Appendix D

Western Hillside Fish and Fish Habitat Survey

December 21, 2021

SEM Report
Western Hillside – Aquatic Habitat Assessment

REF # 074-186

Prepared for:

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Environmental Projects
Rio Tinto

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1.0 Overview

An aquatic habitat assessment of streams located on the Western Hillside of Wabush Lake was conducted by Sikumiut Environmental Management Ltd. (SEM) between August 10th - 14th, 2021, for the Iron Ore Company of Canada (IOC). The goal of this study was to identify and then characterize streams and describe fish habitat utilization to better manage future tailings deposition into Wabush Lake. IOC plans to advance pipelines over the next five years beginning with a 100 m extension of the coarse discharge and raising the central control dyke in 2021 (Figure 1). The central control dyke will be further extended by 200 m in 2022. Coarse discharge pipeline will be advanced incrementally over the next 5 years with a final discharge location approximately 1.8 km north of its current location. Collectively, and herein referred to as the "Work", will involve extending the coarse line and raising the central control dyke to ensure that the tailings beach remains within the tailings lease line limits (storage areas for tailings) as per *Metal and Diamond Mining Effluent Regulations* (*MDMER*).

The study area included approximately 7 km of shoreline extending north from the current tailings outflow location to the northern boundary of the lease line limit and continued west to the top of the watershed (Figure 2). Potential stream locations within the study area were first identified through desktop exercises using high resolution aerial images, 1:50,000 topographic data and water flow modelling. Additional streams that were not identified using the desktop approach were identified *in situ* through both a shoreline traverse (via boat) and field investigation (via foot). A total of 18 potential sites were developed through the desktop exercises. Field investigations positively identified six aquatic environments to be further examined, one of which exhibited a population of brook trout (Hillside Stream). This report summarizes results from the desktop exercise, field investigations and subsequent aquatic assessments.

The *Fisheries Act* prohibits the carrying out of work that could result in the death of fish or causes harmful alteration, disruption, or destruction of fish habitat unless otherwise authorized. The Work will likely trigger the *Fisheries Act* resulting in applying for measures to offset the adverse effects on Hillside Stream. Discussion on developing an offset plan, land use considerations (e.g., future mining activities) and high-level offsetting options are also provided in the discussion section of this report.

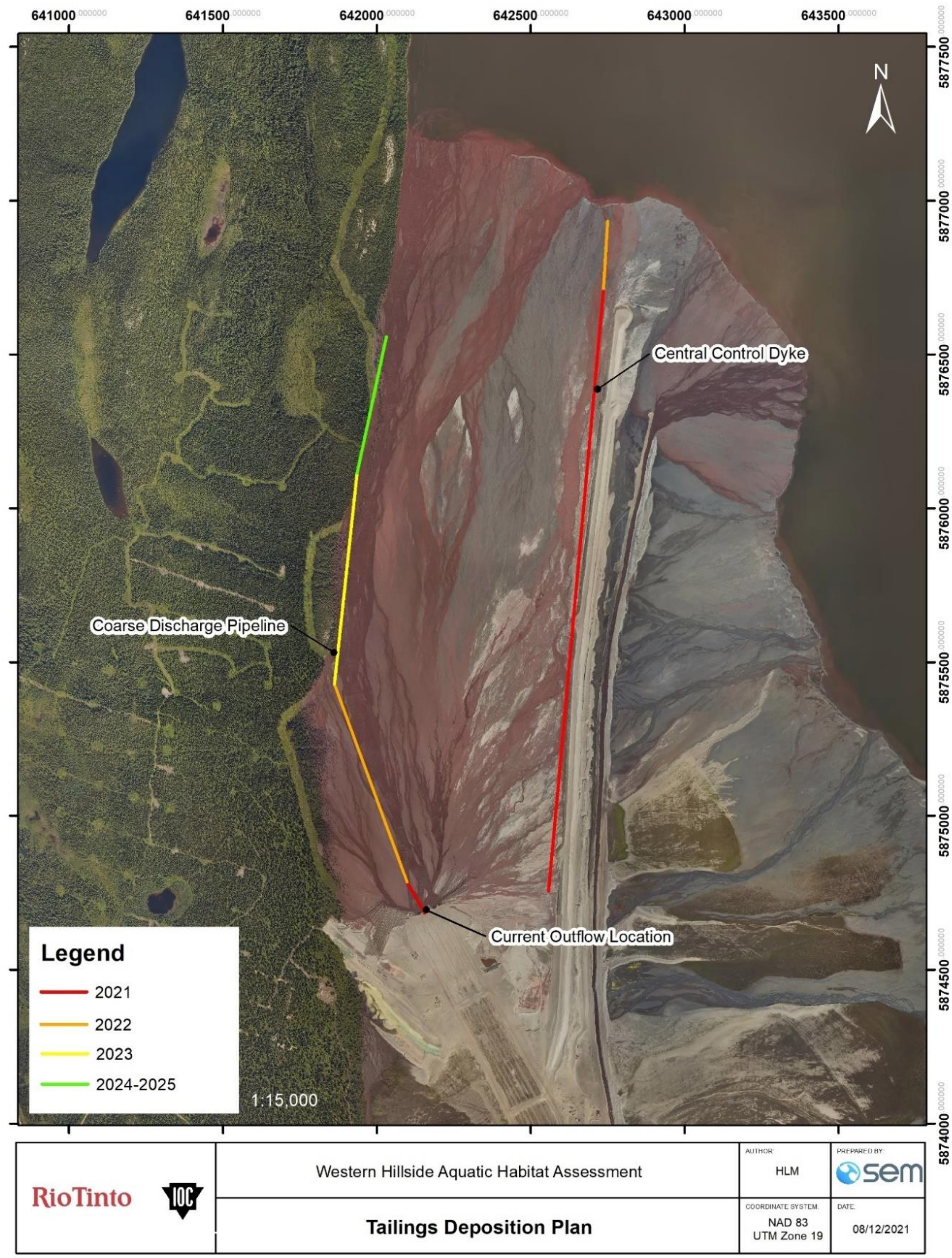


Figure 1 Tailings Deposition Plan, 2021-2025.

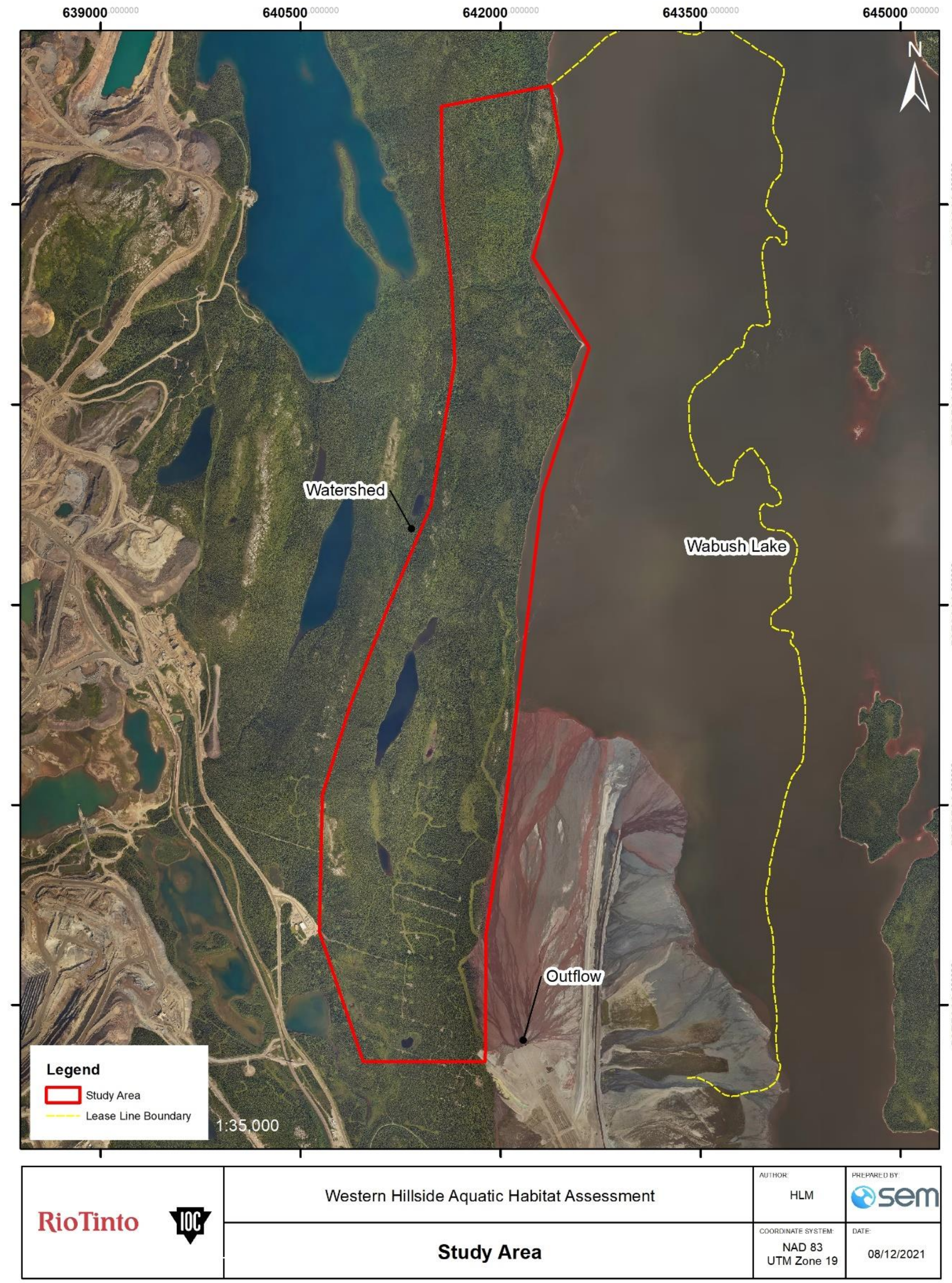


Figure 2 **Study Area of the Western Hillside of Wabush Lake.**

2.0 Objective

The information currently available for the freshwater environment along the Western Hillside of Wabush Lake is limited. A previous study (Ecometrix 2011) had examined two freshwater ponds (primary productivity, benthic community and fish habitat utilization) but there have been no known studies completed to date on the streams within the study area. The objective of this study was to first identify and then characterize stream habitat and determine the fish community and habitat utilization of those streams. The overall purpose of the study was to provide IOC with knowledge of the aquatic environment to guide tailings management and identify potential offsetting requirements under the habitat provisions of the *Fisheries Act*.

3.0 Methods

3.1 Study Area Investigation

The study area consists of approximately 7 km^2 on the Western Hillside of Wabush lake from the shoreline (eastern boundary) of Wabush lake to the top of the watershed (western boundary). Northern and Southern boundaries of the study area were determined by the tailings outflow location and the tailings lease line limits, respectively. There were three ponds and two streams identified in the study area at the 1:50,000 scale (Figure 3). One of the two outflow streams of the largest pond (i.e., Hillside Pond) in the study area was not included in the study area due it being too remote to access and not directly impacted by the Work.

Field staff leveraged a watershed analysis previously conducted by SEM (2018) to help understand what streams may be present that were not identified on the 1:50,000 scale. The drainage areas were based on a Digital Elevation Model (DEM) that was determined from previously collected Light Detection and Ranging (LiDAR) data. Pour points, defined as location at which water flows out of an area, usually the outlet or re-entrant locations from flow accumulation, were determined for the study area to complete the watershed analysis in ArcGIS (Figure 4).

Pour points developed from this exercise and lakes and streams identified at 1:50,000 and were used to focus the field investigation. Access to the study area consisted of boat (for areas north of the tailings extent) and foot (areas south of the tailings extent). The field crews completed a shoreline traverse to visually identify outflow locations into Wabush lake. Potential outflow locations were investigated on foot to determine significance and flagged for future assessment.

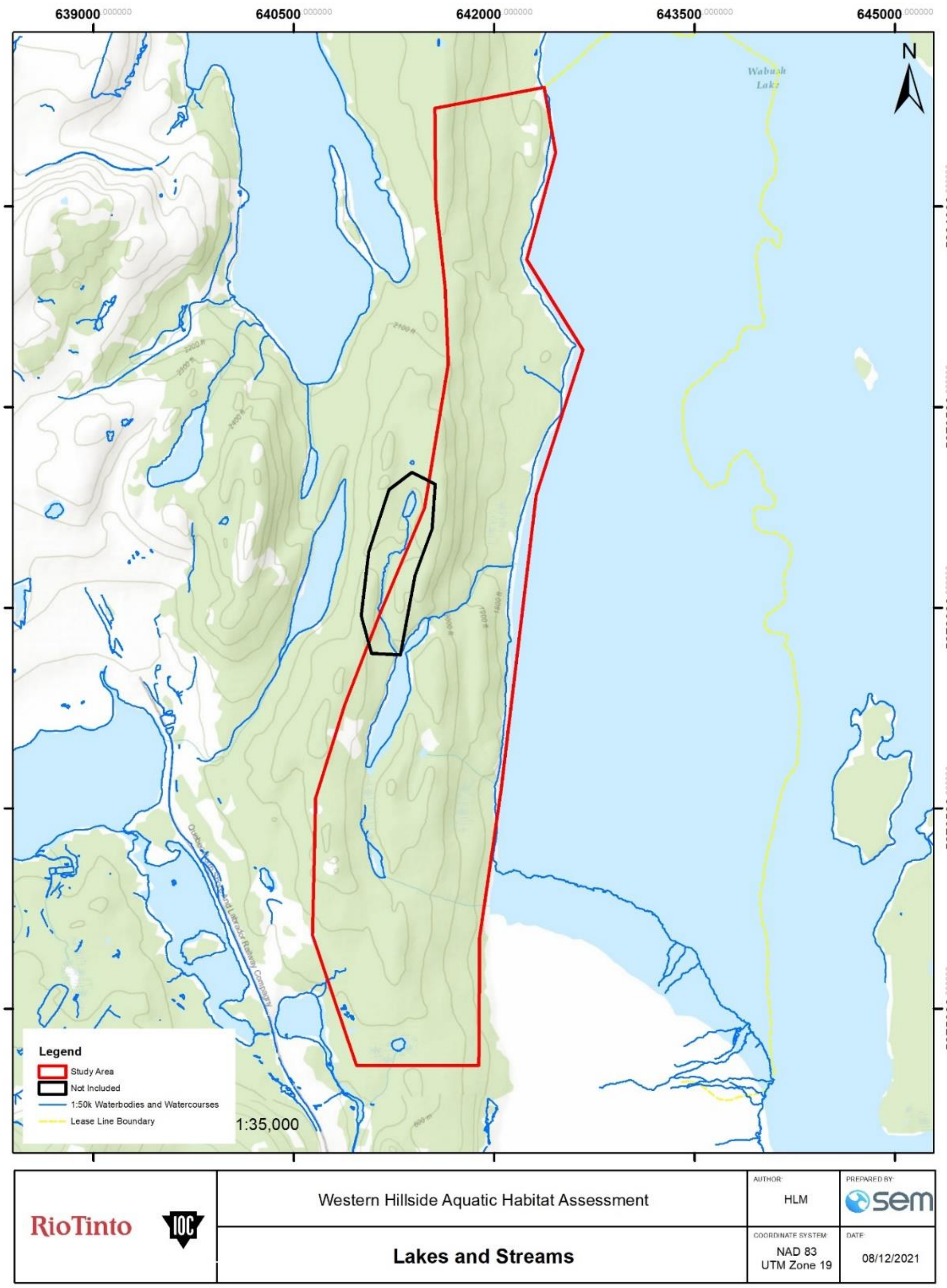


Figure 3 Lakes and Streams Identified at 1:50,000.

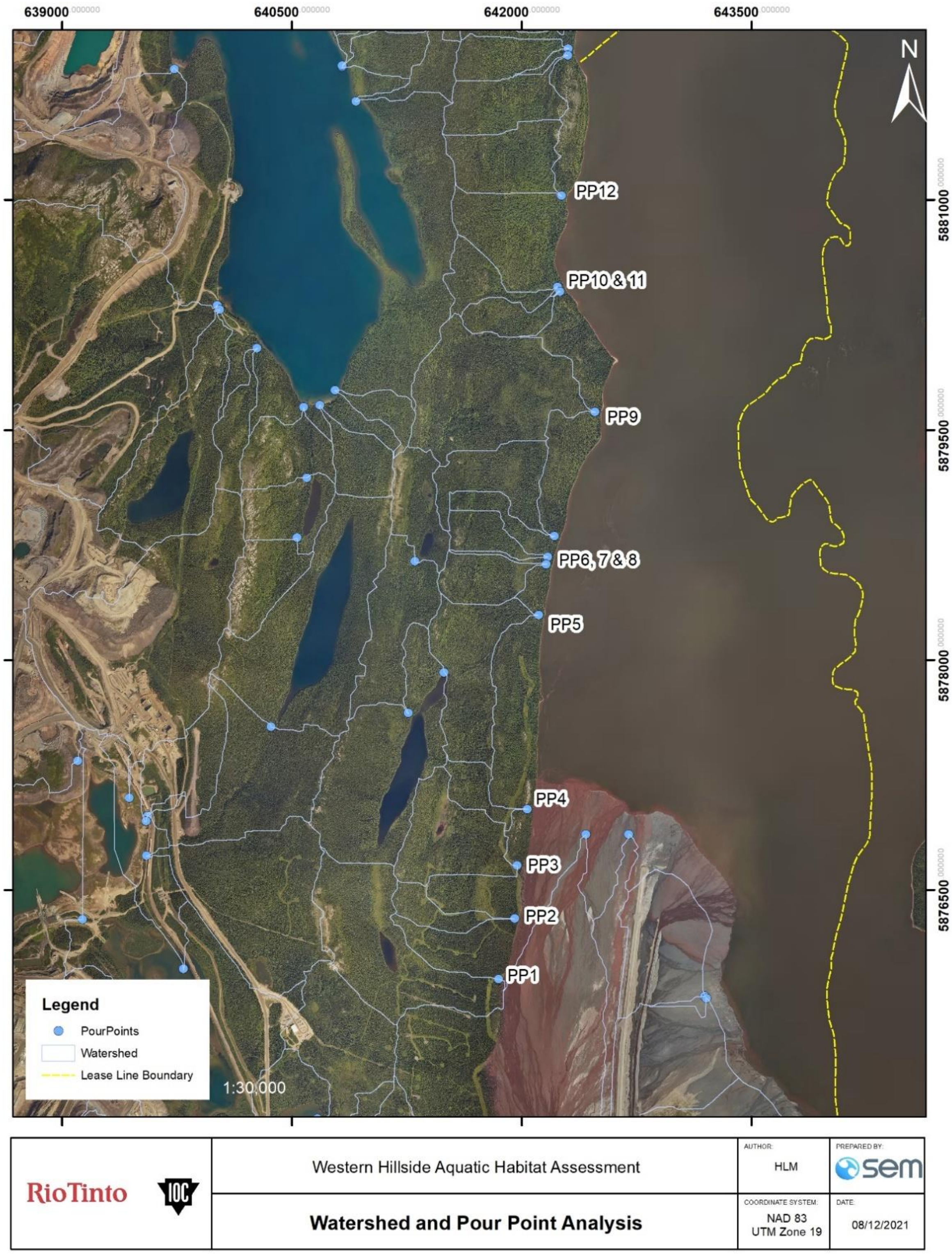


Figure 4 Watershed and Pour Point Analysis.

3.2 Stream Habitat Assessment

Habitat characterization was completed on tributaries and outlets of freshwater ponds using the standard Fisheries and Oceans Canada (DFO) methods (McCarthy *et al.* 2007). Stream habitat was classified, by reach, on a meso-habitat basis as riffle, run, pool, steady and "other" (rapids/cascade/chutes/falls). For each stream segment, the following information was collected:

- Start and end GPS coordinates (UTM, NAD1983) of each stream segment using a handheld GPS unit (GARMIN GPX60);
- Measurement of water velocity (one profile per stream), wetted width and channel width at representative transects within the segment (lower/middle/upper);
- Classification of meso-habitat type;
- Classification of cover type (instream/canopy/overhanging);
- Classification of substrate type (bedrock/boulders/rubble/cobble, etc.); and
- Identification of potential obstructions to fish migration and descriptions of each.

Flow profiles were conducted using a Hach FH950 flow meter. Substrate types were classified using the Wentworth (1917) classification and estimated as a percentage over the reach being assessed. Cover types were classified according to Scruton *et al*. (1997) and estimated as a percentage. Potential obstructions to fish passage and migration were identified and assessed as complete or partial. The GPS location of each barrier was collected.

3.3 Fish Habitat Utilization

Fish species presence was determined in representative stream habitats through spot electrofishing using a Smith-Root LR-24 backpack electrofisher. Spot electrofishing is a fishing methodology employed when qualitative fish species utilization is the only objective of the study. This method eliminates the need to isolate a stream segment with barrier nets and applying consistent fishing effort over the course of several sweeps to develop and estimate of fish populations. Standardized field fish data collection forms as per Scruton and Gibson (1995) were completed for fish collected. Fish captured were identified to species and age, weight (g) and fork length (mm) were measured. Remarks on fish condition and health were also noted.

3.4 Study Team

The study team and their roles in the Western Hillside Aquatic Assessment are described below:

David Scruton, Senior Scientist and Project Manager, was responsible for the overall project management, quality assurance/quality control (QA/QC), assisted with the preparation of the field program design and finalization of this report.

Heather Murphy, Environmental Scientist, was responsible execution of the field program, health and safety in the field, GIS analysis (map preparation) and report compilation.

Grant Vivian, President, assisted with the field collection of the biological data and was responsible for client liaison.

Crystal Kehoe, Director of Health & Safety, Quality Management, completed the required health and safety plans, policies, and documents prior to field program execution.

3.5 Quality Management

SEM personnel implemented the following quality assurance and quality control procedures:

- All personnel involved in field procedures had appropriate education, training and experience.
- Sampling methodologies were consistently applied throughout the study area.
- Fish were collected according to SEM's standard operating procedures, which were always present with field crews.
- Field personnel maintained detailed field notes on customized waterproof forms and in notebooks.
- All field data and notes were checked, verified, and backed up/archived on a regular basis (nightly when possible).

The fish sampling QA/QC procedures included the following:

- Obtaining the necessary Experimental License from DFO and communication with the designated DFO contact prior to fish sampling (License NL-6577-21, Appendix A).
- Experimental License detailed the fishing gear and effort that was permissible and the number of fish that could be collected, and personnel authorized to conduct the fishing, as required.

- Appropriate permits always accompanied field personnel (including the Experimental License and IOC's Permit to Conduct Work).
- Fish measurements were recorded on customized waterproof field data sheets.
- Data collected in the field were 'spot checked' to verify collector and recorder continuity and completeness and subsequently archived on a nightly basis.

3.6 Health and Safety

A comprehensive Health and Safety Plan was completed by SEM's Director of H&S and Quality Management prior to project execution. The plan was reviewed by all project team members and kept with field staff during completion of the study. The health and safety plan, field task hazard assessments, COVID-19 self-inspection form, "Take 5" and toolbox meeting forms were consulted (as applicable) and completed/signed daily.

IOC environment staff met with SEM field staff on Monday, August 9, 2021, prior to field work, to discuss the scope and H&S for the project. Topics included:

- Safety Share
- Review of Scope of Work
- Health and Safety Risk Management (permit to work, work procedures, weather management etc.)
- Emergency Procedures (In-Reach communication and location tracking, IOC security check and 2 hour check-ins with SEM and IOC representatives)
- Incident reporting and management
- How to complete a "Take 5"
- Discuss Critical Risk Management (CRM)
    - CRM's identified for this work included: Vehicle collision/rollover, drowning and COVID-19. These CRM's were included in the SEM H&S Plan.

4.0 Results

4.1 Stream Habitat Identification

A total of 18 sites identified through the desktop exercises were examined in the field for the presence of stream habitat. Twelve of 18 sites resulted from the pour point analysis and six from the 1:50,000 topographic mapping. Each pour point (12), freshwater pond (four; FP1, FP2, FP3 and Hillside Pond) and stream (two; S1 and S2) along the Western Hillside of Wabush Lake were investigated in the field for presence of fish and fish habitat. The field investigation resulted in locating four sites that exhibited suitable fish habitat, therefore, stream habitat surveys and fish habitat utilization studies were completed (S1, S2, Hillside Stream and Sp1). In the case of freshwater ponds, outflow locations (S1 and S2) were identified at FP1 and FP2, respectively, which were not previously identified on the 1:50,000 topographic mapping. Hillside stream was confirmed in the field through use of the 1:50,000 topographic mapping. Pour point 12 resulted from determining the location of a spring-fed stream (Sp1). Investigations of FP3 did not result in locating an outflow location which is consistent with the watershed analysis. See Figure 5 for locations of the identified aquatic habitat. Completed field stream habitat assessment forms can be found in Appendix B.

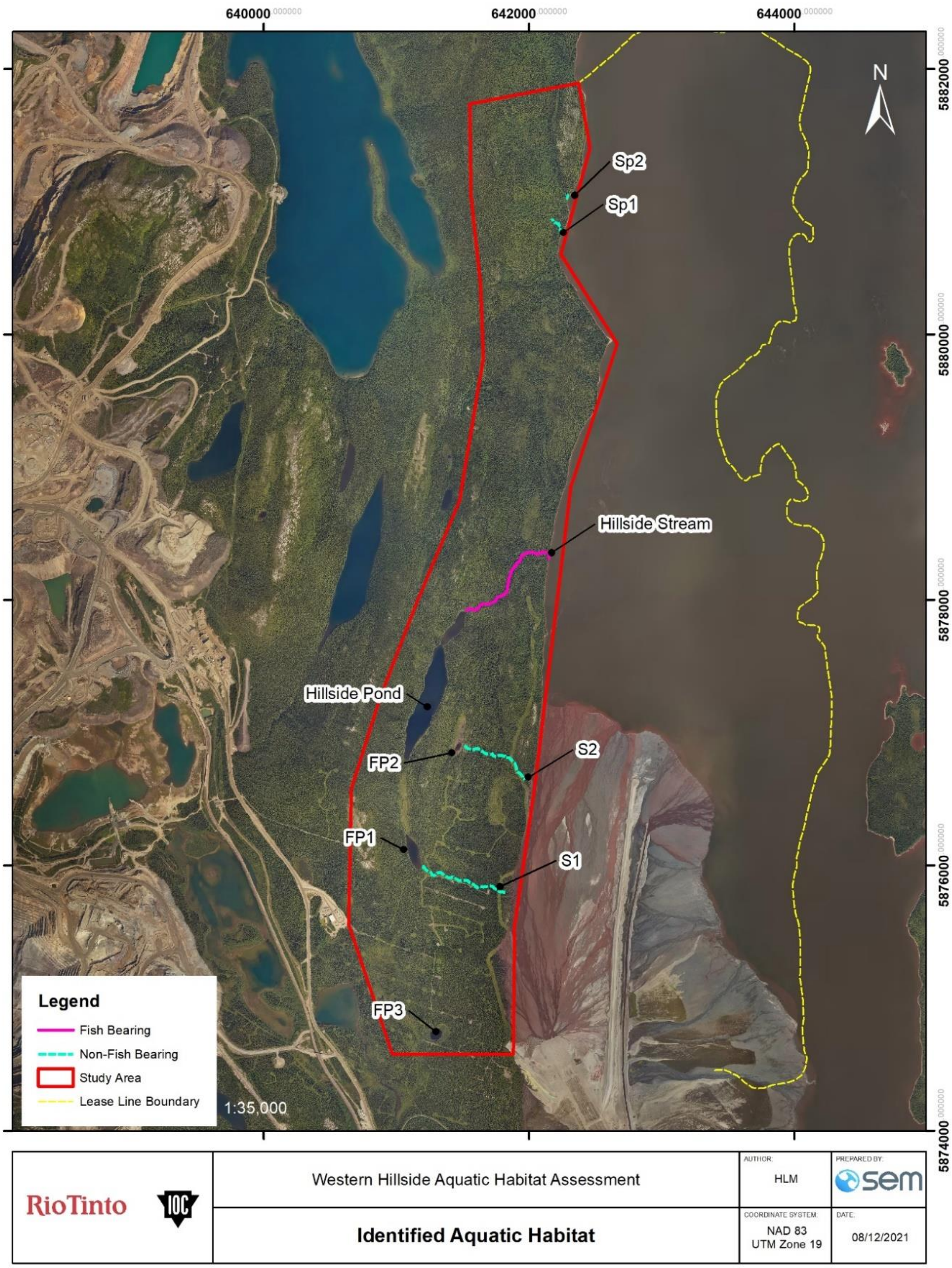


Figure 5 **Identified Aquatic Habitat Through Shoreline Traverse and Field Investigation.**

Stream 2 (S2)

Stream 2 (S2) velocity was, on average, 0.02 m/s with an average depth of 8 cm and width of 0.5 m. The stream consisted of riffle (80%) and run/pool (20%) meso-habitat types. Substrates in S2 consisted of approximately 30% boulders / rubble / cobble and 70% fines (gravel/sand and muck). Canopy and instream cover accounted for approximately 20% coverage, while overhanging vegetation consisted of 50%. No fish were observed during the stream habitat assessment of S2. IOC's tailings beach was noted to have encroached upon the stream near the outflow location.

Figure 6 Representative Stream Habitat of S2.

Hillside Stream

Hillside stream velocity was on average 0.15 m/s with an average depth and width of 11 cm and 1.75 m, respectively. The stream consisted mostly of boulders/rubble/cobble (90%) with some fines (sand/gravel). Overhanging vegetation accounted for most of the cover (50-70%) with some instream and canopy cover. Bank stability appeared to be good except for some minor erosion and undercut banks in sections 2 and 5. Meso-habitat type consisted of riffle and cascade (up to 95%) with small amounts of pool (5%). Brook trout were observed/captured through all reaches of the stream except above the partial barrier (series of falls) located in section 4, which is consistent with Ecometrix Incorporated's (Ecometrix) findings in 2011.

Figure 7 Representative Stream Habitat of Hillside Stream.

Spring 1 (Sp1)

Figure 8 Representative Habitat of Spring 1 (Sp1).

Sp1 is a small stream originating from a spring. Sp1 velocity was on average 0.08 m/s with and average depth and width of 6 cm and 0.25 m, respectively. The stream consisted of 85% riffle and run with the remaining 15% being pool and steady meso-habitat types. Substrates consisted mainly of gravels/sand (50%) with muck/gravel/sand representing 45% and the remaining 5% consisted of rubbles. Most cover types were overhanging alder and fern (70%). The entire reach of Sp1 was found to be 88 m. Some spot electrofishing was conducted in S1 and no fish were observed or captured from the efforts.

Spring 2 (Sp2)

Sp2 was found to also be spring-fed and was directly adjacent (approximately 5 m in length) to the shoreline of Wabush lake. As a result, a stream habitat survey was not conducted for this site.

Freshwater Pond 3 (FP3)

A dry stream bed was discovered on the eastern side of FP4 and is not likely fish-bearing due to lack of connectivity and seasonal intermittent flow. FP4 was examined by EcoMetrix (2011) and fish were not captured during angling, shoreline electrofishing and gill netting efforts. A stream survey was not completed for FP4 due to the lack of notable outflow/stream location.

4.2 Fish Community

Hillside stream was the only stream habitat that exhibited fish presence. Spot electrofishing effort spanned approximately 650 m of the length of the stream for a total effort of 756 seconds. Fishing effort on the stream resulted in the capture of four brook trout (*Salvelinus fontinalis*) ranging from 51 mm (young-of-the-year (YOY)) to 139 mm (1+ age class) (Figure 5). Fish capture efforts were poor due to relatively low flow and shallow water depths. At least an additional ten YOY and five 1+/2+ brook trout were observed during the stream habitat assessment. The presence of multiple age classes suggests a healthy population of brook trout in Hillside Stream with successful recruitment. Completed field electrofishing form and fish data collection form can be found in Appendix C. FP1, FP2, FP3, S1, S2 and Sp1 did not exhibit fish populations.

Figure 9 Brook Trout Captured from Hillside Stream August 10, 2021.

5.0 Discussion

The following discussion provides a general overview of the regulations and approvals, as per the *Fisheries Act*, required to undertake the Work. Since Wabush Lake is the location of the approved tailings area, measures to avoid and mitigate loss of fish and fish habitat in Hillside Stream is not likely possible. Therefore, measures to offset must be considered to counterbalance residual effects of the Work. For complete details of applying to offset adverse effects on fish and fish habitat refer to the applicable DFO policies and guidelines (Section 7.0)

5.1 Fisheries Act Authorization

Subsection 34.4(1) of the *Fisheries Act* prohibits the carrying on of work, an undertaking or activity, other than fishing, that results in the death of fish, and Subsection 35(1) prohibits the harmful alteration, disruption, or destruction of fish habitat (HADD). Any activity likely to cause death to fish or HADD of fish habitat must be authorized by DFO through the issuance of a Fisheries Act Authorization (FAA). Applying for a FAA begins with the submission of a Request for Review to DFO. DFO would review the proposed activity or undertaking and advise if a FAA is required. The proponent would then complete an application for a FAA that should outline specifications, environmental risks, summarize consultations completed, describe the affected fish habitat and habitat utilization, environmental mitigations to (including planned monitoring efforts) associated with the proposed work. The application should also include quantitative estimates of the direct and indirect residual death of fish or HADD of fish habitat so that offset planning can be completed. Ample lead time is required to study, plan and implement a fish and fish habitat offsetting project. Table 1 illustrates an anticipated suggested timeline required to complete the FAA process and offsetting for the loss of habitat for the Western Hillside stream. The suggested timeline can be compressed if needed.

Table 1 Anticipated Timeline for Obtaining DFO Authorization for Hillside Stream.

Milestone	Year
Develop quantifications of habitat loss and fish population estimates. Further study potential offsetting options.	2022 (Q2-Q3)
Submit Request for Review to DFO	2022 (Q4)
Receive HADD Determination from DFO	2023 (Q1)
Develop conceptual offsetting plan and complete additional field studies as needed for the preferred option	2023 (Q2-Q3)
Complete the offset plan.	2023 (Q3-4)
Request and receive FAA from DFO	2024 (Q1)
Complete ground works associated with offsetting option	2024-2026
Potential timing of the Work (i.e. tailings beach encroachment on Hillside stream)	2027-2029
On-going monitoring to determine success of offsetting	2026-2031

5.2 Developing an Offset Plan

DFO's guiding principles for developing an offset plan considers priority be given to the restoration of degraded fish habitat whenever possible, over the creation of new habitat. Habitat offsetting requires a balance between the benefits and adverse effects of restoring degraded fish habitat and offset measures should provide additional benefits to the ecosystem. DFO's preference hierarchy of offsetting measures begins with, in order of importance, restoring habitat, enhancing habitat, and creating habitat. Ideally the proposed measures to offset habitat losses are conducted within the same watershed but they can also take place outside the area where residual effects occur. Targeting habitat restoration, enhancement or creation for the species being impacted by the Work is also preferred. Therefore, the most desirable projects would include habitat restoration within the same watershed targeting species that are most likely to be impacted by the project activities. Introducing new species or species that may compete for habitat is considered a detriment and should be avoided if possible. SEM, in developing the options for offsetting habitat loss associated with the Work, has to take into account DFO's guiding principles and preference criteria.

6.0 Summary

6.1 Results of the 2021 Study

The majority of aquatic habitat located on the Western Hillside of Wabush Lake was deemed to be not suitable fish habitat at the time of assessment due to numerous factors (e.g., intermittent flow, dry channel beds, groundwater, spring-fed streams that may lack sufficient oxygen to support fish, etc.). Hillside Stream was the only site identified to have exhibited suitable fish habitat and contained multiple year classes of brook trout (including YoY). Results of the study are summarized in Table 3.

Table 2 Summary of Aquatic Assessment of Western Hillside Streams.

Site ID	Survey Complete?	If "No", why?	Fish Observed?	Species Present
FP4	N	No notable outflow	N	-
S1	Y	-	N	-
S2	Y	-	N	-
Hillside Stream	Y	-	Y	Brook Trout
Sp1	Y	-	N	-
Sp2	N	Spring 5m from shore of Wabush lake	N	-

6.2 Next Steps

The Work will require offsetting under the habitat provisions of the *Fisheries Act*. It will be necessary to further examine the available offsetting projects as outlined in this study and select a preferred option based on further field and desktop studies. In addition, consultations with DFO will take into account their preference hierarchy and feasibility when selecting the most desirable option. Once the most viable options are selected, the offsetting plan will need to be completed and accepted by DFO. The plan will require scientific rational, quantifications (direct and indirect) of habitat losses and the required replacement of lost habitat. The offsetting plan will need to be accepted by DFO and subsequent terms and conditions to authorize the project will be provided to IOC to complete the Work. Based on the detail provided in the FAA, engineering and environmental surveys may be required prior to the execution of the offsetting plan. Construction required for the offsetting may take approximately one to two years, depending on the scale and complexity of the project. Construction reports along with mitigations employed must be submitted to DFO throughout the construction phase. Once construction is complete, offset monitoring programs are conducted to determine the success of the offsetting project. Generally, these monitoring efforts span a 5-year period and study the target species in which the offsetting was created.

In summary, SEM provides the following recommendations based on the assessment:

1. FAA as per the *Fisheries Act* will be required to carry out the Work (i.e., extension of coarse discharge pipelines that will push tailings further north into fish habitat).

2. More information must be obtained from the Hillside stream to quantify the fish populations and potential habitat loss from the Work.

3. Additional studies on Hillside pond to determine if offsetting options are plausible within the same watershed while also considering future mining activities (e.g., W6, MEB, ATO, access roads and others unknown).

4. Further assessment of potential offsetting options as proposed in this study involving initial consultations with IOC Environment, IOC Mine Planning and DFO. Follow up consultations with field surveys and desktop studies (i.e., topographic, geotechnical and hydrological surveys).

5. Determine the feasibility of developing a conservation project on IOC properties to create a fish habitat bank for future FAA (i.e., W6).

7.0 References

Bradford, M.J., K.D. Smokorowski, K.D. Clarke, B.E. Keatly, and M.C. Wong. 2016. Equivalency metrics for the determination of offset requirements for the Fisheries Protections Program. Canadian Science Advisory Secretariat. Fisheries and Oceans Canada.

EcoMetrix Incorporated. 2011. Baseline Aquatic Assessment of Magy, Trout and Dumbbell Lakes and Two Wabush 6 Area Ponds prepared for Iron Ore Company of Canada, Newfoundland.

Fisheries and Oceans Canada. 2020. Modernizing Offsetting and Fish Habitat Banking. Fisheries and Oceans Canada's Fish and Fish Habitat Protection Program Engagement Fact Sheet.

Fisheries and Oceans Canada. 2019. Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the *Fisheries Act*.

McCarthy, J.H., C.G.J. Grant, and D.A. Scruton. 2007. Standard methods guide for the classification and quantification of fish habitat in rivers of Newfoundland and Labrador. Prepared for Fisheries and Oceans Canada, Newfoundland and Labrador Region. Draft Report, 97 pp.

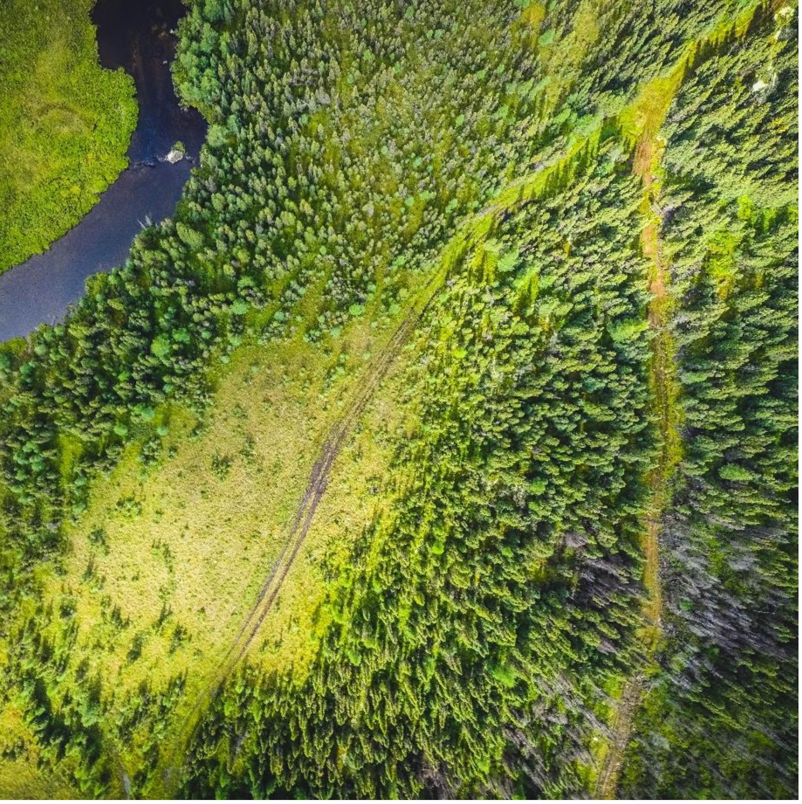
Rio Tinto, Iron Ore Company of Canada (IOC). 2018. Mine Design Report – Wabush 6, Pits 1-5, Phase A-L. Newfoundland , Canada.

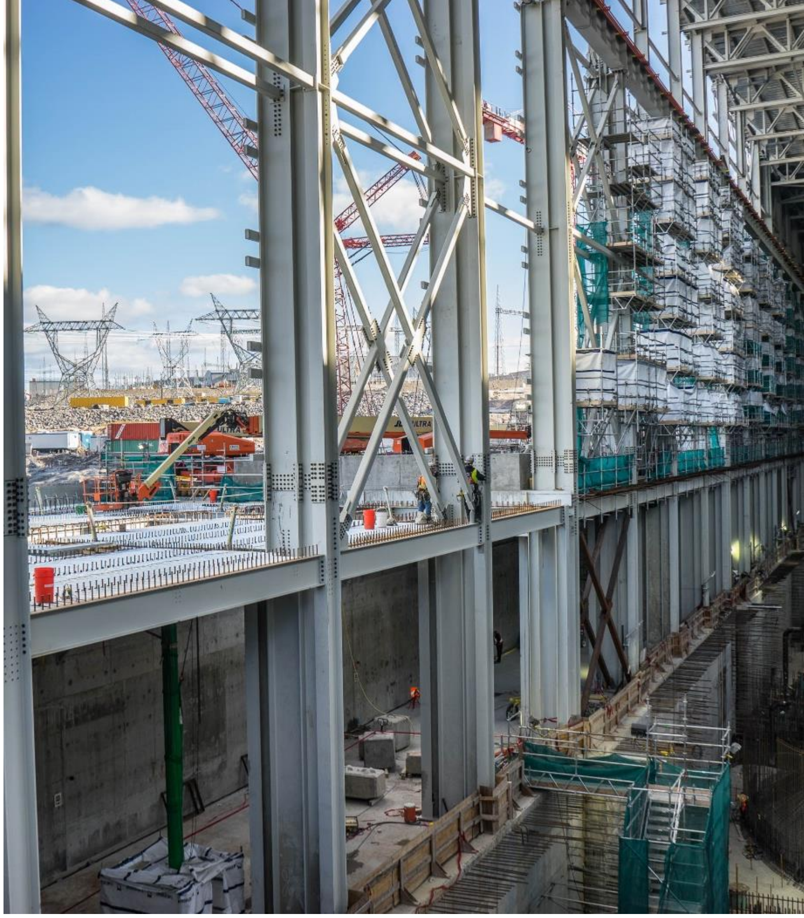
Scruton, D.A., T.C. Anderson, C.E. Bourgeois, and J.P. O'Brien. 1992. Small stream surveys for Public sponsored habitat improvement and enhancement projects. Can. Man. Rep. Fish. Aquat. Sci. 2163: v + 49 p.

Scruton, D.A. and R.J. Gibson. 1995. Quantitative electrofishing in Newfoundland and Labrador : result of workshops to review current methods and recommend standardization of techniques. Can. Manus. Rep. Fish. Aquat. Sci. No. 2308: vii + 145 pp., 4 appendices.

Sikumiut Environmental Management Ltd. (SEM). 2018. Surface Water Flow Modelling prepared for Iron Ore Company of Canada, Newfoundland.

Wentworth, C.K.1922. A scale of grade and class terms for clastic sediments. The Journal of Geology. No. 5: vii 30 + 377 pp.





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Appendix E

Hillside Pond Aquatic Habitat Assessment

December 16, 2022

Prepared for:

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IOC Rio Tinto

Hillside Pond and Stream Aquatic Habitat Characterization Study

REF: 074-208

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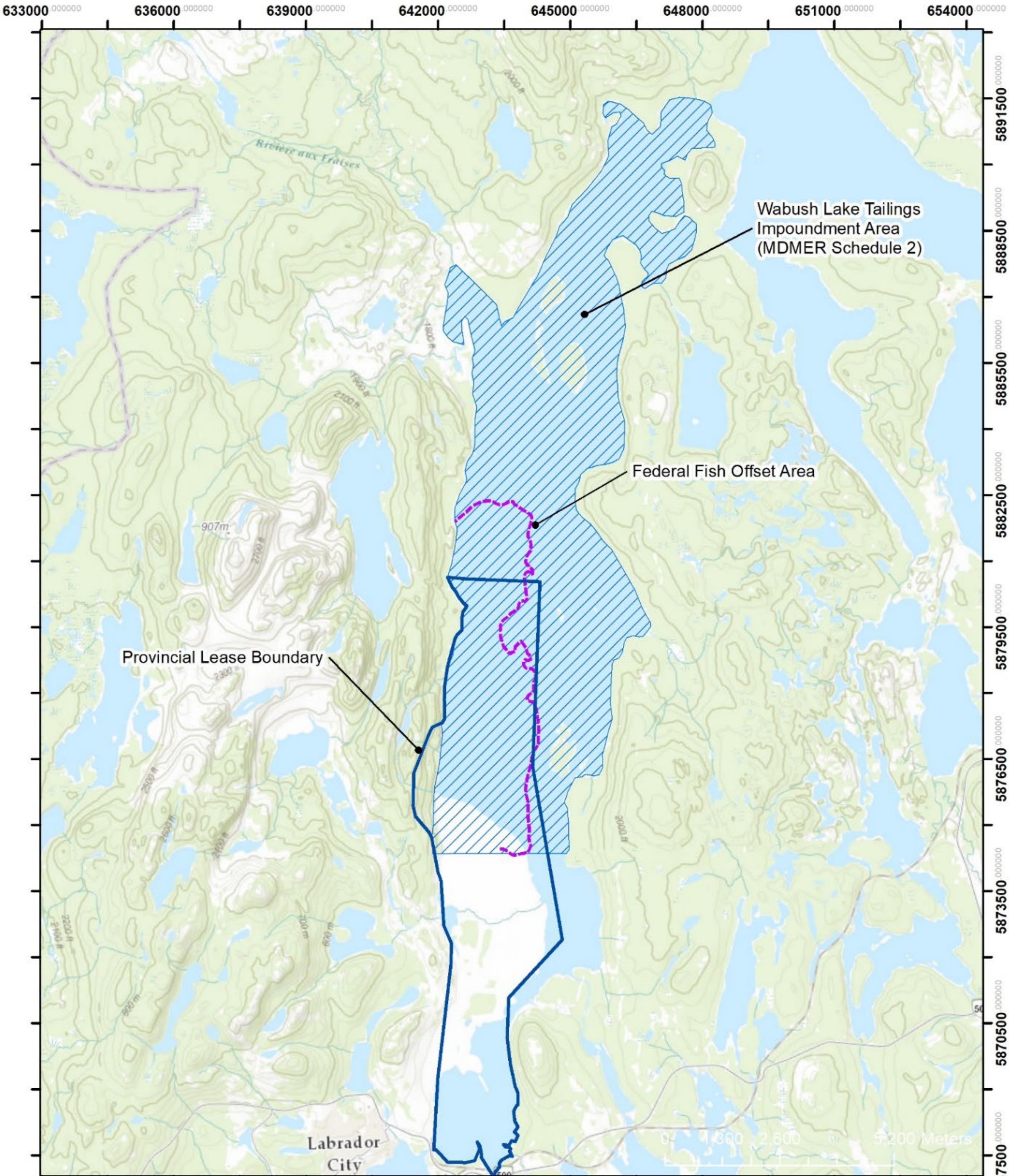
1.0 Introduction

Iron Ore Company of Canada (IOC) operates the Carol Iron Ore mine in Western Labrador. IOC's mine tailings are currently deposited into a portion of Wabush Lake, which is designated as a tailings impoundment area (TIA) under Schedule 2 of the *Metal and Diamond Mining Effluent Regulations* (*MDMER*). This Schedule 2 designation was granted through an amendment to the *MDMER* that entered into effect on February 5th, 2009, following the completion of the required regulatory process by IOC. IOC also operates under two lease boundaries (federal and provincial) which are within the TIA (Figure 1.1). The federal lease boundary is also defined as the "federal fish offset area" and is the area in which IOC is required to compensate for tailings disposal as per paragraph 35(2)(b) of the *Fisheries Act*. The offset plan for the federal fish offset area consisted of a 20-year monitoring period to show effectiveness of mitigation measures (flocculant program) to the quality of habitat outside the federal lease boundaries.

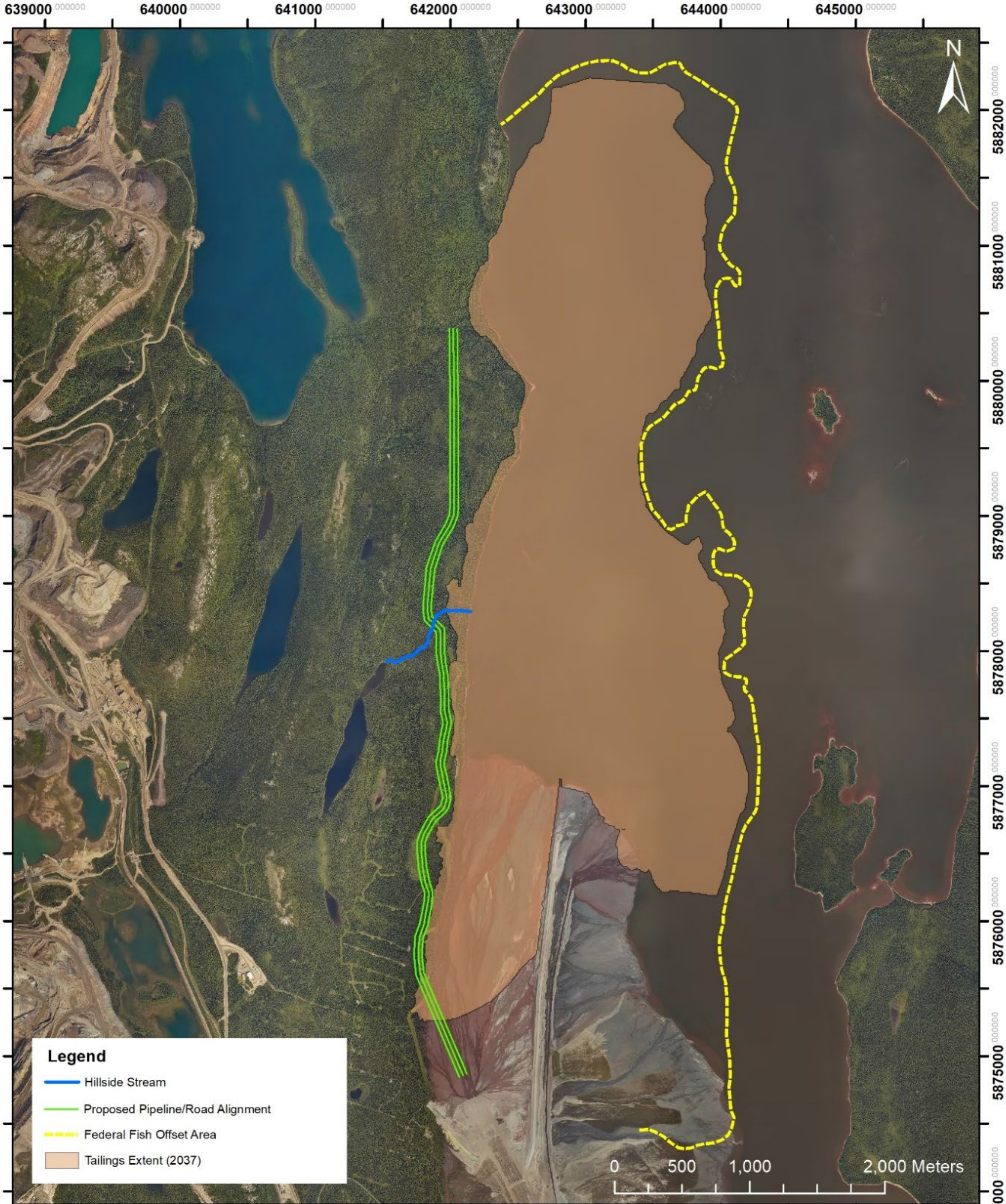
With the progressive filling of Wabush Lake TIA, IOC has been monitoring the potential impact on adjacent watercourses. A study was initiated in 2021 to identify fish habitat that is connected to Wabush Lake from the Western Hillside. The 2021 study identified one stream that was determined to be fish habitat (SEM 2021). This stream is currently approximately 750 m north of the toe of the tailings, namely Hillside Stream (Figure 1.2). IOC is concerned that tailings will eventually cause harmful alteration, disruption or destruction (HADD) of fish habitat through encroachment and will also likely affect connectivity of the stream with Wabush Lake. IOC's tailings deposition plan involves pipeline advancement and an adjacent road construction along the Western Hillside (the "Project"). To complete the Project, IOC will require an additional authorization from Fisheries and Oceans Canada (DFO) to remove any affected fish habitat pursuant to paragraph 35(2)(b) of the *Fisheries Act.*

The Project therefore required the completion of an aquatic baseline study of fish and fish to support required regulatory approvals. Studies were required to determine the fish habitat and utilization of this habitat potentially affected by the tailings deposition and associated infrastructure (pipeline/road). This information will be used to complete an analysis of the HADD of fish habitat as the basis to determine the amount of offsetting that will be required under the *Fisheries Act*. The *Fisheries Act*, as administered by DFO, requires that the affected fish habitat be replaced, or offset, for the Project to proceed. The detailed aquatic baseline information provided herein will support development of a habitat offsetting plan for approval by DFO and discussion with Environment and Climate Change Canada (ECCC). An acceptable offset plan is also a requirement for the amendment to Schedule 2 of the *MDMER*, if deemed required.

The purpose of this report is to provide IOC and other stakeholders with the appropriate background information to guide next steps with planning a fish habitat offsetting plan for Hillside Stream. This report also provides the methods and quantification of the HADD anticipated for Hillside Stream.



RioTinto IOC	Western Hillside Project	Figure Number: 1.1	PREPARED BY: sem
	Wabush Lake Tailings Impoundment Area	COORDINATE SYSTEM: NAD 83 UTM Zone 19	DATE: 11/24/2022



RioTinto IOC	Western Hillside Project	Figure Number: 1.2	PREPARED BY: sem
	Western Hillside Proposed Pipeline	COORDINATE SYSTEM: NAD 83 UTM Zone 19	DATE: 11/24/2022

2.0 Materials and Methods

2.1 Study Team

SEM assembled a Study Team of qualified and experienced professionals and technical specialists for the fisheries and habitat assessment project. The Study Team and their roles are identified in Table 2.1.

Table 2.1 SEM Study Team.

Team Member	Title	Role
Heather Murphy	Environmental Scientist	Project Manager, Field/Reporting Lead
Dave Scruton	Senior Scientist	Overall Scientific Lead
Grant Vivian	President, CEO	Client Liaison, Field Studies
Daniel Frampton	Engineer in Training	Field Studies

2.2 Study Sites and Aquatic Baseline Assessments

Aquatic habitat characterization, fish community, and fish population assessments were conducted in Hillside Pond and Hillside Stream between August 9th and August 18th, 2022. Some results presented (bathymetric profile of the pond and stream habitat surveys) were based on data collected in 2021. This section has been prepared such that all methodologies associated with lacustrine (pond) sampling have been provided first, followed by associated fluvial (stream) sampling methods. The results sections are presented in the same fashion.

The key components of the aquatic baseline assessment for pond habitat consisted of:

- Shoreline and vegetation habitat mapping;
- Bathymetric survey;
- Secchi depth and littoral/profundal zone mapping;
- Water quality;
- Chlorophyll 'a';
- Phytoplankton;
- Zooplankton;
- Sediment quality;
- Benthic invertebrate community;
- Fish community; and
- Fish population assessment using a mark and recapture program (brook trout populations only).

The key components of the aquatic baseline assessment for stream habitat consisted of:

- Habitat and substrate mapping;
- Stream bank and riparian vegetation assessment;
- Benthic invertebrate community;
- Flow characteristics and discharge;
- Water quality;
- Fish community; and
- Fish population assessment using quantitative electrofishing, where possible (brook trout populations only).

The following sections provide detailed methodologies on each key study component.

2.3 Lacustrine Baseline Assessment

2.3.1 Shoreline Habitat Mapping

A survey of the substrate/vegetation distribution in the littoral zone was performed to characterize pond habitat. A visual description of the habitat was made from a boat travelling parallel to the pond shoreline and information was collected on the surrounding vegetation, shoreline substrate composition and connectivity to other waterbodies, while taking representative georeferenced photographs, and collecting detailed notes on a waterproof map. Substrate was described based on the Wentworth classification (1922), while the derivation of composite classification (as coarse, medium, fine) was based on Bradbury *et al*. (2001) (Table 2.2).

Table 2.2 Substrate Types, Codes and Size Ranges.

Broad Substrate Category	Detailed Substrate Category	Code	Definition
Coarse	Bedrock	Be	Continuous solid rock
	Boulder	Bo	Rocks greater than 250 mm in diameter.
	Rubble	Ru	Large rocks ranging from 130 mm – 250 mm in diameter
Medium	Cobble	Co	Rocks ranging from 30 mm – 130 mm
	Gravel	Gr	Granule size or coarser, 2 mm – 30 mm
Fine	Sand	Sa	Fine deposits ranging from 0.06 mm – 2 mm
	Mud	Mu	Material encompassing both silt and clay < 0.06 mm

The distribution of substrate types was delineated on a field map and demarcated by way points collected with a Garmin GPS Map 66i (see Figure 2.1). Nearshore substrate was delineated by boundaries of homogeneous substrate types and waypoints delineated a significant change in the distribution of substrate types. The distribution of substrate was often determined by the shape and orientation of the shoreline, exposure to wind and waves, and underlying surficial geology. In Figure 2.1 for example, waypoints 1 and 2 delineate the boundaries of an area of bedrock and boulder substrate, while waypoint 5 identifies the location of an inlet stream.

More than one substrate type was frequently present in each area, and this was denoted by recording the dominant combination of substrate types in an area (up to three types). Substrate types and presence of vegetation were subsequently categorized under four main headings: (i) coarse (bedrock, boulder); (ii) medium (rubble, cobble, gravel); (iii) fine (sand, silt, muck, clay); and (iv) vegetation for consistency with Bradbury *et al*. (2001). The detailed substrate classification often contained more than one substrate category, and in this case, 50% of the habitat in that area was assigned to each category.

The resulting pond habitat data was digitized and post-processed using ArcGIS software.

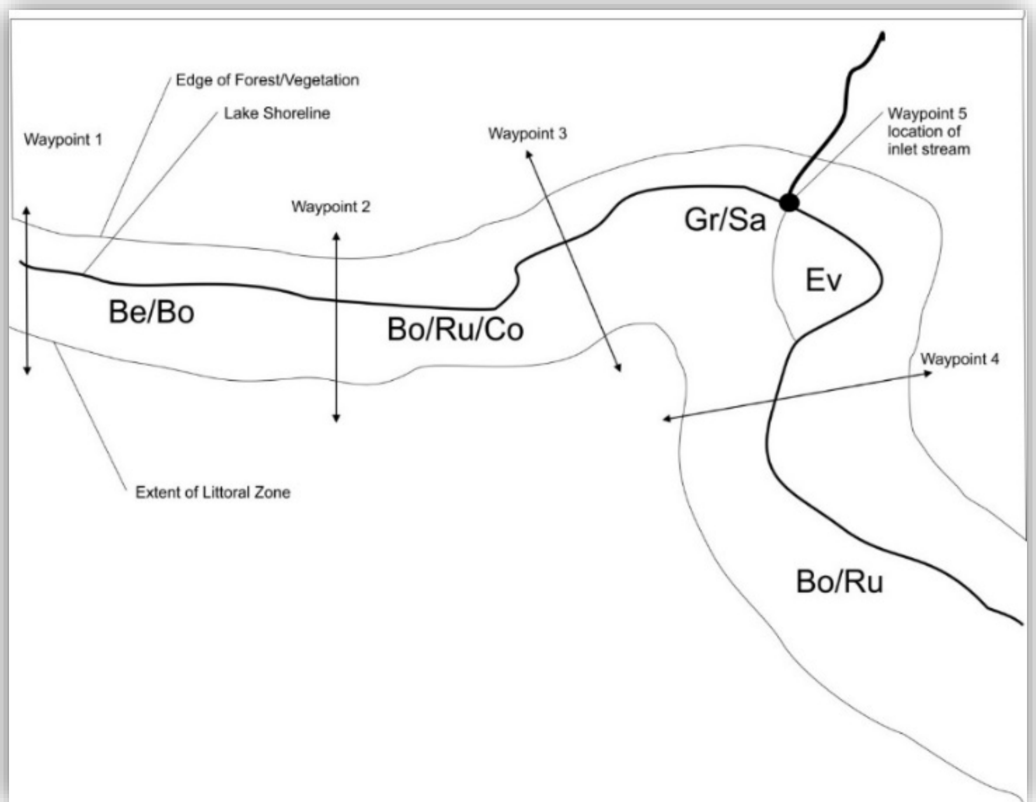


Figure 2.1 Example of Mapping of Pond Shoreline and Substrate Types.

2.3.2 Bathymetry

A bathymetric survey was conducted for Hillside Pond on October 28th, 2021, to determine volume and depth distribution. Bathymetric data were collected using a Sonarmite DFX dual frequency echosounder combining both low-frequency (33 kHz) and high frequency (200 kHz) transducers in one unit. This echosounder was supplemented with a portable handheld echosounder for manual measurement combined with GPS locations where depths were too shallow to operate the Sonarmite (<0.5 m). Bathymetry data (x, y, z; longitude, latitude, and depth) were collected along pre-determined transects and data were sent to a Panasonic Toughbook laptop computer (Model CF31). Bathymetry data were then post-processed using Sonarvista software. Data processing involved application of a general process model which included smoothing, transient filtering, and bottom delineation of the raw data. Once all initial processing was complete, data were exported to a *.csv file for additional analysis and modelling in ArcGIS.

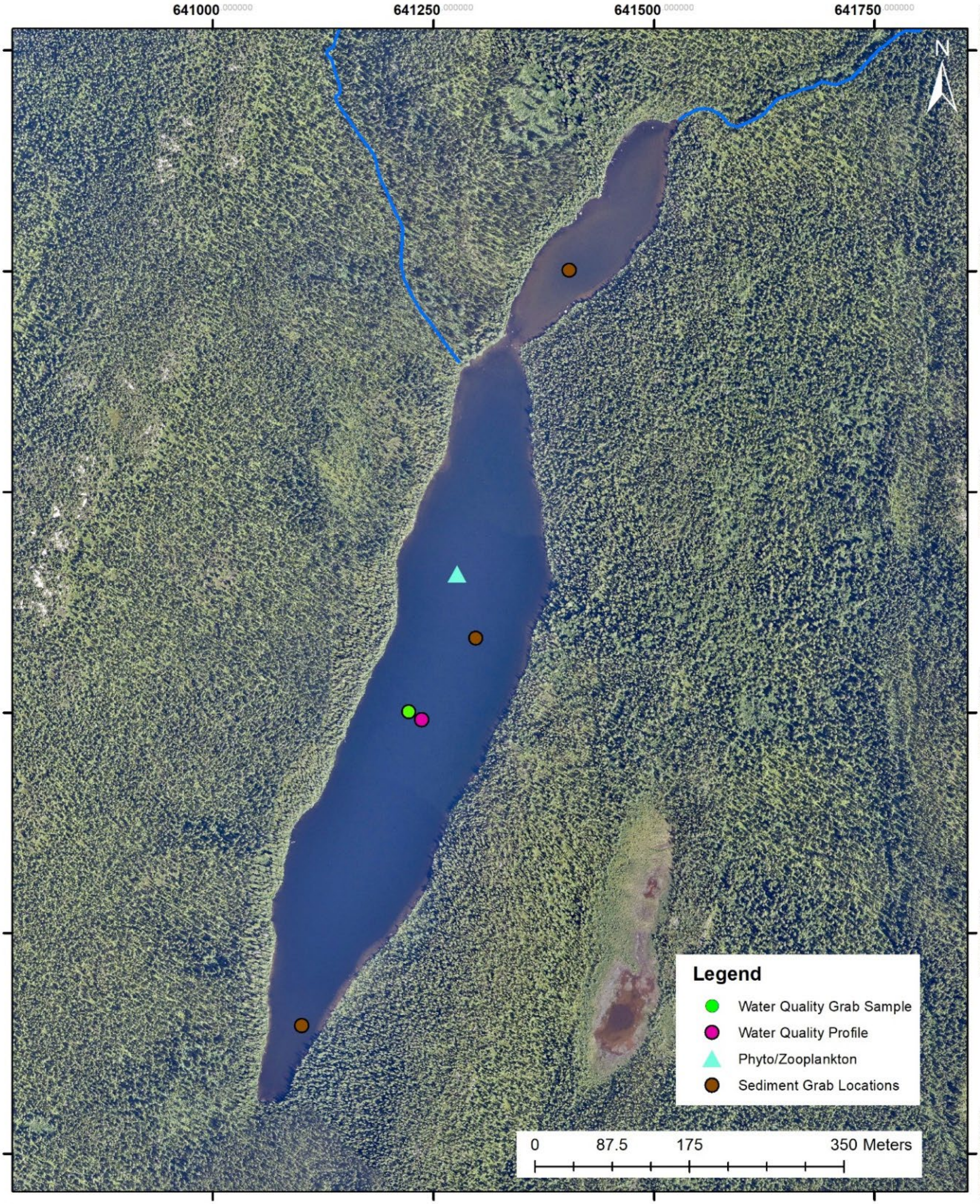
2.3.3 Secchi Depth, Littoral and Profundal Zone Mapping

Secchi depth was measured using a standard 30 cm diameter Secchi disk, with alternating black and white quadrants. The Secchi depth was calculated as the average between depth where the disk was not visible on descent and where it was again viewed on ascent. To the extent possible, Secchi depth measurements were taken at the same period of the day (i.e., 10:00 to 15:00) and by the same individual. To ensure that incident sunlight was at similar angles the measurements were always conducted facing away from the direction of the sun.

The aquatic habitat zones were delineated using a combination of Secchi depth measurements and the bathymetric survey. The Secchi depth represented a reasonable approximation of light penetration and was used to delineate the extent of the littoral zone (Bradbury *et al*. 1999). The profundal zone was defined as the central region of the pond that extended beyond the outer limit of the littoral zone and was not penetrated by sunlight (Bradbury *et al*. 1999). GIS software analysis used the pond bathymetry data in conjunction with Secchi disk depth to delineate littoral and profundal zones.

2.3.4 Water Quality Survey

A surface water sample was collected (Figure 2.2) by grab technique for Rapid Chemical Analysis Package™ (RCAP) at an analytical laboratory. RCAP included a full metal scan and conventional parameters including nutrients, major anions and cations and total organic carbon (TOC) (Table 2.3). Ammonia was collected in a 40 ml clear glass vial (with sulphuric acid preservative and no head space). Samples for all other parameters were collected in three 120 ml plastic bottles with nitric acid preservative for metals, sulphuric acid preservative for TOC and no preservative for all other general parameters. Samples were stored on ice until they were placed in refrigeration at shore-based facilities, and then sent to Bureau Veritas Laboratories (Bedford, NS) for analyses.



RioTinto IOC	Western Hillside Project	Figure Number: 2.2	PREPARED BY: SEM
	Hillside Pond Sampling Locations	COORDINATE SYSTEM: NAD 83 UTM Zone 19	DATE: 11/29/2022

Table 2.3 Water Quality Analysis Parameters.

Rapid Chemical Analysis Package		
Alkalinity	Conductivity	Nitrate + Nitrate
Sulphate	Ammonia	Hardness
Orthophosphate	Total Dissolved Solids	Bicarbonate, Carbonate
Ion Balance, Ion Sum	pH	Total Organic Carbon
Chloride	Reactive Silica	Turbidity
Colour	Saturated pH	Langelier Index
Metals: Ag, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Sn, Sr, Ti, Tl, U, V (determined by inductively coupled plasma spectrometry (ICP).		

Units of reporting and reportable detection limits (RDLs) are provided in the results while certification of analysis and raw data are provided in Appendix A.

Temperature and water quality profiles were collected in Hillside Pond to determine the presence or absence of thermal or chemical stratification. This also allowed determination of whether there were any anoxic zones within the pond. Field water quality measurements were taken at 1 m depth increments in the deepest location of the pond. The water quality details were measured with a multiparameter YSI (ExoSonde 2), which was calibrated prior to its use in the field. Measurements that were taken included: temperature (0.01°C), pH (0.01 pH units), conductivity (1 µS/cm) and dissolved oxygen (DO, 0.01 mg/L, % saturation [0.1%]).

Interpretation of water quality data included comparison with Canadian Council of Ministers of the Environment (CCME) guidelines and comparison with past data and regional databases, wherever possible.

2.3.5 Chlorophyll 'a'

A subsurface chlorophyll 'a' sample was collected at 0.3 m depth in the same location that water quality was taken in a 1 L bottle by grab technique and was immediately wrapped in aluminum foil to ensure no light penetration. Sample was stored on ice in a cooler in the field, then stored in a refrigerator until submission to Bureau Veritas Laboratories.

Laboratory analysis was completed at Dalhousie University by fluorometer with overnight 90% acetone extraction and with correction for phaeopigments by acidification. Duplicate samples were collected and analyzed and reported as the means of both due to the inherent sample variability and to rule out any problems with vacuum filtration. Chlorophyll 'a' was determined by both the acidification method (Holm-Hansen *et al*. 1965) and non-acidification method (Welschmeyer 1994).

2.3.6 Phytoplankton

A 250 ml subsurface water sample was collected and preserved with Lugol's solution for phytoplankton taxonomic analysis.

Sub-samples (5 ml) from field preserved phytoplankton samples were processed at laboratory facilities (Dr. Roy Knoechel) using settling chambers that produce permanent slides (Knoechel and Kalff 1976). The slides were examined under phase contrast illumination at 500 times magnification and individual cells, filaments or colonies were measured using an ocular scale and accumulated in size categories. The biomass (fresh weight) was calculated from abundance and specific biovolume estimates using formulae for simple geometric solids and assuming unit density. The biovolumes of colonial taxa were based on the number of individuals in a colony. Data were accumulated in three size categories (<10 µm, 10-30 µm and >30 µm maximum linear dimensions) which are related to the relative availability of organisms to grazers (Sprules and Knoechel 1984). The <10 µm size range is considered as available to Rotifer grazers while Cladoceran and Calanoid Copepod grazers can feed on that size range plus the 10-30 µm size category. Cells, filaments and colonies greater than 30 µm are generally unavailable to grazers.

2.3.7 Zooplankton

Quantitative zooplankton samples were collected using a vertically integrating tube sampler (Knoechel and Campbell 1992) fitted with a 100 µm mesh Nitex net. The sampler was lowered to a suitable depth so as not to disturb the pond bottom and hauled to surface repeatedly until a total sampled depth of twenty meters (20 m of filtered water) had been obtained to provide a quantitative composite sample of the near-surface zooplankton community. The tows were composited to form one sample in 250 ml mason jars and preserved using 95% ethanol.

A measured sub-sample sufficient to contain at least 100 crustaceans from field preserved zooplankton samples was examined at the selected laboratory (Dr. Roy Knoechel). A dissecting microscope using phase contrast illumination at magnifications of 12 to 50 times was used to identify large (macro) zooplankton. Samples were examined using an inverted microscope at magnification of 200 to 400 times for rotifers and copepod nauplii. Individual organisms were measured using an ocular grid and sorted into taxonomic categories. Individual biomass was calculated from published weight-length regressions, accumulated in taxonomic categories, and then corrected for sub-sample volume and original sampled volume (6.74 L/m) to yield an estimate of total zooplankton biomass (mg/m^3 wet weight).

The zooplankton biomass data were analyzed in three functional/taxonomic categories as follows:

- Copepods, a primarily carnivorous crustacean group as adults and calanoid copepods and nauplii, a primarily herbivorous crustacean group that can feed on all edible-sized phytoplankton in the adult and juvenile copepodite stages but on only the smaller phytoplankton when in the larval nauplius stages;

- Cladocerans, a primarily herbivorous crustacean group that can typically feed on all edible-sized (<30 µm) phytoplankton; and
- Rotifers, the smallest forms which typically feed on the smallest (<10 µm) phytoplankton.

2.3.8 Sediment Quality Survey

Sediment samples were collected from three stations and composited into a single sample using a Petite Ponar grab (11.3 kg, 0.023 m^2 and 2.4 L) and analyzed for organic carbon, and particle size. Sediment samples were collected after all other samples had been collected.

Sample collection utilizing the Petite Ponar grab consisted of first selecting a representative site where the Ponar could penetrate the bottom without being tipped on its side. Prior to deployment, the sampling platform was moored in position using a single anchor at the stern of the boat. The Petite Ponar was primed for release and lowered over the side of the vessel in a vertical position off the pond bottom. The mouth of the trap door mechanism and weight of the equipment allows for penetration into the substrates for sample collection. Once secure at the bottom of the pond, a rapid upward pulling motion on the tether closes the trap door shut (by virtue of the weight of the sampling device), securing the sample inside the chamber. The sample was then retrieved to the surface and emptied into a 20 L bucket. To ensure sufficient sample volume, three grab samples were taken and combined for further sieving and washing at the laboratory (total surface area = 0.08 m^2). Following the retrieval of the sediment sample, a homogenized 250 ml sub-sample was collected using a plastic spoon for chemical analysis at the laboratory. The sample container was filled ensuring no head space above the sediment. The remaining sediment sample was placed in a 5 L plastic sample bucket for subsequent processing to collect a sample for benthic invertebrate community analysis.

All sampling gear was thoroughly rinsed between collections. Nitrile gloves were worn when preparing the sub-sample for chemical analysis and were disposed of after each sample. All samples were kept in coolers with ice packs until stored at refrigeration facilities at the SEM office. Samples were then shipped to Bureau Veritas Laboratories (Bedford, NS) for analysis.

Sediment quality data were compared with CCME guidelines and with past data and regional databases, wherever possible.

2.3.9 Benthic Invertebrate Community

A minimum of 5 L of sediment containing benthic invertebrates was collected using a Petite Ponar grab as described above.

Subsequently, the sample was sieved and washed with freshwater through a 500 µm mesh at the SEM Laboratory. All benthic organisms in the sieved sample were placed into 250 ml sample bottles and preserved with 90% ethanol for future sorting and identification.

Taxonomic identification and enumeration of benthic invertebrates were completed at SEMs laboratory. All field samples were initially washed at the laboratory with a 200 µm mesh screen to remove any fine debris and any excess preservative. Samples were scanned under a binocular microscope at six to 12 times magnification to improve visibility of benthic organisms. All benthic invertebrates were then removed from the sample debris using fine forceps and transferred to a separate container and re-preserved in 70% ethanol.

All organisms were then identified to the lowest practical taxonomic level (genus or species wherever feasible) using current literature and nomenclature and enumerated. The lowest practical level of taxonomic identification, as previously used in studies in western Labrador were as follows for each major benthic group (Table 2.4).

Table 2.4 Lowest Practical Taxonomic Level Identified for Benthic Invertebrates.

Major Taxon	Identification Level
Nematoda	Phylum
Oligochaeta	Family/tribe
Gastropoda	Genus/species
Turbellaria	Family
Hirudinea	Genus/species
Mollusca	Genus/species
Hydracarina	Leave at this level
Cladocera	Order
Ostracoda	Leave at this level
Amphipoda	Genus
Insecta	Genus/species

A reference collection of all taxa identified from samples was prepared and retained for taxonomic verification to ensure consistent taxonomy in future benthic analysis.

The benthic community metrics that were used in data analyses and for comparisons between sites included abundance (total number of individuals), density (total number of individuals per m^2) and taxonomic richness (total number of taxa per sample).

2.3.10 Pond Fish Population Assessment

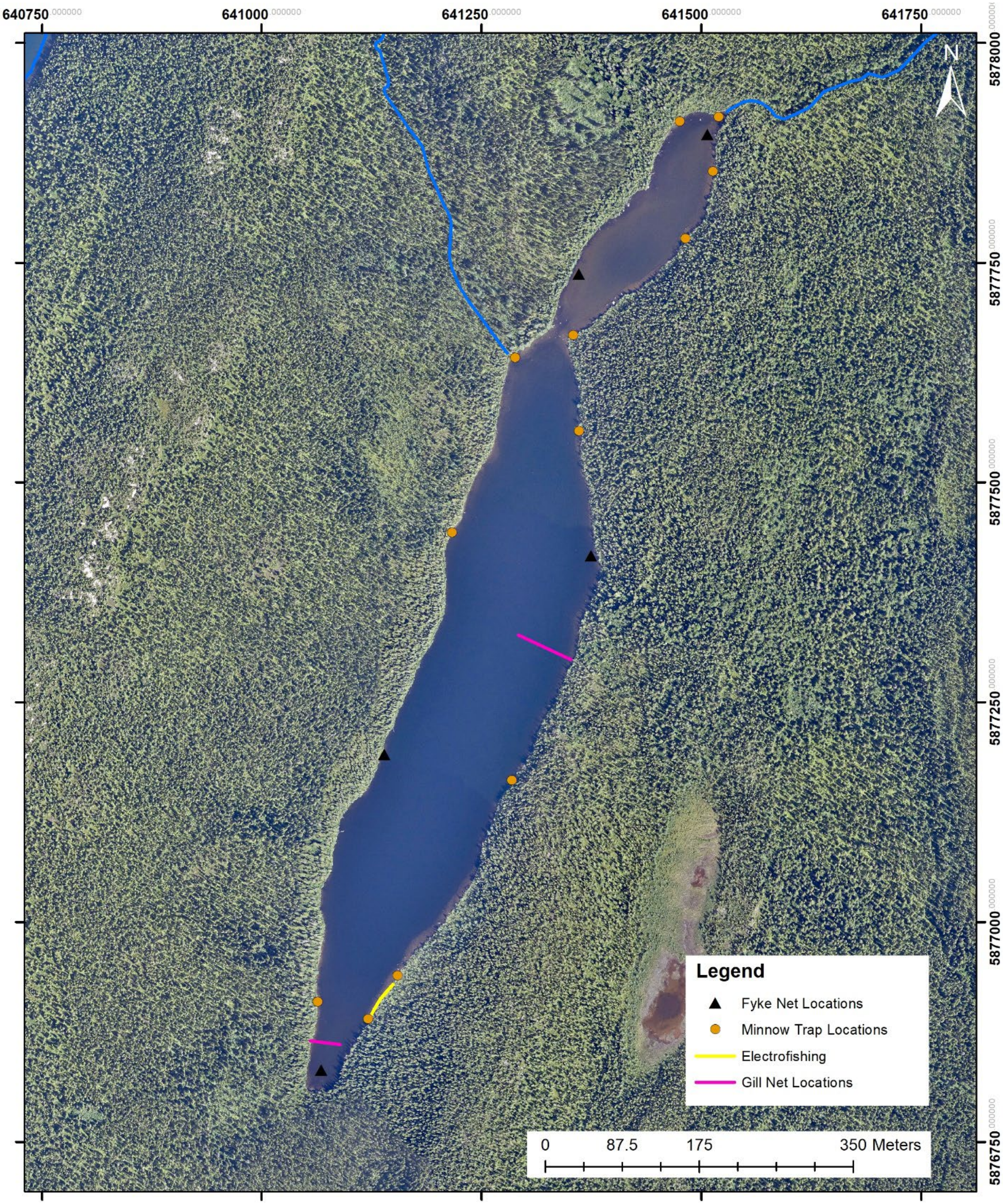
The fish community and population in Hillside Pond was determined through completion of a mark-recapture program using fyke nets, supplemented with shoreline electrofishing, minnow traps and short tended gill net sets (Figure 2.3). All fishing was conducted following conditions outlined in SEM's experimental license (NL-6816-22, Appendix B) issued by DFO for this project. Minnow traps and gill nets were used to target fish species in the pond that may not be susceptible to fyke netting. Five fyke nets were deployed throughout the pond in representative habitats. Fyke nets were set along the shoreline (typically perpendicular to the shoreline) and fished for at least 12 hours prior to checking. This allowed the nets to potentially capture fish during the dawn and dusk periods when fish are more actively feeding and moving. Nets were not baited. However, minnow traps were baited after a period of unsuccessful sets. All captured fish were then identified to species and measured for fork length (1 mm) and weight (1 g).

Fish population estimates were determined using a mark-recapture method for brook trout. After capture, brook trout were marked using a v-notch on the caudal fin and released close to their point of capture but not in the direct vicinity of the nets. After all nets were checked, a total count of fish by species was determined. After the first net set and marked fish had been released, all captures were examined to determine if the fish were marked or not (i.e., recaptured). Any unmarked brook trout would then be marked prior to release. The field team continued fishing until 10% of the total recaptures were marked in order to have data sufficient for a population estimate with reasonable confidence intervals.

Population estimates were determined using the Schnabel multiple mark-recapture method based on the numbers of marked and unmarked fish captured each day. The total number of net nights (nights x nets) of sampling effort was consistent across the entire sampling program.

Length, weight, and condition factor (K, Fulton Method) was measured for all fish. Fish assumed to be young-of-year (YoY) size (65 mm or less) were not included in the calculation of K as applying the condition factor to YoY can be highly inaccurate due to the resolution of weight measurements in small fish, and the fact that YoY fish could still be adapting to exogenous feeding.

Fish scales were obtained from representative size classes and submitted to the Canadian Rivers Institute for ageing.



RioTinto IOC	Western Hillside Project	Figure Number: 2.3	PREPARED BY: sem
	Hillside Pond Fishing Locations	COORDINATE SYSTEM: NAD 83 UTM Zone 19	DATE: 11/29/2022

The main component of the fish capture program involved the use of five fyke nets. Fyke nets utilized in the program had a leader only (more favourable for lacustrine environments) which guided fish towards the entrance. The entrance lead into a series of cone-shaped netting, with netting rings (hoops), allowing fish to pass only in one direction to the bag end, where fish were retained until released. Fyke nets were fixed to the bottom by anchors and were set perpendicular to shore (leader). Fyke nets were constructed of small mesh (1.27 cm mesh, stretch measure), which reduced the chances of entanglement and subsequent death during capture.

Twelve minnow traps were set throughout the pond and were treated in the same fashion as the fyke nets (i.e., fishing duration and mark-recapture procedure). Minnow traps consisted of a cylindrical 1.27 cm wire mesh with inside conical openings in both ends, leading to the inside of the trap. Two experimental gill nets were set to target species not susceptible to fyke traps. Gill nets were experimental type and were comprised of six-panel, multi-mesh monofilament with each panel measuring 15.2 m x 2.4 m deep, consisting of 2.5, 3.8, 5.1, 6.4, 7.6 and 10.2 cm (stretch) mesh sizes. Gill net sets were tended and set for very short durations (1-2 hours). Gill nets were set to fish in areas where fyke netting would not be productive or possible (e.g., pelagic zones), were checked frequently (every hour) and were not used overnight. All live brook trout captured were marked and released as explained above. Gill netting only occurred for one set (1.5 hr) during the project and was only executed to ensure species present in pelagic zones were properly identified.

2.4 Fluvial Baseline Assessment

2.4.1 Stream Habitat Assessment

The approach taken for the Hillside Stream survey followed the methodology described by Scruton *et al*. (1992) as adapted by Sooley *et al*. (1998). These techniques are specific to small streams or streams that can be walked or waded. All stream segments were surveyed in August 2021, in an upstream direction from the confluence of Wabush Lake. Stream segments were delineated by an obvious change in habitat type.

Hillside Stream survey followed standard DFO methods (i.e., McCarthy *et al*. 2007). Stream habitat was classified by reach, on a meso-habitat basis, as: (i) riffle; (ii) run; (iii) pool; (iv) steady; and (v) rapids/cascades/chutes/falls. For each stream segment the following information was collected:

- Measurement of depth, water velocity, wetted width, and channel width at representative transects;
- Classification of meso-habitat type;
- Classification of substrate types;

- Classification of cover types;
- Assessment of stream bank conditions; and
- Identification of potential obstructions to fish migration and description of each.

Substrate types were classified using the Wentworth (1922) classification and estimated as a percentage over the reach being assessed. Cover types were classified following Scruton *et al*. (1992) and estimated as a percentage over the reach being assessed. Stream bank conditions including stability, presence of eroding banks, and presence of undercut banks were assessed following Scruton *et al*. (1992) and estimated as a percentage of the reach. Potential obstructions to fish movement and migration were identified and assessed as complete or partial barriers. The GPS location and photograph of each barrier was collected.

2.4.2 Stream Flow Conditions and Discharge

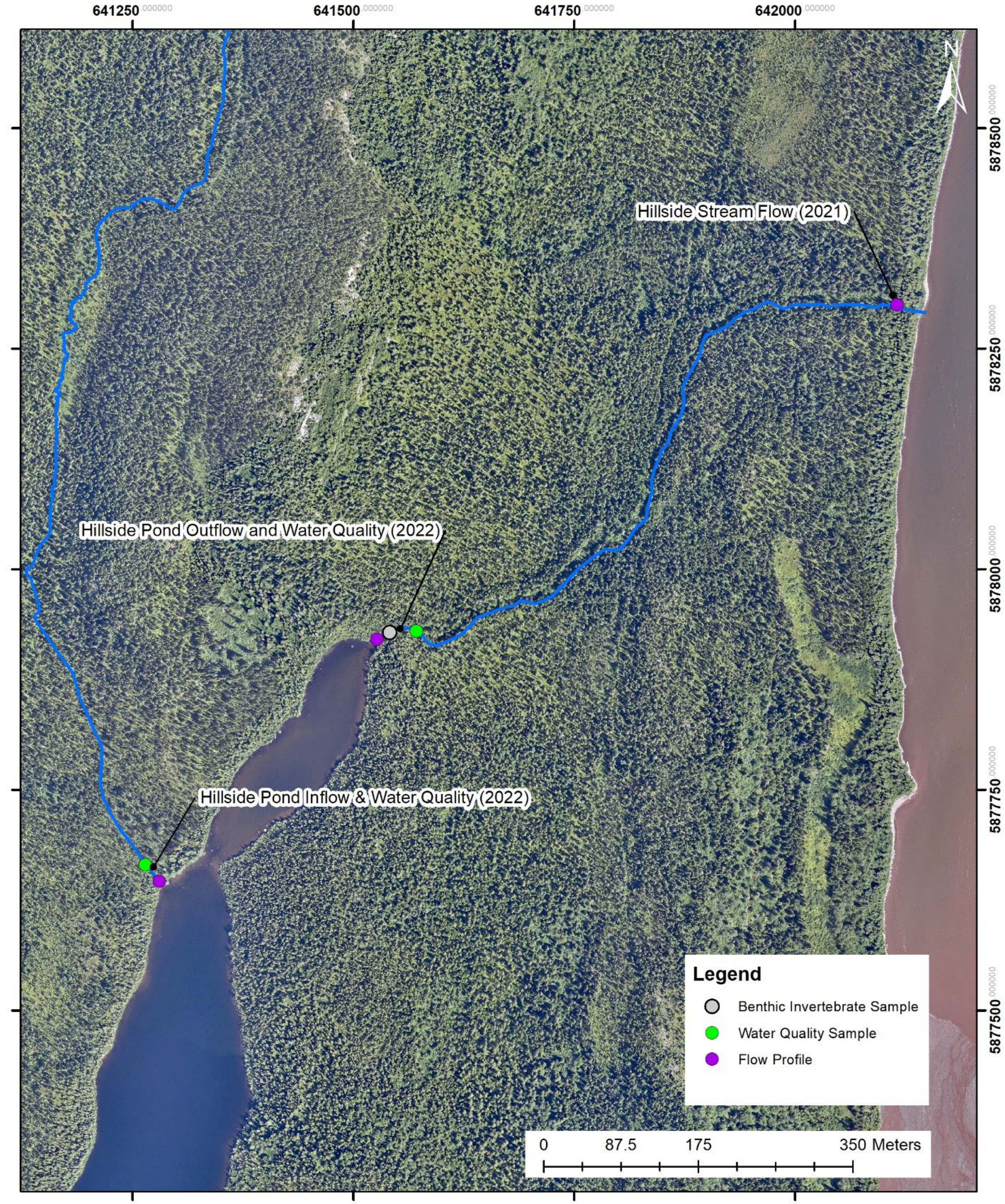
Flow profiles were collected from the inlet to Hillside Pond, outlet of Hillside Pond and Hillside Stream (Figure 2.3). Water depth and velocity measurements were collected at selected locations on each of the study streams using a Hach FH950 Acoustic Doppler Flow Meter with wading rod. Transects were established and marked using survey tape. A measuring tape was stretched across the stream perpendicular to the shoreline at each transect. Depth (nearest cm) and velocity (0.01 m/s) were recorded starting at the water's edge and additional verticals thereafter, or when a noticeable change in velocity or depth was encountered. Velocity was recorded at 60% water depth. Depth and velocity measurements were subsequently used to calculate discharge. All field surveys and calculations followed protocols established by Environment Canada, Water Survey of Canada (WSC 1999).

2.4.3 Water Temperature

Water temperature was taken *in situ* throughout the field program using a multiparameter YSI.

2.4.4 Water Quality Survey

Methods involved with collection of samples for water quality and collection of field water quality data in streams was consistent with methods used in Hillside Pond with the exception of completing a depth profile (see Section 2.3.4).



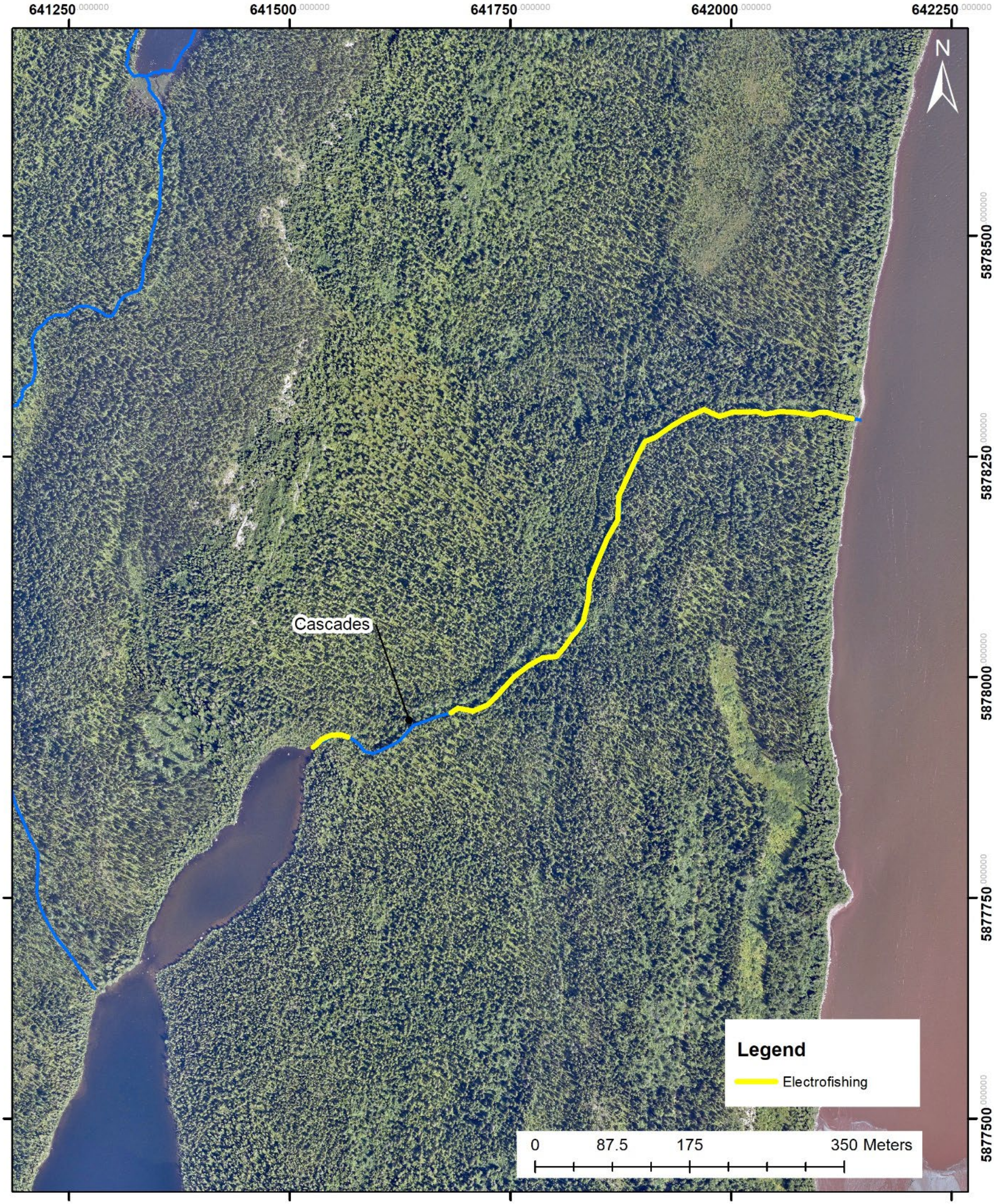
RioTinto IOC	Western Hillside Project	Figure Number: 2.4	PREPARED BY: sem
	Hillside Stream Sampling Locations	COORDINATE SYSTEM: NAD 83 UTM Zone 19	DATE: 11/29/2022

2.4.5 Benthic Invertebrate Community

A Surber sampler (0.25 m tall by 0.5 m wide) was utilized in Hillside Stream where water depths were 30 cm or less and flow was sufficient to carry organisms into the "cod end" of the net. Sample collection utilizing the Surber sampler consisted of selecting a representative site and positioning/securing the mouth of the net facing upstream such that the net portion ran parallel to flow. Substrates directly in front of the net (area = 0.25 m^2) were carefully cleaned with hands or a brush allowing organisms to drift into the collection end of the net. Larger rocks were visually inspected for clinging organisms and any present were manually transferred into the collection net (including pupa casings). Smaller substrates were disturbed using hands, toe-end of a boot or a small trowel to a depth of 5 cm to 10 cm. Once the substrate was thoroughly cleaned, the net was brought back to shore and rinsed using a squirt bottle into the collection cup (250 ml glass jar) to collect any clinging organisms. The sample was then labelled, secured, and brought back to the laboratory for further processing and fixation (80% ethanol).

2.4.6 Fish Community Assessment

Fish species presence in Hillside Stream was determined during both the 2021 and 2022 surveys through spot electrofishing using a Smith-Root LR-24 backpack electrofisher (Figure 2.4). Spot electrofishing is a fishing methodology employed when qualitative fish species utilization is the only objective of the study. This method eliminates the need to isolate a stream segment with barrier nets and applying consistent fishing effort over the course of several sweeps to develop and estimate of fish populations. However, in the case for Hillside Stream, spot electrofishing was the only possible method given the conditions (extremely dense riparian vegetation, numerous instream features and low flow). Standardized field fish data collection forms as per Scruton and Gibson (1995) were completed for fish collected. Fish captured were identified to species. Age, weight (g) and fork length (mm) were also measured. Remarks on fish condition and health were also noted. Condition factor (k) was also calculated as per Section 2.3.10.



RioTinto IOC	Western Hillside Project	Figure Number: 2.5	PREPARED BY: sem
	Hillside Stream Electrofishing Locations	COORDINATE SYSTEM: NAD 83 UTM Zone 19	DATE: 11/29/2022

3.0 Hillside Pond Survey Results

3.1 Overview and Description

Hillside Pond is situated approximately 1.3 km northeast of the IOC Mine Engineering Building (MEB). Access to the pond was gained from behind the MEB along decommissioned exploration trails via ATV and trailer to mobilize equipment. The pond sits near the top of the watershed in a south to north orientation draining into Hillside Stream which terminates at Wabush Lake. There is one small inlet to Hillside Pond which occurs along the northwestern shoreline of the pond near the narrowest portion of the pond. The inlet stream is approximately 1.6 km in length and was preliminarily examined by field personnel (200 m upstream from confluence). Field personnel noted the inlet stream is relatively shallow (<10 cm) with intermittent and braided flow. There is small unnamed pond that drains from the top of the watershed into the inlet stream and eventually into Hillside Pond. A spring was also noted along the shoreline of the pond adjacent to the inlet. The pond has multiple water sources including a combination of groundwater, surface water and runoff from the headwaters. The shoreline of Hillside Pond is dominated by boulders and rubble with some sections of sand and muck. The pond is long, narrow with steep slopes (narrow littoral zone) and deep. Along the southern shoreline and near the outflow of the pond emergent and submerged aquatic vegetation were noted. The majority of the surrounding forest species consisted of black spruce (*Picea mariana*), with riparian vegetation consisting of mainly eastern larch (*Larix laricina*) and green alder (*Alnus viridis*) with some other herbs and shrubs interspersed throughout (Canada burnet, leatherleaf and Kalmia spp.) (Figure 3.1).

Figure 3.1 Hillside Pond, August 2022.

3.2 Lacustrine Habitat Assessment

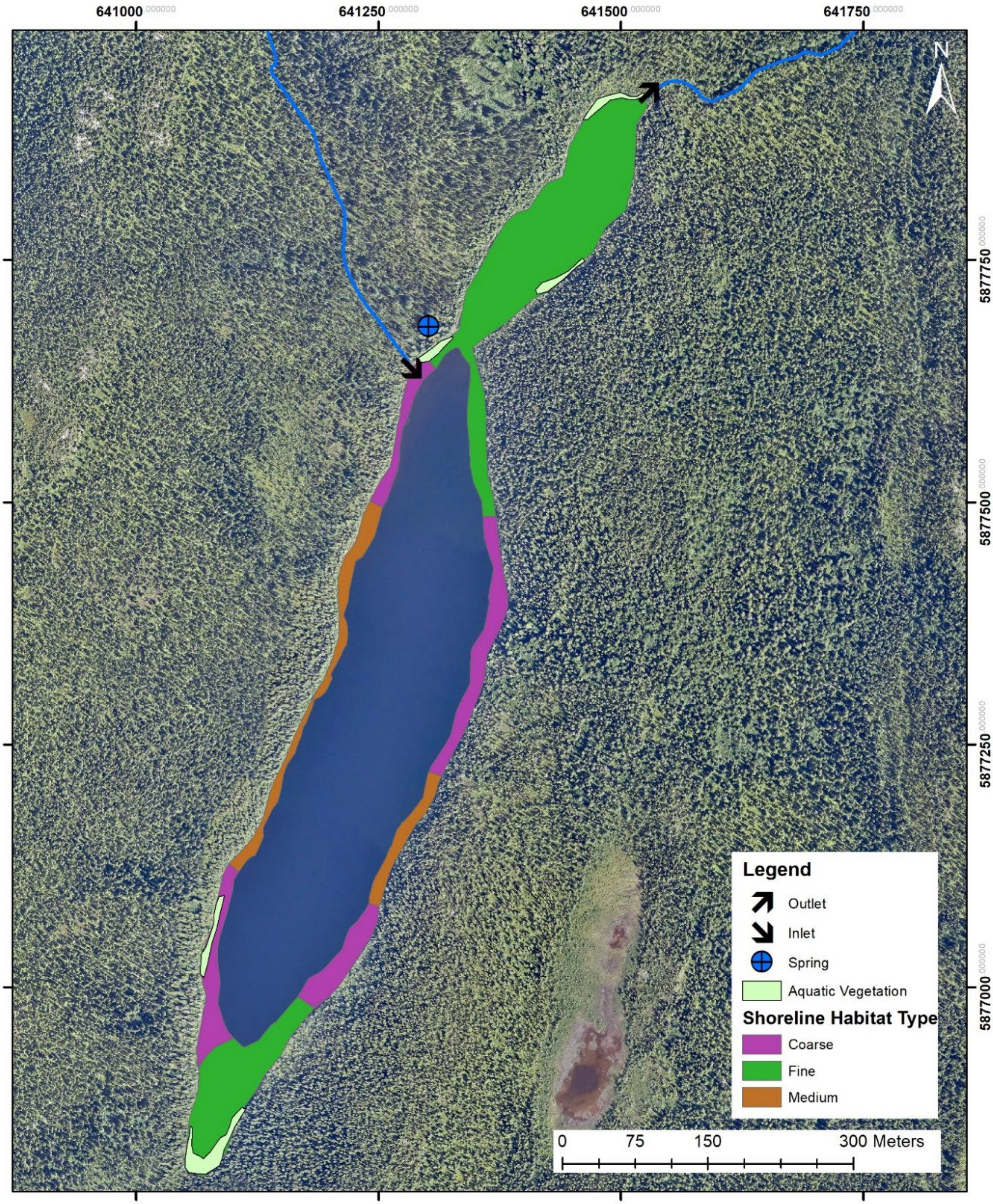
3.2.1 Bathymetry

A bathymetric survey was completed on Hillside Pond on October 28th, 2021, using sonar and GPS. Transects were spaced approximately 30 m apart and oriented in an east-west direction. A total of 40 transect lines were processed to generate a detailed bathymetric map for the lake (Figure 3.2). The surface area of the lake was 132,893 m^2 and the lake volume was 876,304 m^3. The lake bottom has a relatively deep center with steep bathymetry contours with a max depth of 17.61 m and overall mean depth of 6.59 m.

3.2.2 Lake Habitat

A survey of habitat in Hillside Pond conducted on August 11th, 2022, included substrate, vegetation and habitat features (Figure 3.3). The lake was composed of both littoral (48,504 m^2) and profundal (84,389 m^2) zones which were delineated from the mean Secchi depth (4.25 m). The pond shoreline habitat was a combination of fine (31,323 m^2), medium (5,530 m^2) and coarse (11, 651 m^2) substrate material with both emergent and submerged vegetation (2,697 m^2, Figure 3.4). Numerous habitat features were observed throughout the pond including fallen trees, boulder clusters, overhanging riparian vegetation, and spawning gravels which contributed to good quality fish habitat.

RioTinto IOC	Western Hillside Project	Figure Number: 3.2	PREPARED BY: SEM
	Hillside Pond Bathymetry	COORDINATE SYSTEM: NAD 83 UTM Zone 19	DATE: 12/07/22



RioTinto IOC	Western Hillside Project	Figure Number: 3.3	PREPARED BY: SEM
	Hillside Pond Shoreline Habitat Survey	COORDINATE SYSTEM: NAD 83 UTM Zone 19	DATE: 11/29/2022

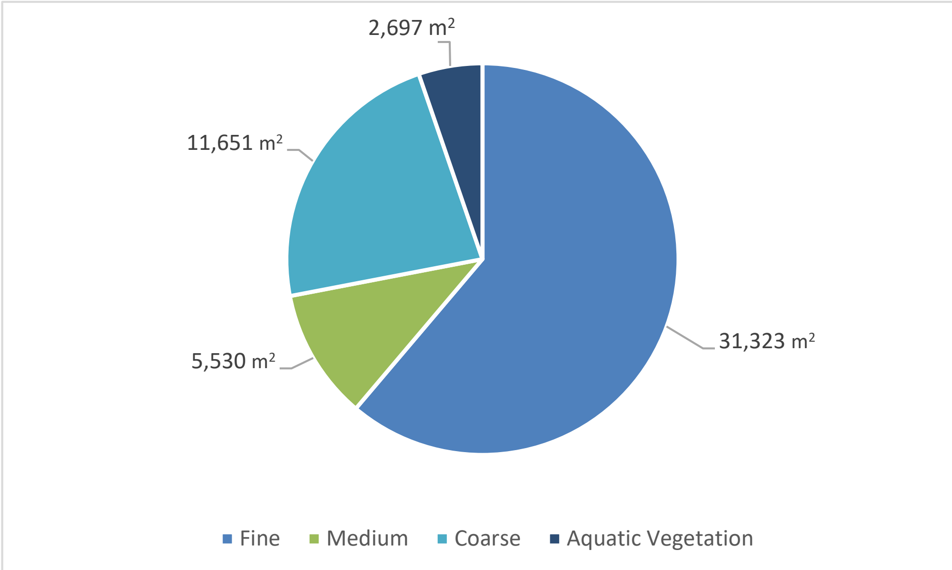


Figure 3.4 Proportions of Habitat Type in Hillside Pond.

3.2.3 Water Quality

The laboratory water quality data for Hillside Pond are provided in Table 3.1. Most metals in Hillside Pond were below detection limits, while aluminum (20 µg/L), barium (5.4 µg/L), calcium (7,200 µg/L), magnesium (1,500 µg/L), manganese (4.7 µg/L), potassium (1,300 µg/L), sodium (400 µg/L), and strontium (16 µg/L) were detected. Phosphorus, iron, lead and copper (among others) were undetected. Hillside Pond had pH near neutral (7.56), alkalinity ($CaCO_3$) of 26 mg/L, conductivity of 52 µS/cm, turbidity of 1.8 NTU's and undetected levels of nitrate, nitrite, their sum (i.e., nitrate + nitrite). TOC was 3.6 mg/L. Chlorophyll 'a', as an indicator of primary productivity, measured 0.331 µg/L and was typical of an oligotrophic lake (Table 3.2).

Table 3.1 Laboratory Water Quality Data for Metals in Hillside Pond, August 2022.

Parameter	Units	RDL	Result
Aluminum (Al)	µg/L	5.0	20
Antimony (Sb)	µg/L	1.0	ND
Arsenic (As)	µg/L	1.0	ND
Barium (Ba)	µg/L	1.0	5.4
Beryllium (Be)	µg/L	1.0	ND
Bismuth (Bi)	µg/L	2.0	ND
Boron (B)	µg/L	50	ND
Cadmium (Cd)	µg/L	0.010	ND
Calcium (Ca)	µg/L	100	7,200
Chromium (Cr)	µg/L	1.0	ND

Table 3.1 Laboratory Water Quality Data for Metals in Hillside Pond, August 2022. (Cont'd)

Parameter	Units	RDL	Result
Cobalt (Co)	µg/L	0.40	ND
Copper (Cu)	µg/L	0.50	ND
Iron (Fe)	µg/L	50	ND
Lead (Pb)	µg/L	0.50	ND
Magnesium (Mg)	µg/L	100	1,500
Manganese (Mn)	µg/L	2.0	4.7
Molybdenum (Mo)	µg/L	2.0	ND
Nickel (Ni)	µg/L	2.0	ND
Phosphorus (P)	µg/L	100	ND
Potassium (K)	µg/L	100	1,300
Selenium (Se)	µg/L	0.50	ND
Silver (Ag)	µg/L	0.10	ND
Sodium (Na)	µg/L	100	400
Strontium (Sr)	µg/L	2.0	16
Thallium (Tl)	µg/L	0.10	ND
Tin (Sn)	µg/L	2.0	ND
Titanium (Ti)	µg/L	2.0	ND
Uranium (U)	µg/L	0.10	ND
Vanadium (V)	µg/L	2.0	ND
Zinc (Zn)	µg/L	5.0	ND
RDL = Reportable Detection Limit, ND = Not Detected.			

Table 3.2 Laboratory Water Quality Data for Calculated Parameters, Inorganics, and Chlorophyll 'a' for Hillside Pond, August 2022.

Parameters	Units	RDL	Hillside Pond
Calculated Parameters			
Calculated TDS	mg/L	1.0	33
Hardness (CaCO3)	mg/L	1.0	24
Anion Sum	me/L	N/A	0.600
Cation Sum	me/L	N/A	0.540
Ion Balance (% Difference)	%	N/A	5.26
Langelier Index (@ 20C)	N/A		-1.45
Langelier Index (@ 4C)	N/A		-1.71
Nitrate (N)	mg/L	0.050	ND
Saturation pH (@ 20C)	N/A		9.02
Saturation pH (@ 4C)	N/A		9.27
Inorganics			
Total Alkalinity (CaCO3)	mg/L	5.0	26
Dissolved Chloride (Cl-)	mg/L	1.0	1.0
Colour	TCU	5.0	13

Table 3.2 Laboratory Water Quality Data for Calculated Parameters, Inorganics, and Chlorophyll 'a' for Hillside Pond, August 2022. (Cont'd)

Parameters	Units	RDL	Hillside Pond
Inorganics			
Nitrate + Nitrite (N)	mg/L	0.050	ND
Nitrite (N)	mg/L	0.010	ND
Nitrogen (Ammonia)	mg/L	0.050	0.054
Total Organic Carbon (C)	mg/L	0.50	3.6
Orthophosphate (P)	mg/L	0.010	ND
pH	pH	N/A	7.56
Reactive Silica (SiO2)	mg/L	0.50	3.2
Dissolved Sulphate (SO4)	mg/L	2.0	2.1
Turbidity	NTU	0.10	1.8
Conductivity	µS/cm	1.0	52
Productivity			
Chlorophyll 'a' (acidification)	µg/L		0.331
RDL= Reportable Detection Limit, ND= Not Detected, N/A= Not Applicable			

Field water quality was measured at the deepest point in the pond (17 m) where a series of parameters were recorded including: dissolved oxygen, temperature, total dissolved solids, pH and conductivity. All five parameters were recorded at every one-meter interval from just below surface to the bottom of the deepest part of the pond. Results of the temperature depth profile are provided in Table 3.3. There was a clear thermocline between 4 and 10 m (Figure 3.5) while an oxygen decrease was apparent at 10 m however dissolved oxygen was not recorded past 10 m due to limitations in cable length.

Table 3.3 Field Water Quality Parameters.

Depth (m)	Parameter				
	DO (% Sat)	Temp (°C)	TDS (mg/L)	pH	Conductivity (µS/cm)
Sub-Surface	91.4	16.5	35.1	7.45	75.7
1	91.1	16.1	35.1	7.23	66.7
2	90.1	15.9	35.1	7.21	64.9
3	89.5	15.6	35.1	7.14	59.5
4	89.3	15.5	35.1	7.13	62.1
5	87.3	14.6	35.75	7.11	59.0
6	88.0	11.6	37.05	7.14	60.3
7	89.8	8.6	37.7	7.19	63.0
8	85.2	7.1	37.05	7.16	62.0
9	85.8	6.5	37.7	7.19	62.9
10	79.1	5.9	37.7	7.16	62.2
11	-	6.0	37.7	7.21	64.5
12	-	5.9	38.5	7.24	66.2

Table 3.3 Field Water Quality Parameters. (Cont'd)

Depth (m)	Parameter				
	DO (% Sat)	Temp (°C)	TDS (mg/L)	pH	Conductivity (µS/cm)
13	-	5.7	37.7	7.30	70.2
14	-	5.7	37.7	7.49	75.7
15	-	5.7	37.7	7.50	80.7
16	-	5.6	46.8	7.69	92.7
17	-	5.6	53.95	7.92	103.0

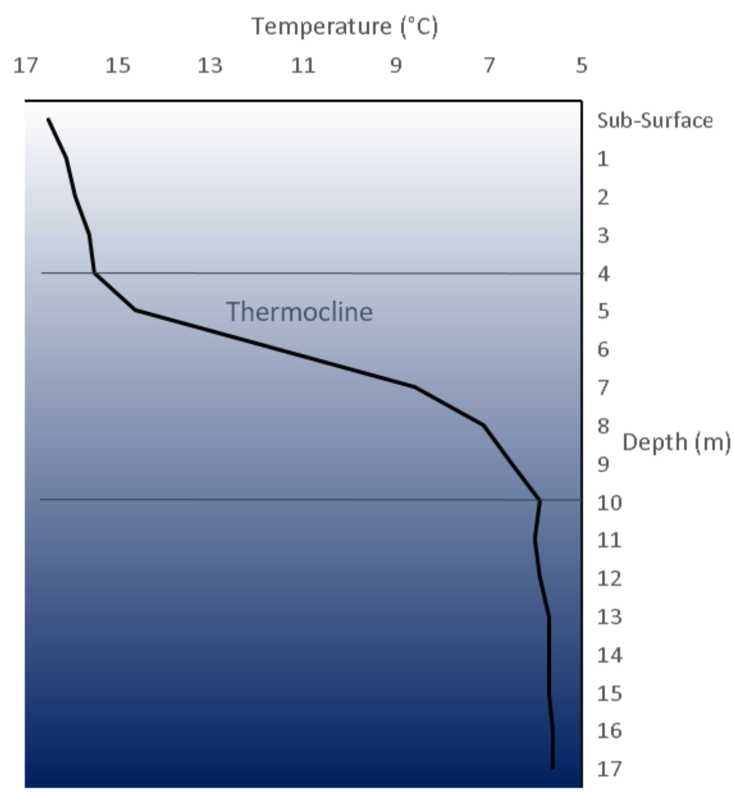


Figure 3.5 Hillside Pond Temperature Depth Profile with Thermocline.

3.2.4 Sediment Quality

Total organic carbon in the sediment of Hillside Pond measured 150 g/kg. The sediment particle size was mainly silt (54%), with some clay (37%) and small amounts of sand (9.6%; Appendix A).

3.3 Phytoplankton and Zooplankton

Results of the phytoplankton and zooplankton studies are not available at the time of submission.

3.4 Benthic Invertebrate Community

Hillside Pond benthic samples had a total abundance of 24 individuals. Pisidiidae (Order: Pelecypoda) and Amphipoda were the dominant taxa (46% each of the sample) while Chironomidae (Order: Diptera) comprised the remaining 8%. Pisidiidae (or "peaclams") are freshwater molluscs that typically reside in most freshwater aquatic environments and favour good water quality with silt, mud and sand substrates. This resulted in a taxon richness of three and density of 800 organisms per square meter. Chironomidae, also known as "midges", represented in Hillside Pond are considered common in nearly all aquatic environments.

3.5 Fish Population Assessment

3.5.1 Fish Community

The fish community in Hillside Pond consisted entirely of brook trout (100%).

3.5.2 Fishing Effort and Catch

Fishing of Hillside Pond was conducted using fyke nets, shoreline electrofishing, minnow traps and gill nets. Mark-recapture data from fishing efforts were used to population estimate for brook trout in the pond. A summary of the fyke net fishing effort, fish catches and the catch per unit of effort (CPUE) are provided in Table 3.4. Fyke netting was conducted August 9th to18th, 2022, with five nets used for the duration. The total net nights fished was 45. Not all nets captured fish each night and the number of nets that captured fish ranged from one to five nets each night, averaging four nets. During nine nights of fishing and across all fishing methods, 127 brook trout were captured with nine mortalities. The total number of brook trout recaptured was 12 fish (10%) with 75% of the recaptures from fyke netting efforts. Catches of brook trout ranged from 11 to 25 fish per night, averaging 15.3 fish. CPUE for brook trout ranged from 1.8 to 2.8 fish/net night averaging 2.44 fish/net night. Brook trout CPUE was highest on the third day of fishing and lowest on the seventh day. Gill netting efforts was conducted on August 11th, 2022 in two locations for a single 1.5 hr set. Gill netting efforts resulted in catching 20 brook trout, three of which were recaptures (25%). Minnow traps were set/checked in the same manner as the fyke nets yielded five fish, with the most successful day being on August 11th, 2022. There were no recaptures in minnow traps. Shoreline electrofishing represented 3% of the total catch across all fishing methods and resulted in four fish with no recaptures. See Table 3.5 for a summary of the fish catches across all fishing methods.

Table 3.4 Summary of Fishing Effort, Fish Catches, and Catch per Unit of Effort for Fyke Netting of Hillside Pond.

Set Date	Haul Date	No. Of Nets	Net Nights	Brook Trout		
				Total	Recap	CPUE[1]
Aug. 9	Aug. 10	5	5	11	0	2.2
Aug. 10	Aug. 11	5	5	13	3	2.6
Aug. 11	Aug. 12	5	5	14	1	2.8
Aug. 12	Aug 13.	5	5	11	0	2.2
Aug. 13	Aug 14.	5	5	15	1	3
Aug 14.	Aug 16.	5	10	18	4	1.8
Aug 16.	Aug 18.	5	10	25	3	2.5
Totals			45	107	12	

[1] Catch per Unit of Effort (CPUE), fish per net night.

Table 3.5 Summary of Fish Catches Across All Method Types.

Gear Type	Effort	Brook Trout		% of Total Catch
		Total*	Recap	
Fyke nets	5 nets	107	9	79
Gill nets	2 nets	20	3	14
Minnow traps	12 traps	5	0	4
Shoreline electrofishing	516 sec	4	0	3
Total		136	12	100

* 9 mortalities are included in the totals

3.5.3 Fish Population Characteristics

The length, weight and condition factor for brook trout captured in Hillside Pond are summarized in Table 3.6. The length of brook trout captured ranged from 58 to 291 mm and averaged 164.8 mm (std. dev. = ± 51.9). Brook trout recaptured during fyke netting were slightly larger than the average for the population, and averaged 184.6 mm, with no fish less than 66 mm and a maximum length of 285 mm. Brook trout weight ranged from 1.0 to 284 g and averaged 57.8 g (std. dev. = ± 54.2). Similarly, the weights of brook trout recaptured were larger than the overall average, and averaged 84.5 g, with no recaptured fish weighing more than 284 g or less than 1.0 g. Condition factor (K) for brook trout captured in Hillside Pond ranged from 0.4 to 1.2, averaging 0.94 (std. dev. = ± 0.2).

The length frequency distribution for brook trout captured in Hillside Pond is provided in Figure 3.6. The distribution was bimodal with the peak size class between 125 to 150 mm (26.5%) and 175 to 200 mm (20.6%). Fish captured less than 100 mm (8.8%) were similar in distribution to fish ranging from 100 to 125 mm (9.6%). Similar numbers of fish were captured in the 150 to 175 mm (11.0%) and 200 to 225 mm

(11.8%) size ranges. Fish captured in Hillside Pond in the 225 to 250 mm range only represented 5.1%. Fish captured in the 250 to 275 mm and 275 to 300 mm ranges represented 3.7% and 2.9%, respectively.

Fish scale analysis indicated that fish up to 76 mm were classified as young of the year, where up to 144 mm were classified as 1+ and 204 mm to 230 mm were classified as 2+.

Table 3.6 Summary of Meristic Data for Fish Caught by Fyke Nets in Hillside Pond.

Species	Parameter	Mean	Min	Max	Std. Dev.
Brook trout (initial capture)	Length (mm)	162.9	58	291	51.0
	Weight (g)	55.2	1	245	50.6
	Condition (k)	0.94	0.4	1.2	0.2
Brook trout (recapture)	Length (mm)	184.6	66	285	60.8
	Weight (g)	84.5	1	284	82.5
	Condition (k)	0.91	0.4	1.3	0.2

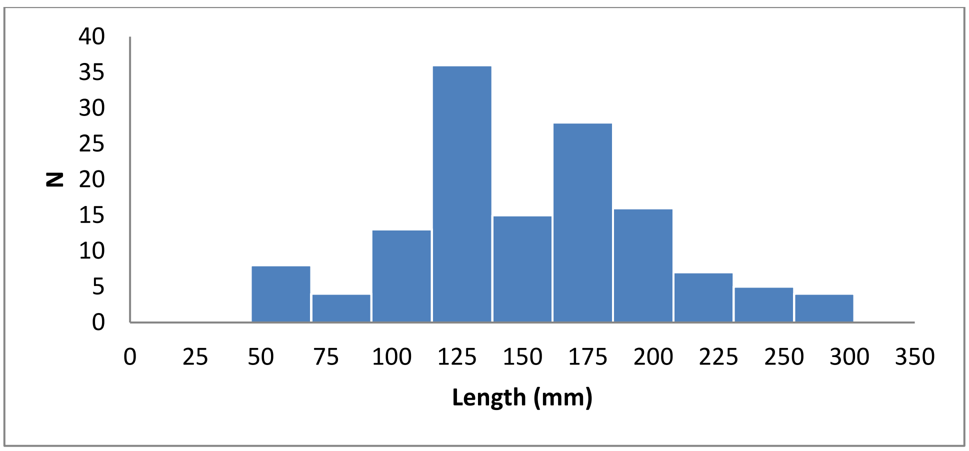


Figure 3.6 Length Frequency Distribution of Brook Trout Captured in Hillside Pond.

3.5.4 Fish Population Estimate

A fish population estimate for brook trout in Hillside Pond was determined from a mark-recapture census and calculated using the Schnabel method. The brook trout population estimate in August 2022 was 623 fish with upper and lower 95% confidence intervals of 1,459 and 396 fish, respectively.

4.0 Hillside Stream

4.1 Overview and Description

Hillside Stream flows from Hillside Pond in a northeast direction and terminates at the confluence with Wabush Lake approximately 750 m north of the current toe of the tailings. The stream is approximately 866 m in length and on average 1.56 m in width. At the confluence with Hillside Pond, the stream is relatively wide (2.3 m) and narrows quickly (1 to 1.5 m) as the stream moves further downstream from the pond. The stream flows from the pond along a steep hillside through a challenging landscape, which results in a series of cascades approximately 70 m downstream from the pond. The cascades were noted to be relatively dry during low flow conditions and there were sections where flow was only apparent from under boulders (SEM 2021). This reach of the stream would likely present a full (during periods of low flow) or partial barrier to upstream migration for fish (Figure 4.1). The stream then meanders through a series of riffles, runs and cascades throughout its length with abundant boulders, rubble and woody debris. Downstream of the partial barrier, the stream slope levels out some but still characterized by fast waters with many riffles/runs but with very little pool meso-habitat type. The stream is densely covered with alder thickets and a canopy of mature conifer forest. The outlet of Hillside Stream is characterized by a naturally occurring French drain along the shoreline of Wabush Lake that would not be conducive to fish attempting to migrate upstream. Figure 4.2 depicts representative habitat for Hillside Stream. Access to Hillside Stream can be made either by boat from Wabush Lake or by ATV to Hillside Pond and then by boat access to the outflow.

The following section presents results from the stream habitat assessment that was completed in August of 2021 and includes additional survey data collected in 2022. In addition to Hillside Stream, some preliminary data was collected for the inlet to Hillside Pond, including water quality and stream flow.

Figure 4.1 Partial Natural Barrier Present in Hillside Stream.

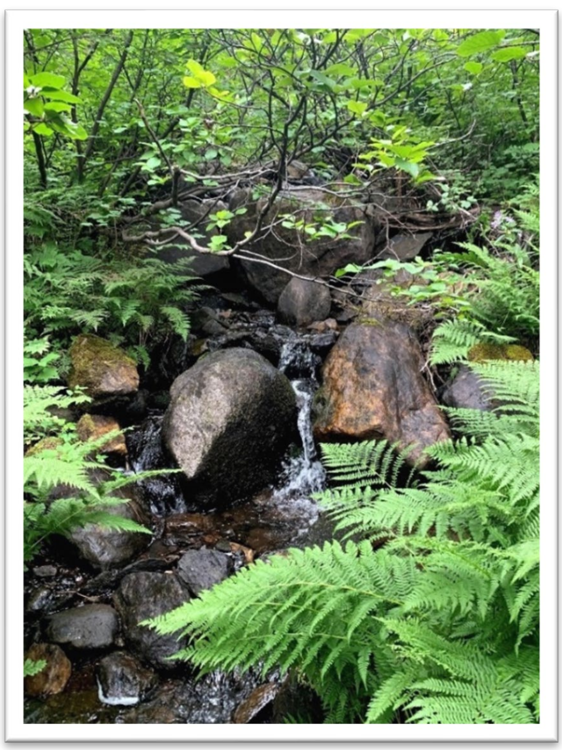


Figure 4.2 Representative Section of Hillside Stream.

4.2 Stream Habitat Assessment

4.2.1 Stream Habitat

A habitat survey of Hillside Stream was completed on August 10th, 2021 (Figure 4.3). Hillside Stream sections were between 44 and 219 m in length (average of 144.3 m length) and width ranged between 1.0 and 2.33 m (averaged 1.56 m width). The stream total length was 866 m (Table 4.1). The main habitat types were primarily riffles (60%), followed by runs (20%), cascades (12.5%) and pools (7.5%).

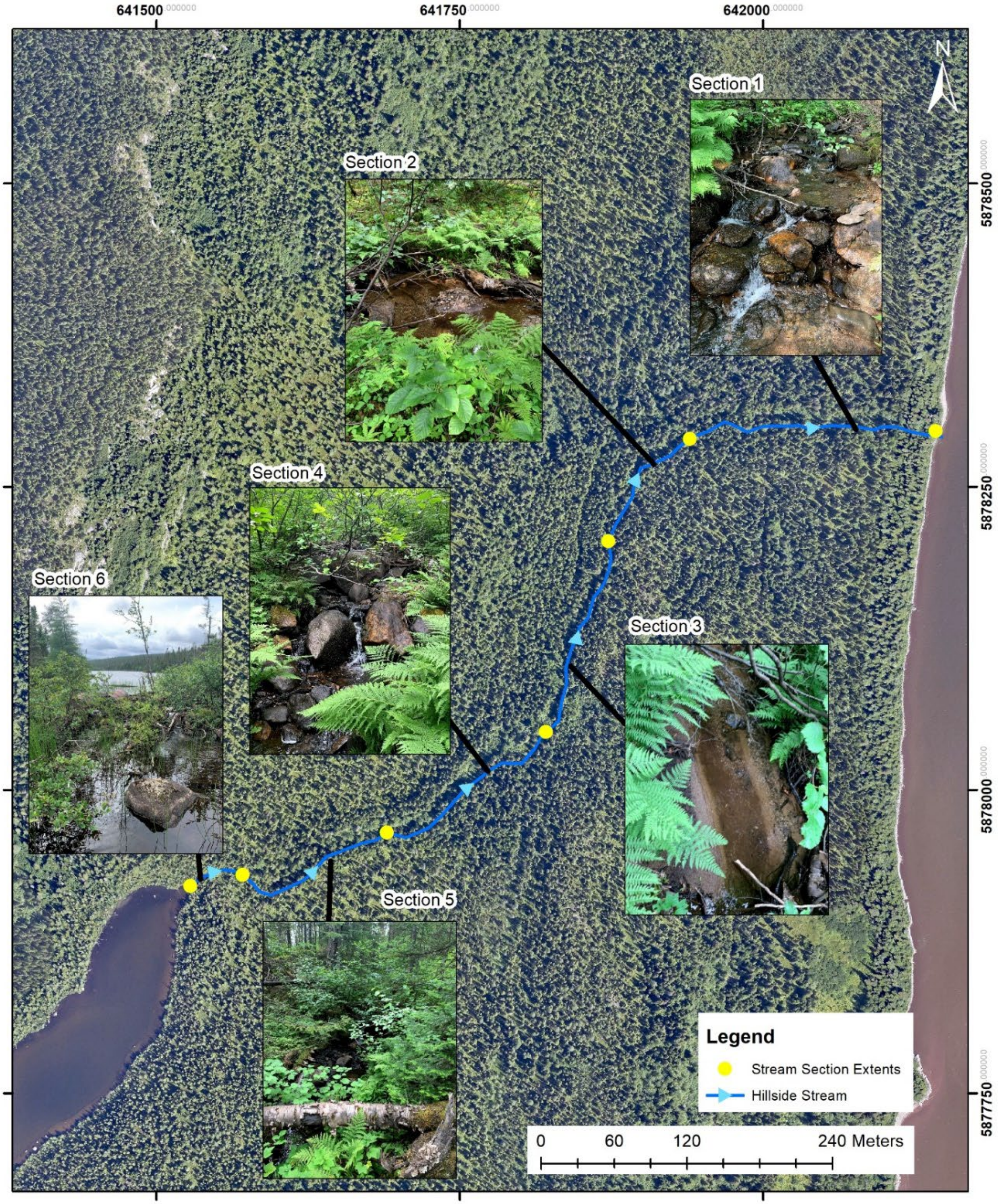
The main substrate types were primarily rubble (30.8%), with some boulder (22.5%), cobble (22.5%) and gravel (12.5%). Small amounts of sand, muck/clay and bedrock were also present (7.5, 2.5 and 1.7%, respectively; Table 4.2). Mean overhanging cover was predominant (54.2%) with some instream cover (15.9%), and smaller proportions of canopy cover (12.5%). Some areas of eroding banks were observed in section 3 (10%), while undercut banks were noted in section 5 (10%), Table 4.3.

Table 4.1 Characteristics of Hillside Stream Sections.

	Start Location		Habitat Type (%)						Habitat Dimensions		
Section No.	x	y	Run	Steady	Riffle	Pool	Rapids	Cascades	Length (m)	Width (m)	Area (m^2)
1	642142	5878296	0	0	70	5	0	25	219	1.5	328.5
2	641935	5878296	25	0	70	0	0	5	115	1.67	192.05
3	641865	5878206	20	0	70	0	0	10	174	1.33	231.42
4	641821	5878048	20	0	70	0	0	10	168	1	168
5	641690	5877965	25	0	50	0	0	25	146	1.5	219
6	641571	5877930	30	0	30	40	0	0	44	2.33	102.52
Mean			20	0	60	7.5	0	12.5	144.3	1.56	206.9
Total									866	-	1,241.5

Table 4.2 Substrate Proportions in Hillside Stream Sections.

Section No.	Muck/Clay (%)	Sand (%)	Gravel (%)	Cobble (%)	Rubble (%)	Boulder (%)	Bedrock (%)	Total (%)
1	0	5	5	30	30	30	0	100
2	0	5	20	30	30	15	0	100
3	0	20	30	30	10	10	0	100
4	0	5	10	15	25	35	10	100
5	0	5	5	20	30	40	0	100
6	15	5	5	10	60	5	0	100
Mean	2.5	7.5	12.5	22.5	30.8	22.5	1.67	100



RioTinto IOC	Western Hillside Project	Figure Number: 4.3	PREPARED BY: sem
	Hillside Stream Survey	COORDINATE SYSTEM: NAD 83 UTM Zone 19	DATE: 11/29/2022

Table 4.3 Cover Type and Stream Bank Characteristics in Hillside Stream Sections.

Section No.	Cover Type[1]				Stream Bank[1]	
	Overhanging	Instream Substrate/Logs	Instream Vegetation	Canopy	Eroding Banks	Undercut Banks
1	65	5	5	10	0	0
2	50	5	5	10	0	0
3	50	10	5	15	10,0	0
4	50	10	5	10	0	0
5	60	15	10	25	0	10,0
6	50	10	10	5	0	0
Mean	54.2	9.2	6.7	12.5	1.7	1.7

[1] Values are shown as percentages.
Note: Values separated by commas represent proportions of eroding and undercut banks in the left and right stream sides.

4.2.2 Water Quality

The water quality data for Hillside Pond outflow and inflow are provided in Table 4.4. Many metals in the Hillside Pond inflow and outflow were below detection limits, but aluminum, barium, calcium, copper, iron, magnesium, manganese and potassium were detected. Both streams had a near neutral pH, and low alkalinity, conductivity, turbidity and colour. Nitrogen, nitrite, and dissolved chloride were all undetected in the inflow stream, while nitrogen (ammonia) was detected at low levels in Hillside Stream (0.066 mg/L, Table 4.5).

Field water quality data for the Hillside Stream was taken on August 13th, 2022, and temperature was measured at 16.7°C, while pH, dissolved oxygen and conductivity had values of 7.3, 8.61 mg/L (or 88% saturation) and 67.7 µS/cm, respectively.

Table 4.4 Laboratory Water Quality Data for Metals in Hillside Stream and inflow to Hillside Pond, August 2022.

Parameter	Units	RDL	Hillside Stream	Inflow
Aluminum (Al)	µg/L	5.0	64	140
Antimony (Sb)	µg/L	1.0	ND	ND
Arsenic (As)	µg/L	1.0	ND	ND
Barium (Ba)	µg/L	1.0	6.7	6.3
Beryllium (Be)	µg/L	1.0	ND	ND
Bismuth (Bi)	µg/L	2.0	ND	ND
Boron (B)	µg/L	50	ND	ND
Cadmium (Cd)	µg/L	0.010	ND	ND
Calcium (Ca)	µg/L	100	7,300	5,800
Chromium (Cr)	µg/L	1.0	ND	ND

Table 4.4 Laboratory Water Quality Data for Metals in Hillside Stream and inflow to Hillside Pond, August 2022. (Cont'd)

Parameter	Units	RDL	Hillside Stream	Inflow
Cobalt (Co)	µg/L	0.40	ND	ND
Copper (Cu)	µg/L	0.50	0.59	0.65
Iron (Fe)	µg/L	50	260	380
Lead (Pb)	µg/L	0.50	ND	ND
Magnesium (Mg)	µg/L	100	1,600	1,200
Manganese (Mn)	µg/L	2.0	54	26
Molybdenum (Mo)	µg/L	2.0	ND	ND
Nickel (Ni)	µg/L	2.0	ND	ND
Phosphorus (P)	µg/L	100	ND	ND
Potassium (K)	µg/L	100	1,300	1,100
Selenium (Se)	µg/L	0.50	ND	ND
Silver (Ag)	µg/L	0.10	ND	ND
Sodium (Na)	µg/L	100	410	530
Strontium (Sr)	µg/L	2.0	16	16
Thallium (Tl)	µg/L	0.10	ND	ND
Tin (Sn)	µg/L	2.0	ND	ND
Titanium (Ti)	µg/L	2.0	3.3	5.8
Uranium (U)	µg/L	0.10	ND	ND
Vanadium (V)	µg/L	2.0	ND	ND
Zinc (Zn)	µg/L	5.0	ND	ND
RDL = Reportable Detection Limit, ND = Not Detected.				

Table 4.5 Laboratory Water Quality Data for Inorganics, Calculated Parameters, and Chlorophyll 'a' for Hillside Stream and inflow to Hillside Pond, August 2022.

Parameters	Units	RDL	Hillside Stream	Inflow
Calculated Parameters				
Calculated TDS	mg/L	1.0	33	28
Hardness ($CaCO_3$)	mg/L	1.0	25	20
Anion Sum	me/L	N/A	0.590	0.450
Cation Sum	me/L	N/A	0.560	0.460
Ion Balance (% Difference)	%	N/A	2.61	1.10
Langelier Index (@ 20C)	N/A		-1.47	-1.83
Langelier Index (@ 4C)	N/A		-1.72	-2.09
Nitrate (N)	mg/L	0.050	0.055	0.076
Saturation pH (@ 20C)	N/A		9.02	9.21
Saturation pH (@ 4C)	N/A		9.27	9.46

Table 4.5 Laboratory Water Quality Data for Inorganics, Calculated Parameters, and Chlorophyll 'a' for Hillside Stream and inflow to Hillside Pond, August 2022. (Cont'd)

Parameters	Units	RDL	Hillside Stream	Inflow
Inorganics				
Total Alkalinity ($CaCO_3$)	mg/L	5.0	26	21
Dissolved Chloride (Cl-)	mg/L	1.0	1.1	1.0
Colour	TCU	5.0	16	32
Nitrate + Nitrite (N)	mg/L	0.050	0.055	0.076
Nitrite (N)	mg/L	0.010	ND	ND
Nitrogen (Ammonia)	mg/L	0.050	0.066	ND
Total Organic Carbon (C)	mg/L	0.50	4.2	5.5
Orthophosphate (P)	mg/L	0.010	ND	ND
pH	pH	N/A	7.55	7.37
Reactive Silica (SiO_2)	mg/L	0.50	2.9	4.8
Dissolved Sulphate (SO_4)	mg/L	2.0	2.0	ND
Turbidity	NTU	0.10	1.9	2.7
Conductivity	µS/cm	1.0	51	40
RDL= Reportable Detection Limit, ND= Not Detected, N/A= Not Applicable				

4.2.3 Stream Flow

The flow regime for Hillside Stream was characterized in both 2021 and 2022. On August 10th, 2021, mean discharge was 0.004 m^3/s and average velocity of 0.093 m/s. Depth and velocity ranged from 0 to 0.1 m (average 0.05 m) and from 0 to 0.25 m/s, respectively. The flow regime at Hillside Stream was characterized on August 17th, 2022, with a mean discharge of 0.036 m^3/s and an average velocity of 0.125 m/s. Depths and velocity ranged from 0 to 0.3 m (average 0.08 m) and from 0 to 0.23 m/s, respectively. Finally, the flow regime at in the inflow to Hillside Pond was characterized on August 17th, 2022, with a mean discharge of 0.005 m^3/s and average velocity of 0.07 m/s. Depth and velocity ranged from 0 to 0.14 m and from 0 to 0.09 m/s, respectively.

4.2.4 Benthic Invertebrate Community

Hillside Stream benthic samples had a total abundance of 140 benthic macroinvertebrate organisms. The sample was also characterized by a taxon richness of 13 and density of 560 individuals/m^2. The dominant family found in Hillside Stream was Simuliidae ("black flies") representing 36% of the individual organisms identified in the sample. The remaining consisted of Pisidiidae (27%), Chironomidae (16%) Rhyacophilidae (9%), Elmidae (9%). The remaining 3% of the organisms consisted of Chloroperlidae, Hydrophyschidae, Hirudinea and Nematoda. Simullidae larva are typically found in most Labradorian streams in both fast and slow moving waters. Pisidiidae are a type of freshwater mussel that typically reside in sandy aquatic meso-habitats and at the outflow of lakes where food is abundant in the water column.

4.2.5 Fish Community

4.2.5.1 Fishing Effort and Catch

Spot electrofishing was conducted at two reaches in Hillside Stream. Coordinates of the upper and lower extents of these sites and details related to the electrofishing site (i.e., width, length, and area) are provided in Table 4.6. Electrofishing was performed along the majority of the stream with a total fishing effort of 1,197 seconds. Brook trout was the only species caught in Hillside Stream.

Fish population estimates in Hillside Stream were not possible due to steep terrain in sections, dense riparian habitat, overhanging vegetation, large instream features (fallen trees and large boulders) and relatively low flows at the time of survey. Population estimates would only be possible if intervention methods such as removal of riparian vegetation and instream features (such as fallen trees) were employed, and the survey was timed appropriately with higher flow conditions.

Table 4.6 Site Characteristics of Electrofishing Sites in Hillside Stream 2021 to 2022.

Upper Boundary		Lower Boundary		Width (m)	Length (m)	Area (m^2)	Effort (sec)	Year
X	Y	X	Y					
642142	5878296	641679	5877967	1.5	648	972	756	2021
641565	5877932	641531	5877920	2.5	44	110	441	2022
Total					692	1,082	1,197	

4.2.5.2 Fish Population Characteristics

The length, weight, and condition factor (K) of brook trout captured by electrofishing in Hillside Stream are summarized in Table 4.7. Fish ranged in length from 51 to 139 mm and averaged 95.2 mm (std. dev. = ± 31.8) while weight ranged from 1 to 45 g and averaged 14.1 g (std. dev. = ± 14.6). Condition factor of fish ranged from 0.84 to 1.68 and averaged 1.16 (std. dev. = ± 0.28), with 63% of the catch having a condition factor equal or greater than 1.0. The total number of fish caught in Hillside Stream was nine and total biomass was 127 g.

Table 4.7 Summary of Brook Trout Meristic Characteristics Captured by Electrofishing in Hillside Stream in 2021 and 2022.

Parameter	Min	Max	Mean	Std. Dev.
Length (mm)	51	139	95.2	31.8
Weight (g)	1	45	14.1	14.6
Condition (K)	0.84	1.68	1.16	0.28

5.0 HADD

The following section provides an analysis of the HADD for Hillside Stream in relation to the pipeline advancement and tailings encroachment on the Western Hillside.

5.1 Regulatory Framework

As of August 28, 2019, new fish and fish habitat protection provisions (FFHPP) of the *Fisheries Act* came into effect. There are two key prohibitions included in the revised *Act* including:

- Subsection 34.4(1) prohibits the carrying on of a work, undertaking or activity, other than fishing, that results in the death of fish; and
- Subsection 35(1) prohibits the carrying on of a work, undertaking or activity that results in the HADD of fish habitat.

The Minister of DFO can issue an authorization which outlines terms and conditions in relation to a proposed work that may result in the death of fish or the HADD of fish habitat. For DFO to issue an authorization to permit a HADD, they require a detailed description of the fish and fish habitat (this report) found at the location of the proposed work and that will be negatively impacted.

This detailed information needs to include:

- the type of waterbodies;
- the characteristics of the fish habitat and how those characteristics support fish in carrying out their life processes;
- the fish species and life cycle stages that are present and an estimate of the relative abundance; and
- a description of how the habitat was characterized (e.g., methods and sampling techniques used).

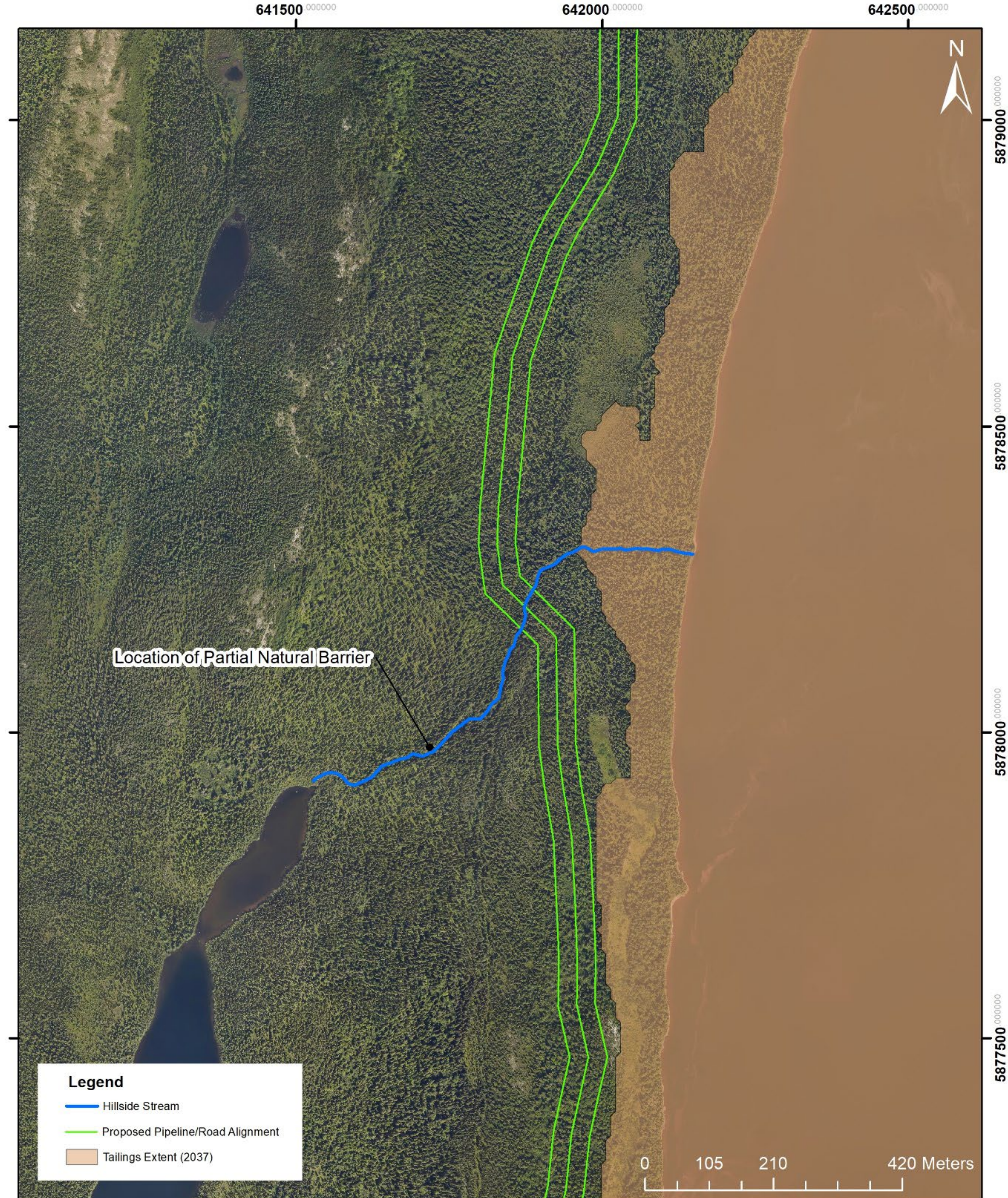
A HADD of fish habitat is defined as any change in fish habitat that reduces its capacity to support one or more life processes of fish. The conservation and protection of fish habitat from 2012 to 2019 recognized that the focus was for the benefit of fisheries and not for the fish per se. Emphasis was placed on fish species that supported, or had the potential to support, commercial, recreational, subsistence, and/or Aboriginal fisheries. DFO revised the *Fisheries Act* in 2019 to place additional emphasis on species that indirectly support fisheries, such as forage fish, since they also form an integral part of an established ecosystem. Recently, species listed as endangered, threatened or of special concern under the *Species at Risk Act* (*SARA*) are also receiving increased attention.

The first step of the HADD determination process was to identify and characterize the fish habitat within the area to be impacted by the project (i.e., Hillside Stream). It was also necessary to document the presence and utilization of these habitats by fish including the fish species, life stages, and relative abundance of fish populations. Hillside stream was also evaluated for connectivity and potential project impacts on fish migration and overwintering (i.e., headwater). Fish habitat and utilization of the watercourses and waterbodies in the project area was collected through preliminary surveys in 2021 and further detailed surveys (presented in this study) in 2022.

5.2 HADD Calculation

To assess how the advancement of the tailings pipeline along the Western Hillside will cause HADD of fish habitat, the modelled footprint of the future tailings at TIA capacity in 2037 and the boundaries of the planned pipeline extension and road were overlain with the Hillside Stream (Figure 5.1). A total of 183 m length of stream will be impacted by tailings encroachment while an additional 181 m will be directly impacted by the pipeline advancement, access road and clearing. Total stream area directly impacted by these activities is 546 m^2 (average stream width of 1.5 m).

The quantity of habitat that will be indirectly impacted by the Project encompasses the remainder of Hillside Stream. The stream does not contain adequate overwintering habitat for brook trout. The cascades a short distance downstream from the outflow of Hillside Pond will prevent fish from accessing Hillside Pond for overwintering. Similarly, the pipeline and road infrastructure and tailings encroachment will prevent fish from migrating downstream to Wabush Lake for overwintering, which creates connectivity issues. Fish that inhabit the area between the cascades and the Project activities will likely become stranded during winter months as there are likely very few refuge areas in the stream (i.e., no identified springs or deep pools). IOC is therefore proposing to compensate for the entire Hillside Stream from the outflow of the pond to Wabush Lake and will ensure that fish cannot not enter into sections of Hillside Stream that could result in stranding (i.e., installation of fish passage barrier at the outlet of Hillside Pond). This barrier would be installed prior to impact occurring from the pipeline/road construction and any tailings infilling occurring. In addition, an extensive fish removal program will be conducted prior to the impact occurring. The total productive habitat (less rapids and cascades) to be included in the HADD is 1,055 m^2 (10.55 habitat units), Table 5.1. Habitat units are defined as 1 unit per 100 m^2 of productive fish habitat.



RioTinto IOC	Western Hillside Project	Figure Number: 5.1	PREPARED BY: sem
	Western Hillside Proposed Pipeline	COORDINATE SYSTEM: NAD 83 UTM Zone 19	DATE: 11/24/2022

Table 5.1 The Quantity of Fish Habitat by Meso-Habitat Type in Hillside Stream Affected by IOC's Tailings Pipeline Advancement Along the Western Hillside.

Section	Habitat Type						
	Run	Steady	Riffle	Pool	Rapids	Cascade	Total
1	0	0	229.95	16.43	0	82.13	328.5
2	48.01	0	134.44	0	0	9.60	192.05
3	46.28	0	161.99	0	0	23.14	231.42
4	33.6	0	117.6	0	0	16.80	168
5	54.75	0	109.5	0	0	54.75	219
6	30.76	0	30.76	41.01	0	0	102.52
Total	213.40	0	784.24	57.43	0	186.42	1,241.49
Total Units	2.1	0	7.8	0.5	0	1.9	12.4
Total Productive Habitat	2.1	0	7.8	0.5	0	0	**10.55***

*Presented precise value not affected by results of rounding

6.0 Conclusions

The advancement of IOC's tailings pipeline and road along the Western Hillside will require the offsetting of Hillside Stream as this habitat will become infilled with future tailings and create connectivity issues with overwintering habitat for the brook trout population that reside in the stream. The 2021 and 2022 field studies determined that Hillside Stream appears to be suitable for spring/summer residency for YOY and 1+ brook trout only. Larger and mature fish were not observed, nor captured during spot electrofishing surveys. The lack of larger and mature trout in the stream is likely due to the fact that the stream is not conducive to spawning (lack of suitable substrates/flow) or exhibit sufficient depth for larger bodied fish. Surveys of Hillside Pond determined that it is likely the headwater system that provides recruitment to the downstream fish community (Hillside Stream) as it contained suitable spawning habitat and presence of mature brook trout. It appears that any fish leaving Hillside Pond that travel downstream of the cascades would eventually need to migrate to Wabush Lake for overwintering purposes as they cannot return to the pond due to the upstream barrier. In addition, the presence of a naturally occurring French drain at the outlet of the stream as it enters Wabush Lake would make upstream migration from Wabush Lake a challenge for fish as well. This further explains why brook trout are the only species present in the Hillside system where Wabush Lake has as many as ten different species.

IOC recognizes that there could be a requirement for amendment of their TIA (Wabush Lake) under Schedule 2 of the *MDMER* which will also result in the requirement of an Environmental Assessment under the *Environmental Protections Act*. On-going consultations with ECCC and the Newfoundland and Labrador Department of Environment and Climate Change, Environmental Assessment Division will determine the any requirements for environmental assessment. These potential jurisdictional requirements do not affect the requirement of a Fisheries Act Authorization and the approval of a fish habitat offsetting plan through DFO.

7.0 References

Bradbury, C., A.S. Power, and M.M. Roberge. 2001. Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador. Fisheries and Oceans, St. John's, NL. 60 pp.

Bradbury, C., M.H.M Roberge, and C. K. Minns. 1999. Life History Characteristics of Freshwater Fishes Occurring in Newfoundland and Labrador, With Major Emphasis on Lake Habitat Characteristics. Can. MS Rep. Fish. Aquat. Sci. 2485, vii + 150 pp.

Environment Canada. 1999. The Water Survey of Canada: Hydrometric Technician Career Development Program. En56-244/1999E. Ottawa, Canada.

Holm-Hansen, O., C.J. Lorenzen, R.W. Holmes, and J.D. Strickland 1965. Fluorometric determination of chlorophyll. ICES J. Mar. Sci. 30: 3-15.

Knoechel, R. and C. Campbell. 1992. A simple, inexpensive device for obtaining vertically integrated, quantitative samples of pelagic zooplankton. Limnol. Oceanogr. 37: 675-680.

Knoechel, R. and J. Kalff. 1976. Track autoradiography: A method for the determination of phytoplankton species productivity. Limnol. Oceanogr. 21: 590-596.

McCarthy, J.H., C.G.J. Grant, and D.A. Scruton. 2007. Standard Methods Guide for the Classification and Quantification of Fish Habitat in Rivers of Newfoundland and Labrador. Fisheries and Oceans Canada, Newfoundland and Labrador Region. Draft Report, 97 pp.

Scruton, D.A., and R.J. Gibson. 1995. Quantitative Electrofishing in Newfoundland. Results of a Workshop to Review Current Methods and Recommend Standardization of Techniques. Can. Manuscr. Rep. Fish. Aquat. Sci. 2308, vii + 148 pp., + app.

Scruton, D.A., T.C. Anderson, C.E. Bourgeois, and J.P. O'Brien. 1992. Small Stream Surveys for Public Sponsored Habitat Improvement and Enhancement Projects. Can. Manuscr. Rep. Fish. Aquat. Sci. No. 2163, v + 49 pp.

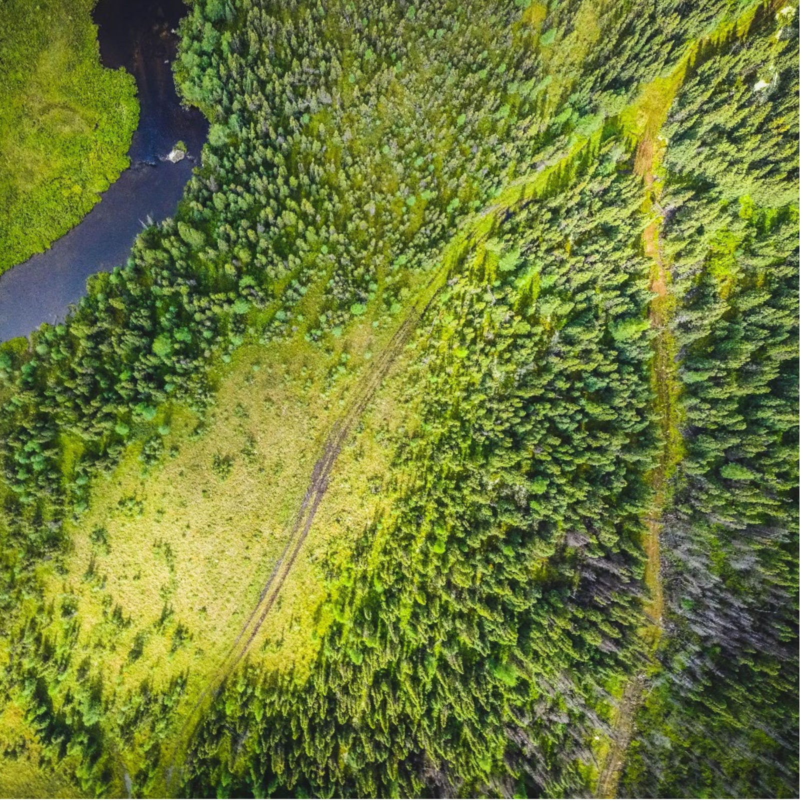
Sprules, W.G. and R. Knoechel. 1984. Lake ecosystem dynamics based on functional representations of trophic components, PP. 383-403. in: D.G. Meyers and R. Strickler (eds.). Trophic Interactions Within Aquatic Ecosystems. AAS Selected Symposium 85.

Sooley, D.R., E.A. Luiker, and M.A. Barnes. 1998. Standard Methods Guide for Freshwater Fish and Fish Habitat Surveys in Newfoundland and Labrador: Rivers & Streams. Fisheries and Oceans, St. John's, NF. iii + 50 pp.

Sikumiut Environmental Management Limited (SEM). 2021. Western Hillside Aquatic Assessment Report.

Welschmeyer, N.A. 1994. Fluorometric analysis of chlorophyll 'a' in the presence of chlorophyll 'b' and pheopigments. Limnol. Oceanogr. 39: 1985-1992.

Wentworth, C.K. 1922. A scale of grade and class for clastic sediments. J. Geol. 30: 377-392.



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