetry of the river bottom below the dam in the physical model, so it does not show this fine scale roughness the eels use to travel along the bottom and along the banks. However, the main travel routes will be along the banks as they move short distance using burst speed between the cobbles and boulders.

The eels will come up along both banks in the dark blue-coloured currents. Both banks will have generally equal numbers of eels as the passage is divided by the naturally high velocities across bedrock sills in the river below which they cannot cross due to the smooth bedrock surfaces. Along both banks there is cobble and boulder substrate and shallow flows the eels will use. Along the left bank they continue upstream to large blues are they can rest before following slow currents to the fishway entrance. Those coming up the right bank also come into the blue area suitable for resting and follow the bottom currents toward the gates and over to the fishway. Most of those coming up this right bank will distribute through the rearing area so that the majority are expected to be following the flow from the fishways as it joins the gate flows diagonally across this area and has an influence along the bottom.

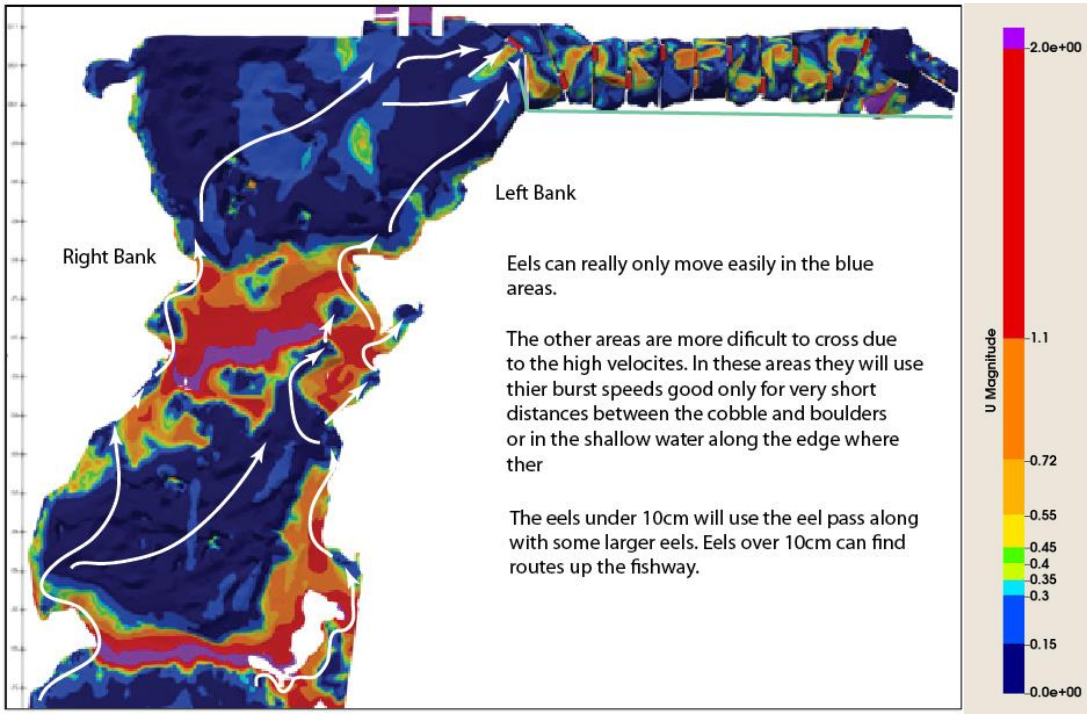


Figure 1: Bottom flow patterns (coloured by velocity) below the refurbished dam.

4.3 Concept Design

As previously noted, for upstream eel passage at the refurbished Ruth Falls dam, it is recommended to use a modern eel pass. The modern eel pass will consist of a covered linear metal, plastic or wooden channel lined with climbing substrate, and equipped with pumped water. The features / modifications of the suggested option are:

1) Louver flow going down a re-designed baffled fishway channel along the toe of the dam

2) Removal of the boulder in front of the spill gate to allow this flow to move straight downstream or be directed more to the right bank and smoothing of the bathymetry in front of the fishway entrance toward the gate flow.

3) The distribution of the gate flow between the three gates in a, 20, 40, 5cfs distribution to reduce the back eddies and provide currents that leads the eels and other fish to the fishway or as needed based on observation following the dam refurbishment.

The flow modelling shows the most appropriate location for eel pass entrance will be immediately downstream of the fishway channel lowest outlet notch on the left bank.

The eel pass, shown as a green line in Figure 2, is the most appropriate route under all scenarios that were considered. It is the only good location of the entrance segment. As shown in Figure 2, the lower segment will rise quickly to the height of the bank and then run on a very low slope to the corner of the concrete fishway. From there, it will turn to run along the left wall of the fishway to the head pond.

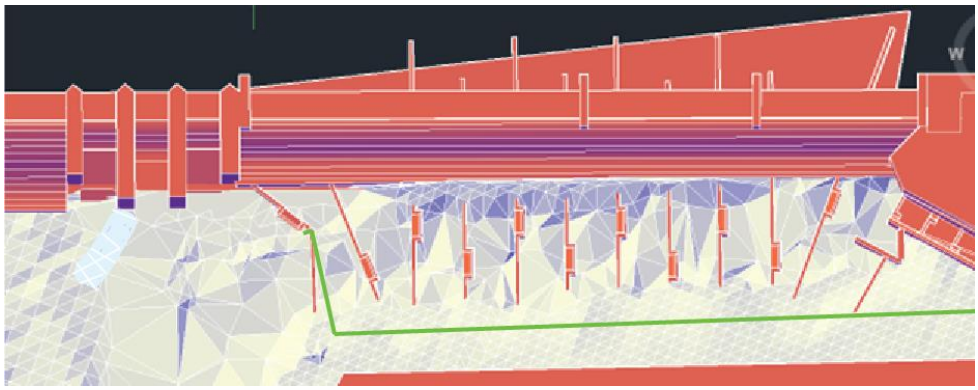


Figure 2: Eel Pass Route

The pass will be enclosed and use eel tiles by Aquatic control, https://www.aquaticcontrol.co.uk/products/eel-passes or Barry and Escott https://www.berryescott.co.uk/eel-tiles, and follow the USFW engineering guide for slope, climb heights and distances between resting areas, water supply design and drop into the head pond. Typical photos of an eel pass using the proposed design are shown as figures 3 to 6.

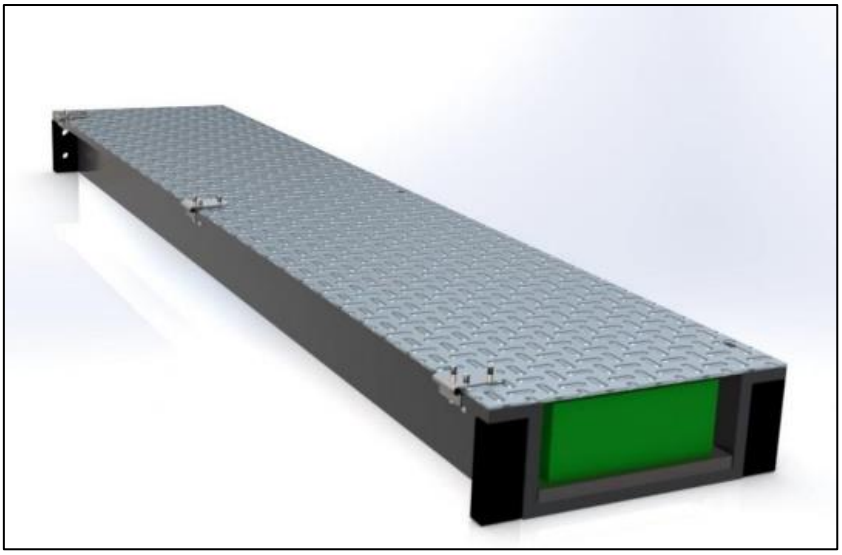


Figure 3: Aquatic enclosed eel pass box



Figure 4: Barry Escott eel boards for elvers and small yellow stage eels. good for eels 50mm to 500mm+ long



Figure 5: A typical design of an enclosed eel pass



Figure 6: An eel using the peg style substrate.

4.4 Design Criteria

To meet the USFW service recommendations, the final design will include:

- Construction Materials:
  - Ramps, pools, and supporting structural elements will be built of rust-resistant metal (typically aluminum) or UV-stable plastic for permanent facilities
- Cover:
  - To minimize predation, a fully secured, opaque cover on the entire unsubmerged length of ramp (and resting sections) the cover will remain open at the entrance below high-water level to allow entry at the water surface.
- Entrance:
  - The following specifications apply to the lower most end of the eel ramp:
    - The entrance will be matched to the surface upon which it rests; this may necessitate shaping the entrance lip to meet an irregular bedrock surface or providing a level sill upon which the entrance invert may rest and will be designed to the specific site chosen.
    - The final location of the entrance will be determined upon completion of the as built fishway and river bottom.
    - The entrance will be uncovered up to the maximum tailwater elevation so that eels may enter at any depth.
    - The entrance will be assessed for the need to be equipped with fencing, netting or other material to guard against predation by birds and carnivorous mammals.
- Climbing substrate:
  - Will run down through the entrance to the minimum tailwater elevation
- Exit: the following specifications apply to the upstream terminal end of the eel ramp:
  - Elevation: the ramp will be well above the fluctuations in headpond levels

- Location: the exit is situated at the head pond between the fishway exit and the utility shed away from turbine intakes, spill gates, and spillways and other structures that may entrain eels.

- Ramp: the following specifications apply to the sloped ramp channel:
  - Height: 6 in. high sidewalls.
  - Width: two tiles wide 3ft 4in wide
  - Length: dependent on slope; uninterrupted runs (i.e., without resting/turning pool) of sloped ramp will not exceed 10 vertical feet; total sloped length without resting pools will be less than 100 feet.
  - Slope: slopes will be 45 degrees or less on the entrance section of the ramp. The second section is very low slope then a 10% slope along the fishway.
  - Depth of Water: ramp will always remain wetted across the surface; depth is dependent on ramp width, flow, slope and influenced by substrate; 1/8 in. of water should be maintained across a flat ramp; flows can be adjusted to provide water depths up to 70mm were needed.
- Resting Section: the following specifications apply to the resting area in the ramp. Turns in the ramp layout will serve as resting pools designed to this standard:
  - Placement: a minimum of one horizontal resting section (resting pool) per 10 vertical feet of ramp.
  - Width: equal to ramp width.
  - Length: equal to the pool width, or longer.
  - Depth of Water: at least 1 inch of water should be maintained in resting pools; to accommodate uniform depth, the resting pools floors may need to be level and deeper than ramp sections to which they are connected.

5. Conclusions

1) The young eels cannot effectively use the pool and weir fishway and require an eel pass to facilitate passage.
2) A modern eel pass will be used at Ruth Falls, following the alignment shown in Figures 1 and 2.
3) The entrance will be on the downstream side, adjacent to the fishway that will provide attraction flow and on the adjacent bank below the low water level.
4) The design criteria for eel passes are set out in the USFW 2019 “Fish Passage Engineering Design Criteria” and will be followed in the detailed engineering design using tiles that have been specifically designed for eels 2 inches (5cm) and up to a size that can use the pool and weir fishway.



Bob Rutherford
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APPENDIX J – Communication Plan

Nova Scotia POWER
An Emera Company

COMMUNICATION PLAN

Ruth Falls Main Dam Refurbishment Project

NSE Application #2019-2638165-00

Revision 2: February 8, 2023

Ruth Falls Main Dam Refurbishment Project Communication Plan

Purpose

Nova Scotia Power (NS Power) is committed to proactively communicating and engaging with community stakeholders, the Mi'kmaq, regulators and the public on the Ruth Falls Main Dam Refurbishment Project (Project). This document is a high-level overview of NS Power's plan for engaging and communicating with the Provincial government, Mi'kmaq and stakeholders regarding 2022 construction activities for the Project. The plan has been prepared as part of NSE Application # 2019-2638165-00

Overview

The Sheet Harbour Hydro system, including generation at Malay Falls and Ruth Falls has been providing clean, renewable electricity to Nova Scotians for nearly one hundred years. The system requires maintenance and upgrades to ensure safe and reliable electricity for many years to come. Nova Scotia Power plans to refurbish the Ruth Falls Main Dam starting in the spring of 2022. The refurbishment will include the replacement of 30 stoplog bays - which adjust water levels in the reservoir - with rubber inflatable dams along the crest of the dam. It also includes replacing 3 deep stoplog bays with sluice gates. To do this safely, NS Power would lower Ruth Falls headpond to pre-inundation conditions.

There are two phases of work associated with the dam refurbishment. The first phase included the installation of the rubber dam control building which was complete in September 2022. Now that this phase of work is complete – all future work will be referred to as the Ruth Falls main dam refurbishment.

NS Power is currently in the regulatory permitting process for the main dam refurbishment, A Fisheries Authorization from DFO (Department of Fisheries and Oceans) and a Watercourse Alteration Approval from NSECC (NS Environment and Climate Change) is required to start any in-stream work. In order to do the work in the safest manner, the Ruth Falls headpond will be temporarily lowered by approximately 18 feet to which is an elevation of 91 feet. This would allow for a dry construction area. The reservoir would remain lowered for approximately 9 months. Pending Permits and approvals, this work is expected to start in July 2024.

Another aspect of this project involves a habitat offsetting project to support recovery efforts of Atlantic Salmon, as part of NS Power's regulatory permitting process. There has been ongoing restoration work on the West River Sheet Harbour to improve Atlantic salmon habitat and restore salmon migration, including significant investment into acid rain mitigation and previous instream habitat restoration. Building on the previous recovery efforts, Nova Scotia Power is partnering with the Mi'kmaw Conservation Group (MCG) and NS Salmon Association on a 7-year habitat offsetting project on the West River Sheet Harbour. The project includes the restoration of a section of the West River to contribute to overall improvements to habitat conditions and fish migration to the upper reaches of the watershed.

There continues to be ongoing engagement between NS Power, the MCG and Millbrook First Nation throughout the planning and implementation of the habitat offsetting program to ensure the community is able to provide input into the program and is aware of any employment opportunities.

Engagement Goals

NS Power's engagement goals are to:

- develop relationships and collaborate with stakeholders, local and Mi'kmaq communities.
- provide accurate and timely Project information that is accessible and easy to understand.
- provide a forum for the exchange of information and dialogue between NS Power, stakeholders and the Mi'kmaq to understand and address areas of interest and potential concerns.

Key Stakeholders and Mi'kmaq Groups

The target audiences and key stakeholders are identified with the associated team member's responsibility to meaningfully engage and communicate relevant Project information.

Elected officials/Municipalities

- Member of Parliament (MP) for central Nova Scotia
- Municipality of the District of Guysborough Eastern-Shore government representatives and key staff
- MLA for the Municipality of the District of Guysborough Eastern-Shore
- Councillor of Preston-Chezzetcook-Eastern-Shore-HRM

Homeowners/Local Residents

- Local community residents on who live/recreation on Ruth Falls head pond
- Local businesses

Mi'kmaq

- Local Mi'kmaq communities, including Millbrook First Nations and the KMKNO

Fishers/Fishing Associations

- Local fishing and recreational associations
  - NS Salmon Association
  - Mi'kmaw Conservation Group
- Regulators, including Nova Scotia Environment (NSE), Department of Fisheries and Oceans (DFO) and Transport Canada (TC)

Engagement Plan

The tables below detail the method and frequency of engagement.

Stakeholder	Contact	Website	Method	Frequency 1	Frequency 2	Frequency 3
Member of Parliament (MP) for Central Nova	Sean Fraser sean.fraser@parl.gc.ca 902-735-7103	Member of Parliament for Central Nova	Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration. In-person meeting with MP, as required.	May 2022	June 2022	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca

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Municipality of the District of Guysborough Council	Fin Armsworthy 902-533-370	Municipality of the District of Guysborough	Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration. In-person meeting with Mayor and Council, as required.	May 2022	June 2022	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca
MLA for Guysborough, Eastern Shore - Tracadie Honorable Greg Morrow	gregmorrow4gt@gmail.com 902-533-2777	Honourable Greg Morrow	Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration. Offer to meet in-person.	May 2022	June 2022	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca

Ruth Falls Main Dam Refurbishment Project
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Stakeholder	Contact	Website	Method	Frequency 1	Frequency 2	Frequency 3
Local residents / property-owners community residents who live / recreation of the Ruth Falls Head Pond	Identify sheet harbour/area residents (larger community) through Canada Post/Postal Code.	N/A	In person delivery of communication notice to property owners whose property is situated along the Ruth Falls Head Pond. Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration.	May 2022	June 2022	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca
Local businesses	Identify sheet harbour/area residents (larger community) through Canada Post/Postal Code.	N/A	Provide communication notice letter via mail to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration.	May 2022	June 2022	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca

Stakeholder	Contact	Website	Method	Frequency	Frequency 2
Nova Scotia Salmon Association (NSSA)	mailto:info@nssalmon.ca	Nova Scotia Salmon Association	Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration.	Ongoing	NSP will update all stakeholders once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca
Mi'kmaw Conservation Group (MCG)	Alyx MacDonald mailto:amacdonald@mikmawconservation.ca	Mi'kmaw Conservation Group	Communications to advise of the Ruth Falls Head Pond	Ongoing	NSP will update all stakeholders once permits are

			drawdown and associated construction activities including expected timeframes and duration.		in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca

Mi'kmaq Community	Contact	Website	Method	Frequency	Frequency 2
Millbrook First Nation and KMKNO	Millbrook First Nation & KMKNO distribution lists.	KMKNO Millbrook First Nation	Communications to advise of the Ruth Falls Head Pond drawdown and associated construction activities including expected timeframes and duration.	Ongoing	NSP will update the Mi'kmaq community once permits are in place. A project email has been provided for reach out at anytime. ruthfallsmaindam@nspower.ca

APPENDIX K – Fish Passage Detailed Designs

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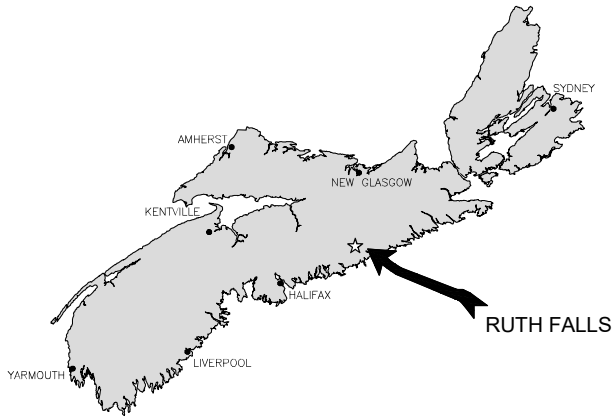
DWG. NO. H096H1-1-620-00-0011

RUTH FALLS

FISHWAY MODIFICATIONS

Nova Scotia POWER
An Emera Company

LIST OF DRAWINGS		
NOVA SCOTIA POWER DWG NO.	DRAWING TITLE	ISSUE / REVISION
H-096H1-1-620-00-011	FISHWAY MODIFICATIONS – COVER SHEET	A
H-096H1-1-620-00-012	FISHWAY MODIFICATIONS – GENERAL NOTES	A
H-096H1-1-620-00-013	FISHWAY MODIFICATIONS – EXISTING CONDITIONS, GENERAL ARRANGEMENT	A
H-096H1-1-620-00-014	FISHWAY MODIFICATIONS – EXISTING CONDITIONS, FISHWAY – PLAN	A
H-096H1-1-620-00-016	FISHWAY MODIFICATIONS – GENERAL ARRANGEMENT PLAN	A
H-096H1-1-620-00-017	FISHWAY MODIFICATIONS – CHANNEL FISHWAY – PLAN AND SECTIONS	A
H-096H1-1-620-00-018	FISHWAY MODIFICATIONS – CHANNEL FISHWAY – CROSS SECTIONS	A
H-096H1-1-620-00-019	FISHWAY MODIFICATIONS – CHANNEL FISHWAY – SECTIONS AND DETAILS	A
H-096H1-1-620-00-020	FISHWAY MODIFICATIONS – FISH BYPASS – PLAN AND SECTIONS	A
H-096H1-1-620-00-021	FISHWAY MODIFICATIONS – FISH BYPASS – SECTIONS AND DETAILS	A
H-096H1-1-620-00-022	FISHWAY MODIFICATIONS – UPSTREAM EEL PASSAGE – PLAN AND SECTIONS	A
H-096H1-1-620-00-023	FISHWAY MODIFICATIONS – UPSTREAM EEL PASSAGE – SECTIONS AND DETAILS	A



PROJECT LOCATION

0 50 100
Kilometres

ISSUED FOR PERMIT

2023-05-05

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS | DWG.NO.

SEAL

ISSUED FOR PERMIT
DATE: 2023-05-05

JOB No. 254103

DEPARTMENTAL APPROVALS
CIVIL | E & I
MECH | CONST

APPROVED
DATE MAY 2023

REFERENCE NO.
SCALE As Noted
UNITS Imperial
DESIGNED EO
DRAWN CC
CHECKED AC
CHECKED EO
DATE 2023-05-03
W.O.

wood.
Nova Scotia POWER An Emera Company
RUTH FALLS
FISHWAY MODIFICATIONS
COVER SHEET
H096H1-1-620-00-0011 REV. A

REDACTED (CONFIDENTIAL INFORMATION REMOVED)

CI 50518 CA IR-5 Attachment 21 Page 426 of 465

DWG. NO. H096H1116200001202

GENERAL NOTES

1. DRAWINGS ARE NOT TO BE SCALED. ONLY FIGURED DIMENSIONS TO BE FOLLOWED.
2. ALL DIMENSIONS ARE IN FEET AND INCHES UNLESS NOTED OTHERWISE.
3. ELEVATIONS ARE SHOWN IN FEET.
4. ELEVATIONS SHOWN ARE TO CGVD 2013. TOPOGRAPHIC SURVEY INFORMATION IS BASED ON FIELD SURVEY PERFORMED BY TALISMAN TECHNICAL SOLUTIONS IN NOVEMBER, 2022.
5. COORDINATES AND ELEVATIONS SHOWN ARE TO THE NOVA SCOTIA CONTROL COORDINATE SYSTEM, WGS72, MODIFIED TRANSVERSE MERCATOR, ZONE 5.
6. DESIGN BASED ON INFORMATION RECEIVED TO DATE. DESIGN TO BE CONFIRMED PRIOR TO CONSTRUCTION.
7. REFER TO THE PROJECT SPECIFICATIONS. IF THERE IS A CONTRADICTION BETWEEN THE DRAWINGS AND THE SPECIFICATIONS, THE MORE STRINGENT OF THE TWO SHALL APPLY IN CONSULTATION WITH THE OWNER AND ENGINEER.
8. THE CONTRACTOR SHALL VERIFY ALL CONDITIONS AND MEASUREMENTS AT THE SITE AND REPORT TO THE ENGINEER ANY DISCREPANCIES OR UNSATISFACTORY CONDITIONS WHICH MAY ADVERSELY AFFECT THE PROPER COMPLETION OF THE PROJECT BEFORE PROCEEDING WITH WORK.
9. THE CONTRACTOR IS TO ASSUME FULL RESPONSIBILITY FOR THE INTEGRITY OF THE STRUCTURE DURING CONSTRUCTION.
10. ELEVATION OF BEARING SURFACES TO BE CONFIRMED IN THE FIELD. REPORT ANY DISCREPANCIES TO ENGINEER PRIOR TO PROCEEDING WITH THE WORK.
11. THE CONTRACTOR TO STORE AND HANDLE ALL MATERIALS IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS AND OWNER'S INSTRUCTIONS.
12. THE CONTRACTOR TO REINSTATE ALL AREAS AFFECTED BY NEW CONSTRUCTION TO THEIR ORIGINAL CONDITION TO THE SATISFACTION OF THE ENGINEER.
13. SHOP DRAWING(S) AND DETAILS OF CONCRETE MIX DESIGN TO BE SUBMITTED TO ENGINEER FOR REVIEW. SHOP DRAWINGS TO BE STAMPED AND SIGNED BY A PROFESSIONAL ENGINEER LICENSED IN THE PROVINCE OF NOVA SCOTIA, CANADA. SHOP DRAWINGS WILL BE REVIEWED AND RETURNED TO CONTRACTOR WITHIN 14 DAYS.
14. SUBMIT ERECTION/SHOP DRAWINGS INDICATING DETAILS AND INFORMATION NECESSARY FOR ASSEMBLY AND ERECTION PURPOSES.
15. SUBSTITUTION REQUESTS FOR ALTERNATIVE PRODUCTS OR METHODS MUST BE APPROVED IN WRITING BY THE STRUCTURAL ENGINEER PRIOR TO USE. CONTRACTOR SHALL PROVIDE, AT THEIR EXPENSE, CALCULATIONS DEMONSTRATING THAT THE SUBSTITUTED PRODUCT MEETS OR EXCEEDS THE PERFORMANCE CAPACITIES OF THE SPECIFIED PRODUCT.
16. ALL PRODUCTS TO BE INSTALLED AS PER MANUFACTURER'S INSTRUCTIONS.
17. WORK SHALL CONFORM TO THE NATIONAL BUILDING CODE OF CANADA AND ITS SUPPLEMENTS, AND THE NOVA SCOTIA BUILDING CODE.
18. MINIMUM REQUIRED BEARING CAPACITY OF 3000 PSF UNDER ALL CONCRETE STRUCTURES.
19. FOUNDATIONS BEARING SURFACE TO BE APPROVED BY ENGINEER PRIOR TO PLACING CONCRETE.
20. ENGINEERED FILL TO BE AN IMPORTED, WELL GRADED MATERIAL (GRANULAR A) FREE OF DEBRIS, ORGANIC OR DELETERIOUS MATERIAL. IT SHALL NOT CONTAIN ROCKS OR LUMPS OVER 4 INCHES IN GREATEST DIMENSION AND IT SHALL CONTAIN NOT MORE THAN 8% PASSING THE 200mm SIEVE. ENGINEERED FILL SHALL BE PLACED IN MAX 6 INCH LIFTS AND COMPACTED TO 98% SPMDD.

CONCRETE NOTES

1. UNLESS OTHERWISE SHOWN, THESE NOTES ARE TYPICAL FOR ALL CONCRETE DRAWINGS.
2. FOR CONCRETE SPECIFICATIONS, REFER TO THE RUTH FALLS FISHWAY MODIFICATIONS PROJECT TECHNICAL SPECIFICATION". IF THERE IS A CONTRADICTION BETWEEN THE DRAWINGS AND SPECIFICATIONS, THE MORE STRINGENT OF THE TWO SHALL APPLY.
3. CONCRETE MATERIALS, TESTING AND WORKMANSHIP TO CONFORM CSA STANDARDS A23.1/A23.2, LATEST EDITION.
4. CONCRETE TO MEET THE FOLLOWING PERFORMANCE CRITERIA:
   a. 28 DAY MINIMUM COMPRESSIVE STRENGTH OF 30 MPa
   b. DURABILITY AND CLASS OF EXPOSURE: F-1
   c. ONLY USE AGGREGATE THAT IS NON-REACTIVE. AGGREGATE SUSCEPTIBLE TO AAR IS NOT PERMITTED.
5. CONCRETE COVER ON REINFORCING STEEL: (UNLESS NOTED OTHERWISE)
   a. EXPOSED TO FLOWING WATER: 4 INCHES
   b. EXPOSED TO WATER: 3 INCHES
   c. CAST AGAINST FILL OR BEDROCK: 3 INCHES
   d. CAST AGAINST FORMS: 2 INCHES
6. WATERSTOPS:
   a. TYPE 1: HYDROTITE CJ 0725 HYDROPHILIC WATERSTOP. INSTALL IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. MAINTAIN A MINIMUM EDGE DISTANCE TO CONCRETE OF 4" UNLESS NOTED OTHERWISE.
   b. TYPE 2: LEAKMASTER HYDROPHILIC WATERSTOP ADHESIVE MANUFACTURED BY HYDROTITE. INSTALL IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
   c. ALL WATERSTOPS TO BE MADE CONTINUOUS
7. CONCRETE TO BE PLACED IN THE DRY.
8. USE HIGH FREQUENCY VIBRATOR TO PLACE ALL CONCRETE. VIBRATION SHALL BE IN ACCORDANCE WITH CSA A23.1 / A23.2.
9. PROVIDE ACCURATE RECORDS OF POURED CONCRETE ITEMS INDICATING DATE AND TIME, LOCATION OF POUR, QUALITY, AIR TEMPERATURE AND TEST SAMPLES.
10. MIX, DELIVER TO SITE OF WORK AND DISCHARGE CONCRETE WITHIN 120 MINUTES MAXIMUM AFTER BATCHING.
11. INSPECTION AND TESTING OF CONCRETE AND CONCRETE MATERIALS WILL BE CARRIED OUT BY TESTING LABORATORY DESIGNATED BY OWNER.
12. REINFORCING STEEL TO BE DEFORMED NEW BILLET STEEL WITH A MINIMUM YIELD STRENGTH OF 400 MPa. REINFORCING STEEL TO CONFORM TO THE LATEST RELEVANT CSA STANDARDS INCLUDING, BUT NOT LIMITED TO:
   a. CSA G30.18 CARBON STEEL BARS FOR CONCRETE REINFORCEMENT
   b. CSA G40.20/G40.21 GENERAL REQUIREMENTS FOR ROLLED OR WELDED STRUCTURAL QUALITY STEEL/STRUCTURAL QUALITY STEEL.
13. REINFORCING STEEL TO BE FREE OF LOOSE MILL SCALE, LOOSE RUST AND FOREIGN MATERIAL.
14. UNLESS NOTED OTHERWISE REINFORCING STEEL TO BE SPLICED AS FOLLOWS:
   a. ALL SPLICES TO BE TENSION LAP SPLICES, CLASS "B".
   b. NO MORE THAN 50% OF THE REINFORCING TO BE SPLICED AT ANY GIVEN LOCATION U.N.O.
15. ALL REINFORCEMENT BENDS TO BE STANDARD BENDS UNLESS NOTED OTHERWISE.
16. DO NOT FIELD BEND REINFORCEMENT EXCEPT WHERE INDICATED OR AUTHORIZED BY ENGINEER. WHEN FIELD BENDING IS AUTHORIZED, BEND WITHOUT HEAT, APPLYING SLOW AND STEADY PRESSURE. REPLACE BARS WHICH DEVELOP CRACKS OR SPLITS.
17. REINFORCING STEEL, EMBEDDED PARTS, ANCHOR RODS, DOWELS ETC. TO BE SECURED IN POSITION PRIOR TO PLACING CONCRETE.
18. SET ANCHOR RODS, SLEEVES AND OTHER MISCELLANEOUS ITEMS EMBEDDED IN CONCRETE AS SHOWN ON DRAWING. IF INSERTS CANNOT BE LOCATED AS SPECIFIED, OBTAIN APPROVAL BEFORE PLACING.
19. CAST-IN-PLACE ANCHORS SHALL BE HELD SECURELY IN POSITION WITH TEMPLATES.
20. REINFORCING STEEL TO BE INSPECTED BY THE ENGINEER PRIOR TO CLOSING THE FORMS.
21. ENSURE COVER TO REINFORCEMENT IS MAINTAINED DURING CONCRETE POUR/PLACEMENT.
22. ALL EXPOSED CORNERS SHALL HAVE A MINIMUM CHAMFER OF 1", UNLESS NOTED OTHERWISE.
23. GROUT TO BE SIKAGROUT – 212 HP, OR BASF MASTERFLOW 928, OR APPROVED EQUIVALENT.

CONCRETE FORMING NOTES

1. CONCRETE FORMWORK TO CONFORM TO THE LATEST RELEVANT CSA STANDARDS. INCLUDING, BUT NOT LIMITED TO:
   a. CSA S269.1 FALSEWORK AND FORMWORK
   b. CSA O86 ENGINEERING DESIGN IN WOOD
   c. CSA A23.1/A23.2 CONCRETE MATERIALS AND METHODS OF CONCRETE CONSTRUCTION
   d. CSA O121 DOUGLAS FIR PLYWOOD
   e. CSA O153 POPLAR PLYWOOD
   f. CSA O151 CANADIAN SOFTWOOD PLYWOOD
2. FORMWORK MATERIALS TO BE WOOD AND WOOD PRODUCT MATERIALS CONFORMING TO CSA O121, CSA-O86 AND CSA O153, LATEST EDITIONS.
3. FORM LINER MATERIAL TO BE PLYWOOD CONFORMING TO CSA O151.
4. FORM RELEASE AGENT: NON-TOXIC, BIODEGRADABLE, LOW VOC.
5. BEFORE PLACEMENT OF CONCRETE, FORMWORK SHALL BE CLEANED IN ACCORDANCE WITH CSA A23.1/A23.2, LATEST EDITION.

STEEL NOTES

1. STRUCTURAL STEEL TO CONFORM TO THE LATEST RELEVANT CSA STANDARDS. INCLUDING, BUT NOT LIMITED TO:
   a. CSA S16 DESIGN OF STEEL STRUCTURES
   b. CSA G40.20/G40.21 GENERAL REQUIREMENTS FOR ROLLED OR WELDED STRUCTURAL QUALITY STEEL/STRUCTURAL QUALITY STEEL
   c. CSA G164 HOT DIP GALVANIZING OF IRREGULARLY SHAPED ARTICLES
   d. CSA W48 FILLER METALS AND ALLIED MATERIALS FOR METAL ARC WELDING
   e. CSA W59 WELDED STEEL CONSTRUCTION
2. ERECT STRUCTURAL STEEL AS INDICATED AND IN ACCORDANCE WITH CSA-S16 AND IN ACCORDANCE WITH REVIEWED ERECTION DRAWINGS.
3. FIELD CUTTING OR ALTERING STRUCTURAL MEMBERS TO THE APPROVAL OF THE ENGINEER.
4. CLEAN WITH A MECHANICAL BRUSH AND TOUCH UP SHOP PRIMER TO BOLTS, WELDS AND BURNED OR SCRATCHED SURFACES AT COMPLETION OF ERECTION.
5. FABRICATOR TO DESIGN CONNECTION DETAILS.
6. DESIGN DETAILS AND CONNECTIONS IN ACCORDANCE WITH REQUIREMENTS OF CSA-S16 TO RESIST FORCES, MOMENTS, SHEARS AND ALLOW FOR MOVEMENTS INDICATED.
7. MATERIALS:
   a. STRUCTURAL STEEL IN ACCORDANCE WITH CSA G40.20/G40.21 GRADE 350W.
   b. ANCHOR RODS IN ACCORDANCE WITH CSA G40.20/G40.21 GRADE 300W UNLESS NOTED OTHERWISE.
   c. STRUCTURAL BOLTS IN ACCORDANCE WITH ASTM F3125/F3125M, GRADE A325M, GALVANIZED.
   d. NUTS SHALL BE HEAVY HEX NUTS IN ACCORDANCE WITH ASTM A563, GALVANIZED.
   e. WASHERS SHALL BE HEAVY DUTY HARDENED WASHERS IN ACCORDANCE WITH ASTM F436/F436M, GALVANIZED.
   f. WELDING MATERIALS IN ACCORDANCE WITH CSA W48 AND CSA W59, BY A COMPANY CERTIFIED BY THE CANADIAN WELDING BUREAU UNDER THE REQUIREMENTS OF CSA W47.1 (DIVISION 1 OR DIVISION 2).
   g. SHOP PAINT PRIMER IN ACCORDANCE WITH CISC/CPMA 2-75 SOLVENT REDUCIBLE ALKYD, GREY.
   h. HOT DIP GALVANIZING IN ACCORDANCE WITH ASTM A123/A123M AND ASTM A153/A153M.
8. FABRICATE STRUCTURAL STEEL IN ACCORDANCE WITH CSA-S16 AND IN ACCORDANCE WITH REVIEWED SHOP DRAWINGS.
9. CLEAN, PREPARE SURFACES AND SHOP PRIME STRUCTURAL STEEL IN ACCORDANCE WITH CSA-S16 EXCEPT WHERE MEMBERS TO BE ENCASED IN CONCRETE.
10. APPLY PAINT AND OTHER COATINGS UNDER COVER, ON DRY SURFACES IN STRICT ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
11. UNLESS NOTED OTHERWISE, ALL STRUCTURAL STEEL, INCLUDING HANDRAILS AND BASE PLATES SHALL BE GALVANIZED.
12. GRATING TO BE SECURED TO SURFACE OF CONCRETE USING HOLD DOWN CLIPS.

ENVIRONMENTAL NOTES

1. ALL CONSTRUCTION SHALL BE DONE IN THE DRY CONDITION.
2. MEASURES SHALL BE TAKEN TO PREVENT MATERIALS SUCH AS FRESH CONCRETE, CEMENT AND CONSTRUCTION DEBRIS FROM ENTERING ANY WATERCOURSE. ALL CONSTRUCTION DEBRIS AND DEMOLISHED MATERIALS WILL BE DISPOSED OF IN ACCORDANCE WITH NSECC WASTE DISPOSAL SITE REGULATIONS.
3. ALL EQUIPMENT AND MACHINERY OPERATED ON OR NEAR A BODY OF WATER WILL BE MECHANICALLY SOUND WITH NO LEAKING FUEL TANKS OR HYDRAULIC CONNECTIONS. FUEL STORAGE, REFUELING AND LUBRICATION SHALL BE COMPLETED IN ACCORDANCE WITH THE SITE'S ENVIRONMENTAL PROTECTION PLAN. MACHINERY AND EQUIPMENT WILL BE STORED ABOVE FLOOD WATER LEVELS.
4. ALL WORK OPERATIONS WILL BE CONDUCTED WITH MEASURES TAKEN TO CAUSE A MINIMUM OF SILTATION AND DISRUPTION TO ADJACENT AND DOWNSTREAM AREAS.

ABBREVIATIONS

ABUT.	ABUTMENT
APPROX.	APPROXIMATE
BP	BASEPLATE
C/L, ℄	CENTERLINE
C/C	CENTER TO CENTER
C.J	CONTROL JOINT
C/W	COMPLETE WITH
COL.	COLUMN
D/S	DOWNSTREAM
DIA.	DIAMETER
DWG	DRAWING
EL.	ELEVATION
EQ	EQUAL
EW	EACH WAY
FDN	FOUNDATION
FIN.	FINISHED
HOR.	HORIZONTAL
I.W.O.	IN WAY OF
O.A.L.	OVERALL LENGTH
O.D.	OUTSIDE DIAMETER
LG	LONG
MIN	MINIMUM
MAX	MAXIMUM
PL	PLATE
HORIZ.	PROJECTION
R	RADIUS
REINF.	REINFORCEMENT
REF	REFERENCE
REQ'D	REQUIRED
STIFF.	STIFFENER
THK	THICK
T.D.	TOP OF
TOC	TOP OF CONCRETE
TOG	TOP OF GRATING
TOS	TOP OF STEEL
T&B	TOP AND BOTTOM
TYP.	TYPICAL
U/S	UPSTREAM
UNO	UNLESS NOTED OTHERWISE
VERT.	VERTICAL
WP	WORKING POINT

PRELIMINARY
NOT FOR CONSTRUCTION

EXISTING CONDITIONS – GENERAL ARRANGEMENT
REFERENCE DRAWINGS: H096E200001203

REV.	BY	CHK.	MECH. E. & I.	CONST.	DWG.
A					

ISSUED FOR PERMIT
DATE: 2023-05-05
M. EO AC

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS

CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE	MAY 2023	

REFERENCE NO.

SCALE: As Noted
UNITS: Imperial
DESIGNED: EO
DRAWN: CC
CHECKED: AC
CHECKED: EO
DATE: 2023-05-03
W.O.

wood.

Nova Scotia POWER An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS
GENERAL NOTES

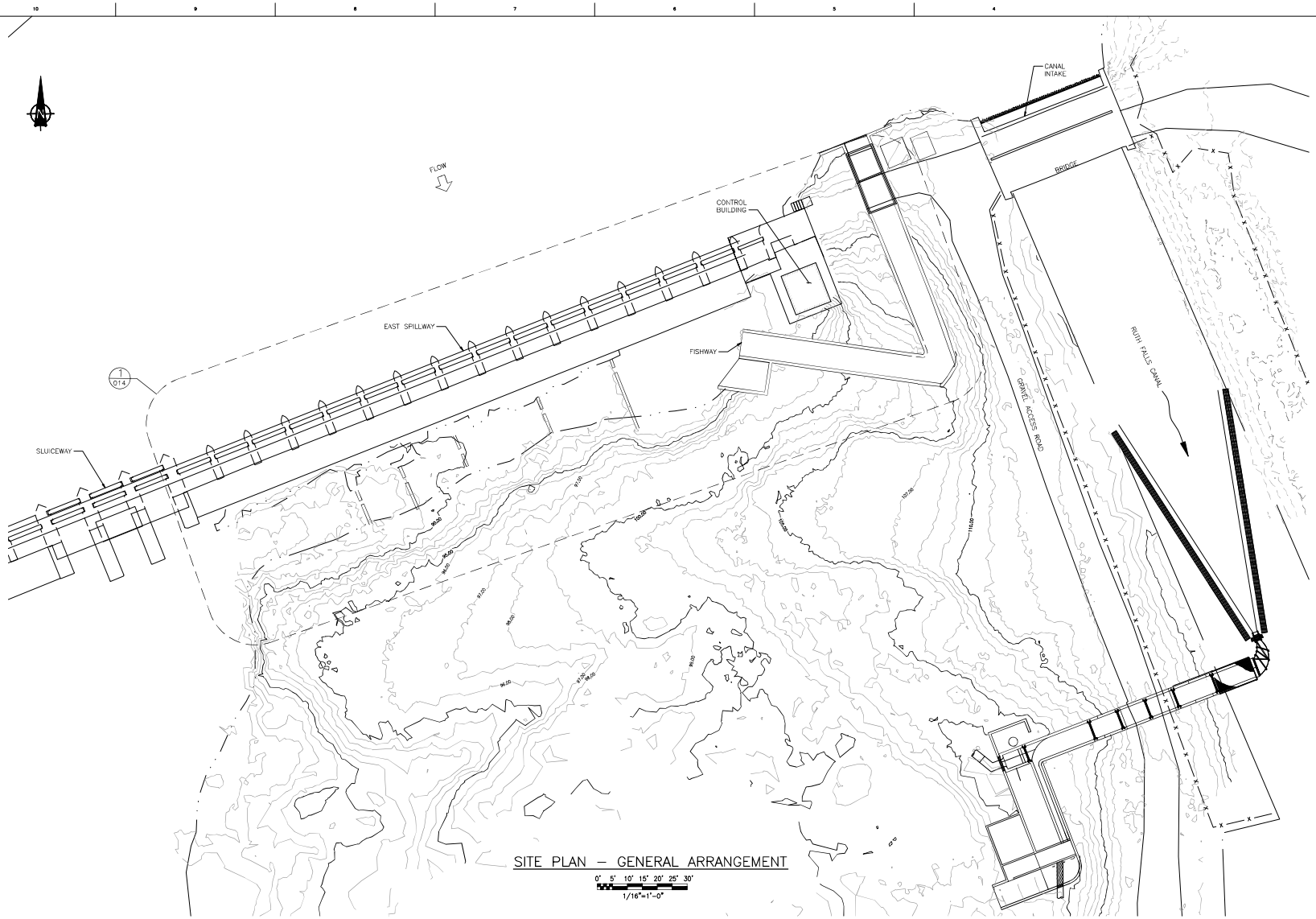
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CI 50518 CA IR-5 Attachment 21 Page 427 of 465

DWG. NO. H-096H1-1-620-00-013

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



SITE PLAN – GENERAL ARRANGEMENT

0' 5' 10' 15' 20' 25' 30'

1/16"=1'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
EXISTING CONDITIONS FISHWAY – PLAN	H-096H1-1-620-00-014
GENERAL NOTES	H-096H1-1-620-00-012

REV	DS	CIVIL	MECH	E & I	CONST	DWRD
A						
RE-ISSUED FOR PERMIT DATE: 2023-08-16						
B						
ISSUED FOR PERMIT DATE: 2023-05-03						

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST
APPROVED	
DATE	MAY 2023

JOB No. 254103

REFERENCE NO.	
SCALE	As Noted (Metric) / Imperial
UNITS	
DESIGNED	EO
DRAWN	CC
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

wood.

New Brunswick POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

EXISTING CONDITIONS GENERAL ARRANGEMENT

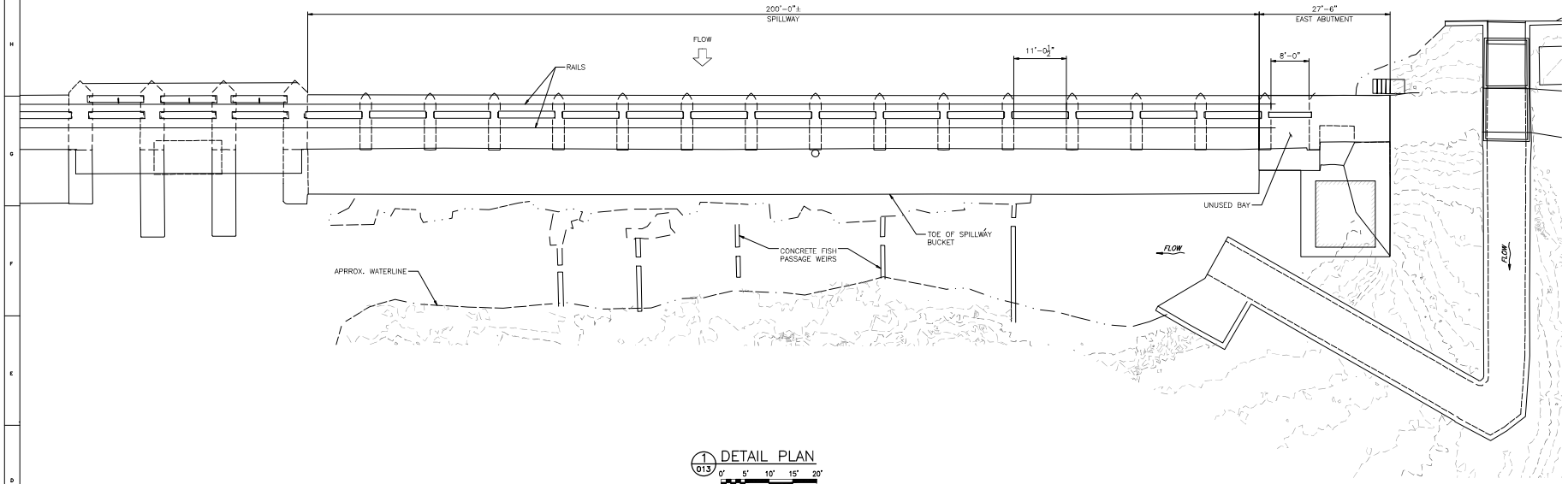
H-096H1-1-620-00-013 REV. B

CI 50518 CA IR-5 Attachment 21 Page 428 of 465

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,1,4

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



1/013 DETAIL PLAN

0' 5' 10' 15' 20'

3/32"=1'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
EXISTING CONDITIONS – GENERAL ARRANGEMENT	H 0,9,6,H,1 1 6,2,0 0,0 0,1,3
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2

REV.	BY	CHK'D	DISCIPLINE	DESCRIPTION
A	EO	AC	CIVIL, MECH, E & I, CONST	ISSUED FOR PERMIT DATE: 2023-05-05

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS

CIVIL	E & I	
MECH	CONST	

APPROVED

DATE MAY 2023

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN CC

CHECKED AC

CHECKED EO

DATE 2023-05-03

W.O.

wood.

New Spokane POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

EXISTING CONDITIONS FISHWAY – PLAN

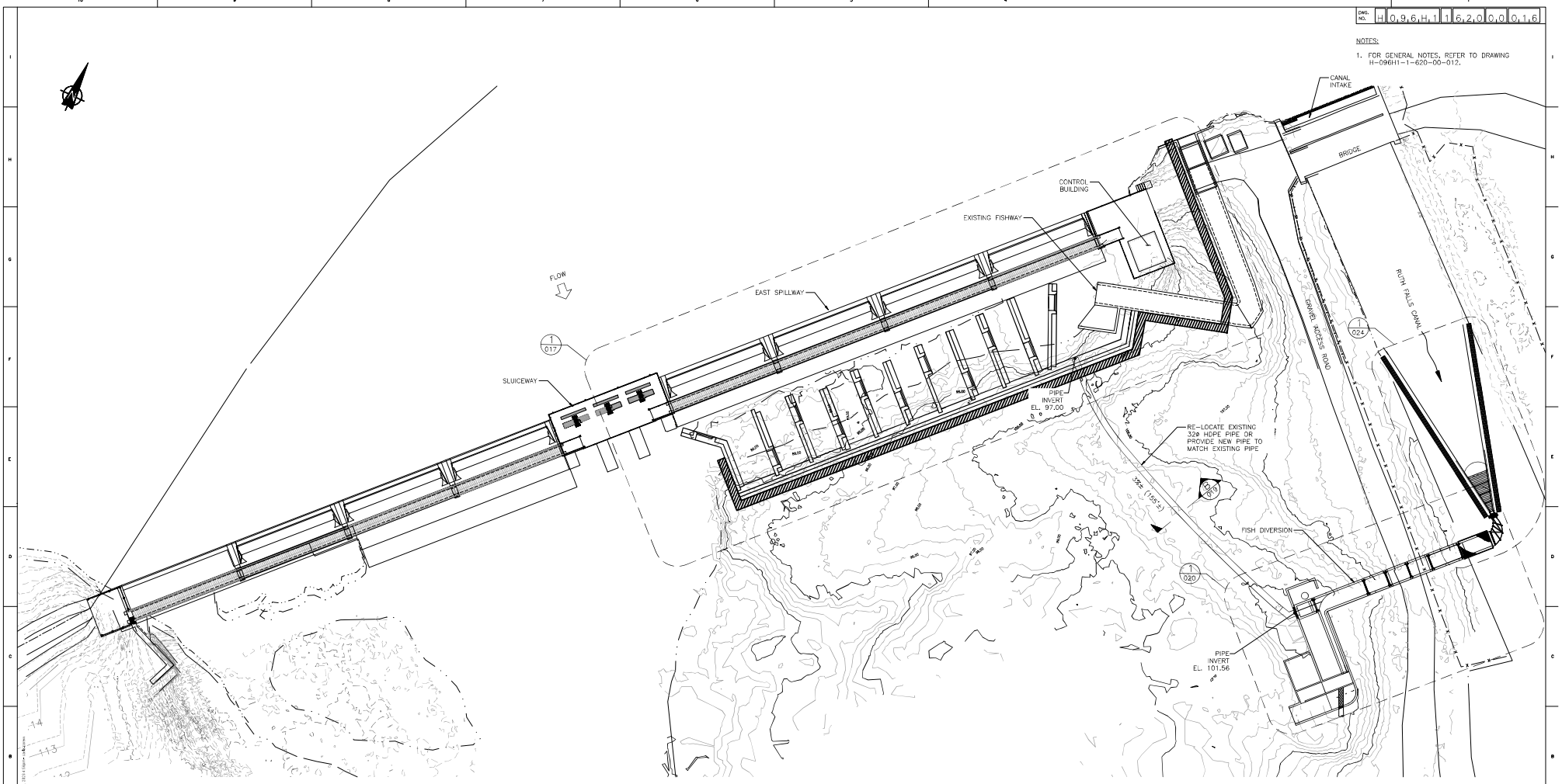
H 0,9,6,H,1 1 6,2,0 0,0 0,1,4 REV. A

CI 50518 CA IR-5 Attachment 21 Page 429 of 465

DWG. NO. H096H1-16200-0116

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



PLAN

0 5' 10' 20' 40'

1"=20'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

DOWNSTREAM EEL PASSAGE – PLAN AND SECTIONS	H096H1-16200-00124
FISH BYPASS – PLAN AND SECTIONS	H096H1-16200-00320
CHANNEL FISHWAY – SECTIONS AND DETAILS	H096H1-16200-00119
CHANNEL FISHWAY – PLAN AND SECTIONS	H096H1-16200-00117
GENERAL NOTES	H096H1-16200-00112
REFERENCE DRAWINGS	DWG.NO.

REV	DS	CIVIL	MECH	E & I	CONST DWGS
0					
1					
2					
3					

RE-ISSUED FOR PERMIT DATE: 2023-08-16

ISSUED FOR PERMIT DATE: 2023-05-05

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS

CIVIL: E & I

MECH: CONST

APPROVED

DATE: MAY 2023

REFERENCE NO.

SCALE: As Noted (Metric) / Imperial

UNITS: Imperial

DESIGNED: EO

DRAWN: AT/CC

CHECKED: AC

CO-CHECKED: EO

DATE: 2023-05-03

W.O.

wood.

New Gold POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

GENERAL ARRANGEMENT PLAN

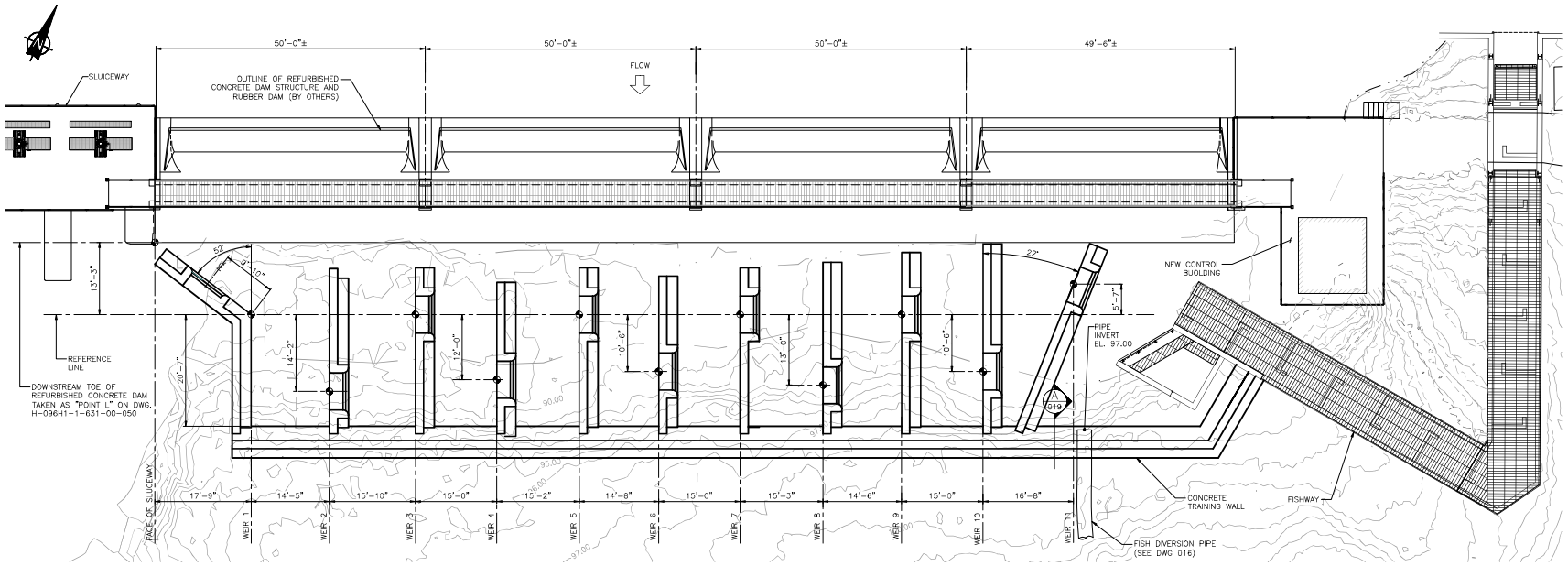
H096H1-16200-00116 REV. 3

CI 50518 CA IR-5 Attachment 21 Page 430 of 465

DWG. NO. H-096H1-1-6200-0017

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. FOR DIMENSIONS OF WEIRS IN CHANNEL FISHWAY SEE DWG. 018 AND 019.

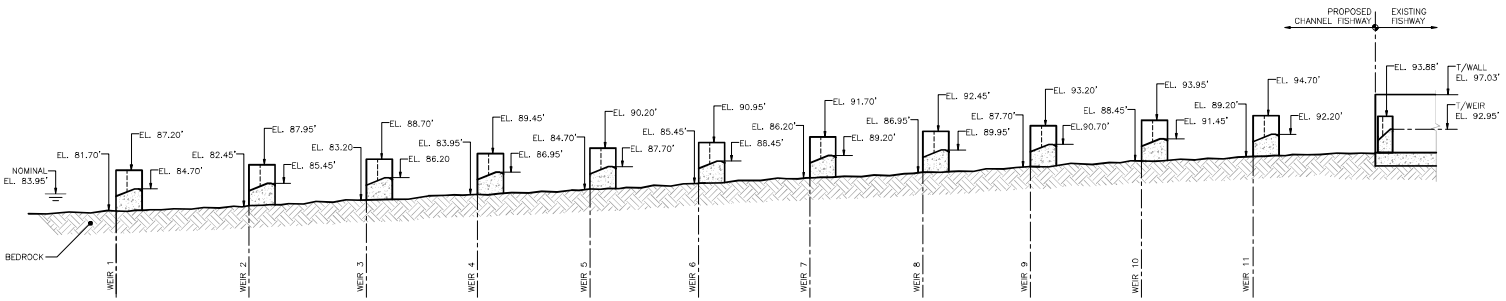


NOTE:
EEL PASSAGE NOT SHOWN FOR CLARIFY (SEE DRAWING 022 FOR DETAILS)

1 016 PLAN

0 2' 5' 10' 20'

1"=10'-0"



DEVELOPED SECTION

0' 5' 10' 15'

1/8"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
EAST SPILLWAY PLAN AND SECTIONS	H-096H1-1-6310-00-050
UPSTREAM EEL PASSAGE – PLAN AND SECTIONS	H-096H1-1-6200-00-022
CHANNEL FISHWAY – SECTIONS AND DETAILS	H-096H1-1-6200-00-019
CHANNEL FISHWAY – CROSS SECTIONS	H-096H1-1-6200-00-018
GENERAL ARRANGEMENT PLAN	H-096H1-1-6200-00-016
GENERAL NOTES	H-096H1-1-6200-00-012

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST
APPROVED	
DATE	MAY 2023

JOB No. 254103

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN AT/CC

CHECKED AC

CHECKED EO

DATE 2023-05-03

W.O.

wood.

New Applo POWER An Emera Company

RUTH FALLS

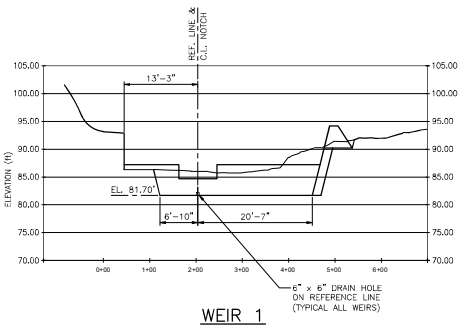
FISHWAY MODIFICATIONS

CHANNEL FISHWAY – PLAN AND SECTIONS

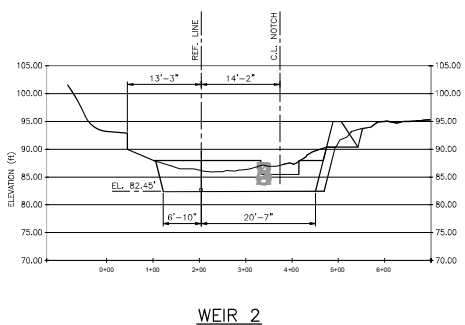
H-096H1-1-6200-00-017 REV. A

CI 50518 CA IR-5 Attachment 21 Page 431 of 465

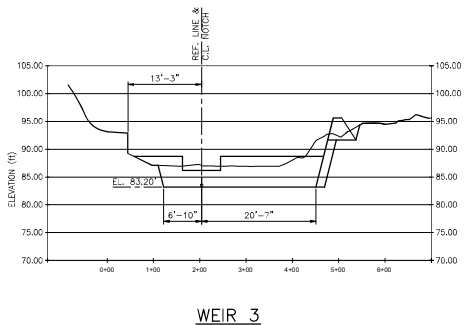
DWG. H096H1-1620-0001



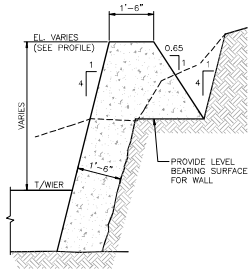
WEIR 1



WEIR 2



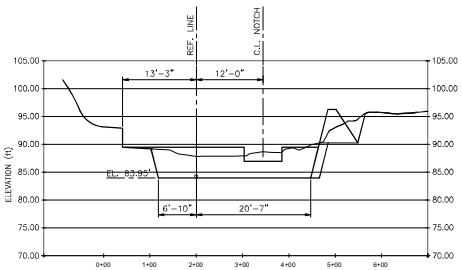
WEIR 3



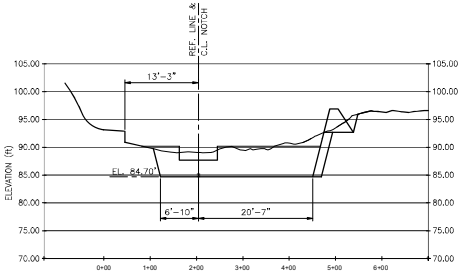
TYP. CONCRETE TRAINING WALL DETAIL

0' 1' 2' 3' 4'
1/2"=1'-0"

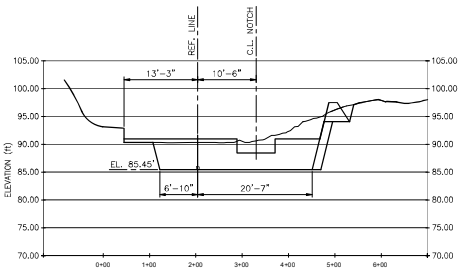
NOTES:
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



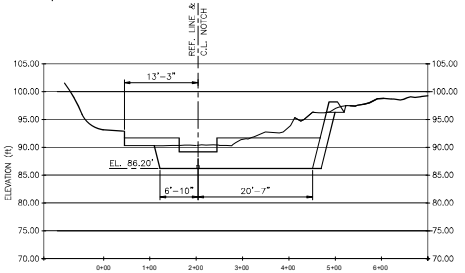
WEIR 4



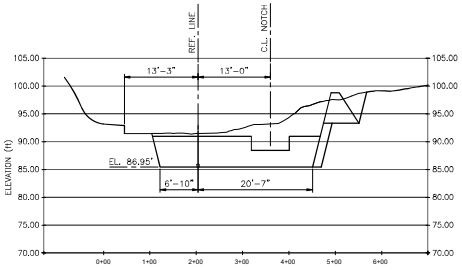
WEIR 5



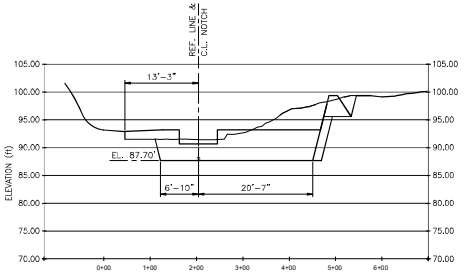
WEIR 6



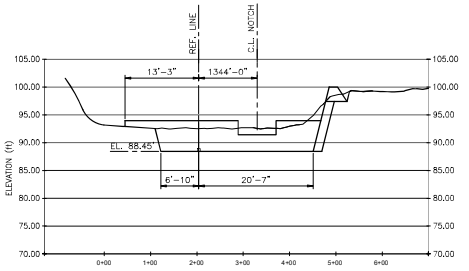
WEIR 7



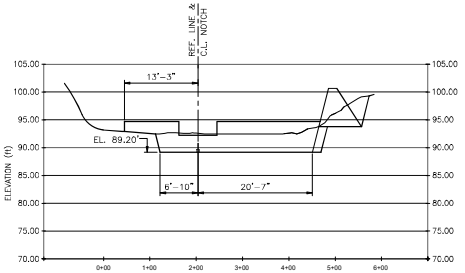
WEIR 8



WEIR 9



WEIR 10



WEIR 11

PRELIMINARY
NOT FOR CONSTRUCTION

GENERAL NOTES	H096H1-1620-0012
REFERENCE DRAWINGS	DWG.NO.

REV.	DS	CIVIL	MECH	E & I	CONST	DWG
A						

ISSUED FOR PERMIT
DATE: 2023-05-05

JOB No. 254103

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST
APPROVED	
DATE	MAY 2023

SCALE	1:20"=1'-0"
UNITS	Imperial
DESIGNED	EO
DRAWN	AT
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

wood.
Nova Scotia POWER
An Emera Company

RUTH FALLS
FISHWAY MODIFICATIONS
CHANNEL FISHWAY – CROSS SECTIONS

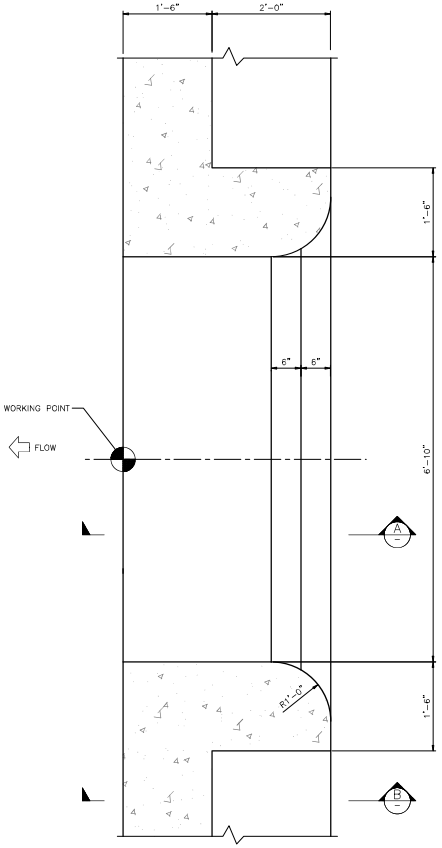
H096H1-1620-0018 REV. A

CI 50518 CA IR-5 Attachment 21 Page 432 of 465

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,1,9

NOTES:

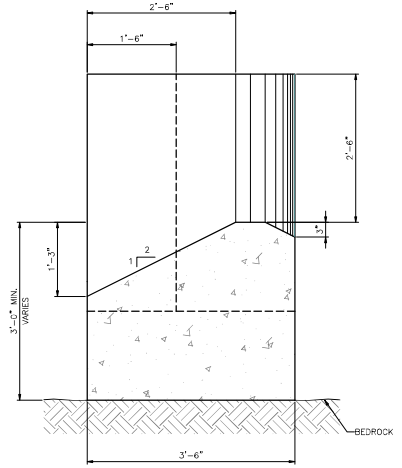
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



TYPICAL WEIR PLAN DETAIL

0' 1' 2' 3'

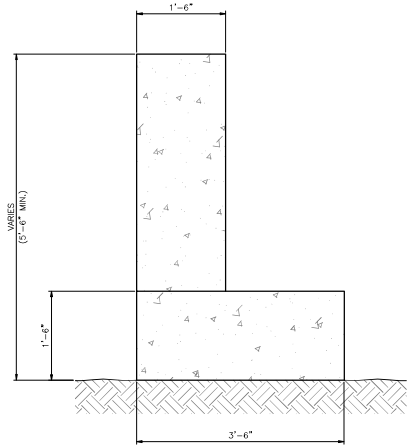
1"=1'-0"



A SECTION

0' 1' 2' 3'

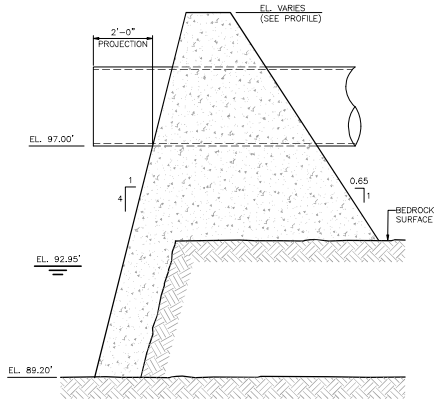
1"=1'-0"



B SECTION

0' 1' 2' 3'

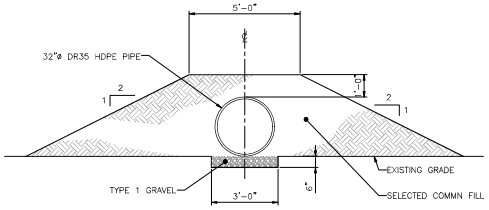
1"=1'-0"



A 017 SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"



B 016 SECTION

0' 1' 2' 3' 4' 5'

3/8"=1'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
CHANNEL FISHWAY – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,7
GENERAL ARRANGEMENT PLAN	H 0,9,6,H,1 1 6,2,0 0,0 0,1,6
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2

REV.	BY	CHK.	MECH. E. & I.	CONST.	ENVIRO.
A					

ISSUED FOR PERMIT
DATE: 2023-05-05
M. EO AC

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE MAY 2023

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN AT/CC

CHECKED AC

CHECKED EO

DATE 2023-05-03

W.O.

wood.

New Kinetic POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

CHANNEL FISHWAY – SECTIONS AND DETAILS

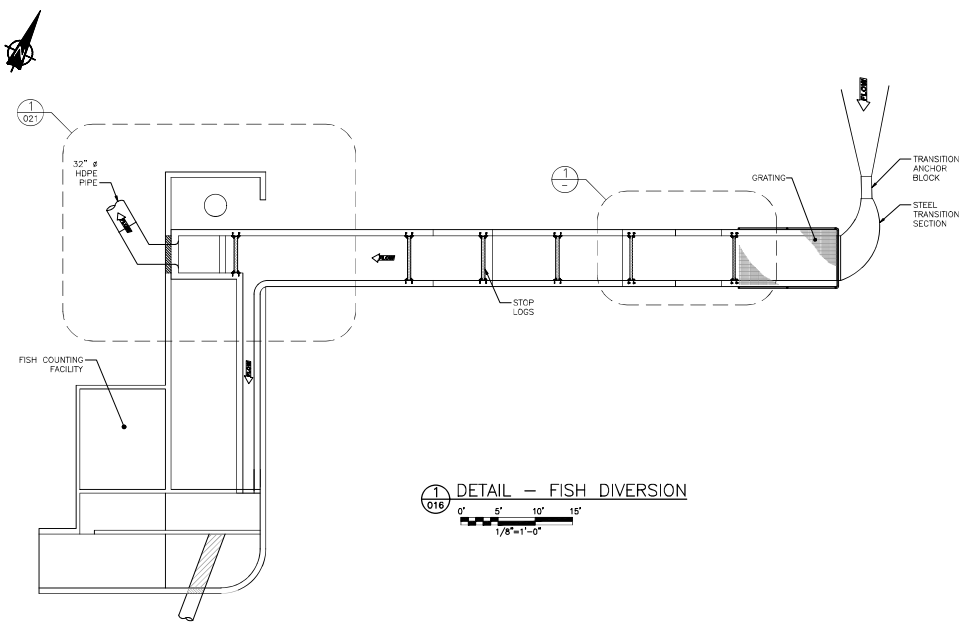
H 0,9,6,H,1 1 6,2,0 0,0 0,1,9 REV. A

CI 50518 CA IR-5 Attachment 21 Page 433 of 465

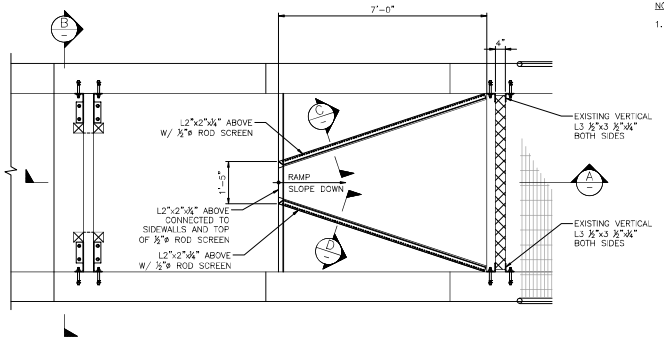
DWG. NO. H-096H1-1-620-00-020

NOTES:

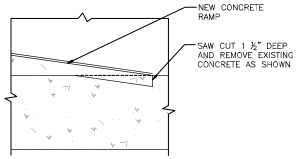
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.



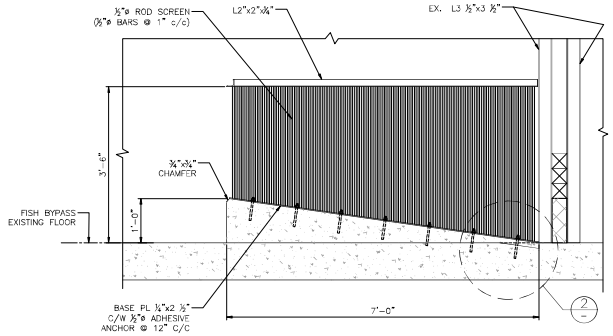
1/016 DETAIL – FISH DIVERSION
0' 5' 10' 15'
1/8"=1'-0"

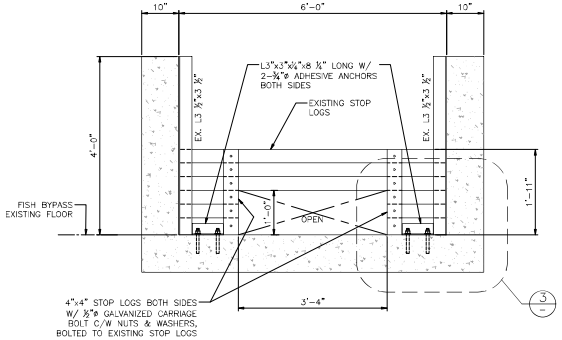


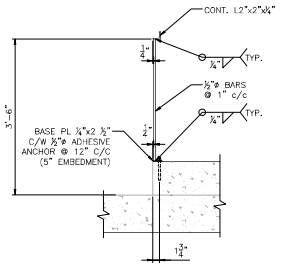
1/– DETAIL PLAN
0' 1' 2' 3' 4'
1/2"=1'-0"

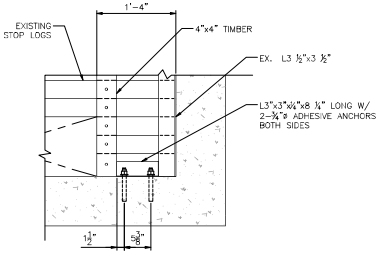


2/– DETAIL
0" 6" 12" 24"
1-1/2"=1'-0"









3/– DETAIL
0' 1' 2' 3'
1"=1'-0"

A/– SECTION
0' 1' 2' 3'
3/4"=1'-0"

B/– SECTION (TYPICAL ALL 6 STOP LOG LOCATIONS)
0' 1' 2' 3'
3/4"=1'-0"

C/– SECTION (AS SHOWN)

D/– SECTION (OPP. HAND)
0' 1' 2' 3'
3/4"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

FISH BYPASS– PLAN AND SECTIONS	H-096H1-1-620-00-021
GENERAL ARRANGEMENT PLAN	H-096H1-1-620-00-016
GENERAL NOTES	H-096H1-1-620-00-012

REV	DS	CIVIL	MECH	E & I	CONST/OWNER
A					
B					

RE-ISSUED FOR PERMIT
DATE: 2023-08-15
IC EO AC

ISSUED FOR PERMIT
DATE: 2023-05-05

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE MAY 2023

JOB No. 254103

REFERENCE NO.	
SCALE	As Noted
UNITS	Imperial
DESIGNED	EO
DRAWN	AT/CC
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

wood.
New Earth POWER
An Enviro Company

RUTH FALLS
FISHWAY MODIFICATIONS

FISH BYPASS – PLAN AND SECTIONS

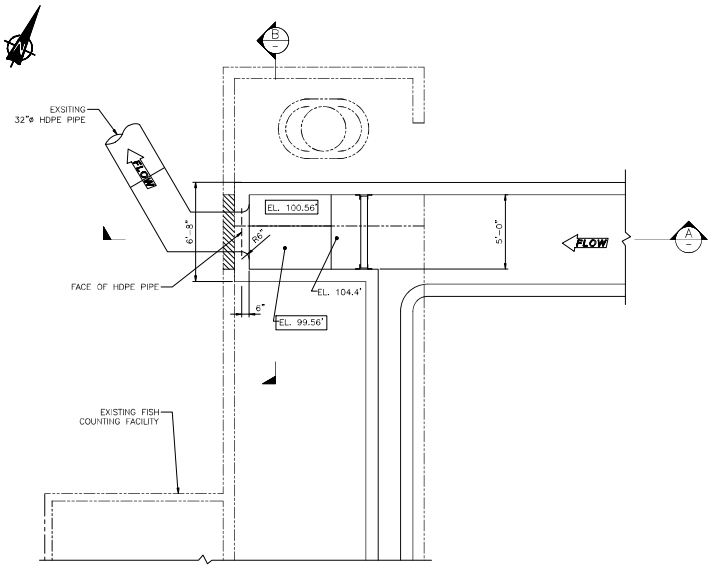
H-096H1-1-620-00-020 REV. B

CI 50518 CA IR-5 Attachment 21 Page 434 of 465

DWG. NO. H-096H1-1-6200-0021

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.

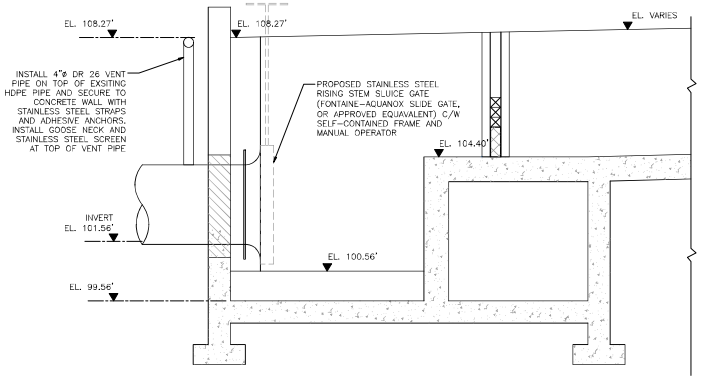


1/020 DETAIL PLAN

0' 1' 5' 10'

1/4"=1'-0"

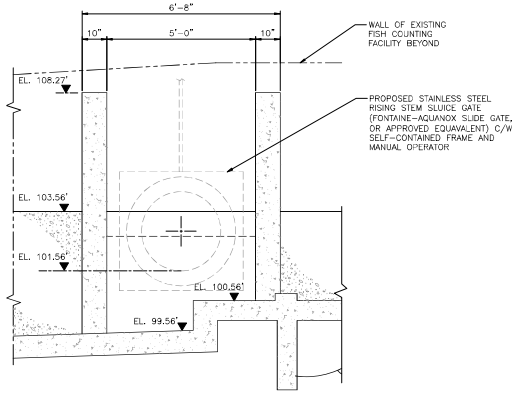
(ACCESS PLATFORM NOT SHOWN FOR CLARITY)



A SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"



B SECTION

0' 1' 2' 3' 4'

1/2"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

FISH BYPASS – PLAN AND SECTIONS	H-096H1-1-6200-0021
GENERAL NOTES	H-096H1-1-6200-0012

REV	DS	CIVIL	MECH	E & I	CONST/OWNER
A	RE-ISSUED FOR PERMIT DATE: 2023-06-13	M. EO	AC		
B	ISSUED FOR PERMIT DATE: 2023-05-25				

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I	
MECH	CONST	

APPROVED

DATE MAY 2023

JOB No. 254103

REFERENCE NO.

SCALE As Noted

UNITS Imperial

DESIGNED EO

DRAWN AT/CC

CHECKED AC

CHECKED EO

DATE 2023-05-03

W.O.

wood.

New Gold POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

FISH BYPASS – SECTIONS AND DETAILS

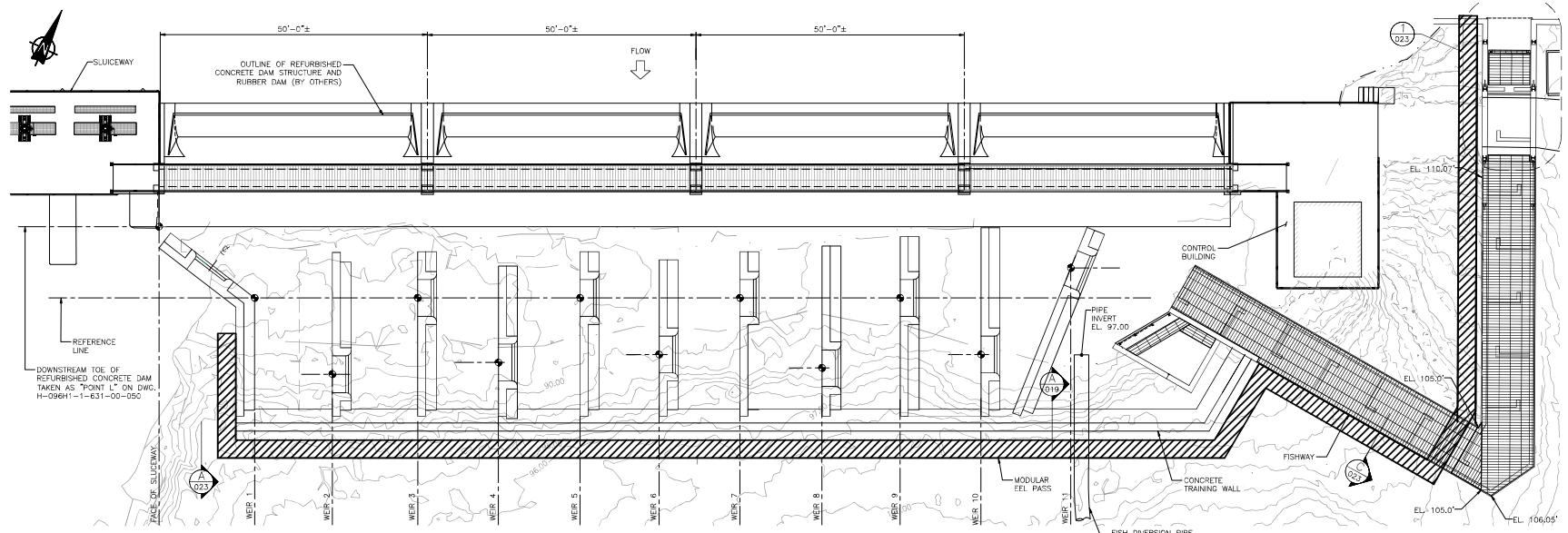
H-096H1-1-6200-0021 REV. B

CI 50518 CA IR-5 Attachment 21 Page 435 of 465

DWG. NO. H 0,9,6,H,1 1 6,2,0 0,0 0,2,2

NOTES:

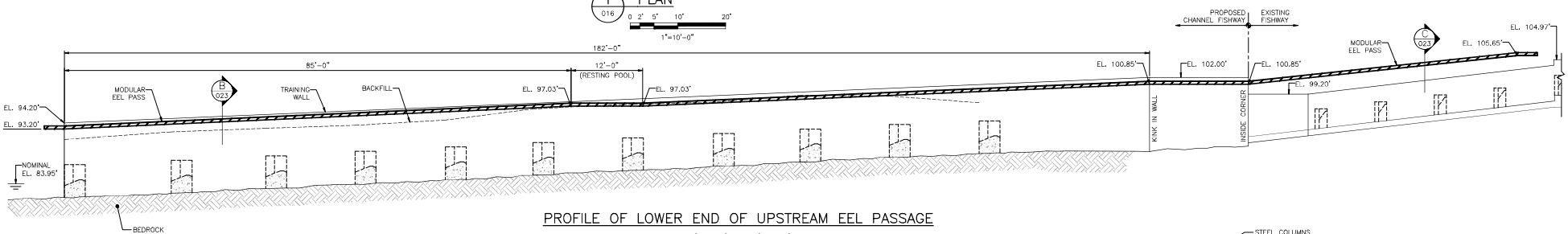
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. FOR DIMENSIONS OF CHANNEL FISHWAY, SEE DRAWING H-096H1-1-620-00-017.



1 016 PLAN

0 2' 5' 10' 20'

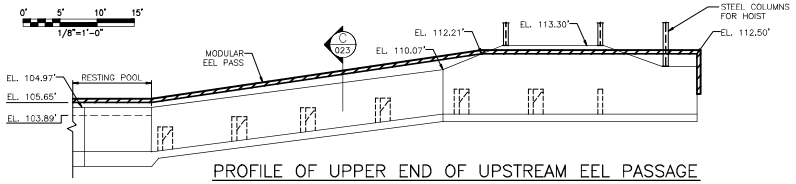
1"=10'-0"



PROFILE OF LOWER END OF UPSTREAM EEL PASSAGE

0' 5' 10' 15'

1/8"=1'-0"



PROFILE OF UPPER END OF UPSTREAM EEL PASSAGE
(FAR SIDE OF FISHWAY)

0' 5' 10' 15'

1/8"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS	DWG.NO.
EAST SPILLWAY PLAN AND SECTIONS	H 0,9,6,H,1 1 6,3,1 0,0 0,5,0
UPSTREAM EEL PASSAGE – SECTIONS AND DETAILS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,3
CHANNEL FISHWAY – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,1,7
GENERAL ARRANGEMENT PLAN	H 0,9,6,H,1 1 6,2,0 0,0 0,1,6
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2

SEAL

REV.	BY	CHK.	MECH. E. & I.	CONST.	ENVIRO.
A					

ISSUED FOR PERMIT
DATE: 2023-05-05
M. EO AC

JOB No. 254103

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST
APPROVED	
DATE	MAY 2023

REFERENCE NO.

SCALE	As Noted
UNITS	Imperial
DESIGNED	EO
DRAWN	AT/CC
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

wood.

New Spain POWER An Emera Company

RUTH FALLS

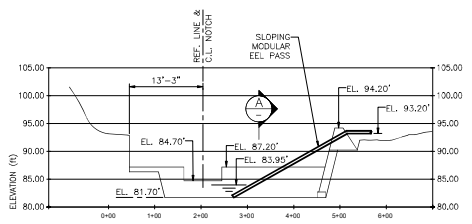
FISHWAY MODIFICATIONS

UPSTREAM EEL PASSAGE – PLAN AND SECTIONS

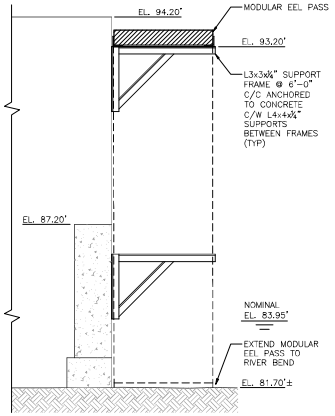
H 0,9,6,H,1 1 6,2,0 0,0 0,2,2 REV. A

CI 50518 CA IR-5 Attachment 21 Page 436 of 465

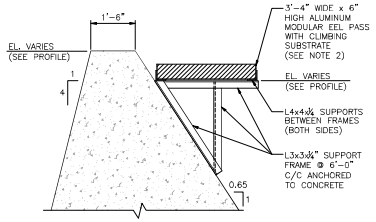
DWG. H 0,9,6,H,1 1 6,2,0 0,0 0,2,3



A 022 SECTION
0' 5' 10' 15' 20'
3/32"=1'-0"



A SECTION
0' 1' 2' 3' 4'
1/2"=1'-0"



B 022 SECTION
0' 1' 2' 3' 4'
1/2"=1'-0"
(TYPICAL ALONG TRAINING WALL)

NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. MODULAR EEL PASS TO CONSIST OF 6" HIGH ALUMINUM TROUGH WITH HINGED LOCKABLE COVER (SEE FIGURE 1), (EXCEPT NO COVER AT DOWNSTREAM END WHERE EEL PASS IS SUBMERGED) C/W CLIMBING SUBSTRATE. CLIMBING SUBSTRATE TO BE HIGH DENSITY CO-POLYMER MANUFACTURED BY AQUATIC CONTROL ENGINEERING OR BERRY AND ESCOTT ENGINEERING. (SEE FIGURE 2)

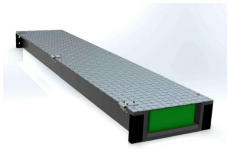
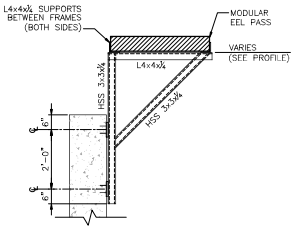


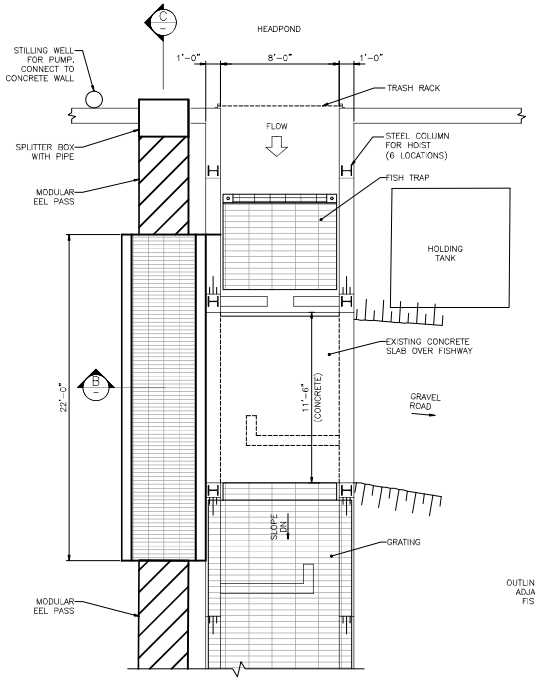
FIGURE 1



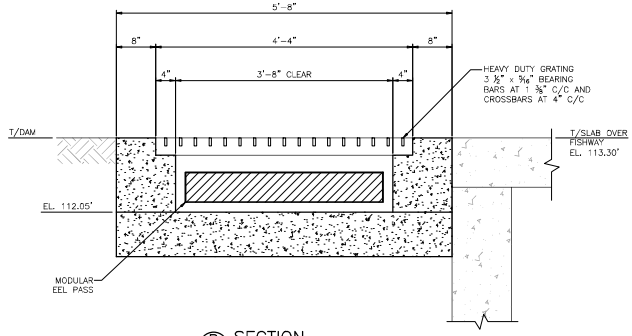
C 022 SECTION
0' 1' 2' 3' 4'
1/2"=1'-0"



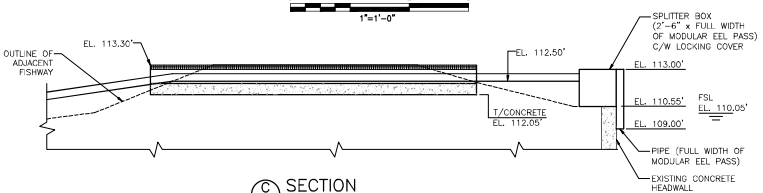
FIGURE 2



1 022 DETAIL
0' 1' 5' 10'
1/4"=1'-0"



B SECTION
0' 1' 2' 3'
1"=1'-0"



C SECTION
0' 1' 5' 10'
1/4"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

UPSTREAM EEL PASSAGE – PLAN AND SECTIONS	H 0,9,6,H,1 1 6,2,0 0,0 0,2,2
GENERAL NOTES	H 0,9,6,H,1 1 6,2,0 0,0 0,1,2
REFERENCE DRAWINGS	DWG.NO.

REV.	DS	CIVIL	MECH	E & I	CONST	BOARD
A						

ISSUED FOR PERMIT
DATE: 2023-05-05
M. EO AC

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS		
CIVIL	E & I	
MECH	CONST	
APPROVED		
DATE	MAY 2023	

SCALE	3/32"=1'-0"
UNITS	Imperial
DESIGNED	EO
DRAWN	CC
CHECKED	AC
CHECKED	EO
DATE	2023-05-03
W.O.	

wood.

New Spain POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

UPSTREAM EEL PASSAGE – SECTIONS AND DETAILS

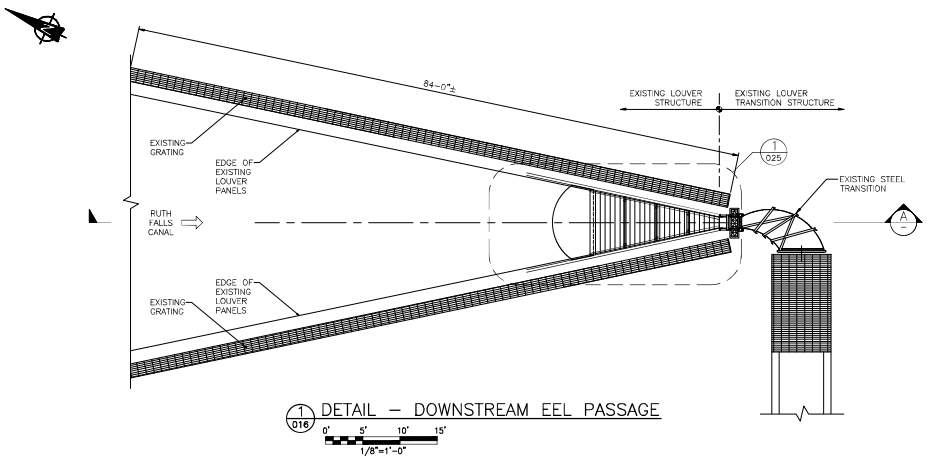
H 0,9,6,H,1 1 6,2,0 0,0 0,2,3 REV. A

CI 50518 CA IR-5 Attachment 21 Page 437 of 465

DWG. NO. H-096H1-1-620-00-024

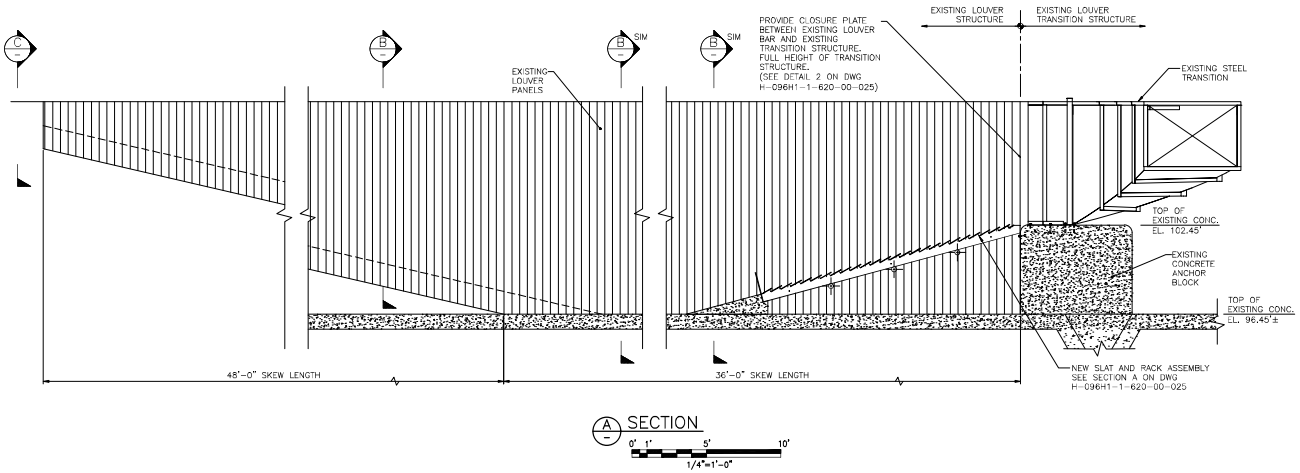
NOTES:

1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. ADHESIVE ANCHORS TO BE HAS-R 316SS ANCHOR RODS C/W HIT-RE 500 V3 EPOXY. SIZE AND LENGTH AS INDICATED.



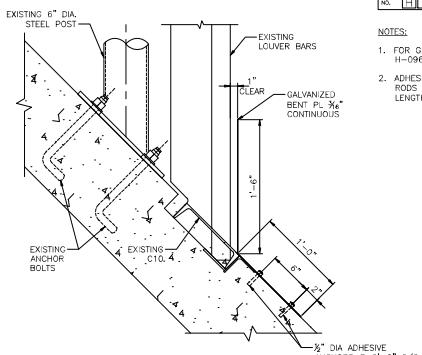
1 / 016 DETAIL – DOWNSTREAM EEL PASSAGE

0' 5' 10' 15'
1/8"=1'-0"



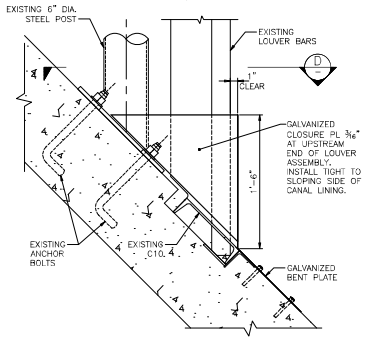
A SECTION

0' 1' 5' 10'
1/4"=1'-0"



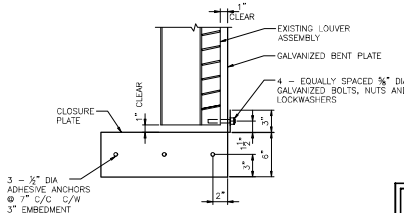
B SECTION

0" 6" 12" 24"
1-1/2"=1'-0"



C SECTION

0" 6" 12" 24"
1-1/2"=1'-0"



D SECTION

0" 6" 12" 24"
1-1/2"=1'-0"

PRELIMINARY
NOT FOR CONSTRUCTION

EEL PASSAGE – SECTIONS AND DETAILS	H-096H1-1-620-00-025
GENERAL ARRANGEMENT PLAN	H-096H1-1-620-00-016
GENERAL NOTES	H-096H1-1-620-00-012

REV	BY	CHK'D	MECH	E & I	CONST'D/WRD
1	EO	AC			

ISSUED FOR PERMIT
DATE: 2023-06-13

SEAL

DEPARTMENTAL APPROVALS

CIVIL	E & I
MECH	CONST

APPROVED

DATE JUNE 2023

JOB No. 254103

REFERENCE NO.

SCALE	As Noted (Imperial)
UNITS	
DESIGNED	EO
DRAWN	CC
CHECKED	AC
CHECKED	EO
DATE	2023-06-13
W.O.	

wood.

New Dutch POWER An Enviro Company

RUTH FALLS
FISHWAY MODIFICATIONS

DOWNSTREAM EEL PASSAGE
PLAN AND SECTIONS

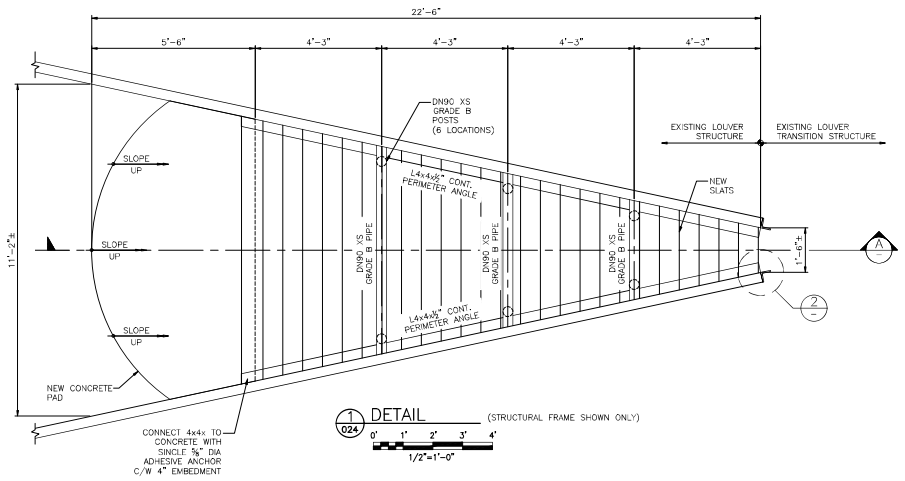
H-096H1-1-620-00-024 REV. A

CI 50518 CA IR-5 Attachment 21 Page 438 of 465

DWG. NO. H096H1-1162000-0025

NOTES:

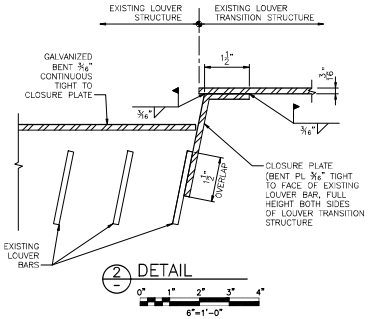
1. FOR GENERAL NOTES, REFER TO DRAWING H-096H1-1-620-00-012.
2. ADHESIVE ANCHORS TO BE HAS-R 316SS ANCHOR RODS C/W HIT-RE 500 V3 EPOXY. SIZE AND LENGTH AS INDICATED.



1/024 DETAIL (STRUCTURAL FRAME SHOWN ONLY)

0' 1' 2' 3' 4'

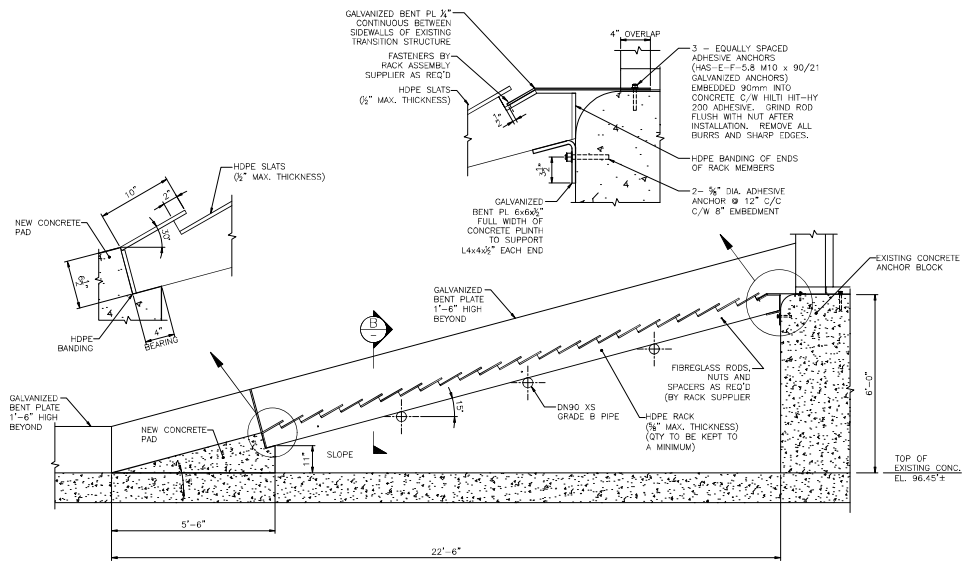
1/2"=1'-0"



2 DETAIL

0" 1" 2" 3" 4"

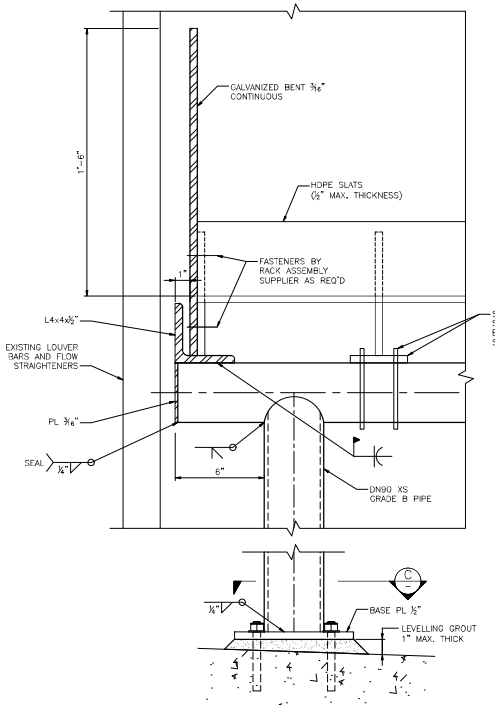
6"=1'-0"



A SECTION

0' 1' 2' 3' 4'

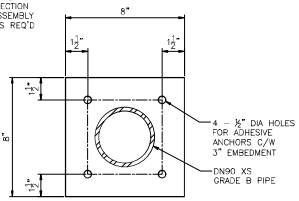
1/2"=1'-0"



B SECTION

0" 6" 9" 12"

3"=1'-0"



C SECTION (6 LOCATIONS)

0" 6" 9" 12"

3"=1'-0"

PRELIMINARY

NOT FOR CONSTRUCTION

EEL PASSAGE – PLAN AND SECTIONS	H096H1-1162000-0024
GENERAL ARRANGEMENT PLAN	H096H1-1162000-0116
GENERAL NOTES	H096H1-1162000-0112

REV	DD	CIVIL	MECH	E & I	CONST'D/WKD
2					
1					
0					

ISSUED FOR PERMIT DATE: 2023-06-13 lc EO AC

SEAL

JOB No. 254103

DEPARTMENTAL APPROVALS

CIVIL: E & I

MECH: CONST

APPROVED

DATE: JUNE 2023

REFERENCE NO.

SCALE: As Noted

UNITS: Imperial

DESIGNED: EO

DRAWN: CC

CHECKED: AC

CO-ORDED: EO

DATE: 2023-06-13

W.O.

wood.

New Brunswick POWER An Emera Company

RUTH FALLS

FISHWAY MODIFICATIONS

DOWNSTREAM EEL PASSAGE SECTIONS AND DETAILS

H096H1-1162000-0025 REV. A

APPENDIX L – ACCDC Report

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

DATA REPORT 7716: Ruth Falls Watershed, NS

Prepared 6 June 2023
by J. Pender, Conservation Data Analyst

CONTENTS OF REPORT

1.0 Preface
- 1.1 Data List
- 1.2 Restrictions
- 1.3 Additional Information
- Map 1: Buffered Study Area

2.0 Rare and Endangered Species
- 2.1 Flora
- 2.2 Fauna
- Map 2: Flora and Fauna

3.0 Special Areas
- 3.1 Managed Areas
- 3.2 Significant Areas
- Map 3: Special Areas

4.0 Rare Species Lists
- 4.1 Fauna
- 4.2 Flora
- 4.3 Location Sensitive Species
- 4.4 Source Bibliography

5.0 Rare Species within 100 km
- 5.1 Source Bibliography



Map 1. A 100 km buffer around the study area

1.0 PREFACE

The Atlantic Canada Conservation Data Centre (AC CDC; www.accdc.com) is part of a network of NatureServe data centres and heritage programs serving 50 states in the U.S.A, 10 provinces and 1 territory in Canada, plus several Central and South American countries. The NatureServe network is more than 30 years old and shares a common conservation data methodology. The AC CDC was founded in 1997, and maintains data for the jurisdictions of New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland and Labrador. Although a non-governmental agency, the AC CDC is supported by 6 federal agencies and 4 provincial governments, as well as through outside grants and data processing fees.

Upon request and for a fee, the AC CDC queries its database and produces customized reports of the rare and endangered flora and fauna known to occur in or near a specified study area. As a supplement to that data, the AC CDC includes locations of managed areas with some level of protection, and known sites of ecological interest or sensitivity.

1.1 DATA LIST

Included datasets:

Filename	Contents
RuthFallsWatNS_7716ob.xls	Rare or legally-protected Flora and Fauna in your study area
RuthFallsWatNS_7716ob100km.xls	A list of Rare and legally protected Flora and Fauna within 100 km of your study area
RuthFallsWatNS_7716ff_py.xls	Rare Freshwater Fish in your study area (DFO database)

1.2 RESTRICTIONS

The AC CDC makes a strong effort to verify the accuracy of all the data that it manages, but it shall not be held responsible for any inaccuracies in data that it provides. By accepting AC CDC data, recipients assent to the following limits of use:

a) Data is restricted to use by trained personnel who are sensitive to landowner interests and to potential threats to rare and/or endangered flora and fauna posed by the information provided.
b) Data is restricted to use by the specified Data User; any third party requiring data must make its own data request.
c) The AC CDC requires Data Users to cease using and delete data 12 months after receipt, and to make a new request for updated data if necessary at that time.
d) AC CDC data responses are restricted to the data in our Data System at the time of the data request.
e) Each record has an estimate of locational uncertainty, which must be referenced in order to understand the record's relevance to a particular location. Please see attached Data Dictionary for details.
f) AC CDC data responses are not to be construed as exhaustive inventories of taxa in an area.
g) The absence of a taxon cannot be inferred by its absence in an AC CDC data response.

1.3 ADDITIONAL INFORMATION

The accompanying Data Dictionary provides metadata for the data provided.

Please direct any additional questions about AC CDC data to the following individuals:

Plants, Lichens, Ranking Methods, All other Inquiries
Sean Blaney
Senior Scientist / Executive Director
(506) 364-2658
sean.blaney@accdc.ca

Animals (Fauna)
John Klymko
Zoologist
(506) 364-2660
john.klymko@accdc.ca

Data Management, GIS
James Churchill
Conservation Data Analyst / Field Biologist
(902) 679-6146
james.churchill@accdc.ca

Billing
Jean Breau
Financial Manager / Executive Assistant
(506) 364-2657
jean.breau@accdc.ca

Questions on the biology of Federal Species at Risk can be directed to AC CDC: (506) 364-2658, with questions on Species at Risk regulations to: Samara Eaton, Canadian Wildlife Service (NB and PE): (506) 364-5060 or Julie McKnight, Canadian Wildlife Service (NS): (902) 426-4196.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in New Brunswick, please contact Hubert Askanas, Energy and Resource Development: (506) 453-5873.

For provincial information about rare taxa and protected areas, or information about game animals, deer yards, old growth forests, archeological sites, fish habitat etc., in Nova Scotia, please contact Donna Hurlburt, NS DLF: (902) 679-6886. To determine if location-sensitive species (section 4.3) occur near your study site please contact a NS DLF Regional Biologist:

Western: Emma Vost
(902) 670-8187
Emma.Vost@novascotia.ca

Western: Sarah Spencer
(902) 541-0081
Sarah.Spencer@novascotia.ca

Central: Shavonne Meyer
(902) 893-0816
Shavonne.Meyer@novascotia.ca

Central: Kimberly George
(902) 890-1046
Kimberly.George@novascotia.ca

Eastern: Harrison Moore
(902) 497-4119
Harrison.Moore@novascotia.ca

Eastern: Maureen Cameron-MacMillan
(902) 295-2554
Maureen.Cameron-MacMillan@novascotia.ca

Eastern: Elizabeth Walsh
(902) 563-3370
Elizabeth.Walsh@novascotia.ca

For provincial information about rare taxa and protected areas, or information about game animals, fish habitat etc., in Prince Edward Island, please contact Garry Gregory, PEI Dept. of Communities, Land and Environment: (902) 569-7595.

2.0 RARE AND ENDANGERED SPECIES

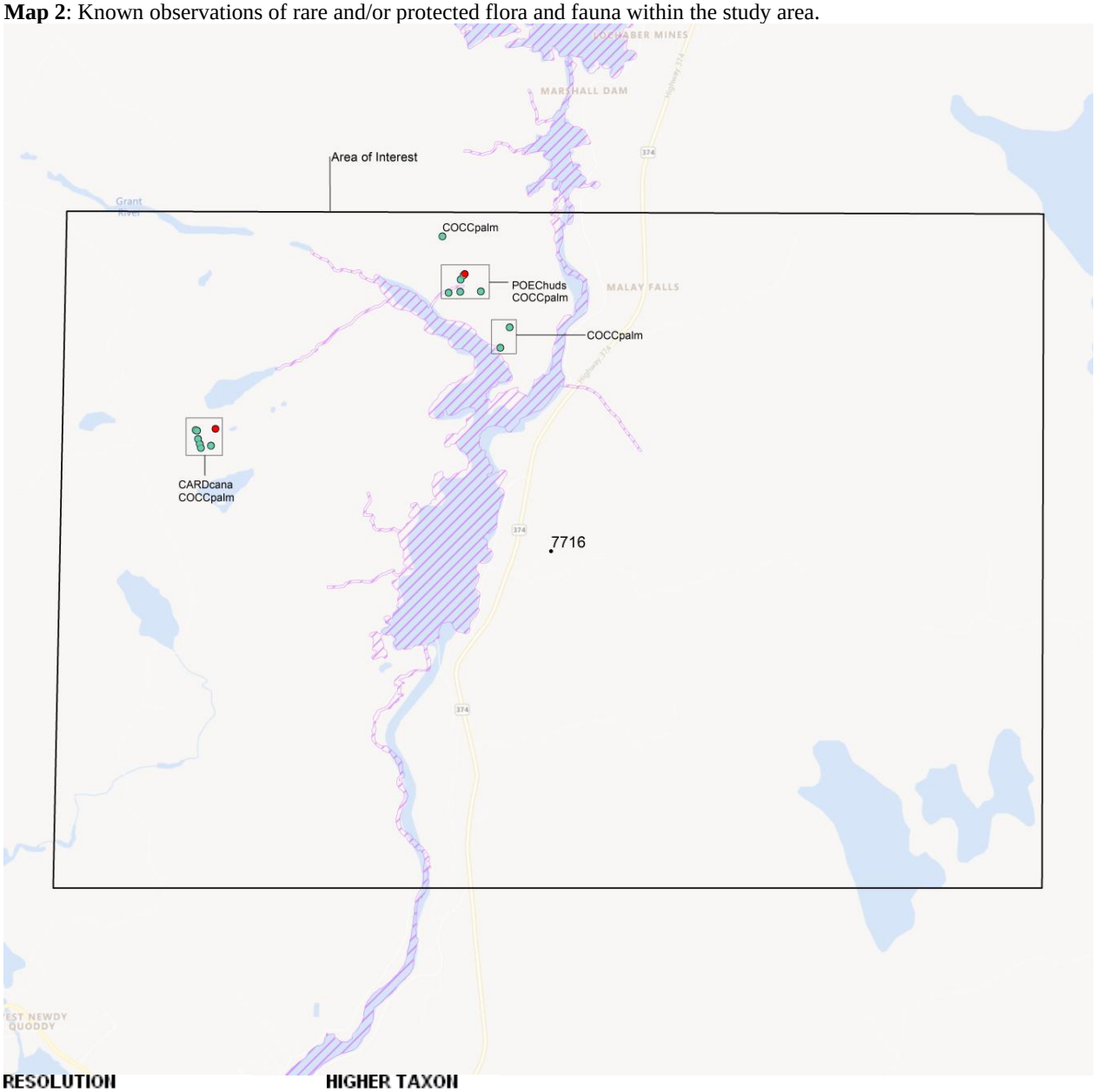
2.1 FLORA

The study area contains no records of vascular and 14 records of 1 nonvascular flora (Map 2 and attached: *ob.xls), excluding 'location-sensitive' species.

2.2 FAUNA

The study area contains 2 records of 2 vertebrate and no records of invertebrate fauna (Map 2 and attached data files - see 1.1 Data List), excluding 'location-sensitive species'. Please see section 4.3 to determine if 'location-sensitive' species occur near your study site.

Map 2: Known observations of rare and/or protected flora and fauna within the study area.

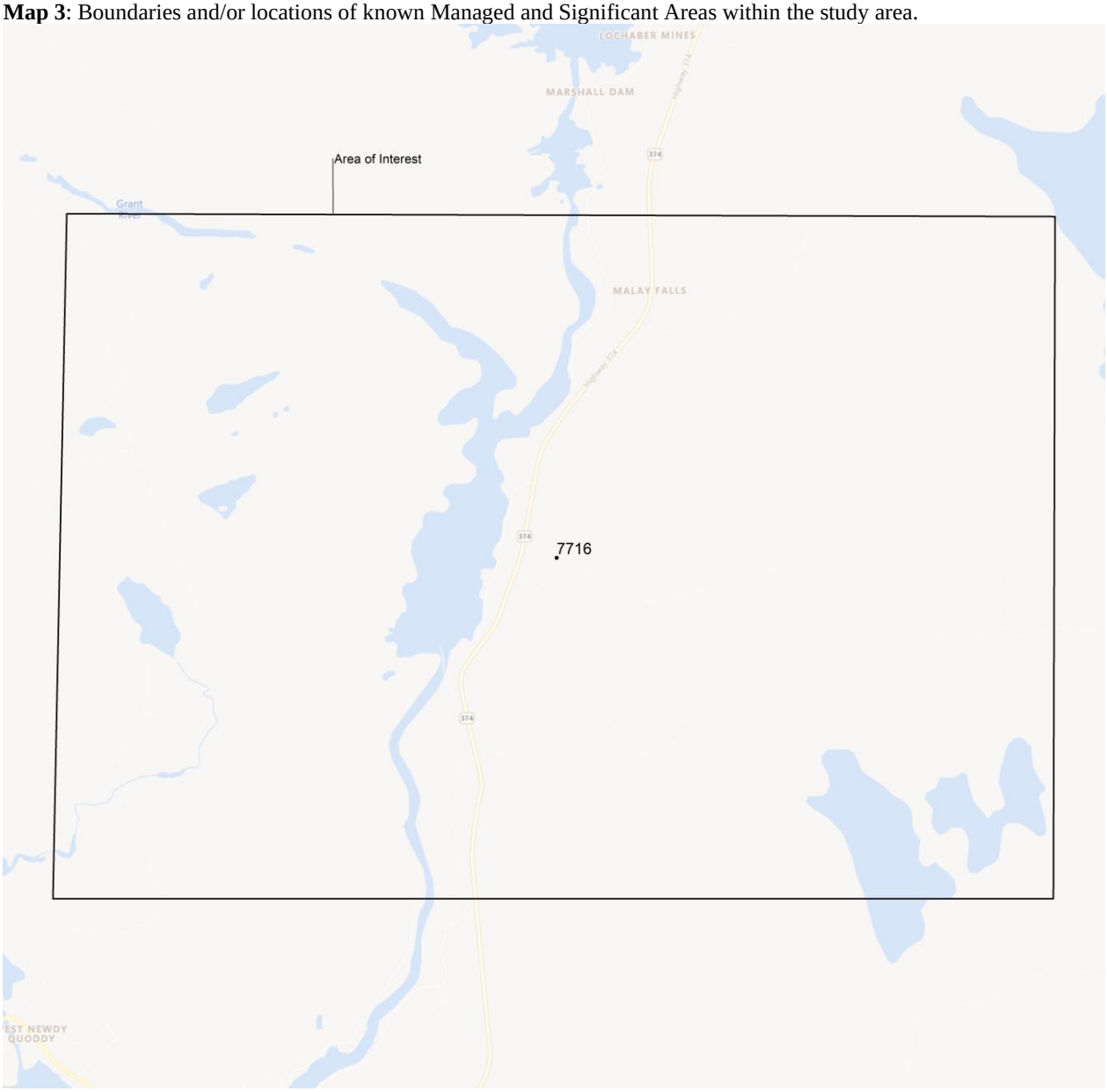


3.0 SPECIAL AREAS

3.1 MANAGED AREAS
The GIS scan identified no managed areas in the vicinity of the study area (Map 3).

3.2 SIGNIFICANT AREAS
The GIS scan identified no biologically significant sites in the vicinity of the study area (Map 3).

Map 3: Boundaries and/or locations of known Managed and Significant Areas within the study area.



4.0 RARE SPECIES LISTS

Rare and/or endangered taxa (excluding "location-sensitive" species, section 4.3) within the study area listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record). [P] = vascular plant, [N] = nonvascular plant, [A] = vertebrate animal, [I] = invertebrate animal, [C] = community. Note: records are from attached files *ob.xls/*ob.shp only.

4.1 FLORA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	14	1.8 ± 0.0

4.2 FAUNA

	Scientific *Name*	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Endangered	S3B	1	3.0 ± 0.0
A	*Poecile hudsonicus*	Boreal Chickadee				S3	1	2.5 ± 0.0

4.3 LOCATION SENSITIVE SPECIES

The Department of Natural Resources in each Maritimes province considers a number of species "location sensitive". Concern about exploitation of location-sensitive species precludes inclusion of precise coordinates in this report. Those intersecting your study area are indicated below with "YES".

Nova Scotia

Scientific *Name*	Common Name	SARA	Prov Legal Prot	Known within the Study Site?
Fraxinus nigra	Black Ash		Threatened	No
Emydoidea blandingii	*Blanding's Turtle - Nova Scotia pop.*	Endangered	Endangered	No
Glyptemys insculpta	Wood Turtle	Threatened	Threatened	No
Falco peregrinus pop. 1	Peregrine Falcon - anatum/tundrius pop.		Vulnerable	No
Bat hibernaculum or bat species occurrence		[Endangered][1]	[Endangered][1]	No

1 *Myotis lucifugus* (Little Brown Myotis), *Myotis septentrionalis* (Long-eared Myotis), and *Perimyotis subflavus* (Tri-colored Bat or Eastern Pipistrelle) are all Endangered under the Federal Species at Risk Act and the NS Endangered Species Act.

4.4 SOURCE BIBLIOGRAPHY

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

# recs	CITATION
12	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database [as of 2018-03]. Mersey Tobeatic Research Institute.
4	Neily, T.H. 2017. Nova Scotia lichen records. Mersey Tobeatic Research Institute.
1	Benjamin, L.K. (compiler). 2007. Significant Habitat & Species Database. Nova Scotia Dept Natural Resources, 8439 recs.

5.0 RARE SPECIES WITHIN 100 KM

A 100 km buffer around the study area contains 36085 records of 156 vertebrate and 1362 records of 64 invertebrate fauna; 4288 records of 234 vascular and 2565 records of 122 nonvascular flora (attached: *ob100km.xls).

Taxa within 100 km of the study site that are rare and/or endangered in the province in which the study site occurs (including “location-sensitive” species). All ranks correspond to the province in which the study site falls, even for out-of-province records. Taxa are listed in order of concern, beginning with legally listed taxa, with the number of observations per taxon and the distance in kilometers from study area centroid to the closest observation (± the precision, in km, of the record).

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Myotis lucifugus*	Little Brown Myotis	Endangered	Endangered	Endangered	S1	51	33.9 ± 0.0	NS
A	*Myotis septentrionalis*	Northern Myotis	Endangered	Endangered	Endangered	S1	3	42.0 ± 0.0	NS
A	*Perimyotis subflavus*	Tricolored Bat	Endangered	Endangered	Endangered	S1	4	75.5 ± 0.0	NS
A	*Emydoidea blandingii*	Blanding's Turtle	Endangered	Endangered	Endangered	S1	1	96.1 ± 0.0	NS
A	*Salmo salar pop. 1*	Atlantic Salmon - Inner Bay of Fundy population	Endangered	Endangered		S1	18	53.1 ± 0.0	NS
A	*Salmo salar pop. 6*	Atlantic Salmon - Nova Scotia Southern Upland population	Endangered			S1	43	6.2 ± 0.0	NS
A	*Charadrius melodus melodus*	Piping Plover melodus subspecies	Endangered	Endangered	Endangered	S1B	993	13.7 ± 0.0	NS
A	*Sterna dougallii*	Roseate Tern	Endangered	Endangered	Endangered	S1B	74	11.9 ± 0.0	NS
A	*Morone saxatilis pop. 2*	Striped Bass - Bay of Fundy population	Endangered			S2S3B,S2S3N	2	74.8 ± 0.0	NS
A	*Icteria virens*	Yellow-Breasted Chat	Endangered	Endangered		SNA	21	55.8 ± 0.0	NS
A	*Lamna nasus*	Porbeagle Shark	Endangered			SNR	1	93.1 ± 1.0	NS
A	*Lasiurus cinereus*	Hoary Bat	Endangered			SUB, S1M	2	72.2 ± 0.0	NS
A	*Lasionycteris noctivagans*	Silver-haired Bat	Endangered			SUB,S1M	1	90.0 ± 0.0	NS
A	*Colinus virginianus*	Northern Bobwhite	Endangered	Endangered			2	66.2 ± 0.0	NS
A	*Asio flammeus*	Short-eared Owl	Threatened	Special Concern		S1B	9	67.9 ± 7.0	NS
A	*Glyptemys insculpta*	Wood Turtle	Threatened	Threatened	Threatened	S2	8514	25.7 ± 1.0	NS
A	*Riparia riparia*	Bank Swallow	Threatened	Threatened	Endangered	S2B	966	14.4 ± 1.0	NS
A	*Chaetura pelagica*	Chimney Swift	Threatened	Threatened	Endangered	S2S3B,S1M	733	8.2 ± 7.0	NS
A	*Limosa haemastica*	Hudsonian Godwit	Threatened			S2S3M	34	71.9 ± 0.0	NS
A	*Acipenser oxyrinchus*	Atlantic Sturgeon	Threatened			S2S3N	2	74.1 ± 0.0	NS
A	*Hydrobates leucorhous*	Leach's Storm-Petrel	Threatened			S3B	73	14.6 ± 7.0	NS
A	*Tringa flavipes*	Lesser Yellowlegs	Threatened			S3M	575	18.2 ± 0.0	NS
A	*Anguilla rostrata*	American Eel	Threatened			S3N	71	9.5 ± 0.0	NS
A	*Sturnella magna*	Eastern Meadowlark	Threatened	Threatened		SHB	2	87.4 ± 0.0	NS
A	*Melanerpes lewis*	Lewis's Woodpecker	Threatened	Threatened		SNA	2	97.1 ± 0.0	NS
A	*Ixobrychus exilis*	Least Bittern	Threatened	Threatened		SUB	2	93.3 ± 0.0	NS
A	*Hylocichla mustelina*	Wood Thrush	Threatened	Threatened		SUB	36	35.8 ± 7.0	NS
A	*Salmo salar pop. 12*	Atlantic Salmon - Gaspe - Southern Gulf of St. Lawrence population	Special Concern			S1	31	61.6 ± 50.0	NS
A	*Antrostomus vociferus*	Eastern Whip-Poor-Will	Special Concern	Threatened	Threatened	S1?B	11	55.9 ± 7.0	NS
A	*Passerculus sandwichensis princeps*	Ipswich Sparrow	Special Concern	Special Concern		S1B	32	19.0 ± 0.0	NS
A	*Bucephala islandica*	Barrow's Goldeneye	Special Concern	Special Concern		S1N,SUM	31	70.2 ± 0.0	NS
A	*Euphagus carolinus*	Rusty Blackbird	Special Concern	Special Concern	Endangered	S2B	246	8.2 ± 7.0	NS
A	*Phalaropus lobatus*	Red-necked Phalarope	Special Concern	Special Concern		S2S3M	7	62.8 ± 0.0	NS
A	*Morone saxatilis pop. 1*	Striped Bass - Southern Gulf of St. Lawrence population	Special Concern			S2S3N	1	86.9 ± 1.0	NS
A	*Histrionicus histrionicus pop. 1*	Harlequin Duck - Eastern population	Special Concern	Special Concern	Endangered	S2S3N,SUM	53	9.1 ± 2.0	NS
A	*Chelydra serpentina*	Snapping Turtle	Special Concern	Special Concern	Vulnerable	S3	211	27.5 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
A	*Hirundo rustica*	Barn Swallow	Special Concern	Threatened	Endangered	S3B	1048	5.9 ± 7.0	NS
A	*Cardellina canadensis*	Canada Warbler	Special Concern	Threatened	Endangered	S3B	1020	3.0 ± 0.0	NS
A	*Chordeiles minor*	Common Nighthawk	Special Concern	Special Concern	Threatened	S3B	368	6.8 ± 7.0	NS
A	*Contopus cooperi*	Olive-sided Flycatcher	Special Concern	Special Concern	Threatened	S3B	1001	5.9 ± 7.0	NS
A	*Dolichonyx oryzivorus*	Bobolink	Special Concern	Threatened	Vulnerable	S3B	636	36.4 ± 7.0	NS
A	*Coccothraustes vespertinus*	Evening Grosbeak	Special Concern	Special Concern	Vulnerable	S3B,S3N,S3M	630	5.9 ± 7.0	NS
A	*Podiceps auritus*	Horned Grebe	Special Concern	Special Concern		S3N,SUM	12	12.9 ± 0.0	NS
A	*Contopus virens*	Eastern Wood-Pewee	Special Concern	Special Concern	Vulnerable	S3S4B	768	5.9 ± 7.0	NS
A	*Phocoena phocoena*	Harbour Porpoise	Special Concern			S4	6	15.7 ± 0.0	NS
A	*Phocoena phocoena pop. 1*	Harbour Porpoise - Northwest Atlantic Population	Special Concern			S4	1	91.9 ± 1.0	NS
A	*Chrysemys picta*	Painted Turtle	Special Concern	Special Concern		S4	26	59.8 ± 0.0	NS
A	*Chrysemys picta picta*	Eastern Painted Turtle	Special Concern	Special Concern		S4	117	57.8 ± 10.0	NS
A	*Calidris subruficollis*	Buff-breasted Sandpiper	Special Concern	Special Concern		SNA	5	71.9 ± 0.0	NS
A	*Zonotrichia querula*	Harris's Sparrow	Special Concern			SNA	1	90.9 ± 0.0	NS
A	*Anarhichas lupus*	Atlantic Wolffish	Special Concern	Special Concern		SNR	1	87.3 ± 0.0	NS
A	*Accipiter cooperii*	Cooper's Hawk	Not At Risk			S1?B,SUN,SUM	18	68.7 ± 0.0	NS
A	*Fulica americana*	American Coot	Not At Risk			S1B	43	62.9 ± 0.0	NS
A	*Chlidonias niger*	Black Tern	Not At Risk			S1B	4	69.6 ± 0.0	NS
A	*Falco peregrinus pop. 1*	Peregrine Falcon - anatum/tundrius	Not At Risk		Vulnerable	S1B,SUM	11	53.4 ± 0.0	NS
A	*Aegolius funereus*	Boreal Owl	Not At Risk			S2?B,SUM	12	51.5 ± 0.0	NS
A	*Globicephala melas*	Long-finned Pilot Whale	Not At Risk			S2S3	3	40.7 ± 100.0	NS
A	*Hemidactylium scutatum*	Four-toed Salamander	Not At Risk			S3	21	31.6 ± 5.0	NS
A	*Megaptera novaeangliae*	Humpback Whale	Not At Risk			S3	1	89.3 ± 0.0	NS
A	*Sterna hirundo*	Common Tern	Not At Risk			S3B	388	5.9 ± 7.0	NS
A	*Sialia sialis*	Eastern Bluebird	Not At Risk			S3B	44	45.1 ± 0.0	NS
A	*Buteo lagopus*	Rough-legged Hawk	Not At Risk			S3N	7	68.9 ± 0.0	NS
A	*Accipiter gentilis*	Northern Goshawk	Not At Risk			S3S4	108	12.2 ± 0.0	NS
A	*Glaucomys volans*	Southern Flying Squirrel	Not At Risk			S3S4	1	40.1 ± 0.0	NS
A	*Lagenorhynchus acutus*	Atlantic White-sided Dolphin	Not At Risk			S3S4	3	93.7 ± 2.0	NS
A	*Ammospiza nelsoni*	Nelson's Sparrow	Not At Risk			S3S4B	159	15.0 ± 0.0	NS
A	*Calidris canutus rufa*	Red Knot rufa subspecies	E,SC	Endangered	Endangered	S2M	108	59.8 ± 0.0	NS
A	*Calidris canutus*	Red Knot	E,SC	E,T		S2M	7	77.3 ± 0.0	NS
A	*Morone saxatilis*	Striped Bass	E,SC			S2S3B,S2S3N	11	66.8 ± 0.0	NS
A	*Gadus morhua*	Atlantic Cod	E,SC,DD			SNR	4	59.3 ± 0.0	NS
A	*Salmo salar*	Atlantic Salmon	E,T,SC			S1B,S1N	10	23.1 ± 0.0	NS
A	*Alces alces americana*	Moose			Endangered	S1	126	8.7 ± 0.0	NS
A	*Alces alces*	Moose				S1	7	15.3 ± 0.0	NS
A	*Picoides dorsalis*	American Three-toed Woodpecker				S1?	4	35.0 ± 7.0	NS
A	*Uria aalge*	Common Murre				S1?B	6	31.1 ± 0.0	NS
A	*Passerina cyanea*	Indigo Bunting				S1?B,SUM	22	35.0 ± 7.0	NS
A	*Nycticorax nycticorax*	Black-crowned Night-heron				S1B	1	96.9 ± 7.0	NS
A	*Oxyura jamaicensis*	Ruddy Duck				S1B	20	74.5 ± 7.0	NS
A	*Gallinula galeata*	Common Gallinule				S1B	7	68.3 ± 0.0	NS
A	*Myiarchus crinitus*	Great Crested Flycatcher				S1B	9	70.9 ± 7.0	NS
A	*Mimus polyglottos*	Northern Mockingbird				S1B	30	56.8 ± 7.0	NS
A	*Toxostoma rufum*	Brown Thrasher				S1B	9	67.9 ± 7.0	NS
A	*Charadrius semipalmatus*	Semipalmated Plover				S1B,S4M	785	17.9 ± 0.0	NS
A	*Calidris minutilla*	Least Sandpiper				S1B,S4M	484	26.5 ± 0.0	NS
A	*Anas acuta*	Northern Pintail				S1B,SUM	58	35.0 ± 7.0	NS
A	*Vireo gilvus*	Warbling Vireo				S1B,SUM	13	36.2 ± 0.0	NS
A	*Vespertilionidae sp.*	bat species				S1S2	87	3.7 ± 0.0	NS
A	*Pooecetes gramineus*	Vesper Sparrow				S1S2B,SUM	19	15.7 ± 0.0	NS
A	*Vireo philadelphicus*	Philadelphia Vireo				S2?B,SUM	37	8.2 ± 7.0	NS
A	*Alca torda*	Razorbill				S2B	7	62.8 ± 0.0	NS

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A	*Fratercula arctica*	Atlantic Puffin				S2B	4	15.0 ± 7.0	NS
A	*Empidonax traillii*	Willow Flycatcher				S2B	18	35.0 ± 7.0	NS
A	*Molothrus ater*	Brown-headed Cowbird				S2B	102	5.9 ± 7.0	NS
A	*Spatula clypeata*	Northern Shoveler				S2B,SUM	25	65.7 ± 7.0	NS
A	*Mareca strepera*	Gadwall				S2B,SUM	39	42.8 ± 7.0	NS
A	*Piranga olivacea*	Scarlet Tanager				S2B,SUM	20	36.1 ± 0.0	NS
A	*Calidris alba*	Sanderling				S2N,S3M	392	17.9 ± 0.0	NS
A	*Martes americana*	American Marten			Endangered	S2S3	1	69.9 ± 0.0	NS
A	*Asio otus*	Long-eared Owl				S2S3	25	31.7 ± 0.0	NS
A	*Rallus limicola*	Virginia Rail				S2S3B	21	73.8 ± 7.0	NS
A	*Rissa tridactyla*	Black-legged Kittiwake				S2S3B	3	76.0 ± 0.0	NS
A	*Petrochelidon pyrrhonota*	Cliff Swallow				S2S3B	198	12.6 ± 0.0	NS
A	*Phalacrocorax carbo*	Great Cormorant				S2S3B,S2S3N	107	13.0 ± 0.0	NS
A	*Cathartes aura*	Turkey Vulture				S2S3B,S4S5M	60	25.4 ± 0.0	NS
A	*Setophaga pinus*	Pine Warbler				S2S3B,S4S5M	43	43.9 ± 0.0	NS
A	*Bucephala clangula*	Common Goldeneye				S2S3B,S5N,S5M	297	6.2 ± 0.0	NS
A	*Icterus galbula*	Baltimore Oriole				S2S3B,SUM	72	7.5 ± 7.0	NS
A	*Pluvialis dominica*	American Golden-Plover				S2S3M	49	67.0 ± 0.0	NS
A	*Numenius phaeopus*	Whimbrel				S2S3M	24	29.7 ± 0.0	NS
A	*Numenius phaeopus hudsonicus*	Whimbrel				S2S3M	102	33.3 ± 0.0	NS
A	*Phalaropus fulicarius*	Red Phalarope				S2S3M	4	62.8 ± 0.0	NS
A	*Perisoreus canadensis*	Canada Jay				S3	530	5.9 ± 7.0	NS
A	*Poecile hudsonicus*	Boreal Chickadee				S3	911	2.5 ± 0.0	NS
A	*Spinus pinus*	Pine Siskin				S3	461	5.9 ± 7.0	NS
A	*Salvelinus fontinalis*	Brook Trout				S3	78	5.3 ± 0.0	NS
A	*Salvelinus namaycush*	Lake Trout				S3	2	30.0 ± 0.0	NS
A	*Pekania pennanti*	Fisher				S3	8	35.5 ± 7.0	NS
A	*Calcarius lapponicus*	Lapland Longspur				S3?N,SUM	9	15.3 ± 0.0	NS
A	*Spatula discors*	Blue-winged Teal				S3B	104	7.5 ± 7.0	NS
A	*Charadrius vociferus*	Killdeer				S3B	446	5.9 ± 7.0	NS
A	*Tringa semipalmata*	Willet				S3B	1179	5.9 ± 7.0	NS
A	*Sterna paradisaea*	Arctic Tern				S3B	76	9.0 ± 0.0	NS
A	*Coccyzus erythropthalmus*	Black-billed Cuckoo				S3B	75	6.8 ± 7.0	NS
A	*Tyrannus tyrannus*	Eastern Kingbird				S3B	175	5.9 ± 7.0	NS
A	*Pheucticus ludovicianus*	Rose-breasted Grosbeak				S3B	475	5.9 ± 7.0	NS
A	*Alosa pseudoharengus*	Alewife				S3B	30	14.4 ± 0.0	NS
A	*Somateria mollissima*	Common Eider				S3B,S3M,S3N	994	5.9 ± 7.0	NS
A	*Tringa melanoleuca*	Greater Yellowlegs				S3B,S4M	922	7.5 ± 7.0	NS
A	*Falco sparverius*	American Kestrel				S3B,S4S5M	318	5.9 ± 7.0	NS
A	*Gallinago delicata*	Wilson's Snipe				S3B,S5M	610	6.5 ± 0.0	NS
A	*Setophaga striata*	Blackpoll Warbler				S3B,S5M	166	5.9 ± 7.0	NS
A	*Cardellina pusilla*	Wilson's Warbler				S3B,S5M	123	5.9 ± 7.0	NS
A	*Pinicola enucleator*	Pine Grosbeak				S3B,S5N,S5M	124	5.9 ± 7.0	NS
A	*Setophaga tigrina*	Cape May Warbler				S3B,SUM	215	3.6 ± 0.0	NS
A	*Branta bernicla*	Brant				S3M	1	87.0 ± 0.0	NS
A	*Pluvialis squatarola*	Black-bellied Plover				S3M	645	30.8 ± 0.0	NS
A	*Arenaria interpres*	Ruddy Turnstone				S3M	245	18.4 ± 0.0	NS
A	*Calidris pusilla*	Semipalmated Sandpiper				S3M	663	17.9 ± 0.0	NS
A	*Calidris melanotos*	Pectoral Sandpiper				S3M	89	53.4 ± 0.0	NS
A	*Limnodromus griseus*	Short-billed Dowitcher				S3M	441	41.8 ± 0.0	NS
A	*Chroicocephalus ridibundus*	Black-headed Gull				S3N	71	13.7 ± 0.0	NS
A	*Picoides arcticus*	Black-backed Woodpecker				S3S4	149	6.8 ± 7.0	NS
A	*Loxia curvirostra*	Red Crossbill				S3S4	163	5.9 ± 7.0	NS
A	*Botaurus lentiginosus*	American Bittern				S3S4B,S4S5M	290	6.5 ± 0.0	NS
A	*Setophaga castanea*	Bay-breasted Warbler				S3S4B,S4S5M	560	5.9 ± 7.0	NS
A	*Actitis macularius*	Spotted Sandpiper				S3S4B,S5M	755	5.9 ± 7.0	NS
A	*Leiothlypis peregrina*	Tennessee Warbler				S3S4B,S5M	566	5.9 ± 7.0	NS

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A	*Passerella iliaca*	Fox Sparrow				S3S4B,S5M	115	10.5 ± 0.0	NS
A	*Mergus serrator*	Red-breasted Merganser				S3S4B,S5M,S5N	336	12.5 ± 0.0	NS
A	*Calidris maritima*	Purple Sandpiper				S3S4N	60	22.3 ± 10.0	NS
A	*Lanius borealis*	Northern Shrike				S3S4N	3	45.0 ± 0.0	NS
A	*Morus bassanus*	Northern Gannet				SHB	56	15.0 ± 0.0	NS
A	*Aythya americana*	Redhead				SHB	13	53.0 ± 0.0	NS
A	*Leucophaeus atricilla*	Laughing Gull				SHB	12	26.4 ± 0.0	NS
A	*Progne subis*	Purple Martin				SHB	6	35.0 ± 7.0	NS
A	*Eremophila alpestris*	Horned Lark				SHB,S4S5N,S5M	17	15.0 ± 7.0	NS
I	*Bombus bohemicus*	Ashton Cuckoo Bumble Bee	Endangered	Endangered	Endangered	S1	24	52.9 ± 5.0	NS
I	*Danaus plexippus*	Monarch	Endangered	Special Concern	Endangered	S2?B,S3M	532	11.4 ± 0.0	NS
I	*Bombus suckleyi*	Suckley's Cuckoo Bumble Bee	Threatened			SH	2	76.4 ± 5.0	NS
I	*Alasmidonta varicosa*	Brook Floater	Special Concern	Special Concern	Threatened	S3	11	50.8 ± 0.0	NS
I	*Bombus terricola*	Yellow-banded Bumble Bee	Special Concern	Special Concern	Vulnerable	S3	84	4.2 ± 0.0	NS
I	*Coccinella transversoguttata richardsoni*	Transverse Lady Beetle	Special Concern		Endangered	SH	5	72.8 ± 2.0	NS
I	*Gomphurus ventricosus*	Skillet Clubtail	Special Concern	Endangered		SH	1	82.7 ± 0.0	NS
I	*Erora laeta*	Early Hairstreak				S1	1	98.0 ± 1.0	NS
I	*Pachydiplax longipennis*	Blue Dasher				S1	11	85.1 ± 0.0	NS
I	*Polygonia comma*	Eastern Comma				S1?	8	90.0 ± 0.0	NS
I	*Polygonia satyrus*	Satyr Comma				S1?	5	74.3 ± 5.0	NS
I	*Euphyes bimacula*	Two-spotted Skipper				S1S2	2	46.3 ± 0.0	NS
I	*Boloria chariclea*	Arctic Fritillary				S1S2	1	95.6 ± 2.0	NS
I	*Somatochlora brevicincta*	Quebec Emerald				S1S2	1	70.5 ± 0.0	NS
I	*Tharsalea dospassosi*	Maritime Copper				S2	12	88.3 ± 1.0	NS
I	*Satyrium acadica*	Acadian Hairstreak				S2	9	81.7 ± 2.0	NS
I	*Neurocordulia michaeli*	Broad-tailed Shadowdragon				S2	26	36.1 ± 0.0	NS
I	*Coenagrion resolutum*	Taiga Bluet				S2	2	89.8 ± 1.0	NS
I	*Margaritifera margaritifera*	Eastern Pearlshell				S2	114	22.8 ± 0.0	NS
I	*Pantala hymenaea*	Spot-Winged Glider				S2?B	7	40.1 ± 1.0	NS
I	*Nymphalis l-album*	Compton Tortoiseshell				S2S3	17	63.0 ± 0.0	NS
I	*Aglais milberti*	Milbert's Tortoiseshell				S2S3	18	68.6 ± 2.0	NS
I	*Lanthus vernalis*	Southern Pygmy Clubtail				S2S3	8	36.2 ± 0.0	NS
I	*Somatochlora kennedyi*	Kennedy's Emerald				S2S3	2	88.3 ± 1.0	NS
I	*Stylurus scudderi*	Zebra Clubtail				S2S3	4	62.5 ± 0.0	NS
I	*Alasmidonta undulata*	Triangle Floater				S2S3	24	39.5 ± 0.0	NS
I	*Strophiona nitens*	Chestnut Bark Long-horned Beetle				S3	1	98.9 ± 0.0	NS
I	*Psephenus herricki*	Herrick's Water Penny Beetle				S3	1	53.6 ± 0.0	NS
I	*Carabus serratus*	Serrated Ground Beetle				S3	1	94.1 ± 0.0	NS
I	*Hippodamia parenthesis*	Parenthesis Lady Beetle				S3	1	89.2 ± 0.0	NS
I	*Chrysochus auratus*	Dogbane Leaf Beetle				S3	2	51.5 ± 0.0	NS
I	*Naemia seriata*	Seaside Lady Beetle				S3	4	63.8 ± 0.0	NS
I	*Elateroides lugubris*	Sapwood Ship-timber Beetle				S3	1	99.9 ± 0.0	NS
I	*Chilocorus stigma*	Twice-stabbed Lady Beetle				S3	3	79.3 ± 0.0	NS
I	*Myzia pullata*	Streaked Lady Beetle				S3	4	85.7 ± 0.0	NS
I	*Monochamus marmorator*	Balsam Fir Sawyer				S3	3	51.7 ± 0.0	NS
I	*Trachysida aspera*	Rough Flower Longhorn Beetle				S3	1	89.2 ± 0.0	NS
I	*Astylopsis sexguttata*	Six-speckled Long-horned Beetle				S3	2	91.3 ± 0.0	NS
I	*Satyrium calanus*	Banded Hairstreak				S3	29	70.5 ± 2.0	NS
I	*Callophrys lanoraieensis*	Bog Elfin				S3	4	22.1 ± 1.0	NS
I	*Strymon melinus*	Gray Hairstreak				S3	1	97.8 ± 1.0	NS
I	*Ophiogomphus mainensis*	Maine Snaketail				S3	14	36.1 ± 0.0	NS
I	*Ophiogomphus rupinsulensis*	Rusty Snaketail				S3	55	36.1 ± 0.0	NS

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I	*Epitheca princeps*	Prince Baskettail				S3	9	85.4 ± 0.0	NS
I	*Somatochlora forcipata*	Forcipate Emerald				S3	3	88.3 ± 1.0	NS
I	*Enallagma vernale*	Vernal Bluet				S3	2	66.7 ± 0.0	NS
I	*Polygonia interrogationis*	Question Mark				S3B	117	14.9 ± 0.0	NS
I	*Cecropterus pylades*	Northern Cloudywing				S3S4	26	45.2 ± 0.0	NS
I	*Amblyscirtes hegon*	Pepper and Salt Skipper				S3S4	32	37.6 ± 0.0	NS
I	*Cupido comyntas*	Eastern Tailed Blue				S3S4	3	18.6 ± 0.0	NS
I	*Argynnis aphrodite*	Aphrodite Fritillary				S3S4	23	65.3 ± 100.0	NS
I	*Polygonia faunus*	Green Comma				S3S4	19	39.0 ± 0.0	NS
I	*Oeneis jutta*	Jutta Arctic				S3S4	3	39.5 ± 0.0	NS
I	*Aeshna clepsydra*	Mottled Darner				S3S4	10	26.8 ± 1.0	NS
I	*Aeshna constricta*	Lance-Tipped Darner				S3S4	15	55.5 ± 1.0	NS
I	*Boyeria grafiana*	Ocellated Darner				S3S4	9	21.4 ± 1.0	NS
I	*Gomphaeschna furcillata*	Harlequin Darner				S3S4	10	66.7 ± 0.0	NS
I	*Erythrodiplax berenice*	Seaside Dragonlet				S3S4	6	78.8 ± 0.0	NS
I	*Nannothemis bella*	Elfin Skimmer				S3S4	6	43.5 ± 0.0	NS
I	*Sympetrum danae*	Black Meadowhawk				S3S4	4	55.9 ± 1.0	NS
I	*Amphiagrion saucium*	Eastern Red Damsel				S3S4	2	63.9 ± 0.0	NS
I	*Sphaerophoria pyrrhina*	Violaceous Globetail				SH	1	75.0 ± 5.0	NS
I	*Icaricia saepiolus*	Greenish Blue				SH	2	70.1 ± 2.0	NS
I	*Polygonia gracilis*	Hoary Comma				SH	2	68.6 ± 2.0	NS
N	*Erioderma mollissimum*	Graceful Felt Lichen	Endangered	Endangered	Endangered	S1	30	9.6 ± 0.0	NS
N	*Erioderma pedicellatum (Atlantic pop.)*	Boreal Felt Lichen - Atlantic pop.	Endangered	Endangered	Endangered	S1	545	4.2 ± 0.0	NS
N	*Peltigera hydrothyria*	Eastern Waterfan	Threatened	Threatened	Threatened	S1	14	24.8 ± 0.0	NS
N	*Pannaria lurida*	Wrinkled Shingle Lichen	Threatened	Threatened	Threatened	S2S3	23	52.1 ± 1.0	NS
N	*Anzia colpodes*	Black-foam Lichen	Threatened	Threatened	Threatened	S3	27	10.0 ± 0.0	NS
N	*Fuscopannaria leucosticta*	White-rimmed Shingle Lichen	Threatened			S3	7	4.5 ± 0.0	NS
N	*Heterodermia squamulosa*	Scaly Fringe Lichen	Threatened			S3	8	25.4 ± 0.0	NS
N	*Pectenia plumbea*	Blue Felt Lichen	Special Concern	Special Concern	Vulnerable	S3	194	6.0 ± 0.0	NS
N	*Sclerophora peronella (Atlantic pop.)*	Frosted Glass-whiskers (Atlantic population)	Special Concern	Special Concern		S3S4	28	14.0 ± 0.0	NS
N	*Pseudevernia cladonia*	Ghost Antler Lichen	Not At Risk			S2S3	16	18.5 ± 1.0	NS
N	*Fissidens exilis*	Pygmy Pocket Moss	Not At Risk			S3	5	68.7 ± 0.0	NS
N	*Chaenotheca servitii*	Flexuous Golden Stubble	Data Deficient			S1	1	24.6 ± 1.0	NS
N	*Sematophyllum demissum*	a Moss				S1	1	90.2 ± 2.0	NS
N	*Cyrto-hypnum minutulum*	Tiny Cedar Moss				S1	1	24.3 ± 0.0	NS
N	*Scytinium schraderi*	Wrinkled Jellyskin Lichen				S1	1	87.7 ± 0.0	NS
N	*Lichina confinis*	Marine Seaweed Lichen				S1	2	20.5 ± 2.0	NS
N	*Polychidium muscicola*	Eyed Mossthorns Woollybear Lichen				S1	1	38.3 ± 0.0	NS
N	*Bryoria nitidula*	Tundra Horsehair Lichen				S1	2	96.6 ± 0.0	NS
N	*Hypogymnia hultenii*	Powdered Honeycomb Lichen				S1	18	18.0 ± 0.0	NS
N	*Jubula pennsylvanica*	a liverwort				S1?	1	46.4 ± 0.0	NS
N	*Tortula obtusifolia*	a Moss				S1?	3	40.3 ± 0.0	NS
N	*Scytinium intermedium*	Forty-five Jellyskin Lichen				S1?	1	92.4 ± 4.0	NS
N	*Sematophyllum marylandicum*	a Moss				S1S2	2	87.5 ± 6.0	NS
N	*Pseudotaxiphyllum distichaceum*	a Moss				S1S2	1	34.9 ± 0.0	NS
N	*Haplocladium microphyllum*	Tiny-leaved Haplocladium Moss				S1S2	1	88.9 ± 5.0	NS
N	*Placidium squamulosum*	Limy Soil Stipplescale Lichen				S1S2	1	41.5 ± 6.0	NS
N	*Cladonia labradorica*	Labrador Lichen				S1S2	1	71.2 ± 0.0	NS
N	*Peltigera ponojensis*	Pale-bellied Pelt Lichen				S1S2	1	62.9 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
N	*Parmotrema reticulatum*	Netted Ruffle Lichen				S1S2	1	88.5 ± 0.0	NS
N	*Solorina spongiosa*	Blinking Owl Lichen				S1S2	7	78.7 ± 0.0	NS
N	*Parmeliella parvula*	Poor-man's Shingles Lichen				S1S2	22	11.1 ± 0.0	NS
N	*Acarospora sinopica*	a cracked lichen				S1S3	2	96.6 ± 0.0	NS
N	*Xylopsora friesii*	a Lichen				S1S3	2	93.6 ± 0.0	NS
N	*Peltigera neckeri*	Black-saddle Pelt Lichen				S1S3	2	49.9 ± 0.0	NS
N	*Stereocaulon intermedium*	Pacific Brain Foam Lichen				S1S3	1	99.1 ± 0.0	NS
N	*Anacamptodon splachnoides*	a Moss				S2	1	95.2 ± 30.0	NS
N	*Sphagnum platyphyllum*	Flat-leaved Peat Moss				S2	2	86.5 ± 3.0	NS
N	*Sphagnum subnitens*	Lustrous Peat Moss				S2	1	40.2 ± 2.0	NS
N	*Nephroma arcticum*	Arctic Kidney Lichen				S2	1	96.5 ± 1.0	NS
N	*Nephroma resupinatum*	a lichen				S2	3	69.7 ± 5.0	NS
N	*Placynthium flabellosum*	Scaly Ink Lichen				S2	1	59.2 ± 17.0	NS
N	*Riccardia multifida*	Delicate Germanderwort				S2?	2	41.9 ± 0.0	NS
N	*Atrichum angustatum*	Lesser Smoothcap Moss				S2?	2	75.7 ± 2.0	NS
N	*Drepanocladus polygamus*	Polygamous Hook Moss				S2?	2	21.4 ± 0.0	NS
N	*Kiaeria starkei*	Starke's Fork Moss				S2?	1	50.5 ± 10.0	NS
N	*Philonotis marchica*	a Moss				S2?	2	72.0 ± 0.0	NS
N	*Platydictya jungermannioides*	False Willow Moss				S2?	3	70.0 ± 0.0	NS
N	*Saelania glaucescens*	Blue Dew Moss				S2?	1	95.9 ± 0.0	NS
N	*Cyrtomnium hymenophylloides*	Short-pointed Lantern Moss				S2?	2	92.2 ± 5.0	NS
N	*Oxyrrhynchium hians*	Light Beaked Moss				S2S3	2	56.7 ± 25.0	NS
N	*Moelleropsis nebulosa*	Blue-gray Moss Shingle Lichen				S2S3	61	7.0 ± 0.0	NS
N	*Moelleropsis nebulosa ssp. frullaniae*	Blue-gray Moss Shingle Lichen				S2S3	3	23.2 ± 0.0	NS
N	*Ramalina thrausta*	Angelhair Ramalina Lichen				S2S3	17	20.6 ± 0.0	NS
N	*Collema leptaleum*	Crumpled Bat's Wing Lichen				S2S3	8	35.9 ± 0.0	NS
N	*Usnea rubicunda*	Red Beard Lichen				S2S3	4	35.0 ± 0.0	NS
N	*Ahtiana aurescens*	Eastern Candlewax Lichen				S2S3	7	10.0 ± 0.0	NS
N	*Usnocetraria oakesiana*	Yellow Band Lichen				S2S3	1	98.9 ± 0.0	NS
N	*Cetraria muricata*	Spiny Heath Lichen				S2S3	1	77.2 ± 1.0	NS
N	*Cladonia incrassata*	Powder-foot British Soldiers Lichen				S2S3	1	24.8 ± 0.0	NS
N	*Cladonia mateocyatha*	Mixed-up Pixie-cup				S2S3	1	99.7 ± 5.0	NS
N	*Chaenotheca gracilenta*	a lichen				S2S3	1	93.7 ± 0.0	NS
N	*Scytinium tenuissimum*	Birdnest Jellyskin Lichen				S2S3	15	40.3 ± 0.0	NS
N	*Parmelia fertilis*	Fertile Shield Lichen				S2S3	6	23.2 ± 0.0	NS
N	*Hypotrachyna minarum*	Hairless-spined Shield Lichen				S2S3	1	45.9 ± 0.0	NS
N	*Parmeliopsis ambigua*	Green Starburst Lichen				S2S3	5	50.7 ± 0.0	NS
N	*Racodium rupestre*	Rockhair Lichen				S2S3	1	100.0 ± 1.0	NS
N	*Fuscopannaria sorediata*	a Lichen				S2S3	11	19.3 ± 0.0	NS
N	*Stereocaulon condensatum*	Granular Soil Foam Lichen				S2S3	5	69.3 ± 0.0	NS
N	*Physcia subtilis*	Slender Rosette Lichen				S2S3	1	53.0 ± 0.0	NS
N	*Dimelaena oreina*	Golden Moonglow Lichen				S2S3	1	94.5 ± 0.0	NS
N	*Cladonia coccifera*	Eastern Boreal Pixie-cup Lichen				S2S3	4	25.1 ± 1.0	NS
N	*Ephemerum serratum*	a Moss				S3	2	70.9 ± 0.0	NS
N	*Fissidens taxifolius*	Yew-leaved Pocket Moss				S3	3	70.9 ± 0.0	NS
N	*Anomodon tristis*	a Moss				S3	3	16.5 ± 0.0	NS
N	*Tetraplodon angustatus*	Toothed-leaved Nitrogen Moss				S3	3	26.3 ± 0.0	NS
N	*Rostania occultata*	Crusted Tarpaper Lichen				S3	2	43.5 ± 0.0	NS
N	*Collema nigrescens*	Blistered Tarpaper Lichen				S3	10	4.2 ± 0.0	NS
N	*Solorina saccata*	Woodland Owl Lichen				S3	5	68.9 ± 2.0	NS

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N	*Fuscopannaria ahlneri*	Corrugated Shingles Lichen				S3	100	10.0 ± 0.0	NS
N	*Scytinium lichenoides*	Tattered Jellyskin Lichen				S3	29	23.2 ± 1.0	NS
N	*Leptogium milligranum*	Stretched Jellyskin Lichen				S3	1	78.0 ± 3.0	NS
N	*Nephroma bellum*	Naked Kidney Lichen				S3	5	51.1 ± 0.0	NS
N	*Placynthium nigrum*	Common Ink Lichen				S3	2	21.6 ± 10.0	NS
N	*Platismatia norvegica*	Oldgrowth Rag Lichen				S3	2	41.2 ± 0.0	NS
N	*Ephebe lanata*	Waterside Rockshag Lichen				S3	2	38.3 ± 0.0	NS
N	*Phaeophyscia adiastola*	Powder-tipped Shadow Lichen				S3	1	93.9 ± 0.0	NS
N	*Phaeophyscia pusilloides*	Pompom-tipped Shadow Lichen				S3	10	71.3 ± 0.0	NS
N	*Peltigera collina*	Tree Pelt Lichen				S3	21	12.3 ± 0.0	NS
N	*Barbula convoluta*	Lesser Bird's-claw Beard Moss				S3?	1	97.9 ± 0.0	NS
N	*Elodium blandowii*	Blandow's Bog Moss				S3?	2	83.5 ± 3.0	NS
N	*Sphagnum lindbergii*	Lindberg's Peat Moss				S3?	1	28.7 ± 0.0	NS
N	*Sphagnum riparium*	Streamside Peat Moss				S3?	2	19.0 ± 0.0	NS
N	*Cladonia stygia*	Black-footed Reindeer Lichen				S3?	5	28.1 ± 0.0	NS
N	*Dichelyma capillaceum*	Hairlike Dichelyma Moss				S3S4	1	93.0 ± 3.0	NS
N	*Encalypta ciliata*	Fringed Extinguisher Moss				S3S4	1	96.7 ± 2.0	NS
N	*Encalypta procera*	Slender Extinguisher Moss				S3S4	9	89.2 ± 0.0	NS
N	*Myurella julacea*	Small Mouse-tail Moss				S3S4	1	95.9 ± 0.0	NS
N	*Splachnum ampullaceum*	Cruet Dung Moss				S3S4	2	12.6 ± 0.0	NS
N	*Tomentypnum nitens*	Golden Fuzzy Fen Moss				S3S4	1	40.4 ± 2.0	NS
N	*Schistidium agassizii*	Elf Bloom Moss				S3S4	2	38.2 ± 0.0	NS
N	*Hylocomiastrum pyrenaicum*	a Feather Moss				S3S4	1	95.3 ± 0.0	NS
N	*Bryoria pseudofuscescens*	Mountain Horsehair Lichen				S3S4	1	99.3 ± 1.0	NS
N	*Enchylium tenax*	Soil Tarpaper Lichen				S3S4	7	67.8 ± 0.0	NS
N	*Sticta fuliginosa*	Peppered Moon Lichen				S3S4	51	9.5 ± 0.0	NS
N	*Arctoparmelia incurva*	Finger Ring Lichen				S3S4	69	48.3 ± 0.0	NS
N	*Scytinium teretiusculum*	Curly Jellyskin Lichen				S3S4	6	52.1 ± 0.0	NS
N	*Leptogium acadiense*	Acadian Jellyskin Lichen				S3S4	12	8.3 ± 0.0	NS
N	*Scytinium subtile*	Appressed Jellyskin Lichen				S3S4	10	11.1 ± 0.0	NS
N	*Cladonia floerkeana*	Gritty British Soldiers Lichen				S3S4	1	96.7 ± 0.0	NS
N	*Vahliella leucophaea*	Shelter Shingle Lichen				S3S4	1	71.1 ± 0.0	NS
N	*Heterodermia speciosa*	Powdered Fringe Lichen				S3S4	16	9.7 ± 0.0	NS
N	*Leptogium corticola*	Blistered Jellyskin Lichen				S3S4	41	10.2 ± 0.0	NS
N	*Melanohalea olivacea*	Spotted Camouflage Lichen				S3S4	2	68.5 ± 0.0	NS
N	*Parmeliopsis hyperopta*	Gray Starburst Lichen				S3S4	3	81.0 ± 1.0	NS
N	*Parmotrema perlatum*	Powdered Ruffle Lichen				S3S4	2	25.7 ± 0.0	NS
N	*Peltigera hymenina*	Cloudy Pelt Lichen				S3S4	2	12.3 ± 1.0	NS
N	*Sphaerophorus fragilis*	Fragile Coral Lichen				S3S4	5	37.6 ± 0.0	NS
N	*Coccocarpia palmicola*	Salted Shell Lichen				S3S4	813	1.8 ± 0.0	NS
N	*Physcia tenella*	Fringed Rosette Lichen				S3S4	6	28.4 ± 3.0	NS
N	*Anaptychia palmulata*	Shaggy Fringed Lichen				S3S4	65	10.0 ± 0.0	NS
N	*Evernia prunastri*	Valley Oakmoss Lichen				S3S4	9	65.4 ± 0.0	NS
N	*Heterodermia neglecta*	Fringe Lichen				S3S4	59	6.0 ± 0.0	NS
P	*Clethra alnifolia*	Coast Pepper-Bush	Endangered	Threatened	Vulnerable	S2	1	91.2 ± 0.0	NS
P	*Juglans cinerea*	Butternut	Endangered	Endangered		SNA	7	67.6 ± 0.0	NS
P	*Fraxinus nigra*	Black Ash	Threatened		Threatened	S1S2	407	46.1 ± 14.0	NS
P	*Liatris spicata*	Dense Blazing Star	Threatened	Threatened		SNA	3	87.5 ± 0.0	NS
P	*Floerkea proserpinacoides*	False Mermaidweed	Not At Risk			S2S3	3	72.2 ± 7.0	NS
P	*Betula minor*	Dwarf White Birch				S1	1	55.2 ± 0.0	NS
P	*Cochlearia tridactylites*	Limestone Scurvy-grass				S1	10	23.6 ± 0.0	NS
P	*Lobelia spicata*	Pale-Spiked Lobelia				S1	1	97.2 ± 7.0	NS
P	*Hudsonia tomentosa*	Woolly Beach-heath				S1	6	76.2 ± 7.0	NS
P	*Ribes americanum*	Wild Black Currant				S1	2	77.3 ± 5.0	NS

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P	*Persicaria careyi*	Carey's Smartweed				S1	1	62.6 ± 3.0	NS
P	*Phytolacca americana*	Common Pokeweed				S1	1	92.8 ± 0.0	NS
P	*Montia fontana*	Water Blinks				S1	1	95.5 ± 1.0	NS
P	*Salix myrtillifolia*	Blueberry Willow				S1	1	55.1 ± 0.0	NS
P	*Salix serissima*	Autumn Willow				S1	2	54.8 ± 0.0	NS
P	*Scrophularia lanceolata*	Lance-leaved Figwort				S1	1	93.2 ± 1.0	NS
P	*Carex alopecoidea*	Foxtail Sedge				S1	3	92.9 ± 0.0	NS
P	*Carex garberi*	Garber's Sedge				S1	4	67.9 ± 0.0	NS
P	*Carex plantaginea*	Plantain-Leaved Sedge				S1	4	48.0 ± 0.0	NS
P	*Carex tenuiflora*	Sparse-Flowered Sedge				S1	1	90.6 ± 1.0	NS
P	*Carex tincta*	Tinged Sedge				S1	2	92.9 ± 0.0	NS
P	*Carex viridula var. saxilittoralis*	Greenish Sedge				S1	4	22.6 ± 0.0	NS
P	*Carex grisea*	Inflated Narrow-leaved Sedge				S1	6	83.8 ± 0.0	NS
P	*Cyperus lupulinus ssp. macilentus*	Hop Flatsedge				S1	18	80.5 ± 0.0	NS
P	*Scirpus atrovirens*	Dark-green Bulrush				S1	1	70.2 ± 0.0	NS
P	*Iris prismatica*	Slender Blue Flag				S1	2	49.9 ± 7.0	NS
P	*Juncus vaseyi*	Vasey Rush				S1	1	69.0 ± 0.0	NS
P	*Malaxis monophyllos var. brachypoda*	North American White Adder's-mouth				S1	1	99.6 ± 7.0	NS
P	*Elymus hystrix*	Spreading Wild Rye				S1	4	52.0 ± 1.0	NS
P	*Potamogeton nodosus*	Long-leaved Pondweed				S1	1	38.6 ± 5.0	NS
P	*Adiantum pedatum*	Northern Maidenhair Fern				S1	2	76.1 ± 0.0	NS
P	*Botrychium lunaria*	Common Moonwort				S1	10	77.1 ± 2.0	NS
P	*Solidago hispida*	Hairy Goldenrod				S1?	2	26.7 ± 7.0	NS
P	*Carex pensylvanica*	Pennsylvania Sedge				S1?	2	69.1 ± 3.0	NS
P	*Allium schoenoprasum*	Wild Chives				S1?	1	93.8 ± 0.0	NS
P	*Allium schoenoprasum var. sibiricum*	Wild Chives				S1?	1	80.1 ± 7.0	NS
P	*Sanicula odorata*	Clustered Sanicle				S1S2	4	67.5 ± 0.0	NS
P	*Ageratina altissima*	White Snakeroot				S1S2	2	88.1 ± 7.0	NS
P	*Proserpinaca intermedia*	Intermediate Mermaidweed				S1S2	1	64.1 ± 0.0	NS
P	*Anemone virginiana var. alba*	Virginia Anemone				S1S2	5	72.2 ± 5.0	NS
P	*Parnassia parviflora*	Small-flowered Grass-of-Parnassus				S1S2	1	92.2 ± 1.0	NS
P	*Carex haydenii*	Hayden's Sedge				S1S2	3	72.4 ± 0.0	NS
P	*Platanthera huronensis*	Fragrant Green Orchid				S1S2	1	70.5 ± 10.0	NS
P	*Carex vacillans*	Estuarine Sedge				S1S3	5	15.0 ± 0.0	NS
P	*Zizia aurea*	Golden Alexanders				S2	42	41.3 ± 1.0	NS
P	*Antennaria parlinii ssp. fallax*	Parlin's Pussytoes				S2	2	87.9 ± 0.0	NS
P	*Rudbeckia laciniata*	Cut-Leaved Coneflower				S2	7	50.9 ± 0.0	NS
P	*Hudsonia ericoides*	Pinebarren Golden Heather				S2	142	90.6 ± 2.0	NS
P	*Desmodium canadense*	Canada Tick-trefoil				S2	20	62.0 ± 0.0	NS
P	*Anemonastrum canadense*	Canada Anemone				S2	6	76.0 ± 0.0	NS
P	*Hepatica americana*	Round-lobed Hepatica				S2	23	52.6 ± 1.0	NS
P	*Ranunculus sceleratus*	Cursed Buttercup				S2	24	73.9 ± 0.0	NS
P	*Comandra umbellata*	Bastard's Toadflax				S2	36	91.1 ± 5.0	NS
P	*Gratiola neglecta*	Clammy Hedge-Hyssop				S2	6	58.6 ± 0.0	NS
P	*Dirca palustris*	Eastern Leatherwood				S2	5	77.1 ± 1.0	NS
P	*Carex gynocrates*	Northern Bog Sedge				S2	2	55.0 ± 0.0	NS
P	*Carex pellita*	Woolly Sedge				S2	10	39.0 ± 10.0	NS
P	*Carex livida*	Livid Sedge				S2	13	40.6 ± 0.0	NS
P	*Juncus greenei*	Greene's Rush				S2	4	87.6 ± 1.0	NS
P	*Luzula spicata*	Spiked Woodrush				S2	1	84.0 ± 0.0	NS
P	*Allium tricoccum*	Wild Leek				S2	9	72.3 ± 0.0	NS

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P	*Lilium canadense*	Canada Lily				S2	98	38.5 ± 0.0	NS
P	*Cypripedium parviflorum var. pubescens*	Yellow Lady's-slipper				S2	25	84.1 ± 0.0	NS
P	*Cypripedium reginae*	Showy Lady's-Slipper				S2	29	41.3 ± 1.0	NS
P	*Platanthera flava var. herbiola*	Pale Green Orchid				S2	9	72.3 ± 7.0	NS
P	*Platanthera macrophylla*	Large Round-Leaved Orchid				S2	12	58.6 ± 0.0	NS
P	*Bromus latiglumis*	Broad-Glumed Brome				S2	28	47.1 ± 0.0	NS
P	*Cinna arundinacea*	Sweet Wood Reed Grass				S2	19	50.7 ± 0.0	NS
P	*Elymus wiegandii*	Wiegand's Wild Rye				S2	14	50.7 ± 0.0	NS
P	*Festuca subverticillata*	Nodding Fescue				S2	2	92.8 ± 1.0	NS
P	*Sparganium hyperboreum*	Northern Burreed				S2	2	71.8 ± 0.0	NS
P	*Cuscuta cephalanthi*	Buttonbush Dodder				S2?	9	76.3 ± 1.0	NS
P	*Crataegus submollis*	Quebec Hawthorn				S2?	3	77.5 ± 7.0	NS
P	*Carex peckii*	White-Tinged Sedge				S2?	3	70.1 ± 0.0	NS
P	*Thuja occidentalis*	Eastern White Cedar			Vulnerable	S2S3	1	64.6 ± 0.0	NS
P	*Osmorhiza longistylis*	Smooth Sweet Cicely				S2S3	14	51.5 ± 0.0	NS
P	*Bidens hyperborea*	Estuary Beggarticks				S2S3	1	88.5 ± 1.0	NS
P	*Erigeron philadelphicus*	Philadelphia Fleabane				S2S3	3	39.8 ± 5.0	NS
P	*Lactuca hirsuta*	Hairy Lettuce				S2S3	1	69.8 ± 7.0	NS
P	*Impatiens pallida*	Pale Jewelweed				S2S3	3	64.0 ± 7.0	NS
P	*Caulophyllum thalictroides*	Blue Cohosh				S2S3	49	46.4 ± 0.0	NS
P	*Boechera stricta*	Drummond's Rockcress				S2S3	4	69.9 ± 0.0	NS
P	*Stellaria humifusa*	Saltmarsh Starwort				S2S3	5	31.3 ± 0.0	NS
P	*Oxybasis rubra*	Red Goosefoot				S2S3	5	29.5 ± 2.0	NS
P	*Hypericum majus*	Large St John's-wort				S2S3	2	92.0 ± 7.0	NS
P	*Hypericum x dissimulatum*	Disguised St. John's-wort				S2S3	3	88.6 ± 1.0	NS
P	*Empetrum atropurpureum*	Purple Crowberry				S2S3	3	91.9 ± 7.0	NS
P	*Euphorbia polygonifolia*	Seaside Spurge				S2S3	7	80.0 ± 2.0	NS
P	*Myriophyllum farwellii*	Farwell's Water Milfoil				S2S3	8	49.3 ± 0.0	NS
P	*Hedeoma pulegioides*	American False Pennyroyal				S2S3	4	40.7 ± 5.0	NS
P	*Oenothera fruticosa ssp. tetragona*	Narrow-leaved Evening Primrose				S2S3	3	72.2 ± 7.0	NS
P	*Polygala polygama*	Racemed Milkwort				S2S3	1	94.2 ± 1.0	NS
P	*Polygonum aviculare ssp. buxiforme*	Box Knotweed				S2S3	2	72.5 ± 0.0	NS
P	*Polygonum oxyspermum ssp. raii*	Ray's Knotweed				S2S3	1	90.7 ± 1.0	NS
P	*Polygonum oxyspermum*	Sharp-fruit Knotweed				S2S3	1	99.1 ± 0.0	NS
P	*Rumex triangulivalvis*	Triangular-valve Dock				S2S3	1	60.6 ± 0.0	NS
P	*Primula mistassinica*	Mistassini Primrose				S2S3	17	49.3 ± 1.0	NS
P	*Anemone quinquefolia*	Wood Anemone				S2S3	21	46.0 ± 0.0	NS
P	*Caltha palustris*	Yellow Marsh Marigold				S2S3	13	76.8 ± 0.0	NS
P	*Amelanchier fernaldii*	Fernald's Serviceberry				S2S3	1	92.9 ± 1.0	NS
P	*Potentilla canadensis*	Canada Cinquefoil				S2S3	4	83.8 ± 5.0	NS
P	*Salix pellita*	Satiny Willow				S2S3	3	58.9 ± 0.0	NS
P	*Tiarella cordifolia*	Heart-leaved Foamflower				S2S3	223	48.6 ± 7.0	NS
P	*Agalinis purpurea var. parviflora*	Small-flowered Purple False Foxglove				S2S3	3	56.1 ± 0.0	NS
P	*Boehmeria cylindrica*	Small-spike False-nettle				S2S3	3	76.4 ± 0.0	NS
P	*Carex adusta*	Lesser Brown Sedge				S2S3	7	31.4 ± 5.0	NS
P	*Carex comosa*	Bearded Sedge				S2S3	2	88.1 ± 0.0	NS
P	*Carex houghtoniana*	Houghton's Sedge				S2S3	1	69.1 ± 1.0	NS
P	*Carex hystericina*	Porcupine Sedge				S2S3	2	93.1 ± 0.0	NS
P	*Eleocharis ovata*	Ovate Spikerush				S2S3	3	77.5 ± 0.0	NS
P	*Scirpus pedicellatus*	Stalked Bulrush				S2S3	7	53.1 ± 0.0	NS
P	*Vallisneria americana*	Wild Celery				S2S3	3	60.7 ± 1.0	NS
P	*Goodyera pubescens*	Downy Rattlesnake-Plantain				S2S3	2	69.5 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Spiranthes casei*	Case's Ladies'-Tresses				S2S3	1	44.5 ± 1.0	NS
P	*Spiranthes casei var. novaescotiae*	Case's Ladies'-Tresses				S2S3	3	60.5 ± 0.0	NS
P	*Spiranthes lucida*	Shining Ladies'-Tresses				S2S3	22	63.4 ± 0.0	NS
P	*Potamogeton friesii*	Fries' Pondweed				S2S3	2	74.8 ± 5.0	NS
P	*Botrychium lanceolatum ssp. angustisegmentum*	Narrow Triangle Moonwort				S2S3	4	61.3 ± 5.0	NS
P	*Botrychium simplex*	Least Moonwort				S2S3	2	58.8 ± 0.0	NS
P	*Ophioglossum pusillum*	Northern Adder's-tongue				S2S3	4	73.8 ± 7.0	NS
P	*Potamogeton pulcher*	Spotted Pondweed			Vulnerable	S3	3	40.9 ± 2.0	NS
P	*Angelica atropurpurea*	Purple-stemmed Angelica				S3	1	54.6 ± 0.0	NS
P	*Conioselinum chinense*	Chinese Hemlock-parsley				S3	1	71.2 ± 5.0	NS
P	*Hieracium robinsonii*	Robinson's Hawkweed				S3	3	75.1 ± 0.0	NS
P	*Senecio pseudoarnica*	Seabeach Ragwort				S3	35	5.9 ± 7.0	NS
P	*Symphyotrichum boreale*	Boreal Aster				S3	3	80.1 ± 7.0	NS
P	*Symphyotrichum undulatum*	Wavy-leaved Aster				S3	2	98.5 ± 7.0	NS
P	*Symphyotrichum ciliolatum*	Fringed Blue Aster				S3	19	47.4 ± 0.0	NS
P	*Betula michauxii*	Michaux's Dwarf Birch				S3	44	7.6 ± 7.0	NS
P	*Betula pumila*	Bog Birch				S3	3	54.8 ± 0.0	NS
P	*Cardamine parviflora*	Small-flowered Bittercress				S3	4	26.3 ± 0.0	NS
P	*Palustricodon aparinoides*	Marsh Bellflower				S3	27	49.8 ± 0.0	NS
P	*Mononeuria groenlandica*	Greenland Stitchwort				S3	51	57.3 ± 7.0	NS
P	*Sagina nodosa*	Knotted Pearlwort				S3	14	22.5 ± 0.0	NS
P	*Sagina nodosa ssp. borealis*	Knotted Pearlwort				S3	7	20.9 ± 0.0	NS
P	*Stellaria longifolia*	Long-leaved Starwort				S3	11	50.1 ± 0.0	NS
P	*Ceratophyllum echinatum*	Prickly Hornwort				S3	3	52.2 ± 0.0	NS
P	*Triosteum aurantiacum*	Orange-fruited Tinker's Weed				S3	112	50.6 ± 1.0	NS
P	*Viburnum edule*	Squashberry				S3	3	77.5 ± 0.0	NS
P	*Empetrum eamesii*	Pink Crowberry				S3	13	91.9 ± 7.0	NS
P	*Vaccinium uliginosum*	Alpine Bilberry				S3	3	96.7 ± 1.0	NS
P	*Halenia deflexa*	Spurred Gentian				S3	1	43.4 ± 1.0	NS
P	*Myriophyllum verticillatum*	Whorled Water Milfoil				S3	1	51.1 ± 0.0	NS
P	*Epilobium strictum*	Downy Willowherb				S3	3	76.6 ± 5.0	NS
P	*Polygala sanguinea*	Blood Milkwort				S3	21	7.8 ± 3.0	NS
P	*Persicaria arifolia*	Halberd-leaved Tearthumb				S3	12	40.9 ± 0.0	NS
P	*Plantago rugelii*	Rugel's Plantain				S3	7	53.0 ± 0.0	NS
P	*Samolus parviflorus*	Seaside Brookweed				S3	14	83.5 ± 1.0	NS
P	*Pyrola minor*	Lesser Pyrola				S3	1	85.1 ± 0.0	NS
P	*Anemone virginiana*	Virginia Anemone				S3	29	63.8 ± 1.0	NS
P	*Cephalanthus occidentalis*	Common Buttonbush				S3	8	93.6 ± 0.0	NS
P	*Galium labradoricum*	Labrador Bedstraw				S3	79	40.2 ± 0.0	NS
P	*Salix pedicellaris*	Bog Willow				S3	55	40.2 ± 0.0	NS
P	*Salix sericea*	Silky Willow				S3	1	85.6 ± 1.0	NS
P	*Lindernia dubia*	Yellow-seeded False Pimperel				S3	11	62.3 ± 0.0	NS
P	*Laportea canadensis*	Canada Wood Nettle				S3	37	47.1 ± 0.0	NS
P	*Pilea pumila*	Dwarf Clearweed				S3	5	67.2 ± 6.0	NS
P	*Viola nephrophylla*	Northern Bog Violet				S3	8	41.3 ± 1.0	NS
P	*Carex bebbii*	Bebb's Sedge				S3	6	71.0 ± 0.0	NS
P	*Carex castanea*	Chestnut Sedge				S3	38	48.8 ± 0.0	NS
P	*Carex cryptolepis*	Hidden-scaled Sedge				S3	6	51.3 ± 0.0	NS
P	*Carex eburnea*	Bristle-leaved Sedge				S3	34	68.4 ± 0.0	NS
P	*Carex hirtifolia*	Pubescent Sedge				S3	33	47.2 ± 0.0	NS
P	*Carex lupulina*	Hop Sedge				S3	29	50.0 ± 0.0	NS
P	*Carex rosea*	Rosy Sedge				S3	16	45.9 ± 4.0	NS
P	*Carex swanii*	Swan's Sedge				S3	3	87.0 ± 0.0	NS
P	*Carex tenera*	Tender Sedge				S3	4	71.4 ± 1.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Carex tribuloides*	Blunt Broom Sedge				S3	11	48.5 ± 5.0	NS
P	*Carex tuckermanii*	Tuckerman's Sedge				S3	1	75.6 ± 0.0	NS
P	*Eleocharis flavescens var. olivacea*	Bright-green Spikerush				S3	8	54.5 ± 0.0	NS
P	*Eriophorum gracile*	Slender Cottongrass				S3	4	73.8 ± 7.0	NS
P	*Schoenoplectus americanus*	Olney's Bulrush				S3	1	84.0 ± 0.0	NS
P	*Cypripedium parviflorum*	Yellow Lady's-slipper				S3	23	59.4 ± 0.0	NS
P	*Neottia bifolia*	Southern Twayblade				S3	97	13.3 ± 0.0	NS
P	*Platanthera grandiflora*	Large Purple Fringed Orchid				S3	142	20.6 ± 1.0	NS
P	*Platanthera hookeri*	Hooker's Orchid				S3	1	88.6 ± 0.0	NS
P	*Dichanthelium linearifolium*	Narrow-leaved Panic Grass				S3	4	67.9 ± 7.0	NS
P	*Piptatheropsis canadensis*	Canada Ricegrass				S3	7	62.6 ± 3.0	NS
P	*Potamogeton praelongus*	White-stemmed Pondweed				S3	11	53.4 ± 1.0	NS
P	*Potamogeton richardsonii*	Richardson's Pondweed				S3	4	47.7 ± 0.0	NS
P	*Potamogeton zosteriformis*	Flat-stemmed Pondweed				S3	13	25.8 ± 7.0	NS
P	*Dryopteris fragrans*	Fragrant Wood Fern				S3	5	44.4 ± 0.0	NS
P	*Sceptridium dissectum*	Dissected Moonwort				S3	4	54.4 ± 1.0	NS
P	*Polypodium appalachianum*	Appalachian Polypody				S3	10	45.6 ± 0.0	NS
P	*Persicaria amphibia var. emersa*	Long-root Smartweed				S3?	2	70.4 ± 0.0	NS
P	*Spiranthes ochroleuca*	Yellow Ladies'-tresses				S3?	23	24.4 ± 0.0	NS
P	*Diphasiastrum x sabinifolium*	Savin-leaved Ground-cedar				S3?	4	60.3 ± 1.0	NS
P	*Bidens vulgata*	Tall Beggarticks				S3S4	6	52.9 ± 0.0	NS
P	*Erigeron hyssopifolius*	Hyssop-leaved Fleabane				S3S4	38	72.8 ± 0.0	NS
P	*Hieracium paniculatum*	Panicled Hawkweed				S3S4	7	76.0 ± 0.0	NS
P	*Bidens beckii*	Water Beggarticks				S3S4	11	54.9 ± 0.0	NS
P	*Packera paupercula*	Balsam Groundsel				S3S4	78	62.4 ± 0.0	NS
P	*Vaccinium boreale*	Northern Blueberry				S3S4	8	30.6 ± 1.0	NS
P	*Vaccinium cespitosum*	Dwarf Bilberry				S3S4	54	36.1 ± 0.0	NS
P	*Vaccinium corymbosum*	Highbush Blueberry				S3S4	8	87.4 ± 0.0	NS
P	*Fagus grandifolia*	American Beech				S3S4	519	21.8 ± 0.0	NS
P	*Bartonia virginica*	Yellow Bartonia				S3S4	1	85.6 ± 7.0	NS
P	*Proserpinaca pectinata*	Comb-leaved Mermaidweed				S3S4	2	37.6 ± 1.0	NS
P	*Nuphar microphylla*	Small Yellow Pond-lily				S3S4	1	69.2 ± 2.0	NS
P	*Persicaria pensylvanica*	Pennsylvania Smartweed				S3S4	13	15.5 ± 1.0	NS
P	*Fallopia scandens*	Climbing False Buckwheat				S3S4	31	46.2 ± 0.0	NS
P	*Rumex pallidus*	Seabeach Dock				S3S4	2	56.6 ± 0.0	NS
P	*Pyrola asarifolia*	Pink Pyrola				S3S4	7	43.6 ± 0.0	NS
P	*Endotropis alnifolia*	alder-leaved buckthorn				S3S4	161	40.4 ± 1.0	NS
P	*Amelanchier spicata*	Running Serviceberry				S3S4	4	20.5 ± 0.0	NS
P	*Crataegus succulenta*	Fleshy Hawthorn				S3S4	1	93.8 ± 0.0	NS
P	*Fragaria vesca ssp. americana*	Woodland Strawberry				S3S4	63	39.3 ± 0.0	NS
P	*Fragaria vesca*	Woodland Strawberry				S3S4	11	18.4 ± 0.0	NS
P	*Galium aparine*	Common Bedstraw				S3S4	20	14.4 ± 0.0	NS
P	*Geocaulon lividum*	Northern Comandra				S3S4	17	6.0 ± 5.0	NS
P	*Limosella australis*	Southern Mudwort				S3S4	6	46.0 ± 5.0	NS
P	*Ulmus americana*	White Elm				S3S4	52	33.9 ± 0.0	NS
P	*Verbena hastata*	Blue Vervain				S3S4	114	53.2 ± 0.0	NS
P	*Viola sagittata var. ovata*	Arrow-Leaved Violet				S3S4	9	58.3 ± 0.0	NS
P	*Symplocarpus foetidus*	Eastern Skunk Cabbage				S3S4	9	95.2 ± 0.0	NS
P	*Triglochin gaspensis*	Gasp ├⌐ Arrowgrass				S3S4	18	20.3 ± 0.0	NS
P	*Juncus acuminatus*	Sharp-Fruit Rush				S3S4	3	71.7 ± 0.0	NS
P	*Juncus subcaudatus*	Woods-Rush				S3S4	16	41.0 ± 1.0	NS
P	*Luzula parviflora ssp. melanocarpa*	Black-fruited Woodrush				S3S4	3	36.1 ± 0.0	NS
P	*Goodyera repens*	Lesser Rattlesnake-plantain				S3S4	1	20.6 ± 0.0	NS
P	*Liparis loeselii*	Loesel's Twayblade				S3S4	4	58.4 ± 0.0	NS

Taxonomic Group	Scientific Name	Common Name	COSEWIC	SARA	Prov Legal Prot	Prov Rarity Rank	# recs	Distance (km)	Prov
P	*Platanthera obtusata*	Blunt-leaved Orchid				S3S4	7	15.6 ± 0.0	NS
P	*Platanthera orbiculata*	Small Round-leaved Orchid				S3S4	19	61.4 ± 0.0	NS
P	*Alopecurus aequalis*	Short-awned Foxtail				S3S4	8	71.9 ± 0.0	NS
P	*Dichanthelium clandestinum*	Deer-tongue Panic Grass				S3S4	98	37.2 ± 0.0	NS
P	*Koeleria spicata*	Narrow False Oats				S3S4	9	62.5 ± 0.0	NS
P	*Equisetum pratense*	Meadow Horsetail				S3S4	9	68.2 ± 0.0	NS
P	*Diphasiastrum complanatum*	Northern Ground-cedar				S3S4	5	28.9 ± 0.0	NS
P	*Diphasiastrum sitchense*	Sitka Ground-cedar				S3S4	2	46.1 ± 1.0	NS
P	*Huperzia appressa*	Mountain Firmoss				S3S4	4	82.6 ± 5.0	NS
P	*Sceptridium multifidum*	Leathery Moonwort				S3S4	4	63.5 ± 0.0	NS
P	*Botrychium matricariifolium*	Daisy-leaved Moonwort				S3S4	4	78.4 ± 0.0	NS
P	*Viola canadensis*	Canada Violet				SH	1	72.2 ± 7.0	NS
P	*Greeneochloa coarctata*	Small Reedgrass				SH	1	98.2 ± 6.0	NS

5.1 SOURCE BIBLIOGRAPHY (100 km)

The recipient of these data shall acknowledge the AC CDC and the data sources listed below in any documents, reports, publications or presentations, in which this dataset makes a significant contribution.

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35	Roland, A.E. & Smith, E.C. 1969. The Flora of Nova Scotia, 1st Ed. Nova Scotia Museum, Halifax, 743pp.
33	Neily, T.H. 2010. Erioderma Pedicellatum records 2005-09. Mersey Tobiatic Research Institute, 67 recs.
31	Blaney, C.S.; Mazerolle, D.M.; Belliveau, A.B. 2013. Atlantic Canada Conservation Data Centre Fieldwork 2013. Atlantic Canada Conservation Data Centre, 9000+ recs.
31	Hubley, Nicole. 2022. Monarch (Danaus plexippus) records submitted to MTRI from the 2021 field season. Mersey Tobeatic Research Institute.
31	Mersey Tobetic Research Institute. 2021. 2020 Monarch records from the MTRI monitoring program. Mersey Tobetic Research Institute, 72 records.
29	NatureServe Canada. 2019. iNaturalist Maritimes Butterfly Records. iNaturalist.org and iNaturalist.ca.
28	Pepper, Chris. 2012. Observations of breeding Canada Warbler's along the Eastern Shore, NS. Pers. comm. to S. Blaney, Jan. 20, 28 recs.
27	Chapman-Lam, C.J. 2022. Atlantic Canada Conservation Data Centre 2021 botanical fieldwork. Atlantic Canada Conservation Data Centre, 15099 recs.
26	Belliveau, A.G. 2021. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2021. E.C. Smith Herbarium.
26	Blaney, C.S.; Spicer, C.D.; Popma, T.M.; Hanel, C. 2002. Fieldwork 2002. Atlantic Canada Conservation Data Centre. Sackville NB, 2252 recs.
25	Ogden, J. NS DNR Butterfly Collection Dataset. Nova Scotia Department of Natural Resources. 2014.
24	Archibald, D.R. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 213 recs.
24	Blaney, C.S.; Mazerolle, D.M.; Oberndorfer, E. 2007. Fieldwork 2007. Atlantic Canada Conservation Data Centre. Sackville NB, 13770 recs.

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23	Belland, R.J. Maritimes moss records from various herbarium databases. 2014.
23	Ferguson, D.C. 1954. The Lepidoptera of Nova Scotia. Part I, macrolepidoptera. Proceedings of the Nova Scotian Institute of Science, 23(3), 161-375.
23	LaPaix, Rich. 2022. Rare species observations, 2018-2022. Nova Scotia Nature Trust.
23	Popma, T.M. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 113 recs.
23	Staicer, Cindy. 2023. 2022 SAR Bird ARU occurrences. Dalhousie University, 379 records.
22	Cameron, R.P. 2018. Degelia plumbea records. Nova Scotia Environment.
20	Belliveau, A.G. 2020. E.C. Smith Herbarium and Atlantic Canada Conservation Data Centre Fieldwork 2019, 2020. E.C. Smith Herbarium.
20	Chapman, C.N. (Cody). 2020. Nova Scotia Black Ash (Fraxinus nigra) field observations by Confederacy of Mainland Mi'kmaq. Forestry Program, Confederacy of Mainland Mi'kmaq.
20	Haughian, Sean. 2021. Update to lichen data from 2017-2021. Nova Scotia Museum.
20	Wilhelm, S.I. et al. 2019. Colonial Waterbird Database. Canadian Wildlife Service.
19	Chapman, C.J. 2018. Atlantic Canada Conservation Data Centre botanical fieldwork 2018. Atlantic Canada Conservation Data Centre, 11171 recs.
19	Hall, R.A. 2001. S.. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 178 recs.
19	Klymko, J.J.D.; Robinson, S.L. 2012. 2012 field data. Atlantic Canada Conservation Data Centre, 447 recs.
18	Bell, G. 2018. Moose, bat and bird records from Goldboro LNG Project, NS, Environmental Assessment. Amec Foster Wheeler.
18	Feltham, Carter. 2022. Monarch (Danaus plexippus) and Milkweed MTRI records from the 2022 Field Season. Mersey Tobeatic Research Institute.
18	Neily, T.H. 2012. 2012 Erioderma pedicellatum records in Nova Scotia.
18	Powell, B.C. 1967. Female sexual cycles of Chrysemy spicta & Clemmys insculpta in Nova Scotia. Can. Field-Nat., 81:134-139. 26 recs.
17	Hall, R.A. 2003. NS Freshwater Mussel Fieldwork. Nova Scotia Dept Natural Resources, 189 recs.
15	Blaney, C.S. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre. Sackville NB, 1042 recs.
15	Blaney, C.S.; Mazerolle, D.M. 2008. Fieldwork 2008. Atlantic Canada Conservation Data Centre. Sackville NB, 13343 recs.
15	e-Butterfly. 2019. Export of Maritimes records and photos. McFarland, K. (ed.) e-butterfly.org.
15	Westwood, A., Staicer, C. 2016. Nova Scotia landbird Species at Risk observations. Dalhousie University.
14	Adams, J. & Herman, T.B. 1998. Thesis, Unpublished map of C. insculpta sightings. Acadia University, Wolfville NS, 88 recs.
14	Cameron, R.P. 2014. 2013-14 rare species field data. Nova Scotia Department of Environment, 35 recs.
14	Churchill, J.L. 2019. Atlantic Canada Conservation Data Centre Fieldwork 2019. Atlantic Canada Conservation Data Centre.
14	Gilhen, J. 1984. Amphibians & Reptiles of Nova Scotia, 1st Ed. Nova Scotia Museum, 164pp.
14	McNeil, Jeffie. 2023. 2022 Turtle Records. Mersey Tobeatic Research Institute.
14	Rock, J. 2020. Atlantic Canada Piping Plover field surveys: Nesting pairs by beach, 2018-2020. Environment and Climate Change Canada - Canadian Wildlife Service, 216 records.
14	Taylor, B.R., and Tam, J.C. 2012. Local distribution of the rare plant Triosteum aurantiacum in northeastern Nova Scotia, Canada. Rhodora, 114(960): 366-382.
14	Toms, Brad. 2022. Non-Lichen Observations from Lichen SMP and NCC Property Searches. Mersey Tobeatic Research Institute.
13	Cameron, R.P. 2017. 2017 rare species field data. Nova Scotia Environment, 64 recs.
13	Munro, Marian K. Nova Scotia Provincial Museum of Natural History Herbarium Database. Nova Scotia Provincial Museum of Natural History, Halifax, Nova Scotia. 2014.
13	Ogden, K. Nova Scotia Museum butterfly specimen database. Nova Scotia Museum. 2017.
13	Robinson, S.L. 2015. 2014 field data.
12	Cameron-MacMillan, Maureen. 2020. Northern Goshawk Nests in Eastern Nova Scotia, as of November, 2020. Nova Scotia Department of Lands and Forestry.
12	Chapman, C.J. 2019. Atlantic Canada Conservation Data Centre 2019 botanical fieldwork. Atlantic Canada Conservation Data Centre, 11729 recs.
12	Chaput, G. 2002. Atlantic Salmon: Maritime Provinces Overview for 2001. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-14. 39 recs.
12	Neily, T.H. 2019. Tom Neily NS Bryophyte records (2009-2013). T.H. Neily, Atlantic Canada Conservation Data Centre, 1029 specimen records.
12	White, S. 2018. Notable species sightings, 2016-2017. East Coast Aquatics.
11	Benjamin, L.K. 2011. NSDNR fieldwork & consultant reports 1997, 2009-10. Nova Scotia Dept Natural Resources, 85 recs.
11	Downes, C. 1998-2000. Breeding Bird Survey Data. Canadian Wildlife Service, Ottawa, 111 recs.
11	NS DNR. 2017. Black Ash records from NS DNR Permanent Sample Plots (PSPs), 1965-2016. NS Dept of Natural Resources.
11	Patrick, Allison. 2021. Animal and plant records from NCC properties from 2019 and 2020. Nature Conservancy Canada.
11	Phinney, Lori; Toms, Brad; et. al. 2016. Bank Swallows (Riparia riparia) in Nova Scotia: inventory and assessment of colonies. Merset Tobeiatc Research Institute, 25 recs.
10	Cameron, R.P. 2013. 2013 rare species field data. Nova Scotia Department of Environment, 71 recs.
10	Neily, T.H. 2013. Email communication to Sean Blaney regarding Listera australis observations made from 2007 to 2011 in Nova Scotia. , 50.
10	Richardson, D., Anderson, F., Cameron, R, McMullin, T., Clayden, S. 2014. Field Work Report on Black Foam Lichen (Anzia colpodes). COSEWIC.
9	Cameron, R.P. 2005. Erioderma pedicellatum unpublished data. NS Dept of Environment, 9 recs.
9	Cameron, R.P. 2006. Erioderma pedicellatum 2006 field data. NS Dept of Environment, 9 recs.
9	McNeil, J.A. 2016. Blandings Turtle (Emydoidea blandingii), Eastern Ribbonsnake (Thamnophis sauritus), Wood Turtle (Glyptemys insculpta), and Snapping Turtle (Chelydra serpentina) sightings, 2016. Mersey Tobeatic Research Institute, 774 records.
9	Webster, R.P. Atlantic Forestry Centre Insect Collection, Maritimes butterfly records. Natural Resources Canada. 2014.
8	Manthorne, A. 2019. Incidental aerial insectivore observations. Birds Canada.
8	Oldham, M.J. 2000. Oldham database records from Maritime provinces. Oldham, M.J; ONHIC, 487 recs.
8	Patrick, A.; Horne, D.; Noseworthy, J. et. al. 2017. Field data for Nova Scotia and New Brunswick, 2015 and 2017. Nature Conservancy of Canada.
7	Cameron, B. 2006. Hepatica americana Survey at Scotia Mine Site in Gays River, and Discovery of Three Yellow-listed Species. Conestoga-Rovers and Associates, (a consulting firm), october 25. 7 recs.
7	Cameron, R.P. 2012. Rob Cameron 2012 vascular plant data. NS Department of Environment, 30 recs.
7	Hill, N.M. 1994. Status report on the Long's bulrush Scirpus longii in Canada. Committee on the Status of Endangered Wildlife in Canada, 7 recs.
7	Neily, T.H. & Pepper, C.; Toms, B. 2020. Nova Scotia lichen database [as of 2020-05-25]. Mersey Tobeatic Research Institute, 668 recs.

# recs	CITATION
7	O'Neil, S. 1998. Atlantic Salmon: Northumberland Strait Nova Scotia part of SFA 18. Dept of Fisheries & Oceans, Atlantic Region, Science. Stock Status Report D3-08. 9 recs.
7	Robinson, S.L. 2011. 2011 ND dune survey field data. Atlantic Canada Conservation Data Centre, 2715 recs.
7	Whittam, R.M. 1999. Status Report on the Roseate Tern (update) in Canada. Committee on the Status of Endangered Wildlife in Canada, 36 recs.
6	Anderson, Frances; Neily, Tom. 2010. A Reconnaissance Level Survey of Calciphilous Lichens in Selected Karst Topography in Nova Scotia with Notes on Incidental Bryophytes. Mersey Tobeatic Research Institute.
6	Gallop, John. 2021. Sheet Harbour rare lichen observations. McCallum Environmental.
6	Hall, R. 2008. Rare plant records in old fieldbook notes from Truro area. Pers. comm. to C.S. Blaney. 6 recs, 6 recs.
6	Richardson, D., Anderson, F., Cameron, R, Pepper, C., Clayden, S. 2015. Field Work Report on the Wrinkled Shingle lichen (Pannaria lurida). COSEWIC.
5	Benjamin, L.K. 2009. Boreal Felt Lichen, Mountain Avens, Orchid and other recent records. Nova Scotia Dept Natural Resources, 105 recs.
5	Blaney, C.S. 2020. Sean Blaney 2020 field data. Atlantic Canada Conservation Data Centre, 4407 records.
5	Blaney, C.S.; Spicer, C.D.; Mazerolle, D.M. 2005. Fieldwork 2005. Atlantic Canada Conservation Data Centre. Sackville NB, 2333 recs.
5	Edsall, J. 2007. Personal Butterfly Collection: specimens collected in the Canadian Maritimes, 1961-2007. J. Edsall, unpubl. report, 137 recs.
5	Hughes, Cory. 2020. Atlantic Forestry Centre Coccinella transversoguttata collections. Canadian Forest Service, Atlantic Forestry Centre.
5	McNeil, J.A. 2020. Snapping Turtle and Eastern Painted Turtle records, 2020. Mersey Tobeatic Research Institute.
5	Plissner, J.H. & Haig, S.M. 1997. 1996 International piping plover census. US Geological Survey, Corvallis OR, 231 pp.
5	Towell, C. 2014. 2014 Northern Goshawk and Common Nighthawk email reports, NS. NS Department of Natural Resources.
5	Walker, J. 2017. Bird inventories at French River, NS, and Memramcook, NB, for Nature Conservancy of Canada. Pers. comm. to AC CDC.
5	White, S. 2019. Notable species sightings, 2018. East Coast Aquatics.
5	Whittam, R.M. 1997. Status Report on the Roseate Tern (Sterna dougallii) in Canada. Committee on the Status of Endangered Wildlife in Canada, 5 recs.
4	Bredin, K.A. 2002. NS Freshwater Mussel Fieldwork. Atlantic Canada Conservation Data Centere, 30 recs.
4	Chapman-Lam, C.J. 2021. Atlantic Canada Conservation Data Centre 2020 botanical fieldwork. Atlantic Canada Conservation Data Centre, 17309 recs.
4	Clayden, S.R. 2005. Confidential supplement to Status Report on Ghost Antler Lichen (Pseudevernia cladonia). Committee on the Status of Endangered Wildlife in Canada, 27 recs.
4	Frittaion, C. 2012. NSNT 2012 Field Observations. Nova Scotia Nature Trust, Pers comm. to S. Blaney Feb. 7, 34 recs.
4	Klymko, J. Dataset of butterfly records at the New Brunswick Museum not yet accessioned by the museum. Atlantic Canada Conservation Data Centre. 2016.
4	Neily, T.H. & Pepper, C.; Toms, B. 2018. Nova Scotia lichen database Update. Mersey Tobeatic Research Institute, 14 recs.
4	O'Neil, S. 1998. Atlantic Salmon: Eastern Shore Nova Scotia SFA 20. Dept of Fisheries & Oceans, Atlantic Region, Science. Stock Status Report D3-10. 4 recs.
4	Olsen, R. Herbarium Specimens. Nova Scotia Agricultural College, Truro. 2003.
3	Basquill, S.P. 2003. Fieldwork 2003. Atlantic Canada Conservation Data Centre, Sackville NB, 69 recs.
3	Basquill, S.P. 2012. 2012 rare vascular plant field data. Nova Scotia Department of Natural Resources, 37 recs.
3	Basquill, S.P., Porter, C. 2019. Bryophyte and lichen specimens submitted to the E.C. Smith Herbarium. NS Department of Lands and Forestry.
3	Blaney, C.S. Miscellaneous specimens received by ACCDC (botany). Various persons. 2001-08.
3	Blaney, C.S.; Mazerolle, D.M. 2011. Fieldwork 2011. Atlantic Canada Conservation Data Centre. Sackville NB.
3	Brunelle, P.-M. (compiler). 2010. ADIP/MDDS Odonata Database: NB, NS Update 1900-09. Atlantic Dragonfly Inventory Program (ADIP), 935 recs.
3	Clayden, S.R. 1998. NBM Science Collections databases: vascular plants. New Brunswick Museum, Saint John NB, 19759 recs.
3	e-Butterfly. 2018. Selected Maritimes butterfly records from 2016 and 2017. Maxim Larrivee, Sambo Zhang (ed.) e-butterfly.org.
3	Hill, N. and D. Patriquin. 2013. 2013 rare plant observations in Williams Lake Backlands area. Fern Hill Institute of Plant Conservation, Berwick, Nova Scotia, 3 records.
3	Klymko, J. Butterfly records at the Nova Scotia Museum not yet accessioned by the museum. Atlantic Canada Conservation Data Centre. 2017.
3	Mersey Tobeatic Research Institute. 2022. Nova Scotia Bobolink observations. pers. comm. to J. Churchill.
3	Neily, T.H. 2016. Email communication (May 6, 2016) to Sean Blaney regarding Fissidens exilis observations made in 2016 in Nova Scotia. Pers. Comm., 3 recs.
3	Neily, T.H. Tom Neily NS Sphagnum records (2009-2014). T.H. Neily, Atlantic Canada Conservation Data Centre. 2019.
2	Basquill, S.P. 2012. 2012 Bryophyte specimen data. Nova Scotia Department of Natural Resources, 37 recs.
2	Bateman, M.C. 2001. Coastal Waterfowl Surveys Database, 1965-2001. Canadian Wildlife Service, Sackville, 667 recs.
2	Belliveau, A. 2013. Rare species records from Nova Scotia. Mersey Tobeatic Research Institute, 296 records. 296 recs.
2	Blaney, C.S. 2016. Atlantic Canada Conservation Data Centre Fieldwork 2016. Atlantic Canada Conservation Data Centre, 6719 recs.
2	Cameron, B. 2005. C. palmicola, E. pedicellatum records from Sixth Lake. Pers. comm. to C.S. Blaney. 3 recs, 3 recs.
2	Cameron, R.P. 2012. Additional rare plant records, 2009. , 7 recs.
2	Chapman, Cody. Unreported Species at Risk Records across Nova Scotia. Chapman, Cody, 5 records.
2	Hill, N. 2003. Floerkea proserpinacoides at Heatherdale, Antigonish Co. 2002. , Pers. comm. to C.S. Blaney. 2 recs.
2	Hill, Nick. 2021. Fraxinus nigra observations at Marshy Hope. Fern Hill Institute of Plant Conservation.
2	Klymko, J.J.D. 2018. 2017 field data. Atlantic Canada Conservation Data Centre.
2	McAlpine, D.F. New Brunswick Museum bee specimens. New Brunswick Museum. 2013.
2	McNeil, J.A. 2019. Snapping Turtle records, 2019. Mersey Tobeatic Research Institute.
2	Nature Conservancy of Canada. 2022. NCC Field data for Nova Scotia. Nature Conservancy of Canada.
2	Neily, T.H.; Smith, C.; Whitman, E. 2011. NCC Logging Lake (Halifax Co. NS) properties baseline survey data. Nature Conservancy of Canada, 2 recs.
2	Sollows, M.C,. 2008. NBM Science Collections databases: mammals. New Brunswick Museum, Saint John NB, download Jan. 2008, 4983 recs.
2	Standley, L.A. 2002. Carex haydenii in Nova Scotia. , Pers. comm. to C.S. Blaney. 4 recs.
2	Whittam, R.M. et al. 1998. Country Island Tern Restoration Project. Canadian Wildlife Service, Sackville, 2 recs.
1	Amiro, Peter G. 1998. Atlantic Salmon: Inner Bay of Fundy SFA 22 & part of SFA 23. Dept of Fisheries & Oceans, Atlantic Region, Science Stock Status Report D3-12. 4 recs.
1	Bagnell, B.A. 2001. New Brunswick Bryophyte Occurrences. B&B Botanical, Sussex, 478 recs.
1	Basquill, S.P. 2011. Field observations & specimen collections, 2010. Nova Scotia Department of Natural Resources, Pers. comm. , 8 Recs.

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1	Belliveau, A.G. 2014. Plant Records from Southern and Central Nova Scotia. Atlantic Canada Conservation Data Centre, 919 recs.
1	Belliveau, A.G. E.C. Smith Herbarium Specimen Database 2019. E.C. Smith Herbarium, Acadia University. 2019.
1	Blaney, C.S.; Spicer, C.D. 2001. Fieldwork 2001. Atlantic Canada Conservation Data Centre. Sackville NB, 981 recs.
1	Blaney, C.S.; Spicer, C.D.; Rothfels, C. 2004. Fieldwork 2004. Atlantic Canada Conservation Data Centre. Sackville NB, 1343 recs.
1	Boyne, A.W. & Grecian, V.D. 1999. Tern Surveys. Canadian Wildlife Service, Sackville, unpublished data. 23 recs.
1	Brach, A.R. 2019. Correspondence to Sean Blaney regarding Calamagrostis cinnoides specimen from Halifax NS. pers. comm., Harvard University Herbaria, 1 record.
1	Bruce, J. 2014. 2014 Wood Turtle email report, Nine Mile River, NS. NS Department of Natural Resources.
1	Calhoun, J.C. Butterfly records databased at the McGuire Center for Lepidoptera and Biodiversity. Calhoun, J.C. 2020.
1	Christie, D.S. 2000. Christmas Bird Count Data, 1997-2000. Nature NB, 54 recs.
1	Clayden, S.R. 2006. Pseudevernia cladonia records. NB Museum. Pers. comm. to S. Blaney, Dec, 4 recs.
1	COSEWIC (Committee on the Status of Wildlife in Canada). 2013. COSEWIC Assessment and Status Report on the Eastern Waterfan Peltigera hydrothyria in Canada. COSEWIC, 46 pp.
1	Daury, R.W. & Bateman, M.C. 1996. The Barrow's Goldeneye (Bucephala islandica) in the Atlantic Provinces and Maine. Canadian Wildlife Service, Sackville, 47pp.
1	Docherty, Joanne. 2022. Phone call to John Klymko about Danaus plexippus observation in Nova Scotia. Personal communication.
1	Doucet, D.A. 2009. Census of Globally Rare, Endemic Butterflies of Nova Scotia Gulf of St Lawrence Salt Marshes. Nova Scotia Dept of Natural Resources, Species at Risk, 155 recs.
1	Eastman, A. 2019. Snapping Turtle observation at Brookfield, Colchester Co. NS. Halifax Field Naturalists Nova Scotia Nature Archive Facebook Page, 1 record.
1	Envirosphere Consultants Ltd., Strum. 2023. SAR records from three Environmental Assessments in Nova Scotia. Envirosphere Consultants Ltd., Strum, 48 records.
1	Golder Associates Ltd. 2021. Black Ash location from Goff's Quarry Expansion Environment Assessment, 2017. Golder Associates Ltd., 1 record.
1	Haughian, S.R. 2018. Description of Fuscopannaria leucosticta field work in 2017. New Brunswick Museum, 314 recs.
1	Heron, J. 2022. Bombus records communicated to J. Klymko over email in autumn 2022. Pers. comm.
1	Hill, N.M. 2021. Observation of Carex haydenii and black ash near Marshy Hope and Ponhook Lake. pers. comm.
1	Holder, M.L.; Kingsley, A.L. 2000. Kinglsey and Holder observations from 2000 field work.
1	Jacques Whitford Ltd. 2003. Cananda Lily location. Pers. Comm. to S. Blaney. 2pp, 1 rec, 1 rec.
1	Klymko, J. Henry Hensel's Butterfly Collection Database. Atlantic Canada Conservation Data Centre. 2016.
1	Lautenschlager, R.A. 2010. Miscellaneous observations reported to ACCDC (zoology). Pers. comm. from various persons, 2 recs.
1	MacKinnon, D.; Wright, P.; Smith, D. 2014. 2014 Common Tern email report, Eastern Passage, NS. NS Department of Environment.
1	McAlpine, D.F. 1998. NBM Science Collections databases to 1998. New Brunswick Museum, Saint John NB, 241 recs.
1	McKendry, Karen. 2016. Rare species observations, 2016. Nova Scotia Nature Trust, 19 recs.
1	NatureServe Canada. 2018. iNaturalist Butterfly Data Export . iNaturalist.org and iNaturalist.ca.
1	Neily, P.D. Plant Specimens. Nova Scotia Dept Natural Resources, Truro. 2006.
1	Neily, T.H. & Pepper, C.; Toms, B. 2019. Boreal Felt Lichen Observation, April 2019. Mersey Tobeatic Research Institute.
1	Neily, T.H. & Pepper, C.; Toms, B. 2019. Boreal Felt Lichen Observation, January 2019. Mersey Tobeatic Research Institute, 1 rec.
1	Neily, T.H. 2013. Email communication to Sean Blaney regarding Agalinis paupercula observations made in 2013 in Nova Scotia. , 1 rec.
1	Payzant, P. 2018. Satyr Comma record from Bible Hill, NS. https://novascotiabutterflies.ca.
1	Pohl, G.P. Specimen data from Northern Forest Research Centre. Northern Forest Research Centre. 2022.
1	Robinson, C.B. 1907. Early intervale flora of eastern Nova Scotia. Transactions of the Nova Scotia Institute of Science, 10:502-506. 1 rec.
1	Sabine, D.L. Bombus terricola specimens in Dwayne Sabine's personal collection. pers. comm. 2022.
1	Sabine, M. 2016. NB DNR staff incidental Black Ash observations. New Brunswick Department of Natural Resources.
1	Skevington, Jeffrey H. 2020. Syrphid records used for the Field Guide to the Flower Flies of Northeastern North America. Canadian National Collection of Insects.
1	Stephen Freeman. 2022. New location for Black Ash in Queens County, NS. Personal communication, 2.
1	Whittam, R.M. 2000. Senecio pseudoarnica on Country Island. , Pers. comm. to S. Gerriets. 1 rec.
1	WIlliams, M. Cape Breton University Digital Herbarium. Cape Breton University Digital Herbarium. 2013.

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

Atlantic Canada Conservation Data Centre
Data Dictionary

Revised: May 15, 2023

I. Biodiversity Database

The following fields of data may be included (and may or may not be populated) in occurrence records.
Text fields are 255 char max. (and may truncate text).

TAXONOMY		
Field	***Type***	***Definition***
MCODE	TXT	8 character 'Museum Code' (1 to 4 = genus, 5 to 8 = sp+ssp)
ELCODE	TXT	Unique Identifier of taxon
SCINAME	TXT	Global Scientific Name of taxon
COMNAME	TXT	English Common Name of taxon
NOMCOMMUN	TXT	French Common Name
LOCATION		
Field	***Type***	***Definition***
SURVEYSITE	TXT	General locality of occurrence
DIRECTIONS	TXT	Specific locality: e.g. bearings and distance from enduring landmark
SUBNAT	TXT	Province/State: 2 character ISO code
COCODE	TXT	County Code (2 chars for province + 4 chars for county name)
MAPCODE	TXT	Map number: NTS identifier in Canada
UTME20	INT	Easting in UTM Zone 20
UTMN20	INT	Northing in UTM Zone 20
LONDEC	DEC	Decimal Longitude
LATDEC	DEC	Decimal Latitude
LOCUNCM	INT	Horizontal precision in metres
PREC	DEC	Precision in metres by power of 10 (e.g. 3 = 10 to the 3rd = 1000 m = 1 km):

prec	***common speech***	***example***	***unit size***	***literal range***
6.0	within province	province	1000.0 km	562.3 - 1778.3 km
5.7	in part of province	'NW NB'	500.0 km	281.2 - 889.1 km
5.0	within in county	county	100.0 km	56.2 - 177.8 km
4.7	within 50s of kilometres		50.0 km	28.1 - 88.9 km
4.0	within 10s of kilometres	BBA grid	10.0 km	5.6 - 17.8 km
3.7	within 5s of kilometres		5.0 km	2.8 - 8.9 km
3.0	within kilometres	topo grid	1.0 km	0.6 - 1.8 km
2.7	within 500s of metres		500.0 m	281.2 - 889.1 m
2.0	within 100s of metres	ball field	100.0 m	56.2 - 177.8 m
1.7	within 50s of metres		50.0 m	28.1 - 88.9 m
1.0	within 10s of metres	boxcar	10.0 m	5.6 - 17.8 m
0.7	within 5s of metres		5.0 m	2.8 - 8.9 m
0.0	***NOT USED***	pace	1.0 m	0.6 - 1.8 m
-1.0	within 10s of centimetres	fingernail	0.1 m	0.1 - 0.2 m

RARITY / STATUS		
Field	***Type***	***Definition***
NRANK	TXT	National Rarity Rank of taxon (in Canada)
NPROT	TXT	National Protection Status of taxon (i.e., COSEWIC in Canada)
NPROTSAR	TXT	National Protection Status of taxon (i.e., SARA in Canada):

code	***Rank and short definition***
X	Extinct in Canada and elsewhere
XT	Extirpated in Canada but surviving elsewhere
E	Endangered in Canada
T	Threatened in Canada
V	Vulnerable in Canada
SC	Special Concern in Canada
DD	Data Deficient: data inadequate for assessment
NAR	Not At Risk in Canada

SRANK — TXT — Subnational (Provincial) Rarity Rank of taxon:

code	***Rank and short definition***
SX	Extinct or extirpated in province
SH	Historically occurring but currently undetected in province
S1	Extremely rare in province
S2	Rare in province

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		S3	Uncommon in province
		S4	Widespread, common and apparently secure in province
		S5	Widespread, abundant and demonstrably secure in province
		SE	Exotic in province
		SA	Accidental, infrequent and outside of range within province
		SNA	Ranking not applicable in province
		SNR	Not yet assessed in province
SPROT	TXT	Provincial Legal Protection Status	
		code	***Rank and short definition***
		Endangered	Facing imminent extirpation or extinction
		Threatened	Likely to become endangered if limiting factors are not reversed
		Vulnerable (NS)	Special concern because of characteristics that make it particularly sensitive to human activities or natural events
		Special Concern (NB)	May become a threatened or endangered species because of a combination of biological characteristics and identified threats
		Extirpated	No longer exists in the wild in the Province but exists in the wild outside of the Province
		Extinct	No longer exists
IUCN	TXT	International Union of Conservation Naturalists rarity rank:	
		code	***Rank and short definition***
		EX	Extinct: no individuals remaining
		EW	Extinct in the Wild: only captive or naturalised survivors
		CR	Critically Endangered: extreme risk of extinction in wild
		EN	Endangered: high risk of extinction in wild
		VU	Vulnerable: high risk of endangerment in wild
		NT	Near Threatened: likely to become endangered soon
		LC	Least Concern: lowest risk, widespread and abundant
		DD	Data Deficient: data inadequate for assessment
		NE	Not Evaluated, not yet assessed against criteria
OBSERVATION			
Field	***Type***	***Definition***	
OBSERVER	TXT	Individual(s) that observed the taxon	
OBDATE	TXT	Date of observation (YYYY MM DD)	
OBDATA	TXT	Concatenation of fields below, relating to observation	
OBEVID	TXT	Type of evidence (e.g., specimen, photo)	
OBCOUNT	TXT	Number of individuals at location	
OBABUN	TXT	Relative rarity of taxon at location, e.g. 'common', 'scattered'	
OBSIZE	TXT	Size of individual	
SIZE	TXT	Size of occurrence 'patch' (in m^2, ha or acres)	
OBDESC	TXT	Details of specimen appearance or conditions	
OBPHEN	TXT	Lifestage of individual (e.g., bud, flowering)	
OBSEX	TXT	Male/female if relevant	
OBACTIV	TXT	Activity of individual when observed (e.g., nesting, crossing road)	
OBASSP	TXT	Other taxa associated with the observation	
NOTETAX	TXT	Identifier's note on taxonomic issues	
GENDESC	TXT	Concatenation of fields below, relating to site	
HABITAT	TXT	Habitat characterization of location	
ECODIST	NUM	National Ecological Framework EcoDistrict identifier	
WSCODE	TXT	Quaternary Watershed identifier	
GENCOM	TXT	General Comments: concatenation of Notes (NOTE1, NOTE2, NOTE3)	
COLLECTION			
Field	***Type***	***Definition***	
CITATION	TXT	Primary source of data	
DATA MANAGEMENT			
Field	***Type***	***Definition***	
IDNUM	TXT	AC CDC record Unique ID	
EDITION	TXT	Last editor's initials and date (YYYY MM DD)	

II. Managed and Biologically Significant Areas (MSA) Database

The following fields of data may be included (and may or may not be populated) for Managed and Biologically Significant Areas.

IDENTITY AND DESCRIPTION		
Field	***Type***	***Definition***
msaGIS	INT	Unique GIS feature identifier
msaCode	TXT	Unique identifier for the MSA feature
msaClass	TXT	Whether the MSA feature is a Managed Area (MA) or biologically Significant Area (SA)

Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

msaName	TXT	MSA feature name
msaNameFr	TXT	MSA feature name (French)
description	TXT	Description of the MSA feature
notes	TXT	Additional notes about the MSA feature
JURISDICTION / OWNERSHIP		
Field	***Type***	***Definition***
localJuris	TXT	Mandated agency with jurisdiction over property
owner	TXT	Property owner
ownerCom	TXT	Details of multiparty arrangements
ownerDate	TXT	Date of property possession
CLASSIFICATION		
Field	***Type***	***Definition***
protStat	TXT	Activities permitted or restricted (when known)
legalAct	TXT	Title of enabling legislation
legalDate	TXT	Year of enabling legislation
estabDate	TXT	Year of site designation
aichit11	TXT	Whether the site counts towards the Aichi Target 11 and Canada Target 1 biodiversity targets (yes or no)
oecm	TXT	Other effective area-based conservation means (yes or no)
iucnCat	TXT	IUCN protected area category. For complete category descriptions, visit https://www.iucn.org/theme/protected-areas/about/protected-area-categories. Features categorized as "YES" are sites which meet the standard definition of a protected area, but the category of protection has not yet been determined and features categorized as "N/A" are other area-based conservation measures or sites that do not meet the protected area definition (2018 Canadian Protected and Conserved Areas Database (CPCAD) User Manual).
msaType	TXT	MSA feature type:

group	***Designation***
Conservation	Conservation Area
	Conservation Easement
	Fee-Simple Ownership by Environmental Non-Governmental Conservation Organization
	Land Trust Property
	Natural Area
	Nature Preserve
	Nature Reserve
	Nature Reserve and Conservation Easement
	Nature Trail
	Other Effective Area-Based Conservation Measure
	Privately Owned Conservation Area
	Privately Owned Natural Area
	Protected Area
	Protected Beach
	Protected Natural Area
	Provincially Owned Natural Area
	To be determined
Heritage	Heritage River
	Museum
	National Historic Event
	National Historic Site
	Provincial Heritage Site
	Provincial Historic Site
	Provincial Historic/Heritage Park
	UNESCO World Heritage Site
Parks	Municipal Park
	National Park
	Nature Park
	Park
	Privately Owned Park
	Provincial Park
	Provincial Park Beach
Wilderness	Ecological Reserve
	Environmentally Sensitive Area
	Significant Ecological Area
	Significant Ecological Area/International Biological Program
	Wilderness Area
	Wilderness Reserve
Wildlife	Eastern Habitat Joint Venture
	Important Bird Area (IBA)
	Marine Protected Area
	Migratory Bird Sanctuary
	National Wildlife Area
	Privately Owned Wildlife Management Area
	Provincial Wildlife Management Area

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			Wildlife Management Area
			Wildlife Park
			Wildlife Refuge
			Wildlife Reserve
			Wildlife Sanctuary
		Other	Education Area
			Experimental Area
			Federal Corrections Facility
			Fossil Site
			International Biological Program
			Memorial Site
			Other Managed Area
			RAMSAR Wetland Site
			Special Management Area
			Water Supply Area
			Watershed

LOCATION AND SPATIAL ATTRIBUTES		
Field	***Type***	***Definition***
subnat	TXT	Two-letter jurisdiction code (NB, NS, PE, NF, LB)
location	TXT	Directions to the MSA feature
biome	TXT	Whether an MSA feature falls within the terrestrial (T) or marine (M) environment
mapCode	TXT	The National Topographic System (NTS) map square the centre of the MSA feature falls within
coCode	TXT	Provincial county code (2 chars for province + 4 chars for county name)
latDec	DEC	Latitude of the centre of the MSA feature
lonDec	DEC	Longitude of the centre of the MSA feature
utmE20	INT	Easting of the centre of the MSA feature (NAD83 UTM Zone 20N)
utmN20	INT	Northing of the centre of the MSA feature (NAD83 UTM Zone 20N)
extentN	DEC	Northern extent of the MSA feature
extentS	DEC	Southern extent of the MSA feature
extentE	DEC	Eastern extent of the MSA feature
extentW	DEC	Western extent of the MSA feature
areaHa	DEC	Area of the polygon (ha)
SOURCE ATTRIBUTES		
Field	***Type***	***Definition***
sourceId	TXT	Unique ID of the MSA feature in the source dataset
jurisId	TXT	Unique ID of the MSA feature in the original dataset
srcFeatType	TXT	Whether the feature was a point (PT) or polygon feature (PY) in the source dataset. True boundaries of point MSA features are not known. Points have been buffered by 15m to be included in this MSA database
url	TXT	Associated website holding additional information about the source feature or database
bestSource	TXT	Unique identifier for the source database
citation	TXT	Primary source of data
edition	TXT	Initials and date (YYYY MM DD) pertaining to the last edit to the MSA feature

NOVA SCOTIA

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APPROVAL

Province of Nova Scotia
Environment Act, S.N.S. 1994-95, c.1 s.1

APPROVAL HOLDER: NOVA SCOTIA POWER INCORPORATED

SITE PID: 40221673

APPROVAL NO: 2019-2638165-00

EXPIRY DATE: May 31, 2028

Pursuant to Part V of the Environment Act, S.N.S. 1994-95, c.1 s.1 as amended from time to time, approval is granted to the Approval Holder subject to the Terms and Conditions attached to and forming part of this Approval, for the following activity:

Water Approval - Dam
Ruth Falls Dam Refurbishment



Administrator: Kevin G Garroway

Effective Date: June 1, 2024

The Minister's powers and responsibilities under the Act with respect to this Approval have been delegated to the Administrator named above. Therefore, any information or notifications required to be provided to the Minister under this Approval can be provided to the Administrator unless otherwise advised in writing.

TERMS AND CONDITIONS OF APPROVAL

Nova Scotia Department of Environment and Climate Change

Approval Holder: NOVA SCOTIA POWER INCORPORATED

Project: Ruth Fall Headpond - PID 40221673

Site:

PID	Civic #	Street Name	Street Type	Community	County
40221673	935	HIGHWAY 374	HWY.	SHEET HARBOUR	HALIFAX COUNTY

Approval No: 2019-2638165-00

File No: 95100-30-BED-2019-2638165

Grid Reference: Easting - 539486, Northing - 4978146

Reference Documents

- Application submitted December 27, 2019 and attachments.
- Updated application submitted February 27, 2020 and attachments
- Updated application submitted May 6, 2022 and attachments
- Updated application submitted March 20, 2023 and attachments
- Updated application submitted June 22, 2020 and attachments
- Updated application submitted February 14, 2022, and attachments
- Updated application submitted August 21, 2023 and attachments
- Updated application submitted April 14, 2021 and attachments

1. Definitions

a. Act means Environment Act. 1994-95, c.1, s.1, and includes, unless the context otherwise requires, the regulations made pursuant to the Act, as amended from time to time.

b. Department means the Nova Scotia Department of Environment and Climate Change, and the contact for the Department for this approval is:
Nova Scotia Department of Environment and Climate Change
Central Region, Bedford Office
30 Damascus Road, Suite 115
Bedford, Nova Scotia B4A 0C1

Phone: (902) 424-7773
Fax: (902) 424-0597

c. Minister means the Minister of Environment and Climate Change and includes any person delegated the authority of the Minister.

d. Site means a place where a designated activity and/or undertaking is occurring or may occur.

e. Surface Watercourse means a watercourse as defined in the Environment Act, excluding groundwater.

2. Scope

a. This Approval (the "Approval") relates to the Approval Holder(s) and their application and all documentation submitted to the Department prior to the issuance of this approval for the Dam situated at or near Ruth Fall Headpond - PID 40221673.

b. The Approval Holder(s) shall ensure the designated activity is carried out in accordance with this Approval and reference documents, including the application and supporting documentation.

3. General

a. Unless otherwise specified in this approval, the Approval Holder(s) shall conduct the Designated Activity in accordance with the following provisions:

i. The Act, as amended from time to time;

ii. Any standard adopted by the Department, as amended from time to time, which includes but is not limited to the following:

Nova Scotia Watercourse Alterations Standard

b. Nothing in this Approval relieves the Approval Holder(s) of the responsibility for obtaining and paying for all licenses, permits, approvals or authorizations necessary for carrying out the work authorized to be performed by this Approval which may be required by municipal by-laws, provincial or federal legislation, or other organizations. The Minister does not warrant that such licenses, permits, approvals or other authorizations will be issued.

c. No authority is granted by this Approval to enable the Approval Holder(s) to commence or continue the designated activity on lands which are not in the control or ownership of the Approval Holder(s). It is the responsibility of the Approval Holder(s) to ensure that such a contravention does not occur. The Approval Holder(s) shall provide, to the Department, proof of such control or ownership upon expiry of any relevant lease or agreement. Failure to retain said authorization may result in this Approval being cancelled or suspended.

d. If there is a discrepancy between the reference documents and the terms and conditions of this Approval, the terms and conditions of this Approval shall apply.

e. Any request for renewal or amendment of this Approval is to be made in writing, to the Department, at least ninety (90) days prior to the Approval expiry.

f. If the Minister cancels or suspends this Approval, the Approval Holder(s) remains subject to the penalty provisions of the Act.

g. The Approval Holder(s) shall advise the Department in writing prior to any proposed extensions or modifications to the Activity and/or the Site. An amendment to this Approval may be required before implementing any extension or modification.

h. The Approval Holder(s) shall immediately notify the Department of any incidents of non-compliance with this Approval.

i. The Approval Holder(s) shall bear all expenses incurred in carrying out the environmental monitoring required under the terms and conditions of this Approval.

j. Unless specified otherwise in this Approval, all samples required to be collected by this Approval shall be collected, preserved and analysed, by qualified personnel, in accordance with recognized industry standards and procedures that are all deemed acceptable to the Department.

k. Unless written authorization is received otherwise from the Minister, all samples required by this Approval shall be analyzed by a laboratory that meets the requirements of the Department's "Policy on Acceptable Certification of Laboratories" as amended from time to time.

l. The Approval Holder(s) shall ensure that this Approval, or a copy, is present on Site while personnel are on Site.

m. The Approval Holder(s) shall notify the Department three business days prior to commencing construction of the Activity. The notification must include the Approval Number.

n. All phases of construction shall be overseen by a qualified professional engineer, licensed to practice in Nova Scotia by the Association of Professional Engineers of Nova Scotia (Engineers Nova Scotia), or technologist who works under the supervision of a qualified professional engineer.

o. Written certification by a qualified professional engineer is required, within 6 weeks of project completion, stating that the construction and installation of the facility meets the requirements of the approved drawings and specifications.

p. The certification shall confirm that all as-built drawings and any other relevant documentation have been turned over to the Approval Holder(s) by the engineer.

q. Within 14 days of completion of the work authorized under this Approval, the Approval Holder(s) is required to submit, to the Department, the enclosed form entitled "Completion of the Approved Work".

r. Upon any changes to the Registry of Joint Stock Companies information, the Approval Holder(s) shall provide a copy to the Department within five (5) business days.

4. Covenant Conditions

a. The Approval does not authorize any activity that would:

i. prejudice any riparian rights of any owner or of any person lawfully in possession of or holding any lands abutting the watercourse;

ii. cause any damage or nuisance to adjacent or abutting land; or

iii. discharge surface water onto adjoining lands without the authorization of the affected landowner(s).

b. The Approval Holder(s) is responsible to construct and maintain any culvert, bridge, dam, sluice, flume, conduit, or other approved structure built or used in or on the watercourse so that the structure(s) operates as originally designed and intended, and so that risks related to potential failure of the structure(s) are effectively mitigated.

c. The Approval Holder(s) shall rehabilitate the site to the satisfaction of the Minister and pay all expenses and costs of such rehabilitation in any of the following circumstances:

i. upon the expiry or termination of this Approval; or

ii. if the culvert, bridge, dam, sluice, flume, conduit, or other approved structure built or used in or on the watercourse is not appropriately maintained to mitigate risks related to potential failure of the structure(s).

d. By granting this Approval, the Department is not responsible for any damages as a result of the approved activities, including any water quality or quantity problems that may be encountered by the Approval Holder(s) or other parties.

5. Surface Water

a. The Approval Holder(s) shall ensure the Site is developed and maintained to prevent contaminants from being discharged into a water resource or beyond the property boundary.

b. Monitoring during construction: The Approval Holder(s) shall ensure that the following water quality limits are met in the water resource downstream of construction activities:

i. Total Suspended Solids, Clear Flows (Normal Background Conditions):

(a) Maximum increase of 25 mg/l from background levels for any short term exposure (24 hour or less);

(b) Maximum average increase of 5 mg/l from background levels for longer term exposure (inputs lasting between 24 hours and 30 days);

ii. Total Suspended Solids, High Flow (Spring Freshets and Storm Events):

(a) Maximum increase of 25 mg/l from background levels at any time when background levels are between 25 mg/l and 250 mg/l;

(b) Maximum increase of 10% over background levels when background is >250 mg/l;

c. Additional surface water monitoring may be required at the request of the Department.

d. The Approval Holder(s) shall develop and implement an Erosion and Sediment Control Plan.

e. No authority is granted by this Approval to enable the Approval Holder(s) to discharge surface water onto adjoining lands without the authorization of the affected landowner(s).

f. The Approval Holder(s) shall install and maintain erosion and sediment controls in line with industry best practices (e.g., Nova Scotia Environment Erosion and Sediment Control Handbook for Construction Sites) with the following considerations:

i. The controls shall be installed prior to the commencement of the construction activities;

ii. The controls shall remain in place until areas disturbed by construction activities are stabilized so that the risk of release of sediment to a water resource has been mitigated;

iii. Control features shall be installed as per applicable product specifications or manufacturer's directions; and

iv. Control materials shall be clean, non-erodible, non-ore-bearing, non-watercourse derived and non-toxic.

g. The Approval Holder(s) shall immediately contact the Department should sulphide bearing material be encountered on the Site.

h. The Approval Holder(s) shall ensure that surface water runoff that may be impacted by petroleum hydrocarbons from the Site is collected and directed for necessary treatment prior to discharge from Site.

i. Erosion and sediment controls shall be inspected daily, at a minimum, and prior to and after precipitation or flow events. These inspections shall confirm the erosion and sediment controls are working as designed and intended. Records outlining results of these inspections and actions taken to correct any

deficiencies shall be kept for the duration of the approval and made available to the Department upon request.

j. Work at the site shall only take place when erosion and sediment controls are functional. Contingency erosion and sediment control materials shall be kept on Site in case of failure.

k. Any silted water pumped from work areas shall be directed to vegetated areas, settling ponds, or other treatment devices that mitigate the risk of release of sediment to a water resource.

l. The Approval Holder(s) shall limit the size of the disturbed area and the removal of riparian vegetation to the area of construction activities as outlined in the supporting documentation.

m. The Approval Holder(s) shall ensure that the following activities take place at a distance of a minimum of thirty (30) metres from a surface watercourse or wetland in an area such that a release will not enter a surface watercourse or wetland:

   i. Fuel storage, refueling, and/or lubrication of equipment

   ii. Washing of machinery or equipment

   iii. Storage of equipment, excavated/stockpiled materials, and potential contaminants

n. Blasting in or near a watercourse is not permitted unless authorized in writing by the Minister.

6. Construction

a. Under authority of this Approval, the watercourse alterations specified herein shall be conducted between June 1st and September 30th (inclusive) of the same calendar year unless otherwise stated in the site specific terms and conditions.

b. All construction activities within or immediately adjacent to the watercourse channel shall be carried out in isolation of the streamflow (i.e., in the dry), unless otherwise stated in the site specific terms and conditions.

c. Disturbed watercourse banks shall be stabilized to mitigate any potential scouring, bank failure, or any other adverse effects as a result of the planned works, where deemed necessary by a qualified professional engineer.

d. The Approval Holder(s) shall ensure any cast-in-place concrete is poured in isolation of the watercourse and cured before it comes in contact with watercourse water.

e. Riprap and other material used in construction shall be clean, non-erodible, non-ore-bearing, non-watercourse derived and consist of non-toxic materials prior to

placement within the watercourse to mitigate against the release of substance into a surface watercourse or wetland.

f. Any equipment used for work within a watercourse shall be clean and free of soil and plant material to avoid the release of contaminants and the potential transfer of invasive species.

g. Any equipment used for work within a watercourse or wetland shall be mechanically sound, with no fuel or oil leaks.

h. An emergency spill-kit must be kept on site when vehicles (including machinery) or equipment is used in a watercourse.

i. Upon completion of construction, modification, or maintenance work all debris resulting from the work must be removed from the work site.

7. Site Specific

a. This Approval authorizes the refurbishment of the Dam on the Ruth Falls Reservoir at or near Malay Falls, Halifax County, Nova Scotia. NSPI shall ensure the work is carried out as described in the NSPI report entitled Environmental & Project Description for Construction Activities, Sheet Harbour Hydro System, Ruth Falls Dam Refurbishment, 2024, received digitally August 21, 2023.

b. Erosion and sediment control measures shall be established in all potentially erodible areas prior to the commencement of project activities and are to be maintained and monitored throughout construction. Any modifications required are to be developed and implemented by qualified personnel in accordance with the guidance outlined in the NSE Erosion and Sedimentation Control Handbook for Construction Sites, as well as the NSE Watercourse Alteration Standard, where deemed applicable by qualified personnel. Details related to ESC modifications are to be forwarded to NSE prior to the start of the works.

c. Sandbags used for erosion protection or in the construction of cofferdams must be filled with inert material, and be free of fines.

d. All work operations shall be conducted in a manner to protect the watercourse from siltation and disturbance to the adjacent and downstream areas. Silt-laden water shall not be released directly into the watercourse. Silt-laden water pumped from the work area shall be directed to heavily vegetated areas, settling ponds or other treatment devices.

e. Any overland flow which has the potential to enter the construction area is to be diverted into vegetated areas, away from the construction area.

f. All surficial runoff from the construction site and associated roadways shall be directed through naturally vegetated areas before it reaches the watercourse. Where direction through natural vegetation is not possible, runoff shall be treated through erosion and sediment control devices to prevent siltation of the watercourse.

g. Road drainage must not be discharged over a cut or fill unless appropriate vertically staged Erosion and Sediment Control measures are in place on the slope from the crest to the toe along the face of the embankment.

h. Wash water associated with concrete work shall not be released to the watercourse.

i. The Approval Holder shall ensure that water within the work area and immediately downstream of the Main Dam does not exceed a pH of 9.

j. The Approval Holder shall establish monitoring locations within 1 meter of the concrete being poured or cured, near the coffer dam wall within the impounded area, and downstream of the coffer dam. The pH of water shall be monitored on a minimum 6-hour frequency while concrete is being poured. Results shall be tabulated and be made available to the Department upon request.

k. The Approval Holder shall establish an upstream pH monitoring location above the Ruth Falls Main Dam. The pH of water shall be monitored on a daily basis to provide background levels while concrete is being poured. Records shall be tabulated and made available to the Department upon request.

l. Silt booms and other Erosion and Sediment Control features shall be installed by qualified personnel and as described in or in keeping with applicable product specifications. Contingency materials shall be kept on Site in case of failure (e.g., additional silt boom, temporary soil cover materials, etc.).

m. The Approval Holder shall ensure that the following water quality limits for turbidity are met in the watercourse downstream of the construction activities:

Clear Flow

Maximum increase of 8 NTU from background levels for a short-term exposure (e.g. 24 hour period). Maximum average increase of 2 NTU from the background levels for a longer term exposure (e.g. 30 day period).

High Flow

Maximum increase of 8 NTU from background levels at any time when background levels are between 8 and 80 NTU. Maximum increase of 10% above background levels when background is greater than 80 NTU.

n. The Approval Holder shall pause work immediately when turbidity exceeds the maximum increase from background levels and shall immediately implement mitigation measures under the supervision of a qualified person.

o. The Approval Holder shall keep all records of turbidity monitoring, and provide those records to the Department upon request.

p. Exposed soils and slopes shall be covered prior to precipitation events as required. Temporary erosion control covers (e.g., hay, straw, erosion control matting) are to be employed as necessary on exposed soils and slopes.

q. A contingency plan shall be in place for significant rainfall events (i.e., greater than or equal to a 1 in 2-year return period storm event).

r. Following any excavation and placement activities, areas disturbed by machinery or equipment shall be returned to pre-maintenance condition. Any exposed soil areas shall be stabilized to prevent erosion, and proper re-vegetation of disturbed areas will take place.

NOVA SCOTIA

File No:95100-30-BED-2019-2638165

COMPLETION OF THE APPROVED WORK

A condition of this Approval requires that the Approval Holder notify Nova Scotia Department of Environment and Climate Change that the work authorized is complete.

Please enter the information on this sheet and return it to Nova Scotia Department of Environment and Climate Change at the following address:

Nova Scotia Department of Environment and Climate Change
Inspection, Enforcement, and Compliance Division
Central Region, Bedford Office
30 Damascus Road, Suite 115
Bedford, NS, B4A 0C1

Phone: 902-424-7773
Fax: 902-424-0597
ECC Contact: Scott Bengert

APPROVAL NUMBER: 2019-2638165-00

NAME OF APPROVAL HOLDER: NOVA SCOTIA POWER INCORPORATED

WORK AUTHORIZED: Dam

DATE WORK WAS COMPLETED: _____

NAME OF CONTRACTOR: _____

COMMENTS: _____
_____
_____
_____
_____

_____ _____
Signature Date

From: NWAR-ESS
To: Thomas, Nadine
Subject: Application for approval submitted
Date: Friday, April 30, 2021 7:24:58 AM

This is an external email from: 010d0179224f42ee-ff561a02-9b47-4606-98e7-bb96bff00b32-000000@bounce.notification.canada.ca - exercise caution

Your Application for Approval to the Navigation Protection Program (NPP) has been successfully submitted.

From: Nadine Thomas

Located on:, Halifax Regional Municipality, Nova Scotia

For: Dam

Your project information has been sent to your regional Navigation Protection Program office for review.

An NPP officer will contact you to let you know what are the next steps.

Request IR-6:

Reference: NS Power applied for the FAA from DFO on June 24, 2020 and received four incomplete letters from DFO between August 4, 2020 and September 11, 2023. Each incomplete letter received by NS Power contained additional requests for information from DFO that had not been requested as part of previous incomplete letters. The additional requests, and any work associated with them, were not known at the time the original Project budget was developed and submitted to the Board. The costs associated with the additional studies, design, construction and Environmental Offsetting, as required by DFO resulted in increases to Project costs.

A summary of the correspondence between NS Power and DFO on NS Power's FAA application is summarized in Attachment 1.

(a) Please provide a detailed timeline of NS Power's application for the FAA, including any follow-up discussions or correspondence with the relevant agencies concerning the application once filed. Please include supporting documentation with the response.

Response IR-6:

(a) Please refer to NSUARB IR-12, part (a).

Request IR-7:

Reference: "As a result of the additional work required to address environmental permitting requirements, the construction timeline was extended leading to increased project costs of approximately $2 million. The project costs submitted as part of the original Application were established in 2018; however, as a result of the additional environmental permitting requirements, construction is now deferred until 2025 and 2026. There have been substantial pricing shifts in concrete and steel commodity markets since 2018, resulting in increased costs. There have also been increases in the amount of project support labour, technical support labour, and term environmental support labour as a result of the extended construction timeline." (ATO, p. 5)

(a) Is it NS Power's position that the extended construction timeline was caused solely by the delay in obtaining necessary permits, or were there any other contributing factors?

(b) If NS Power is aware of any other factors that may have contributed to delays, then please identify and explain.

(c) Is it NS Power's position that if the necessary permits had been obtained in a more timely manner then the construction timeline would not have been extended, and accordingly costs would have been on budget?

Response IR-7:

(a) The extended construction timeline was a direct result of the ongoing environmental regulatory process and associated delay in obtaining permits.

(b) Not applicable.

(c) The enactment of the 2019 Fisheries Act and 2019 Canadian Navigable Waters Act, which took place after the Original Application was approved by the NSUARB, resulted in the requirement for a Fisheries Act Authorization for the Ruth Falls Project. This new permitting requirement resulted in addition costs associated with delays in construction as well as additional costs associated with substantial new scope items such as fish passage upgrades and offsetting due to temporary drawdown of the Ruth Falls reservoir.

Request IR-8:

Reference: "Further engagement with the Mi'kmaq of Nova Scotia and archaeological investigation was required to understand and meaningfully address concerns associated with the protection of pre-contact First Nations archaeological sites and other environmental issues associated with the lowering of the Ruth Falls Reservoir 18 feet below the minimum operating level. This has led to additional costs of approximately $400,000." (ATO, p. 3)

(a) Please provide further details regarding the extent of NS Power's engagement with the Mi'kmaq of Nova Scotia, and explain why this led to additional costs of approximately $400,000.

(b) Please discuss why concerns related to the reservoir lowering could not have been previously anticipated?

Response IR-8:

(a) Please refer to CA IR-13.

(b) Concerns related to the reservoir lowering were not anticipated at the time of the original application because NS Power's process for engagement with the Mi'kmaq of NS as well as the environmental regulatory review process for the Ruth Project was not the same. NS Power's relationship with the KMK and the Mi'kmaq of NS has evolved substantially, based on continued engagement with KMK and Community and lessons learned from other hydro capital refurbishment projects that have included extended drawdowns. Since the original application, NS Power has learned more about Mi'kmaq interest and concern and expectations from the NS Department of Communities Culture, Tourism and Heritage (CCTH) related to archaeological protection for extended drawdowns; these lessons learned led to revised costs for archaeological protection for the drawdown for Ruth Project.

Request IR-9:

Reference: NS Power states that regular labour costs will increase by $444,441, with term labour increasing by $94,851, plus associated overtime, all due to additional "project management support & environmental services labour". (ATO, p. 5)

(a) Please provide a full breakdown of these costs, including when incurred and in respect of which permit applications.

(b) Please elaborate upon any cost minimization efforts NS Power has made with respect to these costs.

Response IR-9:

(a) A variance of $444,441 on internal labour is attributed to additional NS Power project management support due to expanded scope and schedule, and NS Power environmental services labour required to secure the necessary environmental permits for construction and as a result of the extended project timeline.

Yearly breakdown:

Year	**Increase in costs (in Thousands)**	**Description**
2017-2020	($19)	
2021	$85	Managing permitting (DFO, NSECC, and DNRR), Contract LNTP activities
2022	$124	Managing permitting (DFO, NSECC, and DNRR), Controls Building construction
2023	$56	Managing permitting (DFO, NSECC, and DNRR), fish passage upgrades engineering

2024	$47	Managing permitting (DFO) and UARB approvals, fish passage upgrades engineering
2025	$104	Managing project execution, environmental studies, offsetting
2026	$47	Managing final months of project execution, project FIN
Total	**$446**	

A variance of $94,851 on term labour costs is attributed to Environmental Services labour required for providing monitoring support for the 9 months drawdown period in during construction, assisting with post-construction monitoring and environmental studies, engagement meetings and offsetting project on West River as required by the environmental permits for the project.

Yearly breakdown:

Year	**Increase in costs (in Thousands)**	**Description**
2017-2020	$3	Managing site work pertaining to obtaining permits
2021	$0	Managing site work pertaining to obtaining permits
2022	$1	Managing site work pertaining to obtaining permits
2024	$1	Managing site work pertaining to obtaining permits
2025	$30	Managing execution of permit conditions
2026	$60	Managing execution of permit conditions
Total	**$95**	

(b) Cost minimization will be realized by using internal labour rather than contracted labour at a marked-up rate during the upcoming monitoring during the nine months drawdown of Ruth Falls reservoir. NS Power also sought to minimize internal labour costs by incorporating lessons learned in preparing other FAA and Watercourse Alteration Approval applications to reduce the amount of questions asked by regulators and the additional work required to answer the questions. The Company also assigned internal labour resources to the Project that were already familiar with the Sheet Harbour Hydro System and the requirements of its operation, environmental considerations, and geographic constraints.

Request IR-10:

Reference: NS Power states that materials will increase in cost by approximately $1.4M. (ATO, p. 5)

(a) Please elaborate upon any cost minimization efforts NS Power has made with respect to cost of materials.

Response IR-10:

(a) As a result of the NS Power's competitive procurement system, long lead items such as rubber dams, sluice gates, and actuators were procured at a lower cost than the 2019 construction cost estimate. This resulted in a cost minimization of approximately $780,000. These materials were ordered early to avoid any construction delays and possible inflation during the permitting process.

Request IR-11:

Reference: NS Power states that cost of contracts will increase by approximately $2.6M. (ATO, p. 5)

(a) Please provide a full breakdown of these costs.

(b) Please elaborate upon any cost minimization efforts NS Power has made with respect to these costs.

Response IR-11:

(a) Please refer to NSUARB IR-10 (b)(ii)

(b) In 2021, while waiting on obtaining approvals from DFO and NSECC, NS Power issued a Limited Notice to Proceed to the Contractor to allow it to proceed with mobilization, site preparation work, setting up environmental management controls, and procuring miscellaneous steel components (rebar dowels, steel walkway) and the lighting system without locking the Contractor into the Construction Contract. The Contractor mobilized to site, cleared vegetation, grubbed the laydown area, laid out safety and environmental storage containers, started working on the access roads downstream of the dam, and demobilized from site. This work allowed NS Power to minimize the amount of deferral costs (i.e. price of construction labour/accommodations/fuel for mobile equipment) that year.

Later that year, NS Power evaluated cost minimization options to complete some aspects of the Ruth Falls main dam refurbishment work without a drawdown due to the extended timeframe for the DFO Fisheries Act Authorization process. Any work that could be executed under the current (2021/2022) labour / material rates ahead of main refurbishment

activities that required permit approvals were investigated as cost minimization opportunities.

It was evaluated whether refurbishment of the sluiceway scope and new control building could be completed with the headpond at normal supply level via a stand-alone Watercourse Alteration Approval in July 2021, however the sluiceway scope could not be separated from the broader dam refurbishment due to safety concerns therefore only a portion of these cost minimization efforts were realized. That portion included construction of the rubber dams control building which was completed by September 2022. This allowed NS Power to minimize the amount of deferral costs (i.e. price of concrete and steel for the Rubber Dams Controls building, construction labour, fuel for mobile equipment).

Request IR-12:

Reference: NS Power states that costs for consulting have increased by approximately $1.6M. (ATO, p. 5)

(a) Please provide a full breakdown of these costs.

(b) Please elaborate upon any cost minimization efforts NS Power has made with respect to these costs.

(c) If not otherwise addressed in part (a), please provide details of the required offsetting programs and explain why offsetting costs are considered consulting costs.

Response IR-12:

(a) The table below provides a detailed breakdown of the consulting costs that constitute $1.6 million variance:

Description	Increase in costs (in Thousands)
Offsetting (West River Project)	$547
Post-Construction monitoring	$309
Fish passage improvements design	$192
Fish count	$122
Juvenile Gaspereau Entrainment Study	$120
3D Hydraulic modelling	$118
Archaeological reconnaissance during the drawdown	$106
Drawdown monitoring plan	$55
Additional design efforts for rubber dams' controls building	$43
Electrical design work for Rubber Dam Controls Building	$33
Construction Support in 2025-2026	$27
Barn Swallow Monitoring Plan and monitoring	$19
Aerial Imagery Collection for the Juvenile Gaspereau Entrainment Study	[redacted]
Conceptual / Detailed design of the dam refurbishment	$3

Environmental Permitting Application fees	[redacted]
Environmental maintenance flow assessment	$1
Wetland delineation and functional assessment	-$1
RFP support by the external Engineering Consultant	-$6
KMKNO Capacity payments	[redacted]
TOTAL[1]	**$1,631**

Please note that costs associated with KMKNO Capacity Payments were initially budgeted and added to the "Consulting" section of the Original Application, rather than captured in a dedicated "Mi'kmaq Engagement" section of the ATO Application.

(b) Additional Consulting costs were primarily required to address the additional requests from DFO. Competitive procurements processes were used to select consultants for this scope of work.

(c) Please refer to CA IR-14, part (a) and (b) for details of the required offsetting program. Offsetting is completed by a third-party consultant specializing in fish habitat restoration and enhancement, on behalf of NS Power at a location not controlled by NS Power. The consultant is responsible for the development of the offsetting plan, pre-monitoring, execution of physical restoration work and post-monitoring. As such, the costs associated with offsetting are considered consulting costs.

[1] Totals may be off due to rounding of individual line items.

Request IR-13:

Reference: NS Power states that costs for Mi'kmaq Engagement are $[redacted], whereas previously no costs had been budgeted.

(a) Please provide a full breakdown of these costs.

(b) Please explain why these costs were not initially budgeted.

(c) Please explain the discrepancy between the costs referenced at p. 3 of the Application ($400,000) versus the costs referenced at p. 6 of the Application ($[redacted]).

Response IR-13:

(a) Please refer to the table below for a breakdown of the $[redacted] costs:

Description	Variance
KMKNO Capacity Payments: Continued Mi'kmaq engagement costs associated with the extended project schedule (2019-2026)	[redacted]
Mi'kmaq observer: Member of the Mi'Kmaq community observe the drawdown and archaeological work in 2025 (per month: $20/hour x 40 hrs/wk. x 4 weeks + expenses)	
TOTAL:	

(b) Costs associated with KMKNO Capacity Payments were initially budgeted and added to the "Consulting" section of the Original Application, rather than captured in a dedicated "Mi'kmaq Engagement". This was in the amount of $[redacted]. The increase from $[redacted] to $[redacted] as per table in (a) is required to cover additional monthly KMKNO capacity payments as a result of the project's extended timeline and service of the Mi'kmaq observer as a result of evolving expectations.

(c) The $400,000 figure referenced on page 3 of the ATO application refers to costs increases associated with "Archaeology and Mi'kmaq Engagement" whereas the $[redacted] figure referenced on page 6 of the ATO application only refers to "Mi'kmaq Engagement". Please refer to Figure 1 below for a breakdown of the $400,000 as referenced on page 3 of the ATO application:

Description	UARB Approved Original Submission	ATO Submission	Variance
ARCHELOGICAL INVESTIGATION			
Archaeological Reconnaissance and Mitigation for Dewatering of Ruth Falls Reservoir in 2025-2026: To complete archaeological reconnaissance during the drawdown of the Ruth Falls headpond in 2025-2026 and complete preliminary historical background and predictive modeling report.	-	$106,302	$106,302
Archaeology Security costs: Costs to provide security for the exposed pre-contact First Nations archaeological sites on the reservoir during the	-	$133,900	$133,900

drawdown of Ruth Falls reservoir in 2025-2026.			
Methodology and Costing for Archaeological Screening: Additional costs related to methodology and costing for archaeological screening	$2,256	$7,966	$5,710
Other historical costs	-	$2,193	$2,193
MI'KMAQ ENGAGEMENT			
Additional KMKNO Capacity Payments: To provide the KMKNO with necessary resources to meaningfully engage with NS Power.	[redacted]		
Mi'Kmaq observer: Member of the Mi'Kmaq community observe the drawdown and archaeological work in 2025 (per month: $20/hour x 40 hrs/wk. x 4 weeks + expenses)			
TOTAL:	**$78,256**	**$478,468**	**$400,210**

1

Request IR-14:

Reference: "The original contingency amount remains unchanged, however additional contingency has been added to cover uncertainty around the amount of offsetting costs required by DFO, which has yet to be confirmed and has the potential to vary significantly."

(a) On what basis does NS Power state that the "amount of offsetting costs required by DFO … has the potential to vary significantly"?

(b) Please provide NS Power's best estimates on the potential variance of these costs.

Response IR-14:

(a) In response to DFO's regulatory review of NS Power's Fisheries Act Authorization (FAA) application and Crown consultation, DFO directed NS Power to evaluate additional offsetting for the Project in a follow up email dated June 6, 2024. Please refer to NSUARB IR-12 Attachment 14 for a copy of this correspondence. In its original offsetting plan submitted to DFO as part of the FAA application, NS Power proposed 2,700 m^2 of offsetting. DFO has not specifically requested NS Power provide a set amount but has referenced the required offset could be up to 57,500 m^2.

(b) The potential variance ranges from $320,000 to up to $1.45 million. This range includes a low-end estimate based on the budget for NS Power's original offsetting plan for 2,700 m^2, and a high-end estimate based on the 57,000 m^2 referenced in DFO's June 6th 2024 email. The high-end was derived from DFO as guidance to offset the Harmful Alteration, Disruption and Destruction (HADD) of fish habitat using the total area of the Ruth Headpond to be dewatered during the temporary drawdown, the duration of the drawdown, and an average cost of $25/$m^2$ of offsetting to impact area using other NS Power projects which have undergone offsetting.

However, NS Power does not expect this high end estimate to be required by DFO and, as such, the Company estimated a reasonable variance of the cost of offsetting for the Project to be 20,000 m^2 based on feedback provided by DFO. NS Power used the average cost of 25/m^2 to determine a budget of $500,000 for offsetting. The Company also included an additional $500,000 in contingency to account for possible additional offsetting, should it be required by DFO through the regulatory review and Crown consultation process.

Request IR-15:

Reference: NS Power states that costs for Administrative Overhead will increase by $341,503, compared to an original budget of $72,085.

(a) Please provide a full breakdown of these costs.

(b) Please elaborate upon any cost minimization efforts NS Power has made with respect to these costs.

(c) Please explain why the administrative overhead for this project has increased so significantly in just five years.

Response IR-15:

(a) NS Power calculates administrative overhead in accordance with NSUARB-approved Accounting Policy 6230 – Application of Administrative and Vehicle Overhead (Self-Constructed Assets). Administrative Overhead is applied to the project based on the regular and term labour charged to the project, in addition, for regular overtime and term overtime labour costs on the project, administrative overhead is applied to half of the cost of the regular overtime and term overtime cost. Please refer to the table below for a breakdown of administrative overhead by year and the rates used to determine the amounts:

Year	Total Regular, Term and Overtime Labour	Administrative Overhead Rate Applied	Total Administrative Overhead
2017[1]	$16,312	51.90%	$8,141
2018	$21,446	42.69%	$9,155

[1] Prior to August 2017, AO was calculated based on individual employee rates. As such, individual differences will occur when calculating Administrative AO by multiplying Labour by the Admin AO rate.

2019	$36,107	39.29%	$14,186
2020	$71,116	37.16%	$26,426
2021	$101,011	40.28%	$40,689
2022[2]	$131,361	46.15%	$59,196
2023	$55,732	55.46%	$30,912
2024[3]	$47,588	77.70%	$36,973
2025 *(Estimated)*	$134,500	77.70%	$104,500
2026 *(Estimated)*	$107,356	77.70%	$83,410
Total	$722,529		$413,588

(b) Please refer to CA IR-09 (b).

(c) The increase in administrative overhead (AO) is due to the increase in labour spend and an increase in rates. Please refer to part (a) for a breakdown of labour spend and rates used in the AO calculation. At the time of the 2019 filing an AO rate of 39.29% was used for the future forecasted periods. In the current filing, the 2024 rate of 77.70% has been used for future forecasted periods. Regular and Overtime Labour has also increased by $545,477 from the prior submission, this combined with increased AO rates has resulted in an increase total AO of $341,503.

[2] 50% of overtime labour is included for the purposes of the AO calculation. 2022 includes $6,186 in overtime labour.
[3] 2024 includes actual costs to August 31, 2024 and forecasted costs for the remainder of the year.

Request IR-16:

Reference: NS Power states that costs for Contractor Administrative Overhead will increase by $286,012.

(a) Please provide a full breakdown of these costs.

(b) Please elaborate upon any cost minimization efforts NS Power has made with respect to these costs.

Response IR-16:

(a) NS Power calculates contractor administrative overhead in accordance with NSUARB-approved Accounting Policy 6235 – Application of Administrative Overhead (contracted assets). Contract AO is applied to the project based on each dollar of contract costs incurred on the project. Please refer to the table below for a breakdown of contractor administrative overhead by year and the rates used to determine the amounts:

Year	Total Contract Costs	Contractor Administrative Overhead Rate Applied	Total Contractor Administrative Overhead
2017	$2,256	10.76%	$243
2018	$8,028	9.71%	$780
2019	$1,027	12.02%	$123
2020	$22,269	9.75%	$2,172
2021	$641,718	10.08%	$64,704
2022	$727,217	8.38%	$60,926
2023	($27,224)	11.36%	($3,092)

2024[1]	$37,520	12.30%	$4,613
2025 *(Estimated)*	$4,445,491	12.30%	$546,619
2026 *(Estimated)*	$389,532	12.30%	$47,897
Total	$6,247,833		$724,985

(b) The cost minimization efforts related to Contract costs, as described in CA IR-11 (b), would have a direct impact on the minimization of contract AO, as every dollar of Contact investment attracts Contract AO.

[1] 2024 includes actual costs to August 31, 2024, and forecasted costs for the remainder of the year.

Request IR-17:

Reference: NS Power states that AFUDC will increase by $612,215.

(a) Please provide a continuity schedule showing for each year the balances and the AFUDC rates used to calculate the revised AFUDC interest amounts.

Response IR-17:

(a) Please refer to Midgard IR-4 (b) for the breakdown of AFUDC incurred and forecasted and the corresponding AFUDC rates.

Request IR-18:

Reference: In M09579, NS Power sought an Authorization to Overspend on the Gaspereau Dam Safety Remedial Works in the amount of approximately $18M. In M10197, NS Power sought an Authorization to Overspend on the Tusket Main Dam Refurbishment in the amount of approximately $37M.

(a) Has NS Power made any efforts to improve its planning with respect to hydro projects since the ATO applications for Gaspereau and Tusket Falls were filed? If so, please provide details, and confirm whether these efforts have impacted NS Power's planning for Ruth Falls.

Response IR-18:

(a) Yes, for complex projects such as Hydro Dam projects, NS Power has deployed an improved project gating process that ensures project scope and required cost certainty is achieved before projects are filed with the NSUARB for approval. Environmental permitting is a key element required to inform cost certainty, scope and project execution timing; therefore, NS Power continues proactive work to engage with NSECC and DFO at the working level to inform on project plans, align on priorities and facilitate the permit development and approval process. Similarly, NS Power continues to work to engage early and frequently with the Mi'kmaq on hydro capital projects to understand areas of interest and concern, to inform the final project scope.

These efforts have impacted planning for Ruth Falls and other Hydro projects, which has led to greater certainty in the project budgets being brought forward for NSUARB approval.