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October 31, 2023

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Re: *Reliability and Resource Adequacy Study Review* – Pumped Storage at Existing Hydro Sites

In correspondence dated May 5, 2023, the Board of Commissioners of Public Utilities ("Board") directed Newfoundland and Labrador Hydro ("Hydro") to file a number of updates regarding the studies and analyses ongoing within the *Reliability and Resource Adequacy Study Review* ("*RRA Study Review*"). In particular:

1) Hydro shall file by May 19, 2023 a comprehensive list of all reports, studies and analyses it has currently underway or planned with respect to the reliability of the LIL, potential alternative generation resources, the load forecast, and any other issues raised in the 2022 RRAS Update and the May 1-2, 2023 technical conference. This list shall include a description of the scope of each study, report and analysis, the consultant or group undertaking the work and the schedule for completion.

2) Hydro shall file with the Board a copy of each report, study or analysis listed in response to number 1 above as it is completed.[1]

On May 25, 2023, Hydro provided the Board with a list of all reports, studies, and analyses currently underway or planned to support future filings in relation to the RRA Study Review.[2] Enclosed with this letter is an overview of Pumped Storage at Existing Hydro Sites, including an attachment containing the study, "Pump Storage Feasibility Study," performed by Hatch Ltd. ("Pumped Storage Study").[3]

The Pumped Storage Study contains commercially sensitive information. A version in which this information has been redacted is enclosed. The Board has been provided with a complete copy as well as a copy of the redacted version.

[1] "Newfoundland and Labrador Hydro - Reliability and Resource Adequacy Study Review - To Parties - Further Process," Board of Commissioners of Public Utilities, May 5, 2023, p. 2.
[2] "*Reliability and Resource Adequacy Study Review* – Listing of Planned Reports, Studies, and Analyses," Newfoundland and Labrador Hydro, May 25, 2023, Table 1 and att. 1.
[3] "Pump Storage Feasibility Study H371390-0000-200-230-0001," Hatch Ltd., October 20, 2023.

Should you have any questions, please contact the undersigned.

Yours truly,

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Pumped Storage at Existing Hydro Sites

Overview

October 31, 2023

A report to the Board of Commissioners of Public Utilities

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List of Attachments

Attachment 1: "Pump Storage Feasibility Study H371390-0000-200-230-0001," Hatch Ltd., October 20, 2023.

1.0 Context within the RRA Study Review

Newfoundland and Labrador Hydro ("Hydro") filed the "Reliability and Resource Adequacy Study" ("2018 Filing") with the Board of Commissioners of Public Utilities ("Board") in November 2018.[1] Since the 2018 Filing, Hydro has filed regular updates to the Reliability and Resource Adequacy Study, numerous technical notes, additional studies, and third-party reports. Additionally, the *Reliability and Resource Adequacy Study Review* proceeding ("*RRA Study Review*") has included five rounds of requests for information and four technical conferences, providing for ample discourse and exchange of information between Hydro, the Board, and the parties. Further, there are additional studies and reporting underway and upcoming throughout the next year.

The regulatory record for this proceeding is robust, with good reason. The provincial electrical grid is in the midst of unprecedented change—it is evolving from an isolated to an interconnected system, some of the assets the province has historically relied on most are aging and nearing retirement, there are significant new assets integrated into the electrical system and being proven reliable, and the province is facing a material increase in load driven by global transitions from fossil fuels to renewable energy sources.

In the coming years and decades, Hydro will have to make significant investments to maintain its legislative obligation of safely and reliably providing electrical service in an environmentally responsible manner to Newfoundlanders and Labradorians.[2] As such, through the *RRA Study Review*, Hydro is modelling its system expansion in consideration of various forecast scenarios and within the context of continuously evolving energy policy. The numerous studies that Hydro has completed and planned are all necessary to validate and justify the information that Hydro feeds into its models that produce critical information on which timely, prudent decisions are to be made.

While the enclosed study provides valuable, necessary information, it cannot and should not be considered independent of the rest of the studies and analyses ongoing through the *RRA Study Review*. Rather, the study is an input that will (along with other studies completed and ongoing) inform Hydro's broader system resource planning process now and into the future.

---

[1] "Reliability and Resource Adequacy Study," Newfoundland and Labrador Hydro, rev. September 6, 2019 (originally filed November 16, 2018.

[2] *Electrical Power Control Act*, 1994, SNL 1994, c E-5.1, s 3(b)(iii).

2.0 Background

In its May 25, 2023 correspondence to the Board, Hydro advised that it had engaged Hatch Ltd. ("Hatch") to assess the feasibility of utilizing the infrastructure associated with the existing hydroelectric generating facilities to develop new pumped storage projects on the Island Interconnected System ("Pumped Storage Study").[3]

Pumped storage facilities store excess non-dispatchable energy during times of high electricity supply for use during periods when energy is not readily available. Pumped storage facilities operate by pumping water from one reservoir to another at a higher elevation during periods of energy surplus and returning the same water to the lower reservoir during periods of energy demand—generating electricity in the process. Hatch's assessment is divided into two tasks, collectively known as the Pumped Storage Study (provided as Attachment 1), and are detailed as follows:

- **Task 1: Screening Study**: The screening study assessed nine hydroelectric generating facilities on the Island that were identified by Hydro as potential candidates for pumped storage development. The nine locations were screened using a Pugh Analysis,[4] which incorporates both the suitability of the topography and site location as well as consideration of social and environmental factors. Each factor was individually assessed based on the information available before weighting factors were applied; the results were then summated to create a ranking of the sites. The preferred sites were deemed those that had the highest ranking.
- **Task 2: Detailed Analysis and Costing**: The scope of this task was to undertake a high-level evaluation of the top two preferred sites, which were selected due to their higher head and possible potential for pumped storage suitability, and develop AACE[5] Class 5 cost estimates for each.

It is important to note that the Pumped Storage Study is not intended to and does not make recommendations as to whether pumped storage at existing hydroelectric generating facilities are an appropriate solution to meet the needs of the electrical system. This determination will be made in consideration of all matters being contemplated within the *RRA Study Review*. Rather, the Pumped

[3] "*Reliability and Resource Adequacy Study Review* – Listing of Planned Reports, Studies, and Analyses," Newfoundland and Labrador Hydro, May 25, 2023.
[4] A Pugh Analysis, also known as Pugh Concept Selection Process or Pugh Method, is a decision matrix used to evaluate and prioritize alternatives or solutions based on established and weighted evaluation criteria.
[5] Association for the Advancement of Cost Engineering ("AACE").

Storage Study provides valuable information that will serve as input and improve the quality of Hydro's resource planning model. It is a prudent, necessary step in the evaluation of potential resource options to support the future needs of the Island Interconnected System.

The purpose of this overview is to provide a high-level summary of Hatch's findings and recommendations, as well as Hydro's assessment of those findings and planned next steps.

3.0 Summary of Hatch's Findings

3.1 Task 1: Screening Study

Task 1 of the Pumped Storage Study screened the nine locations identified by Hydro for further assessment, using a Pugh analysis to rank the sites based on the aforementioned criteria.

The results of the ranking found that the majority of these locations were not economical, due to the outflow of these generating facilities directly to the ocean.[6] River reservoirs were ruled out due to the limitations that would be put on the capacity of the facility without the addition of a dam.

The screening process then ranked Hinds Lake, Star Lake, and Granite Lake sites the most promising, based on the adopted weighting used in the Pugh Analysis.[7,8] It was determined that Hinds Lake and Star Lake would be evaluated further, due to their higher head and possible potential for pumped storage suitability. The Granite Lake site was not pursued further due to its low head.

[6] Pumped hydro facilities that use the ocean as a lower reservoir must be adapted for use in saltwater. This is often expensive, as it requires special equipment and may result in unacceptable environmental impacts associated with pumping seawater into the upper freshwater reservoir.
[7] The generating assets at the Star Lake Hydroelectric Generating Station are currently owned by the Government of Newfoundland and Labrador and are non-regulated assets. Star Lake has been included for fulsome analysis of options.
[8] The screening process undertaken in Task 1 is summarized in Appendix A of the Pumped Storage Study.

3.2 Task 2: Detailed Analysis and Costing

Task 2 of the Pumped Storage Study undertook a high-level evaluation of the two selected sites (Hinds Lake and Star Lake) and developed AACE Class 5 cost estimates for each. Given that the main objective of the Pumped Storage Study was to utilize the existing infrastructure and equipment, the evaluation of these sites was approached in two ways:

- **Layout 1**: The addition of new pump stations utilizes existing equipment only,[9] thus limiting the capacity of the pump station to 46 MW at Hinds Lake and 11 MW at Star Lake.
- **Layout 2**: Recognizing the capacities of Layout 1 do not utilize the full storage potential in the reservoirs, the limitation of utilizing existing equipment only was removed and a new standalone 200 MW pumped storage facility was proposed at each location. A facility of this size would have the capacity to store energy from new intermittent energy sources (e.g., wind farms) in the future.

Project layouts and cost estimates were developed for Layout 1 and Layout 2 for each site. Due to the similarities in the project layouts for each site, one schedule was prepared for the Layout 1 options and one schedule was prepared for the Layout 2 options, with estimated project completion years of 2028 and 2029, respectively.[10]

Table 1 provides a comparison between the Layout 1 and Layout 2 cost estimates.[11]

[9] The assumption to utilize existing equipment only assumes the addition of new pump stations connected to the existing water conveyance.
[10] Detailed schedules are provided in Appendix C of the Pumped Storage Study. The environmental and permitting activities and regulatory approval processes have not been incorporated into the project schedule; the impact of these items will need to be assessed.
[11] Further details on the work undertaken, the process followed, and the conclusions reached are presented in Appendix D of the Pumped Storage Study.

Table 1: Estimated Class 5 Project Cost ($000)[12,13]

Project Cost	Hinds Lake Layout 1 (46 MW)	Star Lake Layout 1 (11 MW)	Hinds Lake Layout 2 (200 MW)	Star Lake Layout 2 (200 MW)
Temporary Works	1.0	1.0	22.3	22.3
Access and Site Plan	0.3	0.3	0.5	0.5
Project Components	65.6	28.2	414.4	574.1
Indirect Cost	27.5	10.8	152.0	198.3
Contingency	28.3	12.1	176.8	238.6
Total[14]	**122.6**	**52.4**	**766.0**	**1,033.7**

When comparing Layout 1, Hinds Lake has a greater total project cost than Star Lake. The increased cost of the Hinds Lake site is mainly due to the higher equipment costs associated with a larger generating facility, in addition to the increased depth required at this site for unit submergence, and the lengthy excavation required for the penstock connection. Neither of the "Layout 1" options would provide additional capacity to the system, as they rely on the use of the existing generators at each site.

For Layout 2, generating capacity is increased significantly. The total project cost at the Star Lake site is greater than that of Hinds Lake, primarily due to the length of the penstock required, the higher flows, and the required depth of excavation for the new pump/powerhouse.

The costs of potential transmission upgrades were not considered in the cost estimate. These costs, however, could be a significant addition to the costs presented herein.

3.3 Recommendations

The primary conclusions and recommendations of the Pumped Storage Study are as follows:

- The Layout 1 options provide no increase to Hydro's generating capacity and would not utilize the full storage potential of the two sites, thus providing minimal support for additional renewable generation as may be required in future. In Hatch's opinion, the options associated with Layout 1 should not be pursued further.

[12] The total estimated cost is presented in 2023 dollars and does not include escalation, land costs, transmission upgrades, or any additional project costs that may be required.
[13] Totals may not add due to rounding.
[14] Costs do not include Owner's costs, escalation, or borrowing costs.

- The Layout 2 options increase Hydro's generating capacity, provide the ability to store excess energy (such as that from wind in times of high production and low demand), and generate energy when supply is low and demand is high. During generation, the existing facilities would also be used, thus providing 200 MW in addition to the current generating facility capacities.
- Hinds Lake appears more attractive than Star Lake on a cost-per-MW basis due to a higher head and a shorter penstock, which makes Hinds Lake more efficient in terms of producing the same energy when compared to Star Lake.
- The 200 MW installed capacity assumed for both Layout 2 options would need to be optimized to align with the grid demands if this resource option was pursued further.

4.0 Conclusion and Next Steps

Should Hydro's planning process identify a need for pumped storage technology, Hydro will pursue the Layout 2 options in more detail to obtain the information necessary to support the appropriate supply decision for the province. Hydro's next step is to assess pumped storage options at Greenfield sites on the Island Interconnected System. Pending the outcome of this study, Hydro will evaluate pumped storage options in the context of system requirements and generation expansion.

Attachment 1

Pump Storage Feasibility Study

H371390-0000-200-230-001

Hatch Ltd.

October 20, 2023

HATCH

Newfoundland and Labrador Hydro
Pump Storage Feasibility Study
H371390

Engineering Report
Engineering Management
Pump Storage Feasibility Study

Pump Storage Feasibility Study

H371390-0000-200-230-0001

PROVINCE OF NEWFOUNDLAND
PEG Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
CLASS "A"
This Permit Allows
HATCH LTD.
MIRC # 02780
To practice Professional Engineering in Newfoundland and Labrador
Permit No. as issued by PEG-NL D0090
which is valid for the year 2023

2023-10-20	0	Approved for Use	J. Coronado	J. Law	J. Law	T. Chislett
DATE YYYY-MM-DD	REV.	STATUS	PREPARED BY	CHECKED BY	APPROVED BY	APPROVED BY

Disclaimer

This report was prepared by Hatch Ltd. ("Hatch") for the sole and exclusive use of Newfoundland and Labrador Hydro (the "Principal") for the purpose of assisting the management of the Principal in making decisions with respect to the Pump Storage Feasibility Study. This report must not be used by the Principal for any other purpose, or provided to, relied upon, or used by any other person without Hatch's prior written consent, except that this Report may be provided as required by regulatory or self-regulatory bodies or authorities so long as such authorities are informed of the confidential and privileged nature of such information.

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1. Introduction

With the increased installation of variable energy sources, such as solar and wind, electrical grids require both storage and dispatchable capacity to maintain stability. In direct response to this requirement many system operators globally are considering implementing grid based energy storage, like pumped storage. These pumped storage facilities store excess energy during times of high electricity supply, typically when the sun is shining and/or the wind is blowing, and allow the operator to shift this non dispatchable energy to periods when it is not readily available. Pumped storage facilities operate by pumping water from one reservoir to another at a higher elevation during periods of energy surplus and returning the same water back to the lower reservoir during periods of energy demand, generating electricity in the process.

Newfoundland and Labrador Hydro (NL Hydro) currently operates twelve (12) hydro generating stations on the island of Newfoundland and is currently assessing whether any of these existing reservoir facilities are suitable for pumped storage development. Nine (9) of these hydro generating stations were identified by NL Hydro as potential candidates for pumped storage development. NL Hydro engaged Hatch to assess the feasibility of utilizing the infrastructure associated with the existing hydro generating stations to develop new pumped storage projects.

2. Scope

The scope of the overall study consists of two distinct tasks:

- Task 1 - A screening study to evaluate the nine sites for suitability and a selection of three preferred sites.
- Task 2 – A more detailed analysis and costing of each site.

2.1 Task 1 (Screening Study) Approach Summary

The screening study (Task 1) was undertaken using a Pugh analysis. This type of analysis incorporates both suitability of the topography and site location as well as considering social and environmental factors. Each factor was individually assessed based on the available information, before weighting factors were applied, and the results summated to create a ranking of the sites. The preferred sites were deemed to be those that had the highest ranking.

The screening process undertaken is summarized in the project memo titled *Site Location Options Screening Analysis*, document number H371390-0000-200-030-0001, enclosed as Appendix A.

Most of the sites were deemed unfeasible due to the lower reservoir being the ocean. Pumped hydro facilities that use the ocean as a lower reservoir must be adapted for use in saltwater, which is often expensive as it requires special equipment, and environmentally speaking the pumping of salt water into a freshwater reservoir would not be acceptable. River reservoirs could also be ruled out due to the limitations that would be put on the capacity of the facility without the addition of a dam.

The screening process ranked Hinds Lake, Star Lake and Granite Lake sites the highest, based on the adopted weighting used in the Pugh Analysis. While three sites were initially planned to be evaluated, upon discussion between NL Hydro and Hatch, it was determined that Hinds Lake and Star Lake would be evaluated, due to their higher head. The Granite Lake site was not further pursued due to its low head.

Table 2-1 lists the sites with their lower reservoir type and viability:

Table 2-1: Sites with their Lower Reservoir Type

Site	Lower Reservoir	Viability
Bay D'Espoir Generating Facility	Ocean	No
Bishop's Falls	Ocean	No
Cat Arm	Ocean	No
Grand Falls	River	No
Granite Lake	Lake	Yes
Hinds Lake	Lake	Yes (Chosen)
Paradise River	River/Ocean	No
Star Lake	Lake	Yes (Chosen)
Upper Salmon	Lake/pond	Yes

2.2 Task 2 (More Detailed Analysis and Costing) Approach Summary

The scope of Task 2 is to undertake a high-level evaluation of the two selected sites (Hinds Lake and Star Lake) and develop AACE Class 5 cost estimates for each.

The screening study (Task 1) evaluated the sites; however, the study did not provide guidance on the potential capacity of the pumped storage developments at the selected sites. Pumped storage capacity is typically driven by grid factors and the need to absorb non-dispatchable energy, therefore without such guidance, the following assumptions were made to develop the CAPEX estimates.

Given that one of the objectives of the overall study was to utilize the existing infrastructure and equipment, the capacity question was addressed as follows:

- The initial scope of utilizing the existing equipment, assumes the addition of new pump stations connected to the existing water conveyance. This limits the capacity of the pump station to 46 MW for Hinds Lake and 11 MW for Star Lake. This alternative is referred to Layout 1.
- The capacities of Layout 1 do not utilize the full storage potential in the reservoirs and, therefore, mask the true pumped storage potential of the sites. To investigate the full potential of the sites this limitation was removed, allowing the team to locate a new standalone 200 MW pumped storage facility at each of the sites. This new facility would have the capacity to absorb new energy sources (i.e., wind farms) projected for the surrounding area, thus supporting the increase to the province’s generating capacity. The equipment in the new facilities would be reversible and therefore it would provide additional capacity if required. This alternative is referred to as Layout 2.

Project layouts, schedules and cost estimates were developed for Layout 1 and Layout 2 for each site.

This report presents the approach followed and methodology used to develop the conceptual project layouts and the cost estimates for each of the sites.

3. Project Sites

The two sites selected by NL Hydro for assessment are Hinds Lake and Star Lake shown on Figure 3-1. Each site is discussed in the subsequent sections.

Figure 3-1: Site Locations

3.1 Hinds Lake Site Description

Hinds Lake site is in the Long-Range Mountains between Grand Lake and the Town of Buchans. The existing project consists of twelve dams impounding the upper reservoir, with a two-bay gated spillway, an overflow spillway, and control structure at the upstream end of the power canal. The generating facility operates under an average head of 214 m. The rated flow of 40 m^3/s generates 75 MW of power with an average annual production of 340 GWh. The existing Hinds Lake generating station is located on the south bank of Hinds Lake and has one Francis turbine with rated capacity of 75 MW which was commissioned in 1980. Hinds Lake discharges into Grand Lake.

Figure 3-2 shows the layout of the Hinds Lake site.

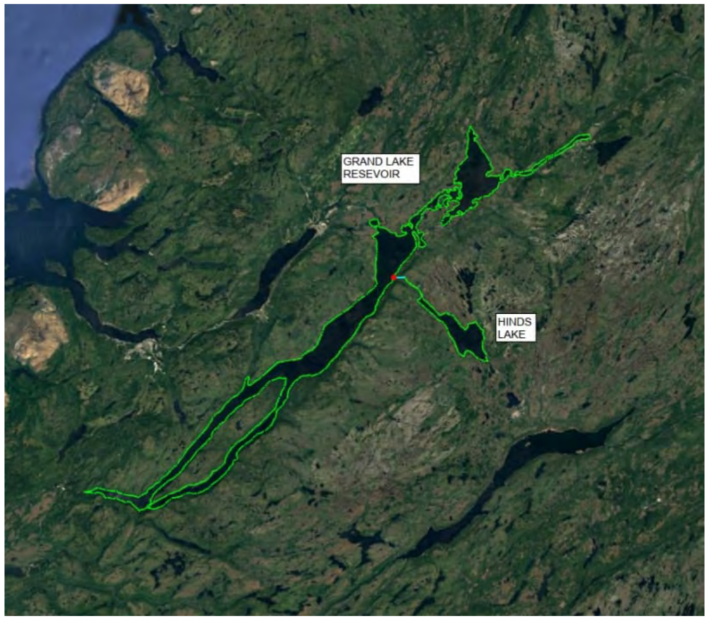

Figure 3-2: Existing Hinds Lake Layout

3.2 Star Lake Site Description

Star Lake is located on the southwestern end of Beothuk Lake, in central Newfoundland and Labrador. The development consists of an embankment dam (East and West sections), concrete overflow spillway, and an embankment saddle dam. The generating station contains a single Francis turbine that operates at a rated head of 137 m, with a capacity of 18.4 MW. The plant discharges into Beothuk Lake.

Figure 3-3 shows the layout of the Star Lake site.

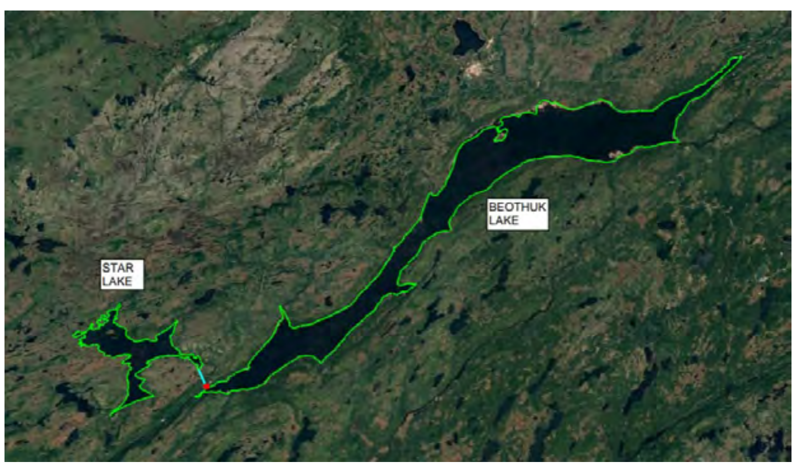

Figure 3-3: Existing Star Lake Layout

4. Approach and Methodology

4.1 Layout 1 – Existing Project Arrangement

As noted previously, each site has been initially assessed based on no modifications being done to the existing stations or conveyance and that the proposed pumped storage facilities would utilize existing facilities as part of the overall arrangement. With this in mind, the primary assumption is that; to not have to modify the existing equipment the pump flow would have to be in the order of 50% of the existing maximum generation flow.

For Layout 1, the existing infrastructure would be used for generation and a new pumphouse would be constructed for the pumping operation. The new pumphouse has been located close to the existing generating facility to minimize the amount of excavation and length of new penstock. New intakes with adequate submergence for pumps are required at the lower reservoir. Short conveyance interconnections are needed to connect this new pumping facility to the existing conveyance (penstock). As the required pumping flows are low in comparison with the generation flows, we estimated that the upper intakes would not have to be modified. This arrangement requires no alteration to the upper reservoir or upper inlet/outlet structures.

The primary assumption of the pump flow being 50% of the generation flow, implies that the pump station would be operated in the order of 16 hours a day and the generation station would operate at full capacity 8 hours a day, the hours of pumping and generation will vary for month to month according to the available inflow. Current operation dictates 24-hour generation. If this layout advances, these assumptions will need to be validated in the subsequent phase.

The following are the new primary project components that are required for Layout 1.

- Upper Conveyance (Interconnecting Penstock)
- Pump Station
- Lower Conveyance
- Lower Intake.

The following sections summarize the methodology used for sizing of the new components.

4.1.1 Upper Conveyance

The upper conveyance is the short section of penstock that connects the pump station to the existing penstocks upstream of the existing powerhouse. The conveyance has been sized so that the water velocities through the penstocks are approximately 3 m/s at full pumping flow.

Given the short length of this conveyance, it was assumed for the purpose of this estimation that the penstock would be a single diameter and a single thickness. A maximum surge (transient) pressure of 20% has also been considered. The material thickness for the section was selected by determining the maximum pressure in the section and comparing it to the allowable pressure. The maximum pressure is the normal pressure due to head plus the maximum surge pressure in the section. The penstock material has been assumed to be ASTM A36 steel.

For the proposes of estimating the excavation for the penstock it has been assumed that the new penstock at each location is buried half a penstock diameter (i.e., 0.5d) below the existing ground.

The steel and excavation volumes and cost have been estimated using standard approaches and historical unit rates.

4.1.2 Pump Station

Two (2) pumps have been considered per Pump Station to provide redundancy. Each pump has been sized to pump one quarter (¼) of the total generation flow each and they are located in a shaft style pumphouse. The unit center line has been calculated according to the required pump submergence. Each pump has low pressure intake valves and one valve on the high-pressure conveyance side.

A superstructure is located above the shaft pumphouse, to house all the electrical and mechanical Balance of Plant, with an overhead gantry crane for installation and maintenance purposes.

4.1.3 Lower Conveyance

The lower conveyance connects the pumphouse to the lower reservoir. It is designed as a concrete-lined tunnel. The inner diameter of the lower conveyance was assumed to be the same as upper conveyance and routed along the shortest path between the powerhouse and the lower reservoir.

4.1.4 Lower Intake

The size and flow area of the lower intake structure has been determined such that the flow velocity at the entrance is approximately 1 m/s and there is adequate submergence to prevent vortex formation during pumping operations. The entrance section is rectangular with the longest side corresponding to the vertical depth, and the shortest section being the width.

The lower intakes each have a single trashrack, one (1) service gate and one set of stoplog for maintenance of the service gate.

Trashrack

The Trashracks are located in the bellmouth entries of the lower intakes. The trashrack bars have been sized based on structural, deformation, buckling, vibration, natural frequency and dimensional verifications and are appropriate for this conceptual planning work.

The gap between trashrack bars is assumed to be 100 mm, a maximum flow velocity in the order of 1 m/s and a differential pressure of 1 m have been considered.

Gate

The gate weights have been estimated using the formulas provided in Design of Hydraulic Gates, Erbisti 2014.

The conveyance at the gate shaft sector is dimensioned to have a maximum flow velocity of 4 m/s.

Submergence

Pumping submergence is a critical design aspect for pumped storage projects. The lower intakes have been designed to have sufficient submergence below the minimum operating level to prevent the entrainment of air or debris and the generation of vortices. The submergence level as measured from the minimum operating level to the crown of the intake conduit has been estimated using Gordon's criteria:

Gordon Criteria

$S = CV\sqrt{D}$

S = Minimum submergence requirements as measured to the crown of the intake conduit.

C = Constant. Values range from 0.54 for symmetrical to 0.72 for lateral approach conditions.

V = Velocity in the intake conduit (m/s).

D = Conduit diameter.

Figure 4-1 illustrates the Gordon submergence parameters.

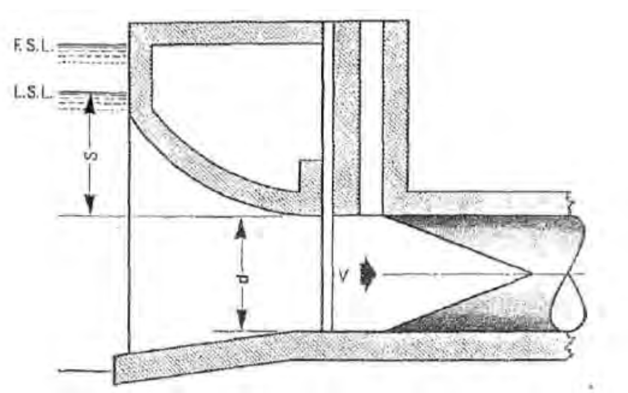

Figure 4-1: Gordon Submergence Parameters

4.2 Layout 2 – 200 MW Reversible Pump Storage Arrangement

Layout 2 relaxes the previous limitation of utilizing the existing conveyance and facilities for the project. A new standalone pumped storage facility with installed a storage capacity PS of 200 MW has been developed for assessment in this layout option.

The primary new project components are as follows:

- Upper Intake
- Penstock
- Pump-Turbine Generating Station
- Lower Conveyance
- Lower Intake.

The transmission lines necessary to connect these options to the grid were not analyzed and should be reviewed at a later phase, should NL Hydro choose to pursue larger PS projects.

4.2.1 Upper Intake

The design criteria presented in Section 4.1.4 was used for the design of the upper intakes for the 200 MW layout.

The upper intake for Layout 2 will have a pair of trashracks, two (2) service gates and one set of stoplogs for maintenance of the service gates.

4.2.2 Penstock

A new conveyance is required to connect the upper and lower reservoirs. Hatch assumed that the new penstocks are steel and are buried. The penstocks have been sized such that that the water velocities through the penstocks are within a range of 3 m/s and 5 m/s. For both Hinds Lake and Star Lake this requires the use of two side by side penstocks. The new penstock alignment was assumed to run parallel to the existing.

Three equal length sections have been assumed for design and costing. A maximum surge (transient) pressure of 20% has been considered. The material thickness for each section was selected by calculating the maximum pressure in the length and comparing it to the allowable pressure. The maximum pressure is the normal pressure due to head plus the maximum surge pressure in the section. A transient surge pressure of 20% was estimated for Hinds Lake and 25% for Star Lake. The need for additional surge protection (i.e., surge tanks) to manage hydraulic transience should be confirmed through analysis in subsequent phases of the project. The penstock material has been assumed to be ASTM A36 steel.

The full penstock in Layout 2 is assumed to be buried, similarly to Layout 1 at half a penstock diameter (i.e., 0.5d) below the existing surface. Standard approaches are used to estimate weights and costs.

4.2.3 *Pump-Turbine Generating Station*

For Layout 2 a new standalone pump-generating station is required to house the reversible pump-turbine generating units. A shaft / silo powerhouse arrangement has been selected as appropriate. The equipment characteristics and conceptual arrangement of the equipment has been developed for the two-unit powerhouse along with the required inlet valves. At this conceptual stage, the units are assumed to be identical. Mirroring one unit may provide an opportunity to reduce the diameter of the powerhouse shaft. This should be investigated should this option be chosen to be progressed as a smaller diameter shaft will reduce excavation volumes and subsequently reduce construction time and cost. However, mirroring the equipment will increase the manufacturing schedule and cost.

The unit submergence required was dictated by the submergence during pumping.

4.2.4 *Lower Conveyance*

The design criteria presented in Section 4.1.3 was used for the design of the lower conveyance for the 200 MW layout.

4.2.5 *Lower Intake*

Lower intake design follows the same principles as used for the upper intake. While the upper intake is horizontal, the lower intake is placed at a 45° angle to minimize the bend radius required to connect the draft tube and the intake.

5. Layout No. 1 Overview

5.1 Hinds Lake

5.1.1 Layout and Option Description

Hatch proposed that the new pump station be constructed to the west of the existing powerhouse as seen in Figure 5-1, as that area appears to be at a lower elevation than the east location. This lower elevation will reduce the excavation volumes and costs associated with the construction.

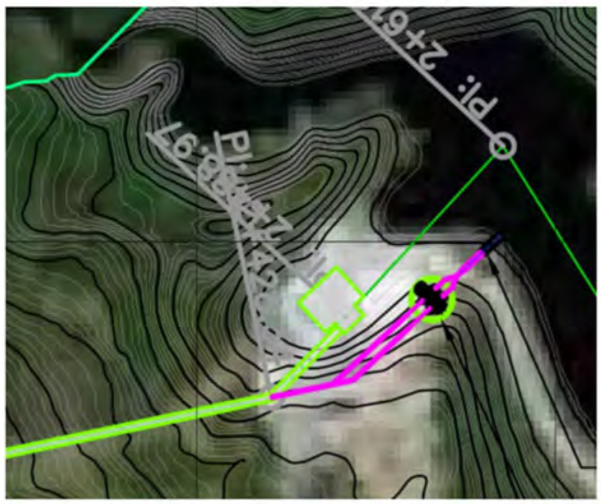

Figure 5-1: Hinds Lake Layout No. 1 (Existing Project) - Existing Powerhouse and Proposed Pumphouse Arrangement

Figure 5-2 shows the profile of the new pump station.

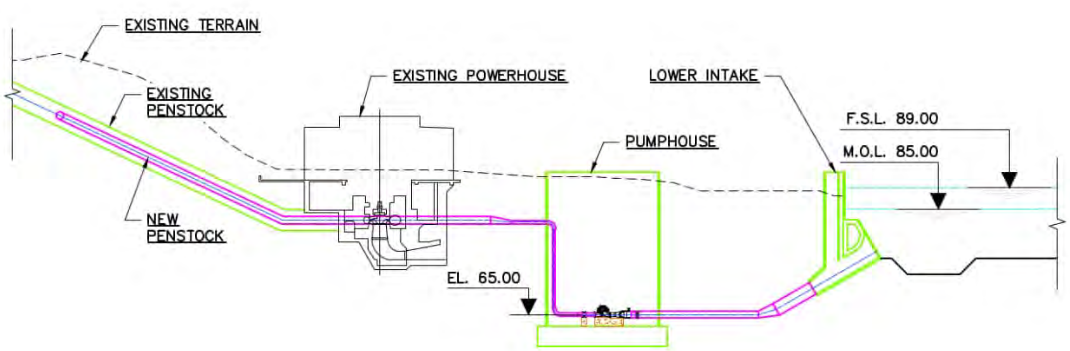

Figure 5-2: Hinds Lake Layout No. 1 (Existing Project) – Profile View

The new pumphouse will connect to the existing penstock at the bend located upstream of the powerhouse. The new lower intake will be located downstream of the pumphouse.

The generation design flows will not be affected as the generation units (turbines) will not be changed. We assumed that the pumping and generation will be 16 hours of pumping and 8 hours of generation. This will vary during the year, as the volume of water for full capacity operation is supplemented by natural inflow.

The proposed layout can be found in drawing H371390-0000-221-271-0001 of Appendix B.

5.1.2 Site Development and Temporary Works

Site development and temporary works are required for the construction of the project. This includes the installation of a cofferdam for the lower intake as well as allowance for associated construction water management and pumping. Allowances included clearing of the site as well as the construction of temporary roads.

5.1.3 Upstream Conveyance

The pumphouse will connect into the existing penstock along the shortest path. The length of the new penstock required to connect the new pumps to the existing penstock was estimated to be approximately 100 m with the internal diameter of 3 m. The angle of approach for the penstock connection will have minimal impact on pumping efficiency and performance, however this should be confirmed.

5.1.4 Pumphouse

The pumphouse at Hinds Lake is a silo powerhouse of approximately 26 m internal diameter. The pumphouse is assumed to be circular to minimize excavation costs and design efficiency. This diameter of pumphouse is enough to accommodate the two 22.8 MW pumps. The required pump submergence for this layout is estimated at 20 m.

5.1.5 Lower Conveyance

The lower conveyance is 36 m long with a nominal diameter of 3m.

5.1.6 Lower Intake

The lower intake for this layout is approximately 30 m long. The intake entrance is 4 m x 6 m (width x height) and includes trash bars of 16 mm x120 mm (bar width x bar height) and a free spacing of 50mm between bars. The gates section is 4 m x 5 m (width x height). Supporting infrastructure for the intake gates included a gate building, gate hoist and other supports. The location of the intake was positioned to minimize the distance between the pumphouse and lake shore.

5.2 Star Lake

5.2.1 Layout and Option Description

The existing Star Lake generating station is located on the north bank of Beothuk Lake. The closest available space for the construction of the new pumphouse is northwest of the existing powerhouse as shown in Figure 5-3 The required pump submergence is 6.34 m.

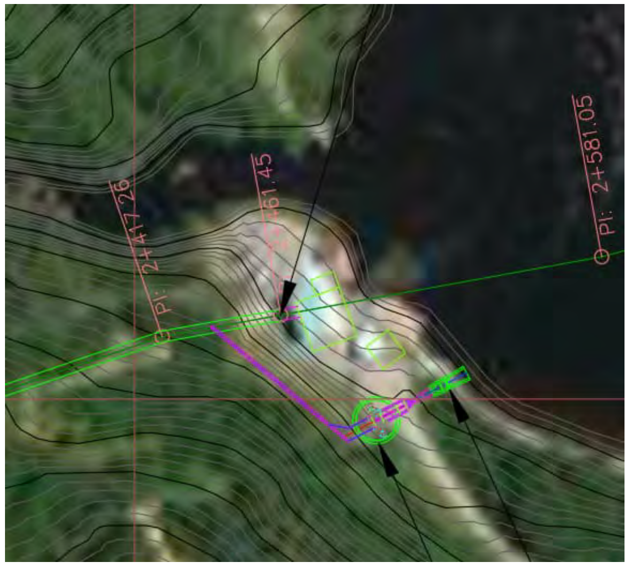

Figure 5-3: Star Lake Layout No. 1 (Existing Project) - Existing Powerhouse and Proposed Pumphouse Arrangement

The Star Lake pump station layout can be seen in Figure 5-4.

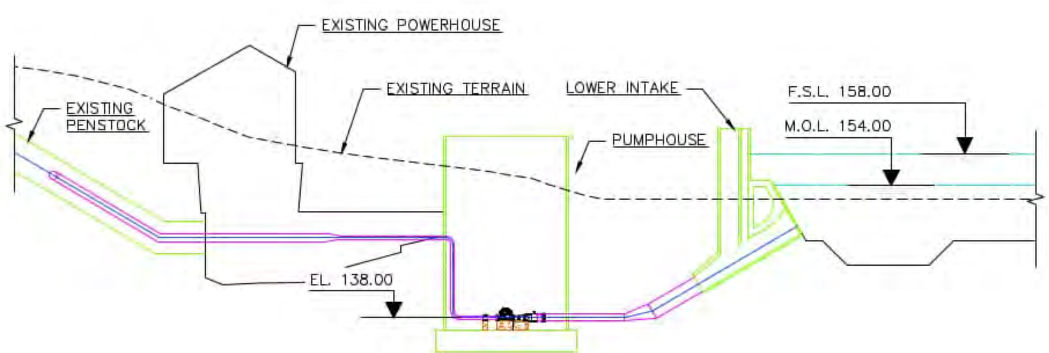

Figure 5-4: Star Lake Layout No. 1 (Existing Project) – Profile View

The proposed layout can be found in drawing H371390-0000-221-271-0002 of Appendix B.

5.2.2 Site Development and Temporary Works

The site development and temporary works are similar to those described in Section 5.1.2.

5.2.3 Upstream Conveyance

The pumphouse will connect into the existing penstock along the shortest path. The length of new penstock required to connect the new pumps to the existing penstock is estimated to be approximately 100 m with an internal diameter is 2.5 m. The angle of approach for this penstock connection will have minimal impact on pumping efficiency and performance, however this should be confirmed later.

5.2.4 Pumphouse

The pumphouse at Star Lake is a silo powerhouse of approximately 14 m internal diameter. The pumphouse is assumed as a circular to minimize excavation costs and design efficiency. This diameter of pumphouse is enough to accommodate the two 5.6 MW pumps. The required pump submergence for this layout is estimated at 15 m.

5.2.5 Lower Conveyance

The lower conveyance is 20 m long and with a nominal diameter of 2.5 m.

5.2.6 Lower Intake

The lower intake for this layout is approximately 30 m long. The intake entrance is 4m x 4m (width x height) and includes trash bars 16 mm x120 mm (bar width x bar height) and a free spacing of 50 mm between bars. The gates section is 3.5 m x 4.0 m (width x height). Supporting infrastructure for the intake gates included a gate building, gate hoist and other supports.

6. Layout No. 2 Overview

Layout 2 for each of the Hinds Lake and Star Lake sites is for the development of a standalone 200 MW facility with two 100 MW reversible pump-turbines.

We assumed that the operational ratio will be 12 hours of pumping and 12 hours of generation.

6.1 Hinds Lake 200 MW

6.1.1 Layout and Option Description

This layout involves the addition of 2 x 100 MW reversible pump-turbines. The powerhouse would be a shaft / silo powerhouse to house the two units. We assumed that each unit would be fed by a standalone penstock. Figure 6-1 shows the proposed project layout with two penstocks aligning parallel to the existing penstock. The required submergence is 45 m.

Figure 6-1: Hinds Lake Layout 2 (200 MW) – Plan View

The new powerhouse shaft considered for the installation of the reversible units can be in the same space as was considered for the addition of the pumphouse in Layout 1 above.

Further detail of the proposed layout can be found in drawing H371390-0000-221-271-0003 of Appendix B.

6.1.2 Site Development and Temporary Works

As in Layout 1, installation costs included the use of a temporary cofferdam for installation of the new lower intake as well as an allowance for associated pumping, clearing of the site as well as the construction of temporary roads.

6.1.3 *Upper Intake*

The Hinds Lake upper intake for this layout is approximately 43 m long. The intake entrance has two (2) bays of 8m x 8m (width x height) and includes trash bars of 20mm x150 mm (bar width x bar height) and a free spacing of 100mm between bars. The gates section has two (2) bays of 4.5m x 5.0 m (width x height). Supporting infrastructure for the intake gates included a gate building, gate hoist and other supports.

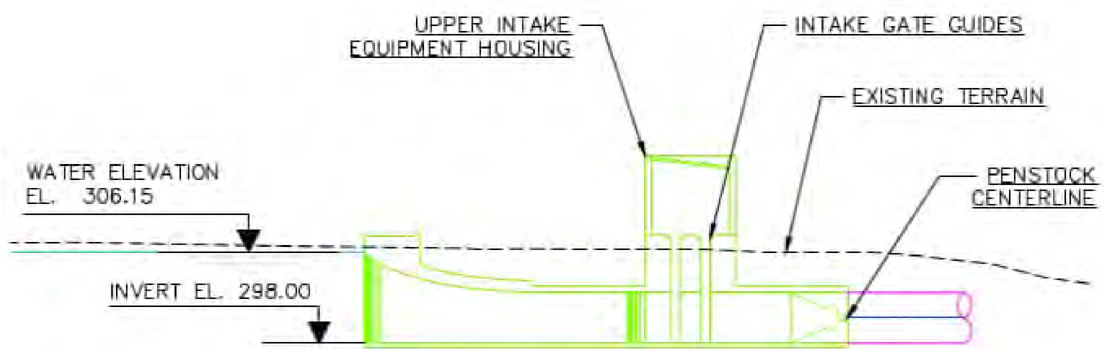

Figure 6-2: Hinds Lake Layout 2 (200 MW) - Upper Intake

The existing Hinds Lake upper intake is connected to Grand Lake Reservoir by means of a canal that is over 5 km long and is rated for 40 m^3/s. Hinds Lake Layout 2 would increase the flow to 111 m^3/s. The next phase of the project should confirm the capacity of the canal. In the present study, Hatch assumed that no upgrades are required to the canal.

6.1.4 *Upstream Conveyance*

A new penstock is required for each unit within the new powerhouse. As noted previously these penstocks are assumed to follow the existing penstock alignment, have 1500 m length and a diameter of 4.5 m. The following figure shows the penstock section view.

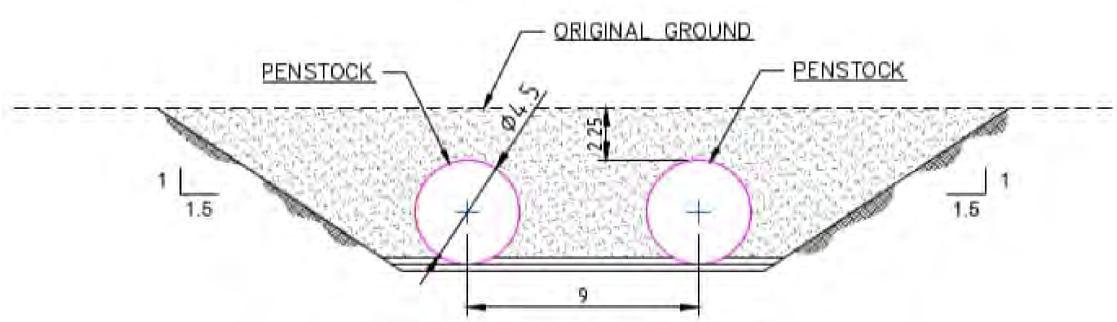

Figure 6-3: Hinds Lake Layout 2 (200 MW) - Penstock Section

6.1.5 Powerhouse

The powerhouse at Hinds Lake is a silo powerhouse of approximately 26 m internal diameter, located in the same area as the Hinds Lake pumphouse detailed in Section 5.1.4. The powerhouse is assumed as circular to minimize excavation costs and design efficiency. This powerhouse accommodates the two 100 MW reversible pump/turbines. The required pump submergence for this layout is estimated at 45 m. The following figure shows the penstock, powerhouse, and lower intake profile view.

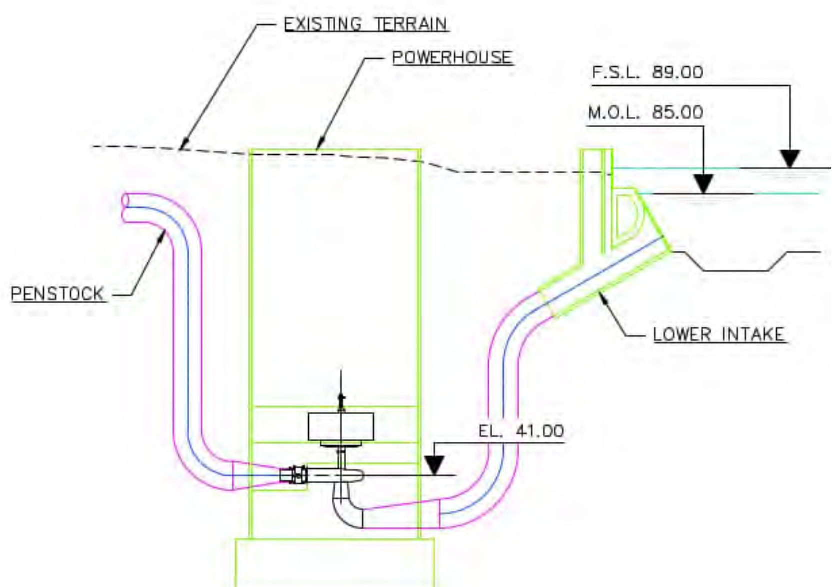

Figure 6-4: Hinds Lake Layout 2 (200 MW) - Lower Profile View

6.1.6 Lower Conveyance

The lower conveyance has two (2) separate S shape concrete lined tunnels that are 40 m long and with a nominal diameter of 5m.

6.1.7 Lower Intake

The lower intake for this layout is approximately 20 m long. The intake entrance has two (2) bays of 8m x 8m (width x height) and includes trash bars of 20mm x150 mm (bar width x bar height) and a free spacing of 100mm between bars. The gates section has two (2) bays of 4.5m x 5 m (width x height). Supporting infrastructure for the intake gates will need to include a gate building, gate hoist and other supports.

6.2 Star Lake 200 MW

6.2.1 Layout and Option Description

Star Lake, as with Hinds Lake, would require 2 parallel penstocks each feeding a 100 MW reversible pump-turbine. Figure 6-5 shows the plan view of this Layout.

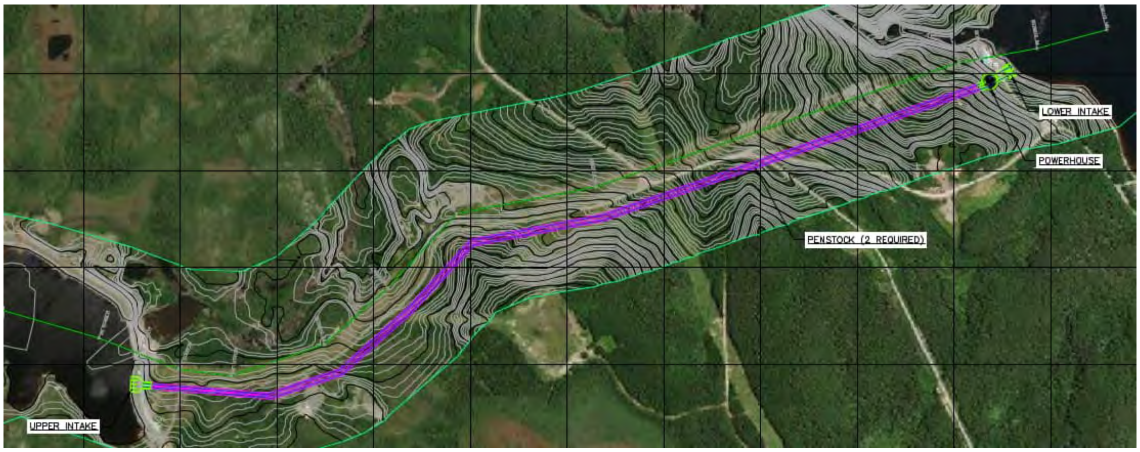

Figure 6-5: Star Lake Layout 2 (200 MW) – Plan View

Further detail of the proposed layout can be found in drawing H371390-0000-221-271-0004 of Appendix B.

6.2.2 Site Development and Temporary Works

The site development and temporary works is similar to those described in Section 6.1.2.

6.2.3 Upper Intake

The Star Lake upper intake for this layout is approximately 43 m long. The intake entrance has four (4) bays of 6m x 8m (width x height) and includes trashrack. The gates section has two (2) bays of 5.0m x 5.0m (width x height). Supporting infrastructure for the intake gates will need to include a gate building, gate hoist and other supports. Figure 6-6 shows the plan sectional view of the intake.

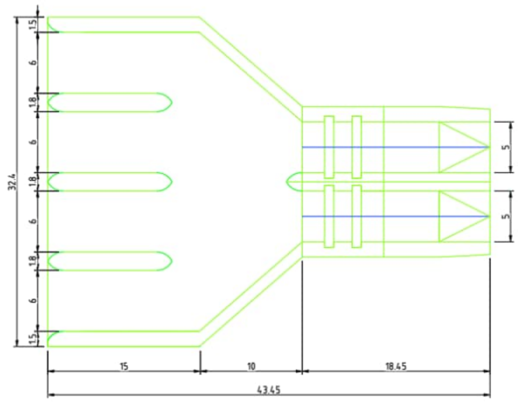

Figure 6-6: Star Lake Layout 2 (200 MW) – Upper Intake Plan Sectional View

6.2.4 Upstream Conveyance

A new penstock is required for each unit within the new powerhouse. As noted previously, these penstocks are assumed to follow the existing penstock alignment and are 1950 m in length with a diameter of 5 m. The penstock section view is similar to that shown in Section 6.1.4.

6.2.5 Powerhouse

The powerhouse at Star Lake is a silo powerhouse of approximately 30 m internal diameter, located in the same area as the Star Lake pumphouse detailed in Section 5.2.4. The powerhouse is assumed as circular to minimize excavation costs and design efficiency. This powerhouse accommodates the two 100 MW reversible pump/turbines. The required pump submergence for this layout is estimated at 32 m. The following figure shows the penstock, powerhouse, and lower intake profile view.

Figure 6-7 shows the Star Lake penstock, powerhouse, lower conveyance, and lower intake plan view.

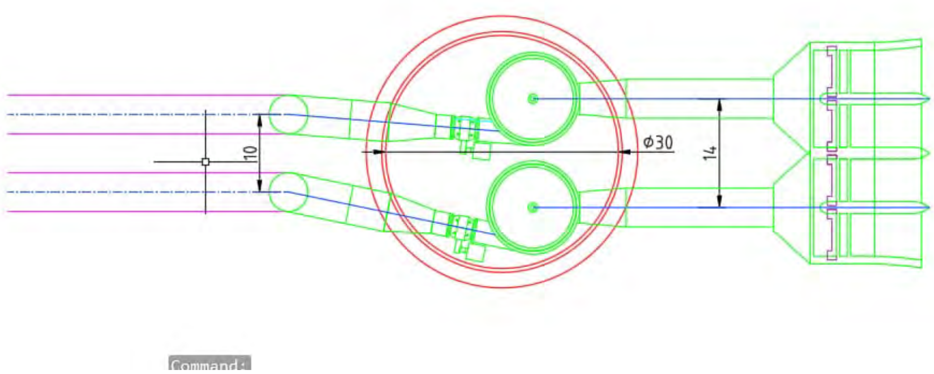

Figure 6-7: Star Lake Layout 2 (200 MW) - Lower Plan View

6.2.6 Lower Conveyance

The lower conveyance has two (2) separate S shape concrete lined tunnels that are 40 m long and with a nominal diameter of 5 m.

6.2.7 Lower Intake

A new intake as shown in Figure 6-7, is approximately 15 m long, has four (4) entry bays that are 6m x 8m (width x height) and includes a trashrack. The gates section has two (2) bays of 5.5m x 5.5 m (width x height). Supporting infrastructure for the intake gates will need to include a gate building, gate hoist and other supports.

7. Project Development Schedules

Preliminary project development schedules have been prepared for the proposed layouts. Due to the similarity between the project layouts, one schedule has been prepared for both Layout 1 options and one schedule for both Layout 2 options. The schedules are enclosed in Appendix C and the key activities are presented in Table 7-1 and Table 7-2.

These schedules are indicative and intended to provide a high-level summary of the overall project duration rather than the specific details of the individual tasks.

The following assumptions have been made regarding the overall procurement approach:

- The NL Hydro Pumped Storage Projects will be developed utilizing a traditional Design-Bid-Build contracting model.
- An Engineer will be engaged by NL Hydro to manage the investigations, advance the project design, and assist with the tendering for the equipment and civil packages.
- The owner will select the Pump/Turbine/Generator vendor through a tender process.

Please note that the environmental and permitting activities and regulatory approval processes have not been incorporated into the project schedule. The impact will need to be assessed.

Table 7-1: Development Schedule – Summary and Milestones for Layout 1

Activity	Start	Completion
FEL 2 Study	October 2023	January 2024
Investigations	January 2024	March 2024
Award Construction Contract		November 2024
FEL 3 & 4 Design	March 2024	April 2025
Construction	February 2025	November 2027
Commissioning	October 2027	January 2028
In service	March 2028	

Table 7-2: Development Schedule – Summary and Milestones for Layout 2

Activity	Start	Completion
FEL 2 Study	September 2023	February 2024
Investigations	February 2024	June 2024
Award Construction Contract		March 2025
FEL 3 & 4 Design	June 2024	December 2025
Construction	June 2025	March 2029
Commissioning	November 2028	May 2029
In service	July 2029	

8. Cost Estimates

This section of the report provides an overview of the Cost Estimate preparation undertaken for both layout options developed for Hinds Lake and Star Lake. Further details on the work undertaken, process followed, and conclusions reached are presented in the Basis of Cost Estimate (H371390-0000-621-610-0001) enclosed as Appendix D.

Hatch has prepared Class 5 AACE Cost Estimates for the proposed projects layouts which can be found in Appendix B of the Basis of Cost Estimate. This anticipated accuracy for this level of assessment is -50%/+100%. The scope of the estimate aligns with the full Hatch scope of the feasibility study and as detailed in the basis of estimate.

8.1 Approach

The capital cost estimate was completed based on the following assumptions and qualifications:

- The Estimate is commensurate with the level of engineering done to date and in accordance with the level of project development outlined in the AACE guidelines for a Class 5 estimate.
- Generation Units based on team experience.
- Single Conceptual General Arrangement Drawing per layout.
- Preliminary discipline MTO and equipment obtained from conceptual design.
- For Layout 2 options, the additional transmission costs are not included.
- “All-in” unit pricing for the supply and installation of bulk commodities (bulk earthworks, concrete, steel, buildings) based on Hatch in-house data for the region.
- Factored indirect cost estimates. Factors are based on Hatch benchmarks from similar past projects.
- Labour rates based on local base rates and Hatch in-house data for projects located in the region.
- An estimate base date of nominally Q2 2023.
- All costs provided in Canadian Dollars.
- All costs exclusive of escalation beyond the base date.
- Owner’s cost excluded.
- Goods and services taxes and sales taxes not included.
- None of the pricing for commodities, the design / supply of equipment or construction contracts is based on quotations or contracts.

8.2 Cost Estimate

The AACE Class 5 estimates for the projects CAPEX including contingency, less identified exclusions, are shown in Table 8-1, which presents a high-level summary of the CAPEX for the four options.

Table 8-1: Cost Estimate Summary

WBS	Hinds Lake Option 1 (46 MW)	Star Lake Option 1 (11 MW)	Hinds Lake Option 2 (200 MW)	Star Lake Option 2 (200 MW)
00000 – General (excluded)	-	-	-	-
10000 – Temporary Works	1.0	1.0	22.3	22.3
20000 – Access and Site Plan	0.3	0.3	0.5	0.5
30000 – Project Components	65.6	28.2	414.4	574.1
70000 – Indirect Cost	27.5	10.8	152.0	198.3
80000 - Contingency	28.3	12.1	176.8	238.6
90000 – Owner's Costs (excluded)	-	-	-	-
TOTAL CAPEX ($M)	**122.6**	**52.4**	**766.0**	**1,033.7**

Contingency allowances have been included as 30% of the sum of the estimated Direct and Indirect costs.

8.3 Cost per MW

With the information provided in Section 8.2, the cost per MW is presented in Table 8-2.

Table 8-2: Project Cost / MW

Options Detail	Hinds Lake Option 1 (46 MW)	Star Lake Option 1 (11MW)	Hinds Lake Option 2 (200MW)	Star Lake Option 2 (200MW)
Capacity (MW)	46	11	200	200
Total Capex ($M)	122.6	52.4	766	1033.7
$M/MW	**2.7**	**4.8**	**3.8**	**5.2**

For Option 1, Hinds Lake has a larger total project cost than Star Lake. The larger cost of the Hinds Lake facility is due largely to the more expensive equipment (larger capacity) as well as the increased depth for unit submergence and length of excavation required for the penstock connection. However the cost ($) per MW is less due to the greater capacity.

For Option 2, the total cost of Star Lake is greater than Hinds Lake Option 2 due to the length of the penstock, the higher flows and the required depth of excavation for the new pump/powerhouse.

9. Conclusions and Recommendations

The following are the primary conclusions and recommendations of the Feasibility Study.

- The Layout 1 options provide little if any increase to NL Hydro's generating capacity or support the development of renewable generation or utilize the storage potential of the two sites. In Hatch's opinion, Layout 1 options should not be further pursued.
- The Layout 2 options increase NL Hydro's generating capacity, provide the ability to absorb excess energy be it wind energy or other types of generation, in time of high production and low demand, and generate energy when the supply is low, and demand is high. During generation the existing facilities would also be used. These layouts utilize a portion of the storage potential of these two sites.
- Hinds Lake appears more attractive than Star Lake, on a cost per MW basis. This efficiency is because Hinds Lake has both a higher head and a shorter penstock, which makes it more efficient in terms of producing the same energy when compared to Star Lake. Although if comparing the loss of present generation due to pumping, Star Lake may be more attractive.
- The 200 MW installed capacity assumed for the Layout 2's should be optimized to align with the grid demands. Capacities above 200 MW may be considered.
- No revenue estimates have been undertaken as part of this study and these are required to assess the financial viability of the options presented.

Appendix A
Site Assessment Memo

H371390-0000-200-030-0001

Project Memo

H371390

October 20, 2023

To: Kathleen Wadden

From: Jorge Coronado
Shem Evans
James Law
Julia Hiscock
Ian Walker
Devin Greenfield

Newfoundland and Labrador Hydro Pumped Storage Feasibility Study

Site Location Options Screening Analysis

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1. Introduction

As part of the Reliability and Resource Adequacy Study (RRA) for the Public Utilities Board, Newfoundland and Labrador Hydro (NL Hydro) has been asked to investigate pumped storage as an option for the island. With increases in variable energy sources such as solar and wind, globally pumped storage is being used as energy storage during times of high electricity supply.

NL Hydro currently operates twelve (12) hydro generating stations on the island of Newfoundland, of which NL Hydro has selected nine (9) for the present study. NL Hydro has engaged Hatch to assess the feasibility of converting any of these nine existing hydro generating facilities into a Pumped Storage facility. The nine sites are to be ranked.

This memo describes the approach and suitability of the nine sites selected by NL Hydro and presents the ranking. Each site was assessed based on an established set of criteria rating the pumped storage characteristics, environmental and social impacts, existing facilities, and interconnection capacity. Following completion of the initial assessment and ranking of the suitability of all nine sites, the three preferred sites are identified. Preparation of Class 5 capital cost estimates for the preferred sites will be undertaken and documented separately in the following task.

The nine project sites considered as part of this assessment, are shown in Figure 1-1 and locations are summarized in Table 1-1.

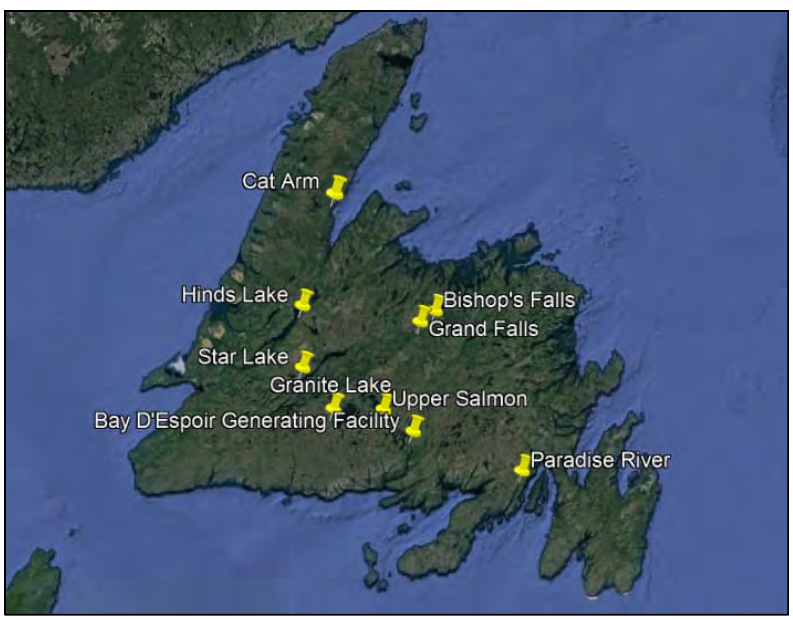


Figure 1-1: Map of All Considered Sites

For simplicity within the memo the sites are numbered as follows:

Table 1-1: Site Number and UTM Coordinates

Site	Name	Latitude	Longitude
1	Bay d'Espoir	47.9903	-55.79972
2	Bishop's Falls	49.0154	-55.47217
3	Cat Arm	50.0257	-56.76483
4	Grand Falls	48.9254	-55.66783
5	Granite Lake	48.1966	-56.81525
6	Hinds Lake	49.0825	-57.20136
7	Paradise River	47.6181	-54.43146
8	Star Lake	48.5523	-57.20567
9	Upper Salmon	48.1836	-56.17303

2. Pumped Storage Projects

2.1 Overview

Pumped storage projects consist of two reservoirs, a conveyance system that allows water to be transferred between them, and a generating / pumping facility along the conveyance. These pumped storage projects operate by pumping water from the lower reservoir to the upper reservoir in times of surplus energy, and in times of high demand, water from the upper reservoir is released back to the lower reservoir and in the process, electricity is generated.

Pumped storage projects are net consumers of electricity as the round-trip efficiency (process of pumping the water up to the upper reservoir and returning it to the lower reservoir) is typically between 75% to 80%. This means that approximately 20% to 25% is lost in the process through a combination of equipment efficiencies, evaporation, filtration and headloss along the conveyance.

2.2 Open vs. Closed-Loop Projects

Pumped storage projects can be characterized either as open-loop or closed-loop. Open-loop projects have an ongoing hydrologic connection to a natural body of water. With closed-loop projects, reservoirs are not connected to an outside body of water. This illustrated in Figure 2-1 as extracted from the US DOE.

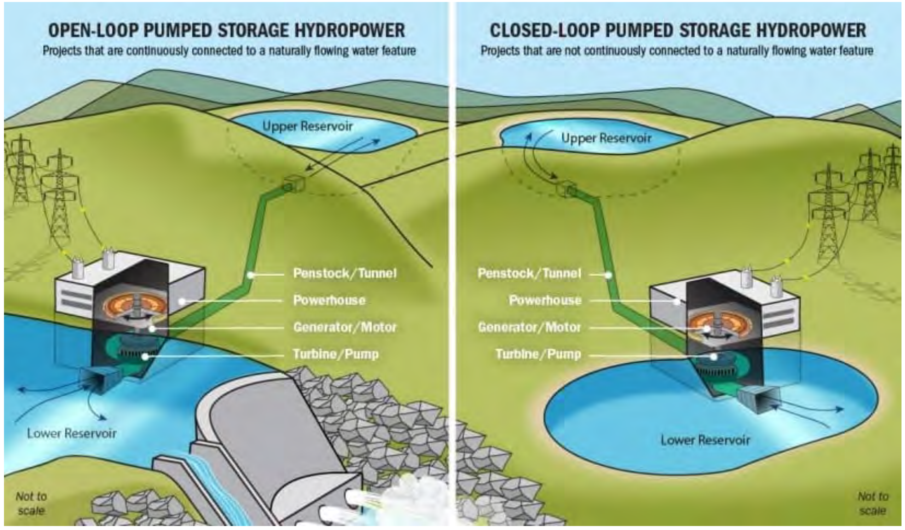


Figure 2-1: Open-Loop vs Closed-Loop

All of the projects being assessed in this study are open-loop projects as they are directly connected to an existing operating regime.

2.3 Project Profiles

The pumped storage projects are typically defined by the profile of the project and the location of the powerhouse. For this assessment we are specifically excluding this aspect given that the existing facilities will be utilized, however the projects will be Layout Alternative C (some form of tunnel) or Layout Alternative F (surface conveyance).

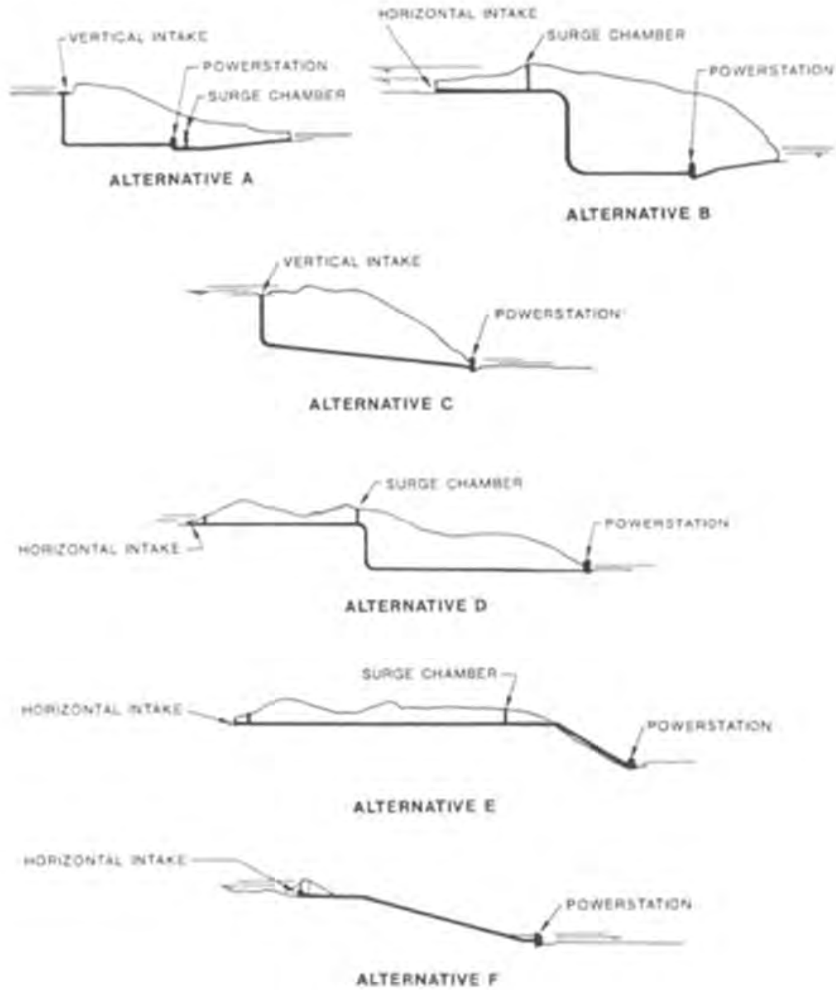


Figure 2-2: Typical Pumped Storage Layouts

3. Ranking Approach

The following section provides additional justification for the assessment and weighting of the factors considered in ranking each site for the Pugh analysis. A Pugh Analysis, also known as Pugh Concept Selection Process or Pugh Method, is a decision matrix used to evaluate and prioritize alternatives or solutions based on established and weighted evaluation criteria.

3.1 Pumped Storage Characteristics

The nine (9) existing sites were assessed against two (2) pumped storage characteristics, Generating Capacity and the relation between the conveyance length and the project head.

To support the assessment, four (4) classification criteria were defined and established for both factors. The classification criteria range from 1 to 5, and represent the least to the most complex, respectively.

3.1.1 Generating Capacity

The potential generating capacity of the sites is one of the main criteria when assessing the sites. Twelve (12) hours of storage (operation) was assumed in each case to maintain a consistent point of comparison.

The energy storage potential is calculated by the following equation:

$$E = \rho V g H \ (MWh)$$

with:

- ρ: Density of Water 1000 (kg/m^3)
- V: The possible operational storage volumes (m^3) of the upper and lower reservoirs were analyzed to determine the viability of producing 12 hours of continuous generation. The operational volume is considered as 80% of the lesser of the two.
- g: Gravity 9.81 (m/s^2)
- H: Head, the difference in elevation between the both the upper and lower reservoirs (m)

The generation capacity will be determined by the energy storage potential (MWh) of each site divided by 12 hours of storage.

$$C = \frac{E}{HoursStorage}$$

with:

- C: Generating Capacity (MW)
- E: Energy Storage Potential (MWh)

3.1.2 *Conveyance Length / Heads*

The relationship between the conveyance length (i.e., the distance between upstream and downstream reservoirs) and the head on the facility is a standard assessment criterion for quickly assessing the potential economic viability of pumped storage facilities. This approach was recommended in the 1990 EPRI – Pumped Storage Screening Guidelines. This criterion indirectly incorporates both cost and operating issues into the assessment. Shorter conveyances are cheaper and tend to have fewer operational issues.

The screening process assesses the relationship between operating head (H) and water conveyance length (L). The sites with lower L/H ratio are ranked higher.

3.1.3 *Operating Range of Pump -Turbines*

There is a relationship between the maximum head to the minimum head that a pump - turbine can typically accommodate during operation. For the purposes of this study, the operating range of Pump-Turbine units, Maximum head/Minimum head, ratio was limited to a value of 1.25 or less reflecting an assumed maximum operating range of the turbines in the pump mode. The operational flexibility of the units in the generation mode is much greater. The operating range was simply verified and not included in the Pugh analysis.

3.1.4 *Ocean as Tailwater*

The majority of the pumped turbine vendors will not provide equipment for sea water installations and globally projects that are planning to use seawater as a water source are installing desalination facilities to purify the water prior to use. None are using the sea as one of the reservoirs. Beside the technical complications of seawater corrosion on the metallic elements of a PSP, the present analysis implies the use of existing reservoirs, and the pumping of sea water into a freshwater reservoir is not an option.

Consequently, in this screening analysis when a site has the “lower reservoir” as the ocean, this site will be deemed to have no freshwater storage capacity, and in turn no generating capacity.

3.2 Environmental and Social

The nine (9) existing sites were assessed against eight (8) biophysical factors, and five (5) social factors. Refer to the sub-sections below for additional information associated with the biophysical and social factors. Additional investigations and ground truthing may be required to confirm or deny the existing environmental and social attributes for each site.

To support the assessment, five (5) classification criteria were defined and established for all thirteen (13) factors. These are shown in the figure below. The classification criteria range from 1 to 5, and represent the least to the most complex, respectively.

Table 3-1: Environmental and Social Criteria Ranking

	Environmental and Social Criteria Ranking						
			Classification of Rankings				
	Environmental Criteria	Unit of Measurement	1	2	3	4	5
Biophysical Factors	Protected areas	Distance	50-60 km	40-50 km	30-40 km	20-30 km	10-20 km
	Scheduled Salmon River	Scheduled, unscheduled, neither	Neither		Unsceduled		Scheduled
	Species at Risk (Aquatic)	Number of	0	1-2	3-4	5-6	7+
	DFO Obligations	Number of	0	1-2	3-4	5-6	7+
	Protected Species (Terrestrial)	Index	0	0-10	11-20	21-30	30+
	Proximity to Core Caribou Areas	Distance	>40 km	30-40 km	20-30 km	10-20 km	<10 km
	Promity to Wetlands	Distance	4.1-5.0 km	3.1-4.0 km	2.1-3.0 km	1.0-2.0 km	<=1 km
	Saltwater Intrusion Potential	Rating	Fresh Downstream		Brackish/Unknown		Salt Downstream
Social Factors	Structures within 30m of reservoir	Number of	0	1-10	11-30	31-50	50+
	Proximity to the built environment	Distance	60+ km	40-60 km	20-40 km	1-20 km	<1 km
	Potential Public Water Supplies	Number of	0	1	2	3	4
	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	Distance from reserve Distance from community	>=200 km >=70 km	100-199 km 40-69 km	50-99 km 20-39 km	15-49 km 0-19 km	<15 km 0 km
	Archaeological Potential	Presence of sites	Low Potential for Sites		High Potential for Sites within 5k		Known sites within 5k

The outputs of the assessment were captured in a table that list the nine (9) existing sites and the respective classification criteria for the thirteen (13) factors. The overall environmental and social complexity index was determined for each site by totaling the classification criteria, with the lower numbers corresponding to a lower complexity, and vice versa.

The assessment for each site and the respective environmental and social complexity indexes are presented in the sections below. Maps showing the area of assessment are included in Attachment 1.

3.2.1 Description of Biophysical Factors

3.2.1.1 Protected Areas

The four main types of protected areas in NL are provincial parks, wilderness reserves, ecological reserves, and wildlife reserves. Protected areas are established for a variety of reasons, including but not limited to biodiversity conservation, recreation, and ecotourism. Protected areas are established under the Wilderness and Ecological Reserves Act and the Provincial Parks Act. Certain activities are not permitted within protected areas (e.g., large-scale industrial uses are not permitted in wilderness or ecological reserves).

A proximity analysis was undertaken to measure the distance from each site to the closest protected area. The locations of protected area boundaries were retrieved from the National Parks and National Park Reserves of Canada Legislative Boundaries web service, and the Newfoundland and Labrador Department of Municipal and Provincial Affairs GIS Data webpage. Geospatial data was imported into QGIS software, and the shortest line between features process was executed. Results were rounded to the nearest kilometre and recorded.

3.2.1.2 Scheduled Salmon River

Fisheries and Oceans Canada (DFO) regulates Canada's fisheries and ocean resources. Atlantic Salmon are considered a keystone species and are an important species for Indigenous communities and for recreational purposes. Due to declining Atlantic Salmon stocks, DFO has enabled the development of various research programs and management measures (e.g., Wild Atlantic Salmon Conservation Policy, Wild Atlantic Salmon Conservation Implementation Plan, etc.).

Each site was investigated to determine if the watercourse or surrounding watercourse was a scheduled DFO salmon river. Information regarding the schedule status of waterways was retrieved from the 2023-2024 DFO Anglers' Guide. The classification criteria options for this factor are scheduled, unscheduled, or neither (i.e., not included in the DFO Angler's Guide). If the watercourse was not included in the DFO Angler's Guide, it does not preclude the presence of Atlantic Salmon.

3.2.1.3 Species at Risk – Aquatic

The *Species at Risk Act* (SARA) gives legislated protection to any listed species.

DFO's Aquatic Species at Risk (SAR) map was consulted to determine if there are any listed aquatic SAR at the sites, including the reservoir and/or tailrace. The number of listed SAR were counted and recorded.

3.2.1.4 DFO Obligations

Many of the sites include infrastructure or processes for enhancing fish habitat and/or fish passage and are facilitated by existing agreements made with DFO.

Using material provided by NL Hydro, it was determined which sites had existing DFO obligations related to fish habitat and/or fish passage. The number of DFO obligations for each site were counted and recorded.

3.2.1.5 Protected Species – Terrestrial

Terrestrial SAR are protected under the NL Endangered Species Act (ESA), and the federal Species at Risk Act (SARA). Federal protections are relative toa species status recommendation put forth by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

COSEWIC is the organization that makes recommendations to the Federal Government to consider classifications of species as being either extirpated, endangered, threatened, or a special concern, and whether the species should be listed under Schedule 1 of the SARA The COSEWIC status is a good indication of what will be protected by SARA in the future.

The SAR listed by COSEWIC and in the SARA are typically aligned, however, there are instances where SAR are listed by COSEWIC but are yet to be included in the SARA.

Data requests were made to the Atlantic Canada Conservation Data Centre (AC CDC) for Rare Taxa Reports for all sites. These reports included:

- Detailed observation data for all species of conservation concern known within 5 km of the sites.
- A list of location sensitive species of conservation concern known within 5 km of the sites.
- A list of all species of conservation concern known within 100 km of the sites.
- Information on protected and other managed natural areas within 5 km of the sites.
- Information on freshwater and marine fish, waterfowl, pelagic and colonial birds, and marine mammals from databases separate from the main AC CDC database.

Data from the requests were then condensed into the number of species within 5 km of each site that was listed either by ESA, SARA, or COSEWIC. A weighted assessment was completed to distinguished between engendered, threatened, vulnerable and special concern species. The number of species listed as "Endangered" was multiplied by 3, "Threatened" by 2, and "Vulnerable" or "Special Concern" by 1.

AC CDC also provided a map of rare species around each site, all of which are provided in Attachment 2.

3.2.1.6 Proximity to Core Caribou Areas

Since the mid to late 1990's, caribou populations on the Island of Newfoundland have been in a state of decline. The Newfoundland Caribou was listed to "Special Concern" by COSEWIC in November 2014 and SARA in August 2021. Other parts of Canada show that large expanses of undisturbed habitat are necessary for caribou conservation.

A proximity analysis was undertaken to measure the distance from each site to the closest core caribou area. Information regarding the location of core caribou area was retrieved from *A Report on the Newfoundland Caribou* written by the Newfoundland and Labrador Department of Conservation published in October 2015. Geospatial data was extracted from the report, imported into QGIS software, and the shortest line between features process was executed. Results were rounded to the nearest tenth of a kilometre and recorded.

AC CDC reports also provided geospatial information related to 'Sensitive Caribou Area's' with 5 km of each site. Although not considered a 'core Caribou area', this information was still incorporated into the criteria ranking.

3.2.1.7 Proximity to Wetlands

Wetlands provide many ecosystem services such as, but not limited to, habitat for flora and fauna, cleaning and purifying water, and flooding and erosion control. Due to their importance, the NL Department of Environment and Climate Change established a Policy for Development in Wetlands. In addition, the NL *Water Resources Act* is applicable to wetlands.

A proximity analysis was undertaken to measure the distance from each site to the closest wetland. Locations of wetlands was retrieved from Natural Resources Canada's (NRCan) CANVEC 50k dataset. Geospatial data was imported into QGIS software and the shortest line between features process was executed. Results were rounded to the nearest tenth of a kilometre and recorded.

3.2.1.8 Saltwater Intrusion Potential

For a proposed pumped storage site that has saltwater present in the tailrace, saltwater would be pumped into the upper reservoir to store energy. This would contaminate the freshwater reservoir with saltwater, which has the potential to affect the ecosystem. This would likely result in identifying and implementing potentially costly and extensive mitigation measures to reduce the potential environmental effect.

Saltwater intrusion was evaluated based on an analysis of satellite imagery and other mapping from a variety of sources looking for signs of tidal water at the tailrace of each site. Sites were recorded to either have freshwater, saltwater, or brackish at the tailrace.

3.2.2 Description of Social Factors

3.2.2.1 Structures within 30m of Reservoir

The development of a pumped storage facility will likely cause the level of the reservoir to fluctuate compared to standard hydroelectric operations. This may be perceived as undesirable to people who have structures (e.g., homes, cabins) surrounding the reservoir.

Structures were sourced by two datasets: the Government of NL's Large Scale Community Mapping Application, and Microsoft's Canadian Building Footprint database. The Large-Scale Community Mapping Application was beneficial for structures within municipal boundaries (e.g., Grand Falls, Bishop's Falls), whereas the Microsoft database was more complete for remote structures. Reservoir boundaries were retrieved from NRCan's CANVEC dataset. Geospatial data was imported into QGIS, and a 30 m buffer process was run for each reservoir. The number of structures found within each buffer were counted and recorded.

3.2.2.2 Proximity to the Built Environment

Proximity of a potential site to population centres will likely bring both positive (e.g., employment, economic activity, etc.), and negative (e.g., noise, traffic, etc.) impacts to the community. Sites that are closer to population centres will likely require more engagement.

Each site was evaluated based on their proximity to the nearest municipal boundary, or noted if it was within a municipality. Municipal boundaries were retrieved from the NL Department of Municipal and Provincial Affairs "Municipal plans and development regulations registered under the Urban and Rural Planning Act, 2000" webpage. Geospatial data was imported into QGIS software, and the shortest line between features process was executed. Results were rounded to the nearest tenth of a kilometre and recorded.

3.2.2.3 Potential Public Water Supplies

Water supplies directly in a potential development watershed, or adjacent to, will likely require consultation to evaluate impacts and possible mitigation measures to satisfy all relevant stakeholders.

An analysis was undertaken to look for any water supplies that were within site watersheds or adjacent to them. Information was retrieved from the Government of NL's Water Use License Mapping Application and Water Resources Portal. The number of water supplies were counted and recorded.

3.2.2.4 Proximity to First Nations, and Legislated Boundaries of Aboriginal Lands

The Canadian courts have established that federal and provincial governments have a duty to consult Indigenous groups about contemplated government actions or decisions that might have a negative impact on Aboriginal and treaty rights.

There are two registered bands under the *Indian Act* on the Island of Newfoundland: Miawpukek First Nation, and Qalipu First Nation.

For proximity to Miawpukek, the reservation boundary was retrieved from the Government of Canada's "First Nations Location – Pre-packaged SHP file" database. Geospatial data was then imported into QGIS software and the shortest line between features process was executed. Results were rounded to the nearest kilometre and recorded.

A slightly different methodology was utilized for 'proximity' to the Qalipu First Nation. Sixty-seven (67) traditional Mi'kmaq communities were mapped in QGIS. These communities were identified in the Agreement for the Recognition of the Qalipu Mi'kmaq Band between the Federation of Newfoundland Indians (the pre-cursor organization representing what is now Qalipu First Nation) and the Government of Canada. The shortest line between features process was executed against this information. Results were rounded to the nearest kilometre and recorded.

The classification criteria for Maiwpukek and Qualipi were averaged and rounded to the nearest full number. This number was then assigned as the final classification for each site.

3.2.2.5 Archaeological Potential

Under the NL *Historic Resources Act*, archaeological sites are protected, and high potential areas require impact assessment.

For each facility a 5 km buffer was established in QGIS, exported as a shapefile, and provided to NL Provincial Archaeological Office for comments. The Provincial Archaeological authority indicated the archeological potential at each site. This information was recorded.

3.3 Interconnection

The nine (9) existing sites were assessed against two (2) electrical interconnection characteristics, Transmission Capacity and Voltage of the line.

To support the assessment, five (5) classification criteria were defined and established for both factors. The classification criteria range from 1 to 5, and represent the least to the most complex, respectively.

Sites were assessed by determining the steady state transmission capacity available at the Point of Interconnection (POI) using load flow software package PSSE Version 33 and the latest 2032 Peak Load Flow System model provided by Newfoundland & Labrador Hydro.

Any future determination of transmission capacity would include dynamic studies of the effect of additional generation at a specific location and the effect of summer ambient temperatures. The following assumptions and criteria were used in determining the available transmission capacity:

Assumptions

a. The 2032 Peak Winter case is studied to maximize generation opportunities of pumped storage generation to assist with the Reliability of Supply to the Island during major generation dispatch interruptions. Any future studies related to the progressing of pumped storage options will include summer peaking conditions to consider the minimum transmission capacity at Point of Interconnection due to higher ambient temperatures.

b. The existing generation at each site is at maximum output to the interconnected system.

c. The Labrador Island Link is in Monopole mode with 675 MW export from Muskrat Falls. This export value can be reduced to allow additional Island generation opportunities from the studied pumped storage facilities.

d. Pumped storage generation is modeled on the high side of the existing generating plants step-up transformer. The power output of the pumped storage generator is increased until a transmission limitation is experienced.

e. The existing plants electrical infrastructure including step-up transformers will not be utilized in any future pumped storage generation additions. New step-up transformers will be required.

f. Transformation between the POI and either the 138kV or 230kV grid is assumed to be adequate for this study.

g. N-1 contingencies of the 230kV transmission system near the POI are considered for this screening study.

Criteria

a. Transmission lines ratings cannot exceed the winter thermal rating (Rate C).

b. Where there are multiple transmission lines at the POI, then loss of each transmission line is modeled to determine transmission capacity.

c. Where there is only one transmission line at the POI, then loss of that transmission line shall not cause a loss of generation greater than 155 MW to prevent under frequency load shedding on the Island Grid. It is understood that with the final commissioning of the Labrador Island and Maritime Link’s frequency controllers, it is likely that the loss of more than 155 MW could be tolerated without load shedding. Studies are presently underway to determine the maximum generation loss to prevent under frequency load shedding, but as a worse case scenario it is agreed that the 155 MW value will remain for the purpose of the screening study.

Figures presenting the interconnection at each project site are enclosed as Attachment 3.

3.4 Facilities and Equipment

For this screening study all sites are considered to have appropriate access roads, existing intake, conveyance system, powerhouse, and tailrace. In general, the facilities and equipment needed for a PSP have different characteristics than those of traditional hydro stations. New equipment will need to be used in all cases. Existing arrangements and turbine settings do not allow for sufficient submergence for pumping operation if the existing turbines were replaced with reversible pump turbines. Therefore, in this initial assessment these assets are not considered in the Pugh analysis.

4. Site Summaries

The following section provides a brief overview of each Site including final ranking and brief description of why that ranking was given.

4.1 Site 1 - Bay d'Espoir

The Bay d'Espoir Generating Facility is the most downstream facility in the Bay d'Espoir system. The development includes a reservoir impounded by six embankment dams (including a saddle dam), a gated spillway and two Powerhouses.

Powerhouse 1 has six generating units of 75 MW nominal capacity each. The first four units were commissioned in 1967 (Phase 1) and the last two units were commissioned in 1970 (Phase 2). A single headrace canal provides water to the three intakes and the powerhouse discharges via a 4.5 km long tailrace channel which flows into Fortune Bay.

Powerhouse 2 includes a single unit of 150 MW nominal capacity. Water is provided by a separate headrace canal, intake, and penstock. This powerhouse discharges in its own tailrace channel connecting Powerhouse 2 to the tailrace channel of Powerhouse 1. This facility was commissioned in 1977 (Phase 3) and was constructed with the provision for the future installation of a second 150 MW unit.

The seven generating units at Bay d'Espoir utilize approximately 181 m of head to produce a rated output of 604 MW with a rated flow of 397 m^3/s. The plant produces an average of 2,650 GWh annually, making it the largest hydroelectric plant on the Island.

4.1.1 Pumped Storage Characteristics

The main characteristics of Site 1 Bay d'Espoir are shown on the following table:

Table 4-1: Bay D'Espoir Pumped Storage Characteristics

Site No.		1
Name		Bay d'Espoir Generating Facility
Current Capacity	MW	613.5
Upper Reservoir		Long Pond
• **FSL (Max Oper Elev.)**	m AHD	182.7
• **Min Operational Elev**	m AHD	178.31
• **Area of upper Reservoir**	km^2	178
• **Up. Res. Storage**	Mm^3	781.42
Lower Reservoir		Ocean
• **FSL (Max Oper Elev.)**	m AHD	0
• **Min Operational Elev**	m AHD	0
• **Area of Lower Reservoir**	km^2	0
• **Lower Res. Storage**	Mm^3	0
Storage	Mm^3	0
Head	m	181
Energy Storage Potential	MWh	0.00
Hours of Storage	hrs	12
PSP Capacity	MW	0.00
PUGH OUTPUT – PSP Capacity		**5**
Head Range Verification	≤ 1.25	1.02
Conveyance Length	m	1129
Conveyance Ratio (L/H)		6.25
PUGH OUTPUT – Conveyance / Head		**3**

Since Site 1 has the Atlantic Ocean as the lower reservoir, it's storage capacity as defined in the criteria, is zero, and thus is deemed not feasible within the present study.

4.1.2 Environmental and Social

The overall environmental and social complexity index for the Bay d'Espoir site is relatively high, and the site is ranked as 7th.

Factors that resulted in higher (i.e., classification rankings of 3, 4 and 5), and therefore more complex, classifications are as follows:

- Approximately 15 km from Jipujijkuei Kuespem Provincial Park
- Approximately 8.2 km from core caribou habitat
- Approximately 2.0 km from the nearest wetland
- Approximately 2.5 km from the Town of Milltown-Head of Bay d'Espoir
- Approximately 13 km from Miawpukek, and 14 km from St. Albans Qalipu Community

- High potential for archaeological sites.

Factors that resulted in lower (i.e., classification rankings of 1 and 2), and therefore less complex, classifications are follows:

- Not on a scheduled salmon watercourse
- Two aquatic SAR potentially present at tailrace
- No known DFO obligations
- No protected terrestrial species known within 5 km
- Brackish/unknown water at the tailrace
- Zero identified structures within 30 m of the reservoir
- Adjacent to St. Albans protected watershed.

	Bay d'Espoir Biophysical Factors							
Criteria	Protected areas	Scheduled Salmon River	Species at Risk (Aquatic)	DFO Obligations	Protected Species (Terrestrial)	Proximity to Core Caribou Areas	Promity to Wetlands	Saltwater Intrusion Potential
Value	15 km	Neither	2	0	0	8.2 km	2.0 km	Brackish/Unknown
Ranking	5	1	2	1	1	5	4	3

	Bay d'Espoir Social Factors				
Criteria	Structures within 30m of reservoir	Proximity to the built environment	Potential Public Water Supplies	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	Archaeological Potential
Value	0	2.5 km	1	13 km 14 km	High potential
Ranking	1	4	2	5	3

	Bay d'Espoir Environment and Social Complexity Index
Cumulative Index	2.85
Overall Ranking	7th

Figure 4-1: Site 1 – Environmental Screening

4.1.3 Interconnection

The Point of Interconnection for the study was the 230kV bus at Bay d'Espoir. The 230kV transmission system is capable of an additional generation source of 440 MW and this limitation is a result of thermal overloading of both TL 202 and TL 206 for an outage of TL 267 with all other Bay d'Espoir generating units in-service. For the loss of TL 217 between Sunnyside and Western Avalon, overloading of TL 201 would occur with an additional generation output of 420 MW from the Bay d'Espoir plant.

It is understood that there is currently a transmission restriction between Bay d'Espoir and the eastern portion of the 230kV transmission grid which is presently being studied by Newfoundland and Labrador Hydro. This study will address both steady state and transient conditions of N-1 and N-1-1 contingencies and propose long term solutions for increasing the transmission capacity for this corridor.

The amount of power that can be provided by the Bay d'Espoir plant will be heavily dependant on system conditions, LIL import levels and generation dispatched on the Avalon Peninsula. The higher the LIL import levels (or Avalon generation output) the lower the flow on TL201/TL217 and therefore more available capacity to deliver the additional power from Bay d'Espoir. The 420 MW assumes the LIL is operating in monopole at 675 MW with no Holyrood generation online.

4.2 Site 2 - Bishop's Falls

Located on the Exploits River, the Bishop's Falls Generating Facility is part of the Exploits Generation Assets, which are operated by NL Hydro on behalf of the Government of Newfoundland and Labrador. The facility is run-of river type, with three dams– an Ambursen overflow dam, gated concrete gravity spillway section, and embankment type. The net head of the facility is approximately 11 m. There are 9 units at Bishops Falls with a total capacity of approximately 21 MW. Units BF1-6 were rebuilt with new Seagull turbines in 2003 and are rated for a maximum output of 3.0 MW each, BF7 is rated for a maximum output of 2.25 MW, while BF8 and BF9 have maximum outputs of approximately 1 MW each.

4.2.1 Pumped Storage Characteristics

Table 4-2: Bishop Falls Pumped Storage Characteristics

Site No.		2
Name		Bishop's Falls
Current Capacity	MW	22
Upper Reservoir		None
• **FSL (Max Oper Elev.)**	m AHD	9
• **Min Operational Elev**	m AHD	5
• **Area of upper Reservoir**	km^2	0.15
• **Up. Res. Storage**	Mm^3	0.6
Lower Reservoir		Ocean
• **FSL (Max Oper Elev.)**	m AHD	0
• **Min Operational Elev**	m AHD	0
• **Area of Lower Reservoir**	km^2	0
• **Lower Res. Storage**	Mm^3	0
Storage	Mm^3	0
Head	m	0
Energy Storage Potential	MWh	0.00
Hours of Storage	hrs	12
PSP Capacity	MW	0.00
PUGH OUTPUT – PSP Capacity		**5**
Head Range Verification	≤ 1.25	-
Conveyance Length	m	200
Conveyance Ratio (L/H)		-
PUGH OUTPUT – Conveyance / Head		**-**

4.2.2 *Environmental and Social*

The overall environmental and social complexity index for the Bishop's Falls site is relatively high, and this site is ranked as 9th.

Factors that resulted in higher (i.e., classification rankings of 3, 4 and 5), and therefore more complex, classifications are as follows:

- Approximately 29 km from Notre Dame Provincial Park
- On a scheduled salmon watercourse
- Five DFO obligations
- Approximately 19.2 km from core caribou habitat
- Approximately 0.5 km from the nearest wetland
- Saltwater at the tailrace
- Eight one (81) structures within 30 m of the reservoir
- Within the Town of Bishop's Falls
- Approximately 123 km from Miawpukek, and within Bishop's Falls Qalipu Community
- Known archaeological sites around the facility.

Factors that resulted in lower (i.e., classification rankings of 1 and 2), and therefore less complex, classifications are follows:

- One aquatic SAR potentially present at tailrace
- Multiple protected terrestrial species known within 5 km
- No relevant water permits or protected watershed.

	Bishop's Falls Biophysical Factors							
Criteria	Protected areas	Scheduled Salmon River	Species at Risk (Aquatic)	DFO Obligations	Protected Species (Terrestrial)	Proximity to Core Caribou Areas	Promity to Wetlands	Saltwater Intrusion Potential
Value	29 km	Scheduled	1	5	8	19.2 km	0.5 km	Fresh Downstream
Ranking	4	5	2	4	2	4	5	1

	Bishop's Falls Social Factors				
Criteria	Structures within 30m of reservoir	Proximity to the built environment	Potential Public Water Supplies	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	Archaeological Potential
Value	81	0 km	0	123 km 0 km	Known sites
Ranking	5	5	1	4	5

	Bishop's Falls Environment and Social Complexity Index
Cumulative Index	3.55
Overall Ranking	9th

Figure 4-2: Site 2 – Environmental Screening

4.2.3 Interconnection

The Point of Interconnection for the study was the 66kV bus at Bishop's Falls. Transmission line rating of this line was not available in the system model and is assumed to be in the [redacted] range. The 66kV transmission line is stepped down to 6.9kV with a [redacted] transformer at Grand Falls and subsequently stepped up again to 230kV. For this site, it is assumed that there are no transformation restrictions to accessing the 230kV grid as in the other site assumptions. The 66kV transmission line is overloaded when additional pumped storage generation of 78 MW is added at Bishop's Falls.

4.3 Site 3 - Cat Arm

Commissioned in 1985, the Cat Arm development is located on the eastern side of the Great Northern Peninsula. The development includes two reservoirs, ten dams and dykes, two overflow spillways, one forebay tunnel and one power tunnel delivering water to two Pelton units. Each of the two units operates with a rated flow of 20 m^3/s to generate a total 127 MW of electrical power with an average annual production of 680 GWh. The Cat Arm facility discharges into White Bay.

4.3.1 Pumped Storage Characteristics

Table 4-3: Cat Arm Pumped Storage Characteristics

Site No.		3
Name		Cat Arm
Current Capacity	MW	134
Upper Reservoir		Cat Arm
• **FSL (Max Oper Elev.)**	m AHD	393.2
• **Min Operational Elev**	m AHD	385.95
• **Area of upper Reservoir**	km^2	60.2
• **Up. Res. Storage**	Mm^3	436.45
Lower Reservoir		Ocean
• **FSL (Max Oper Elev.)**	m AHD	0
• **Min Operational Elev**	m AHD	0
• **Area of Lower Reservoir**	km^2	0
• **Lower Res. Storage**	Mm^3	0
Storage	Mm^3	0
Head	m	390
Energy Storage Potential	MWh	0.00
Hours of Storage	hrs	12
PSP Capacity	MW	0.00
PUGH OUTPUT – PSP Capacity		5
Head Range Verification	≤ 1.25	1.02
Conveyance Length	m	2900
Conveyance Ratio (L/H)		7.44
PUGH OUTPUT – Conveyance / Head		3

4.3.2 Environmental and Social

The overall environmental and social complexity index for the Cat Arm site is relatively moderate, and the site is ranked as 4th.

Factors that resulted in higher (i.e., classification rankings of 3, 4 and 5), and therefore more complex, classifications are as follows:

- Approximately 28 km from Main River Waterway Provincial Park
- Six (6) aquatic SAR potentially present at tailrace or reservoir
- Approximately 18.5 km from core caribou habitat
- Saltwater at the tailrace
- Approximately 18.3 km from the Town of Jackson's Arm
- High potential for archaeological sites.

Factors that resulted in lower (i.e., classification rankings of 1 and 2), and therefore less complex, classifications are follows:

- Not on a scheduled salmon watercourse
- One (1) DFO obligation
- No protected terrestrial species known within 5 km
- Approximately 4 km from the nearest wetland
- Zero identified structures within 30m of the reservoir
- No relevant water permits or protected watershed
- Approximately 249 km from Miawpukek, and 29 km from Sops Arm Qalipu Community.

	Cat Arm Biophysical Factors							
Criteria	Protected areas	Scheduled Salmon River	Species at Risk (Aquatic)	DFO Obligations	Protected Species (Terrestrial)	Proximity to Core Caribou Areas	Promity to Wetlands	Saltwater Intrusion Potential
Value	28 km	Neither	6	1	0	19.2 km	0.5 km	Brackish/Unknown
Ranking	4	1	4	2	1	4	2	5

	Cat Arm Social Factors				
Criteria	Structures within 30m of reservoir	Proximity to the built environment	Potential Public Water Supplies	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	Archaeological Potential
Value	0	18.3 km	0	249 km 29 km	High potential
Ranking	1	4	1	2	3

	Cat Arm Environment and Social Complexity Index
Cumulative Index	2.675
Overall Ranking	4th

Figure 4-3: Site 3 – Environmental Screening

4.3.3 *Interconnection*

The Point of Interconnection for the study was the 230kV bus at Cat Arm. The 230kV transmission system is capable of an additional generation source of 25 MW. This limitation is the results from the loss of TL 247 with full generation of 134 MW at the existing facility and subsequent loss of 155 MW to the Island grid and possible load shedding.

4.4 Site 4 - Grand Falls

The Grand Falls Generating Facility is located on the Exploits River, upstream of the Bishop's Falls Generating Facility. It is also part of the Exploits Generation Assets. The generating facility consists of a concrete gravity dam, embankment dam and Roller Compacted Concrete (RCC) overflow dam. The net head is approximately 32 m at maximum generation of 75 MW at Grand Falls.

4.4.1 *Pumped Storage Characteristics*

Table 4-4: Grand Falls Pumped Storage Characteristics

Site No.		4
Name		Grand Falls
Current Capacity	MW	75
Upper Reservoir		Grand Falls
• **FSL (Max Oper Elev.)**	m AHD	0
• **Min Operational Elev**	m AHD	0
• **Area of upper Reservoir**	km^2	0.04
• **Up. Res. Storage**	Mm^3	0
Lower Reservoir		Bishop Falls
• **FSL (Max Oper Elev.)**	m AHD	0
• **Min Operational Elev**	m AHD	0
• **Area of Lower Reservoir**	km^2	0
• **Lower Res. Storage**	Mm^3	0
Storage	Mm^3	0
Head	m	30
Energy Storage Potential	MWh	0.00
Hours of Storage	hrs	12
PSP Capacity	MW	0.00
PUGH OUTPUT – PSP Capacity		5
Head Range Verification	≤ 1.25	1.02
Conveyance Length	m	87
Conveyance Ratio (L/H)		2.89
PUGH OUTPUT – Conveyance / Head		2

4.4.2 Environmental and Social

The overall environmental and social complexity index for the Grand Falls facility site is relatively high, and the site is ranked as 8th.

Factors that resulted in higher (i.e., classification rankings of 3, 4 and 5), and therefore more complex, classifications are as follows:

- On a scheduled salmon watercourse
- Seven (7) DFO obligations
- Multiple protected terrestrial species known within 5 km
- Approximately 27.1 km from core caribou habitat
- Approximately 0.6 km from the nearest wetland
- Within the Town of Grand Falls-Windsor
- Approximately 112 km from Miawpukek, and within Grand Falls-Windsor Qalipu Community
- Known archaeological sites around the facility.

Factors that resulted in lower (i.e., classification rankings of 1 and 2), and therefore less complex, classifications are follows:

- Approximately 46 km from Notre Dame Provincial Park
- No known aquatic SAR
- Freshwater at the tailrace
- Zero identified structures within 30 m of the reservoir; and
- No relevant water permits or protected watershed.

	Grand Falls Biophysical Factors							
Criteria	Protected areas	Scheduled Salmon River	Species at Risk (Aquatic)	DFO Obligations	Protected Species (Terrestrial)	Proximity to Core Caribou Areas	Promity to Wetlands	Saltwater Intrusion Potential
Value	46 km	Scheduled	0	7	36	27.1 km	0.6 km	Fresh Downstream
Ranking	2	5	1	5	5	3	5	1

	Grand Falls Social Factors				
Criteria	Structures within 30m of reservoir	Proximity to the built environment	Potential Public Water Supplies	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	Archaeological Potential
Value	0	0 km	0	112 km 0 km	Known sites
Ranking	1	5	1	4	5

	Grand Falls Environment and Social Complexity Index
Cumulative Index	3.25
Overall Ranking	8th

Figure 4-4: Site 4 – Environmental Screening

4.4.3 *Interconnection*

The Point of Interconnection for the study was the 230kV bus at Grand Falls. The 230kV transmission system is capable of an additional generation source of 93 MW. This limitation is the results from the loss of TL 235 with full generation of 63 MW at the existing Grand Falls and Bishop's Falls facilities and subsequent loss of 155 MW to the Island grid and possible load shedding.

4.5 Site 5 - Granite Canal

The Granite Canal Generating Facility is the most upstream generating facility in the Bay d'Espoir system. The generating facility operates under approximately 37 m of head with a rated flow 122 m^3/s, with a capacity of 40 MW and average annual production of 220 GWh. The generating station has one-40 MW Kaplan turbine. Commissioned in 2003, Granite Canal is the newest generating facility on the island. Granite Canal discharges into the Meelpaeg reservoir, which controls flow into the downstream Upper Salmon development.

4.5.1 *Pumped Storage Characteristics*

Table 4-5: Granite Canal Pumped Storage Characteristics

Site No.		5
Name		Granite Lake
Current Capacity	MW	41
Upper Reservoir		Granite Lake
• **FSL (Max Oper Elev.)**	m AHD	312.53
• **Min Operational Elev**	m AHD	311.37
• **Area of upper Reservoir**	km^2	65
• **Up. Res. Storage**	Mm^3	75.4
Lower Reservoir		Meelpaeg Reservoir
• **FSL (Max Oper Elev.)**	m AHD	273.71
• **Min Operational Elev**	m AHD	266.98
• **Area of Lower Reservoir**	km^2	309
• **Lower Res. Storage**	Mm^3	2079.57
Storage	Mm^3	60.32
Head	m	42
Energy Storage Potential	MWh	6,838
Hours of Storage	hrs	12
PSP Capacity	MW	569
PUGH OUTPUT – PSP Capacity		1
Head Range Verification	≤ 1.25	1.03
Conveyance Length	m	165
Conveyance Ratio (L/H)		3.97
PUGH OUTPUT – Conveyance / Head		2

4.5.2 Environmental and Social

The overall environmental and social complexity index for the Granite Canal site is relatively low, and the site is ranked as 1st.

Factors that resulted in higher (i.e., classification rankings of 3, 4 and 5), and therefore more complex, classifications are as follows:

- Lower reservoir noted as unscheduled salmon watercourse
- Three (3) DFO obligations
- Approximately 14.3 km from core caribou habitat
- Approximately 0.3 km from the nearest wetland
- High potential for archaeological sites.

Factors that resulted in lower (i.e., classification rankings of 1 and 2), and therefore less complex, classifications are follows:

- Approximately 60 km from Little Grand Lake Provincial Ecological Reserve
- No known aquatic SAR
- No protected terrestrial species known within 5 km
- Freshwater at the tailrace
- Zero identified structures within 30 m of the reservoir
- Approximately 68.5 km from the Town of Buchans
- Downstream adjacent to St. Albans protected watershed
- Approximately 85 km from Miawpukek, and Approximately 70 km from Buchans Qalipu Community.

	Granite Lake Biophysical Factors							
Criteria	Protected areas	Scheduled Salmon River	Species at Risk (Aquatic)	DFO Obligations	Protected Species (Terrestrial)	Proximity to Core Caribou Areas	Promity to Wetlands	Saltwater Intrusion Potential
Value	60 km	Unscheduled	0	3	0	14.3 km	0.3 km	Fresh Downstream
Ranking	1	3	1	3	1	4	5	1

	Granite Lake Social Factors				
Criteria	Structures within 30m of reservoir	Proximity to the built environment	Potential Public Water Supplies	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	Archaeological Potential
Value	0	65.5 km	1	85 km 70 km	High potential
Ranking	1	1	2	2	3

	Granite Lake Environment and Social Complexity Index
Cumulative Index	2.125
Overall Ranking	1st

Figure 4-5: Site 5 – Environmental Screening

4.5.3 Interconnection

The Point of Interconnection for the study was the 230kV bus at Granite Canal. The 230kV transmission system is capable of an additional generation source of 330 MW and this limitation is a result of thermal overloading of TL 263 for an outage of TL 269.

4.6 Site 6 - Hinds Lake

The Hinds Lake development, located in the Long-Range Mountains between Grand Lake and the Town of Buchans, consists of twelve dams impounding the reservoir, with a two-bay gated spillway, an overflow spillway and control structure at the upstream end of the power canal. The generating facility operates under an average net head of 214 m. The rated flow of 40 m^3/s generates 75 MW of power with an average annual production of 340 GWh. The generating station has one-75 MW Francis turbine, which was commissioned in 1980. Hinds Lake discharges into Grand Lake.

4.6.1 Pumped Storage Characteristics

Table 4-6:Hinds Lake Pumped Storage Characteristics

Site No.		6
Name		Hinds Lake
Current Capacity	MW	75
Upper Reservoir		Hinds Lake
• **FSL (Max Oper Elev.)**	m AHD	311.3
• **Min Operational Elev**	m AHD	310.9
• **Area of upper Reservoir**	km^2	498
• **Up. Res. Storage**	Mm^3	199.2
Lower Reservoir		Grand Lake Reservoir
• **FSL (Max Oper Elev.)**	m AHD	89
• **Min Operational Elev**	m AHD	85
• **Area of Lower Reservoir**	km^2	54
• **Lower Res. Storage**	Mm^3	216
Storage	Mm^3	159.36
Head	m	224
Energy Storage Potential	MWh	97,316
Hours of Storage	hrs	12
PSP Capacity	MW	8,109
PUGH OUTPUT – PSP Capacity		1
Head Range Verification	≤ 1.25	1.00
Conveyance Length	m	1419
Conveyance Ratio (L/H)		6.33
PUGH OUTPUT – Conveyance / Head		3

4.6.2 Environmental and Social

The overall environmental and social complexity index for the Hinds Lake site is relatively high, and the site is ranked as 6th.

Factors that resulted in higher (i.e., classification rankings of 3, 4 and 5), and therefore more complex, classifications are as follows:

- Approximately 28 km from Sir Richard Squires Memorial Provincial Park
- Lower reservoir noted as unscheduled salmon watercourse
- Approximately 16.8 km from core caribou habitat
- Approximately 1.6 km from the nearest wetland
- Approximately 10.9 km from the Town of Howley
- Town of Deer Lake and Town of Howley drinking water downstream
- Approximately 171 km from Miawpukek, and 20 km from Deer Lake Qalipu Community High potential for archaeological sites.

Factors that resulted in lower (i.e., classification rankings of 1 and 2), and therefore less complex, classifications are follows:

- No known aquatic SAR
- One (1) known DFO obligation
- One (1) protected terrestrial species known within 5 km
- Freshwater at the tailrace
- One (1) identified structure within 30 m of the reservoir.

	Hinds Lake Biophysical Factors							
Criteria	Protected areas	Scheduled Salmon River	Species at Risk (Aquatic)	DFO Obligations	Protected Species (Terrestrial)	Proximity to Core Caribou Areas	Promity to Wetlands	Saltwater Intrusion Potential
Value	28 km	Unscheduled	0	1	7	16.8 km	1.6 km	Fresh Downstream
Ranking	4	3	1	2	2	4	4	1

	Hinds Lake Social Factors				
Criteria	Structures within 30m of reservoir	Proximity to the built environment	Potential Public Water Supplies	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	Archaeological Potential
Value	1	10.9 km	3	171 km 20 km	High potential
Ranking	2	4	4	3	3

	Hinds Lake Environment and Social Complexity Index
Cumulative Index	2.8
Overall Ranking	6th

Figure 4-6: Site 6 – Environmental Screening

4.6.3 Interconnection

The Point of Interconnection for the study was the 138kV bus at Hinds Lake. The 138kV transmission system is capable of an additional generation source of 84 MW. This limitation is the results from the loss of TL 243 with full generation of 75 MW at the existing Hinds Lake facility and subsequent loss of 155 MW to the Island grid and possible load shedding. The thermal limit of TL 243 is also reached for the addition of 84 MW.

4.7 Site 7 - Paradise River

The Paradise River Generating Station is located on the Burin Peninsula. The development is run of river type, and includes a double curvature concrete arch dam with an overflow section and an embankment saddle dam. Commissioned in 1989, the plant operates at a rated flow of 25 m^3/s to generate 8 MW of power, with an average annual production of 36 GWh. The plant contains one Francis-type unit and discharges into brackish waters at the mouth of Paradise River

4.7.1 Pumped Storage Characteristics

Table 4-7:Paradise River Pumped Storage Characteristics

Site No.		7
Name		Paradise River
Current Capacity	MW	8
Upper Reservoir		Paradise River
• **FSL (Max Oper Elev.)**	m AHD	35
• **Min Operational Elev**	m AHD	31
• **Area of upper Reservoir**	km^2	0.58
• **Up. Res. Storage**	Mm^3	2.32
Lower Reservoir		Ocean
• **FSL (Max Oper Elev.)**	m AHD	0
• **Min Operational Elev**	m AHD	0
• **Area of Lower Reservoir**	km^2	0
• **Lower Res. Storage**	Mm^3	0
Storage	Mm^3	0
Head	m	33
Energy Storage Potential	MWh	0.00
Hours of Storage	hrs	12
PSP Capacity	MW	0.00
PUGH OUTPUT – PSP Capacity		**5**
Head Range Verification	≤ 1.25	1.13
Conveyance Length	m	250
Conveyance Ratio (L/H)		7.58
PUGH OUTPUT – Conveyance / Head		**4**

4.7.2 Environmental and Social

The overall environmental and social complexity index for the Paradise River site ranks relatively low, and the site is ranked as 3rd.

Factors that resulted in higher (i.e., classification rankings of 3, 4 and 5), and therefore more complex, classifications are as follows:

- Approximately 37 km from the Bay du Nord Wilderness Reserve
- Seven (7) aquatic SAR potentially present at tailrace
- Saltwater at the tailrace
- Approximately 22.5 km from the Town of Terrenceville
- Approximately 95 km from Miawpukek, and 34 km from Swift Current Qalipu Community
- High potential for archaeological sites.

Factors that resulted in lower (i.e., classification rankings of 1 and 2), and therefore less complex, classifications are follows:

- Not on a scheduled salmon watercourse
- No known DFO obligations
- No protected terrestrial species known within 5 km
- Approximately 40.3 km from core caribou habitat
- Approximately 4.4 km from the nearest wetland
- Zero identified structures within 30 m of the reservoir (Rank 1)
- No relevant water permits or protected watershed.

	Paradise River Biophysical Factors							
Criteria	Protected areas	Scheduled Salmon River	Species at Risk (Aquatic)	DFO Obligations	Protected Species (Terrestrial)	Proximity to Core Caribou Areas	Promity to Wetlands	Saltwater Intrusion Potential
Value	37 km	Neither	7	0	0	40.3 km	4.4 km	Salt downstrem
Ranking	3	1	5	1	1	1	1	5

	Paradise River Social Factors				
Criteria	Structures within 30m of reservoir	Proximity to the built environment	Potential Public Water Supplies	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	Archaeological Potential
Value	0	22.5 km	0	95 km 34 km	High potential
Ranking	1	3	1	3	3

	Paraside River Environment and Social Complexity Index
Cumulative Index	2.3
Overall Ranking	3rd

Figure 4-7: Site 7 – Environmental Screening

4.7.3 *Interconnection*

The Point of Interconnection for the study was the 25kV bus at Paradise River. The 25kV distribution line is stepped up to 138kV with a 15 MVA transformer at Monkstown Substation. For the purpose of this site, it is assumed that there are no transformation restrictions to accessing the 138kV grid as in the other site assumptions. The 25kV distribution line is overloaded when additional pumped storage generation of 22 MW is added at Paradise River.

4.8 Site 8 - Star Lake

Star Lake is located on the southwestern end of Beothuk Lake, in central Newfoundland and Labrador. The development consists of an embankment dam (East and West sections), concrete overflow spillway and an embankment saddle dam. The plant contains a single Francis turbine that operates at a rated head of 137 m, with a capacity of 18.4 MW. The plant discharges into Beothuk Lake.

4.8.1 *Pumped Storage Characteristics*

Table 4-8: Star Lake Pumped Storage Characteristics

Site No.		8
Name		Star Lake
Current Capacity	MW	18.4
Upper Reservoir		Star Lake
• FSL (Max Oper Elev.)	m AHD	292
• Min Operational Elev	m AHD	284
• Area of upper Reservoir	km^2	28.5
• Up. Res. Storage	Mm^3	228
Lower Reservoir		Beothuk Lake
• FSL (Max Oper Elev.)	m AHD	158
• Min Operational Elev	m AHD	154
• Area of Lower Reservoir	km^2	177
• Lower Res. Storage	Mm^3	708
Storage	Mm^3	182.4
Head	m	132
Energy Storage Potential	MWh	65,609
Hours of Storage	hrs	12
PSP Capacity	MW	5,467
PUGH OUTPUT – PSP Capacity		1
Head Range Verification	≤ 1.25	1.06
Conveyance Length	m	1720
Conveyance Ratio (L/H)		13.03
PUGH OUTPUT – Conveyance / Head		5

4.8.2 Environmental and Social

The overall environmental and social complexity index for the Star Lake site ranks as relatively moderate, and the site is ranked as 5th.

Factors that resulted in higher (i.e., classification rankings of 3, 4 and 5), and therefore more complex, classifications are as follows:

- Approximately 13 km from Little Grand Lake Provincial Ecological Reserve
- On a scheduled salmon watercourse
- Multiple protected terrestrial species known within 5 km
- Approximately 12.4 km from core caribou habitat
- Approximately 0.9 km from the nearest wetland
- Approximately 38.4 km from the Town of Buchans
- High potential for archaeological sites.

Factors that resulted in lower (i.e., classification rankings of 1 and 2), and therefore less complex, classifications are follows:

- No known aquatic SAR
- No known DFO obligations
- Freshwater at the tailrace
- No identified structures within 30m of the reservoir
- No relevant water permits or protected watershed
- Approximately 130 km from Miawpukek, and approximately 40 km from Buchans Qalipu Community.

	Star Lake Biophysical Factors							
Criteria	Protected areas	Scheduled Salmon River	Species at Risk (Aquatic)	DFO Obligations	Protected Species (Terrestrial)	Proximity to Core Caribou Areas	Promity to Wetlands	Saltwater Intrusion Potential
Value	13 km	Scheduled	0	0	16	12.4 km*	0.9 km	Fresh Downstream
Ranking	5	5	1	1	3	5	5	1

*Due to the AC CDC provided Star Lake map identifying a sensitive caribou area closer than the closest core area, the "Proximity to Core Caribou Areas" rank was increased from a 4 to a 5

	Star Lake Social Factors				
Criteria	Structures within 30m of reservoir	Proximity to the built environment	Potential Public Water Supplies	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	Archaeological Potential
Value	0	38.4 km	0	130 km 40 km	High potential
Ranking	1	3	1	2	3

	Star Lake Environment and Social Complexity Index
Cumulative Index	2.725
Overall Ranking	5th

Figure 4-8: Site 8 – Environmental Screening

4.8.3 Interconnection

The Point of Interconnection for the study was the 66kV bus at Star Lake. The 230kV transmission system is capable of an additional generation source of 49 MW and this limitation is a result of thermal overloading of TL 280.

4.9 Site 9 - Upper Salmon

The Upper Salmon Generating Facility is located in the Bay d'Espoir system, downstream of the Granite Canal Generating Facility and upstream of the Bay d'Espoir Generating Facility. The Upper Salmon reservoir is impounded by two earth embankment dams, and water is conveyed to the intake via a power canal approximately 3.5 km long. There are two gated spillways on the reservoir. The plant operates at a net head of 51 m, with rated flow of 189.8 m^3/s, generating 84 MW with an average annual production of 570 GWh. The generating station houses a single Francis turbine, which was commissioned in 1980. The facility discharges into Godaleich Pond, which forms the upstream headwaters of the Bay d'Espoir development.

4.9.1 Pumped Storage Characteristics

Table 4-9: Upper Salmon Pumped Storage Characteristics

Site No.		9
Name		Upper Salmon
Current Capacity	MW	84
Upper Reservoir		Cold Spring Pond/ Great Burnt Lake
• **FSL (Max Oper Elev.)**	m AHD	247.31
• **Min Operational Elev**	m AHD	246.81
• **Area of upper Reservoir**	km^2	114
• **Up. Res. Storage**	Mm^3	57
Lower Reservoir		Godaleich Pond
• **FSL (Max Oper Elev.)**	m AHD	194
• **Min Operational Elev**	m AHD	192
• **Area of Lower Reservoir**	km^2	3.12
• **Lower Res. Storage**	Mm^3	6.24
Storage	Mm^3	4.992
Head	m	54
Energy Storage Potential	MWh	735
Hours of Storage	hrs	12
PSP Capacity	MW	61
PUGH OUTPUT – PSP Capacity		**4**
Head Range Verification	≤ 1.25	1.01
Conveyance Length	m	427
Conveyance Ratio (L/H)		7.9
PUGH OUTPUT – Conveyance / Head		**4**

4.9.2 Environmental and Social

The overall environmental and social complexity index for the Upper Salmon facility ranks relatively low, and the site is ranked as 2nd.

Factors that resulted in higher (i.e., classification rankings of 3, 4 and 5), and therefore more complex, classifications are as follows:

- Meelpaeg reservoir noted as unscheduled salmon watercourse
- Approximately 26.0 km from core caribou habitat
- Approximately 0.3 km from the nearest wetland
- Approximately 37.3 km from the Town of Buchans
- Approximately 46 km from Miawpukek, and 43 km from Buchans Qalipu Community
- High potential for archaeological sites.

Factors that resulted in lower (i.e., classification rankings of 1 and 2), and therefore less complex, classifications are follows:

- Approximately 50 km from Jipujijkuei Kuespem Provincial Park
- No known aquatic SAR
- One (1) known DFO obligations
- No protected terrestrial species known within 5 km
- Freshwater at the tailrace
- Zero identified structures within 30 m of the reservoir
- Downstream adjacent to St. Albans protected watershed.

	Upper Salmon Biophysical Factors							
Criteria	Protected areas	Scheduled Salmon River	Species at Risk (Aquatic)	DFO Obligations	Protected Species (Terrestrial)	Proximity to Core Caribou Areas	Promity to Wetlands	Saltwater Intrusion Potential
Value	50 km	Unscheduled	0	1	0	26.0 km*	0.3 km	Fresh Downstream
Ranking	1	3	1	2	1	4	5	1

*Due to the AC CDC provided Upper Salmon map identifying the site to be close to a sensitive caribou area the rank was increased from a 4 to a 5

	Upper Salmon Social Factors				
Criteria	Structures within 30m of reservoir	Proximity to the built environment	Potential Public Water Supplies	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	Archaeological Potential
Value	0	37.3 km	1	46 km 43 km	High potential
Ranking	1	3	2	3	3

	Upper Salmon Environment and Social Complexity Index
Cumulative Index	2.275
Overall Ranking	2nd

Figure 4-9: Site 9 – Environmental Screening

4.9.3 *Interconnection*

The Point of Interconnection for the study was the 230kV bus at Upper Salmon. The 230kV transmission system is capable of an additional generation source of 273 MW and this limitation is a result of thermal overloading of TL 263 for an outage of TL 234.

5. Results

5.1 Pumped Storage Characteristics

Table 5-1 presents the summary of the site ranking from a Pumped Storage characteristics perspective.

Table 5-1: Site Ranking Pumped Storage Criteria

Description / Name	Bay d'Espoir	Bishop's Falls	Cat Arm	Grand Falls	Granite Canal	Hinds Lake	Paradise River	Star Lake	Upper Salmon
PSP Capacity	5	5	5	5	3	1	5	1	5
Conveyance Length / Heads	3	5	3	5	5	3	1	1	4
Pumped Storage Characteristic Index	8	10	8	10	8	4	6	2	9
Overall Ranking	6	9	5	8	4	2	3	1	7

5.2 Environmental and Social

Table 5-2 presents the summary of the site ranking from an Environmental and Social perspective.

Table 5-2: Site Ranking - Environmental and Social Criteria

Description / Name	Weight	Bay d'Espoir	Bishop's Falls	Cat Arm	Grand Falls	Granite Canal	Hinds Lake	Paradise River	Star Lake	Upper Salmon
Protected areas	7.5	5	4	4	2	1	4	3	5	1
Scheduled Salmon River	7.5	1	5	1	5	3	3	1	5	3
Species at Risk (Aquatic)	7.5	2	2	4	1	1	1	5	1	1
DFO Obligations	7.5	1	4	2	5	3	2	1	1	2
Protected Species (Terrestrial)	7.5	1	2	1	5	1	2	1	3	1
Proximity to Core Caribou Areas	7.5	5	4	4	3	4	4	1	5	3
Promity to Wetlands	7.5	4	5	2	5	5	4	1	5	5
Saltwater Intrusion Potential	10	3	1	5	1	1	1	5	1	1
Structures within 30m of reservoir	7.5	1	5	1	1	1	2	1	1	1
Proximity to the built environment	7.5	4	5	4	5	1	4	3	3	3

Description / Name	Weight	Bay d'Espoir	Bishop's Falls	Cat Arm	Grand Falls	Granite Canal	Hinds Lake	Paradise River	Star Lake	Upper Salmon
Potential Public Water Supplies	7.5	2	1	1	1	2	4	1	1	2
Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	7.5	5	4	2	4	2	3	3	2	3
Archaeological Potential	7.5	3	5	3	5	3	3	3	3	3
Environmental and Social Complexity Index		**2.85**	**3.55**	**2.675**	**3.25**	**2.125**	**2.8**	**2.3**	**2.725**	**2.2**
Overall Ranking		7th	9th	4th	8th	1st	6th	3rd	5th	2nd

5.3 Interconnection

Table 5-3 presents the summary of the site ranking from an Interconnection perspective.

Table 5-3: Site Ranking – Interconnection Criteria

Description / Name	Bay d'Espoir	Bishop's Falls	Cat Arm	Grand Falls	Granite Canal	Hinds Lake	Paradise River	Star Lake	Upper Salmon
Available Transmission	1	4	5	4	1	4	5	5	1
Voltage	1	4	1	1	1	3	5	4	1
Interconnection Index	**2**	**8**	**6**	**5**	**2**	**7**	**10**	**9**	**2**
Overall Ranking	1,2,3	7	5	4	1,2,3	6	9	8	1,2,3

6. Pugh Analysis Results

6.1 Pugh Analysis Criteria Weighting

Table 6.1 presents the relative weighting of the assessment criteria used in the Pugh Analysis. Site characteristics was assigned an overall 50 % weighting and then further subdivided into criteria assessing the potential PSP Capacity and an assessment of the site conveyance length / head (L/H) at 35 % and 15 % respectively. Environmental and Social was assigned a 35 % and Interconnection a 15 % weighting. These weighting are subjective and can be adjusted to assess the sensitivity of the results to the criteria weighting.

Table 6-1: Pugh Analysis Criteria Weighting

A	Site Characteristics	50%
A.1	PSP Capacity	35.0%
A.2	Conveyance Length / Heads	15.0%
B	**Environmental and Social**	**35%**
B.1	Protected areas	2.6%
B.2	Scheduled Salmon River	2.6%
B.3	Species at Risk (Aquatic)	2.6%
B.4	DFO Obligations	2.6%
B.5	Protected Species (Terrestrial)	2.6%
B.6	Proximity to Core Caribou Areas	2.6%
B.7	Proximity to Wetlands	2.6%
B.8	Saltwater Intrusion Potential	3.5%
B.9	Structures within 30m of reservoir	2.6%
B.10	Proximity to the built environment	2.6%
B.11	Potential Public Water Supplies	2.6%
B.12	Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	2.6%
B.13	Archaeological Potential	2.6%
C	**Interconnection**	**15%**
C.1	Available Transmission	10.0%
C.2	Voltage	5.0%

6.2 Pugh Analysis Values

Sites 1, 2, 3 and 7 (Bay d'Espoir, Bishop's Falls, Cat Arm and Paradise River) have been excluded due to the tailwater being the Atlantic Ocean and therefore are not deem viable, irrespective of the Pugh Analysis results. The details (weighting and scoring) of remaining potential sites are presented in Table 6.2.

Table 6-2: Potential Site Scoring

Evaluation Criteria	Weighting	Site 4		Site 5		Site 6		Site 8		Site 9	
		Grand Falls		Granite Lake		Hinds Lake		Star Lake		Upper Salmon	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Site Characteristics	**50%**										
PSP Capacity	35.0%	5	1.75	1	0.35	1	0.35	1	0.35	4	1.4
Conveyance Length / Heads	15.0%	2	0.3	2	0.3	3	0.45	5	0.75	4	0.6
Environmental and Social	**35%**										
Protected areas	2.6%	2	0.053	1	0.0263	4	0.11	5	0.1313	1	0.0263
Scheduled Salmon River	2.6%	5	0.131	3	0.0788	3	0.08	5	0.1313	3	0.0788
Species at Risk (Aquatic)	2.6%	1	0.026	1	0.0263	1	0.03	1	0.0263	1	0.0263
DFO Obligations	2.6%	5	0.131	3	0.0788	2	0.05	1	0.0263	2	0.0525
Protected Species (Terrestrial)	2.6%	5	0.131	1	0.0263	2	0.05	3	0.0788	1	0.0263
Proximity to Core Caribou Areas	2.6%	3	0.079	4	0.1050	4	0.11	5	0.1313	3	0.0788
Promity to Wetlands	2.6%	5	0.131	5	0.1313	4	0.11	5	0.1313	5	0.1313
Saltwater Intrusion Potential	3.5%	1	0.035	1	0.0350	1	0.04	1	0.0350	1	0.0350
Structures within 30m of reservoir	2.6%	1	0.026	1	0.0263	2	0.05	1	0.0263	1	0.0263
Proximity to the built environment	2.6%	5	0.131	1	0.0263	4	0.11	3	0.0788	3	0.0788
Potential Public Water Supplies	2.6%	1	0.026	2	0.0525	4	0.11	1	0.0263	2	0.0525
Proximity to First Nations, and Legislated Boundaries of Aboriginal lands	2.6%	4	0.105	2	0.0525	3	0.08	2	0.0525	3	0.0788
Archaeological Potential	2.6%	5	0.131	3	0.0788	3	0.08	3	0.0788	3	0.0788
Interconnection	**15%**										
Available Transmission	10.0%	4	0.4	1	0.1	4	0.4	5	0.5	1	0.1
Voltage	5.0%	1	0.05	1	0.05	3	0.15	4	0.2	1	0.05
		3.6375		1.54375		2.33		2.75375		2.92	
		5		1		2		3		4	
Energy Stoage Potential (MWh)		0		6838		97317		65609		735	

6.3 Pugh Results Summary

Summary of site suitability ranking is presented in Figure 6-3. Note the Pugh Analysis has been undertaken with the lowest number (cumulative of weighting x scoring) representing the best site.

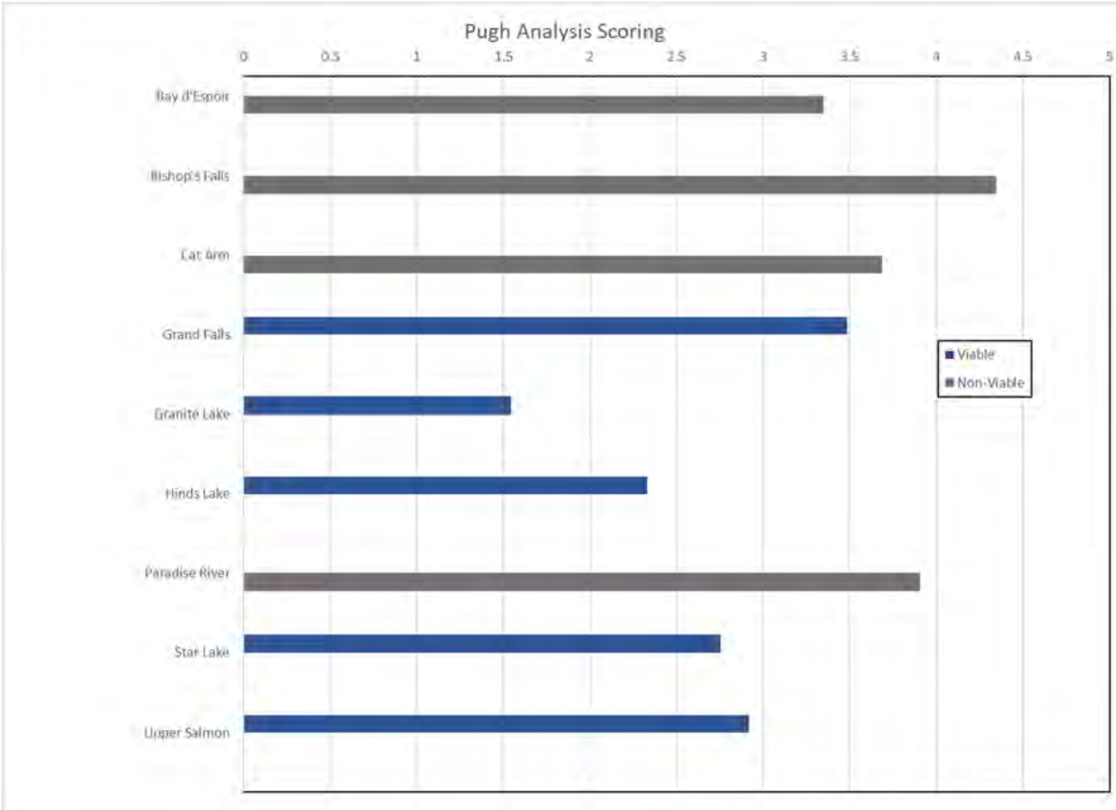


Figure 6-1: Pugh Analysis Results Summary

Based on the Pugh Analysis undertaken the Granite Lake, Hinds Lake, and Star Lake sites rank highest and appear to be the best candidates from the existing sites for potential pumped hydro development. Viability in this chart is dictated by if the tailwater is ocean (not viable) or freshwater (viable).

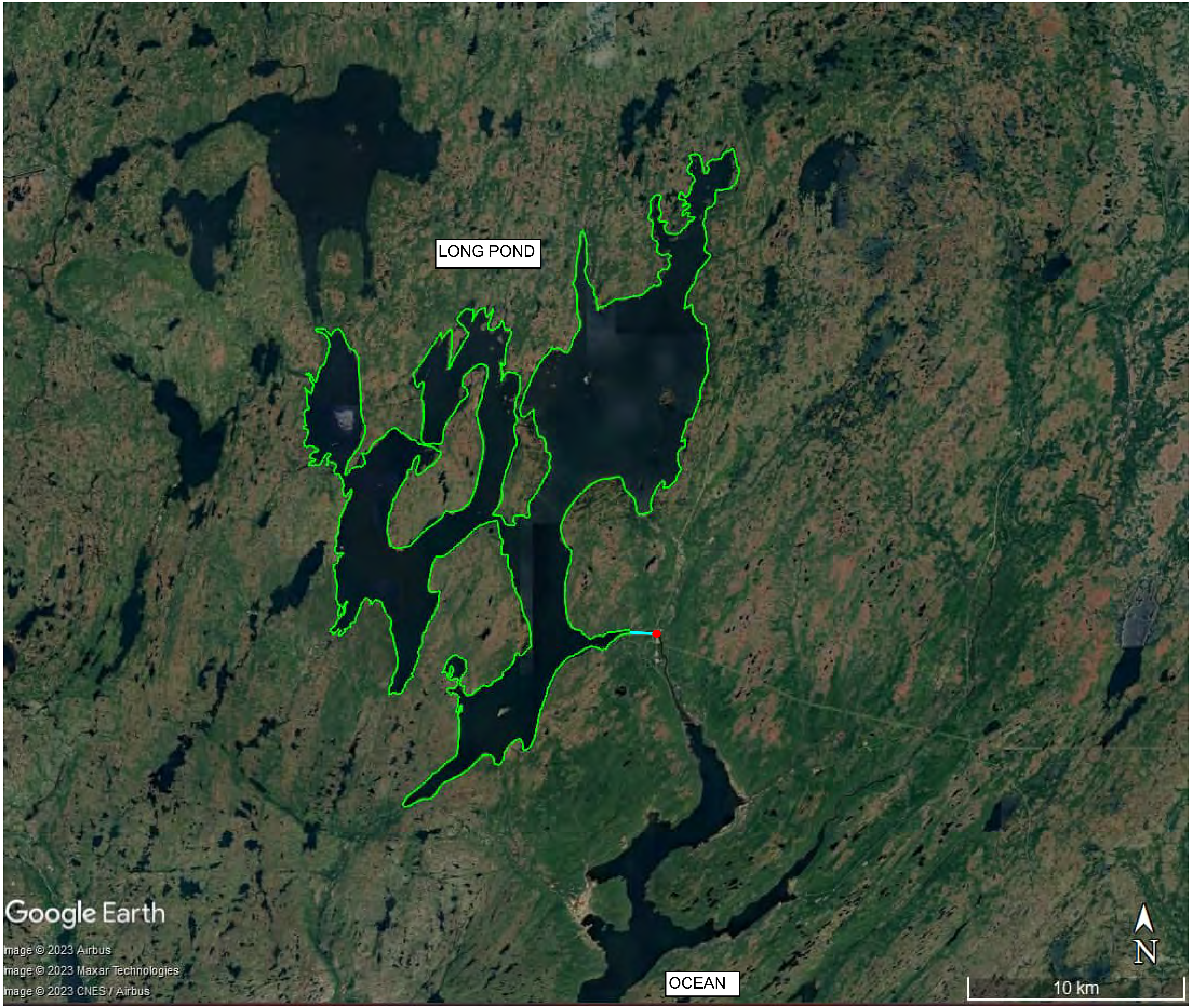
7. Conclusions

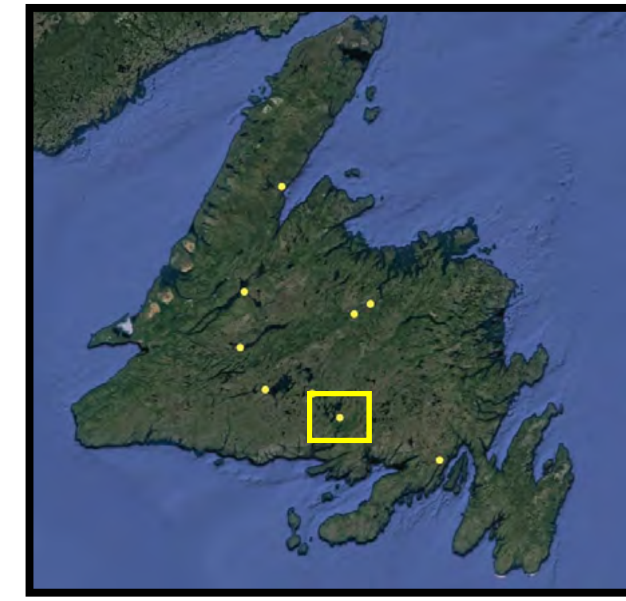
Based on the screening analysis of the nine (9) potential sites proposed by NL Hydro the following conclusions can be drawn.

1. Four (4) sites have the Atlantic Ocean as the tailwater reservoir and therefore are not suitable for Pumped Storage Projects.
2. The type and settings of the existing turbines at all nine (9) facilities make them not suitable for use as pumping equipment and therefore all sites would require at least some new equipment to make a project viable.
3. The Hinds Lake site ranks highest based purely on the Pumped Storage Criteria.
4. The Granite Lake site ranks highest based purely on the Environmental and Social Criteria.
5. The Granite Lake, Upper Salmon, and Bay d'Espoir sites all ranked equally and highest based purely on the Interconnection Criteria.

The Granite Lake, Hinds Lake, and Star Lake sites rank highest based on the assumed weighting in the Pugh Analysis and therefore offer the best potential of the nine (9) sites to further evaluate / investigate Pumped Storage development.

Attachment 1
Site Capacity Maps





LEGEND

- RESERVOIR OUTLINE
- PENSTOCK
- POWER HOUSE

UPPER RESERVOIR: LONG POND
Available Storage: 781 Mm3
Max Operational Level: 182.7 m
Area: 178 km2

LOWER RESERVOIR: OCEAN

POWERHOUSE
Units: 7
Type: Francis
Plant: 613.5 MW
Head: 176 m

PENSTOCK
Length: 1129 m
Diam: 5.2 - 4.1 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL).

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY		
SITE ARRANGEMENT BAY D'ESPOIR		
DATE: 2023-10-20	FIGURE 1	

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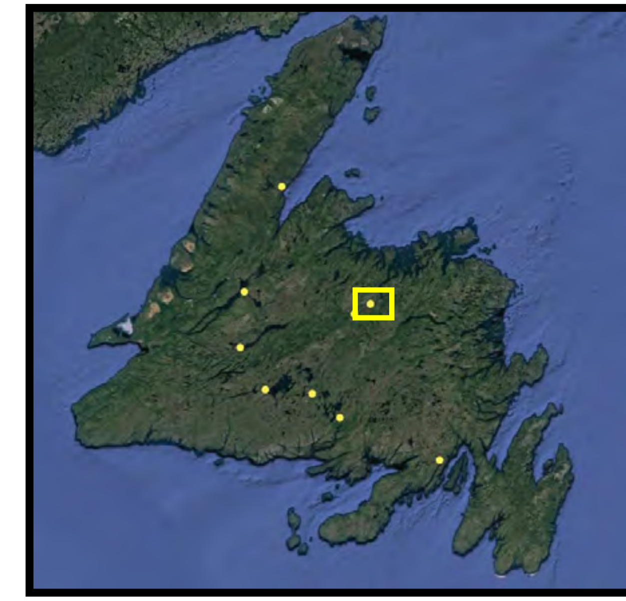


LEGEND

ELEVATION PROFILE PATH
PENSTOCK
POWER HOUSE

UPPER RESERVOIR: N/A

LOWER RESERVOIR: OCEAN

POWERHOUSE
Units: 9
Type: Francis
Plant: 22 MW

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

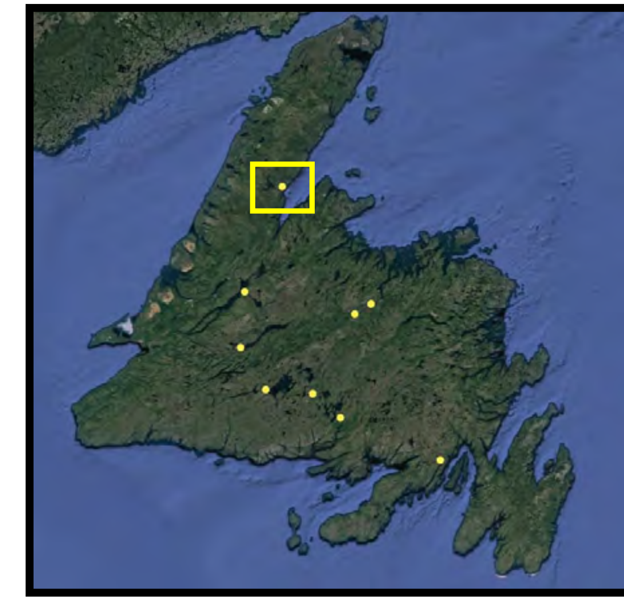
HATCH | HATCH DOCUMENT NUMBER: | REV. 0

NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

SITE ARRANGEMENT
BISHOPS FALLS

DATE: 2023-10-20 | FIGURE 1

H371390-0000-200-230-0001-AP0A, Page 2 of 9



LEGEND

- RESERVOIR BOUNDARY
- PENSTOCK
- POWER HOUSE

UPPER RESERVOIR: CAT ARM RESEVOIR
Available Storage: 393 Mm3
Max Operational Level: 393.2 m
Area: 60.2 km2

LOWER RESERVOIR: OCEAN

POWERHOUSE
Units: 2
Type: Pelton
Plant: 134 MW
Head: 380.5 m

PENSTOCK
Length: 2900 m
Diam: 5.7 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY		
SITE ARRANGEMENT CAT ARM		
DATE: 2023-10-20	FIGURE 1	

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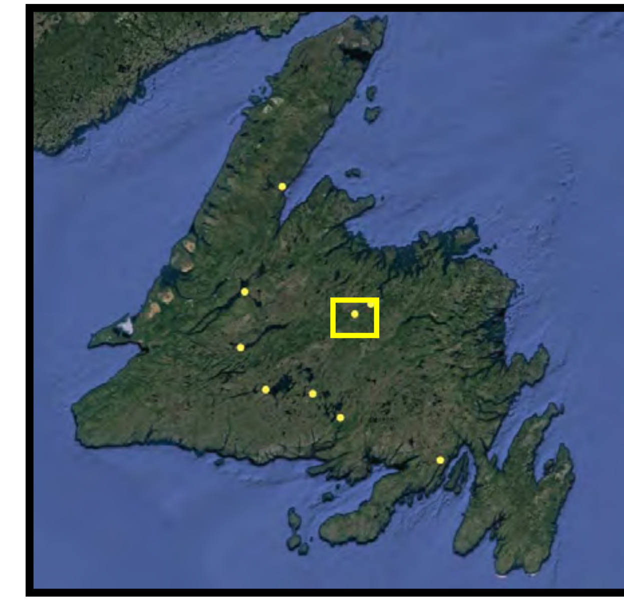


LEGEND

ELEVATION PROFILE PATH
PENSTOCK
POWER HOUSE

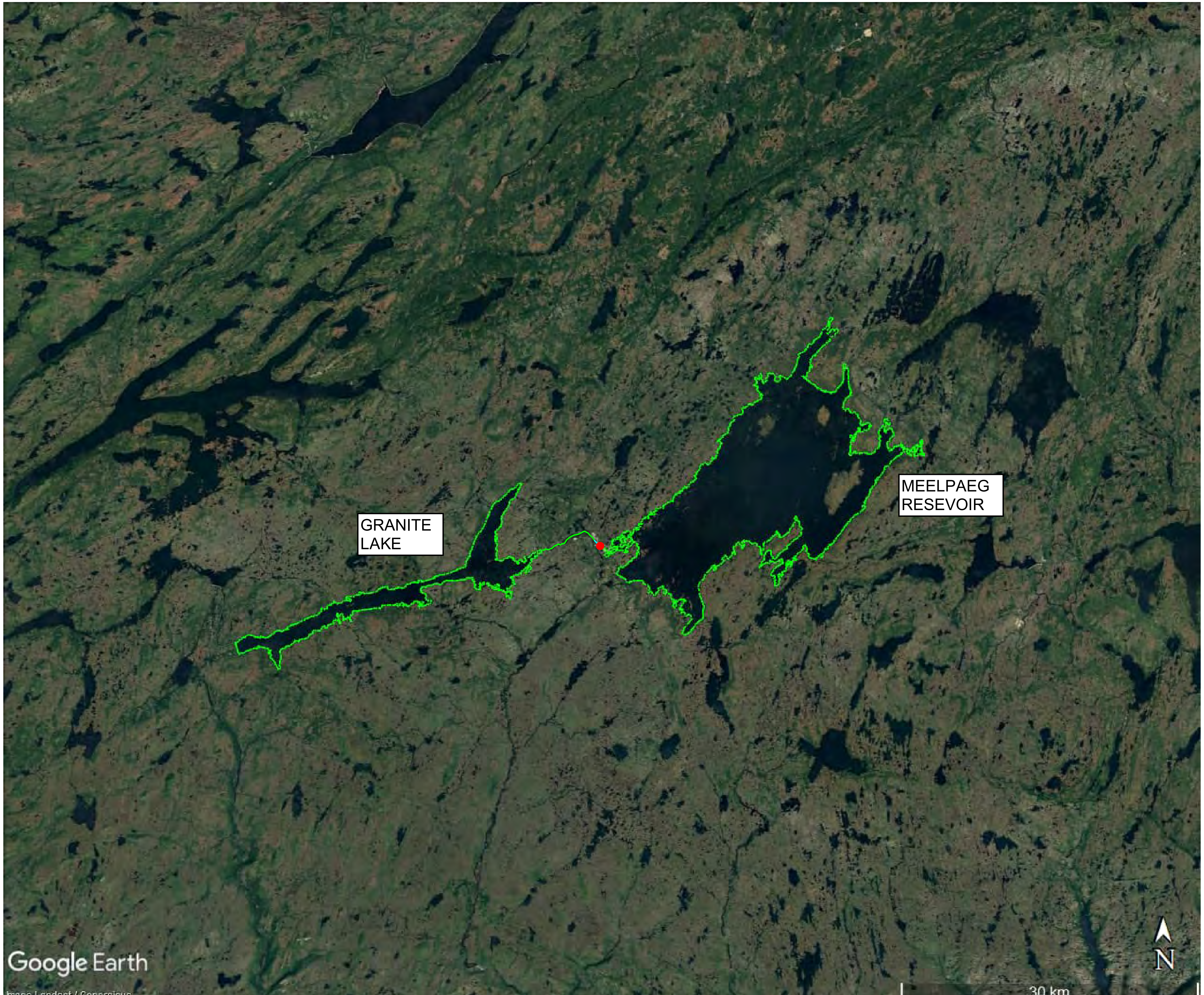
UPPER RESERVOIR: N/A

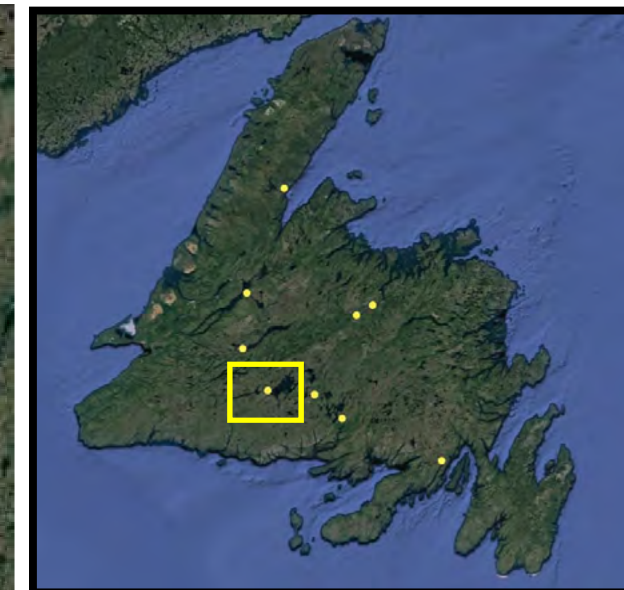
LOWER RESERVOIR: N/A

POWERHOUSE
Units: 2
Type: Francis
Plant:75 MW

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL).

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY SITE ARRANGEMENT GRAND FALLS		
DATE: 2023-10-20	FIGURE 1	





LEGEND

RESERVOIR BOUNDARY
POWER HOUSE

UPPER RESERVOIR: LONG LAKE
Available Storage: 75 Mm3
Max Operational Level: 313 m
Area: 65 km2

LOWER RESERVOIR: MEELPAEG RESERVOIR
Available Storage: 2080 Mm3
Min Operational Level: 367 m
Area: 309 km2

POWERHOUSE
Units: 1
Type: Kaplan
Plant: 40 MW
Head: 38.82 m

PENSTOCK
Length: 1923 m
Diam: 5.7 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY		
SITE ARRANGEMENT GRANITE LAKE		
DATE: 2023-10-20	FIGURE 1	

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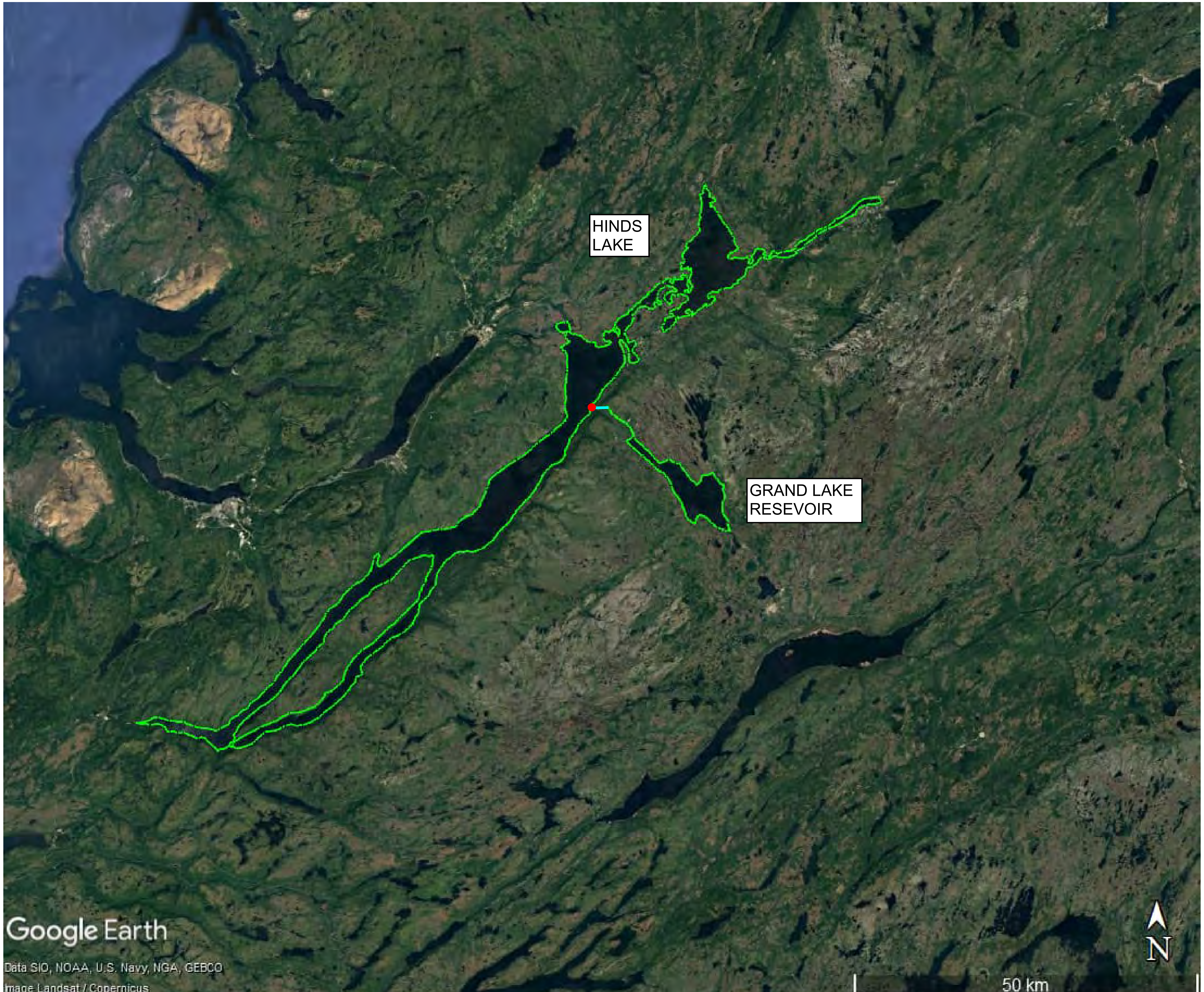
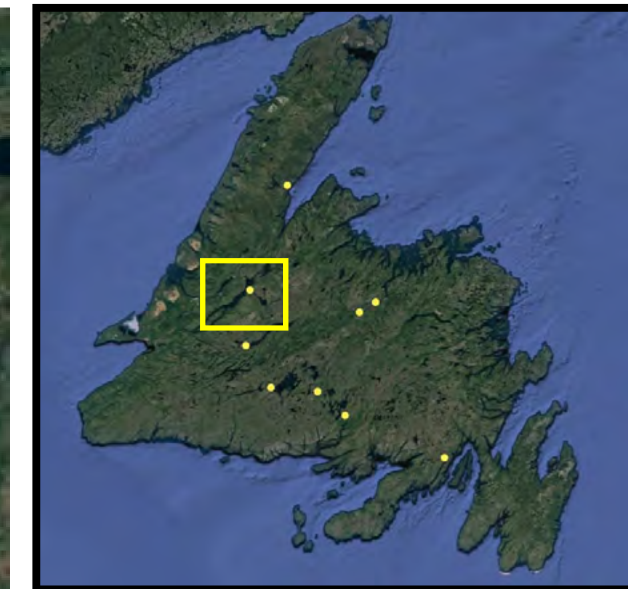




LEGEND

- RESERVOIR BOUNDARY
- PENSTOCK
- POWER HOUSE

UPPER RESERVOIR: HINDS LAKE
Available Storage: 199 Mm3
Max Operational Level: 311 m
Area: 498 km2

LOWER RESERVOIR: GRAND LAKE RESERVOIR
Available Storage: 216 Mm3
Min Operational Level: 85 m (assumed)
Area: 54 km2

POWERHOUSE
Units: 1
Type: Francis
Plant: 75 MW
Head: 214 m

PENSTOCK
Length: 1419 m
Diam: 4.55 m

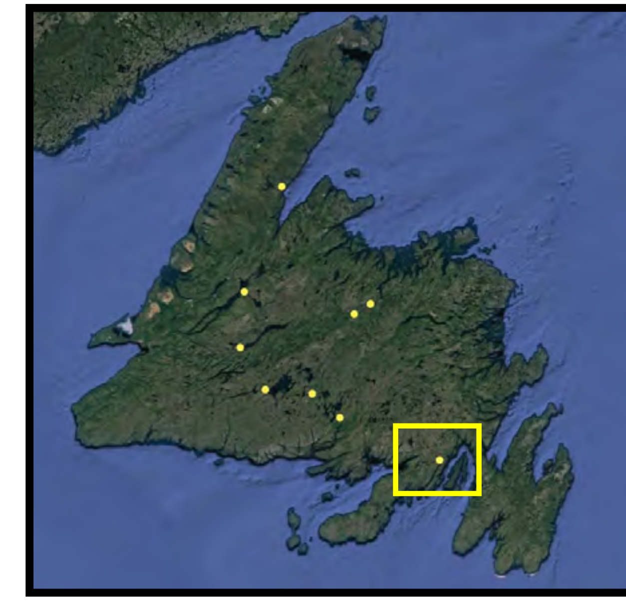
All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH | HATCH DOCUMENT NUMBER: | REV. 0

NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

SITE ARRANGEMENT
HINDS LAKE

DATE: 2023-10-20 | FIGURE 1



LEGEND

RESERVOIR BOUNDARY
PENSTOCK
POWER HOUSE

UPPER RESERVOIR: PARADISE RIVER Available Storage: 2.32 Mm3
Max Operational Level: 35 m (assumed)
Area: 0.58 km2

LOWER RESERVOIR: OCEAN

POWERHOUSE
Units: 1
Type: Francis
Plant: 8.1 MW
Head: 37.5 m

PENSTOCK
Length: 35.88 m
Diameter: 7 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL).

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY		
SITE ARRANGEMENT PARADISE RIVER		
DATE: 2023-10-20	FIGURE 1	

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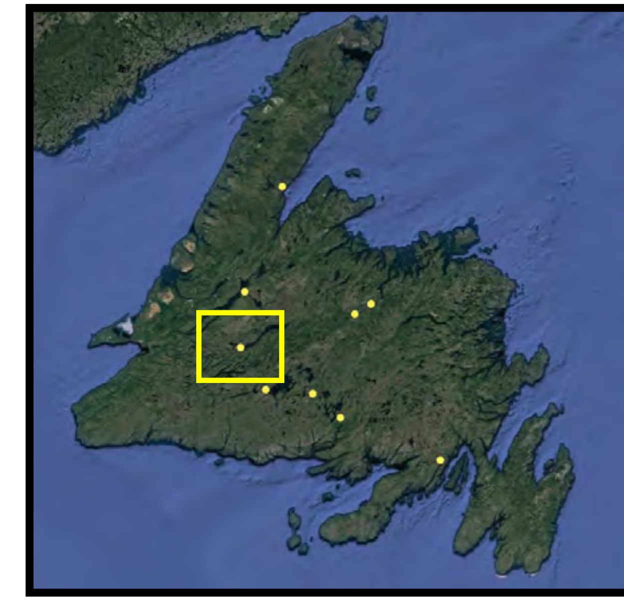

LEGEND

- RESERVOIR BOUNDARY
- PENSTOCK
- POWER HOUSE

UPPER RESERVOIR: STAR LAKE
Available Storage: 228 Mm3
Max Operational Level: 292 m
Area: 28.5 km2

LOWER RESERVOIR: BEOTHUK LAKE
Available Storage: 708
Min Operational Level: 154 m (assumed)
Area: 177 km2

POWERHOUSE
Units: 1
Type:
Plant: 18.4 MW
Head: 137 m

PENSTOCK
Length: 122 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY SITE ARRANGEMENT STAR LAKE		
DATE: 2023-10-20	FIGURE 1	

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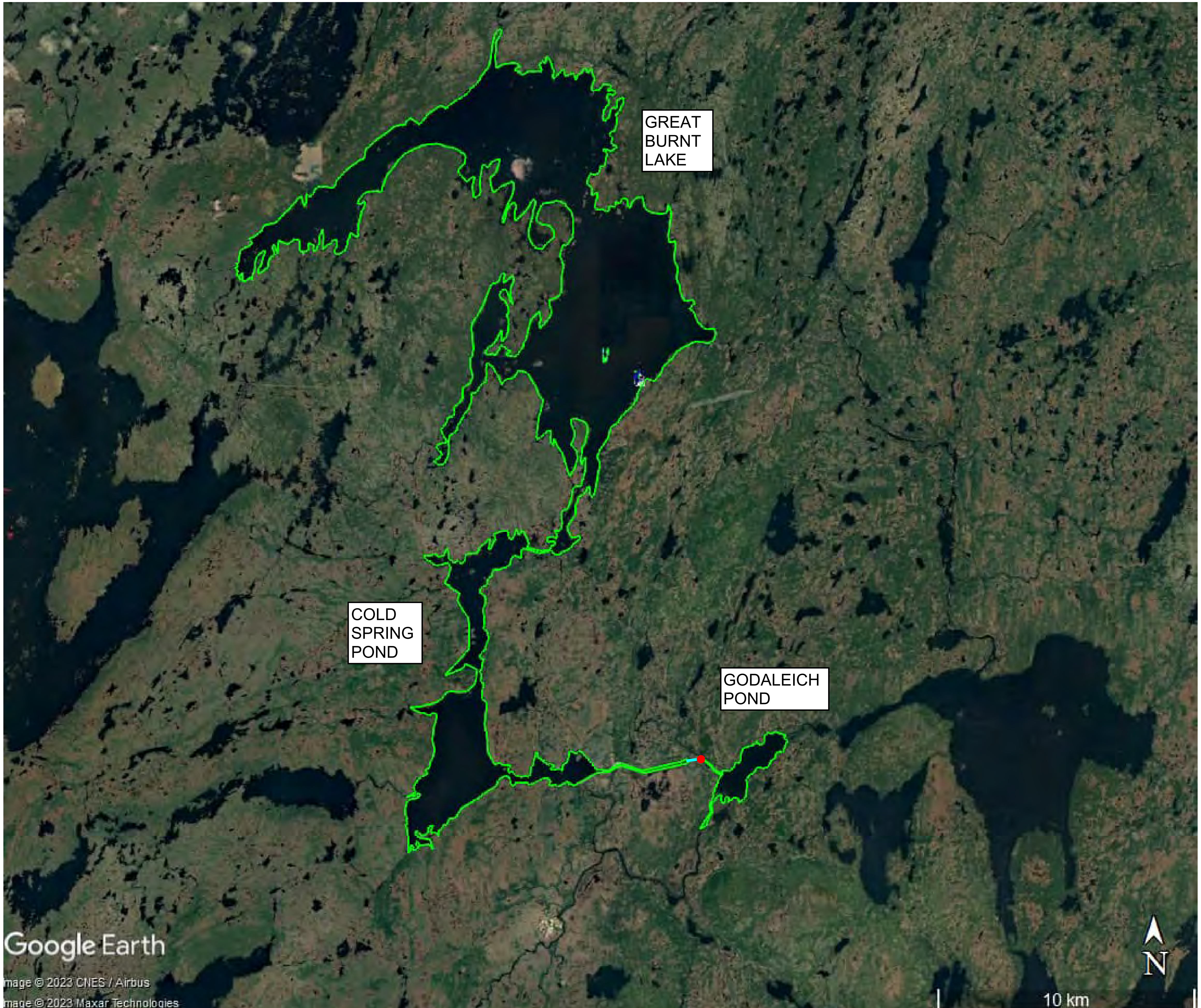
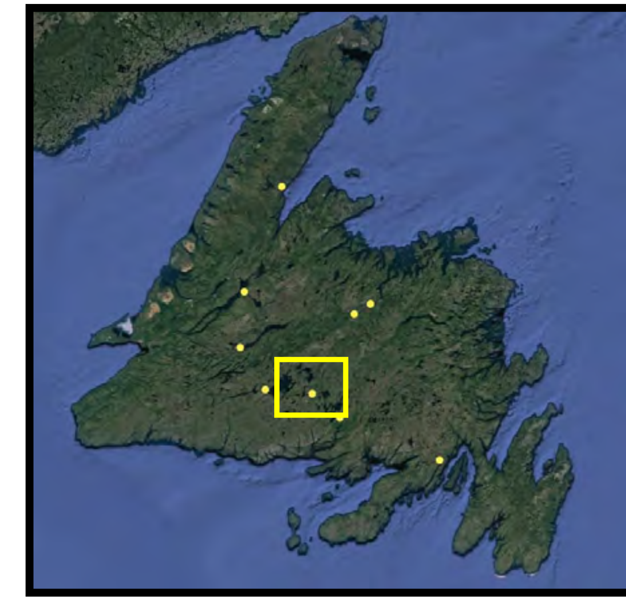




LEGEND

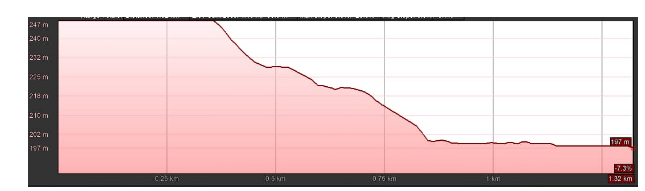
RESERVOIR BOUNDARY
PENSTOCK
POWER HOUSE

UPPER RESERVOIR: COLD SPRING POND/ GREAT BURNT LAKE
Available Storage: 57 Mm3
Max Operational Level: 247.31 m
Area: 114 km2

LOWER RESERVOIR: GODALEICH POND
Available Storage: 6.24 Mm3
Min Operational Level: 191 m (assumed)
Area: 3.12 km2

POWERHOUSE
Units: 1
Type: Francis
Plant: 84 MW
Head: 54 m

PENSTOCK
Length: 427 m



All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH | HATCH DOCUMENT NUMBER: | REV. 0

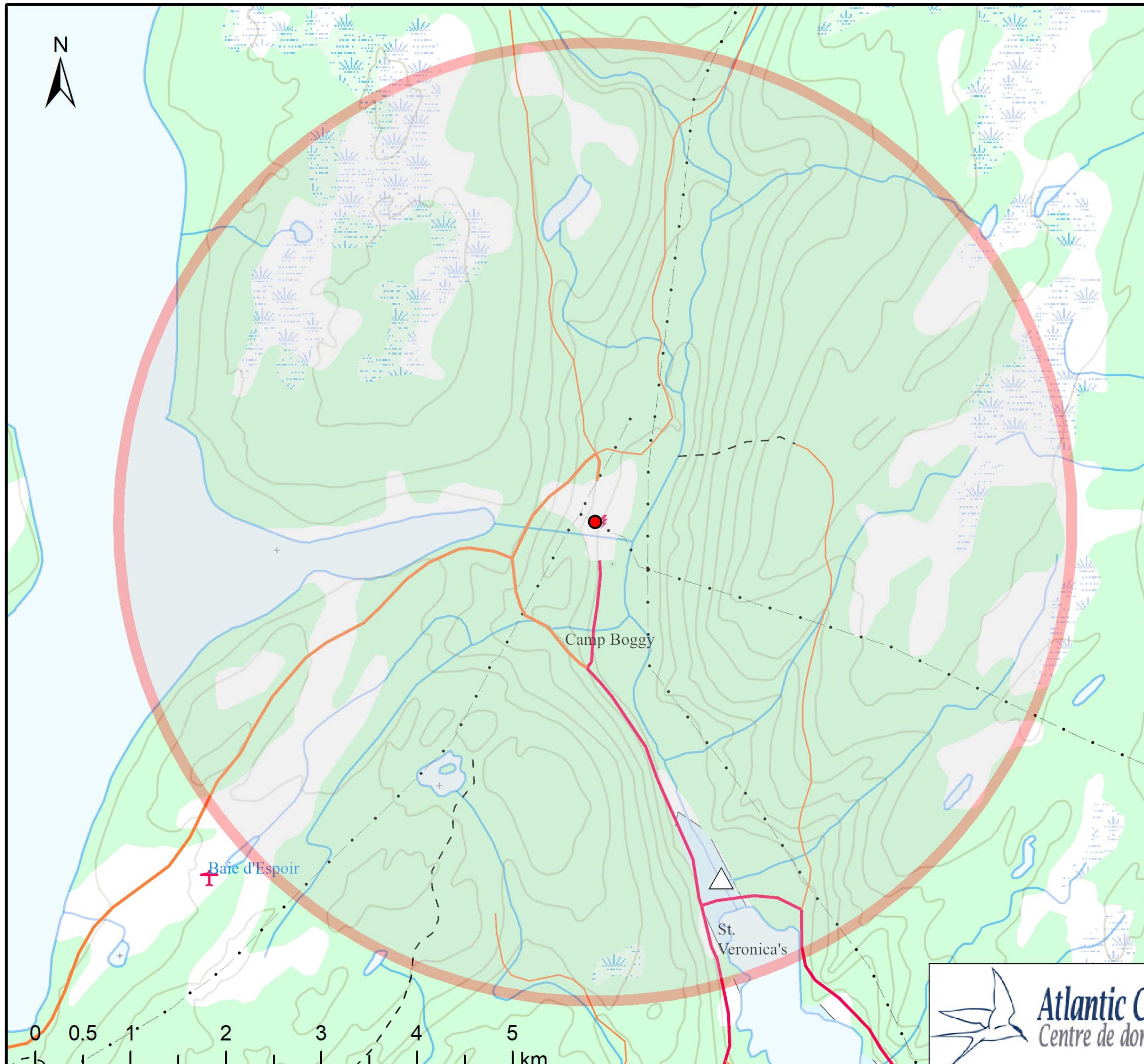
NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

SITE ARRANGEMENT
UPPER SALMON

DATE: 2023-10-20 | FIGURE 1

Attachment 2
Atlantic Canada Conservation Data Centre (AC CDC) Maps

GIS Scan of Rare and Provincially/Federally Listed Species for Point of Interest at the Bay D'Espoir Generating Facility in Newfoundland and Labrador



Legend

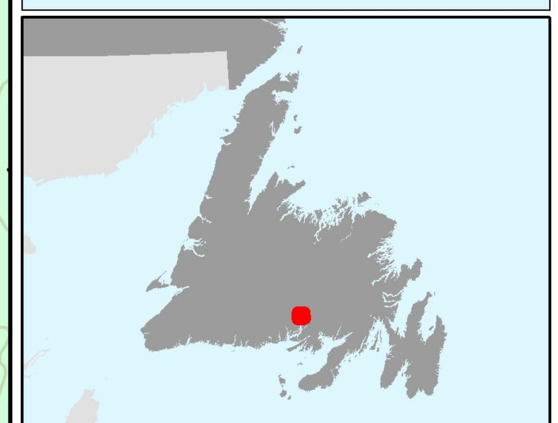
- Point of Interest (POI)
- 5 km Buffer Around POI

Rare Flora

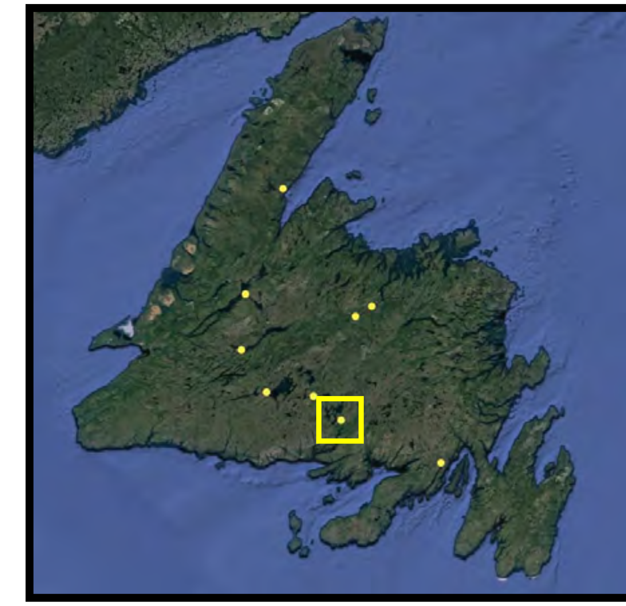
- 200m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



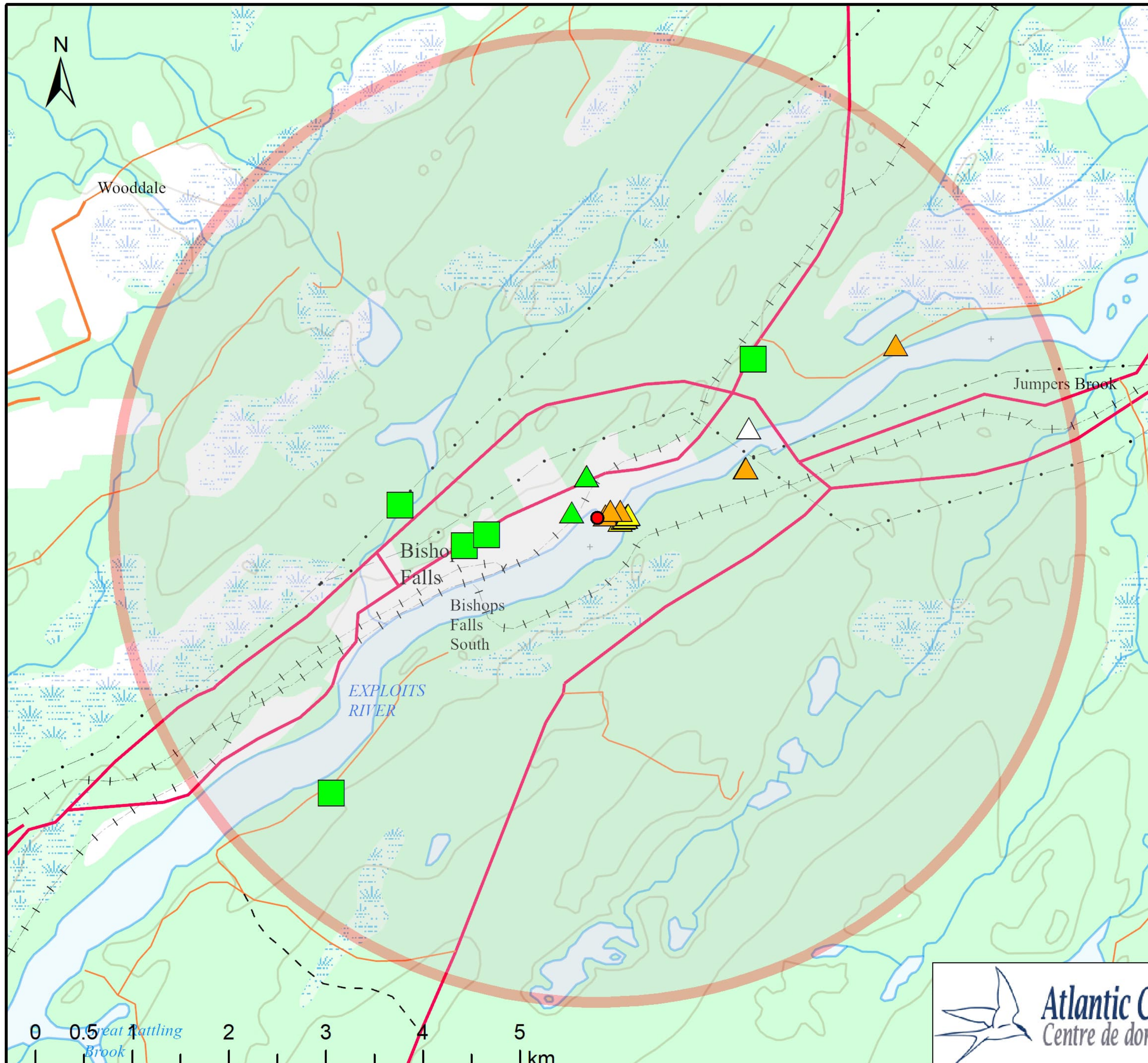
NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Bay d'Espoir.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY AC CDC Map Bay d'Espoir		
DATE: 2023-10-20	FIGURE 1	

GIS Scan of Rare and Provincially/Federally Listed Species for Bishop's Falls Point of Interest in Newfoundland and Labrador



Legend

- Point of Interest (POI)
- 5 km Buffer Around POI

Rare Fauna

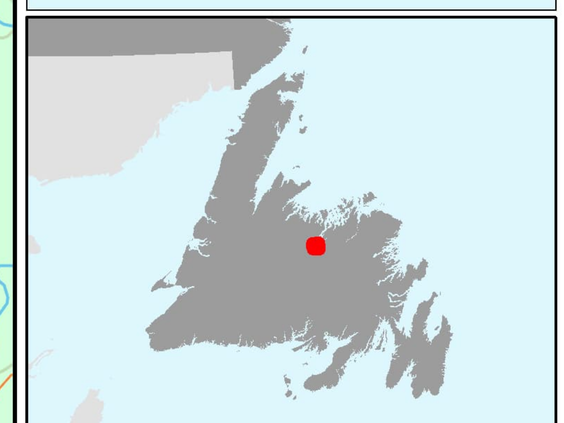
- 1000m Accuracy

Rare Flora

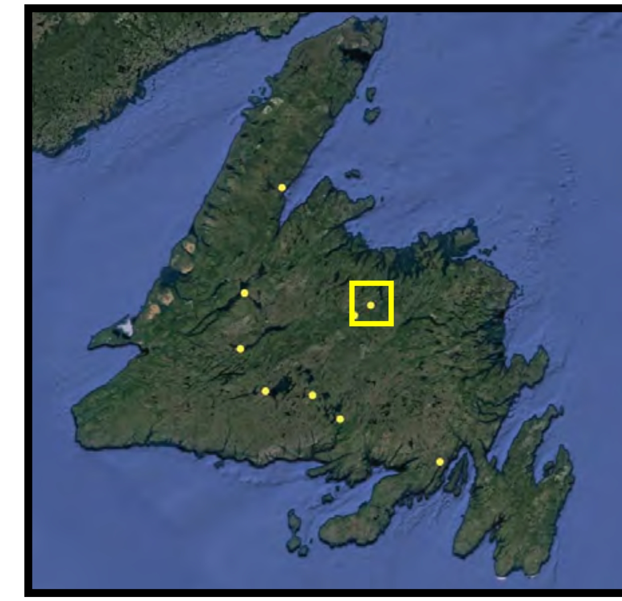
- 10m Accuracy
- 50m Accuracy
- 100m Accuracy
- 1000m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Bishop's Falls.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY		
AC CDC Map Bishop's Falls		
DATE: 2023-10-20	FIGURE 2	

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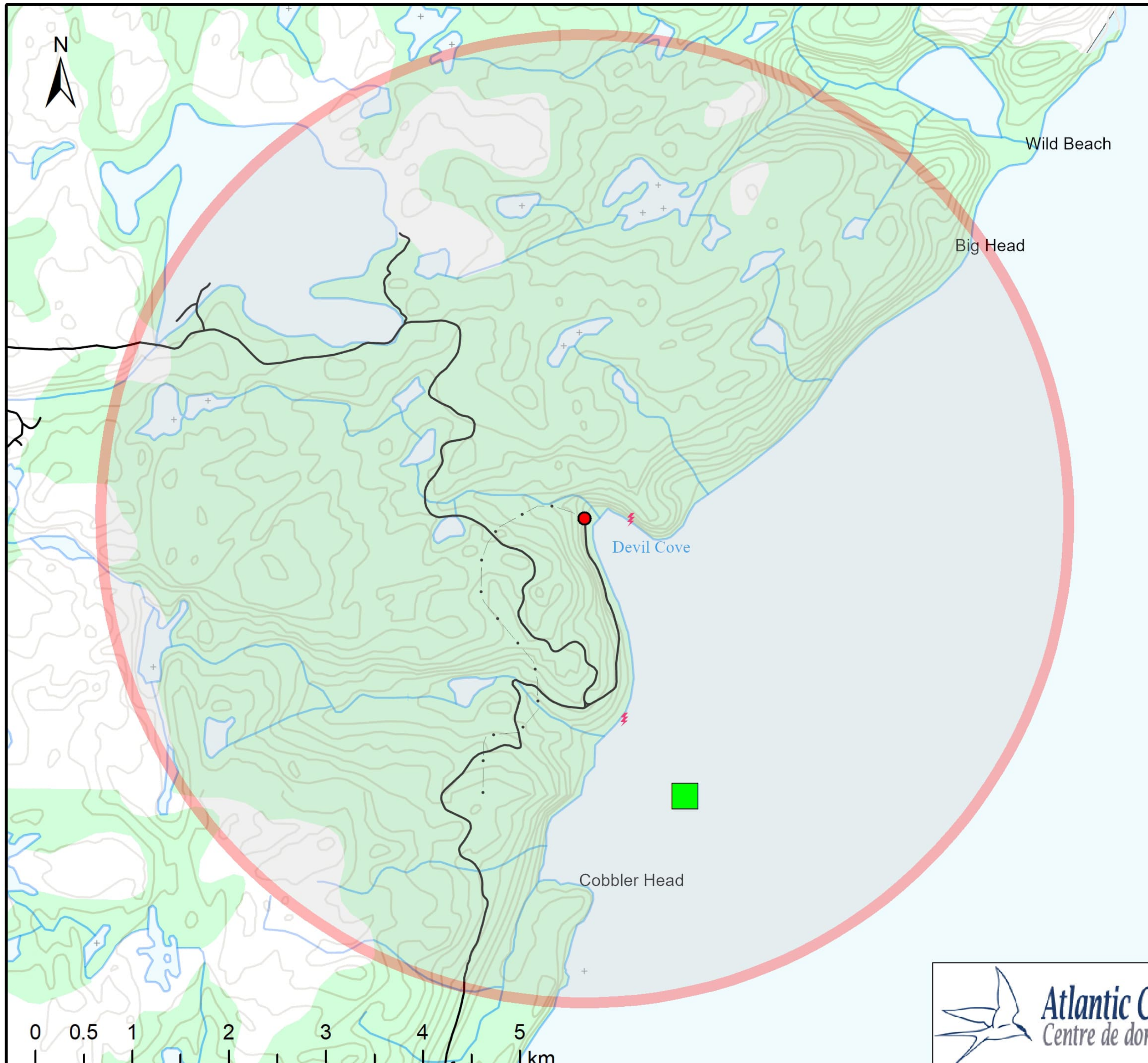
GIS Scan of Rare and Provincially/Federally Listed Species for Cat Arm Point of Interest in Newfoundland and Labrador



Legend

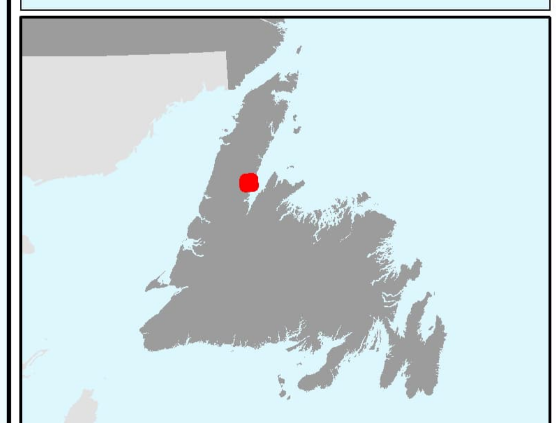
- Point of Interest (POI)
- 5 km Buffer Around POI

Rare Fauna

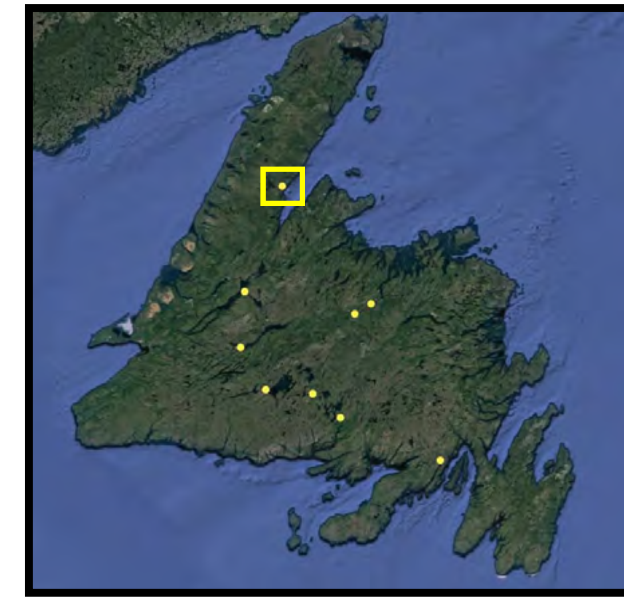
- 1000m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Cat Arm.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

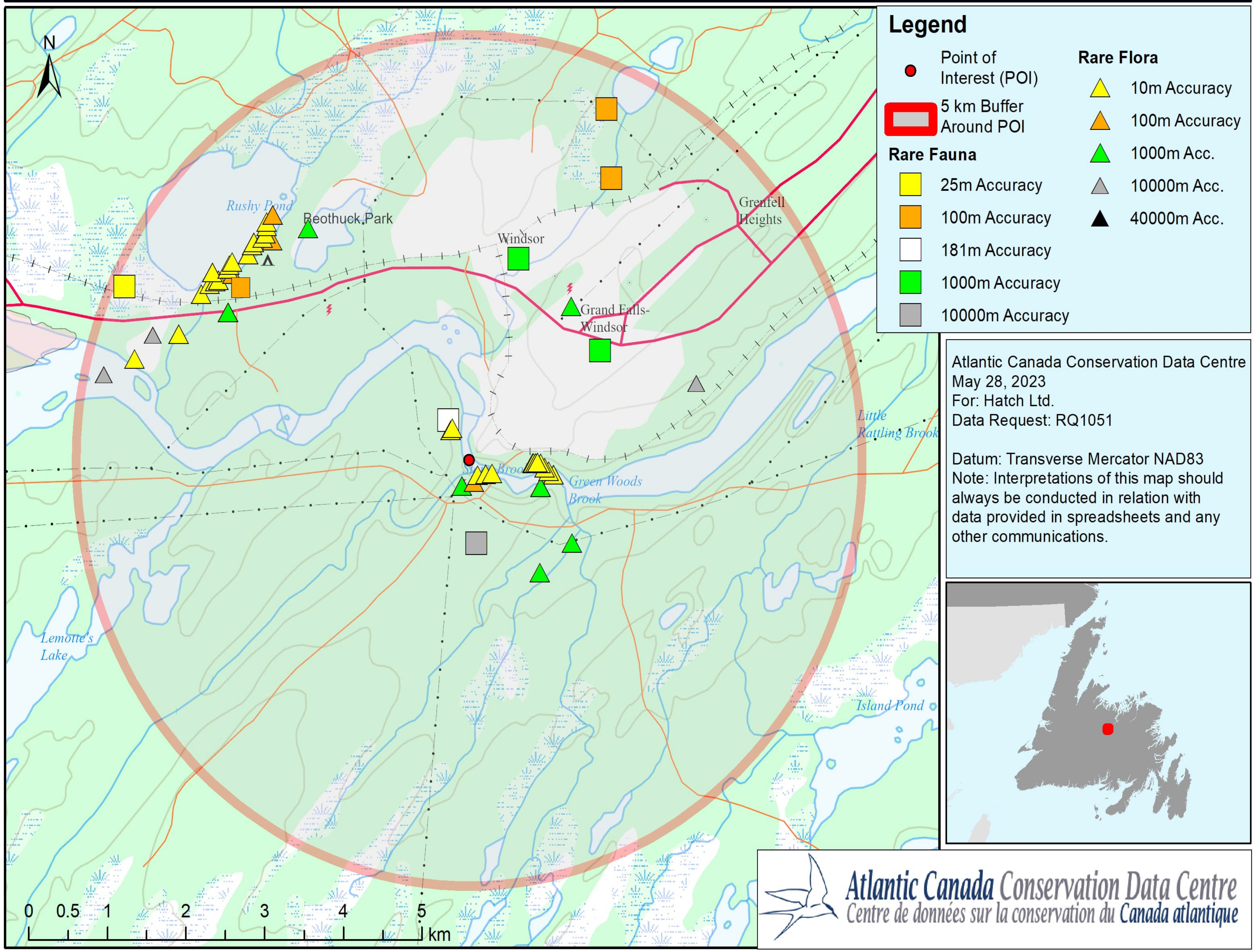
HATCH | HATCH DOCUMENT NUMBER: | REV. 0

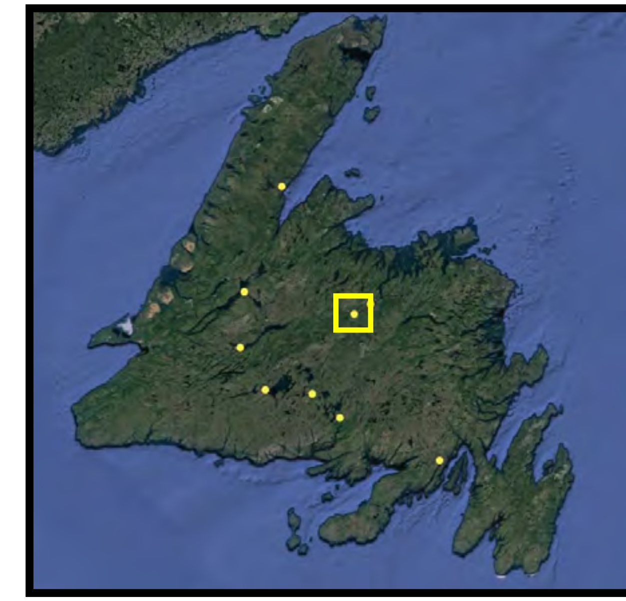
NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

AC CDC Map
Cat Arm

DATE: 2023-10-20 | FIGURE 3

GIS Scan of Rare and Provincially/Federally Listed Species for Grand Falls Point of Interest in Newfoundland and Labrador





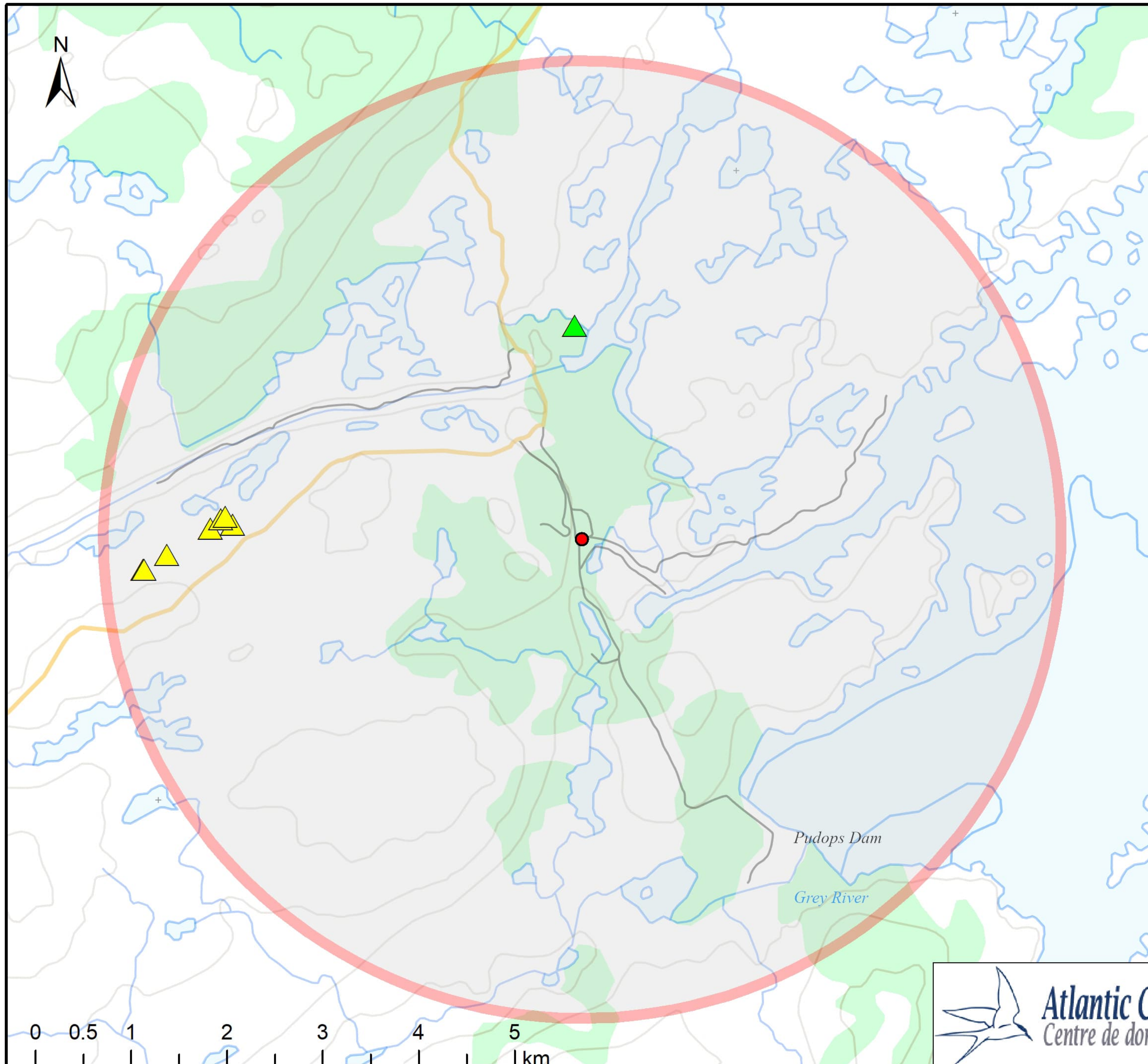
NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Grand Falls.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY AC CDC Map Grand Falls		
DATE: 2023-10-20	FIGURE 4	

GIS Scan of Rare and Provincially/Federally Listed Species for Granite Lake Point of Interest in Newfoundland and Labrador



Legend

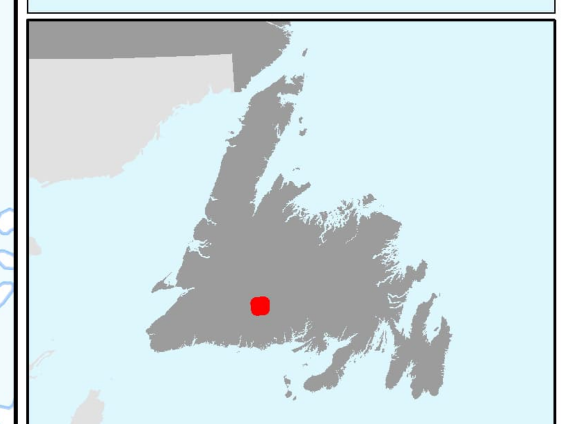
- Point of Interest (POI)
- 5 km Buffer Around POI

Rare Flora

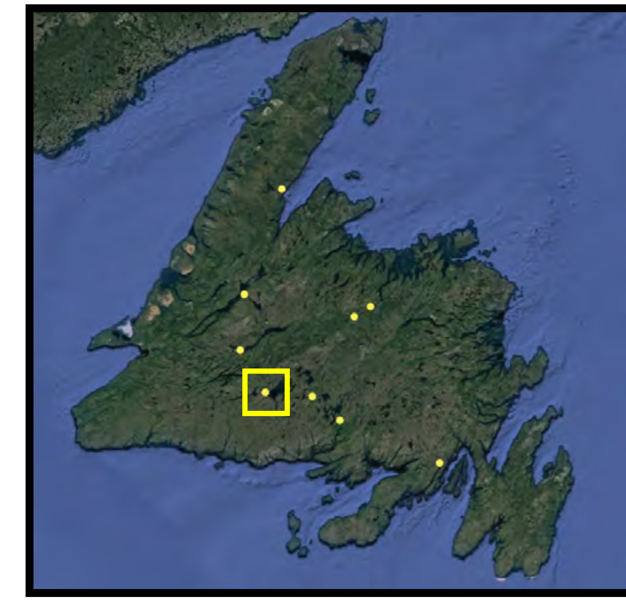
- 5m Accuracy
- 1000m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Granite Lake.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY AC CDC Map Granite Lake		
DATE: 2023-10-20	FIGURE 5	

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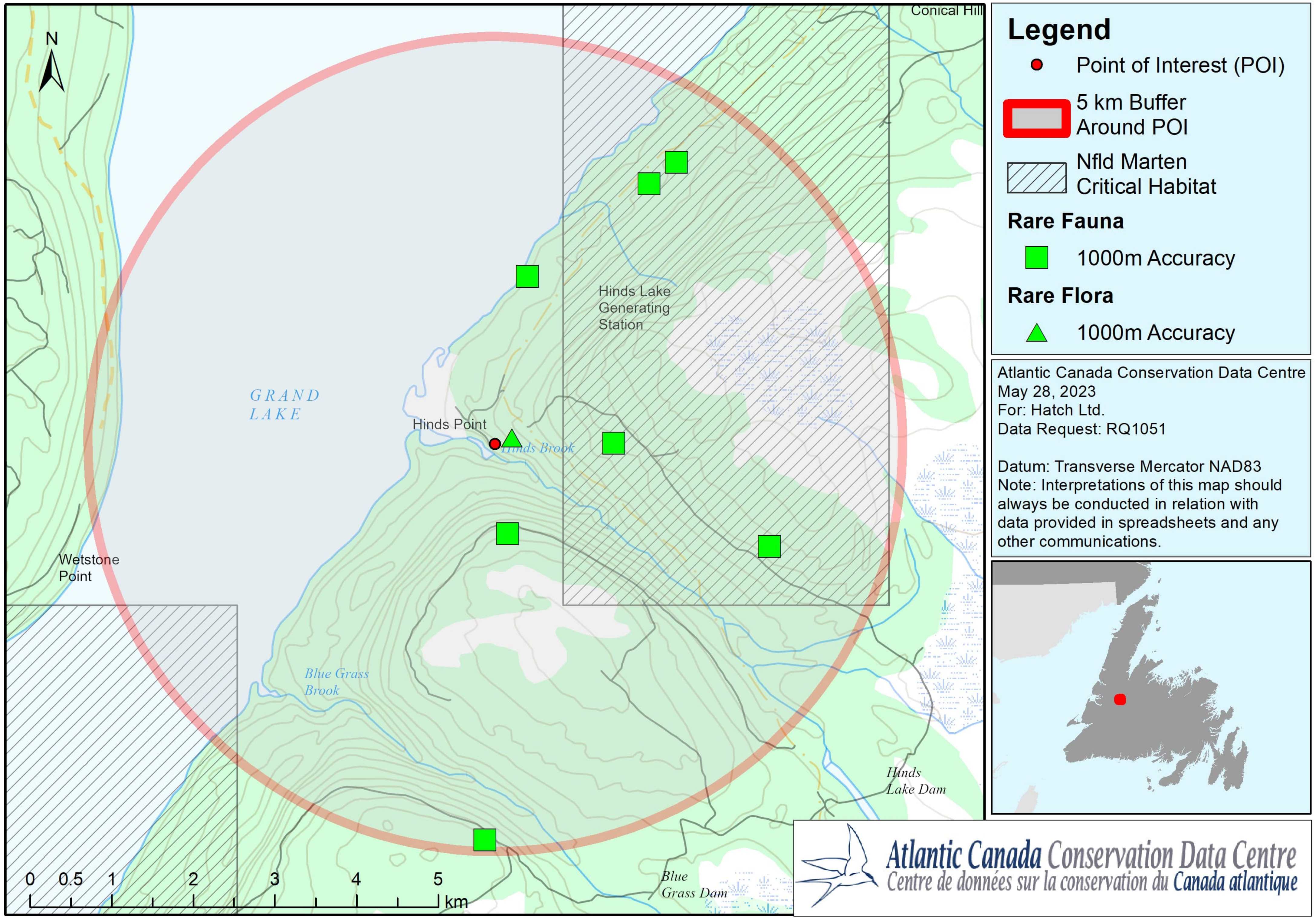
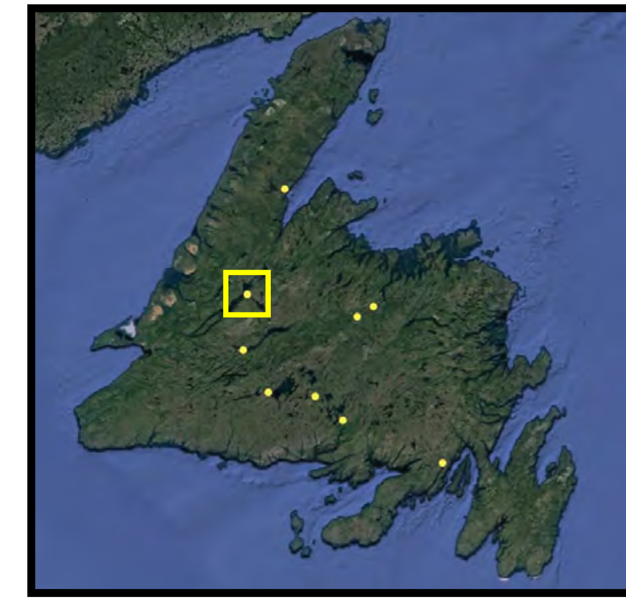
GIS Scan of Rare and Provincially/Federally Listed Species for Hinds Lake Point of Interest in Newfoundland and Labrador





NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Hinds Lake.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY AC CDC Map Hinds Lake		
DATE: 2023-10-20	FIGURE 6	

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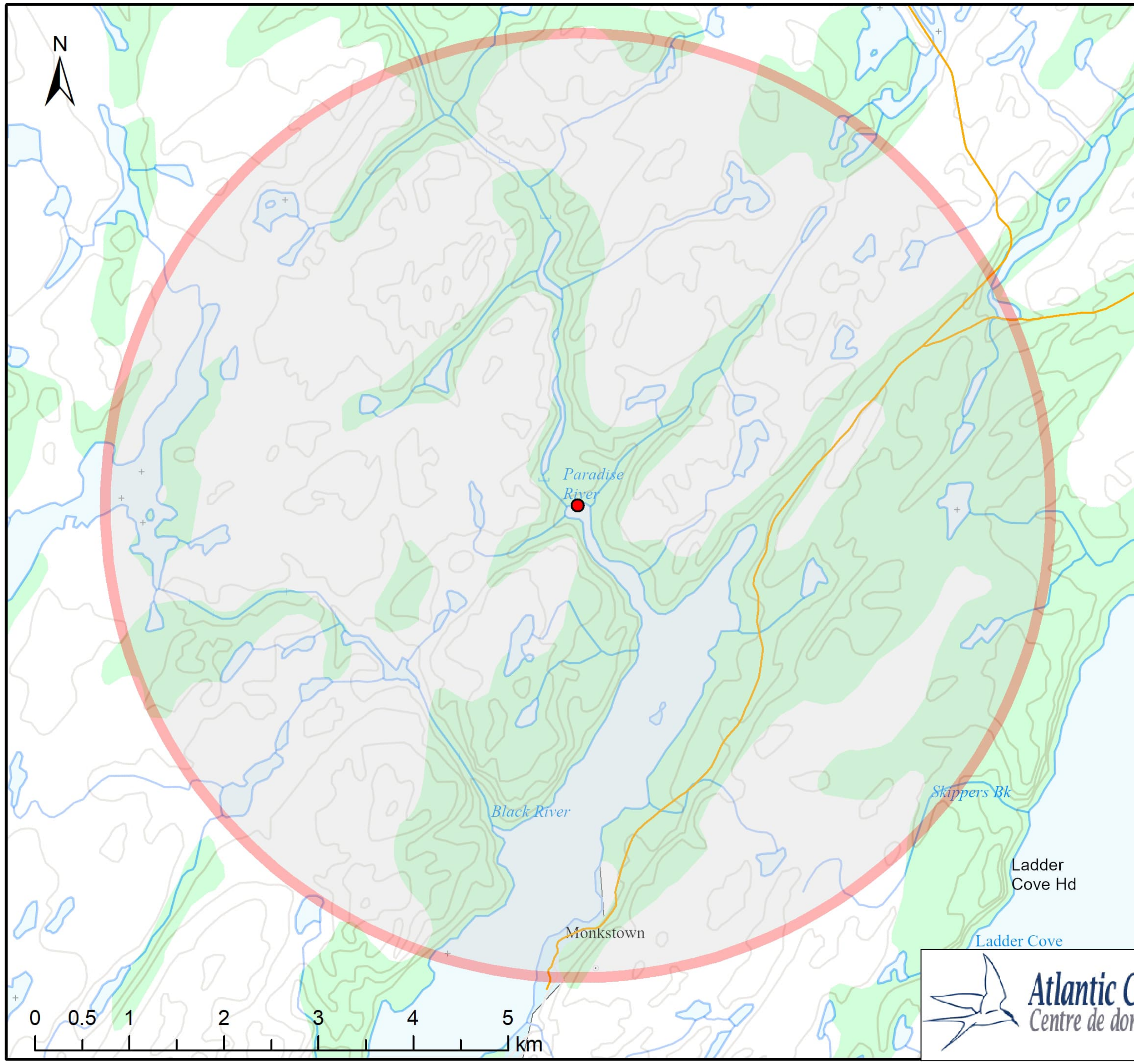
GIS Scan of Rare and Provincially/Federally Listed Species for Paradise River Point of Interest in Newfoundland and Labrador

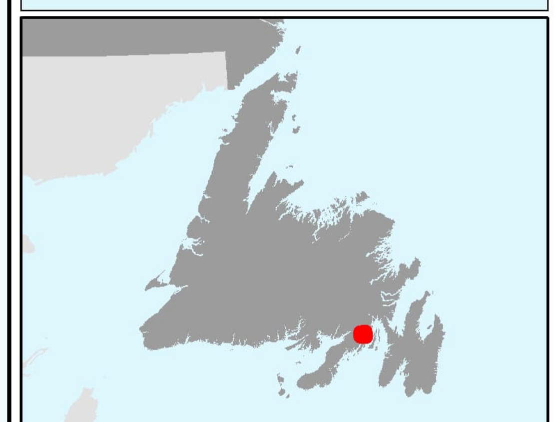


Legend

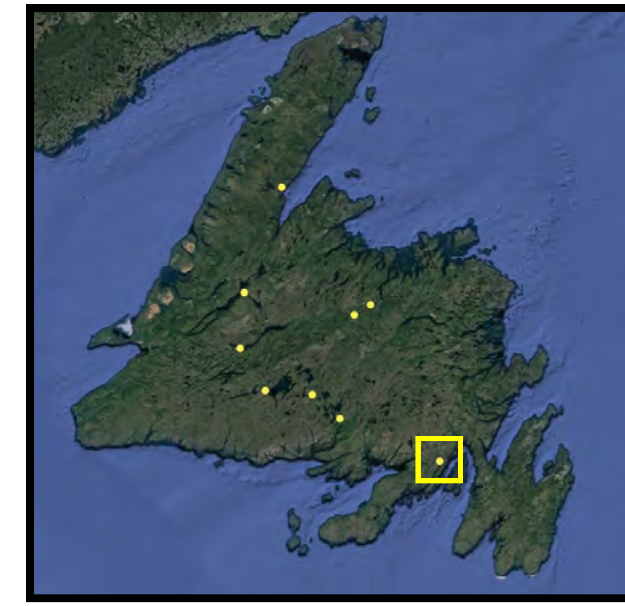
- Point of Interest (POI)
- 5 km Buffer Around POI

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Paradise River.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH

HATCH DOCUMENT NUMBER:

REV. 0

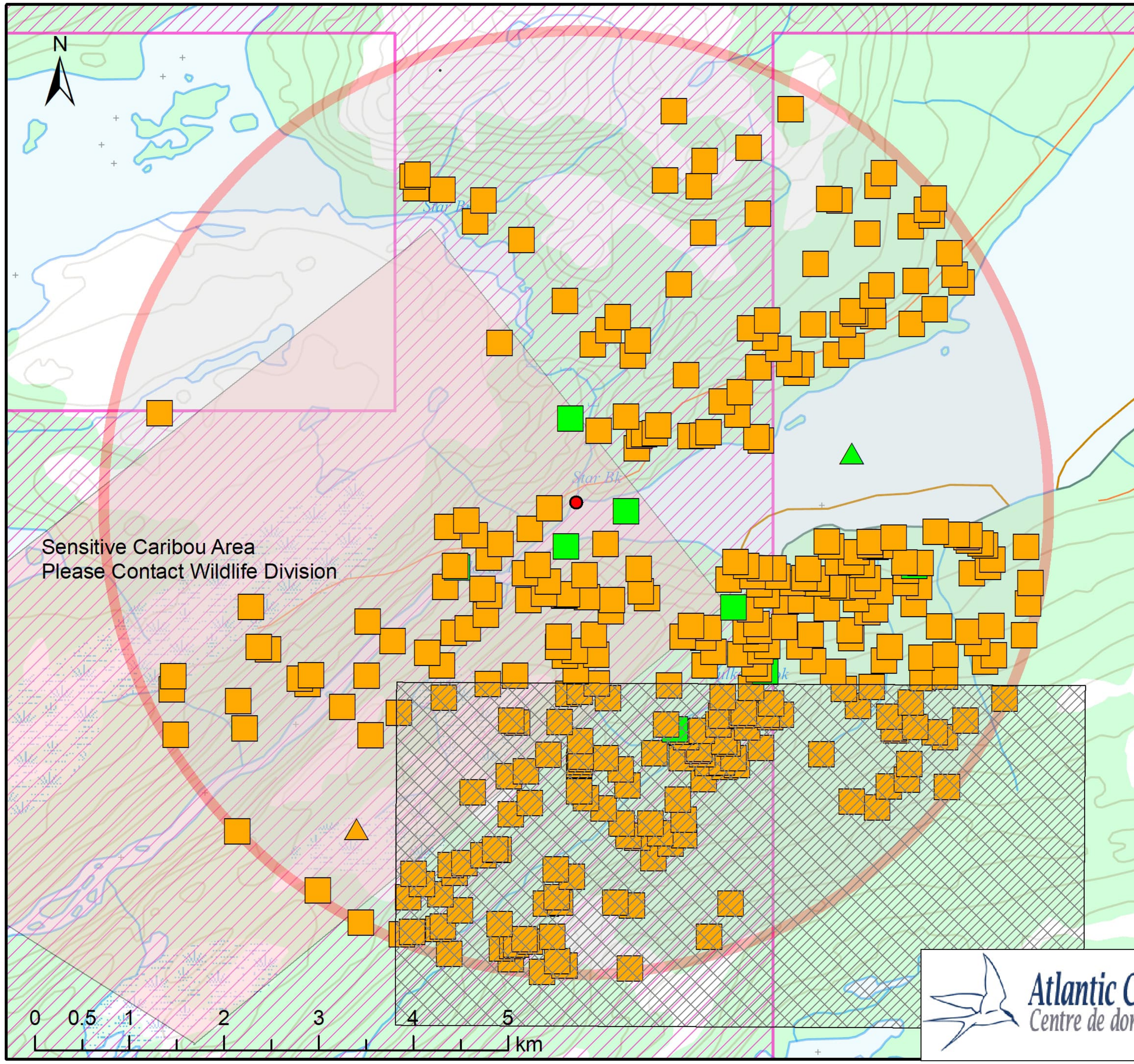
NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

AC CDC Map
Paradise River

DATE: 2023-10-20

FIGURE 7

GIS Scan of Rare and Provincially/Federally Listed Species for Star Lake Point of Interest in Newfoundland and Labrador



Legend

- Point of Interest (POI)
- 5 km Buffer Around POI
- Bat Hibernacula Area
- Sensitive Wildlife Area
- Nfld Marten Critical Habitat

Rare Flora

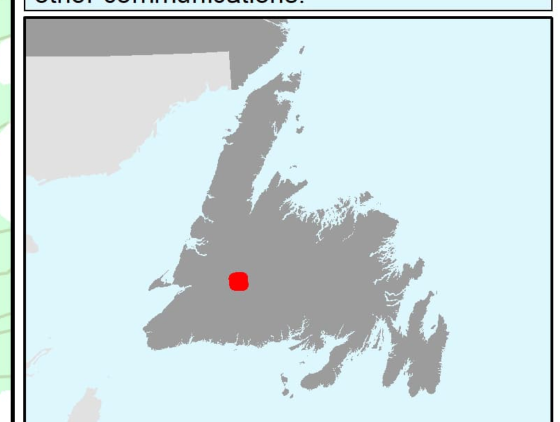
- 100m Accuracy
- 1000m Acc.

Rare Fauna

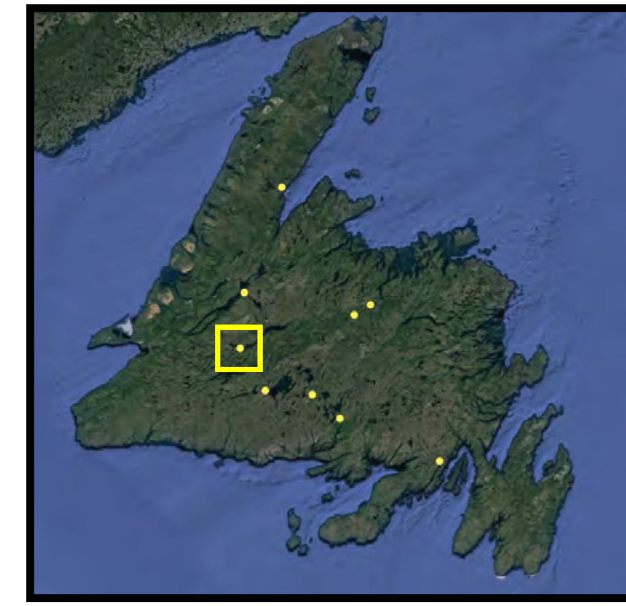
- 100m Accuracy
- 1000m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Star Lake.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH

HATCH DOCUMENT NUMBER:

REV. 0

NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

AC CDC Map
Star Lake

DATE: 2023-10-20

FIGURE 8

H371390-0000-200-230-0001-AP0B, Page 8 of 9

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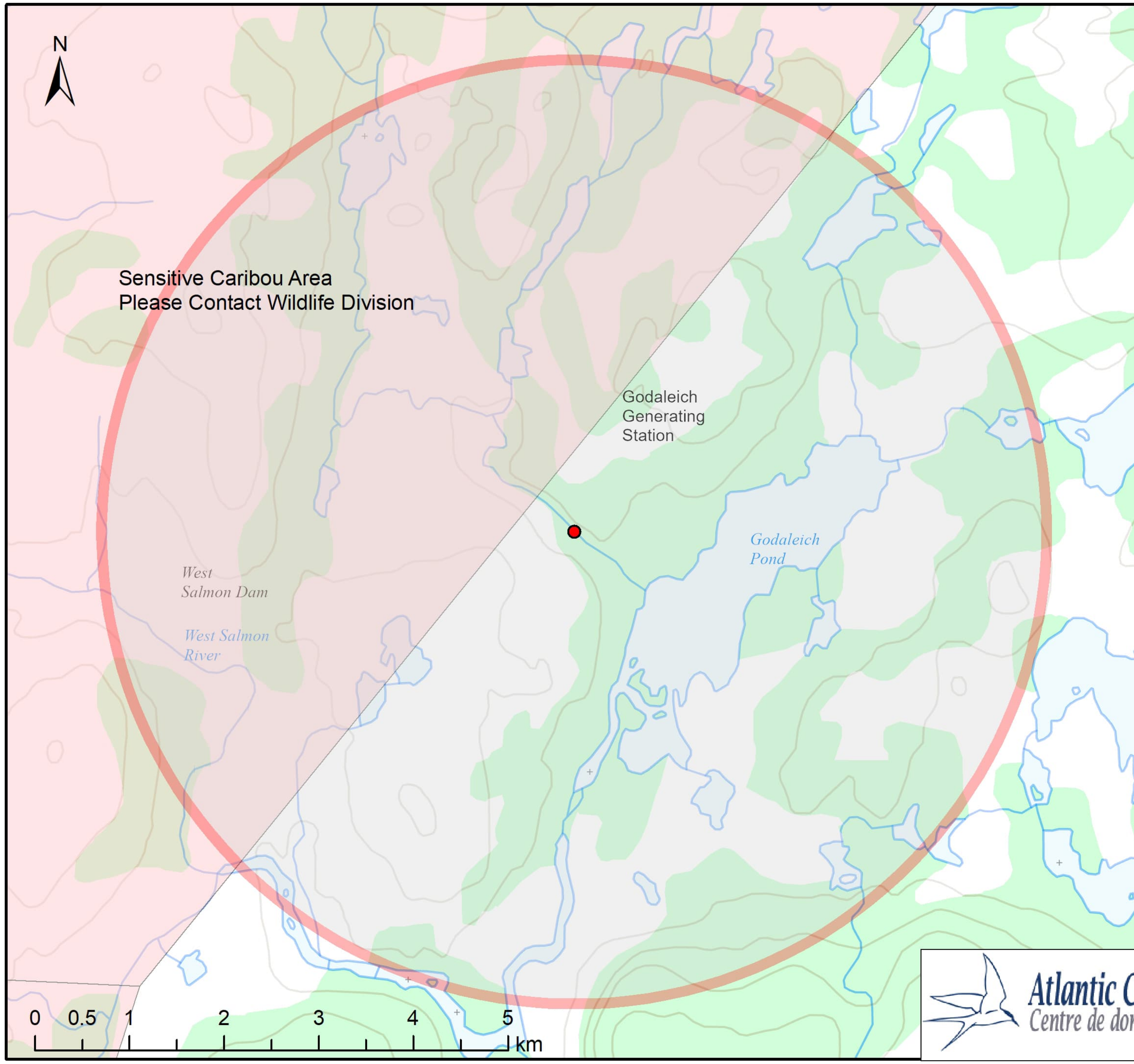
GIS Scan of Rare and Provincially/Federally Listed Species for Upper Salmon Point of Interest in Newfoundland and Labrador

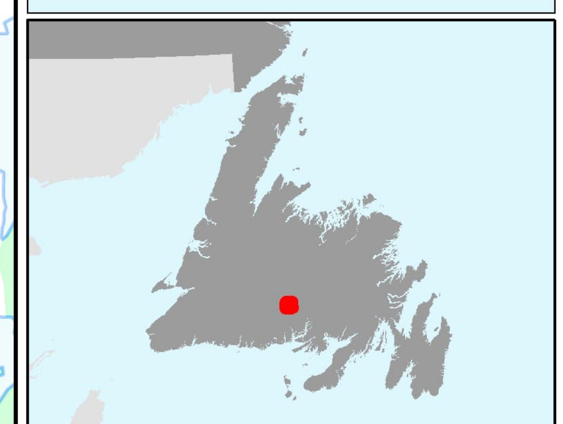


Legend

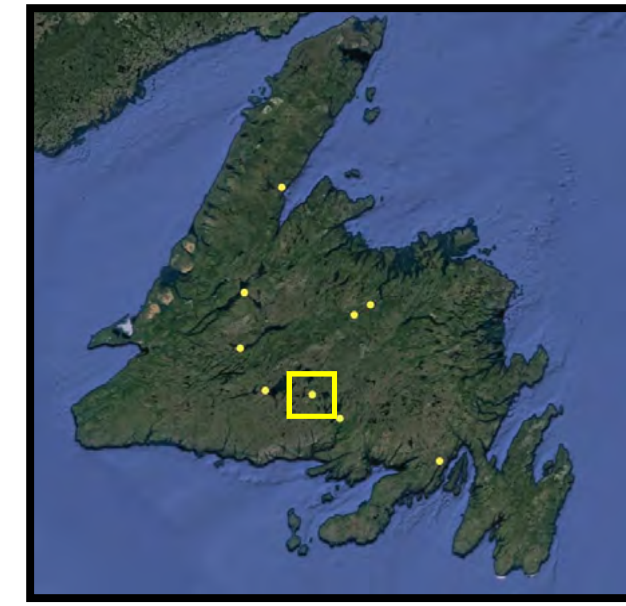
- Point of Interest (POI)
- 5 km Buffer Around POI
- Sensitive Wildlife Area

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



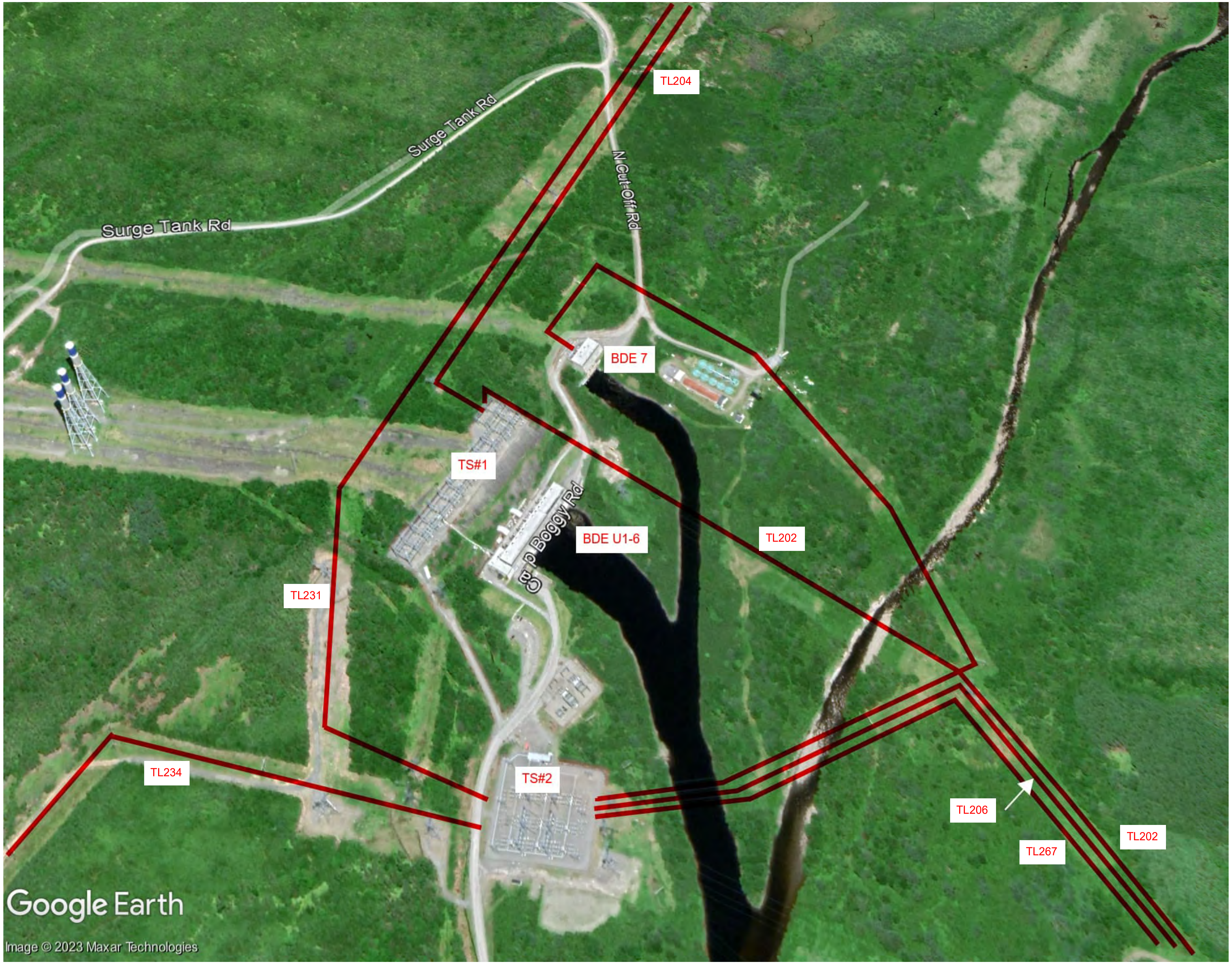
NOTES

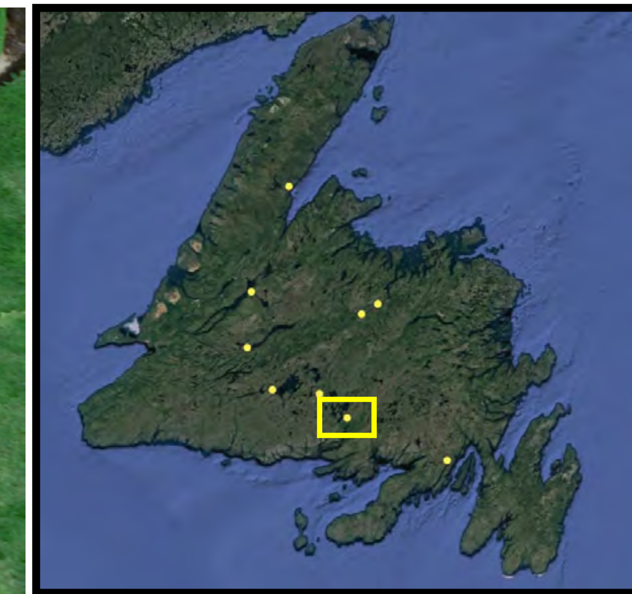
Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Upper Salmon.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY AC CDC Map Upper Salmon		
DATE: 2023-10-20	FIGURE 9	

Attachment 3
Interconnection Figures





LEGEND

230kV Transmission Lines

TS#1 - Terminal Station No. 1

TS#2 - Terminal Station No. 2

BDE U1-6 - Bay d'Espoir Units 1 to 6

BDE 7 - Bay d'Espoir Unit 7

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION BAY D'ESPOIR PLANT		
DATE: 2023-10-20	FIGURE 1	

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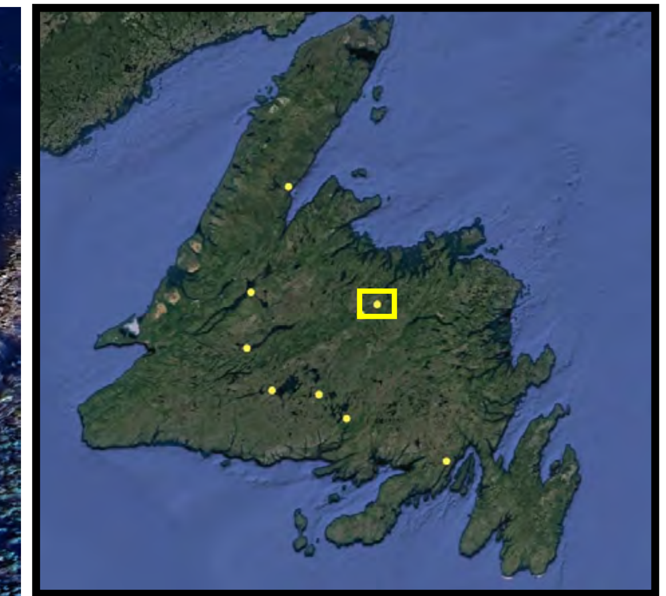

LEGEND

66kV Transmission Line

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION BISHOP'S FALLS PLANT		
DATE: 2023-10-20	FIGURE 2	

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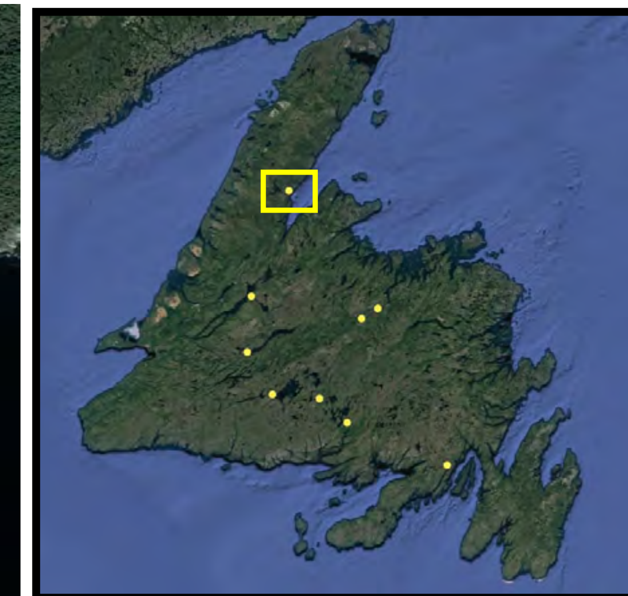


LEGEND

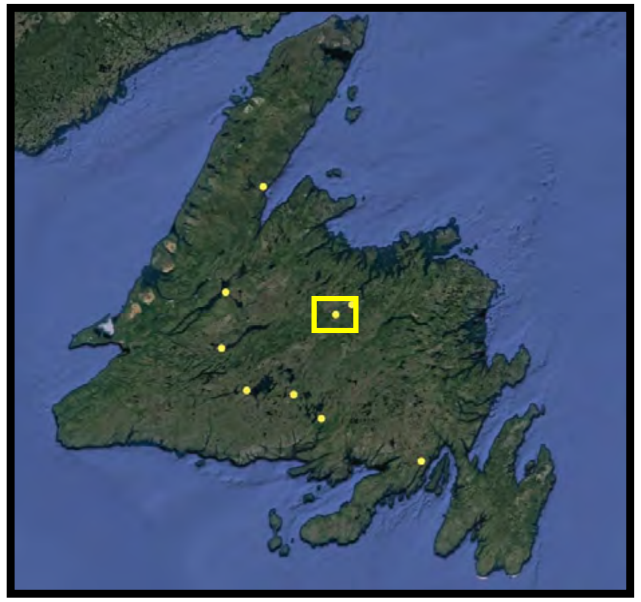
230kV Transmission Line

CAT U1-2 - Cat Arm Units 1 and 2

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION CAT ARM PLANT		
DATE: 2023-10-20	FIGURE 3	



LEGEND

230kV Transmission Line

STB TS - Stony Brook Terminal Station

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION GRAND FALLS PLANT		
DATE: 2023-10-20	FIGURE 4	

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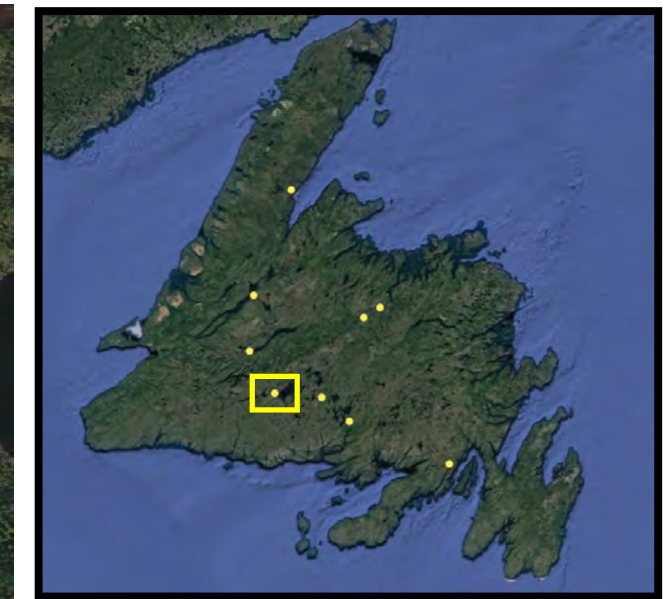


LEGEND

230kV Transmission Lines

GCL U1 - Granite Canal Unit 1

GCL TS - Granite Canal Terminal Station

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH

HATCH DOCUMENT NUMBER:

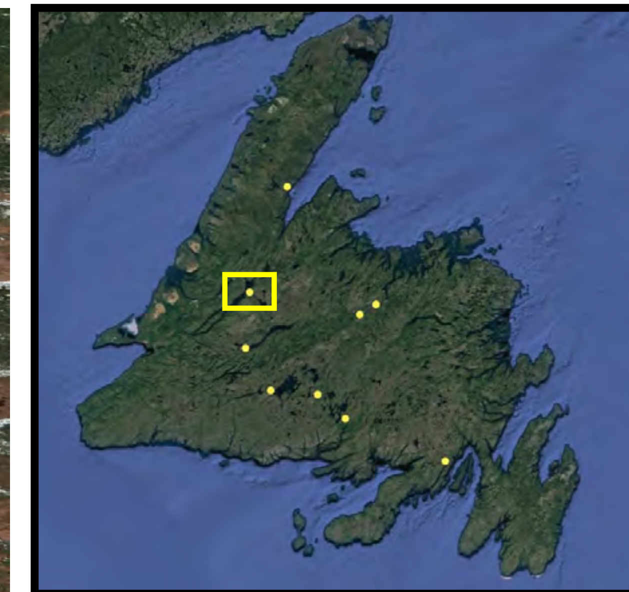
REV. 0

NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

TRANSMISSION INTERCONNECTION
GRANITE CANAL PLANT

DATE: 2023-10-20

FIGURE 5



LEGEND

230kV Transmission Line

HLK U1 - Hinds Lake Unit 1

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION HINDS LAKE PLANT		
DATE: 2023-10-20	FIGURE 6	

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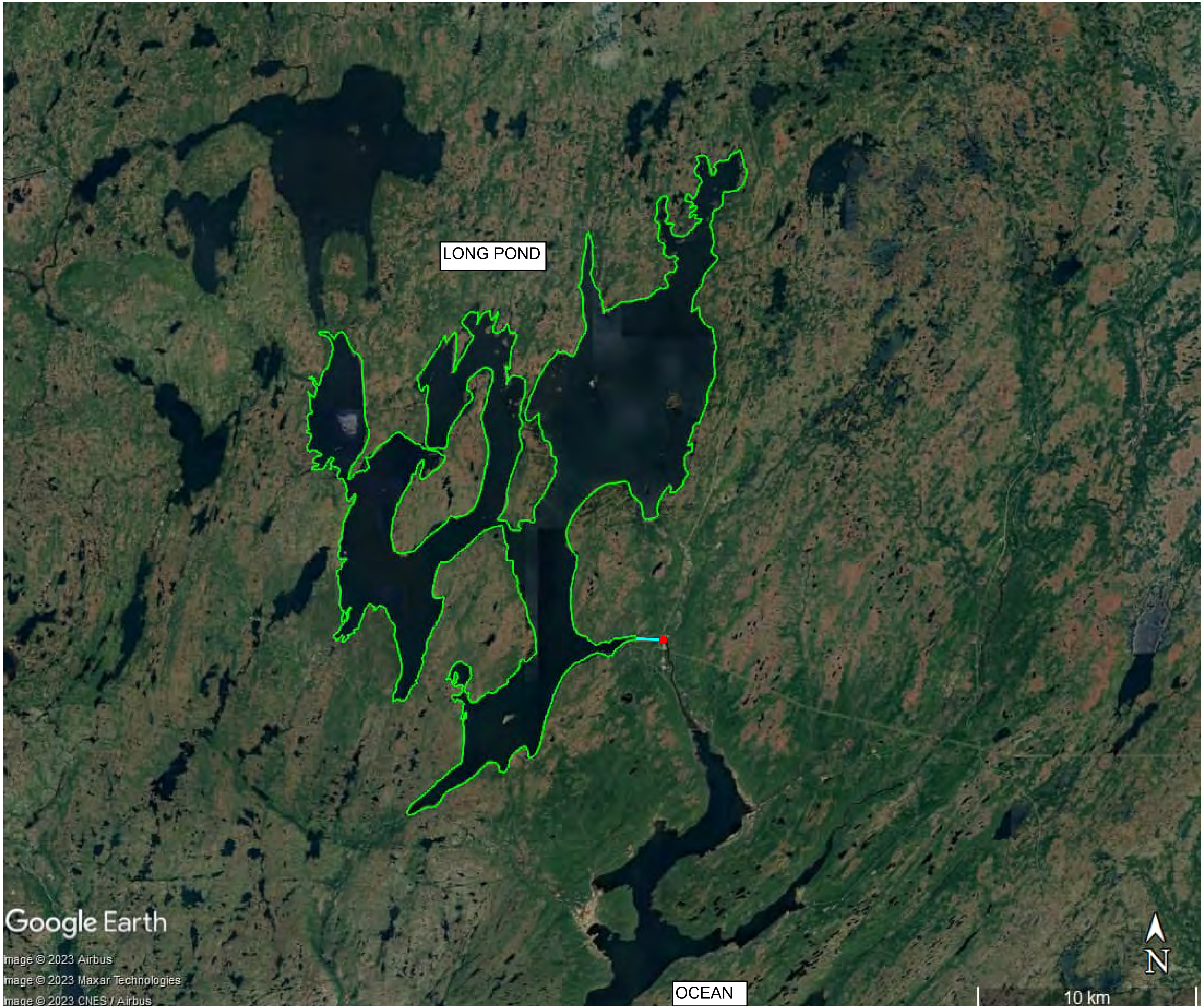
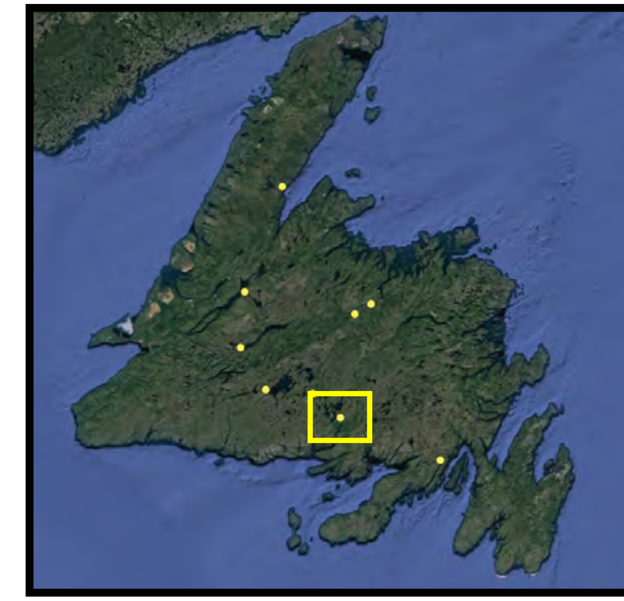




LEGEND

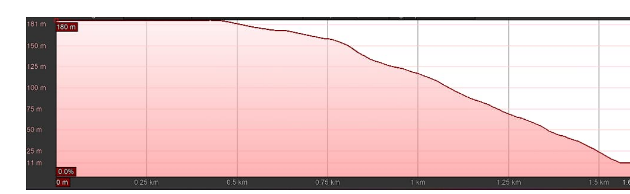
- RESERVOIR OUTLINE
- PENSTOCK
- POWER HOUSE

UPPER RESERVOIR: LONG POND
Available Storage: 781 Mm3
Max Operational Level: 182.7 m
Area: 178 km2

LOWER RESERVOIR: OCEAN

POWERHOUSE
Units: 7
Type: Francis
Plant: 613.5 MW
Head: 176 m

PENSTOCK
Length: 1129 m
Diam: 5.2 - 4.1 m



All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL).

HATCH | HATCH DOCUMENT NUMBER: | REV. 0

NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

SITE ARRANGEMENT
BAY D'ESPOIR

DATE: 2023-10-20 | FIGURE 1

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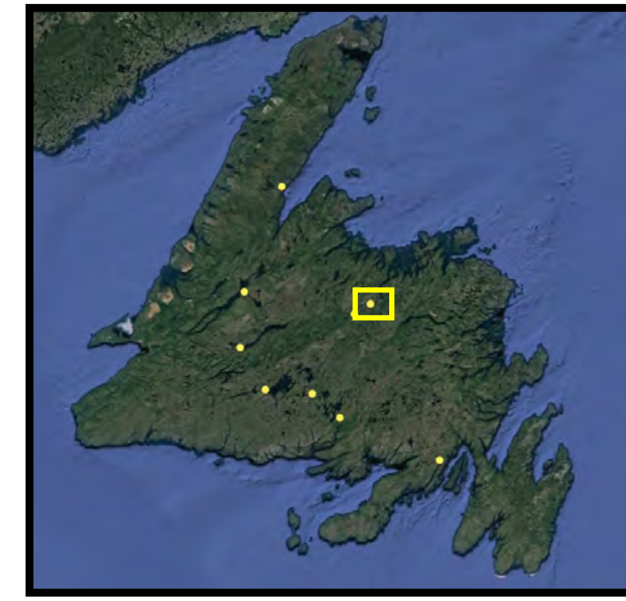


LEGEND

ELEVATION PROFILE PATH
PENSTOCK
POWER HOUSE

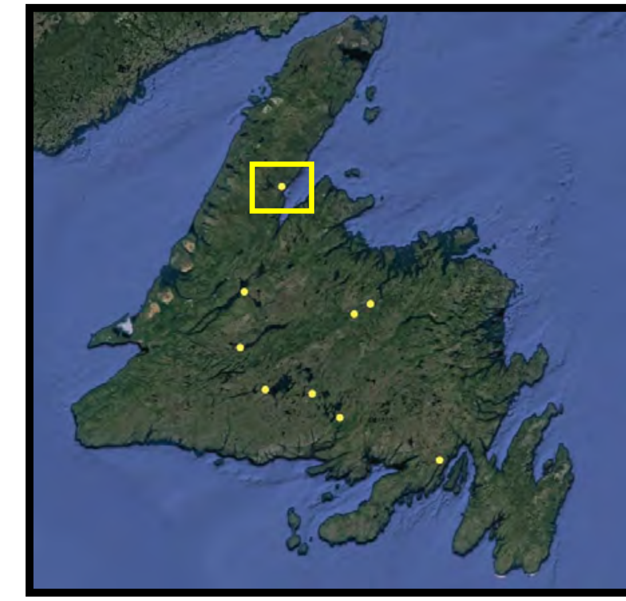
UPPER RESERVOIR: N/A

LOWER RESERVOIR: OCEAN

POWERHOUSE
Units: 9
Type: Francis
Plant: 22 MW

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL).

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY SITE ARRANGEMENT BISHOPS FALLS		
DATE: 2023-10-20	FIGURE 1	



LEGEND

- RESERVOIR BOUNDARY
- PENSTOCK
- POWER HOUSE

UPPER RESERVOIR: CAT ARM RESEVOIR
Available Storage: 393 Mm3
Max Operational Level: 393.2 m
Area: 60.2 km2

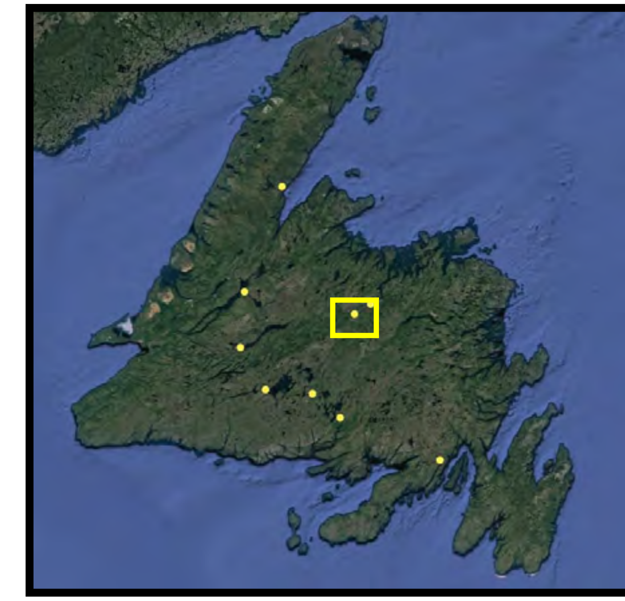
LOWER RESERVOIR: OCEAN

POWERHOUSE
Units: 2
Type: Pelton
Plant: 134 MW
Head: 380.5 m

PENSTOCK
Length: 2900 m
Diam: 5.7 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL).

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY SITE ARRANGEMENT CAT ARM		
DATE: 2023-10-20	FIGURE 1	



LEGEND

ELEVATION PROFILE PATH
PENSTOCK
POWER HOUSE

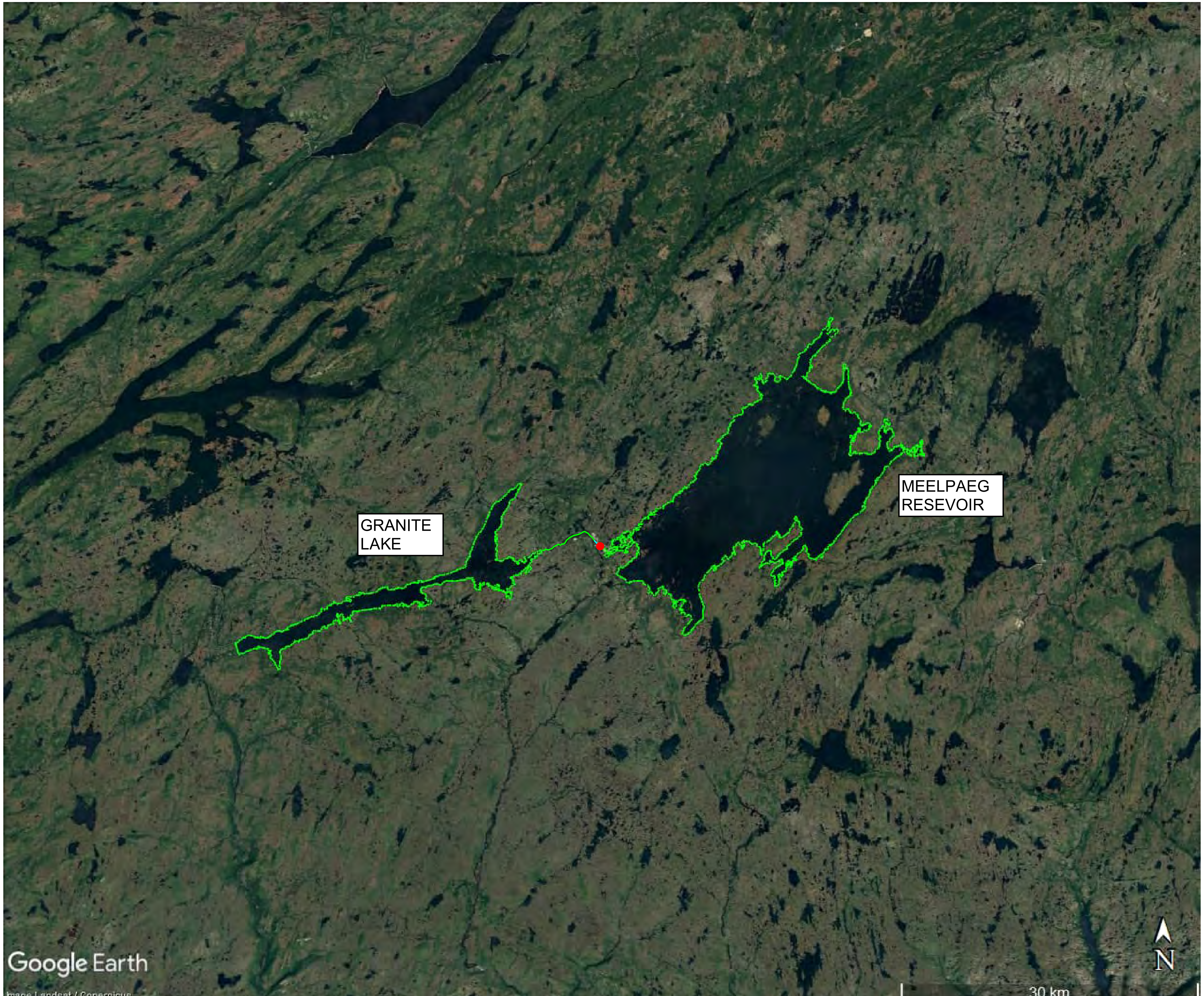
UPPER RESERVOIR: N/A

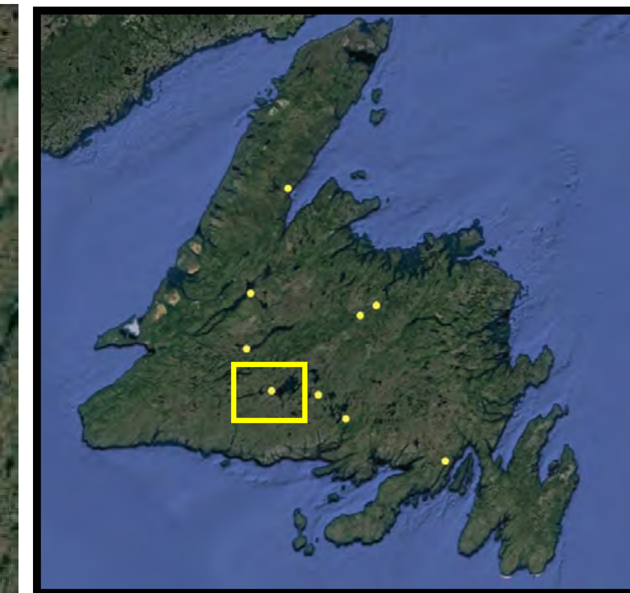
LOWER RESERVOIR: N/A

POWERHOUSE
Units: 2
Type: Francis
Plant:75 MW

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL).

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY SITE ARRANGEMENT GRAND FALLS		
DATE: 2023-10-20	FIGURE 1	





LEGEND

RESERVOIR BOUNDARY
POWER HOUSE

UPPER RESERVOIR: LONG LAKE
Available Storage: 75 Mm3
Max Operational Level: 313 m
Area: 65 km2

LOWER RESERVOIR: MEELPAEG RESERVOIR
Available Storage: 2080 Mm3
Min Operational Level: 367 m
Area: 309 km2

POWERHOUSE
Units: 1
Type: Kaplan
Plant: 40 MW
Head: 38.82 m

PENSTOCK
Length: 1923 m
Diam: 5.7 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY		
SITE ARRANGEMENT GRANITE LAKE		
DATE: 2023-10-20	FIGURE 1	

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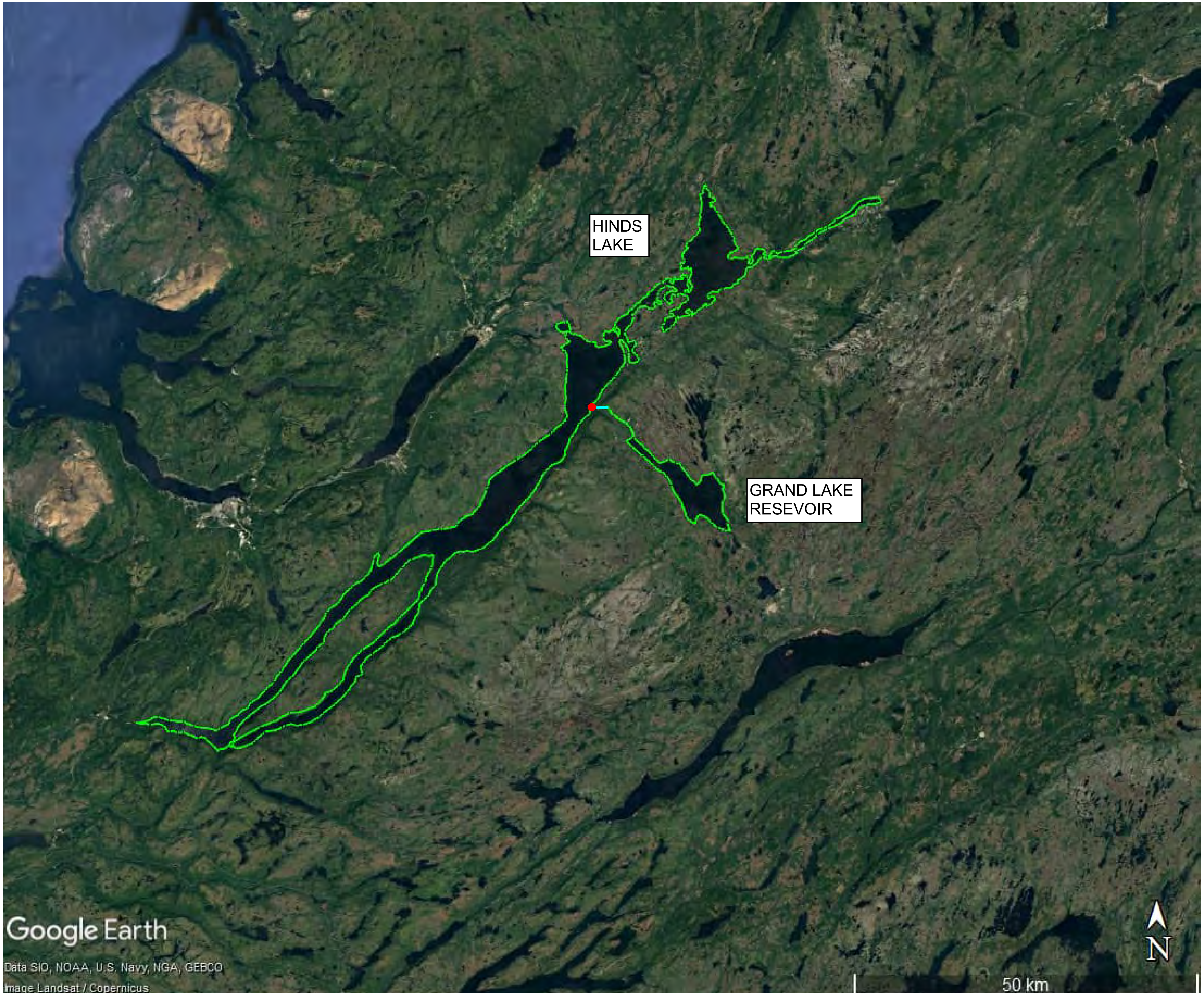

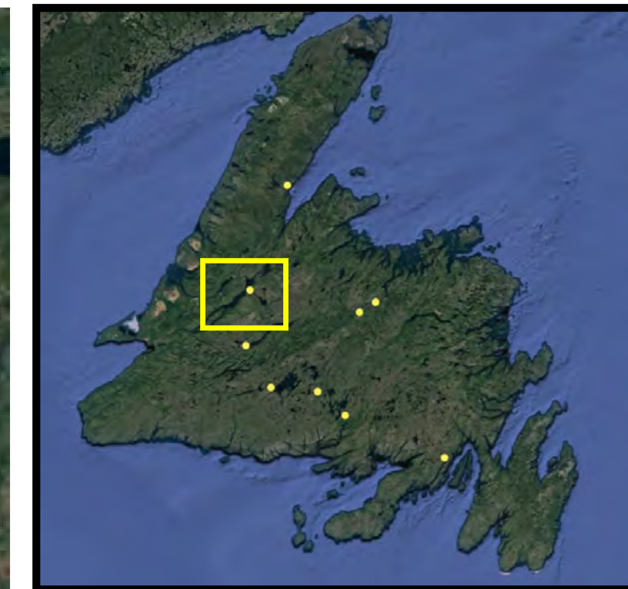

LEGEND

- RESERVOIR BOUNDARY
- PENSTOCK
- POWER HOUSE

UPPER RESERVOIR: HINDS LAKE
Available Storage: 199 Mm3
Max Operational Level: 311 m
Area: 498 km2

LOWER RESERVOIR: GRAND LAKE RESERVOIR
Available Storage: 216 Mm3
Min Operational Level: 85 m (assumed)
Area: 54 km2

POWERHOUSE
Units: 1
Type: Francis
Plant: 75 MW
Head: 214 m

PENSTOCK
Length: 1419 m
Diam: 4.55 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY SITE ARRANGEMENT HINDS LAKE		
DATE: 2023-10-20	FIGURE 1	

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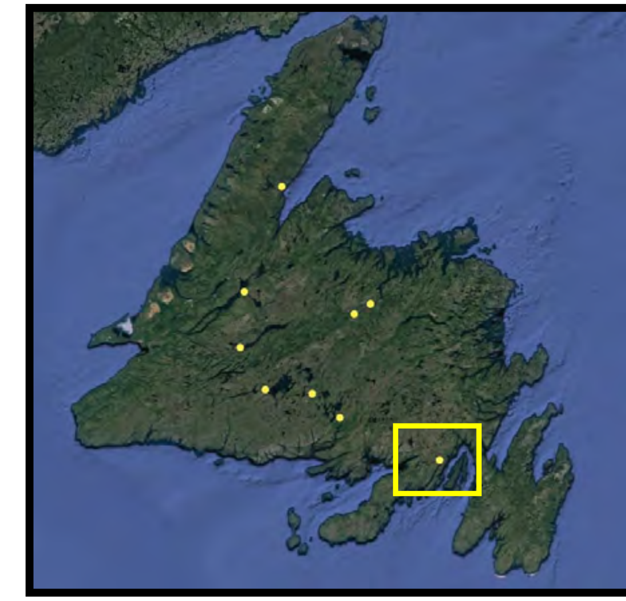


LEGEND

- RESERVOIR BOUNDARY
- PENSTOCK
- POWER HOUSE

UPPER RESERVOIR: PARADISE RIVER Available Storage: 2.32 Mm3
Max Operational Level: 35 m (assumed)
Area: 0.58 km2

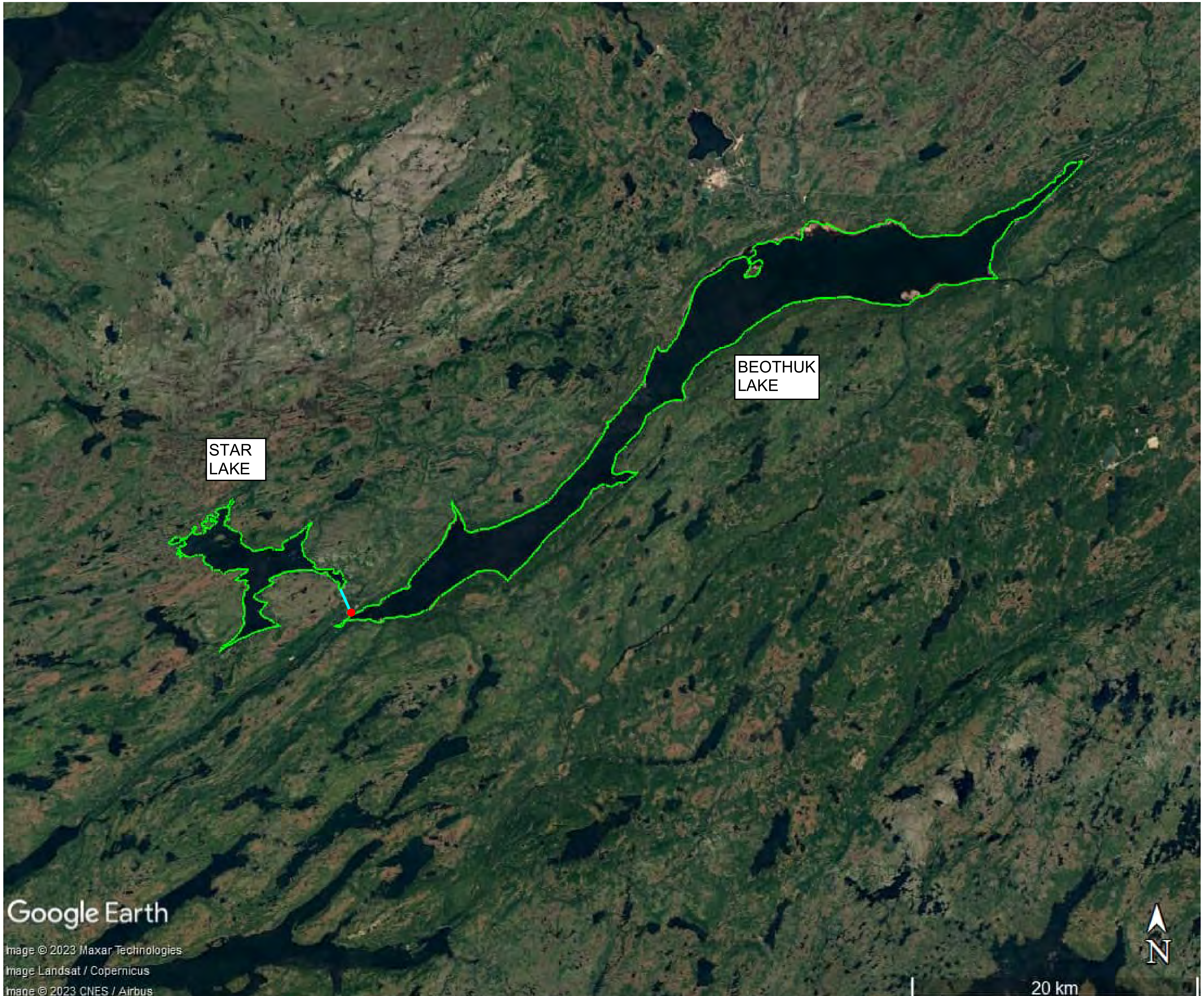
LOWER RESERVOIR: OCEAN

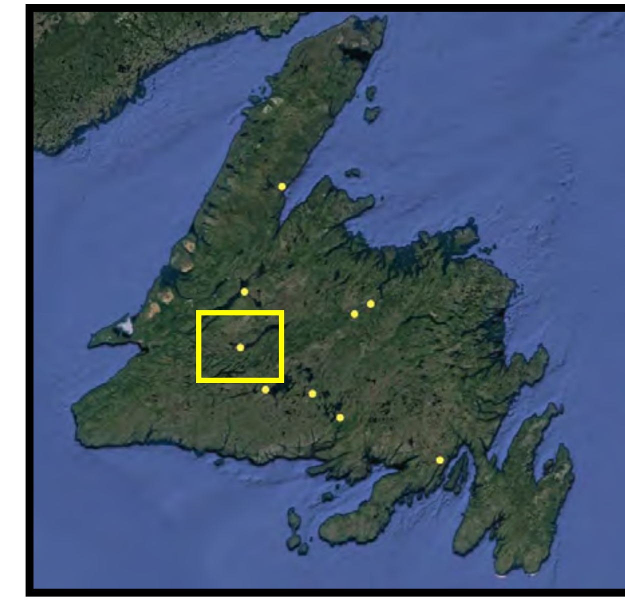
POWERHOUSE
Units: 1
Type: Francis
Plant: 8.1 MW
Head: 37.5 m

PENSTOCK
Length: 35.88 m
Diameter: 7 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL).

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY		
SITE ARRANGEMENT PARADISE RIVER		
DATE: 2023-10-20	FIGURE 1	





LEGEND

RESERVOIR BOUNDARY
PENSTOCK
POWER HOUSE

UPPER RESERVOIR: STAR LAKE
Available Storage: 228 Mm3
Max Operational Level: 292 m
Area: 28.5 km2

LOWER RESERVOIR: BEOTHUK LAKE
Available Storage: 708
Min Operational Level: 154 m (assumed)
Area: 177 km2

POWERHOUSE
Units: 1
Type:
Plant: 18.4 MW
Head: 137 m

PENSTOCK
Length: 122 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL).

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY SITE ARRANGEMENT STAR LAKE		
DATE: 2023-10-20	FIGURE 1	

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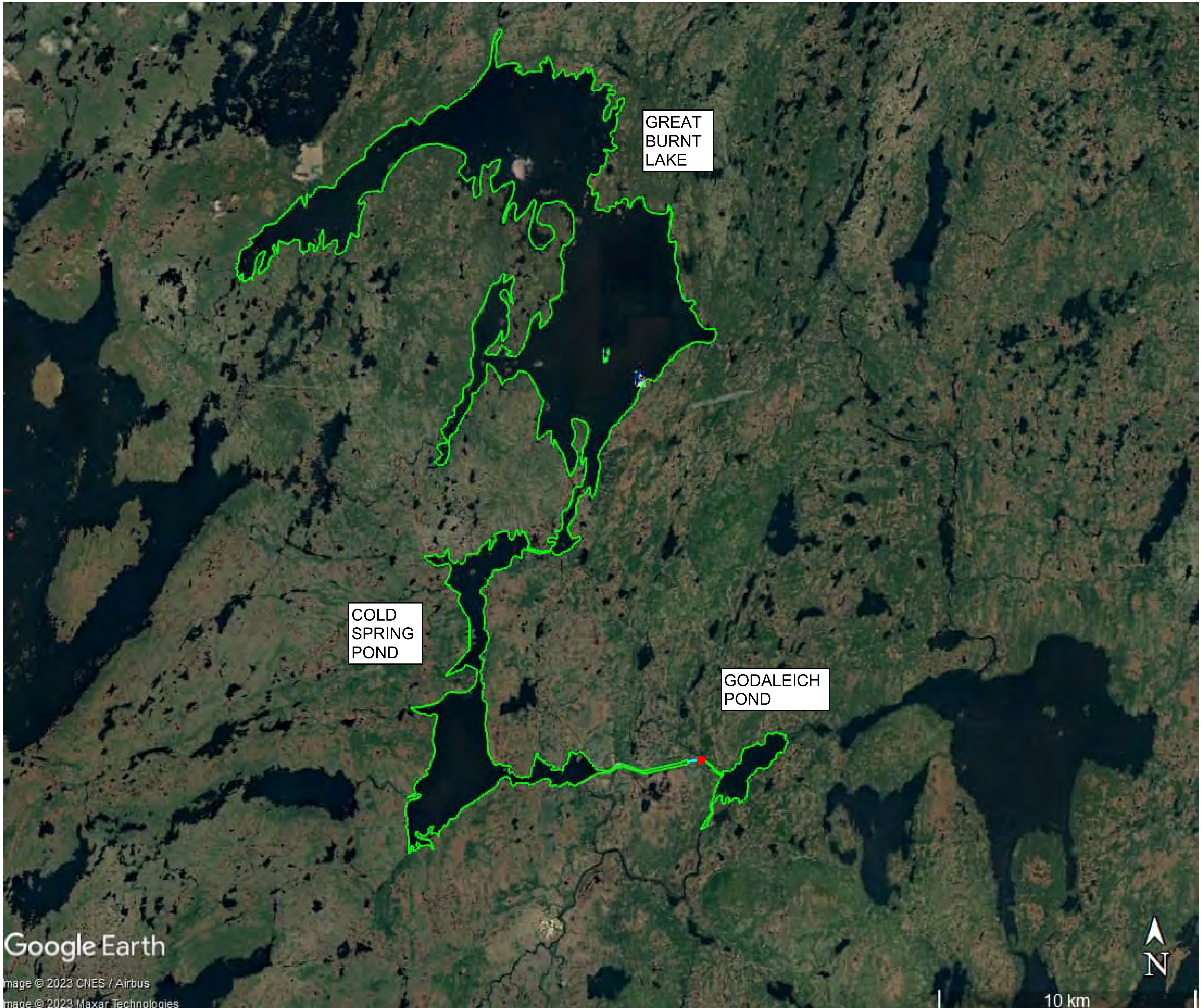
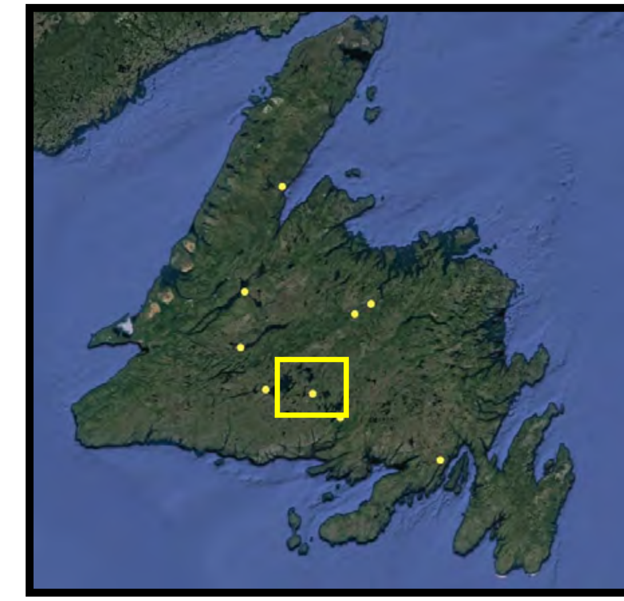




LEGEND

- RESERVOIR BOUNDARY
- PENSTOCK
- POWER HOUSE

UPPER RESERVOIR: COLD SPRING POND/ GREAT BURNT LAKE
Available Storage: 57 Mm3
Max Operational Level: 247.31 m
Area: 114 km2

LOWER RESERVOIR: GODALEICH POND
Available Storage: 6.24 Mm3
Min Operational Level: 191 m (assumed)
Area: 3.12 km2

POWERHOUSE
Units: 1
Type: Francis
Plant: 84 MW
Head: 54 m

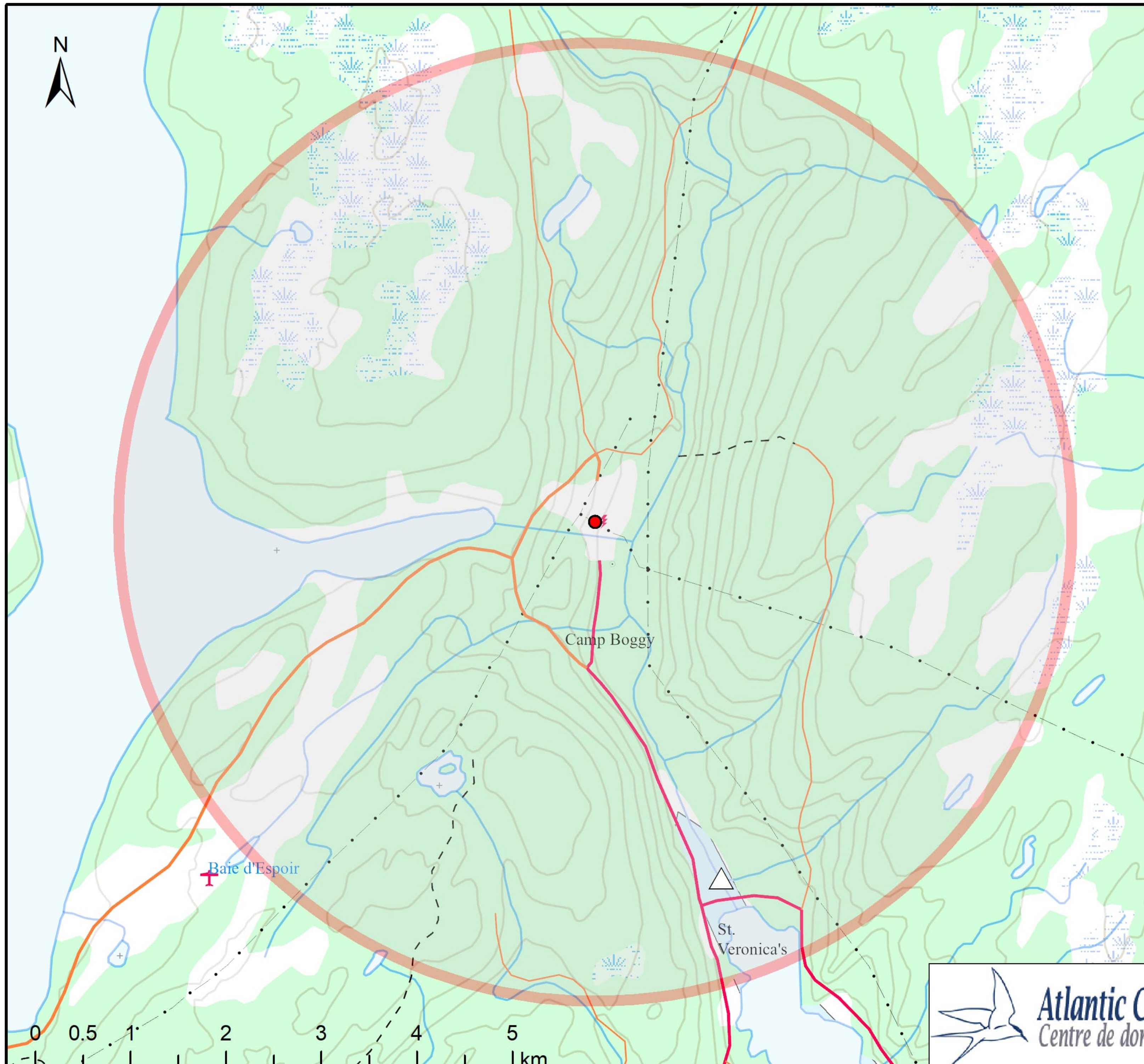
PENSTOCK
Length: 427 m

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY SITE ARRANGEMENT UPPER SALMON		
DATE: 2023-10-20	FIGURE 1	

Document Path: C:\Users\TOEW75256\OneDrive - Hatch Ltd\MILMOC\SedModelling\Delft\Modelling\Map w Title Block - TSS.mxd

GIS Scan of Rare and Provincially/Federally Listed Species for Point of Interest at the Bay D'Espoir Generating Facility in Newfoundland and Labrador



Legend

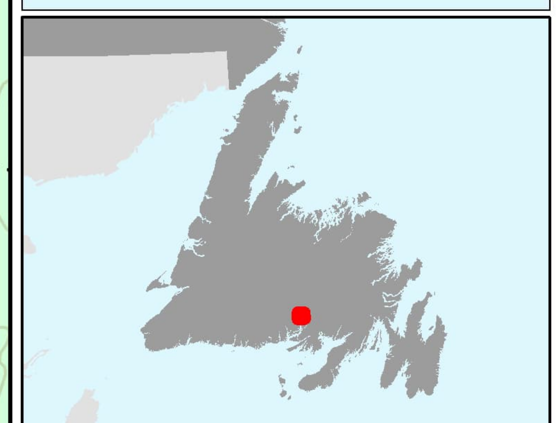
- Point of Interest (POI)
- 5 km Buffer Around POI

Rare Flora

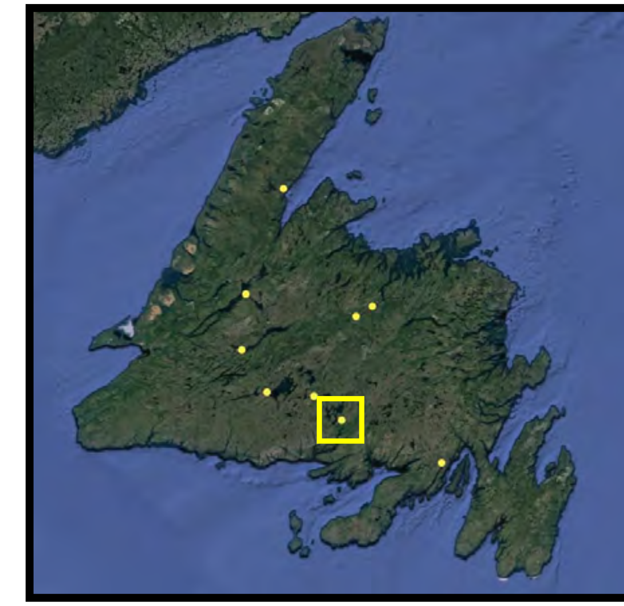
- 200m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



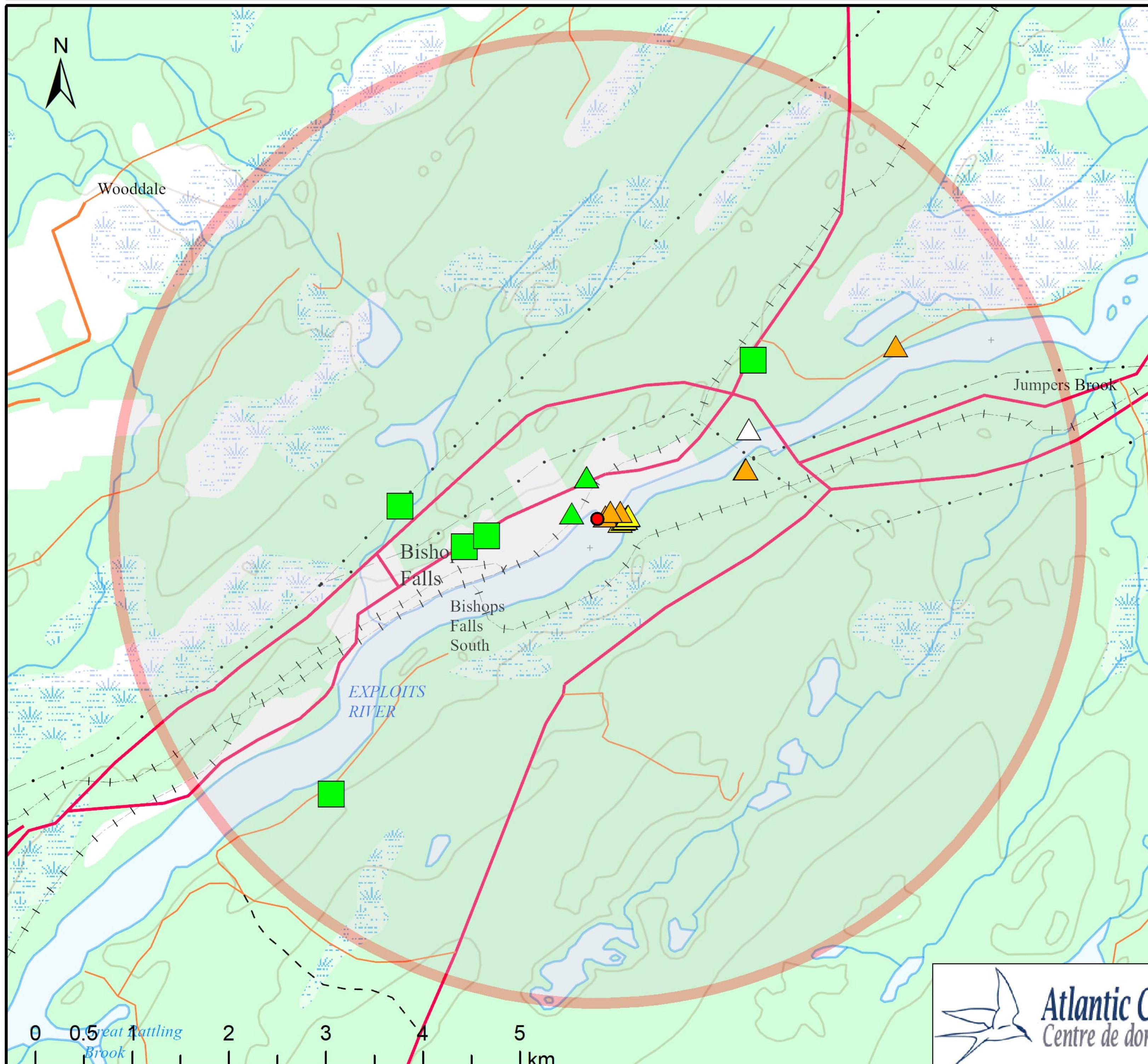
NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Bay d'Espoir.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY AC CDC Map Bay d'Espoir		
DATE: 2023-10-20	FIGURE 1	

GIS Scan of Rare and Provincially/Federally Listed Species for Bishop's Falls Point of Interest in Newfoundland and Labrador



Legend

- Point of Interest (POI)
- 5 km Buffer Around POI

Rare Fauna

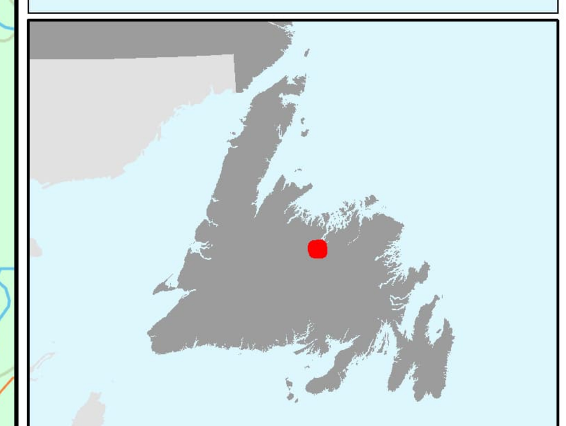
- 1000m Accuracy

Rare Flora

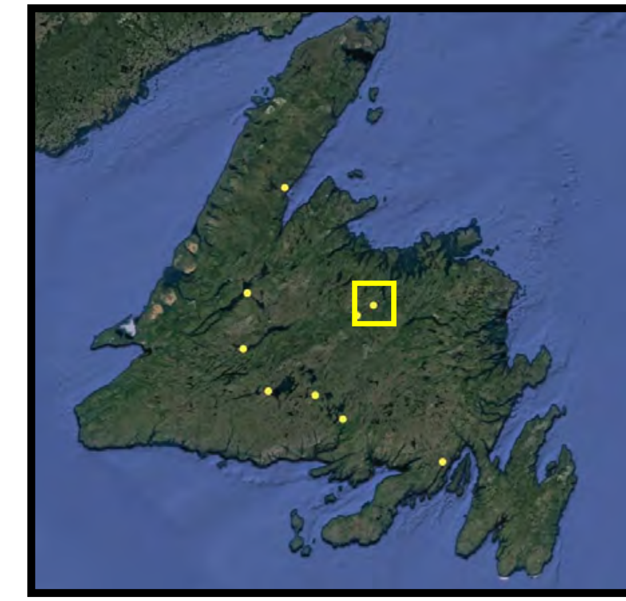
- 10m Accuracy
- 50m Accuracy
- 100m Accuracy
- 1000m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



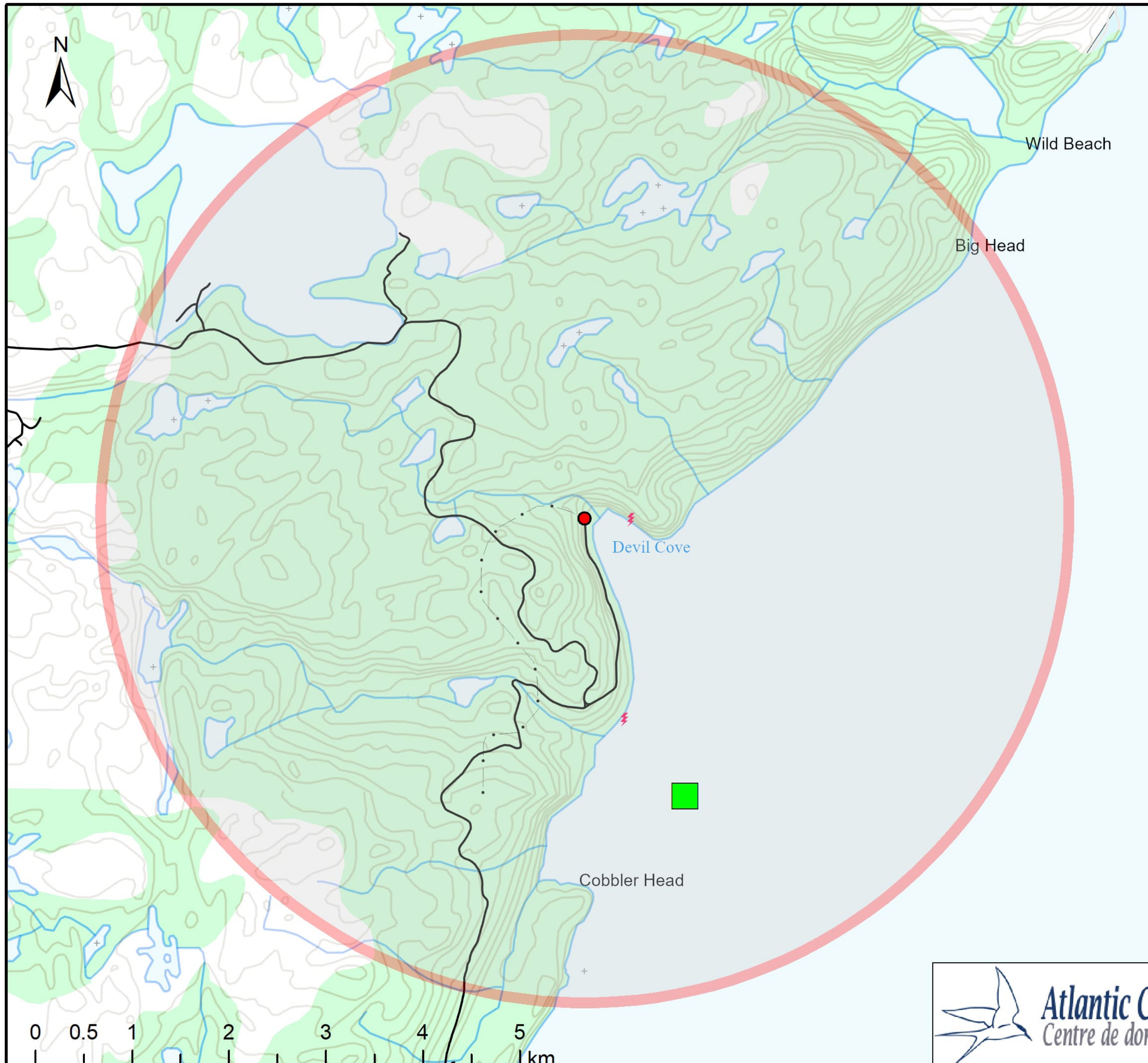
NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Bishop's Falls.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY AC CDC Map Bishop's Falls		
DATE: 2023-10-20	FIGURE 2	

GIS Scan of Rare and Provincially/Federally Listed Species for Cat Arm Point of Interest in Newfoundland and Labrador



Legend

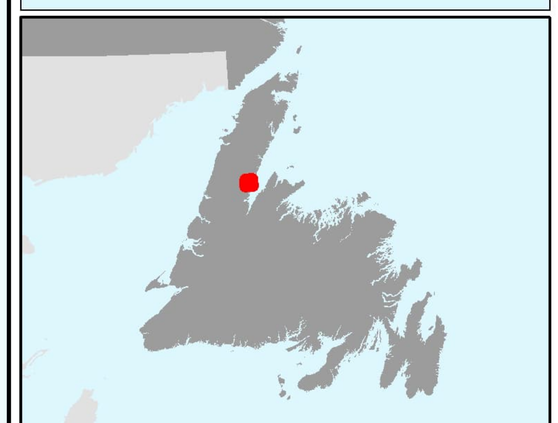
- Point of Interest (POI)
- 5 km Buffer Around POI

Rare Fauna

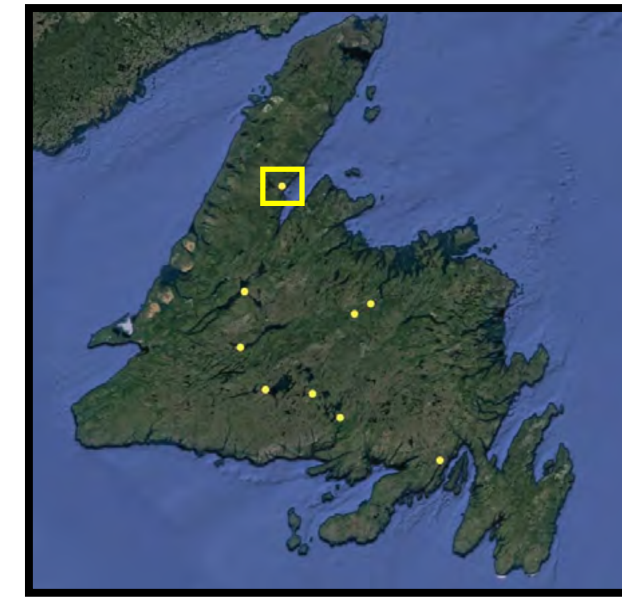
- 1000m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



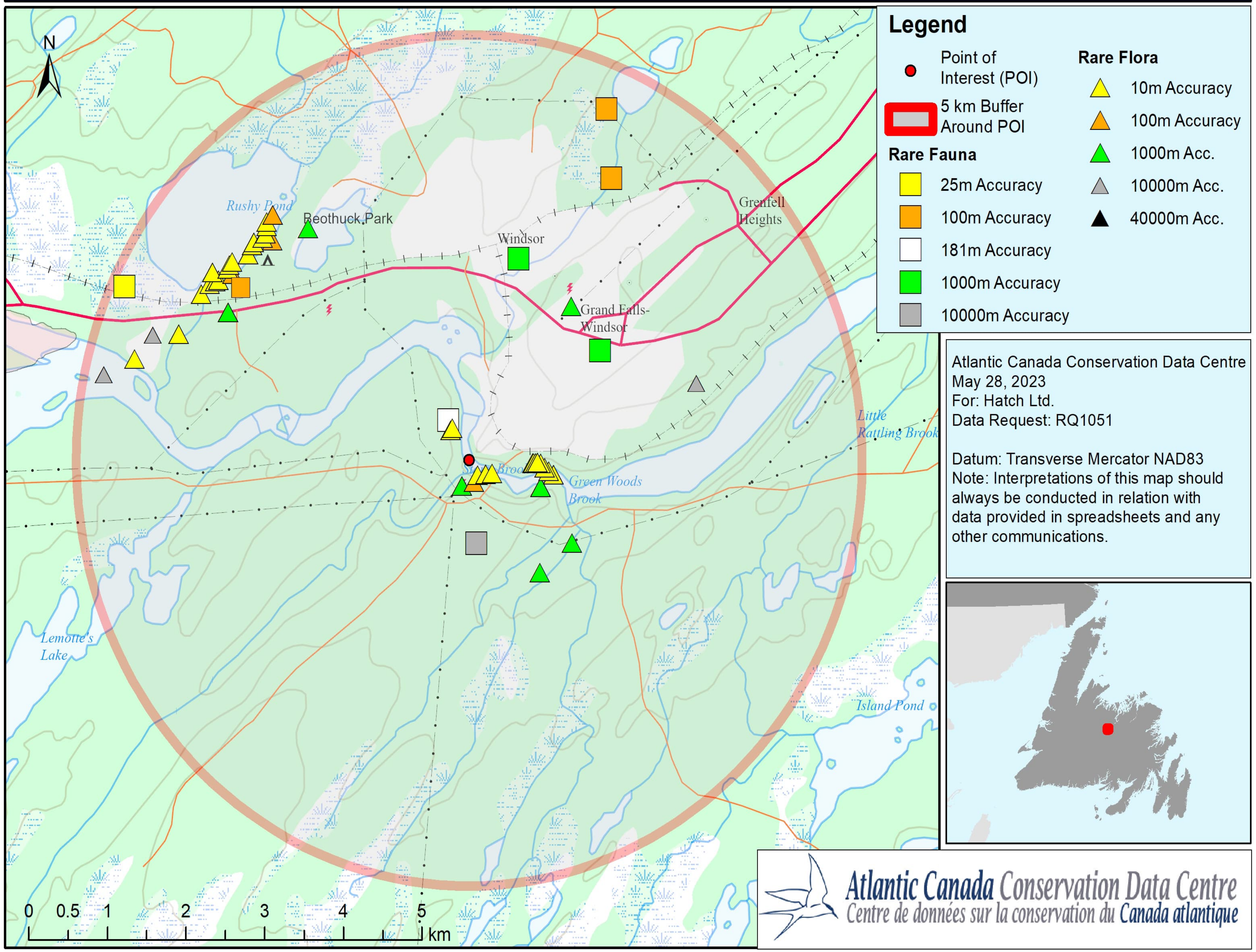
NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Cat Arm.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY AC CDC Map Cat Arm		
DATE: 2023-10-20	FIGURE 3	

GIS Scan of Rare and Provincially/Federally Listed Species for Grand Falls Point of Interest in Newfoundland and Labrador



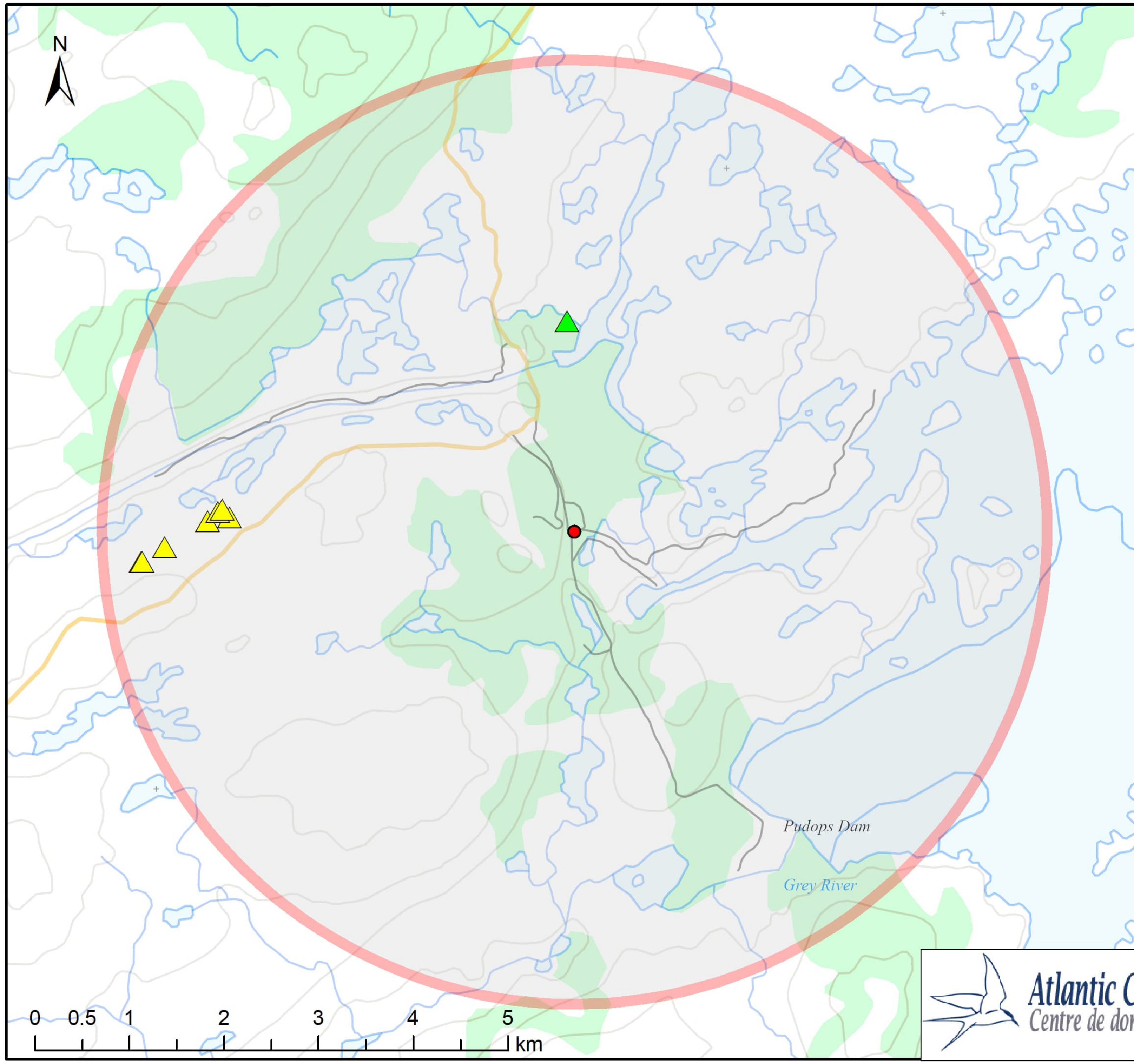
NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Grand Falls.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY		
AC CDC Map Grand Falls		
DATE: 2023-10-20	FIGURE 4	

GIS Scan of Rare and Provincially/Federally Listed Species for Granite Lake Point of Interest in Newfoundland and Labrador



Legend

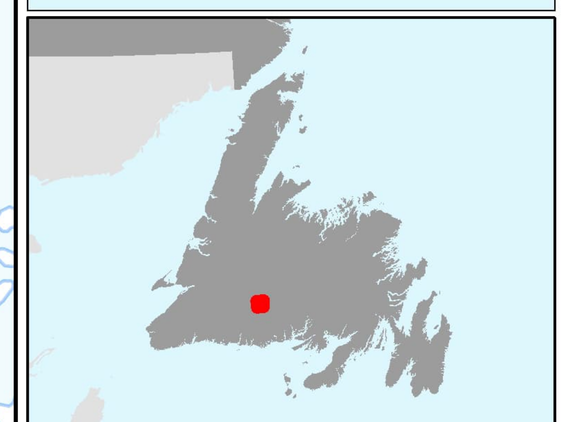
- Point of Interest (POI)
- 5 km Buffer Around POI

Rare Flora

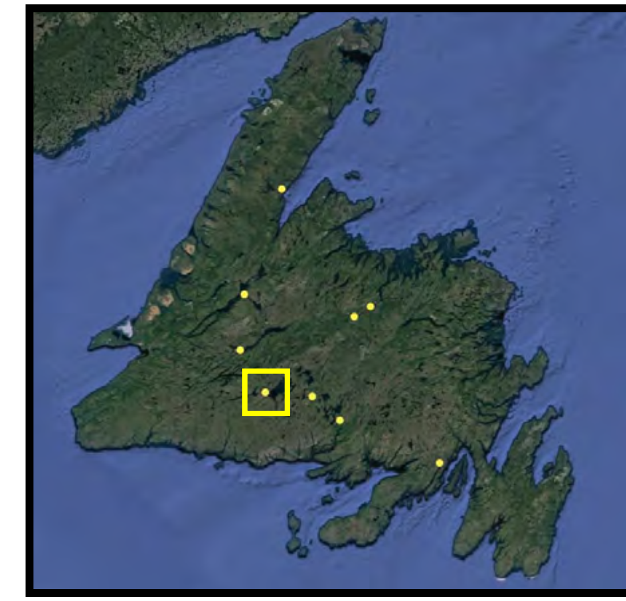
- 5m Accuracy
- 1000m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



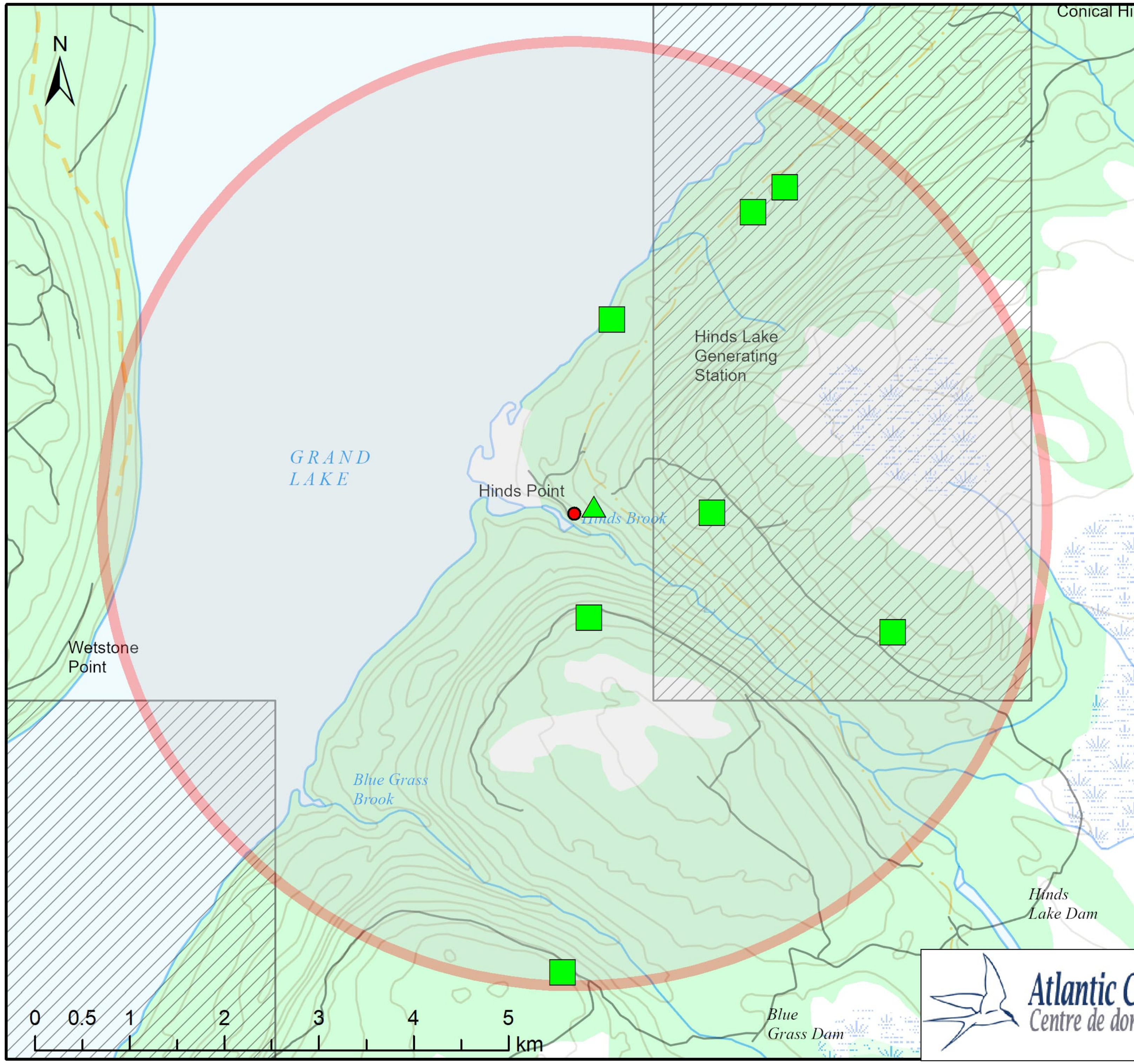
NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Granite Lake.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY AC CDC Map Granite Lake		
DATE: 2023-10-20	FIGURE 5	

GIS Scan of Rare and Provincially/Federally Listed Species for Hinds Lake Point of Interest in Newfoundland and Labrador



Legend

- Point of Interest (POI)
- 5 km Buffer Around POI
- Nfld Marten Critical Habitat

Rare Fauna

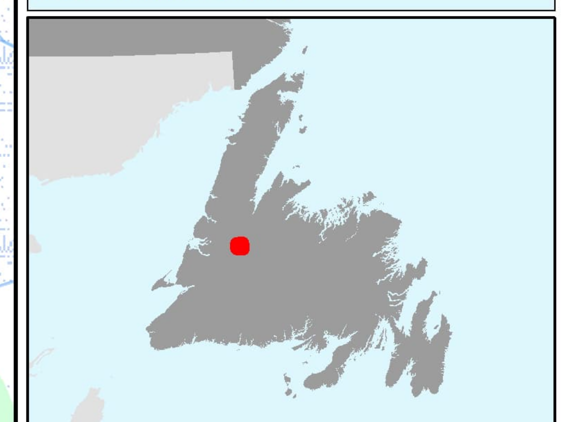
- 1000m Accuracy

Rare Flora

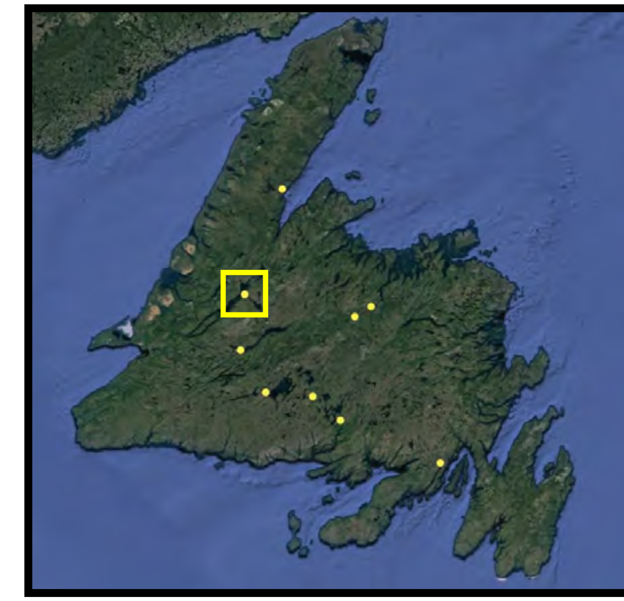
- 1000m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



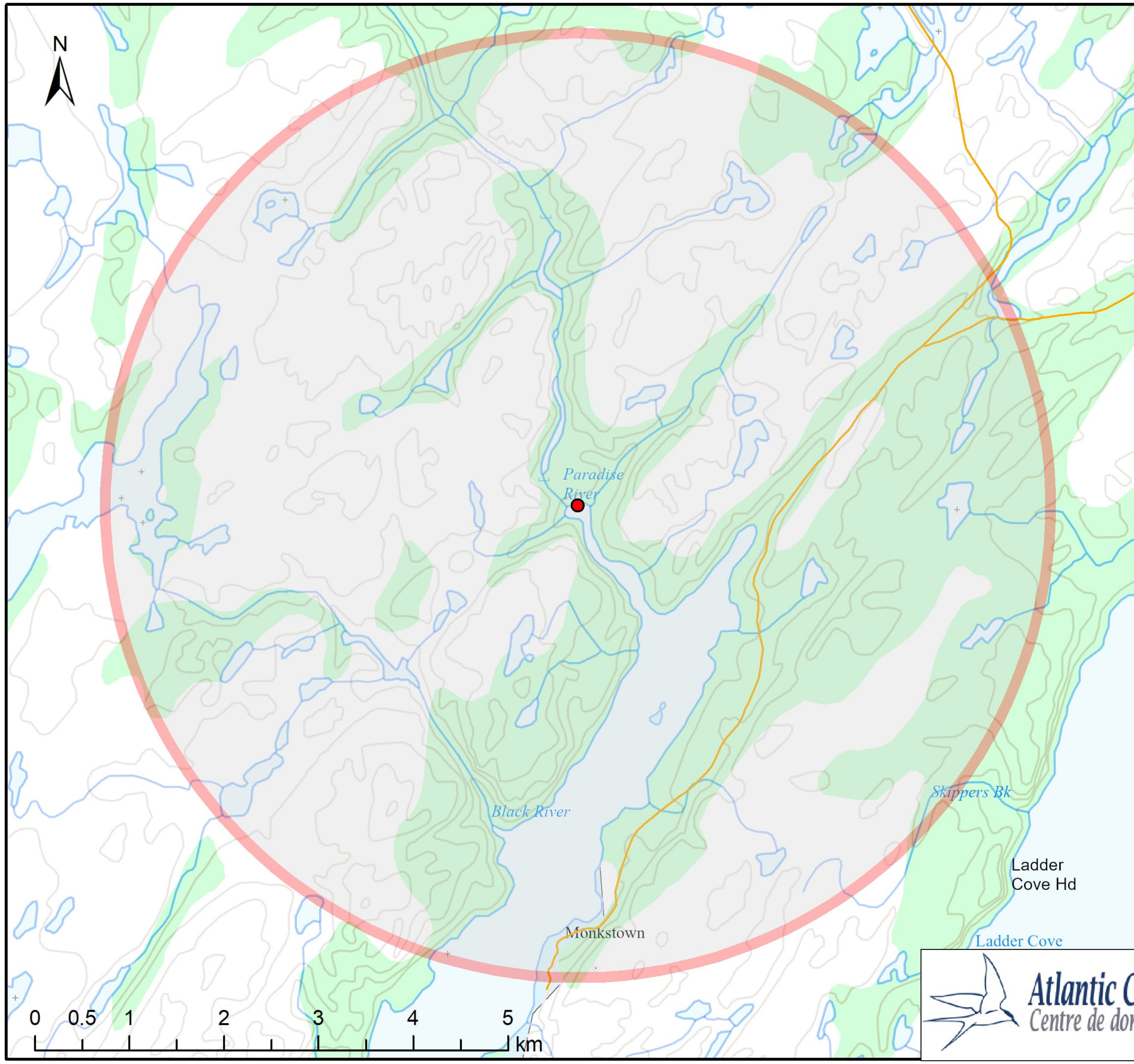
NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Hinds Lake.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY		
AC CDC Map Hinds Lake		
DATE: 2023-10-20	FIGURE 6	

GIS Scan of Rare and Provincially/Federally Listed Species for Paradise River Point of Interest in Newfoundland and Labrador

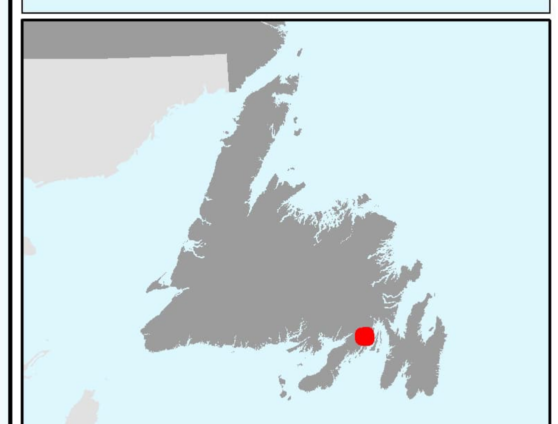


Legend

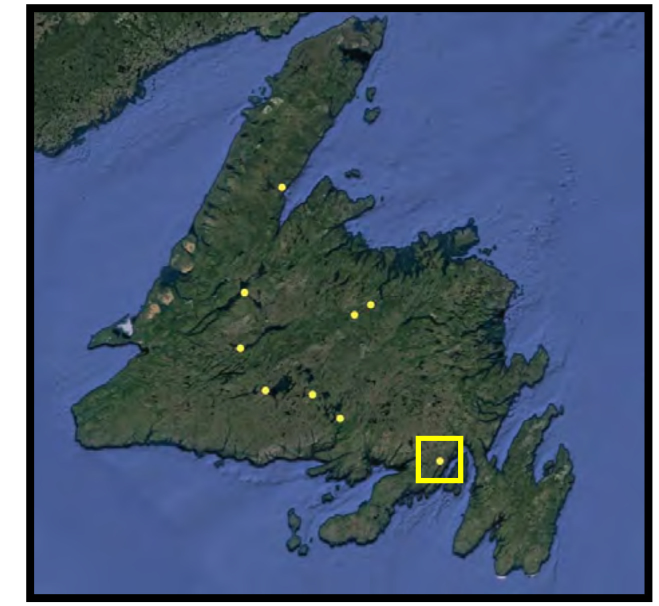
- Point of Interest (POI)
- 5 km Buffer Around POI

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



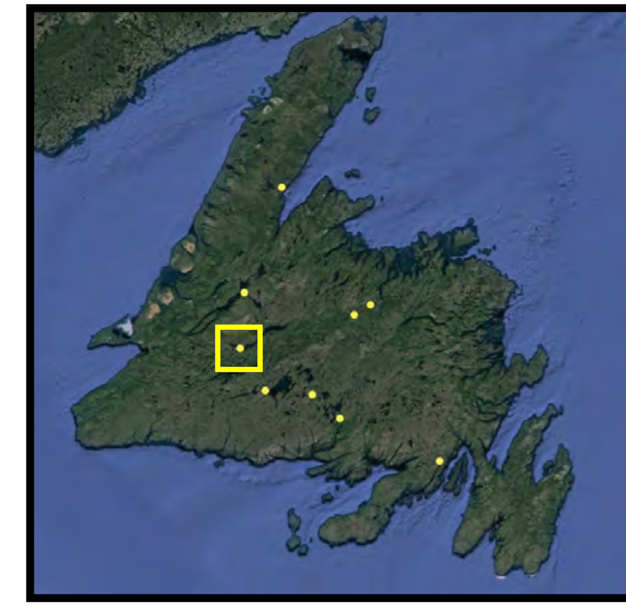
NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Paradise River.

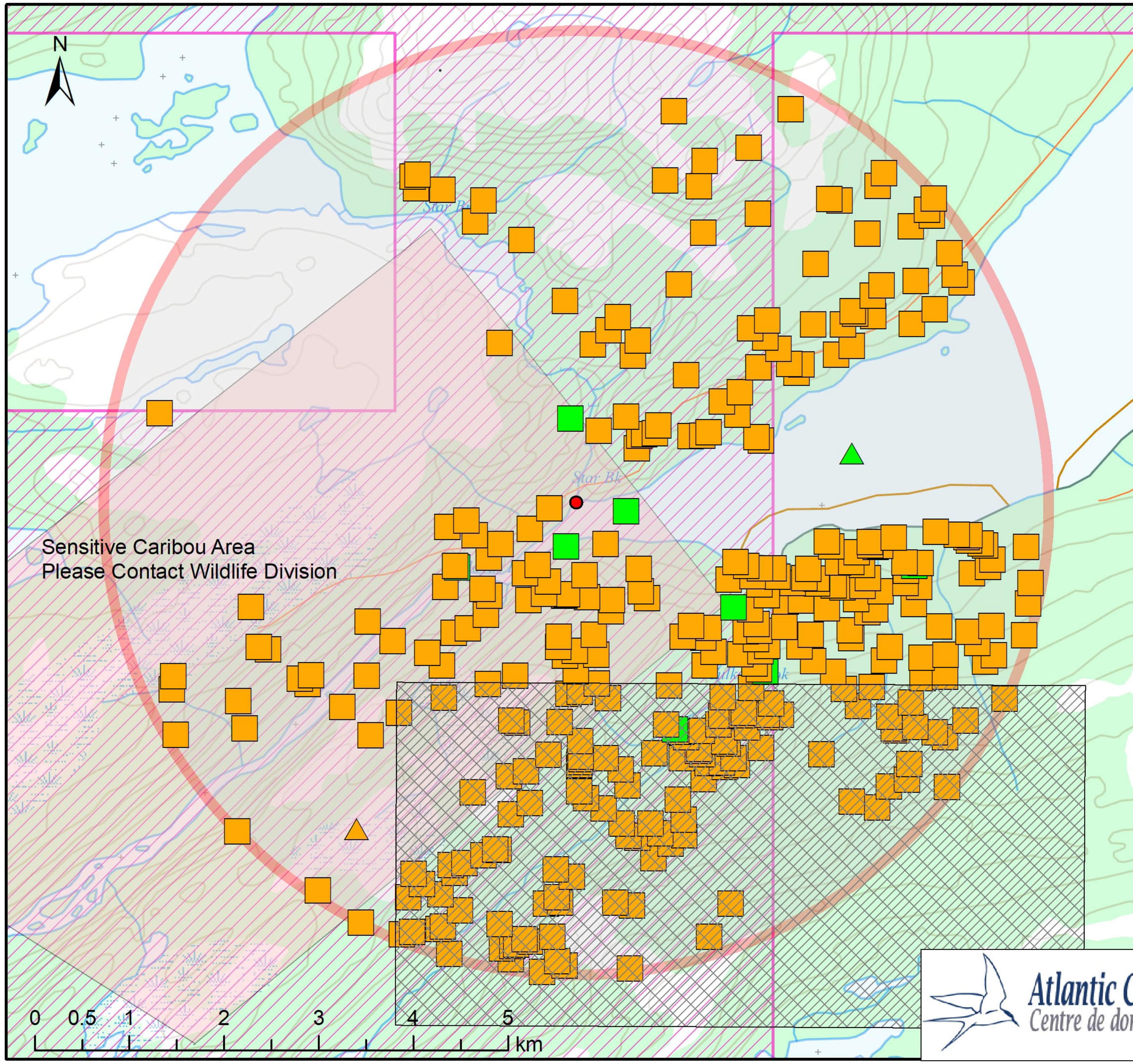
All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY AC CDC Map Paradise River		
DATE: 2023-10-20	FIGURE 7	

Document Path: C:\Users\TOEW75256\OneDrive - Hatch Ltd\MILMOC\SedModelling\Delft\Modelling\Map w Title Block - TSS.mxd



GIS Scan of Rare and Provincially/Federally Listed Species for Star Lake Point of Interest in Newfoundland and Labrador



Legend

- Point of Interest (POI)
- 5 km Buffer Around POI
- Bat Hibernacula Area
- Sensitive Wildlife Area
- Nfld Marten Critical Habitat

Rare Flora

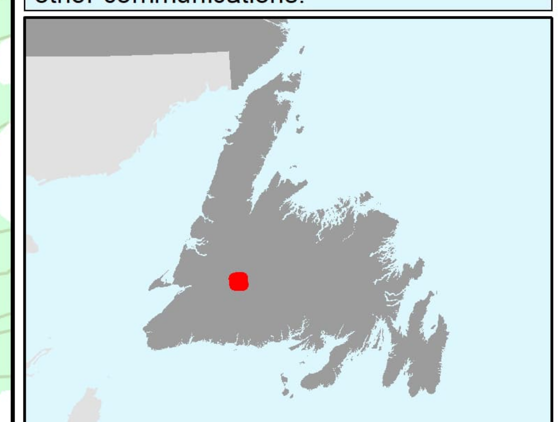
- 100m Accuracy
- 1000m Acc.

Rare Fauna

- 100m Accuracy
- 1000m Accuracy

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique

NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Star Lake.

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

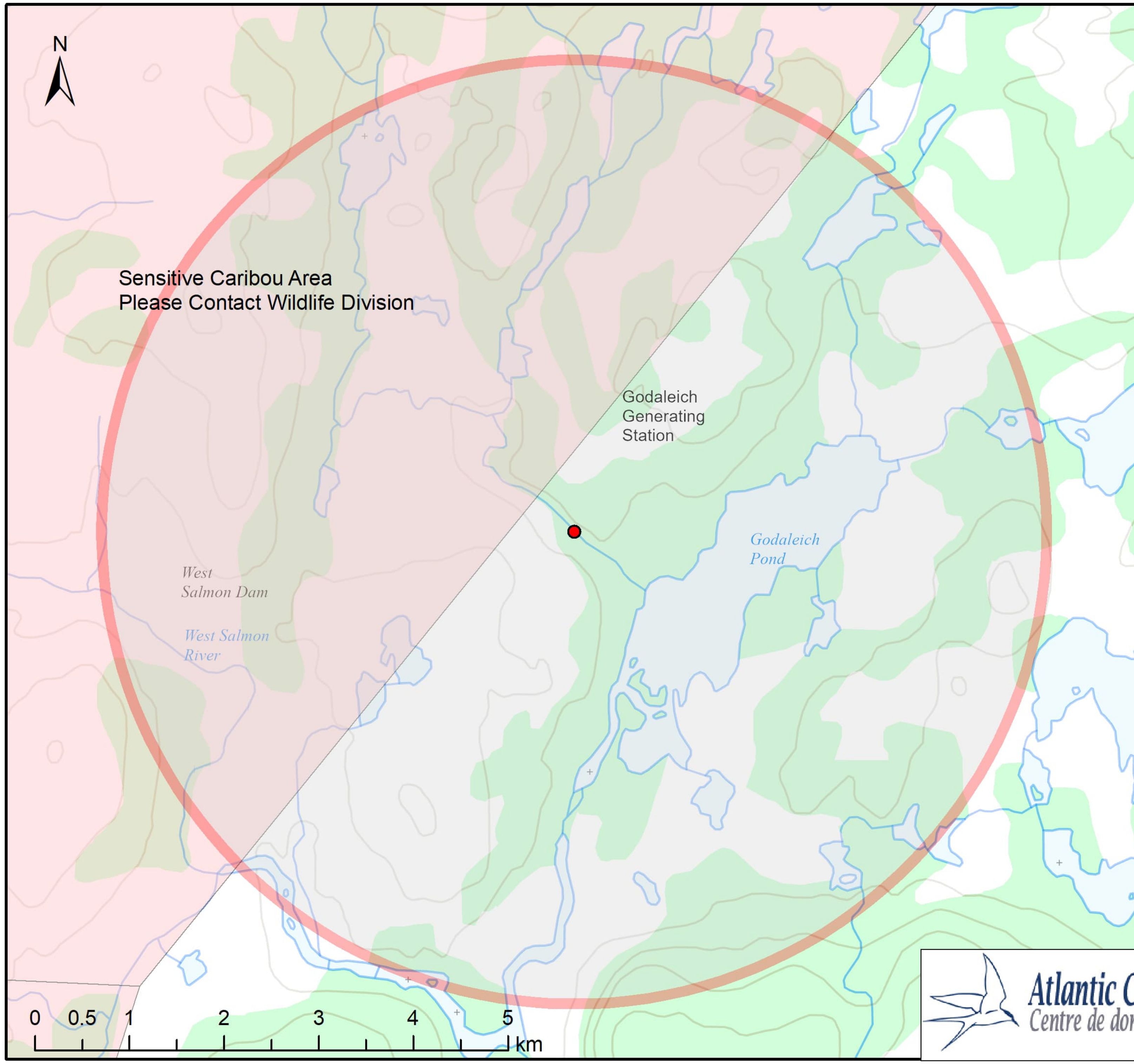
HATCH | HATCH DOCUMENT NUMBER: | REV. 0

NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

AC CDC Map
Star Lake

DATE: 2023-10-20 | FIGURE 8

GIS Scan of Rare and Provincially/Federally Listed Species for Upper Salmon Point of Interest in Newfoundland and Labrador

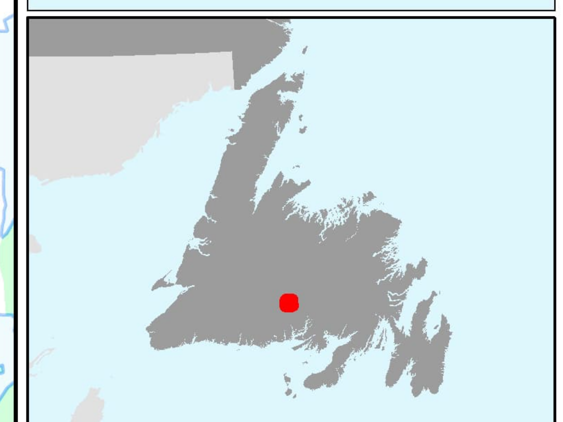


Legend

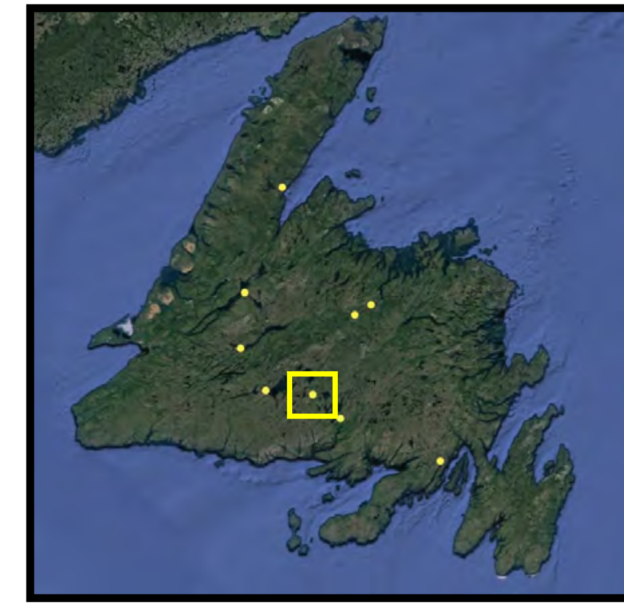
- Point of Interest (POI)
- 5 km Buffer Around POI
- Sensitive Wildlife Area

Atlantic Canada Conservation Data Centre
May 28, 2023
For: Hatch Ltd.
Data Request: RQ1051

Datum: Transverse Mercator NAD83
Note: Interpretations of this map should always be conducted in relation with data provided in spreadsheets and any other communications.



Atlantic Canada Conservation Data Centre
Centre de données sur la conservation du Canada atlantique



NOTES

Map identifying rare species received from Atlantic Canada Conservation Data Centre (AC CDC) for Upper Salmon.

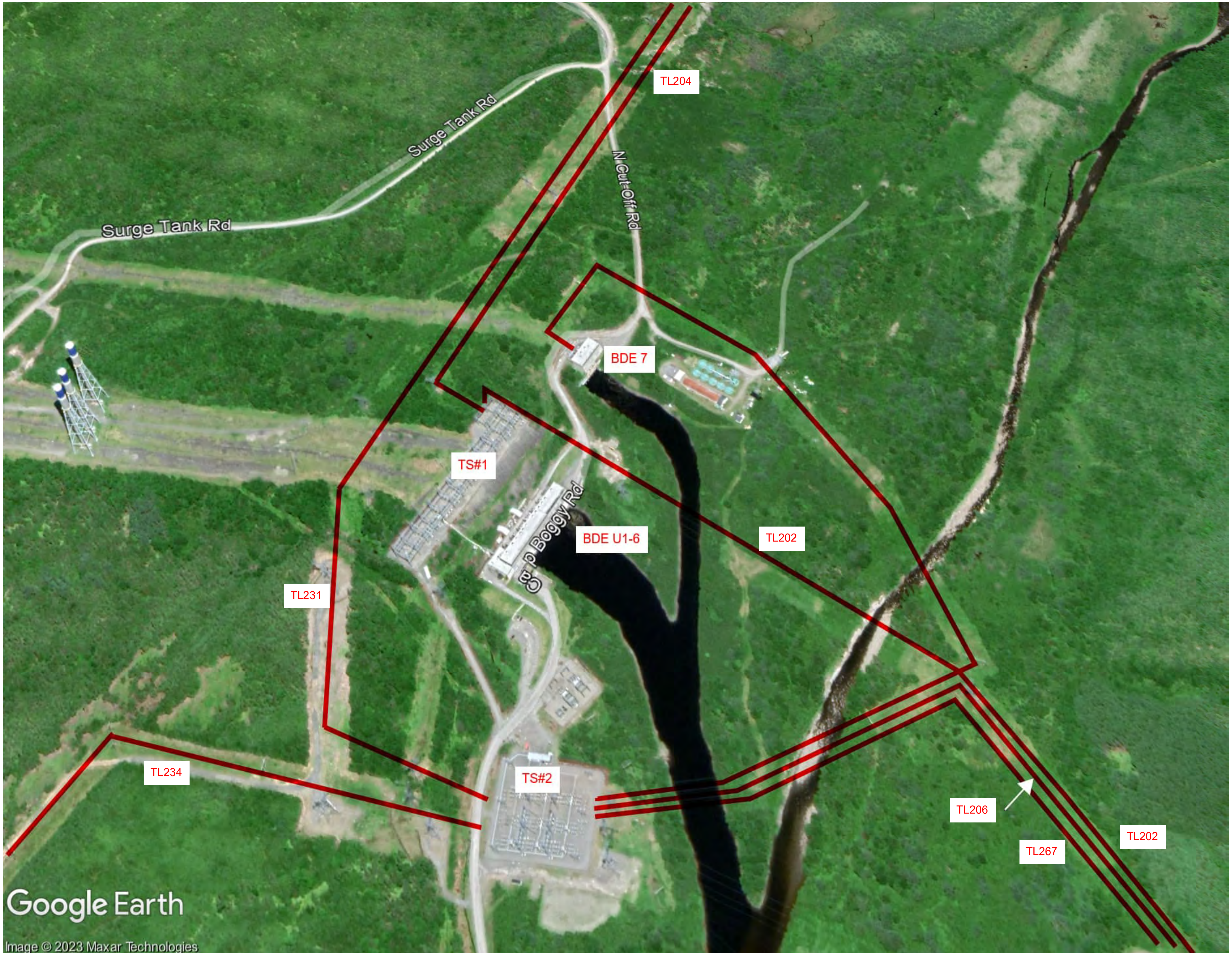
All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

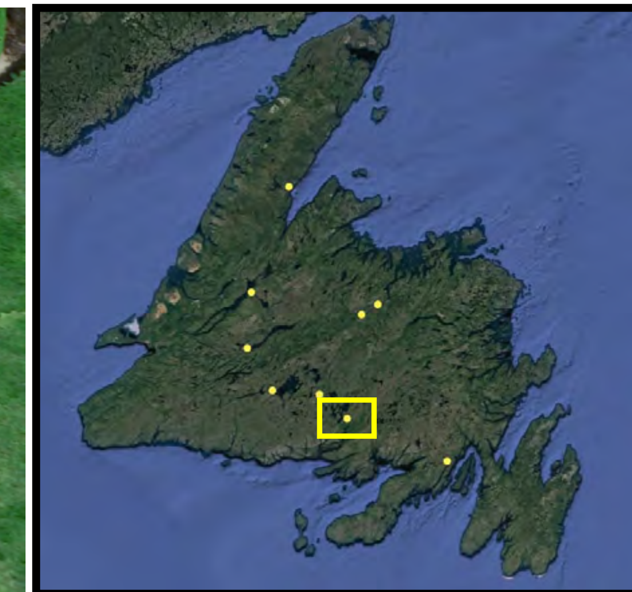
HATCH | HATCH DOCUMENT NUMBER: | REV. 0

NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

AC CDC Map
Upper Salmon

DATE: 2023-10-20 | FIGURE 9





LEGEND

230kV Transmission Lines

TS#1 - Terminal Station No. 1

TS#2 - Terminal Station No. 2

BDE U1-6 - Bay d'Espoir Units 1 to 6

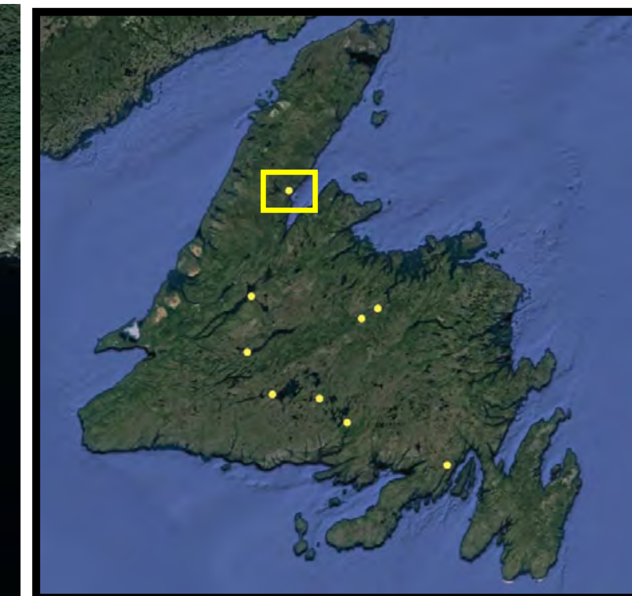
BDE 7 - Bay d'Espoir Unit 7

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION BAY D'ESPOIR PLANT		
DATE: 2023-10-20	FIGURE 1	


LEGEND
66kV Transmission Line
NOTES
Bishop's Falls Plant
Fallsview Municipal Park
NLC Liquor Express at Bishop's...
Krista's Clover Farm
Denine's Classic Cuts
Mill Rd
Main St
Mayor Ave
Sydney St
Google Earth
Image © 2023 CNES / Airbus
Image © 2023 Airbus
HATCH
NEWFOUNDLAND AND LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY
TRANSMISSION INTERCONNECTION
BISHOP'S FALLS PLANT
REV. 0
DATE: 2023-10-20
FIGURE 2
H371390-0000-200-230-0001-AP0C, Page 2 of 9



LEGEND

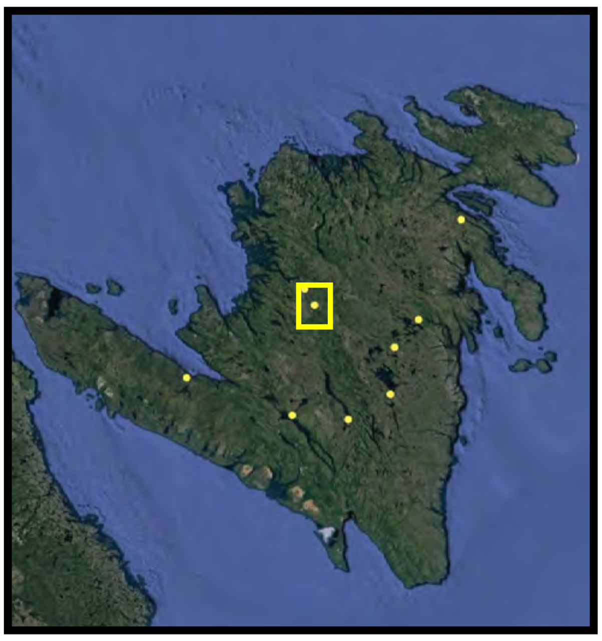
230kV Transmission Line

CAT U1-2 - Cat Arm Units 1 and 2

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION CAT ARM PLANT		
DATE: 2023-10-20	FIGURE 3	



LEGEND

230kV Transmission Line

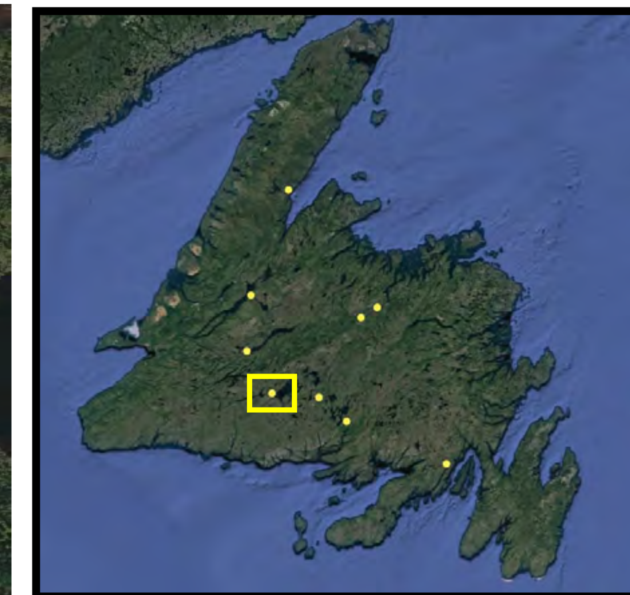
STB TS - Stony Brook Terminal Station

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:
REV:	0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY	
TRANSMISSION INTERCONNECTION GRAND FALLS PLANT	
DATE: 2023-10-20	FIGURE 4

H371390-0000-200-230-0001-AP0C, Page 4 of 9



LEGEND

230kV Transmission Lines

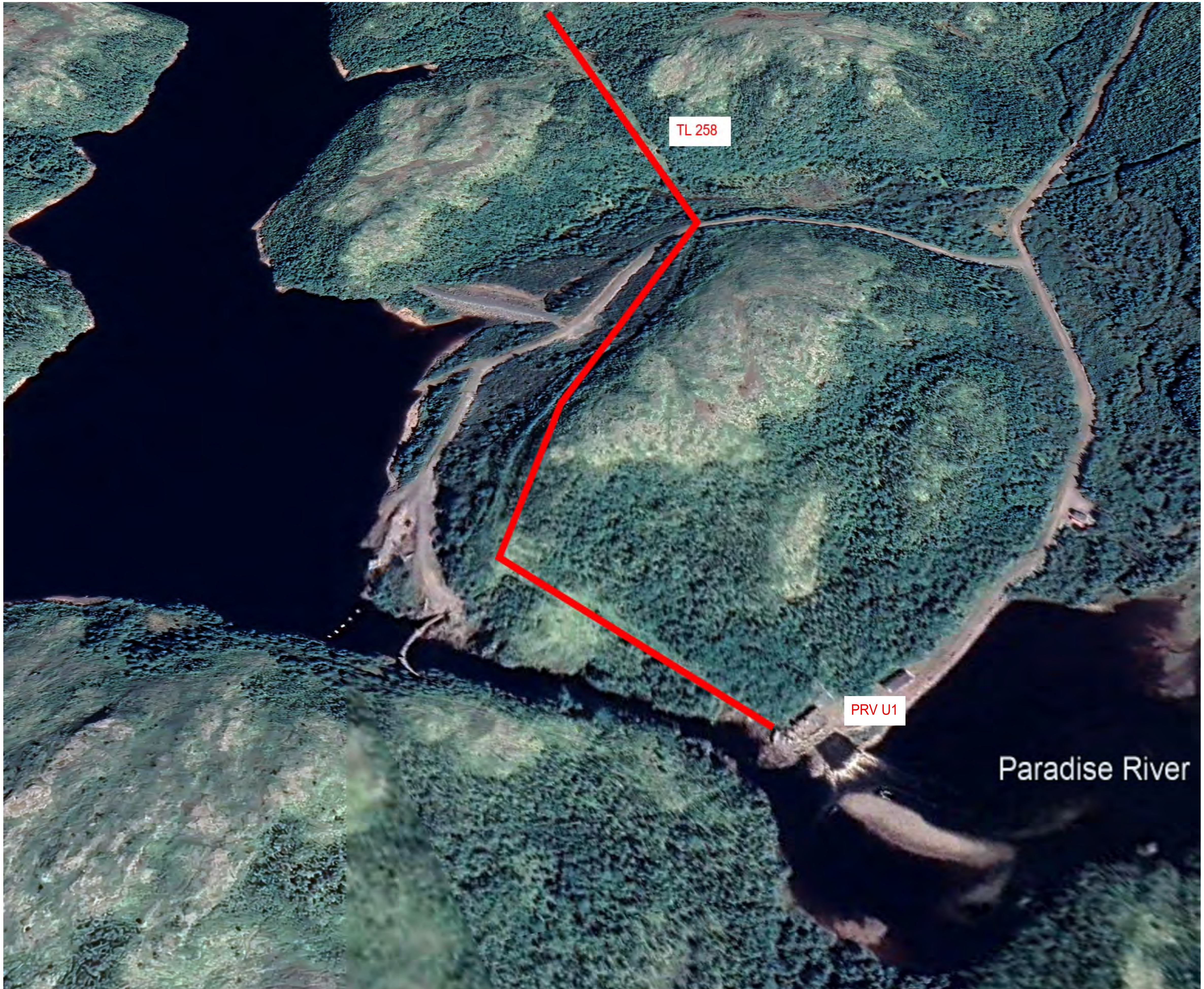
GCL U1 - Granite Canal Unit 1

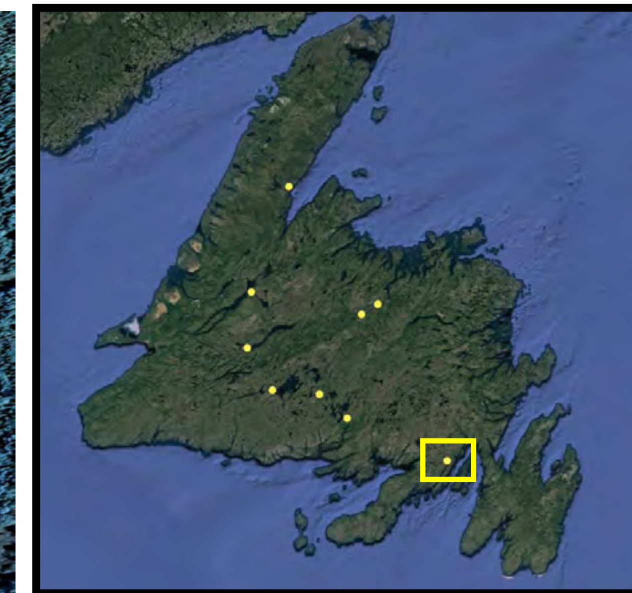
GCL TS - Granite Canal Terminal Station

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION GRANITE CANAL PLANT		
DATE: 2023-10-20	FIGURE 5	





LEGEND

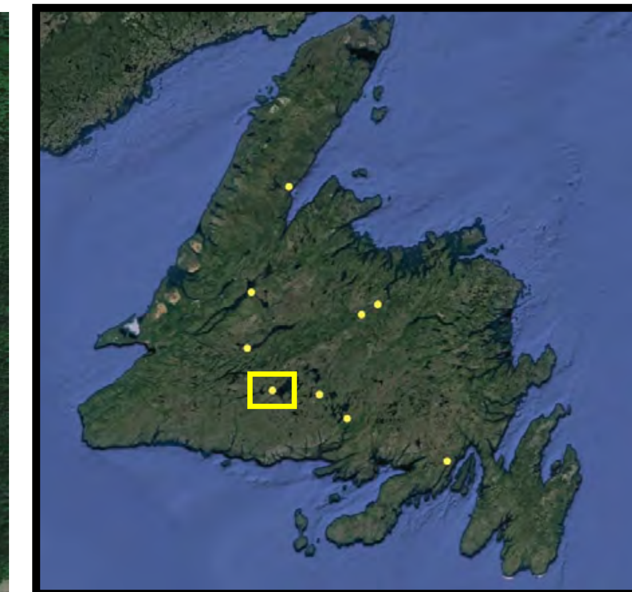
25kV Distribution Line

PRV U1 - Paradise River Unit 1

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION PARADISE RIVER PLANT		
DATE: 2023-10-20	FIGURE 7	



LEGEND

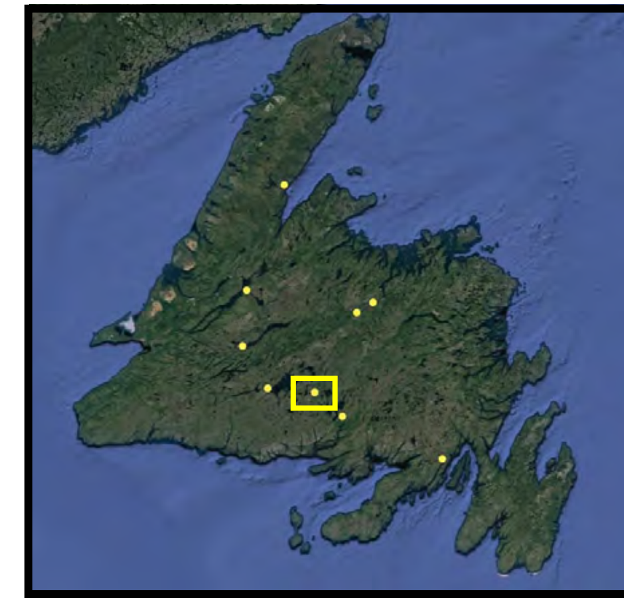
138kV Transmission Line

SLK U1 - Star Lake Unit 1

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION STAR LAKE PLANT		
DATE: 2023-10-20	FIGURE 8	



LEGEND

230kV Transmission Lines

USL U1 - Upper Salmon Unit 1

NOTES

All units are metric and in metres unless otherwise specified.
Transverse Mercator Projection, NAD 1983, Zone 14
Elevations are in metres above sea level (MSL)

HATCH	HATCH DOCUMENT NUMBER:	REV. 0
NEWFOUNDLAND AND LABRADOR HYDRO PUMP STORAGE FEASIBILITY STUDY TRANSMISSION INTERCONNECTION UPPER SALMON PLANT		
DATE: 2023-10-20	FIGURE 9	

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Appendix B
Conceptual Drawings

H371390-0000-221-271-0000

NEWFOUNDLAND & LABRADOR HYDRO
PUMP STORAGE
FEASIBILITY STUDY

DRAWING LIST		
#	DRAWING NUMBER	TITLE - DESCRIPTION
1	H371390-0000-221-271-0000	PACKAGE - COVER SHEET & DRAWING LIST
2	H371390-0000-221-271-0001	HINDS LAKE - LAYOUT 1 - 46 MW PUMPHOUSE - SITE PLAN AND PROFILE
3	H371390-0000-221-271-0002	STAR LAKE - LAYOUT 1 - 11 MW PUMPHOUSE - SITE PLAN AND PROFILE
4	H371390-0000-221-271-0003	HINDS LAKE - LAYOUT 2 - 200 MW REVERSIBLE PS - SITE PLAN AND PROFILE
5	H371390-0000-221-271-0004	STAR LAKE - LAYOUT 2 - 200 MW REVERSIBLE PS - SITE PLAN AND PROFILE

FOR INFORMATION ONLY

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hydro

DRAWING No.	DRAWING TITLE
-	-

REFERENCE DRAWINGS

Hatch Ltd. Permit to Practice
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No.	DESCRIPTION	BY	CHK'D	DATE
0	ISSUED FOR USE	DS	JC	2023-10-20
A	ISSUED FOR INFORMATION	DS	JC	2023-08-04

REVISIONS

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	D. SALAZAR	NR	2023-08-04
DESIGNER	D. GREENFIELD	NR	2023-08-04
CHECKER	J. CORONADO	NR	2023-08-04
DESIGN COORD.		NR	2023-08-04
RESP. ENG.		NR	2023-08-04
LEAD DISC. ENG.		NR	2023-08-04
ENG. MANAGER		NR	2023-08-04
PROJ. MANAGER	J. LAW	NR	2023-08-04

DRAWING APPROVAL STATUS:

NEWFOUNDLAND & LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

PACKAGE
COVER SHEET & DRAWING LIST

SCALE: NTS OR AS NOTED
DWG. No. H371390-0000-221-271-0000
REV 0
SHEET SIZE: A1

Plotted: Oct 20, 2023 - 1:26pm Drawing: C:\Users\solo18470\Downloads\H371390-0000-221-271-0000.dwg

H371390-0000-221-271-0001

PLAN
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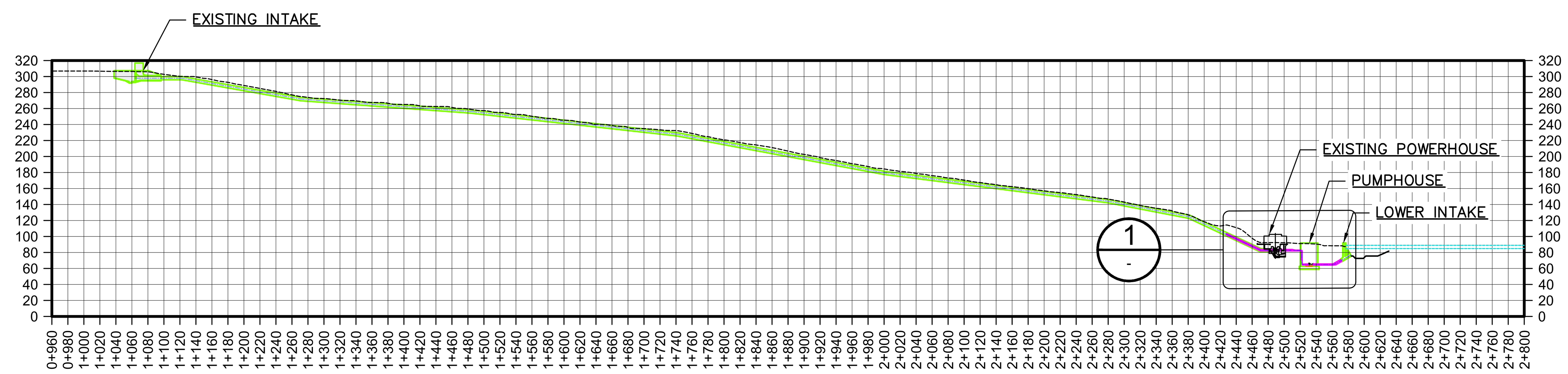

PROFILE
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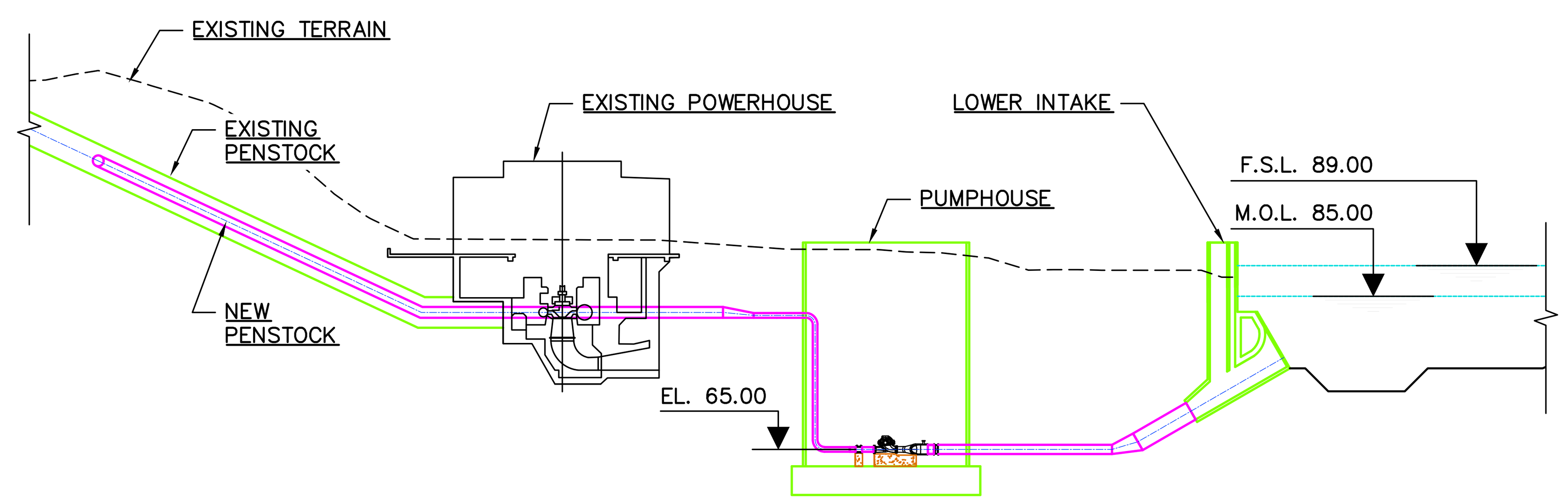

DETAIL 1
SCALE: 1:750

10 m 0 1:750 40 m
50 m 0 1:5000 250 m

FOR INFORMATION ONLY

HATCH

newfoundland labrador hydro

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	D. SALAZAR	NR	2023-08-04
DESIGNER	D. GREENFIELD	NR	2023-08-04
CHECKER	J. CORONADO	NR	2023-08-04
DESIGN COORD.		NR	2023-08-04
RESP. ENG.		NR	2023-08-04
LEAD DISC. ENG.		NR	2023-08-04
ENG. MANAGER		NR	2023-08-04
PROJ. MANAGER	J. LAW	NR	2023-08-04

DRAWING APPROVAL STATUS:

No.	DESCRIPTION	BY	CHK'D	DATE
0	ISSUED FOR USE	DS	JC	2023-10-20
A	ISSUED FOR INFORMATION	DS	JC	2023-08-04

REVISIONS

Hatch Ltd. Permit to Practice APEGA - P03481
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DRAWING No.	DRAWING TITLE
-	-

REFERENCE DRAWINGS

NEWFOUNDLAND & LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

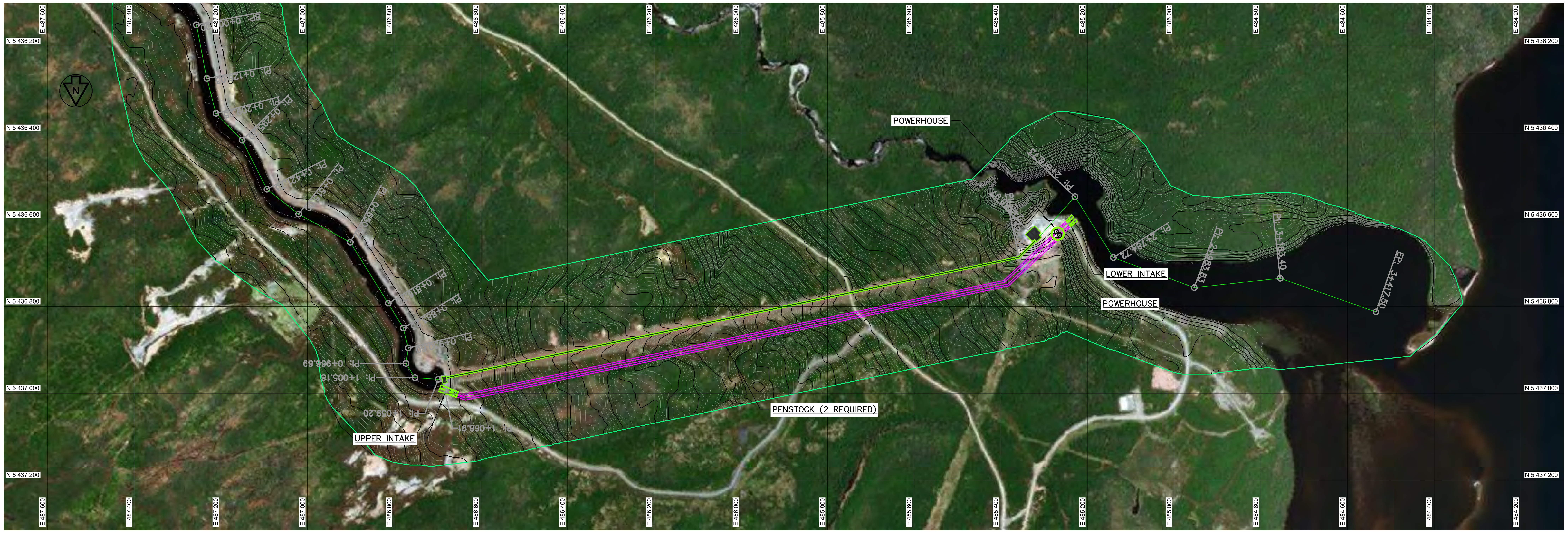
HINDS LAKE
LAYOUT 1 - 46 MW PUMPHOUSE
SITE PLAN AND PROFILE

SCALE: NTS OR AS NOTED
DWG. No. H371390-0000-221-271-0001
REV 0
SHEET SIZE: A1

Plotted: Oct 20, 2023 – 1:26pm Drawing: C:\Users\sslo18470\Downloads\H371390-0000-221-271-0001.dwg


NEWFOUNDLAND & LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY
STAR LAKE
LAYOUT 1 - 11 MW PUMPHOUSE
SITE PLAN AND PROFILE
DWG. No. H371390-0000-221-271-0002
REV 0
SHEET SIZE: A1
SCALE NTS OR AS NOTED
HATCH
FOR INFORMATION ONLY
DRAFTSPERSON D. SALAZAR
DESIGNER D. GREENFIELD
CHECKER J. CORONADO
DESIGN COORD.
RESP. ENG.
LEAD DISC. ENG.
ENG. MANAGER
PROJ. MANAGER J. LAW
ROLE NAME SIGNATURE DATE
DRAWING APPROVAL STATUS:
0 ISSUED FOR USE DS JC 2023-10-20
A ISSUED FOR INFORMATION DS JC 2023-08-04
No. DESCRIPTION BY CHK'D DATE
REVISIONS
Hatch Ltd. Permit to Practice APEGA - P03481
REG. PROFESSIONAL
DRAWING No. DRAWING TITLE
REFERENCE DRAWINGS
SITE PLAN
SCALE: 1:5000
PROFILE
SCALE: 1:5000
DETAIL
SCALE: 1:500
EXISTING POWERHOUSE
LOWER INTAKE
PUMPHOUSE
EXISTING PENSTOCK
EXISTING INTAKE
EXISTING TERRAIN
F.S.L. 158.00
M.O.L. 154.00
EL. 138.00
H371390-0000-221-271-0002

H371390-0000-221-271-0003



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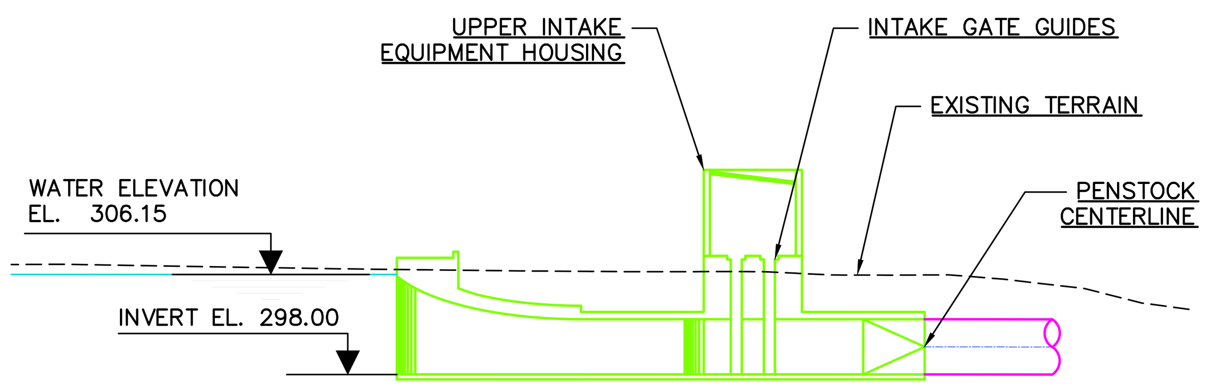

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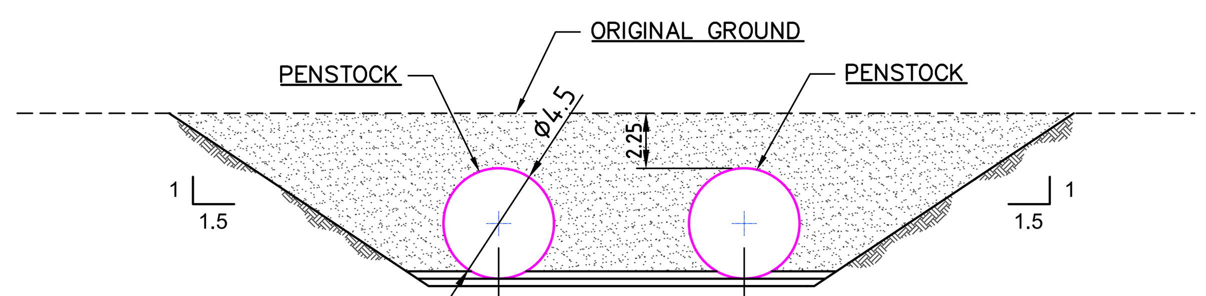

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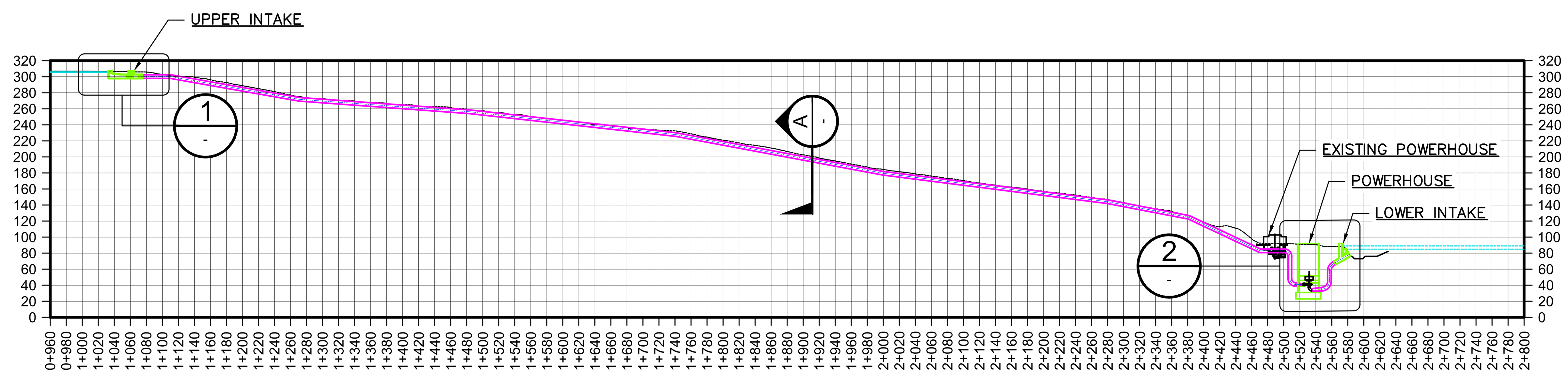
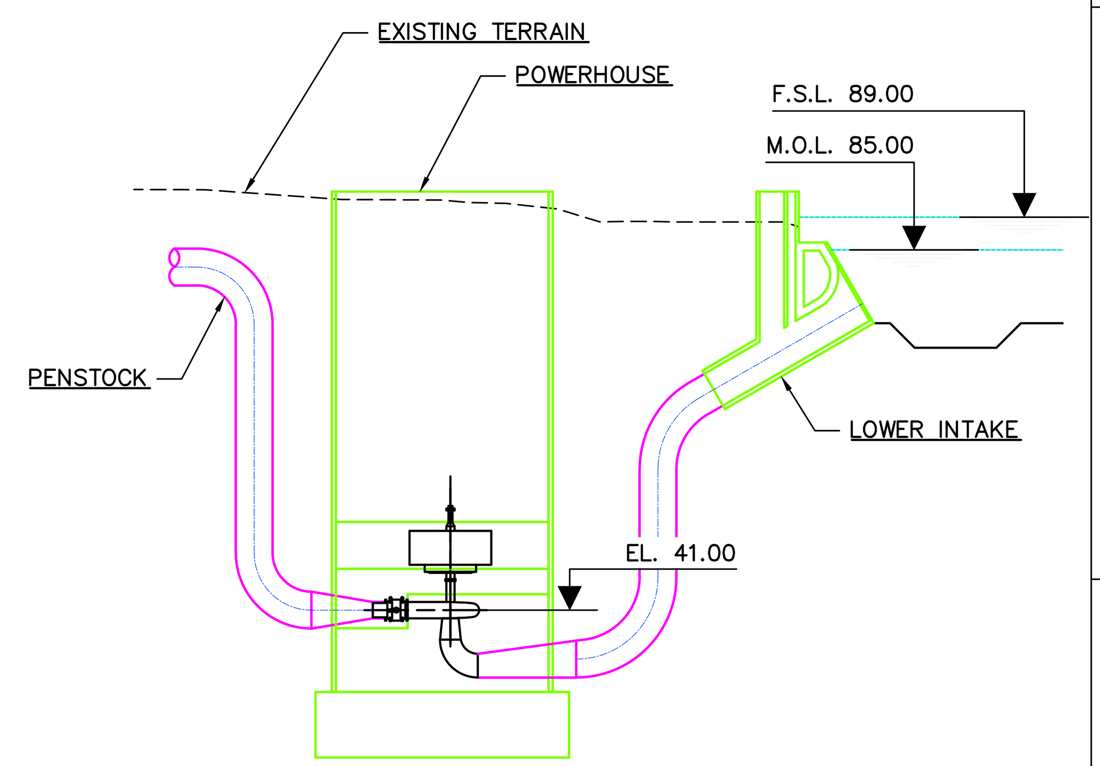


PROFILE
SCALE: 1:5000



DETAIL 2
SCALE: 1:750

5 m 0 1:500 25 m
10 m 0 1:750 40 m
50 m 0 1:5000 250 m

FOR INFORMATION ONLY

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hydro

No.	DESCRIPTION	BY	CHK'D	DATE
0	ISSUED FOR USE	DS	JC	2023-10-20
A	ISSUED FOR INFORMATION	DS	JC	2023-08-04

REVISIONS

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	D. SALAZAR	NR	2023-08-04
DESIGNER	D. GREENFIELD	NR	2023-08-04
CHECKER	J. CORONADO	NR	2023-08-04
DESIGN COORD.		NR	2023-08-04
RESP. ENG.		NR	2023-08-04
LEAD DISC. ENG.		NR	2023-08-04
ENG. MANAGER		NR	2023-08-04
PROJ. MANAGER	J. LAW	NR	2023-08-04

DRAWING APPROVAL STATUS:

DRAWING No.	DRAWING TITLE
-	-

REFERENCE DRAWINGS

Hatch Ltd. Permit to Practice
APEGA - P03481
REG. PROFESSIONAL

NEWFOUNDLAND & LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

HINDS LAKE
LAYOUT 2 - 200 MW REVERSIBLE PS
SITE PLAN AND PROFILE

SCALE: NTS OR AS NOTED
DWG. No. H371390-0000-221-271-0003
REV 0
SHEET SIZE: A1

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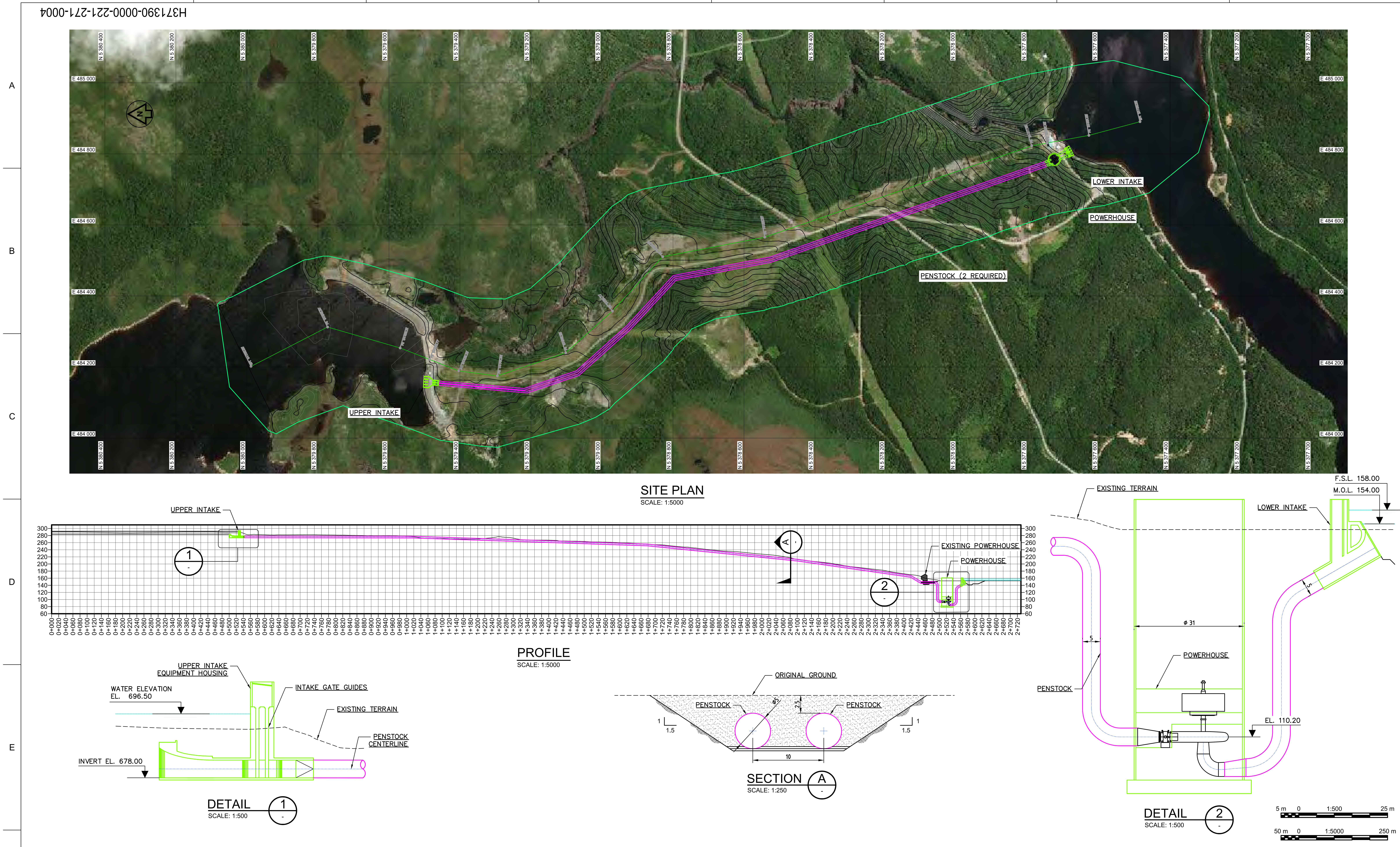

FOR INFORMATION ONLY

HATCH

hydro

No.	DESCRIPTION	BY	CHK'D	DATE
0	ISSUED FOR USE	DS	JC	2023-10-20
A	ISSUED FOR INFORMATION	DS	JC	2023-08-04

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	D. SALAZAR	NR	2023-08-04
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CHECKER	J. CORONADO	NR	2023-08-04
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LEAD DISC. ENG.		NR	2023-08-04
ENG. MANAGER		NR	2023-08-04
PROJ. MANAGER	J. LAW	NR	2023-08-04

DRAWING APPROVAL STATUS:

REVISIONS

DRAWING No. | DRAWING TITLE

REFERENCE DRAWINGS

Hatch Ltd. Permit to Practice APEGA - P03481

REG. PROFESSIONAL

NEWFOUNDLAND & LABRADOR HYDRO
PUMP STORAGE FEASIBILITY STUDY

STAR LAKE
LAYOUT 2 - 200 MW REVERSIBLE PS
SITE PLAN AND PROFILE

SCALE: NTS OR AS NOTED
DWG. No. H371390-0000-221-271-0004
REV 0

SHEET SIZE: A1

Plotted: Oct 20, 2023 - 1:26pm Drawing: C:\Users\sds18470\Downloads\H371390-0000-221-271-0004.dwg

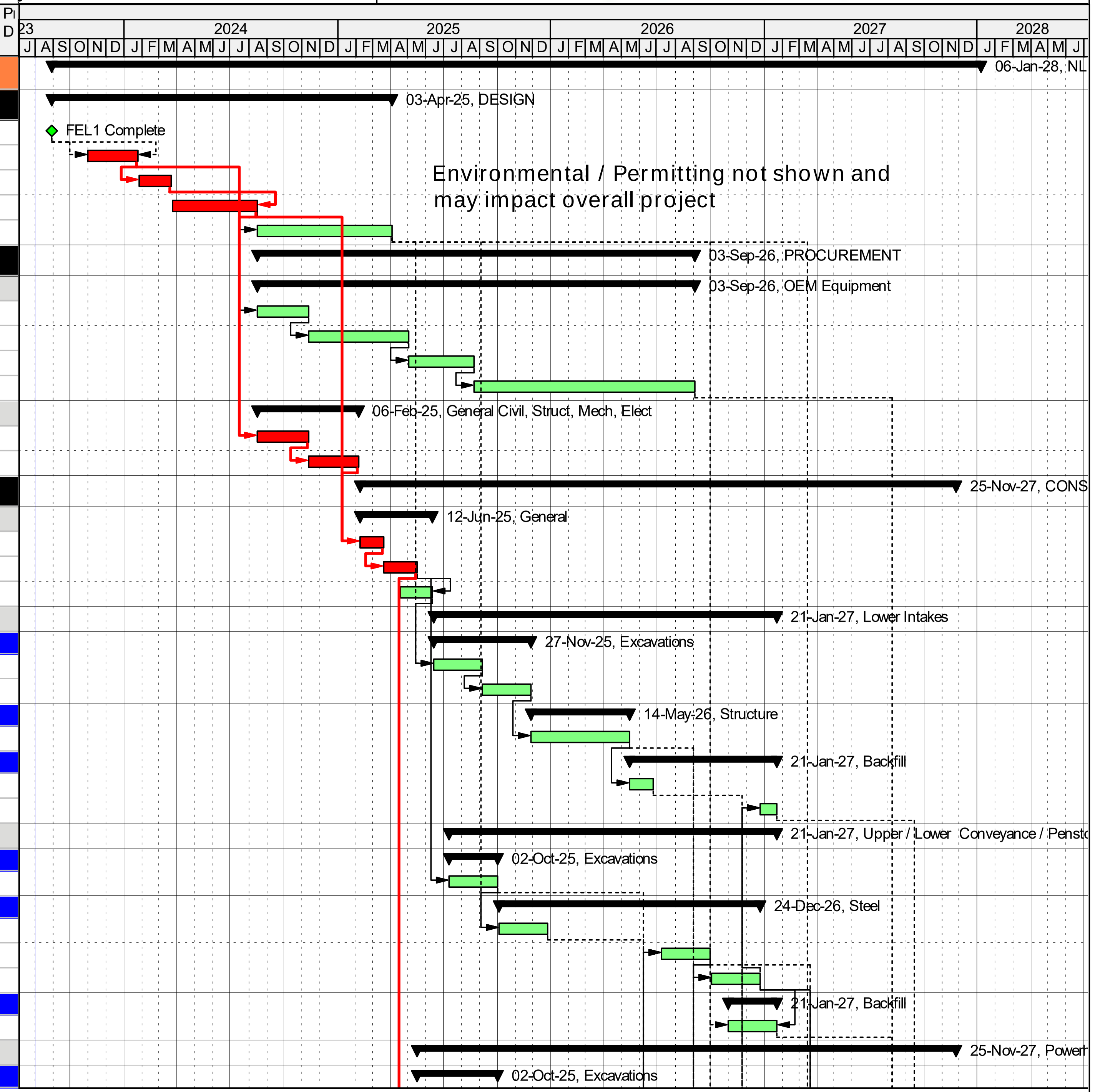
Appendix C
Schedules

HATCH

Newfoundland & Labrador Hydro
Pump Storage Feasibility Study
Layout 1 Project Schedule

newfoundland labrador hydro

Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
NL Hydro Pump Station		1121	31-Aug-23	06-Jan-28	0
DESIGN		401	31-Aug-23	03-Apr-25	170
A1040	FEL1 Complete	0		31-Aug-23*	40
A1000	FEL2	60	31-Oct-23	25-Jan-24*	0
A1010	Site Investigations	40	26-Jan-24	22-Mar-24	0
A1020	FEL3 (Includes Excavation Drawings IFC)	100	25-Mar-24	15-Aug-24	0
A1030	FEL4	160	16-Aug-24	03-Apr-25	170
PROCUREMENT		530	16-Aug-24	03-Sep-26	100
OEM Equipment		530	16-Aug-24	03-Sep-26	100
A1050	Specification	60	16-Aug-24	11-Nov-24	100
A1060	Bid, Eval, Award	120	12-Nov-24	01-May-25	100
A1070	Engineering	80	02-May-25	21-Aug-25	100
A1080	Fabrication & Delivery Pumps (16M ARO)	270	22-Aug-25	03-Sep-26	100
General Civil, Struct, Mech, Elect		120	16-Aug-24	06-Feb-25	0
A1090	Contract Bid Package	60	16-Aug-24	11-Nov-24	0
A1100	Bid, Eval, Award	60	12-Nov-24	06-Feb-25	0
CONSTRUCTION		730	07-Feb-25	25-Nov-27	0
General		90	07-Feb-25	12-Jun-25	120
A1110	Mobilization	30	07-Feb-25	20-Mar-25	0
A1120	Site Clearing & Grubbing	40	21-Mar-25	15-May-25	0
A1340	Access Road relocation	40	18-Apr-25	12-Jun-25	120
Lower Intakes		420	13-Jun-25	21-Jan-27	190
Excavations		120	13-Jun-25	27-Nov-25	120
A1140	Lower Intake Cofferdam	60	13-Jun-25	04-Sep-25	120
A1190	Lower Intake Excavations / Slope Stabilization	60	05-Sep-25	27-Nov-25	120
Structure		120	28-Nov-25	14-May-26	120
A1180	Lower Intake Structure	120	28-Nov-25	14-May-26	120
Backfill		180	15-May-26	21-Jan-27	190
A1370	Lower Intake Backfill / Riprap	30	15-May-26	25-Jun-26	320
A1380	Lower Intake Remove Cofferdam	20	25-Dec-26	21-Jan-27	190
Upper / Lower Conveyance / Penstock		400	11-Jul-25	21-Jan-27	120
Excavations		60	11-Jul-25	02-Oct-25	160
A1210	Penstock Excavation	60	11-Jul-25	02-Oct-25	160
Steel		320	03-Oct-25	24-Dec-26	20
A1220	Penstock Installation & Tie in to Existing	60	03-Oct-25	25-Dec-25	160
A1310	Vertical Shaft Installation (Upper Conveyance)	60	10-Jul-26	01-Oct-26	20
A1360	Inlet Connection Penstock (Lower Conveyance)	60	02-Oct-26	24-Dec-26	20
Backfill		60	30-Oct-26	21-Jan-27	120
A1410	Backfill	60	30-Oct-26	21-Jan-27	120
Powerhouse		660	16-May-25	25-Nov-27	0
Excavations		100	16-May-25	02-Oct-25	0

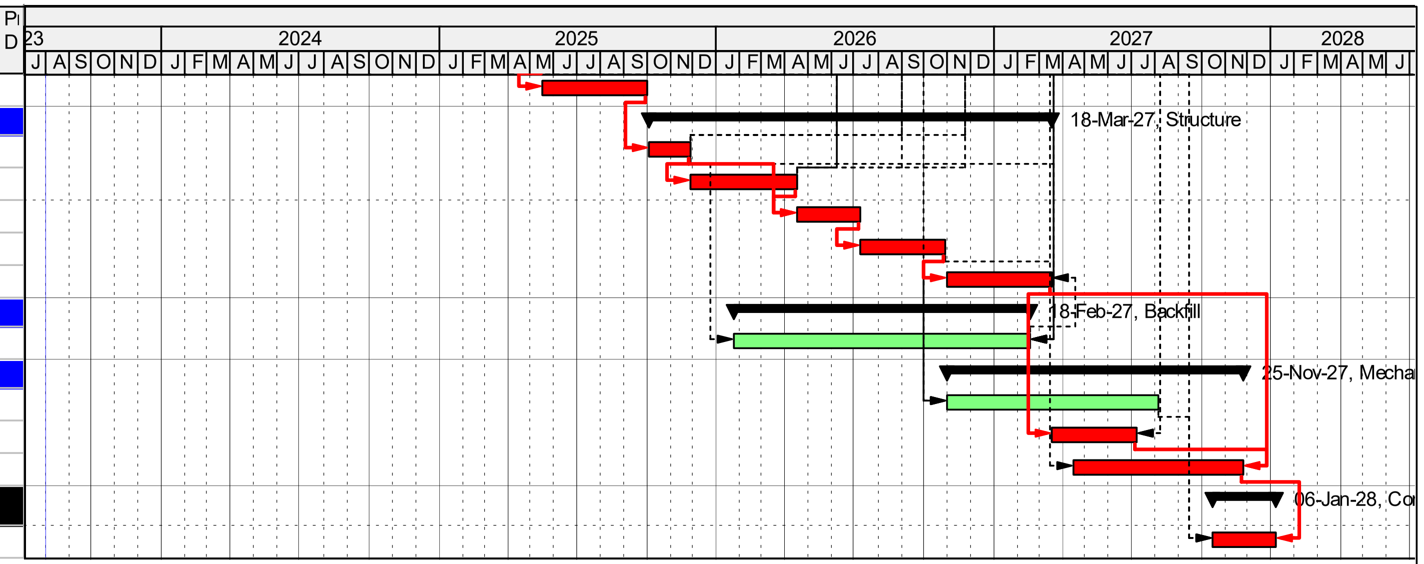


Remaining Work | Critical Remaining Work | Actual Work | Milestone | Critical Milestone | Milestone Actual | Summary

Page 1 of 2 Run Time: 09-Aug-23 11:07

Date	Revision	Checked	Approved
02-Aug-23	Draft for Review		
09-Aug-23	Pumphouse - Issued for Use	JC	JL

Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
A1170	Pumphouse Excavation	100	16-May-25	02-Oct-25	0
Structure		380	03-Oct-25	18-Mar-27	0
A1230	Pumphouse Baseslab	40	03-Oct-25	27-Nov-25	0
A1250	Perimeter Walls	100	28-Nov-25	16-Apr-26	0
A1260	OEM Equipment Foundations	60	17-Apr-26	09-Jul-26	0
A1270	Substructure Completion	80	10-Jul-26	29-Oct-26	0
A1290	Building & Gantry Crane Installation	100	30-Oct-26	18-Mar-27	0
Backfill		280	23-Jan-26	18-Feb-27	20
A1280	Backfill as Required	280	23-Jan-26	18-Feb-27	20
Mechanical / Electrical		280	30-Oct-26	25-Nov-27	0
A1400	Install Misc Structural / Mechanical / Electrical / Ventillation	200	30-Oct-26	05-Aug-27	50
A1300	Install Equipment	80	19-Mar-27	08-Jul-27	0
A1320	Install Electrical	160	16-Apr-27	25-Nov-27	0
Commissioning		60	15-Oct-27	06-Jan-28	0
A1350	Commissioning	60	15-Oct-27	06-Jan-28	0



Remaining Work
Critical Remaining Work
Actual Work
Milestone
Critical Milestone
Milestone Actual
Summary

Page 2 of 2 Run Time: 09-Aug-23 11:07

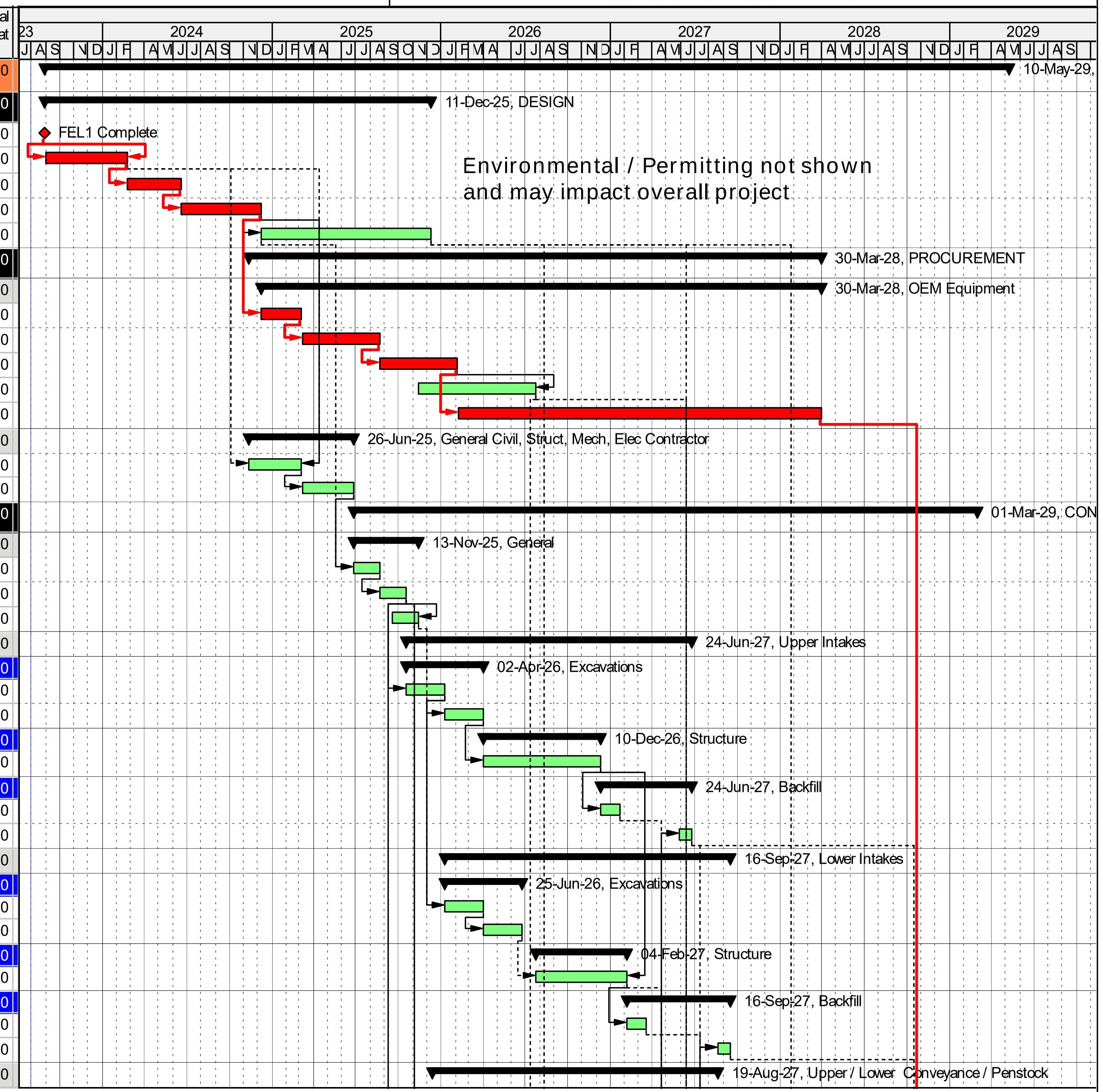
Date	Revision	Checked	Approved
02-Aug-23	Draft for Review		
09-Aug-23	Pumphouse - Issued for Use	JC	JL

HATCH

Newfoundland & Labrador Hydro
Pump Storage Feasibility Study
Layout 2 Project Schedule

newfoundland labrador hydro

Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
NL Hydro 200MW Pumped Storage		1471	31-Aug-23	10-May-29	0
DESIGN		581	31-Aug-23	11-Dec-25	140
A1040	FEL1 Complete	0		31-Aug-23*	0
A1000	FEL2	120	01-Sep-23	23-Feb-24*	0
A1010	Site Investigations	80	26-Feb-24	18-Jun-24	0
A1020	FEL3	120	19-Jun-24	09-Dec-24	0
A1030	FEL4	260	10-Dec-24	11-Dec-25	140
PROCUREMENT		880	12-Nov-24	30-Mar-28	0
OEM Equipment		860	10-Dec-24	30-Mar-28	0
A1050	Specification	60	10-Dec-24	06-Mar-25	0
A1060	Bid, Eval, Award	120	07-Mar-25	21-Aug-25	0
A1070	Engineering	120	22-Aug-25	05-Feb-26	0
A1390	Fabrication & Delivery Draft Tubes	180	14-Nov-25	23-Jul-26	40
A1080	Fabrication & Delivery PTG (32M ARO)	560	06-Feb-26	30-Mar-28	0
General Civil, Struct, Mech, Elec Contractor		160	12-Nov-24	26-Jun-25	20
A1090	Contract Bid Package	80	12-Nov-24	06-Mar-25	20
A1100	Bid, Eval, Award	80	07-Mar-25	26-Jun-25	20
CONSTRUCTION		960	27-Jun-25	01-Mar-29	0
General		100	27-Jun-25	13-Nov-25	220
A1110	Mobilization	40	27-Jun-25	21-Aug-25	20
A1120	Site Clearing & Grubbing	40	22-Aug-25	16-Oct-25	20
A1340	Access Road relocation	40	19-Sep-25	13-Nov-25	220
Upper Intakes		440	17-Oct-25	24-Jun-27	350
Excavations		120	17-Oct-25	02-Apr-26	160
A1130	Upper Intake Cofferdam	60	17-Oct-25	08-Jan-26	160
A1150	Upper Intake Excavations / Slope Stabilization	60	09-Jan-26	02-Apr-26	160
Structure		180	03-Apr-26	10-Dec-26	160
A1160	Upper Intake Structure	180	03-Apr-26	10-Dec-26	160
Backfill		140	11-Dec-26	24-Jun-27	350
A1200	Upper Intake Backfill / Riprap	30	11-Dec-26	21-Jan-27	440
A1330	Upper IntakeRemove Cofferdam	20	28-May-27	24-Jun-27	350
Lower Intakes		440	09-Jan-26	16-Sep-27	310
Excavations		120	09-Jan-26	25-Jun-26	180
A1140	Lower Intake Cofferdam	60	09-Jan-26	02-Apr-26	180
A1190	Lower Intake Excavations / Slope Stabilization	60	03-Apr-26	25-Jun-26	180
Structure		140	24-Jul-26	04-Feb-27	160
A1180	Lower Intake Structure	140	24-Jul-26	04-Feb-27	160
Backfill		160	05-Feb-27	16-Sep-27	310
A1370	Lower Intake Backfill / Riprap	30	05-Feb-27	18-Mar-27	420
A1380	Lower Intake Remove Cofferdam	20	20-Aug-27	16-Sep-27	310
Upper / Lower Conveyance / Penstock		440	12-Dec-25	19-Aug-27	80

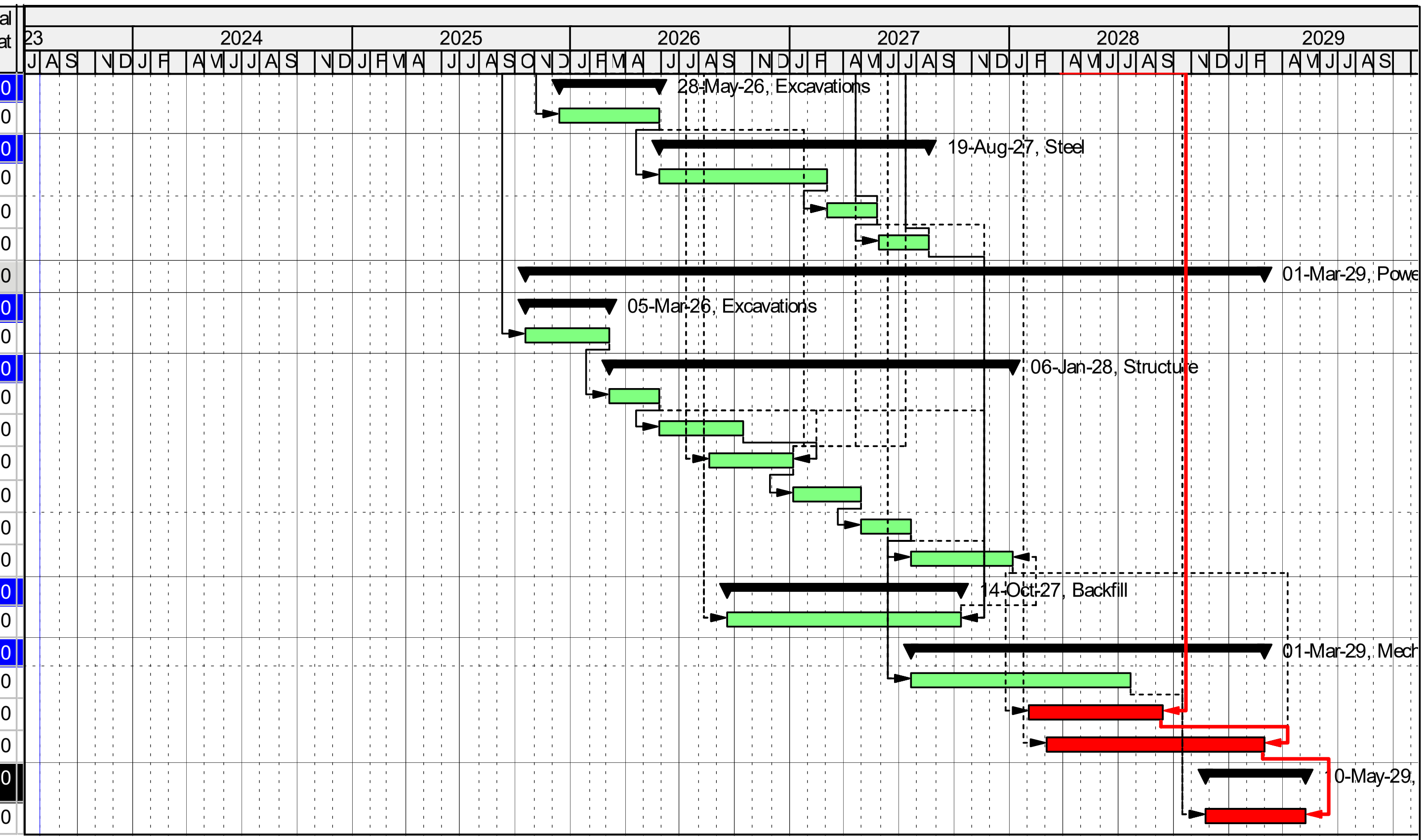


Remaining Work — Critical Remaining Work — Actual Work — Milestone — Critical Milestone — Milestone Actual — Summary

Page 1 of 2 Run Time: 09-Aug-23 11:14

Date	Revision	Checked	Approved
02-Aug-23	Draft for Review		
09-Aug-23	200MW Pumped Storage - Issued for Use	JC	JL

Activity ID	Activity Name	Remaining Duration	Start	Finish	Total Float
Excavations		120	12-Dec-25	28-May-26	80
A1210	Penstock Excavation	120	12-Dec-25	28-May-26	80
Steel		320	29-May-26	19-Aug-27	80
A1220	Penstock Installation	200	29-May-26	04-Mar-27	80
A1310	Vertical Shaft Installation (Upper Conveyance)	60	05-Mar-27	27-May-27	80
A1360	Inlet Connection Penstock (Lower Conveyance)	60	28-May-27	19-Aug-27	80
Powerhouse		880	17-Oct-25	01-Mar-29	0
Excavations		100	17-Oct-25	05-Mar-26	20
A1170	Powerhouse Excavation	100	17-Oct-25	05-Mar-26	20
Structure		480	06-Mar-26	06-Jan-28	20
A1230	Powerhouse Baseslab	60	06-Mar-26	28-May-26	20
A1250	Perimeter Walls	100	29-May-26	15-Oct-26	20
A1240	Draft Tubes Installation & Concrete Pour	100	21-Aug-26	07-Jan-27	20
A1260	OEM Equipment Deck & Foundations	80	08-Jan-27	29-Apr-27	20
A1270	Substructure Completion	60	30-Apr-27	22-Jul-27	20
A1290	Building & Gantry Crane Installation	120	23-Jul-27	06-Jan-28	20
Backfill		280	18-Sep-26	14-Oct-27	80
A1280	Backfill	280	18-Sep-26	14-Oct-27	80
Mechanical / Electrical		420	23-Jul-27	01-Mar-29	0
A1400	Install Misc Structural / Mechanical / Electrical / Ventillation	260	23-Jul-27	20-Jul-28	90
A1300	Install Equipment	160	04-Feb-28	14-Sep-28	0
A1320	Install Electrical	260	03-Mar-28	01-Mar-29	0
Commissioning		120	24-Nov-28	10-May-29	0
A1350	Commissioning	120	24-Nov-28	10-May-29	0



Remaining Work | Critical Remaining Work | Actual Work | Milestone | Critical Milestone | Milestone Actual | Summary

Page 2 of 2 Run Time: 09-Aug-23 11:14

Date	Revision	Checked	Approved
02-Aug-23	Draft for Review		
09-Aug-23	200MW Pumped Storage - Issued for Use	JC	JL

Appendix D
Basis of Estimate

H371390-0000-621-620-0001

HATCH

Newfoundland and Labrador Hydro
Pump Storage Feasibility Study
H371390

Project Controls Report
Cost Estimating
Basis of Estimate

Report

Basis of Estimate

H371390-0000-621-610-0001

PROVINCE OF NEWFOUNDLAND
PEG Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
CLASS "A"
This Permit Allows
HATCH LTD.
MIRC # 02780
To practice Professional Engineering in Newfoundland and Labrador
Permit No. as issued by PEG-NL D0090
which is valid for the year 2023

			[p.p]			
2023-10-20	0	Approved for Use	V. Tillous	J. Coronado	J. Law	T. Chislett
DATE YYYY-MM-DD	REV.	STATUS	PREPARED BY	CHECKED BY	APPROVED BY	APPROVED BY

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Appendix A Estimate Summaries

Appendix B Detailed Estimate

1. Introduction

Newfoundland Labrador Hydro (NL Hydro) has engaged Hatch to review the feasibility of converting any of 9 (nine) existing hydro generating facilities identified prior to this study, into a Pump Storage (PS) facility, while utilizing the existing infrastructure.

In a previous task a Pugh Analysis was used to rank the sites that showed PS potential. Based on the findings of this initial report, Hinds Lake and Star Lake were selected by NL Hydro to proceed into the AACE Class 5 cost estimate phase.

This document has been prepared by the Project Estimating Manager on behalf of the Project Manager to document the assumptions associated with the Capital Cost estimate preparation for the Pumped Storage Feasibility Study

The audience for this document includes the NL Hydro and the Hatch project team.

2. Scope of Work

As per the initial scope of work (Layout 1) each of the selected sites has been assessed with the underlying assumption that no modifications are to be done to the existing stations or conveyance and that the proposed PS facilities would utilize the existing equipment as part of the overall arrangement. This assumption limits the PS capacity of each potential site to the generation capacity already available.

In addition to the base scope, Hatch has presented a 200 MW Reversible Pump/Turbine Station option (Layout 2) to further investigate the potential of each site.

This document presents estimates for both project sites and both layout options.

2.1 Layout 1

In Layout 1 the existing infrastructure and facilities would be used for generation and a new pumphouse would be constructed for the pumping operation.

The pump station's primary dimensions and design flows have been sized so that the pump flow is equivalent to half of the generation flow. Operationally this would mean that the pump station would be operated 16 hours a day and the generation station would operate at full capacity 8 hours a day. These assumptions should be revisited during subsequent phases.

The following list contains the new primary project components that are required for the development of Layout 1 and are shown in Figure 2-1.

- Upper Conveyance (Connection Penstock)
- Pump Station
- Lower Conveyance
- Lower Intake.

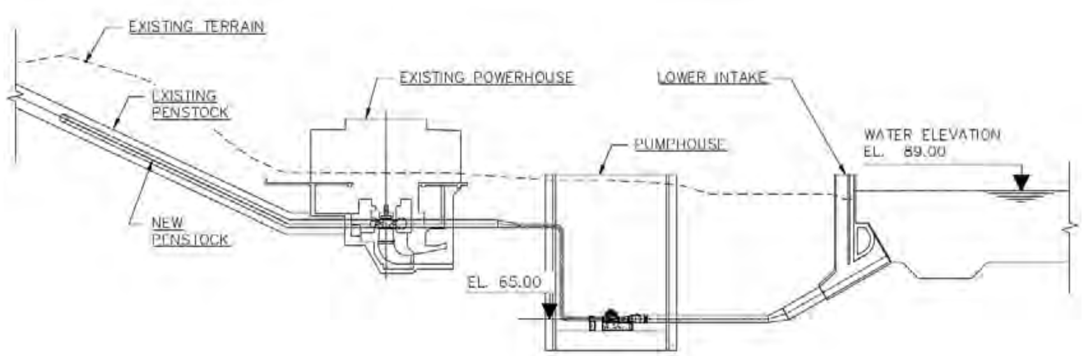

Figure 2-1: Pump Station Profile View

2.2 Layout 2

Layout 2 relaxes the previous limiting assumption of utilizing the existing conveyance and generating facilities for the PS project. A new standalone 200 MW PS development has been considered for this option.

The following list contains the new project components that are required for the development of Layout 2 and shown in Figure 2-2, Figure 2-3 and Figure 2-4.

- Upper Intake
- Penstock
- Pump-Generating Station
- Lower Conveyance
- Lower Intake.

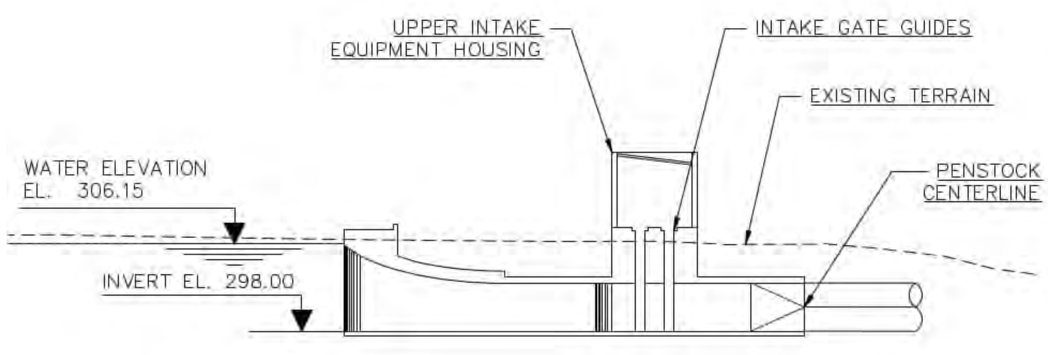

Figure 2-2: Layout 2 - New Upper Intake Type

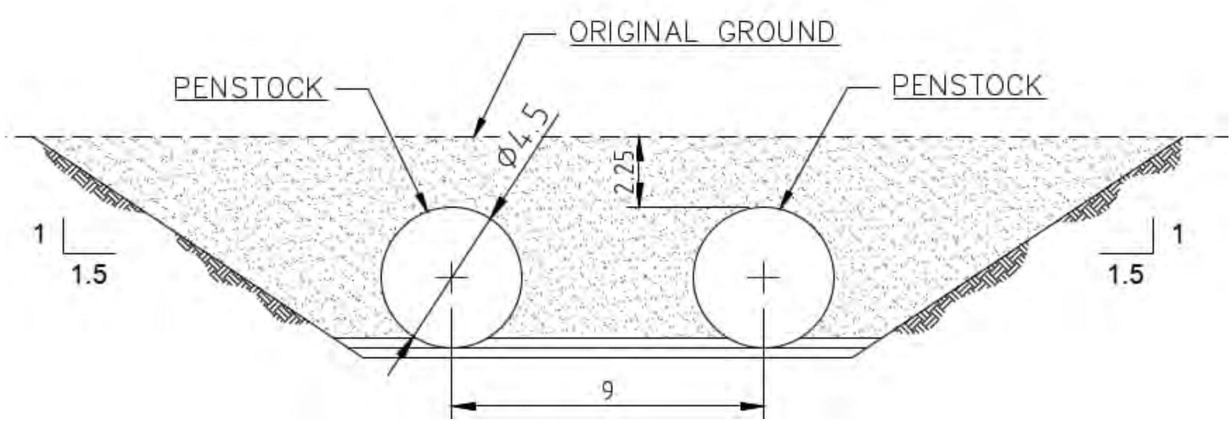

Figure 2-3: Layout 2 - New Buried Penstock Section

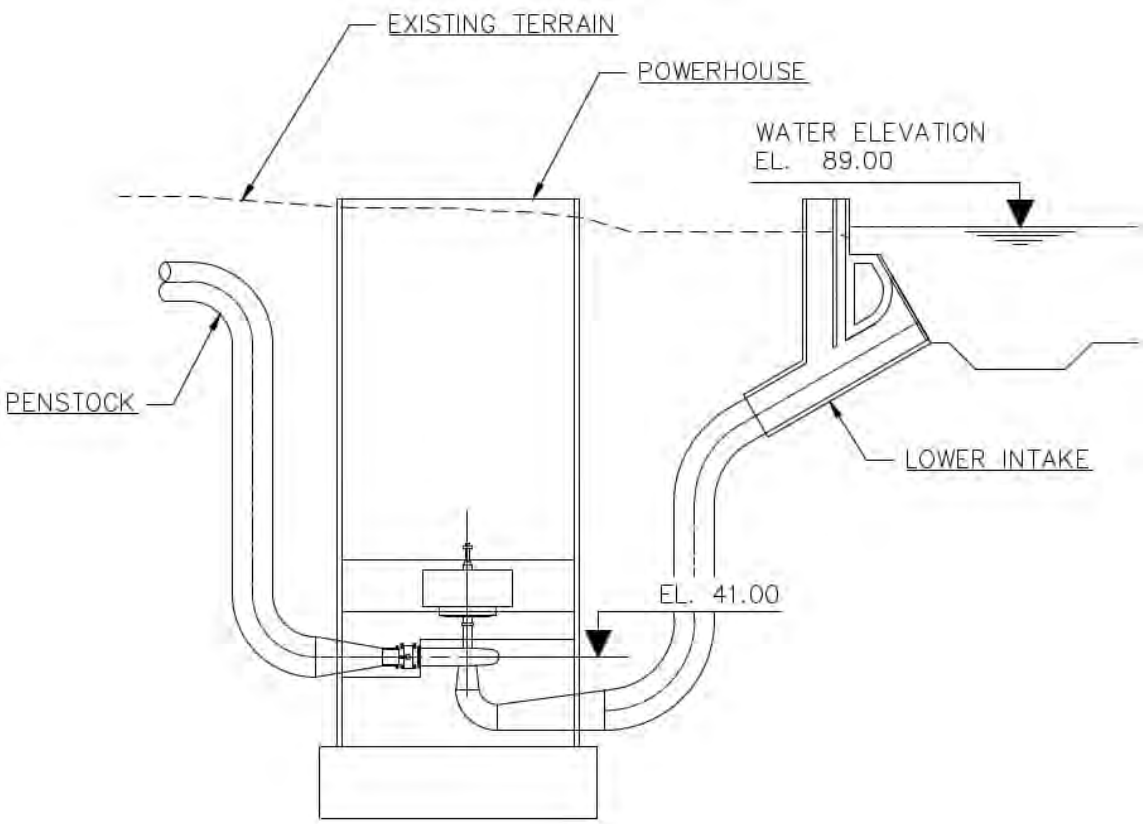

Figure 2-4: Layout 2 - New Silo Type Powerhouse

3. Definitions, Acronyms and Abbreviations

The following terms, acronyms and abbreviations are defined for use in this document.

3.1 Acronyms & Abbreviations

Table 3-1: Acronyms & Abbreviations

Abbreviation or Term	Meaning or Definition
CAPEX	Capital Expenditures
MTO	Material Take-Off
MEL	Mechanical Equipment List
DC	Direct Cost
IC	Indirect Cost
BOP	Balance of Plant
MCAD	Millions of Canadian Dollars

4. Estimating Tools

The estimate has been produced in MS Excel and delivered in .pdf and .xlsx formats. This Basis of Estimate (BoE) is delivered in PDF format.

5. Estimate Summary

5.1 Estimate Summary Level 1 Tabulation

Table 5-1 presents a summary of the estimates for each of the four options.

Table 5-1: Estimate Summary Level 1 Tabulation (MCAD)

WBS	Hinds Lake Option 1 (40MW)	Star Lake Option 1 (11MW)	Hinds Lake Option 2 (200MW)	Star Lake Option 2 (200MW)
00000 – General (excluded)	-	-	-	-
10000 – Temporary Works	1.0	1.0	22.3	22.3
20000 – Access and Site Plan	0.3	0.3	0.5	0.5
30000 – Project Components	65.6	28.2	414.4	574.1
70000 – Indirect Cost	27.5	10.8	152.0	198.3
80000 - Contingency	28.3	12.1	176.8	238.6
90000 – Owner's Costs (excluded)	-	-	-	-
TOTAL CAPEX	**122.6**	**52.4**	**766.0**	**1,033.7**

5.2 Accuracy Statement

The capital cost estimate for all the options was prepared in accordance with the AACE guidelines for Conceptual study: Class 5 estimate. The anticipated level of accuracy is -50%/+100%.

The estimate is based on limited information, conceptual designs, configurations, equipment sizing, and a location chosen primarily based on photographs and team experience. No site visits and very limited design were undertaken to support the design, conceptual layout and ultimately the estimate. The estimating method is based on discipline MTO (from the conceptual design), and equipment supply, and installation costs based on Hatch experience, while factoring for the remaining disciplines / trades.

The estimate relies significantly on the general experience of the project team and leverages information from similar projects and in-house benchmarks.

5.3 Exclusions, Assumptions and Qualifications

The capital cost estimate was compiled based on the following assumptions and qualifications:

- The estimate is commensurate with the level of engineering done to date and in accordance with the level of project development outlined in the AACE guidelines for a Class 5 estimate. Design effort limited to a single Conceptual General Arrangement for each layout.
- Costs for Generation Units are based on the experience of the team.
- Preliminary discipline MTO and equipment list obtained from conceptual design.
- "All-in" unit pricing for the supply and installation of bulk commodities (bulk earthworks, concrete, steel, buildings) based on Hatch in-house data for the region.
- Factored indirect cost estimates. Factors are based on Hatch benchmarks from similar past projects.
- Labour rates based on local base rates and Hatch in-house data for projects located in the region.
- An estimate base date of nominally Q2 2023.
- All costs provided in Canadian Dollars.
- All costs exclusive of escalation beyond the base date.
- Owner's cost excluded.
- Goods and services taxes and sales taxes not included.
- None of the pricing for commodities, the design / supply of equipment or construction contracts is based on quotations or contracts.

5.3.1 Exclusions

The following items are specifically excluded from the capital cost estimate.

- Auxiliary facilities and utilities such as, administration buildings, changing rooms, permanent camp, warehouse, parking lots, water supply system, sewage, and drainage systems, and other of similar nature.
- Access road upgrading or other logistical improvements required for construction.
- Switch yard and transmission line are excluded from the scope of work. The estimate does not include anything related to interconnection downstream of the main transformer.
- Pre-Commercial production costs that occur after facilities are handed over to the Owner are excluded.
- Sustaining capital costs and closure costs. The capital cost estimate is limited to costs to project construction and complete pre-operational testing.
- Estimate based on EPCM or Design – Bid – Build execution model. The estimate does not include a risk premium for EPC.
- Allowances for significant changes to the scope of the Project.
- Allowances for either:
    - General project risks that could affect any project (such as variations in market conditions, that could affect equipment, commodities and / or labour costs, labour unrest, disputes with residents including local indigenous groups, geotechnical or process related design issues, delays due to the late receipt of equipment or materials, poor performance by contractors, force majeure, etc.)
    - Risks that are specific to this Project.
- Allowance for the risks associated with the provincial political, legal, or regulatory environment, including:
    - The risk of changes to any laws, regulations, rules, or policies, or the governmental or judicial interpretation thereof.
    - The risk of Client failing to comply with any such laws, regulations, rules or policies and the costs of any resulting penalties, fines, suits, etc.
    - The risk of Client not being able to obtain or maintain any permits, licenses and other authorisations required for the Project.
- Costs associated with lost time due abnormal weather events.
- Costs associated with schedule delays.

6. Estimate Basis

6.1 Foreign Currency Basis

All prices are provided in Canadian Dollars.

6.2 Escalation

All database prices appropriately escalated to the estimate base date.

Future escalation excluded beyond estimate base date.

6.3 Provisional Sums and Allowances

6.3.1 Design Growth

Previous project experience indicates that there is a gap between what is known and identified during the estimating process and what is expected during the execution or construction phase. A design growth allowance is a subjective amount added to the MTO based on the degree of engineering completed and a comparison to historical experience of the expected quantity. Design growths have been included in the MTO provided by engineering, according with the present development from preliminary model.

6.3.2 Growth Allowances

Growth allowance only applies on items for which a quantity was estimated. This growth is only applicable to net quantities provided by engineering in the form of a detailed MTO obtained from the conceptual design.

Table 6-1: Growth percentages

Trade	Growth %
Site development	25%
Earthworks	25%
Concrete	20%
Structural Steel	20%

7. Structure & Coding

7.1 Work Breakdown Structure (WBS)

The estimate development has followed the standard Hatch approach and utilizes a defined Work Breakdown Structure (WBS). The WBS is a logical division and sub-division of the work into a 4-level hierarchical manner. Within the WBS, the Project is divided into Areas, Facilities, and Sub-facilities or Systems. The WBS is enclosed in Appendix A of this document.

7.2 Commodity Codes

Commodity Codes are used to collect the estimate items into groups of work of a similar nature or discipline. The standard Commodity Code is an alpha character which is directly aligned with the project standard discipline descriptions.

Table 7-1: Commodity Codes Used

Commodity Codes Used	
A	Site Development
C	Concrete
D	Roadwork
E	Earthworks
F	Architectural
J	Control and Instrumentation
L	Electrical Equipment and bulks
M	Mechanical Equipment
N	Mechanical Platework and Tanks
P	Minor pipe Work and Fittings
S	Steel
Y	Indirect
Z	Contingency
X	Owner’s Cost (Excluded)

7.3 Cost Codes / Resource Types

A resource is the smallest level of detail with which a cost may be associated and represents the basic “building blocks” from which the capital cost estimate is built. One or more resources are used to make up a commodity. As an example, the concrete commodity price may be made up of a combination of individual formwork, rebar, concrete, consumables, plant, and labour resources.

Resources are coded with a unique alpha-numeric code (in a similar way to commodities), and carry the pricing information used in the estimate, including any special attribute, such as foreign currency.

Table 7-2: Resource Types

Cost Code	Resource Type
M	Materials
E	Equipment
L	Labour
S	Subcontract / Complex

8. Direct Costs

Direct costs are generally quantity based and include all the permanent equipment, materials and labour associated with the physical construction of the permanent facility / asset, and includes:

- Supply, assembly, and installation of permanent equipment, gates, and racks.
- Supply, fabrication, and installation of bulk materials. Including conveyances, earthworks, concrete, and structural support needed.
- Supplemental resources for equipment and bulk material installation, such as labour and construction equipment.
- Site preparations (bulk earthworks) and the construction of roads.
- Supply, fabrication and erection of permanent buildings and associated services.
- Contractor's distributable costs such as mobilization and demobilisation, overheads and profit, supervision, general construction equipment including construction cranes, small tools and consumables used in construction, etc.

8.1 Quantities and Costs Summary by Commodity

Table 8-1: Costs by Commodity (MCAD)

Trade	Description	Hinds Lake Option 1 (40MW)	Star Lake Option 1 (11MW)	Hinds Lake Option 2 (200MW)	Star Lake Option 2 (200MW)
A	Temporary works/ Roads	1.3	1.3	22.8	22.8
E	Soil movement	8.9	3.0	126.9	189.9
C	Concrete	18.2	12.2	16.9	60.8
F	Buildings	2.2	2.5	6.0	13.3
S	Steel works	7.3	4.0	127.1	172.6
L	Electrical equipment and bulks	6.1	0.2	11.5	11.5
M	Mechanical equipment	22.9	6.3	125.9	125.9
Y	Indirect Costs	27.5	10.8	152.0	198.3
Z	Contingency	28.3	12.1	176.8	238.6
V	Owner's Costs	-	-	-	-

Table 8-2: Quantities and Costs by Commodity Hinds Lake Option 1 (46 MW)

Work	Unit	Quantity	Cost MCAD	% of DC
Mechanical and Electrical	Gl.	1	28.9	43%
Concrete	m3	5,410	18.2	27%
Soil Movement	m3	178,100	8.9	13%
Steel works	mt	270	7.3	11%
Buildings	m2	530	2.2	3%
Other	Gl.	1	1.3	2%

Table 8-3: Quantities and Costs by Commodity Star Lake Option 1 (11 MW)

Work	Unit	Quantity	Cost MCAD	% of DC
Mechanical and Electrical	Gl.	1	6.5	22%
Concrete	m3	3,600	12.2	42%
Soil Movement	m3	44,800	3.0	10%
Steel works	mt	150	4.0	14%
Buildings	m2	600	2.5	8%
Other	Gl.	1	1.3	4%

Table 8-4: Quantities and costs by commodity Hinds Lake Option 2 (200 MW)

Work	Unit	Quantity	Cost MCAD	% of DC
Mechanical and Electrical	Gl.	1	137.4	31%
Concrete	m3	5,000	16.9	4%
Soil Movement	m3	1,008,400	126.9	29%
Steel works	mt	6,850	127.1	29%
Buildings	m2	1,420	6.0	1%
Other	Gl.	1	22.8	5%

Table 8-5: Quantities and costs by commodity Star Lake Option 2 (200 MW)

Work	Unit	Quantity	Cost MCAD	% of DC
Mechanical and Electrical	Gl.	1	137.4	23%
Concrete	m3	18,020	60.8	10%
Soil Movement	m3	1,547,000	189.9	32%
Steel works	mt	9,300	172.6	29%
Buildings	m2	3,860	13.3	2%
Other	Gl.	1	22.8	4%

8.2 Basis by Commodity

8.2.1 Permanent Equipment

Mechanical costs consist of permanent equipment and the associated labour costs required to install the equipment.

Main equipment:

- Pumps including low pressure and high-pressure valves.
- BOP equipment (Compressor, tanks, small pumps, fire suppression system, ventilation system, and other).
- Gantry crane.
- Unit heaters and control panels for Gates and trash racks.
- All Pump and Pump / Turbine equipment estimated using in-house database and considering the power generation:

  Option 1:

  - 46MW for Hinds Lake
  - 11MW for Start Lake

  Option 2:

  - 200MW for Hinds Lake
  - 200MW for Start Lake

  No quotes were received for the present conceptual study.

8.2.2 Earthworks and Road works

Quantities provided in the form of Preliminary discipline MTOs obtained from conceptual design. Prices were obtained from an in-house database for similar tasks.

Includes the following tasks:

- Excavation in common soil.
- Excavation in rock.
- Backfill with local material (obtained from excavation).
- Backfill with borrowed/ treated (crushing and screening) materials.

Option 1: Earthworks average All-in Unit rate: $45 CAD/m3.

Option 2: Earthworks average All-in Unit rate: $123 CAD/m3.

8.2.3 *Concrete*

Quantities provided in the form of discipline MTOs obtained from conceptual design. Prices were obtained from an in-house database for similar tasks in the region.

Includes the following tasks:

- Walls.
- Contention and Support (slabs, footings).
- Concrete considered 30MPa – reinforcement: 100 to 150 kg/m3.
- Concrete average All-in Unit rate: $3,300 CAD/m3 (both options).

8.2.4 *Steel work*

Quantities provided in the form of discipline MTOs obtained from conceptual design. Prices by kg were obtained from an in-house database for similar tasks.

Includes the following tasks:

- Connection Penstocks (conveyance).
- Gates.
- Trash racks.
- Rails and supports.

Prices include supply, fabrication, transport, and installation of all steel components.

Option 1: Steel works average all-in Unit rate: $27 CAD/kg.

Option 2: Steel works average all-in Unit rate: $19 CAD/kg.

8.2.5 *Architectural*

Facility buildings quantified by square meter (footprint) according with preliminary site dimensions.

Prices were obtained from an in-house database and include superstructure, services and finishings.

Two principal buildings:

- Powerhouse building.
- Electrical building.

Buildings average all-in unit rate: $4,000 CAD/m2

Auxiliary buildings and utilities, like an administration building, changing rooms, vigilance, parking lots, exterior lighting etc., and any allowance for site enhancement were not included in the present analysis.

8.2.6 *Electrical and Instrumentation*

Main equipment has been estimated using an in-house database.

- Transformers.
- BOP Electrical equipment and bulks (switchgears, battery banks, panels, small transformers, VFDs, MCCs, lighting, grounding, cable, trays, and conduits).

Switchyard and distribution line are excluded from the present conceptual study.

8.2.7 *Piping*

Small piping and insulation allowance has been included with the equipment. No details have been included in the present conceptual study.

8.3 Construction Labour Rate

The scope of installation and construction works varies according to the type of equipment or task. Installation costs are based on either an installation factor of equipment supply cost or installation manhours multiplied by the labour rates. The installation base labour hours are based on standard publications and in-house data and typically includes:

- Equipment unloading and inspection.
- Storage, storage protection, and preventative maintenance.
- Assembly and setting of equipment, levelling, grouting, preliminary and final alignments, and final balancing.
- Labour for first oil fill and cleaning.
- Installation of onboard equipment.
- Contractor mechanical completion testing.
- Contractor Punch-List.
- Touch-up painting.

The labour rate includes the following items:

- Fully burdened labour rate (includes vacation pay, payroll taxes, benefits). Based in Newfoundland average basic wages per position.
- Insurances and incentives.
- Work regime considered: Simple – 10 hours/day x 5 days/week.
- Small tools.
- Expenses.
- Construction equipment.

- Consumables.
- Personal protective equipment.
- Contractors distributable.

8.3.1 *Labour Rate*

For the commodities described in Section 7, where installation hours are applied, an all-inclusive hourly trade labour rate was applied.

Table 8-6: Labour Rates (2023)

Code	Trade	All-in labour man-hr (CAD)
A	Temporary works/ Roads	238.72
E	Soil movement	238.72
C	Concrete	120.32
S	Steel works	145.51
L	Electrical equipment and bulks	140.30
M	Mechanical equipment	169.68

8.4 Productivity, Difficulty and Level of Effort

The chosen Productivity Factor is 1.5 which affects the base productivity for every task and is related to the following deviation conditions:

- Work in open area of easy access (0.90).
- Few contractors, very little unemployment (1.20).
- Low complexity in main tasks (0.90).
- 5% of absenteeism. (1.10).
- Some delays related to normal weather events. (1.10).
- Normal productivity delays during the day (breaks, station cleaning, meetings, etc.) (1.28).

8.5 Indirect cost

Indirect costs were estimated by factoring based on historical information from similar projects and adjusted to account for site specific factors. A description of what is included in Indirect Cost is presented below:

8.5.1 Field Indirect Cost - Temporary Facilities

The cost associated with the Temporary Facilities covers the following items:

- Construction area development including temporary laydown / staging areas, material borrow quarries and stockpiles, temporary roads, etc.
- The supply and installation of temporary utilities infrastructure such as for water, power, fuel storage and distribution.
- Temporary buildings, such as, offices and trailers, ablution blocks, construction camp, etc.
- Site office supplies, furniture.
- Communications systems and local area network required to support the site construction activities.

8.5.2 Field Indirect Cost - Temporary Construction Services

The cost associated with the Temporary Construction Services covers the following items:

- Communications services (phone and internet) required during construction and pre-operational testing.
- Security.
- Potable water distribution during construction.
- Medical services (Emergencies).
- Warehousing.
- Surveying service.
- Cleaning and waste management.

8.5.3 Field Indirect Cost - Construction Mobile Equipment

The Construction Mobile Equipment costs cover construction equipment to be rented directly by the owners (such as heavy lift cranes, warehouse equipment, special scaffolding, man-lifts, etc). The budget includes mobilization, demobilization, fuel, and operators.

8.5.4 Freight and Logistics

The Freight and Logistics covers costs for the transportation of equipment and materials from the anticipated market to the plant site.

8.5.5 Preliminary studies and investigations

Allowance made for following Pre-Feasibility and Feasibility studies and site investigations.

8.5.6 EPCM

It is assumed that equipment supply packages will be grouped as set out in the project execution strategy and that established construction contractors will be engaged to complete the site work.

The cost for EPCM services covers the following:

- Detailed engineering.
- Procurement of equipment, materials, and contracts.
- Construction management.
- Project controls / reporting.
- Project administration.
- Health, Safety and Environmental requirements.
- QA/QC.
- Office expenses, communication, IT services, etc.
- Travel costs associated with the EPCM team.

8.5.7 Spare parts and First Fills

Allowance to cover all the equipment spare parts and consumables needed for commissioning.

This cost does not cover sustainable capital or operation.

9. Owner Costs

The development of Owner's Costs has been excluded from this estimate.

Owner's costs include those tasks that will be managed directly by the Owner. A list of typical Owner's costs is shown below:

- Site security and first aid services.
- Owner's management, general and administrative (G&A) costs including statutory supervision of Contractors and others, required by law.
- Land acquisition and right of way.
- Cost of financing and interest charges during construction.
- Taxes and duties.
- Operational readiness including recruitment and training costs (for operations).
- Technology studies and metallurgical test work.
- Environmental studies and reports.
- Project application, approval and permitting.
- Third-party due diligence reviews and consulting services.
- Insurances.
- In-process inventory.
- Working capital.
- Performance bond premiums.
- Environmental and ecological cost issues.
- Business and operating systems.
- Start-up, hot commissioning, and production ramp up costs.
- Owner's contingency.

10. Contingency

Contingency included in the cost estimate is an allowance for normal and expected items of work which must be performed within the defined scope of work and project execution plan as covered by the cost estimate, but which could not be explicitly foreseen or described at the time the estimate was completed.

The contingency amount is an integral part of the cost estimate, and it should be assumed that contingency will be spent in completing the project. Contingency does not cover potential scope changes, price escalation, currency fluctuations. Contingency does not include allowances for project "event" risks such as labour unrest, blockades, adverse market conditions, force majeure, or any of the items that are specifically excluded from the cost estimate.

Typical uncertainties applicable to contingency:

- Insufficient information due to incomplete engineering and/or lack of vendor or conditions information.
- Equipment or material costs obtained by ratio or update from historical costs or previous estimates.

Contingency allowances have been included as 30% of the sum of the estimated Direct and Indirect costs.

Contingency = 30% x (Direct Costs + Indirect Costs).

Appendix A
Estimate Summaries

Estimate Summaries

WBS	HINDS LAKE Option 1 (46MW) - WBS Description	Total MCAD
0000	**General**	-
0100	**Auxiliary Facilities (Excluded)**	-
0200	**Auxiliary Utilities (Excluded)**	-
1000	**Temporary Works**	**1.0**
2000	**Access and Site Plan**	**0.3**
2100	Site Development	0.3
3000	**Project Components**	**65.6**
3100	**Upper Reservoir (Not part of the scope)**	-
3200	**Upper Inlet/Outlet Structure (Not part of the scope)**	-
3300	**Upstream Conveyance**	**8.4**
3400	**Powerhouse**	**48.4**
3500	**Downstream Conveyance**	**4.9**
3600	**Lower Intake Structure**	**3.9**
	TOTAL DIRECT COST	66.9
70000	**Indirect Cost**	**27.5**
	TOTAL DIRECT AND INDIRECT COST	94.3
80000	**Contingency**	**28.3**
	TOTAL COST + CONTINGENCY	122.6
90000	**Owner's Costs**	-
	TOTAL	122.6

WBS	STAR LAKE Option 1 (11MW) - WBS Description	Total MCAD
0000	**General**	-
0100	**Auxiliary Facilities (Excluded)**	-
0200	**Auxiliary Utilities (Excluded)**	-
1000	**Temporary Works**	**1.0**
2000	**Access and Site Plan**	**0.3**
2100	**Site Development**	**0.3**
3000	**Project Components**	**28.2**
3100	**Upper Reservoir (Not part of the present scope)**	-
3200	**Upper Inlet/Outlet Structure (Not part of the present scope)**	
3300	**Upstream Conveyance**	**5.9**
3400	**Powerhouse**	**20.2**
3500	**Downstream Conveyance**	**0.3**
3600	**Lower Intake Structure**	**1.9**
	TOTAL DIRECT COST	**29.5**
70000	Indirect Cost	10.8
	TOTAL DIRECT AND INDIRECT COST	**40.3**
80000	**Contingency**	**12.1**
	TOTAL COST + CONTINGENCY	**52.4**
90000	**Owner's Costs**	-
	TOTAL	**52.4**

WBS	HINDS LAKE Option 2 (200MW) - WBS Description	Total MCAD
0000	**General**	-
0100	**Auxiliary Facilities (Excluded)**	-
0200	**Auxiliary Utilities (Excluded)**	-
1000	**Temporary Works**	22.3
2000	**Access and Site Plan**	0.5
2100	**Site Development**	0.5
3000	**Project Components**	414.4
3100	**Upper Reservoir (Not part of the scope)**	-
3200	**Upper Inlet/Outlet Structure**	9.1
3300	**Upstream Conveyance**	146.8
3400	**Powerhouse**	236.1
3500	**Downstream Conveyance**	11.4
3600	**Lower Intake Structure**	11.0
	TOTAL DIRECT COST	437.3
70000	Indirect Cost	152.0
	TOTAL DIRECT AND INDIRECT COST	589.2
80000	Contingency	176.8
	TOTAL COST + CONTINGENCY	766.0
90000	Owner's Costs	-
	TOTAL	766.0

WBS	STAR LAKE Option 2 (200MW) - WBS Description	Total MCAD
0000	General	-
0100	Auxiliary Facilities (Excluded)	-
0200	Auxiliary Utilities (Excluded)	-
1000	Temporary Works	22.3
2000	Access and Site Plan	0.5
2100	Site Development	0.5
3000	Project Components	574.1
3100	Upper Reservoir (Not part of the scope)	-
3200	Upper Inlet/Outlet Structure	16.7
3300	Upstream Conveyance	195.8
3400	Powerhouse	337.2
3500	Downstream Conveyance	11.4
3600	Lower Intake Structure	12.9
	TOTAL DIRECT COST	596.9
70000	Indirect Cost	198.3
	TOTAL DIRECT AND INDIRECT COST	795.2
80000	Contingency	238.6
	TOTAL COST + CONTINGENCY	1,033.7
90000	Owner's Costs	-
	TOTAL	1,033.7

Appendix B
Detailed Estimate

HATCH

CAPITAL COST ESTIMATE

Summary

Client:	**Newfoundland and Labrador Hydro**
Plant:	
Project #:	**H3971390**
Project:	**Pump Storage Feasibility Study**
Currency:	**CAD**
Revision#:	**Rev. 0**
Date:	**2023-10-18**
Location:	**Newfoundland**
Estimate Class:	**Class 5**
Target Estimate Accurecy:	**+50% - 30%**

Approvals		
ESTIMATOR:	Victoria Tillous	10/18/2023 Date
CHECKED BY:	James Law	10/18/2023 Date
ENGINEERING MANAGER:	Jorge Coronado	10/18/2023 Date
PROJECT MANAGER:	James Law	10/18/2023 Date

0.2 | 179,761,348.14

0	Level	1	2	3	4	WBS	Nr	ITEM	Trade	Bill description	F	Unit	Bill quantity	Growth	Final quantity	Net Rate	Net Final Amount
D	1	0	0	0	0	0000				General							
D	2	0	1	0	0	0100				Auxiliary facilities							
D	2	0	2	0	0	0200				Auxiliary Utilities							
D	1	1	0	0	0	1000				Temporary Works							
D		1	0	0	0	1000	1	1000-001	A	Cofferdam in the intake		m2	360.00	25%	450.00	1,900.00	855,000.00
D		1	0	0	0	1000	2	1000-002	A	Pumping		Hr	1,440.00	25%	1,800.00	90.00	162,000.00
D	1	2	0	0	0	2000				Access and Site Plan							
D	2	2	1	0	0	2100				Site Development							
D		2	1	0	0	2100	1	2100-001	A	Clearing and Grubbing		m2	4,000.00	25%	5,000.00	10.00	50,000.00
D		2	1	0	0	2100	2	2100-002	A	Internal Roads (7.5m width) Rip Rap		Km	0.50	25%	0.63	373,100.00	233,187.50
D	1	3	0	0	0	3000				Project Components							
D	2	3	1	0	0	3100				Upper Reservoir							
D	3	3	1	1	0	3110				General							
D	2	3	2	0	0	3200				Upper Inlet/Outlet Structure							
D	3	3	2	1	0	3210				Upper Intake - Civil Modifications							
D		3	2	1	0	3210	2	3210-002	E	Excavation in Common soil		m3	-	25%	-	30.00	-
D		3	2	1	0	3210	3	3210-003	E	Excavation in rock		m3	-	25%	-	70.00	-
D		3	2	1	0	3210	4	3210-004	E	Backfill		m3	-	25%	-	80.00	-
D		3	2	1	0	3210	2	3210-002	C	Reinforced concrete 30MPa - 150 kg/m3		m3	-	20%	-	3,400.00	-
D	3	3	2	2	0	3220				Upper Intake - Equipment							
D		3	2	2	0	3220	1	3220-001	S	Intake Trashrack - Intake 1		mt	-	20%	-	23,000.00	-
D		3	2	2	0	3220	2	3220-002	M	Instrumentation(Unit Heaters, Gate Panels)		ea	-	0%	-	23,100.00	-
D	2	3	3	0	0	3300				Upstream Conveyance (Highpresurre)							
I	3	3	3	1	0	3310				Upstream Conveyance - Connection to Existing Penstock							
D		3	3	1	0	3310	1	3310-001	S	Upstream Conveyance - Steel		mt	172.50	20%	207.00	26,000.00	5,382,000.00
D		3	3	1	0	3310	3	3310-003	E	Excavation in Common soil		m3	10,000.00	25%	12,500.00	30.00	375,000.00
D		3	3	1	0	3310	4	3310-004	E	Excavation in rock		m3	10,000.00	25%	12,500.00	70.00	875,000.00
D		3	3	1	0	3310	3	3310-003	E	Backfill - local/ medium difficult place		m3	18,000.00	25%	22,500.00	80.00	1,800,000.00
D	2	3	4	0	0	3400				Pumphouse							48,373,955.25
D	3	3	4	1	0	3410				Pumphouse Civil works							
D		3	4	1	1	3411	1	3411-001	E	Excavation Shafts and Tunnels		m3	-	25%	-	4,400.00	-
D		3	4	1	1	3411	2	3411-002	E	Excavation (100% rock)		m3	-	25%	-	70.00	-
D		3	4	1	1	3411	3	3411-003	C	Reinforced concrete 30MPa - 150 kg/m3		m3	3,770.00	25%	4,712.50	3,370.00	15,881,125.00
D	4	3	4	1	2	3412				Buildings							
D		3	4	1	2	3412	1	3412-001	F	Electrical Building		m2	60.00	0%	60.00	3,000.00	180,000.00
D		3	4	1	2	3412	2	3412-002	F	Pumphouse superstructure		m2	450.00	0%	450.00	4,500.00	2,025,000.00
D		3	4	1	2	3412	4	3412-004	E	Excavation in Common soil		m3	4,674.10	25%	5,842.63	30.00	175,278.78
D		3	4	1	2	3412	5	3412-005	E	Excavation in rock		m3	14,022.30	25%	17,527.88	70.00	1,226,951.47
D	3	3	4	2	0	3420				Pumphouse - Equipment							
D		3	4	2	0	3420	1	3420-001	M	Mechanical BOP		LS	1.00	0%	1.00	2,106,000.00	2,106,000.00
D		3	4	2	0	3420	2	3420-002	L	Electrical BOP		LS	1.00	0%	1.00	418,600.00	418,600.00
D		3	4	2	0	3420	3	3420-003	M	Gantry Crane (60 mt)		ea	1.00	0%	1.00	1,455,000.00	1,455,000.00
D		3	4	2	0	3420	4	3420-004	M	Pump (including low pressure and high pressure valve)		ea	2.00	0%	2.00	9,637,000.00	19,274,000.00
D		3	4	2	0	3420	5	3420-005	L	Main transformers		ea	2.00	0%	2.00	2,816,000.00	5,632,000.00
D	2	3	5	0	0	3500				Downstream Conveyance (Low Pressure)							4,855,559.48
D		3	5	0	0	3500	1	3500-001	S	Downstream Conveyance - Steel		mt	38.50	20%	46.20	26,000.00	1,201,200.00
D		3	5	0	0	3500	2	3500-002	C	Concrete Lining		m3	250.35	20%	300.41	3,300.00	991,368.83
D		3	5	0	0	3500	3	3500-003	E	Excavation (100% rock Tunnel)		m3	490.87	25%	613.59	4,340.00	2,662,990.65
D	2	3	6	0	0	3600				Lower Intake Structure							3,909,892.00
D	3	3	6	1	0	3610				Lower Inlet - Civil							
D		3	6	1	0	3610	2	3610-002	E	Excavation in Common soil		m3	12,000.00	25%	15,000.00	30.00	450,000.00
D		3	6	1	0	3610	3	3610-003	E	Excavation in rock		m3	8,000.00	25%	10,000.00	70.00	700,000.00
D		3	6	1	0	3610	4	3610-004	E	Backfill		m3	6,600.00	25%	8,250.00	80.00	660,000.00
D		3	6	1	0	3610	2	3610-002	C	Reinforced concrete 30MPa - 150 kg/m3		m3	333.90	20%	400.68	3,400.00	1,362,312.00
D	3	3	6	2	0	3620				Lower Inlet - Metal works and building							
D		3	6	2	0	3620	1	3620-001	S	Intake Gates - Intake 1 (Including Supports and Hoists)		mt	8.00	20%	9.60	37,300.00	358,080.00
D		3	6	2	0	3620	2	3620-002	S	Intake Bulkheads - Intake 1		mt	8.00	20%	9.60	27,000.00	259,200.00
D		3	6	2	0	3620	3	3620-003	S	Intake Trashrack - Intake 1		mt	2.00	20%	2.40	23,000.00	55,200.00
D		3	6	2	0	3620	4	3620-004	M	Instrumentation(Unit Heaters, Gate Panels)		ea	1.00	0%	1.00	23,100.00	23,100.00
D		3	6	2	0	3620	5	3620-005	F	Gates building		m2	20.00	0%	20.00	2,100.00	42,000.00
D	3	3	6	3	0	3630				Lower Reservoir							
C	1	7	0	0	0	7000				Indirect Cost							
I		7	0	0	0	7000	1	7000-001	Y	EPCM	15%	LS	1.00	0%	1.00	10,030,739.13	10,030,739.13
I		7	0	0	0	7000	1	7000-001	Y	Preliminary studies	10%	LS	1.00	0%	1.00	6,687,159.42	6,687,159.42
I		7	0	0	0	7000	1	7000-001	Y	Site services, temporary facilities and mobile equipment	7%	LS	1.00	0%	1.00	4,681,011.60	4,681,011.60
I		7	0	0	0	7000	1	7000-001	Y	Freight	12%	LS	1.00	0%	1.00	3,152,400.00	3,152,400.00
I		7	0	0	0	7000	1	7000-001	Y	Spare parts & First Fills	6%	LS	1.00	0%	1.00	1,444,850.00	1,444,850.00
I		7	0	0	0	7000	1	7000-001	Y	Contract assistance during Pre-operation testing	3%	LS	1.00	0%	1.00	788,100.00	788,100.00
I		7	0	0	0	7000	1	7000-001	Y	Third Party consultants	1%	LS	1.00	0%	1.00	668,715.94	668,715.94
C	1	8	0	0	0	8000				Contingency							
C		8	0	0	0	8000	1	8000-001	Z	Contingency	30%	LS	1.00	0%	1.00	28,297,371.10	28,297,371.10
OC	1	9	0	0	0	9000				Owners Cost							
OC		9	0	0	0	9000	1	9000-001	V	Owner's Costs excluded		LS	1.00	0%	1.00	-	-

3942134.828

Labour (PF 1.50) and Materials:

ITEM	Bill description	PF	Unit Man Hrs	Man Hrs Final qty	Labor-All in hourly rate	Currency	FOREX	UR Labor-All in (CAD)	UR Materials	Currency	FOREX	Price growth	UR Materials (CAD)
1000-001	Cofferdam in the intake	1.50	1.800	2.703	238.72	CAD	1	645.17	1,242.18	CAD	1	-	1,242.18
1000-002	Pumping	1.50	-	-	238.72	CAD	1	-	-	CAD	1	-	-
2100-001	Clearing and Grubbing	1.50	0.00	0.00	238.72	CAD	1	0.29	-	CAD	1	-	-
2100-002	Internal Roads (7.5m width) Rip Rap	1.50	187.57	281.62	238.72	CAD	1	67,228.54	305,866.17	CAD	1	-	305,866.17
3210-002	Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-
3210-003	Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
3210-004	Backfill	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50
3210-002	Reinforced concrete 30MPa - 150 kg/m3	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81
3220-001	Intake Trashrack - Intake 1	1.50	28.00	42.04	145.51	CAD	1	6,117.44	16,840.50	CAD	1	-	16,840.50
3220-002	Instrumentation(Unit Heaters, Gate Panels)	1.50	12.00	18.02	169.68	CAD	1	3,057.22	-	CAD	1	-	-
3310-001	Upstream Conveyance - Steel	1.50	22.00	33.03	145.51	CAD	1	4,806.56	21,115.00	CAD	1	-	21,115.00
3310-003	Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-
3310-004	Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
3310-003	Backfill - local/ medium difficult place	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50
3411-001	Excavation Shafts and Tunnels	1.50	0.20	0.30	238.72	CAD	1	71.69	-	CAD	1	-	-
3411-002	Excavation (100% rock)	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
3411-003	Reinforced concrete 30MPa - 150 kg/m3	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81
3412-001	Electrical Building	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-
3412-002	Pumphouse superstructure	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-
3412-004	Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-
3412-005	Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
3420-001	Mechanical BOP	1.50	1,200.00	1,801.72	169.68	CAD	1	305,721.52	-	CAD	1	-	-
3420-002	Electrical BOP	1.50	800.00	1,201.14	140.30	CAD	1	168,516.20	-	CAD	1	-	-
3420-003	Gantry Crane (60 mt)	1.50	1,000.00	1,501.43	169.68	CAD	1	254,767.93	-	CAD	1	-	-
3420-004	Pump (including low pressure and high pressure valve)	1.50	2,500.00	3,753.57	169.68	CAD	1	636,919.83	-	CAD	1	-	-
3420-005	Main transformers	1.50	1,500.00	2,252.14	140.30	CAD	1	315,967.87	-	CAD	1	-	-
3500-001	Downstream Conveyance - Steel	1.50	22.00	33.03	145.51	CAD	1	4,806.56	21,115.00	CAD	1	-	21,115.00
3500-002	Concrete Lining	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,453.26	CAD	1	-	1,453.26
3500-003	Excavation (100% rock Tunnel)	1.50	0.20	0.30	238.72	CAD	1	71.69	-	CAD	1	-	-
3610-002	Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-
3610-003	Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
3610-004	Backfill	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50
3610-002	Reinforced concrete 30MPa - 150 kg/m3	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81
3620-001	Intake Gates - Intake 1 (Including Supports and Hoists)	1.50	32.00	48.05	145.51	CAD	1	6,991.36	30,230.50	CAD	1	-	30,230.50
3620-002	Intake Bulkheads - Intake 1	1.50	28.00	42.04	145.51	CAD	1	6,117.44	20,857.50	CAD	1	-	20,857.50
3620-003	Intake Trashrack - Intake 1	1.50	28.00	42.04	145.51	CAD	1	6,117.44	16,840.50	CAD	1	-	16,840.50
3620-004	Instrumentation(Unit Heaters, Gate Panels)	1.50	12.00	18.02	169.68	CAD	1	3,057.22	-	CAD	1	-	-
3620-005	Gates building	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-

Permanent Equipment, Subcontracts/ Complex, AUX and FA columns:

ITEM	Bill description	UR Equipment	Currency	FOREX	Price growth	UR Equipment (CAD)	UR Subcontracts	Currency	FOREX	Price growth	UR subcontracts (CAD)	AUX	Labor FA (CAD)	Materials FA (CAD)	Equipment FA (CAD)	Subcontracts FA (CAD)
1000-001	Cofferdam in the intake		CAD	1		-	-	CAD	1	-	-		290,326.66	558,981.00	-	-
1000-002	Pumping		CAD	1		-	83.70	CAD	1	-	83.70		-	-	-	150,660.00
2100-001	Clearing and Grubbing		CAD	1		-	6.42	CAD	1	-	6.42		1,433.71	-	-	32,083.33
2100-002	Internal Roads (7.5m width) Rip Rap		CAD	1		-	-	CAD	1	-	-		42,017.84	191,166.35	-	-
3210-002	Excavation in Common soil		CAD	1		-	19.86	CAD	1	-	19.86		-	-	-	-
3210-003	Excavation in rock		CAD	1		-	21.39	CAD	1	-	21.39		-	-	-	-
3210-004	Backfill		CAD	1		-	-	CAD	1	-	-		-	-	-	-
3210-002	Reinforced concrete 30MPa - 150 kg/m3		CAD	1		-	-	CAD	1	-	-		-	-	-	-
3220-001	Intake Trashrack - Intake 1		CAD	1		-	-	CAD	1	-	-		-	-	-	-
3220-002	Instrumentation(Unit Heaters, Gate Panels)	20,000.00	CAD	1		20,000.00	-	CAD	1	-	-		-	-	-	-
3310-001	Upstream Conveyance - Steel		CAD	1		-	-	CAD	1	-	-		994,957.57	4,370,805.00	-	-
3310-003	Excavation in Common soil		CAD	1		-	19.86	CAD	1	-	19.86		112,008.74	-	-	248,263.89
3310-004	Excavation in rock		CAD	1		-	21.39	CAD	1	-	21.39		560,043.72	-	-	267,361.11
3310-003	Backfill - local/ medium difficult place		CAD	1		-	-	CAD	1	-	-		806,462.95	933,750.00	-	-
3411-001	Excavation Shafts and Tunnels		CAD	1		-	4,265.46	CAD	1	-	4,265.46		-	-	-	-
3411-002	Excavation (100% rock)		CAD	1		-	21.39	CAD	1	-	21.39		-	-	-	-
3411-003	Reinforced concrete 30MPa - 150 kg/m3		CAD	1		-	-	CAD	1	-	-		8,513,262.81	7,355,318.73	-	-
3412-001	Electrical Building		CAD	1		-	3,000.00	CAD	1	-	3,000.00		-	-	-	180,000.00
3412-002	Pumphouse superstructure		CAD	1		-	4,422.00	CAD	1	-	4,422.00		-	-	-	1,989,900.00
3412-004	Excavation in Common soil		CAD	1		-	19.86	CAD	1	-	19.86		52,354.02	-	-	116,041.04
3412-005	Excavation in rock		CAD	1		-	21.39	CAD	1	-	21.39		785,310.24	-	-	374,901.84
3420-001	Mechanical BOP	1,400,000.00	CAD	1		1,800,000.00	-	CAD	1	-	-		305,721.52	-	1,800,000.00	-
3420-002	Electrical BOP	400,000.00	CAD	1		250,000.00	-	CAD	1	-	-		168,516.20	-	250,000.00	-
3420-003	Gantry Crane (60 mt)	1,200,000.00	CAD	1		1,200,000.00	-	CAD	1	-	-		254,767.93	-	1,200,000.00	-
3420-004	Pump (including low pressure and high pressure valve)	9,000,000.00	CAD	1		9,000,000.00	-	CAD	1	-	-		1,273,839.66	-	18,000,000.00	-
3420-005	Main transformers	2,500,000.00	CAD	1		2,500,000.00	-	CAD	1	-	-		631,935.74	-	5,000,000.00	-
3500-001	Downstream Conveyance - Steel		CAD	1		-	-	CAD	1	-	-		222,062.99	975,513.00	-	-
3500-002	Concrete Lining		CAD	1		-	-	CAD	1	-	-		542,707.72	436,581.57	-	-
3500-003	Excavation (100% rock Tunnel)		CAD	1		-	4,265.46	CAD	1	-	4,265.46		43,985.73	-	-	2,617,253.49
3610-002	Excavation in Common soil		CAD	1		-	19.86	CAD	1	-	19.86		134,410.49	-	-	297,916.67
3610-003	Excavation in rock		CAD	1		-	21.39	CAD	1	-	21.39		448,034.97	-	-	213,888.89
3610-004	Backfill		CAD	1		-	-	CAD	1	-	-		295,703.08	342,375.00	-	-
3610-002	Reinforced concrete 30MPa - 150 kg/m3		CAD	1		-	-	CAD	1	-	-		723,839.61	625,385.49	-	-
3620-001	Intake Gates - Intake 1 (Including Supports and Hoists)		CAD	1		-	-	CAD	1	-	-		67,117.03	290,212.80	-	-
3620-002	Intake Bulkheads - Intake 1		CAD	1		-	-	CAD	1	-	-		58,727.40	200,232.00	-	-
3620-003	Intake Trashrack - Intake 1		CAD	1		-	-	CAD	1	-	-		14,681.85	40,417.20	-	-
3620-004	Instrumentation(Unit Heaters, Gate Panels)	20,000.00	CAD	1		20,000.00	-	CAD	1	-	-		3,057.22	-	20,000.00	-
3620-005	Gates building		CAD	1		-	2,010.00	CAD	1	-	2,010.00		-	-	-	40,200.00
7000-001	EPCM		CAD	1		-							-	-	-	-
7000-001	Preliminary studies		CAD	1		-							-	-	-	-
7000-001	Site services, temporary facilities and mobile equipment		CAD	1		-							-	-	-	-
7000-001	Freight		CAD	1		-							-	-	-	-
7000-001	Spare parts & First Fills		CAD	1		-							-	-	-	-
7000-001	Contract assistance during Pre-operation testing		CAD	1		-							-	-	-	-
7000-001	Third Party consultants		CAD	1		-							-	-	-	-
8000-001	Contingency		CAD	1		-							-	-	-	-
9000-001	Owner's Costs excluded		CAD	1		-							-	-	-	-

83,672,265.64

0	Level	1	2	3	4	WBS	Nr	ITEM	Trade	Bill description	F	Unit	Bill quantity	Growth	Final quantity	Net Rate	Net Final Amount	Labour							Materials					Permanent Equipment					Subcontracts/ Complex					AUX	Labor FA	Materials FA	Equipment FA	Subcontracts FA
																		PF 1.50	Unit Man Hrs	Man Hrs Final qty	Labor-All in hourly rate	Currency	FOREX	UR Labor-All in (CAD)	UR Materials	Currency	FOREX	Price growth	UR Materials (CAD)	UR Equipment	Currency	FOREX	Price growth	UR Equipment (CAD)	UR Subcontracts	Currency	FOREX	Price growth	UR subcontracts (CAD)		(CAD)	(CAD)	(CAD)	(CAD)
D	1	0	0	0	0	0000				General																																		
D	2	0	1	0	0	0100				Auxiliary facilities																																		
D	2	0	2	0	0	0200				Auxiliary Utilities																																		
D	1	1	0	0	0	1000				Temporary Works																																		
D		1	0	0	0	1000	1	1000-001	A	Cofferdam (with pumping)		m2	360.00	25%	450.00	1,900.00	855,000.00	1.50	1.800	2.703	238.72	CAD	1	645.17	1,242.18	CAD	1	-	1,242.18		CAD	1		-	-	CAD	1	-	-		290,326.66	558,981.00	-	-
D		1	0	0	0	1000	2	1000-002	A	Pumping		Hr	1,440.00	25%	1,800.00	90.00	162,000.00	1.50	-	-	238.72	CAD	1	-	-	CAD	1	-	-		CAD	1		-	83.70	CAD	1	-	83.70		-	-	-	150,660.00
D	1	2	0	0	0	2000				Access and Site Plan																																		
D	2	2	1	0	0	2100				Site Development																																		
D		2	1	0	0	2100	1	2100-001	A	Clearing and Grubbing		m2	4,000.00	25%	5,000.00	10.00	50,000.00	1.50	0.00	0.00	238.72	CAD	1	0.29	-	CAD	1	-	-		CAD	1		-	6.42	CAD	1	-	6.42		1,433.71	-	-	32,083.33
D		2	1	0	0	2100	2	2100-002	A	Internal Roads (7.5m width) Rip Rap		Km	0.50	25%	0.63	374,000.00	233,750.00	1.50	187.57	281.62	238.72	CAD	1	67,228.54	305,866.17	CAD	1	-	305,866.17		CAD	1		-	-	CAD	1	-	-		42,017.84	191,166.35	-	-
D	1	3	0	0	0	3000				Project Components																																		
D	2	3	1	0	0	3100				Upper Reservoir																																		
D	3	3	1	1	0	3110				General																																		
D	2	3	2	0	0	3200				Upper Inlet/Outlet Structure																																		
D	3	3	2	1	0	3210				Upper Intake - Civil																																		
D		3	2	1	0	3210	2	3210-002	E	Excavation in Common soil		m3	-	25%	-	30.00	-	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-		CAD	1		-	19.86	CAD	1	-	19.86		-	-	-	-
D		3	2	1	0	3210	3	3210-003	E	Excavation in rock		m3	-	25%	-	70.00	-	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-	21.39	CAD	1	-	21.39		-	-	-	-
D		3	2	1	0	3210	4	3210-004	E	Backfill		m3	-	25%	-	80.00	-	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50		CAD	1		-	-	CAD	1	-	-		-	-	-	-
D		3	2	1	0	3210	2	3210-002	C	Reinforced concrete 30MPa - 150 kg/m3		m3	-	20%	-	3,400.00	-	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81		CAD	1		-	-	CAD	1	-	-		-	-	-	-
D	3	3	2	2	0	3220				Upper Intake - Equipment																																		
D		3	2	2	0	3220	1	3220-001	S	Intake Gates - Intake 1 (Including Supports and Hoists)		mt	-	20%	-	37,300.00	-	1.50	32.00	48.05	145.51	CAD	1	6,991.36	30,230.50	CAD	1	-	30,230.50		CAD	1		-	-	CAD	1	-	-		-	-	-	-
D		3	2	2	0	3220	2	3220-002	S	Intake Bulkheads - Intake 1		mt	-	20%	-	27,000.00	-	1.50	28.00	42.04	145.51	CAD	1	6,117.44	20,857.50	CAD	1	-	20,857.50		CAD	1		-	-	CAD	1	-	-		-	-	-	-
D		3	2	2	0	3220	3	3220-003	S	Intake Trashrack - Intake 1		mt	-	20%	-	23,000.00	-	1.50	28.00	42.04	145.51	CAD	1	6,117.44	16,840.50	CAD	1	-	16,840.50		CAD	1		-	-	CAD	1	-	-		-	-	-	-
D		3	2	2	0	3220	4	3220-004	M	Instrumentation(Unit Heaters, Gate Panels)		ea	-	0%	-	23,100.00	-	1.50	12.00	18.02	169.68	CAD	1	3,057.22	-	CAD	1	-	-	20,000.00	CAD	1		20,000.00	-	CAD	1	-	-		-	-	-	-
D		3	2	2	0	3220	5	3220-005	F	Gates building		m2	-	0%	-	2,100.00	-	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-		CAD	1		-	2,010.00	CAD	1	-	2,010.00		-	-	-	-
D	2	3	3	0	0	3300				Upstream Conveyance																																		
I	3	3	3	1	0	3310				Upstream Conveyance - Surface Penstock (Steel)																																		
D		3	3	1	0	3310	1	3310-001	S	Upstream Conveyance - Surface Penstock (Steel)		mt	110.00	20%	132.00	26,000.00	3,432,000.00	1.50	22.00	33.03	145.51	CAD	1	4,806.56	21,115.00	CAD	1	-	21,115.00		CAD	1		-	-	CAD	1	-	-		634,465.70	2,787,180.00	-	-
D		3	3	1	0	3310	3	3310-003	E	Excavation in Common soil		m3	4,500.00	25%	5,625.00	30.00	168,750.00	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-		CAD	1		-	19.86	CAD	1	-	19.86		50,403.93	-	-	111,718.75
D		3	3	1	0	3310	4	3310-004	E	Excavation in rock		m3	10,500.00	25%	13,125.00	70.00	918,750.00	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-	21.39	CAD	1	-	21.39		588,045.90	-	-	280,729.17
D		3	3	1	0	3310	3	3310-003	E	Backfill - local/ medium difficult place		m3	13,500.00	25%	16,875.00	80.00	1,350,000.00	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50		CAD	1		-	-	CAD	1	-	-		604,847.21	700,312.50	-	-
I	3	3	3	2	0	3320				Upstream Conveyance - Shafts and Tunnels																																		
D		3	3	2	0	3320	1	3320-001	E	Excavation (100% rock)		m3		25%	-	70.00	-	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-	21.39	CAD	1	-	21.39		-	-	-	-
D		3	3	2	0	3320	2	3320-002	S	Upstream Conveyance - Shafts and Tunnels (liner)		mt		20%	-	-	-	1.50	-	-	145.51	CAD	1	-	-	CAD	1	-	-		CAD	1		-	-	CAD	1	-	-		-	-	-	-
D		3	3	2	0	3320	1	3320-001	C	Concrete behind Steel Liner		m3	-	20%	-	-	-	1.50	-	-	120.32	CAD	1	-	-	CAD	1	-	-		CAD	1		-	-	CAD	1	-	-		-	-	-	-
D	2	3	4	0	0	3400				Powerhouse							20172548.78																											
D	3	3	4	1	0	3410				Powerhouse - Civil																																		
D	4	3	4	1	1	3411				Vertical Shafts																																		
D		3	4	1	1	3411	1	3411-001	E	Excavation Shafts and Tunnels		m3		25%	-	4,400.00	-	1.50	0.20	0.30	238.72	CAD	1	71.69	-	CAD	1	-	-		CAD	1		-	4,265.46	CAD	1	-	4,265.46		-	-	-	-
D		3	4	1	1	3411	2	3411-002	E	Excavation (100% rock)		m3		25%	-	70.00	-	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-	21.39	CAD	1	-	21.39		-	-	-	-
D	4	3	4	1	2	3412				Buildings																																		
D		3	4	1	2	3412	1	3412-001	F	Electrical Building		m2	128.00	0%	128.00	3,000.00	384,000.00	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-		CAD	1		-	3,000.00	CAD	1	-	3,000.00		-	-	-	384,000.00
D		3	4	1	2	3412	1	3412-001	C	Pump Reinforced concrete		m3	2,639.00	20%	3,166.80	3,400.00	10,767,120.00	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81		CAD	1		-	-	CAD	1	-	-		5,720,912.61	4,942,774.19	-	-
D		3	4	1	2	3412	2	3412-002	F	Pumphouse superstructure		m2	450.00	0%	450.00	4,500.00	2,025,000.00	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-		CAD	1		-	4,422.00	CAD	1	-	4,422.00		-	-	-	1,989,900.00
D		3	4	1	2	3412	4	3412-004	E	Excavation in Common soil		m3	1,717.67	25%	2,147.08	30.00	64,412.47	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-		CAD	1		-	19.86	CAD	1	-	19.86		19,239.36	-	-	42,643.44
D		3	4	1	2	3412	5	3412-005	E	Excavation in rock		m3	5,153.00	25%	6,441.25	70.00	450,887.27	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-	21.39	CAD	1	-	21.39		288,590.38	-	-	137,771.11
D	3	3	4	2	0	3420				Powerhouse - Equipment																																		
D		3	4	2	0	3420	1	3420-001	M	Mechanical BOP		LS	1.00	0%	1.00	1,406,000.00	1,406,000.00	1.50	1,200.00	1,801.72	169.68	CAD	1	305,721.52	-	CAD	1	-	-	1,100,000.00	CAD	1		1,100,000.00	-	CAD	1	-	-		305,721.52	-	1,100,000.00	-
D		3	4	2	0	3420	2	3420-002	L	Electrical BOP		LS	1.00	0%	1.00	162,129.05	162,129.05	1.50	200.00	300.29	140.30	CAD	1	42,129.05	-	CAD	1	-	-	120,000.00	CAD	1		120,000.00	-	CAD	1	-	-		42,129.05	-	120,000.00	-
D		3	4	2	0	3420	3	3420-003	M	Gantry Crane		ea	1.00	0%	1.00	401,000.00	401,000.00	1.50	200.00	300.29	169.68	CAD	1	50,953.59	-	CAD	1	-	-	350,000.00	CAD	1		350,000.00	-	CAD	1	-	-		50,953.59	-	350,000.00	-
D		3	4	2	0	3420	4	3420-004	M	Main Transformers		ea	1.00	0%	1.00	1,704,000.00	1,704,000.00	1.50	800.00	1,201.14	169.68	CAD	1	203,814.35	-	CAD	1	-	-	1,500,000.00	CAD	1		1,500,000.00	-	CAD	1	-	-		203,814.35	-	1,500,000.00	-
D		3	4	2	0	3420	4	3420-004	M	Unit pump and Valve included		ea	2.00	0%	2.00	1,404,000.00	2,808,000.00	1.50	800.00	1,201.14	169.68	CAD	1	203,814.35	-	CAD	1	-	-	1,200,000.00	CAD	1		1,200,000.00	-	CAD	1	-	-		407,628.69	-	2,400,000.00	-
D	2	3	5	0	0	3500				Downstream Conveyance							257,404.43																											
D		3	5	0	0	3500	1	3500-001	C	Concrete Lining		m3	62.83	20%	75.40	3,300.00	248,814.14	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,453.26	CAD	1	-	1,453.26		CAD	1		-	-	CAD	1	-	-		136,209.00	109,573.41	-	-
D		3	5	0	0	3500	2	3500-002	E	Excavation Tunnel (100% rock)		m3	98.17	25%	122.72	70.00	8,590.29	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-	21.39	CAD	1	-	21.39		5,498.22	-	-	2,624.81
D	2	3	6	0	0	3600				Lower Intake Structure																																		
D	3	3	6	1	0	3610				Lower Inlet - Civil																																		
D		3	6	1	0	3610	2	3610-002	E	Excavation in Common soil		m3	180.00	25%	225.00	30.00	6,750.00	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-		CAD	1		-	19.86	CAD	1	-	19.86		2,016.16	-	-	4,468.75
D		3	6	1	0	3610	3	3610-003	E	Excavation in rock		m3	120.00	25%	150.00	70.00	10,500.00	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-	21.39	CAD	1	-	21.39		6,720.52	-	-	3,208.33
D		3	6	1	0	3610	4	3610-004	E	Backfill		m3	99.00	25%	123.75	80.00	9,900.00	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50		CAD	1		-	-	CAD	1	-	-		4,435.55	5,135.63	-	-
D		3	6	1	0	3610	2	3610-002	C	Reinforced concrete 30MPa - 150 kg/m3		m3	297.60	20%	357.12	3,400.00	1,214,208.00	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81		CAD	1		-	-	CAD	1	-	-		645,147.25	557,396.59	-	-
D	3	3	6	2	0	3620				Lower Inlet - Metal works and building																																		
D		3	6	2	0	3620	1	3620-001	S	Intake Gates - Intake 1 (Including Supports and Hoists)		mt	6.50	20%	7.80	37,300.00	290,940.00	1.50	32.00	48.05	145.51	CAD	1	6,991.36	30,230.50	CAD	1	-	30,230.50		CAD	1		-	-	CAD	1	-	-		54,532.59	235,797.90	-	-
D		3	6	2	0	3620	2	3620-002	S	Intake Bulkheads - Intake 1		mt	6.50	20%	7.80	27,000.00	210,600.00	1.50	28.00	42.04	145.51	CAD	1	6,117.44	20,857.50	CAD	1	-	20,857.50		CAD	1		-	-	CAD	1	-	-		47,716.02	162,688.50	-	-
D		3	6	2	0	3620	3	3620-003	S	Intake Trashrack - Intake 1		mt	1.80	20%	2.16	23,000.00	49,680.00	1.50	28.00	42.04	145.51	CAD	1	6,117.44	16,840.50	CAD	1	-	16,840.50		CAD	1		-	-	CAD	1	-	-		13,213.67	36,375.48	-	-
D		3	6	2	0	3620	4	3620-004	M	Instrumentation(Unit Heaters, Gate Panels)		ea	1.00	0%	1.00	23,100.00	23,100.00	1.50	12.00	18.02	169.68	CAD	1	3,057.22	-	CAD	1	-	-	20,000.00	CAD	1		20,000.00	-	CAD	1	-	-		3,057.22	-	20,000.00	-
D		3	6	2	0	3620	5	3620-005	F	Gates building		m2	20.00	0%	20.00	2,100.00	42,000.00	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-		CAD	1		-	2,010.00	CAD	1	-	2,010.00		-	-	-	40,200.00
D	3	3	6	3	0	3630				Lower Reservoir							10,846,550.80																											
C	1	7	0	0	0	7000				Indirect Cost																																		
I		7	0	0	0	7000	1	7000-001	Y	EPCM	15%	LS	1.00	0%	1.00	4,418,682.18	4,418,682.18														CAD	1		-							-	-	-	-
I		7	0	0	0	7000	1	7000-001	Y	Preliminary studies	10%	LS	1.00	0%	1.00	2,945,788.12	2,945,788.12														CAD	1		-							-	-	-	-
I		7	0	0	0	7000	1	7000-001	Y	Site services, temporary facilities and mobile equipment	7%	LS	1.00	0%	1.00	2,062,051.69	2,062,051.69														CAD	1		-							-	-	-	-
I		7	0	0	0	7000	1	7000-001	Y	Freight	12%	LS	1.00	0%	1.00	658,800.00	658,800.00														CAD	1		-							-	-	-	-
I		7	0	0	0	7000	1	7000-001	Y	Spare parts & First Fills	6%	LS	1.00	0%	1.00	301,950.00	301,950.00														CAD	1		-							-	-	-	-
I		7	0	0	0	7000	1	7000-001	Y	Contract assistance during Pre-operation testing	3%	LS	1.00	0%	1.00	164,700.00	164,700.00														CAD	1		-							-	-	-	-
I		7	0	0	0	7000	1	7000-001	Y	Third Party consultants	1%	LS	1.00	0%	1.00	294,578.81	294,578.81														CAD	1		-							-	-	-	-
C	1	8	0	0	0	8000				Contingency																																		
C		8	0	0	0	8000	1	8000-001	Z	Contingency	30%	LS	1.00	0%	1.00	12,091,329.60	12,091,329.60														CAD	1		-							-	-	-	-
OC	1	9	0	0	0	9000				Owners Cost																																		
OC		9	0	0	0	9000	1	9000-001	Y	Owner's Costs excluded		LS	1.00	0%	1.00	-	-														CAD	1		-							-	-	-	-

7,470,738.00

0.2 179,761,348.14

0	Level	1	2	3	4	WBS	Nr	ITEM	Trade	Bill description	E	Unit	Bill quantity	Growth	Final quantity	Net Rate	Net Final Amount
D	1	0	0	0	0	0000				General							
D	2	0	1	0	0	0100				Auxiliary facilities							
D	2	0	2	0	0	0200				Auxiliary Utilities							
D	1	1	0	0	0	1000				Temporary Works							
D		1	0	0	0	1000	1	1000-001	A	Cofferdam in the intake		m2	360.00	25%	450.00	1,900.00	855,000.00
D		1	0	0	0	1000	2	1000-002	A	Pumping		Hr	1,440.00	25%	1,800.00	90.00	162,000.00
D	1	2	0	0	0	2000				Access and Site Plan							
D	2	2	1	0	0	2100				Site Development							
D		2	1	0	0	2100	1	2100-001	A	Clearing and Grubbing		m2	4,000.00	25%	5,000.00	10.00	50,000.00
D		2	1	0	0	2100	2	2100-002	A	Internal Roads (7.5m width) Rip Rap		Km	0.50	25%	0.63	373,100.00	233,187.50
D	1	3	0	0	0	3000				Project Components							
D	2	3	1	0	0	3100				Upper Reservoir							
D	3	3	1	1	0	3110				General							
D	2	3	2	0	0	3200				Upper Inlet/Outlet Structure							
D	3	3	2	1	0	3210				Upper Intake - Civil Modifications							
D		3	2	1	0	3210	2	3210-002	E	Excavation in Common soil		m3	-	25%	-	30.00	-
D		3	2	1	0	3210	3	3210-003	E	Excavation in rock		m3	-	25%	-	70.00	-
D		3	2	1	0	3210	4	3210-004	E	Backfill		m3	-	25%	-	80.00	-
D		3	2	1	0	3210	2	3210-002	C	Reinforced concrete 30MPa - 150 kg/m3		m3	-	20%	-	3,400.00	-
D	3	3	2	2	0	3220				Upper Intake - Equipment							
D		3	2	2	0	3220	1	3220-001	S	Intake Trashrack - Intake 1		mt	-	20%	-	23,000.00	-
D		3	2	2	0	3220	2	3220-002	M	Instrumentation(Unit Heaters, Gate Panels)		ea	-	0%	-	23,100.00	-
D	2	3	3	0	0	3300				Upstream Conveyance (Highpressure)							
I	3	3	3	1	0	3310				Upstream Conveyance - Connection to Existing Penstock							
D		3	3	1	0	3310	1	3310-001	S	Upstream Conveyance - Steel		mt	172.50	20%	207.00	26,000.00	5,382,000.00
D		3	3	1	0	3310	3	3310-003	E	Excavation in Common soil		m3	10,000.00	25%	12,500.00	30.00	375,000.00
D		3	3	1	0	3310	4	3310-004	E	Excavation in rock		m3	10,000.00	25%	12,500.00	70.00	875,000.00
D		3	3	1	0	3310	3	3310-003	E	Backfill - local/ medium difficult place		m3	18,000.00	25%	22,500.00	80.00	1,800,000.00
D	2	3	4	0	0	3400				Pumphouse							48,373,955.25
D	3	3	4	1	0	3410				Pumphouse Civil works							
D		3	4	1	1	3411	1	3411-001	E	Excavation Shafts and Tunnels		m3	-	25%	-	4,400.00	-
D		3	4	1	1	3411	2	3411-002	E	Excavation (100% rock)		m3	-	25%	-	70.00	-
D		3	4	1	1	3411	3	3411-003	C	Reinforced concrete 30MPa - 150 kg/m3		m3	3,770.00	25%	4,712.50	3,370.00	15,881,125.00
D	4	3	4	1	2	3412				Buildings							
D		3	4	1	2	3412	1	3412-001	F	Electrical Building		m2	60.00	0%	60.00	3,000.00	180,000.00
D		3	4	1	2	3412	2	3412-002	F	Pumphouse superstructure		m2	450.00	0%	450.00	4,500.00	2,025,000.00
D		3	4	1	2	3412	4	3412-004	E	Excavation in Common soil		m3	4,674.10	25%	5,842.63	30.00	175,278.78
D		3	4	1	2	3412	5	3412-005	E	Excavation in rock		m3	14,022.30	25%	17,527.88	70.00	1,226,951.47
D	3	3	4	2	0	3420				Pumphouse - Equipment							
D		3	4	2	0	3420	1	3420-001	M	Mechanical BOP		LS	1.00	0%	1.00	2,106,000.00	2,106,000.00
D		3	4	2	0	3420	2	3420-002	L	Electrical BOP		LS	1.00	0%	1.00	418,600.00	418,600.00
D		3	4	2	0	3420	3	3420-003	M	Gantry Crane (60 mt)		ea	1.00	0%	1.00	1,455,000.00	1,455,000.00
D		3	4	2	0	3420	4	3420-004	M	Pump (including low pressure and high pressure valve)		ea	2.00	0%	2.00	9,637,000.00	19,274,000.00
D		3	4	2	0	3420	5	3420-005	L	Main transformers		ea	2.00	0%	2.00	2,816,000.00	5,632,000.00
D	2	3	5	0	0	3500				Downstream Conveyance (Low Pressure)							4,855,559.48
D		3	5	0	0	3500	1	3500-001	S	Downstream Conveyance - Steel		mt	38.50	20%	46.20	26,000.00	1,201,200.00
D		3	5	0	0	3500	2	3500-002	C	Concrete Lining		m3	250.35	20%	300.41	3,300.00	991,368.83
D		3	5	0	0	3500	3	3500-003	E	Excavation (100% rock Tunnel)		m3	490.87	25%	613.59	4,340.00	2,662,990.65
D	2	3	6	0	0	3600				Lower Intake Structure							3,909,892.00
D	3	3	6	1	0	3610				Lower Inlet - Civil							
D		3	6	1	0	3610	2	3610-002	E	Excavation in Common soil		m3	12,000.00	25%	15,000.00	30.00	450,000.00
D		3	6	1	0	3610	3	3610-003	E	Excavation in rock		m3	8,000.00	25%	10,000.00	70.00	700,000.00
D		3	6	1	0	3610	4	3610-004	E	Backfill		m3	6,600.00	25%	8,250.00	80.00	660,000.00
D		3	6	1	0	3610	2	3610-002	C	Reinforced concrete 30MPa - 150 kg/m3		m3	333.90	20%	400.68	3,400.00	1,362,312.00
D	3	3	6	2	0	3620				Lower Inlet - Metal works and building							
D		3	6	2	0	3620	1	3620-001	S	Intake Gates - Intake 1 (including Supports and Hoists)		mt	8.00	20%	9.60	37,300.00	358,080.00
D		3	6	2	0	3620	2	3620-002	S	Intake Bulkheads - Intake 1		mt	8.00	20%	9.60	27,000.00	259,200.00
D		3	6	2	0	3620	3	3620-003	S	Intake Trashrack - Intake 1		mt	2.00	20%	2.40	23,000.00	55,200.00
D		3	6	2	0	3620	4	3620-004	M	Instrumentation(Unit Heaters, Gate Panels)		ea	1.00	0%	1.00	23,100.00	23,100.00
D		3	6	2	0	3620	5	3620-005	F	Gates building		m2	20.00	0%	20.00	2,100.00	42,000.00
D	3	3	6	3	0	3630				Lower Reservoir							
C	1	7	0	0	0	7000				Indirect Cost							
I		7	0	0	0	7000	1	7000-001	Y	EPCM	15%	LS	1.00	0%	1.00	10,030,739.13	10,030,739.13
I		7	0	0	0	7000	1	7000-001	Y	Preliminary studies	10%	LS	1.00	0%	1.00	6,687,159.42	6,687,159.42
I		7	0	0	0	7000	1	7000-001	Y	Site services, temporary facilities and mobile equipment	7%	LS	1.00	0%	1.00	4,681,011.60	4,681,011.60
I		7	0	0	0	7000	1	7000-001	Y	Freight	12%	LS	1.00	0%	1.00	3,152,400.00	3,152,400.00
I		7	0	0	0	7000	1	7000-001	Y	Spare parts & First Fills	6%	LS	1.00	0%	1.00	1,444,850.00	1,444,850.00
I		7	0	0	0	7000	1	7000-001	Y	Contract assistance during Pre-operation testing	3%	LS	1.00	0%	1.00	788,100.00	788,100.00
I		7	0	0	0	7000	1	7000-001	Y	Third Party consultants	1%	LS	1.00	0%	1.00	668,715.94	668,715.94
C	1	8	0	0	0	8000				Contingency							
C		8	0	0	0	8000	1	8000-001	Z	Contingency	30%	LS	1.00	0%	1.00	28,297,371.10	28,297,371.10
OC	1	9	0	0	0	9000				Owners Cost							
OC		9	0	0	0	9000	1	9000-001	V	Owner's Costs excluded		LS	1.00	0%	1.00	-	-

Bill description	Labour							Materials					Permanent Equipment				
	PF 1.50	Unit Man Hrs	Man Hrs Final qty	Labor-All in hourly rate	Currency	FOREX	UR Labor-All in (CAD)	UR Materials	Currency	FOREX	Price growth	UR Materials (CAD)	UR Equipment	Currency	FOREX	Price growth	UR Equipment (CAD)
General																	
Auxiliary facilities																	
Auxiliary Utilities																	
Temporary Works																	
Cofferdam in the intake	1.50	1.800	2.703	238.72	CAD	1	645.17	1,242.18	CAD	1	-	1,242.18		CAD	1		-
Pumping	1.50	-	-	238.72	CAD	1	-	-	CAD	1	-	-		CAD	1		-
Access and Site Plan																	
Site Development																	
Clearing and Grubbing	1.50	0.00	0.00	238.72	CAD	1	0.29	-	CAD	1	-	-		CAD	1		-
Internal Roads (7.5m width) Rip Rap	1.50	187.57	281.62	238.72	CAD	1	67,228.54	305,866.17	CAD	1	-	305,866.17		CAD	1		-
Project Components																	
Upper Reservoir																	
General																	
Upper Inlet/Outlet Structure																	
Upper Intake - Civil Modifications																	
Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-		CAD	1		-
Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-
Backfill	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50		CAD	1		-
Reinforced concrete 30MPa - 150 kg/m3	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81		CAD	1		-
Upper Intake - Equipment																	
Intake Trashrack - Intake 1	1.50	28.00	42.04	145.51	CAD	1	6,117.44	16,840.50	CAD	1	-	16,840.50		CAD	1		-
Instrumentation(Unit Heaters, Gate Panels)	1.50	12.00	18.02	169.68	CAD	1	3,057.22	-	CAD	1	-	-	20,000.00	CAD	1		20,000.00
Upstream Conveyance (Highpressure)																	
Upstream Conveyance - Connection to Existing Penstock																	
Upstream Conveyance - Steel	1.50	22.00	33.03	145.51	CAD	1	4,806.56	21,115.00	CAD	1	-	21,115.00		CAD	1		-
Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-		CAD	1		-
Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-
Backfill - local/ medium difficult place	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50		CAD	1		-
Pumphouse																	
Pumphouse Civil works																	
Excavation Shafts and Tunnels	1.50	0.20	0.30	238.72	CAD	1	71.69	-	CAD	1	-	-		CAD	1		-
Excavation (100% rock)	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-
Reinforced concrete 30MPa - 150 kg/m3	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81		CAD	1		-
Buildings																	
Electrical Building	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-		CAD	1		-
Pumphouse superstructure	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-		CAD	1		-
Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-		CAD	1		-
Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-
Pumphouse - Equipment																	
Mechanical BOP	1.50	1,200.00	1,801.72	169.68	CAD	1	305,721.52	-	CAD	1	-	-	1,400,000.00	CAD	1		1,800,000.00
Electrical BOP	1.50	800.00	1,201.14	140.30	CAD	1	168,516.20	-	CAD	1	-	-	400,000.00	CAD	1		250,000.00
Gantry Crane (60 mt)	1.50	1,000.00	1,501.43	169.68	CAD	1	254,767.93	-	CAD	1	-	-	1,200,000.00	CAD	1		1,200,000.00
Pump (including low pressure and high pressure valve)	1.50	2,500.00	3,753.57	169.68	CAD	1	636,919.83	-	CAD	1	-	-	9,000,000.00	CAD	1		9,000,000.00
Main transformers	1.50	1,500.00	2,252.14	140.30	CAD	1	315,967.87	-	CAD	1	-	-	2,500,000.00	CAD	1		2,500,000.00
Downstream Conveyance (Low Pressure)																	
Downstream Conveyance - Steel	1.50	22.00	33.03	145.51	CAD	1	4,806.56	21,115.00	CAD	1	-	21,115.00		CAD	1		-
Concrete Lining	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,453.26	CAD	1	-	1,453.26		CAD	1		-
Excavation (100% rock Tunnel)	1.50	0.20	0.30	238.72	CAD	1	71.69	-	CAD	1	-	-		CAD	1		-
Lower Intake Structure																	
Lower Inlet - Civil																	
Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-		CAD	1		-
Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-		CAD	1		-
Backfill	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50		CAD	1		-
Reinforced concrete 30MPa - 150 kg/m3	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81		CAD	1		-
Lower Inlet - Metal works and building																	
Intake Gates - Intake 1 (including Supports and Hoists)	1.50	32.00	48.05	145.51	CAD	1	6,991.36	30,230.50	CAD	1	-	30,230.50		CAD	1		-
Intake Bulkheads - Intake 1	1.50	28.00	42.04	145.51	CAD	1	6,117.44	20,857.50	CAD	1	-	20,857.50		CAD	1		-
Intake Trashrack - Intake 1	1.50	28.00	42.04	145.51	CAD	1	6,117.44	16,840.50	CAD	1	-	16,840.50		CAD	1		-
Instrumentation(Unit Heaters, Gate Panels)	1.50	12.00	18.02	169.68	CAD	1	3,057.22	-	CAD	1	-	-	20,000.00	CAD	1		20,000.00
Gates building	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-		CAD	1		-
Lower Reservoir																	
Indirect Cost																	
EPCM														CAD	1		-
Preliminary studies														CAD	1		-
Site services, temporary facilities and mobile equipment														CAD	1		-
Freight														CAD	1		-
Spare parts & First Fills														CAD	1		-
Contract assistance during Pre-operation testing														CAD	1		-
Third Party consultants														CAD	1		-
Contingency																	
Contingency														CAD	1		-
Owners Cost																	
Owner's Costs excluded														CAD	1		-

Bill description	Subcontracts/ Complex					AUX	Labor FA	Materials FA	Equipment FA	Subcontracts FA
	UR Subcontracts	Currency	FOREX	Price growth	UR subcontracts (CAD)		(CAD)	(CAD)	(CAD)	(CAD)
General										
Auxiliary facilities										
Auxiliary Utilities										
Temporary Works										
Cofferdam in the intake	-	CAD	1	-	-		290,326.66	558,981.00	-	-
Pumping	83.70	CAD	1	-	83.70		-	-	-	150,660.00
Access and Site Plan										
Site Development										
Clearing and Grubbing	6.42	CAD	1	-	6.42		1,433.71	-	-	32,083.33
Internal Roads (7.5m width) Rip Rap	-	CAD	1	-	-		42,017.84	191,166.35	-	-
Project Components										
Upper Reservoir										
General										
Upper Inlet/Outlet Structure										
Upper Intake - Civil Modifications										
Excavation in Common soil	19.86	CAD	1	-	19.86		-	-	-	-
Excavation in rock	21.39	CAD	1	-	21.39		-	-	-	-
Backfill	-	CAD	1	-	-		-	-	-	-
Reinforced concrete 30MPa - 150 kg/m3	-	CAD	1	-	-		-	-	-	-
Upper Intake - Equipment										
Intake Trashrack - Intake 1	-	CAD	1	-	-		-	-	-	-
Instrumentation(Unit Heaters, Gate Panels)	-	CAD	1	-	-		-	-	-	-
Upstream Conveyance (Highpressure)										
Upstream Conveyance - Connection to Existing Penstock										
Upstream Conveyance - Steel	-	CAD	1	-	-		994,957.57	4,370,805.00	-	-
Excavation in Common soil	19.86	CAD	1	-	19.86		112,008.74	-	-	248,263.89
Excavation in rock	21.39	CAD	1	-	21.39		560,043.72	-	-	267,361.11
Backfill - local/ medium difficult place	-	CAD	1	-	-		806,462.95	933,750.00	-	-
Pumphouse										
Pumphouse Civil works										
Excavation Shafts and Tunnels	4,265.46	CAD	1	-	4,265.46		-	-	-	-
Excavation (100% rock)	21.39	CAD	1	-	21.39		-	-	-	-
Reinforced concrete 30MPa - 150 kg/m3	-	CAD	1	-	-		8,513,262.81	7,355,318.73	-	-
Buildings										
Electrical Building	3,000.00	CAD	1	-	3,000.00		-	-	-	180,000.00
Pumphouse superstructure	4,422.00	CAD	1	-	4,422.00		-	-	-	1,989,900.00
Excavation in Common soil	19.86	CAD	1	-	19.86		52,354.02	-	-	116,041.04
Excavation in rock	21.39	CAD	1	-	21.39		785,310.24	-	-	374,901.84
Pumphouse - Equipment										
Mechanical BOP	-	CAD	1	-	-		305,721.52	-	1,800,000.00	-
Electrical BOP	-	CAD	1	-	-		168,516.20	-	250,000.00	-
Gantry Crane (60 mt)	-	CAD	1	-	-		254,767.93	-	1,200,000.00	-
Pump (including low pressure and high pressure valve)	-	CAD	1	-	-		1,273,839.66	-	18,000,000.00	-
Main transformers	-	CAD	1	-	-		631,935.74	-	5,000,000.00	-
Downstream Conveyance (Low Pressure)										
Downstream Conveyance - Steel	-	CAD	1	-	-		222,062.99	975,513.00	-	-
Concrete Lining	-	CAD	1	-	-		542,707.72	436,581.57	-	-
Excavation (100% rock Tunnel)	4,265.46	CAD	1	-	4,265.46		43,985.73	-	-	2,617,253.49
Lower Intake Structure										
Lower Inlet - Civil										
Excavation in Common soil	19.86	CAD	1	-	19.86		134,410.49	-	-	297,916.67
Excavation in rock	21.39	CAD	1	-	21.39		448,034.97	-	-	213,888.89
Backfill	-	CAD	1	-	-		295,703.08	342,375.00	-	-
Reinforced concrete 30MPa - 150 kg/m3	-	CAD	1	-	-		723,839.61	625,385.49	-	-
Lower Inlet - Metal works and building										
Intake Gates - Intake 1 (including Supports and Hoists)	-	CAD	1	-	-		67,117.03	290,212.80	-	-
Intake Bulkheads - Intake 1	-	CAD	1	-	-		58,727.40	200,232.00	-	-
Intake Trashrack - Intake 1	-	CAD	1	-	-		14,681.85	40,417.20	-	-
Instrumentation(Unit Heaters, Gate Panels)	-	CAD	1	-	-		3,057.22	-	20,000.00	-
Gates building	2,010.00	CAD	1	-	2,010.00		-	-	-	40,200.00
Lower Reservoir										
Indirect Cost										
EPCM							-	-	-	-
Preliminary studies							-	-	-	-
Site services, temporary facilities and mobile equipment							-	-	-	-
Freight							-	-	-	-
Spare parts & First Fills							-	-	-	-
Contract assistance during Pre-operation testing							-	-	-	-
Third Party consultants							-	-	-	-
Contingency										
Contingency							-	-	-	-
Owners Cost										
Owner's Costs excluded							-	-	-	-

3942134.828

83,672,265.64

0	Level	1	2	3	4	WBS	Nr	ITEM	Trade	Bill description	F	Unit	Bill quantity	CHANGE	Growth	Final quantity	Net Rate	Net Final Amount
D	1	0	0	0	0	0000				General								
D	2	0	1	0	0	0100				Auxiliary facilities								
D	2	0	2	0	0	0200				Auxiliary Utilities								
D	1	1	0	0	0	1000				Temporary Works								
D		1	0	0	0	1000	1	1000-001	A	Cofferdam (with pumping)		m2	360.00	4.00	25%	450.00	1,900.00	855,000.00
D		1	0	0	0	1000	2	1000-002	A	Pumping		Hr	1,440.00	4.00	25%	1,800.00	90.00	162,000.00
D	1	2	0	0	0	2000				Access and Site Plan								
D	2	2	1	0	0	2100				Site Development								
D		2	1	0	0	2100	1	2100-001	A	Clearing and Grubbing		m2	4,000.00	30 times more per	25%	5,000.00	10.00	50,000.00
D		2	1	0	0	2100	2	2100-002	A	Internal Roads (7.5m width) Rip Rap		Km	0.50	2.50	25%	0.63	374,000.00	233,750.00
D	1	3	0	0	0	3000				Project Components								
D	2	3	1	0	0	3100				Upper Reservoir								
D	3	3	1	1	0	3110				General								
D	2	3	2	0	0	3200				Upper Inlet/Outlet Structure								
D	3	3	2	1	0	3210				Upper Intake - Civil								
D		3	2	1	0	3210	2	3210-002	E	Excavation in Common soil		m3	360.00		25%	-	30.00	-
D		3	2	1	0	3210	3	3210-003	E	Excavation in rock		m3	240.00		25%	-	70.00	-
D		3	2	1	0	3210	4	3210-004	E	Backfill		m3	198.00		25%	-	80.00	-
D		3	2	1	0	3210	2	3210-002	C	Reinforced concrete 30MPa - 150 kg/m3		m3	595.20		20%	-	3,400.00	-
D	3	3	2	2	0	3220				Upper Intake - Equipment								
D		3	2	2	0	3220	1	3220-001	S	Intake Gates - Intake 1 (Including Supports and Hoists)		mt	13.00		20%	-	37,300.00	-
D		3	2	2	0	3220	2	3220-002	S	Intake Bulkheads - Intake 1		mt	13.00		20%	-	27,000.00	-
D		3	2	2	0	3220	3	3220-003	S	Intake Trashrack - Intake 1		mt	3.60		20%	-	23,000.00	-
D		3	2	2	0	3220	4	3220-004	M	Instrumentation(Unit Heaters, Gate Panels)		ea	2.00		0%	-	23,100.00	-
D		3	2	2	0	3220	5	3220-005	F	Gates building		m2	40.00		0%	-	2,100.00	-
D	2	3	3	0	0	3300				Upstream Conveyance								
I	3	3	3	1	0	3310				Upstream Conveyance - Surface Penstock (Steel)								
D		3	3	1	0	3310	1	3310-001	S	Upstream Conveyance - Surface Penstock (Steel)		mt			20%	132.00	26,000.00	3,432,000.00
D		3	3	1	0	3310	3	3310-003	E	Excavation in Common soil		m3			25%	5,625.00	30.00	168,750.00
D		3	3	1	0	3310	4	3310-004	E	Excavation in rock		m3			25%	13,125.00	70.00	918,750.00
D		3	3	1	0	3310	3	3310-003	E	Backfill - local/ medium difficult place		m3			25%	16,875.00	80.00	1,350,000.00
I	3	3	3	2	0	3320				Upstream Conveyance - Shafts and Tunnels								
D		3	3	2	0	3320	1	3320-001	E	Excavation (100% rock)		m3			25%	-	70.00	-
D		3	3	2	0	3320	2	3320-002	S	Upstream Conveyance - Shafts and Tunnels (liner)		mt			20%	-	-	-
D		3	3	2	0	3320	1	3320-001	C	Concrete behind Steel Liner		m3	-		20%	-	-	-
D	2	3	4	0	0	3400				Powerhouse								20,172,548.78
D	3	3	4	1	0	3410				Powerhouse - Civil								
D	4	3	4	1	1	3411				Vertical Shafts								
D		3	4	1	1	3411	1	3411-001	E	Excavation Shafts and Tunnels		m3			25%	-	4,400.00	-
D		3	4	1	1	3411	2	3411-002	E	Excavation (100% rock)		m3			25%	-	70.00	-
D	4	3	4	1	2	3412				Buildings								
D		3	4	1	2	3412	1	3412-001	F	Electrical Building		m2	128.00		0%	128.00	3,000.00	384,000.00
D		3	4	1	2	3412	1	3412-001	C	Pump Reinforced concrete		m3	2,639.00		20%	3,166.80	3,400.00	10,767,120.00
D		3	4	1	2	3412	2	3412-002	F	Pumphouse superstructure		m2	450.00		0%	450.00	4,500.00	2,025,000.00
D		3	4	1	2	3412	4	3412-004	E	Excavation in Common soil		m3	1,717.67		25%	2,147.08	30.00	64,412.47
D		3	4	1	2	3412	5	3412-005	E	Excavation in rock		m3	5,153.00		25%	6,441.25	70.00	450,887.27
D	3	3	4	2	0	3420				Powerhouse - Equipment								
D		3	4	2	0	3420	1	3420-001	M	Mechanical BOP		LS	1.00		0%	1.00	1,406,000.00	1,406,000.00
D		3	4	2	0	3420	2	3420-002	L	Electrical BOP		LS	1.00		0%	1.00	162,129.05	162,129.05
D		3	4	2	0	3420	3	3420-003	M	Gantry Crane		ea	1.00		0%	1.00	401,000.00	401,000.00
D		3	4	2	0	3420	4	3420-004	M	Main Transformers		ea	1.00		0%	1.00	1,704,000.00	1,704,000.00
D		3	4	2	0	3420	4	3420-004	M	Unit pump and Valve included		ea	2.00		0%	2.00	1,404,000.00	2,808,000.00
D	2	3	5	0	0	3500				Downstream Conveyance								257,404.43
D		3	5	0	0	3500	1	3500-001	C	Concrete Lining		m3	62.83		20%	75.40	3,300.00	248,814.14
D		3	5	0	0	3500	2	3500-002	E	Excavation Tunnel (100% rock)		m3	98.17		25%	122.72	70.00	8,590.29
D	2	3	6	0	0	3600				Lower Intake Structure								
D	3	3	6	1	0	3610				Lower Inlet - Civil								
D		3	6	1	0	3610	2	3610-002	E	Excavation in Common soil		m3	180.00	2.00	25%	225.00	30.00	6,750.00
D		3	6	1	0	3610	3	3610-003	E	Excavation in rock		m3	120.00	2.00	25%	150.00	70.00	10,500.00
D		3	6	1	0	3610	4	3610-004	E	Backfill		m3	99.00	2.00	25%	123.75	80.00	9,900.00
D		3	6	1	0	3610	2	3610-002	C	Reinforced concrete 30MPa - 150 kg/m3		m3	297.60	2.00	20%	357.12	3,400.00	1,214,208.00
D	3	3	6	2	0	3620				Lower Inlet - Metal works and building								
D		3	6	2	0	3620	1	3620-001	S	Intake Gates - Intake 1 (Including Supports and Hoists)		mt	6.50	2.00	20%	7.80	37,300.00	290,940.00
D		3	6	2	0	3620	2	3620-002	S	Intake Bulkheads - Intake 1		mt	6.50	2.00	20%	7.80	27,000.00	210,600.00
D		3	6	2	0	3620	3	3620-003	S	Intake Trashrack - Intake 1		mt	1.80	2.00	20%	2.16	23,000.00	49,680.00
D		3	6	2	0	3620	4	3620-004	M	Instrumentation(Unit Heaters, Gate Panels)		ea	1.00	2.00	0%	1.00	23,100.00	23,100.00
D		3	6	2	0	3620	5	3620-005	F	Gates building		m2	20.00	2.00	0%	20.00	2,100.00	42,000.00
D	3	3	6	3	0	3630				Lower Reservoir								10,846,550.80
C	1	7	0	0	0	7000				Indirect Cost								
I		7	0	0	0	7000	1	7000-001	Y	EPCM	15%	LS	1.00		0%	1.00	4,418,682.18	4,418,682.18
I		7	0	0	0	7000	1	7000-001	Y	Preliminary studies	10%	LS	1.00		0%	1.00	2,945,788.12	2,945,788.12
I		7	0	0	0	7000	1	7000-001	Y	Site services, temporary facilities and mobile equipment	7%	LS	1.00		0%	1.00	2,062,051.69	2,062,051.69
I		7	0	0	0	7000	1	7000-001	Y	Freight	12%	LS	1.00		0%	1.00	658,800.00	658,800.00
I		7	0	0	0	7000	1	7000-001	Y	Spare parts & First Fills	6%	LS	1.00		0%	1.00	301,950.00	301,950.00
I		7	0	0	0	7000	1	7000-001	Y	Contract assistance during Pre-operation testing	3%	LS	1.00		0%	1.00	164,700.00	164,700.00
I		7	0	0	0	7000	1	7000-001	Y	Third Party consultants	1%	LS	1.00		0%	1.00	294,578.81	294,578.81
C	1	8	0	0	0	8000				Contingency								
C		8	0	0	0	8000	1	8000-001	Z	Contingency	30%	LS	1.00		0%	1.00	12,091,329.60	12,091,329.60
OC	1	9	0	0	0	9000				Owners Cost								
OC		9	0	0	0	9000	1	9000-001	Y	Owner's Costs excluded		LS	1.00		0%	1.00	-	-

7,470,738.00

ITEM	Bill description	Labour							Materials				
		PF 1.50	Unit Man Hrs	Man Hrs Final qty	Labor-All in hourly rate	Currency	FOREX	UR Labor-All in (CAD)	UR Materials	Currency	FOREX	Price growth	UR Materials (CAD)
	General												
	Auxiliary facilities												
	Auxiliary Utilities												
	Temporary Works												
1000-001	Cofferdam (with pumping)	1.50	1.800	2.703	238.72	CAD	1	645.17	1,242.18	CAD	1	-	1,242.18
1000-002	Pumping	1.50	-	-	238.72	CAD	1	-	-	CAD	1	-	-
	Access and Site Plan												
	Site Development												
2100-001	Clearing and Grubbing	1.50	0.00	0.00	238.72	CAD	1	0.29	-	CAD	1	-	-
2100-002	Internal Roads (7.5m width) Rip Rap	1.50	187.57	281.62	238.72	CAD	1	67,228.54	305,866.17	CAD	1	-	305,866.17
	Project Components												
	Upper Reservoir												
	General												
	Upper Inlet/Outlet Structure												
	Upper Intake - Civil												
3210-002	Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-
3210-003	Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
3210-004	Backfill	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50
3210-002	Reinforced concrete 30MPa - 150 kg/m3	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81
	Upper Intake - Equipment												
3220-001	Intake Gates - Intake 1 (Including Supports and Hoists)	1.50	32.00	48.05	145.51	CAD	1	6,991.36	30,230.50	CAD	1	-	30,230.50
3220-002	Intake Bulkheads - Intake 1	1.50	28.00	42.04	145.51	CAD	1	6,117.44	20,857.50	CAD	1	-	20,857.50
3220-003	Intake Trashrack - Intake 1	1.50	28.00	42.04	145.51	CAD	1	6,117.44	16,840.50	CAD	1	-	16,840.50
3220-004	Instrumentation(Unit Heaters, Gate Panels)	1.50	12.00	18.02	169.68	CAD	1	3,057.22	-	CAD	1	-	-
3220-005	Gates building	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-
	Upstream Conveyance												
	Upstream Conveyance - Surface Penstock (Steel)												
3310-001	Upstream Conveyance - Surface Penstock (Steel)	1.50	22.00	33.03	145.51	CAD	1	4,806.56	21,115.00	CAD	1	-	21,115.00
3310-003	Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-
3310-004	Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
3310-003	Backfill - local/ medium difficult place	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50
	Upstream Conveyance - Shafts and Tunnels												
3320-001	Excavation (100% rock)	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
3320-002	Upstream Conveyance - Shafts and Tunnels (liner)	1.50	-	-	145.51	CAD	1	-	-	CAD	1	-	-
3320-001	Concrete behind Steel Liner	1.50	-	-	120.32	CAD	1	-	-	CAD	1	-	-
	Powerhouse												
	Powerhouse - Civil												
	Vertical Shafts												
3411-001	Excavation Shafts and Tunnels	1.50	0.20	0.30	238.72	CAD	1	71.69	-	CAD	1	-	-
3411-002	Excavation (100% rock)	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
	Buildings												
3412-001	Electrical Building	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-
3412-001	Pump Reinforced concrete	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81
3412-002	Pumphouse superstructure	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-
3412-004	Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-
3412-005	Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
	Powerhouse - Equipment												
3420-001	Mechanical BOP	1.50	1,200.00	1,801.72	169.68	CAD	1	305,721.52	-	CAD	1	-	-
3420-002	Electrical BOP	1.50	200.00	300.29	140.30	CAD	1	42,129.05	-	CAD	1	-	-
3420-003	Gantry Crane	1.50	200.00	300.29	169.68	CAD	1	50,953.59	-	CAD	1	-	-
3420-004	Main Transformers	1.50	800.00	1,201.14	169.68	CAD	1	203,814.35	-	CAD	1	-	-
3420-004	Unit pump and Valve included	1.50	800.00	1,201.14	169.68	CAD	1	203,814.35	-	CAD	1	-	-
	Downstream Conveyance												
3500-001	Concrete Lining	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,453.26	CAD	1	-	1,453.26
3500-002	Excavation Tunnel (100% rock)	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
	Lower Intake Structure												
	Lower Inlet - Civil												
3610-002	Excavation in Common soil	1.50	0.03	0.04	238.72	CAD	1	8.96	-	CAD	1	-	-
3610-003	Excavation in rock	1.50	0.13	0.19	238.72	CAD	1	44.80	-	CAD	1	-	-
3610-004	Backfill	1.50	0.10	0.15	238.72	CAD	1	35.84	41.50	CAD	1	-	41.50
3610-002	Reinforced concrete 30MPa - 150 kg/m3	1.50	10.00	15.01	120.32	CAD	1	1,806.53	1,560.81	CAD	1	-	1,560.81
	Lower Inlet - Metal works and building												
3620-001	Intake Gates - Intake 1 (Including Supports and Hoists)	1.50	32.00	48.05	145.51	CAD	1	6,991.36	30,230.50	CAD	1	-	30,230.50
3620-002	Intake Bulkheads - Intake 1	1.50	28.00	42.04	145.51	CAD	1	6,117.44	20,857.50	CAD	1	-	20,857.50
3620-003	Intake Trashrack - Intake 1	1.50	28.00	42.04	145.51	CAD	1	6,117.44	16,840.50	CAD	1	-	16,840.50
3620-004	Instrumentation(Unit Heaters, Gate Panels)	1.50	12.00	18.02	169.68	CAD	1	3,057.22	-	CAD	1	-	-
3620-005	Gates building	1.50	-	-	152.13	CAD	1	-	-	CAD	1	-	-
	Lower Reservoir												
	Indirect Cost												
7000-001	EPCM												
7000-001	Preliminary studies												
7000-001	Site services, temporary facilities and mobile equipment												
7000-001	Freight												
7000-001	Spare parts & First Fills												
7000-001	Contract assistance during Pre-operation testing												
7000-001	Third Party consultants												
	Contingency												
8000-001	Contingency												
	Owners Cost												
9000-001	Owner's Costs excluded												

ITEM	Bill description	Permanent Equipment					Subcontracts/ Complex					AUX	Labor FA	Materials FA	Equipment FA	Subcontracts FA
		UR Equipment	Currency	FOREX	Price growth	UR Equipment (CAD)	UR Subcontracts	Currency	FOREX	Price growth	UR subcontracts (CAD)		(CAD)	(CAD)	(CAD)	(CAD)
	General															
	Auxiliary facilities															
	Auxiliary Utilities															
	Temporary Works															
1000-001	Cofferdam (with pumping)		CAD	1		-	-	CAD	1	-	-		290,326.66	558,981.00	-	-
1000-002	Pumping		CAD	1		-	83.70	CAD	1	-	83.70		-	-	-	150,660.00
	Access and Site Plan															
	Site Development															
2100-001	Clearing and Grubbing		CAD	1		-	6.42	CAD	1	-	6.42		1,433.71	-	-	32,083.33
2100-002	Internal Roads (7.5m width) Rip Rap		CAD	1		-	-	CAD	1	-	-		42,017.84	191,166.35	-	-
	Project Components															
	Upper Reservoir															
	General															
	Upper Inlet/Outlet Structure															
	Upper Intake - Civil															
3210-002	Excavation in Common soil		CAD	1		-	19.86	CAD	1	-	19.86		-	-	-	-
3210-003	Excavation in rock		CAD	1		-	21.39	CAD	1	-	21.39		-	-	-	-
3210-004	Backfill		CAD	1		-	-	CAD	1	-	-		-	-	-	-
3210-002	Reinforced concrete 30MPa - 150 kg/m3		CAD	1		-	-	CAD	1	-	-		-	-	-	-
	Upper Intake - Equipment															
3220-001	Intake Gates - Intake 1 (Including Supports and Hoists)		CAD	1		-	-	CAD	1	-	-		-	-	-	-
3220-002	Intake Bulkheads - Intake 1		CAD	1		-	-	CAD	1	-	-		-	-	-	-
3220-003	Intake Trashrack - Intake 1		CAD	1		-	-	CAD	1	-	-		-	-	-	-
3220-004	Instrumentation(Unit Heaters, Gate Panels)	20,000.00	CAD	1		20,000.00	-	CAD	1	-	-		-	-	-	-
3220-005	Gates building		CAD	1		-	2,010.00	CAD	1	-	2,010.00		-	-	-	-
	Upstream Conveyance															
	Upstream Conveyance - Surface Penstock (Steel)															
3310-001	Upstream Conveyance - Surface Penstock (Steel)		CAD	1		-	-	CAD	1	-	-		634,465.70	2,787,180.00	-	-
3310-003	Excavation in Common soil		CAD	1		-	19.86	CAD	1	-	19.86		50,403.93	-	-	111,718.75
3310-004	Excavation in rock		CAD	1		-	21.39	CAD	1	-	21.39		588,045.90	-	-	280,729.17
3310-003	Backfill - local/ medium difficult place		CAD	1		-	-	CAD	1	-	-		604,847.21	700,312.50	-	-
	Upstream Conveyance - Shafts and Tunnels															
3320-001	Excavation (100% rock)		CAD	1		-	21.39	CAD	1	-	21.39		-	-	-	-
3320-002	Upstream Conveyance - Shafts and Tunnels (liner)		CAD	1		-	-	CAD	1	-	-		-	-	-	-
3320-001	Concrete behind Steel Liner		CAD	1		-	-	CAD	1	-	-		-	-	-	-
	Powerhouse															
	Powerhouse - Civil															
	Vertical Shafts															
3411-001	Excavation Shafts and Tunnels		CAD	1		-	4,265.46	CAD	1	-	4,265.46		-	-	-	-
3411-002	Excavation (100% rock)		CAD	1		-	21.39	CAD	1	-	21.39		-	-	-	-
	Buildings															
3412-001	Electrical Building		CAD	1		-	3,000.00	CAD	1	-	3,000.00		-	-	-	384,000.00
3412-001	Pump Reinforced concrete		CAD	1		-	-	CAD	1	-	-		5,720,912.61	4,942,774.19	-	-
3412-002	Pumphouse superstructure		CAD	1		-	4,422.00	CAD	1	-	4,422.00		-	-	-	1,989,900.00
3412-004	Excavation in Common soil		CAD	1		-	19.86	CAD	1	-	19.86		19,239.36	-	-	42,643.44
3412-005	Excavation in rock		CAD	1		-	21.39	CAD	1	-	21.39		288,590.38	-	-	137,771.11
	Powerhouse - Equipment															
3420-001	Mechanical BOP	1,100,000.00	CAD	1		1,100,000.00	-	CAD	1	-	-		305,721.52	-	1,100,000.00	-
3420-002	Electrical BOP	120,000.00	CAD	1		120,000.00	-	CAD	1	-	-		42,129.05	-	120,000.00	-
3420-003	Gantry Crane	350,000.00	CAD	1		350,000.00	-	CAD	1	-	-		50,953.59	-	350,000.00	-
3420-004	Main Transformers	1,500,000.00	CAD	1		1,500,000.00	-	CAD	1	-	-		203,814.35	-	1,500,000.00	-
3420-004	Unit pump and Valve included	1,200,000.00	CAD	1		1,200,000.00	-	CAD	1	-	-		407,628.69	-	2,400,000.00	-
	Downstream Conveyance															
3500-001	Concrete Lining		CAD	1		-	-	CAD	1	-	-		136,209.00	109,573.41	-	-
3500-002	Excavation Tunnel (100% rock)		CAD	1		-	21.39	CAD	1	-	21.39		5,498.22	-	-	2,624.81
	Lower Intake Structure															
	Lower Inlet - Civil															
3610-002	Excavation in Common soil		CAD	1		-	19.86	CAD	1	-	19.86		2,016.16	-	-	4,468.75
3610-003	Excavation in rock		CAD	1		-	21.39	CAD	1	-	21.39		6,720.52	-	-	3,208.33
3610-004	Backfill		CAD	1		-	-	CAD	1	-	-		4,435.55	5,135.63	-	-
3610-002	Reinforced concrete 30MPa - 150 kg/m3		CAD	1		-	-	CAD	1	-	-		645,147.25	557,396.59	-	-
	Lower Inlet - Metal works and building															
3620-001	Intake Gates - Intake 1 (Including Supports and Hoists)		CAD	1		-	-	CAD	1	-	-		54,532.59	235,797.90	-	-
3620-002	Intake Bulkheads - Intake 1		CAD	1		-	-	CAD	1	-	-		47,716.02	162,688.50	-	-
3620-003	Intake Trashrack - Intake 1		CAD	1		-	-	CAD	1	-	-		13,213.67	36,375.48	-	-
3620-004	Instrumentation(Unit Heaters, Gate Panels)	20,000.00	CAD	1		20,000.00	-	CAD	1	-	-		3,057.22	-	20,000.00	-
3620-005	Gates building		CAD	1		-	2,010.00	CAD	1	-	2,010.00		-	-	-	40,200.00
	Lower Reservoir															
	Indirect Cost															
7000-001	EPCM		CAD	1		-							-	-	-	-
7000-001	Preliminary studies		CAD	1		-							-	-	-	-
7000-001	Site services, temporary facilities and mobile equipment		CAD	1		-							-	-	-	-
7000-001	Freight		CAD	1		-							-	-	-	-
7000-001	Spare parts & First Fills		CAD	1		-							-	-	-	-
7000-001	Contract assistance during Pre-operation testing		CAD	1		-							-	-	-	-
7000-001	Third Party consultants		CAD	1		-							-	-	-	-
	Contingency															
8000-001	Contingency		CAD	1		-							-	-	-	-
	Owners Cost															
9000-001	Owner's Costs excluded		CAD	1		-							-	-	-	-