APPENDIX J GOOSE LAKE DOWNSTREAM FISH AND FISH HABITAT MONITORING 2025: TECHNICAL MEMORANDUM

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MEMO

TO	Chris LeGoffe, Jane Quackenbush, Scott Morrison, Audie Altiche (B2Gold)
FROM	Hossein Mehdi, Cameron Stevens (ERM)
DATE	1 January 2026
REFERENCE	0773592 - 02
SUBJECT	Back River Mine – Goose Lake Downstream Fish and Fish Habitat Monitoring 2025: Technical Memorandum

1. INTRODUCTION

The Back River Mine is a gold mine located in the Kitikmeot Region of Nunavut and operated by B2Gold Back River Corp. (B2Gold Nunavut). It includes a number of freshwater lakes and streams within its footprint. Goose Lake provides a permitted water source for mine construction and operations under Water Licence 2AM-BRP1831 Amendment No. 1 and *Fisheries Act* Authorization (FAA) 12-HCAA-CA7-00007. In support of commissioning the processing plant (milling facility) and associated infrastructure, the FAA allows the withdrawal of up to 608,700 m³ annually from Goose Lake. As Goose Lake and downstream waters support Arctic Grayling (*Thymallus arcticus*), a species of ecological and cultural importance, downstream habitat protection and monitoring is a regulatory requirement under the FAA.

As part of the application for the recently amended FAA to increase water usage from Goose Lake, B2Gold Nunavut submitted a downstream effects assessment on Arctic Grayling habitat (*Downstream Assessment of the Goose Lake Water Withdrawal Increase on Arctic Grayling Spawning and Rearing Habitat*; WSP 2024). The effects assessment of an increase in water withdrawal from Goose Lake demonstrated that it may result in the following changes:

- Goose Lake outflows are expected to be, on average, 15.6% less compared to baseline conditions (i.e., natural flow regime).
- The onset of spring ecological flows (i.e., flows exceeding 30% mean annual discharge or MAD) may be delayed by up to 6 days and late summer ecological flows may cease up to 3 days earlier for the Project-affected versus the baseline average scenarios.
- No expected change in the overall availability of suitable spawning habitat in the Goose Lake Outlet (GLO) reach and only a minor decrease (3% decrease under average conditions) for Propeller Lake Inlet (PLI) reach.
- No measurable effects from water withdrawals on the suitability of fry (i.e., young-of-year [YOY]) rearing habitat for Arctic Grayling in stream reaches immediately below Goose Lake.

Conditions of the recently amended FAA (Condition 3.2.3) requires that B2Gold Nunavut monitor and report on water withdrawals from Goose Lake as per Section 4.7 of the Back River Project Fish Offsetting Plan (B2Gold Nunavut 2025). Specifically, the monitoring plan is to be implemented during the open water season when there is potential for water withdrawals to exceed 10% of instantaneous flows, delay the onset of spring flow conditions (by greater than 3 days), or result in flows that are less than 30% of the mean annual discharge (MAD) (B2Gold Nunavut 2025).

In 2024, Fisheries and Oceans Canada (DFO) completed its review of B2Gold Nunavut's request to increase water withdrawals from Goose Lake and confirmed that the *Fisheries Act* Authorization (FAA) amendment application must include an updated monitoring plan to address potential effects of the increased withdrawal on downstream Arctic Grayling habitat. Consistent with FAA Condition 3.2.3 and Section 4.7 of the Back River Project Fish Offsetting Plan (B2Gold Nunavut 2025), B2Gold Nunavut proposed that the Goose Lake downstream monitoring program be implemented during the open-water season when water withdrawals have the potential to exceed defined ecological flow thresholds.

The 2025 monitoring program was implemented in accordance with the requirements of the amended *Fisheries Act* Authorization (FAA; Condition 3.2.3), which directs monitoring and reporting on water withdrawal activities from Goose Lake as described in Section 4.7 of the Back River Project Fish Offsetting Plan (B2Gold Nunavut 2025). Field surveys were conducted during two site visits representing spring freshet and summer baseflow conditions and followed the monitoring activities, data collection requirements, and habitat assessment methods specified in the FAA amendment and supporting downstream effects assessment (WSP 2024). The program focused on assessing potential effects to Arctic Grayling spawning and young-of-year (YOY) rearing habitat within the GLO, Connector Pond, and PLI reaches, with results providing the information required to evaluate compliance with FAA requirements, assess the effectiveness of mitigation measures where applicable, and support ongoing water management and adaptive management decisions at the Mine.

2. BACKGROUND

2.1 STUDY AREA

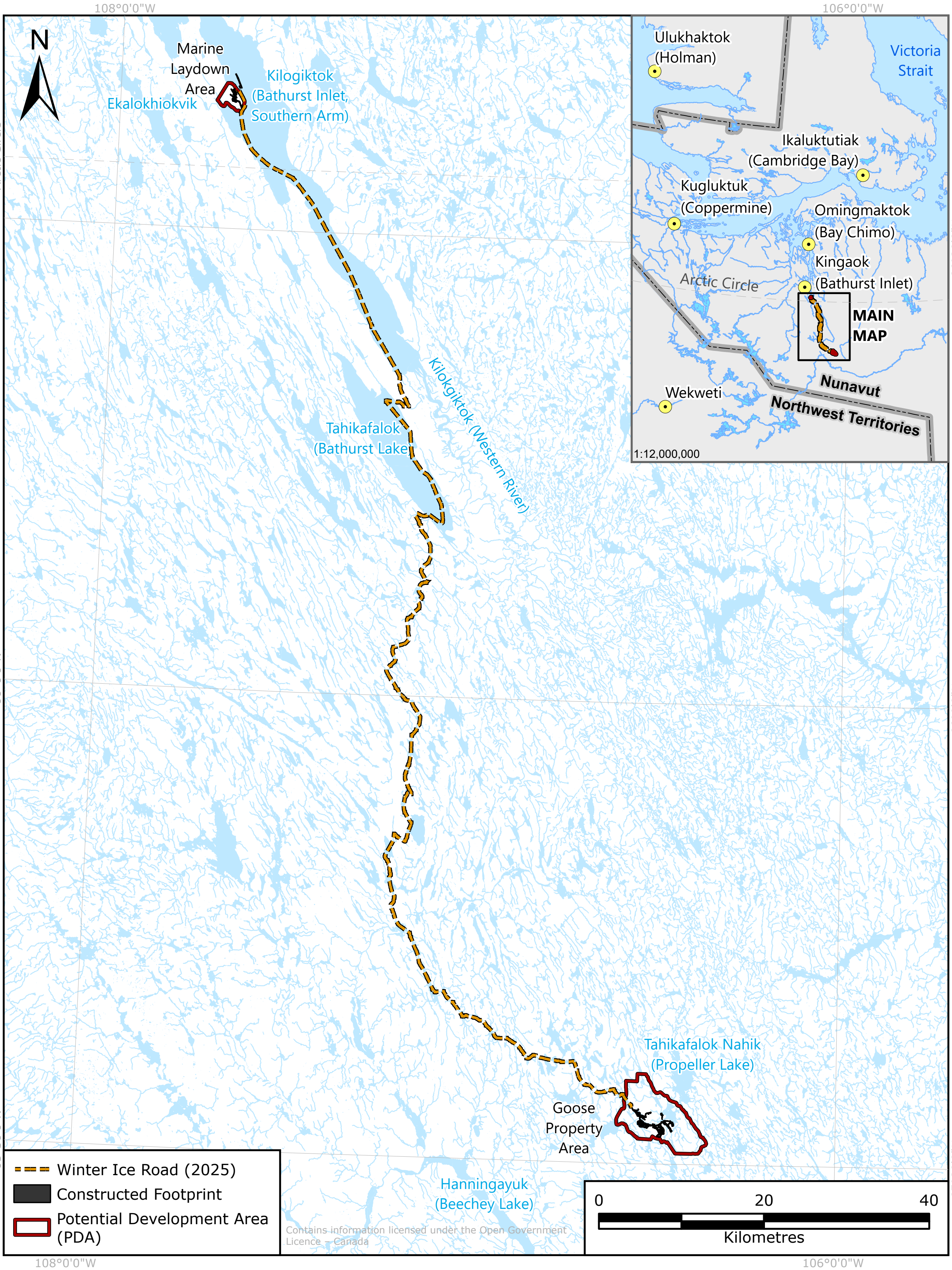
The Goose Lake–Propeller Lake system is located on the northeast end of the Back River Mine (Figures 2.1 and 2.2). Goose Lake is a primary headwater lake that discharges northward through a short, wade-able outlet channel into Connector Pond, and then continues downstream through the PLI before entering Propeller Lake. Hydrology in the system is strongly influenced by snowmelt, resulting in peak flows during freshet in June followed by steadily declining discharge during summer baseflow. These seasonal changes drive the distribution, availability, and connectivity of fish habitat.

The Goose Lake Outlet is approximately 315 m in length and provides alternating riffle–run habitat with substrates ranging from gravel to boulder and finer glacial materials (Photos 2.1 and 2.2). During freshet, wetted widths and depths expand substantially, supporting migration movements and spawning access for Arctic Grayling. As flows decrease, wetted width and depth contract sharply, reducing lateral habitat availability.

Connector Pond is a shallow waterbody located immediately downstream of GLO (Photos 2.3 and 2.4). Although small in surface area, it contains broad littoral margins that provide low-velocity refuge and feeding habitat for YOY Arctic Grayling during the early rearing period. The pond is sensitive to rapid water-level reduction following freshet, resulting in seasonal exposure of shoreline habitats.

The Propeller Lake Inlet, approximately 338 m in length, conveys flows into the west side of Propeller Lake (Photos 2.5 – 2.6). Like GLO, the inlet contains shallow riffle and run habitat with coarse mixed substrates, providing functional spawning sites and transitional rearing habitat for YOY prior to dispersal into deeper lake environments. Together, GLO and PLI reaches and the Connector Pond form a seasonal migratory corridor between the two lakes, as well as habitat for spawning and early rearing environments for Arctic Grayling that may overwinter in either Propeller Lake or Goose Lake where Arctic Grayling is one of the dominant large-bodied species in the fish community (Sabina 2015; WSP 2024).

FIGURE 2.1 BACK RIVER PROJECT OVERVIEW



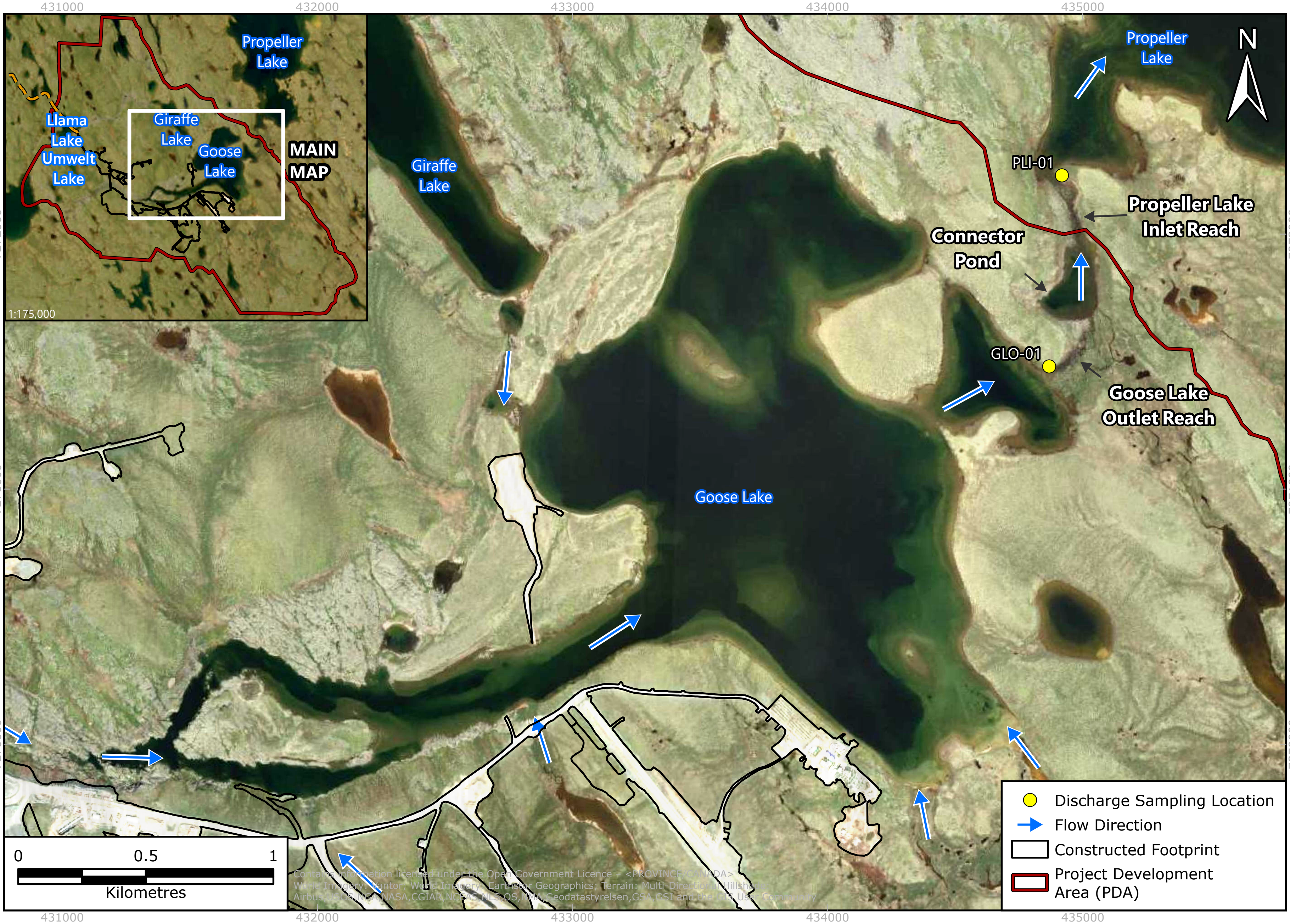
ERM

CLIENT: B2Gold Nunavut
GIS NUMBER: BAC-10-136-09

DATE: 18 December 2025

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:650,000 when printed at 8.5x11

FIGURE 2.2 OVERVIEW OF 2025 OPEN-WATER SEASON FISH AND FISH HABITAT SAMPLING LOCATIONS



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GIS NUMBER: BAC-10-136-01

DATE: 12/18/2025

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:21,000 when printed at 8.5x11

2.2 ARCTIC GRAYLING

Adult Arctic Grayling overwinter in deeper lake environments and migrate into tributary channels in spring to spawn once water temperatures rise above approximately 4°C (Ford et al. 1995). Spawning occurs soon after ice break-up and typically lasts 2 to 3 weeks (Ford et al. 1995; Scott and Crossman 1973). Grayling preferentially spawn in small streams with gravel substrate, particularly at riffle–run transitions where water velocities are moderate and substrate interstices provide egg protection (Larocque et al. 2014).

Eggs incubate within gravel until fry emerge in early to mid-summer, completing the spawning period (Scott and Crossman 1973). Young-of-year occupy shallow, lower-velocity rearing habitats along stream margins and pools during early summer (Larocque et al. 2014). As flows decline naturally through July and August, wetted width and channel depth contract, reducing rearing habitat and often prompting juveniles to move into nearby lake refuges before freeze-up. Adults typically return to lake habitats shortly after spawning and may no longer rely on stream habitat until the following year (Ford et al. 1995).

Recent habitat surveys confirmed that both GLO and PLI include suitable spawning habitat and that Arctic Grayling eggs and YOY occur within these reaches (WSP 2024). Because Arctic Grayling rely on short, predictable seasonal flow windows for spawning and early growth, any changes in discharge magnitude or timing, such as those associated with operational water withdrawal, have the potential to influence recruitment success and long-term population persistence.

PHOTO 2.1 AERIAL PHOTOGRAPH OF GOOSE LAKE OUTLET ON MAY 31, 2025

PHOTO 2.2 AERIAL PHOTOGRAPH OF GOOSE LAKE OUTLET ON JULY 16, 2025

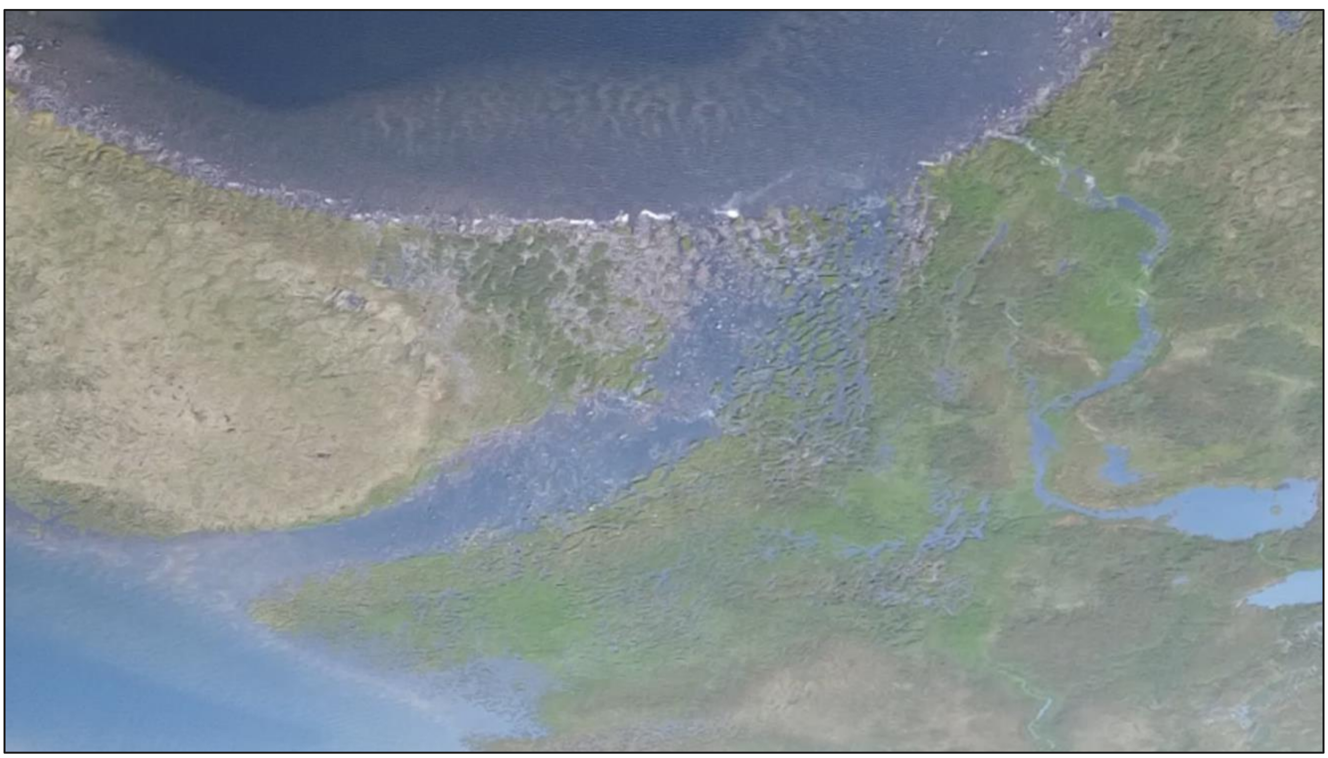


PHOTO 2.3 AERIAL PHOTOGRAPH OF CONNECTOR POND ON MAY 31, 2025

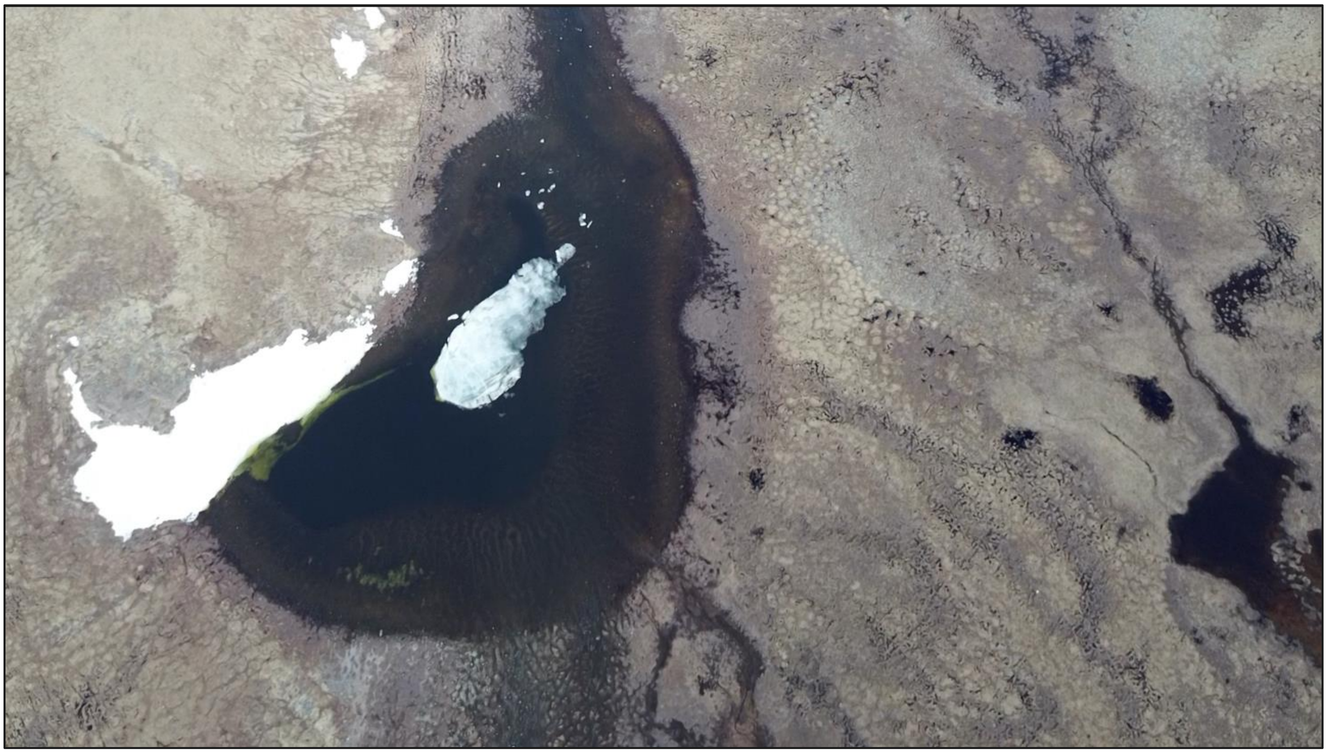


PHOTO 2.4 AERIAL PHOTOGRAPH OF CONNECTOR POND ON JULY 16, 2025

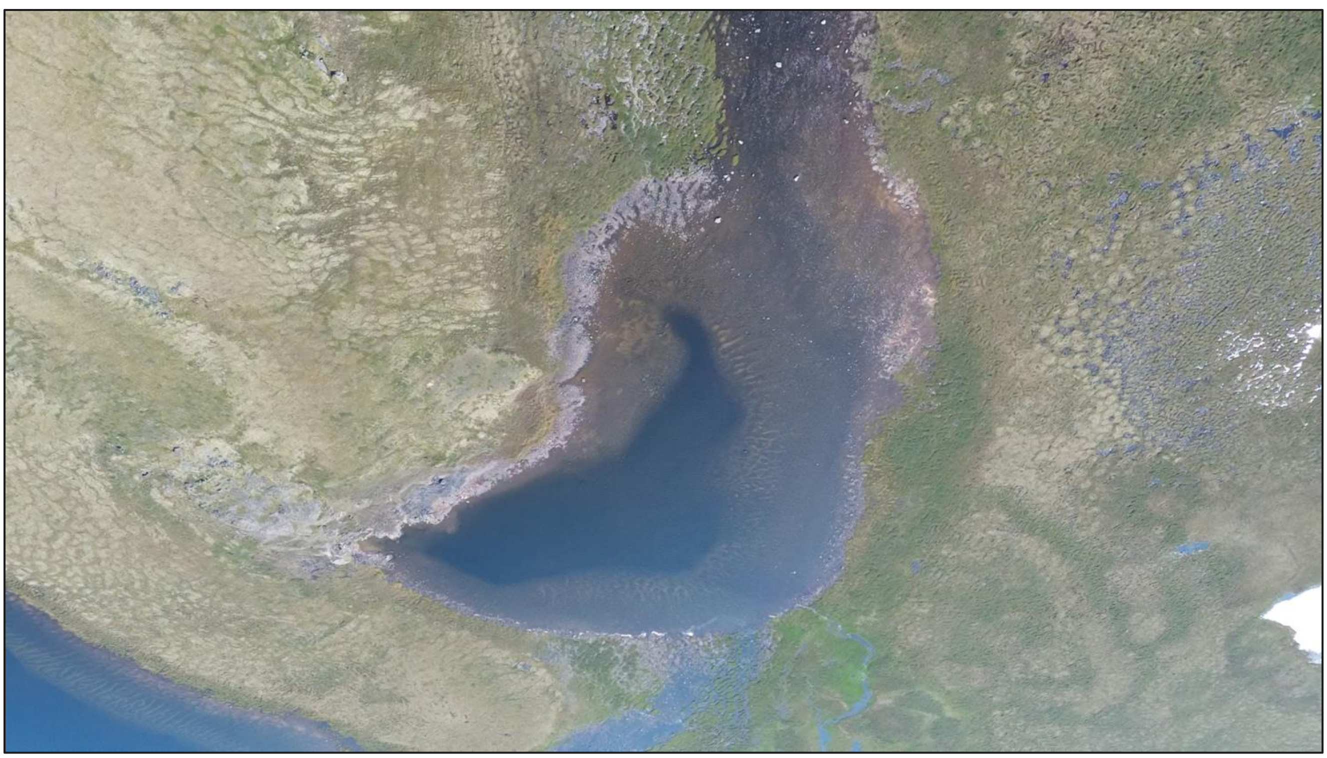


PHOTO 2.5 AERIAL PHOTOGRAPH OF PROPELLER LAKE INLET ON MAY 31, 2025

PHOTO 2.6 AERIAL PHOTOGRAPH OF PROPELLER LAKE INLET ON JULY 16, 2025

3. METHODS

Downstream monitoring was completed between May 29 to 31 and July 15 to 16, 2025 in accordance with the monitoring requirements outlined in Section 4.7 of the Back River Project Fish Offsetting Plan (B2Gold Nunavut 2025). The monitoring program was designed to evaluate Arctic Grayling spawning and rearing habitat suitability under operational water withdrawal scenarios and to confirm predictions made in earlier downstream effects assessments (WSP 2024).

3.1 HABITAT ASSESSMENTS

Habitat assessments were completed across all three reaches (GLO, Connector Pond, and PLI) during both field campaigns following the methods prescribed in the Back River Project Fish Offsetting Plan (B2Gold Nunavut 2025) and habitat classification approaches applied previously within these reaches (WSP 2024).

For each habitat unit, habitat type (riffle, run, or pool), dominant substrate composition, and availability of instream and overhead cover were recorded. Depth and velocity measurements were also taken along a representative cross-section within each habitat unit. Four evenly spaced depth measurements were collected using a graduated wading staff, and flow velocity was measured at 0.6 of the total water depth at the same locations using a handheld current meter (SonTek FlowTracker 2). These measurements complemented the discharge assessments completed at the designated discharge measurement cross-sections at GLO and PLI (Section 3.2). These observations were used to support habitat suitability scoring for spawning and YOY rearing life stages.

Field observations, habitat assessment data, and GPS points were used to map habitat across the three study areas. Drone flights were also conducted over GLO, Connector Pond, and PLI during the May and July field programs to obtain high-resolution aerial imagery of channel morphology, shoreline conditions, and wetted extents. This imagery provided supporting spatial information on substrate type, rearing microhabitats, and channel connectivity. Drone observations were used to refine field-based habitat mapping and confirm the distribution of suitable microhabitats across each reach.

Additionally, at GLO, a wildlife camera was installed from May to August to capture twice-daily shoreline images, providing supplementary information on seasonal changes in water levels, shoreline exposure, and habitat availability.

3.2 HYDROLOGICAL MEASUREMENTS

3.2.1 DISCHARGE MEASUREMENTS

Discharge measurements were conducted using transect methods at previously established stations on GLO (GLO-01) and PLI (PLI-01) during the May and July field programs following velocity-area methods prescribed in the Back River Project Fish Offsetting Plan and methods outlined in WSP (2024). At each transect, the channel was divided into 1-m intervals across the wetted width. Depth was measured at each interval using a graduated staff, and water velocity was recorded at 0.6 of the total depth using a handheld current meter (SonTek Flow Tracker 2). Total discharge was calculated by summing the products of depth, width, and velocity across all 1-m sections.

For each discharge transect, cross-sectional hydraulic indices were derived from the depth and velocity profiles (WSP 2024). At each 1-m vertical, wetted cell widths, depths, and velocities were used to calculate flow area (m^2), discharge (m^3/s), and average velocity (m/s). Top width was defined as the sum of all wetted cell widths, and average depth was calculated as flow area divided by top width. Maximum depth was taken as the deepest measured point along the transect. These metrics are reported for GLO-01 and PLI-01 and used to compare observed 2025 hydraulic conditions with modelled baseline and Project scenarios from WSP (WSP 2024).

3.3 WATER QUALITY MEASURMENTS

Water-quality measurements were collected within each habitat unit at the three reaches during each field program using a YSI ProQuatro multiparameter meter. Temperature, dissolved oxygen, conductivity, and pH were recorded to help interpret environmental conditions influencing YOY distribution and habitat suitability. Measurements were taken in conjunction with habitat assessments.

3.4 YOUNG-OF-YEAR MONITORING AND SPAWNING SURVEYS

3.4.1 MAY EGG AND FRY SURVEYS

Egg and fry surveys were conducted between May 27 and May 31, 2025 at GLO and PLI to assess Arctic Grayling spawning activity using a standardized kick-net plume method. Field crew targeted shallow riffle and run habitats containing suitable gravel substrates. At each selected site, a 400-µm mesh D-frame kick net was positioned immediately downstream of the sampling area. A 1 m × 1 m section of substrate upstream of the net was then gently agitated by foot to create a benthic plume, allowing any dislodged eggs or fry to be carried into the net.

After each kick-net effort, the contents of the net were rinsed into a white sorting tray for visual inspection. Substrate composition, water depth, local flow characteristics (if eggs were present), and other relevant microhabitat attributes were recorded at each sampling location to document habitat conditions. This method allowed detection of substrate-embedded eggs and newly emerged fry while minimizing disturbance to the spawning habitat and maintaining consistency with recognized Arctic Grayling spawning-assessment procedures previously applied within the Goose watershed (WSP 2024).

3.4.2 JULY YOUNG-OF-YEAR SURVEYS

YOY visual surveys were conducted in July to enumerate newly emerged Arctic Grayling along the margins of GLO, Connector Pond, and PLI. Field crews walked slowly along shorelines or waded through shallow margins while scanning ahead with polarized sunglasses to improve visibility. When YOY were observed, direct counts were made, and each observation was recorded with its corresponding location. Surveys focused on nearshore areas where YOY typically concentrate, particularly shallow (<10–20 cm), low-velocity areas that provide suitable rearing habitat. These areas generally included gently sloping shorelines, pockets of reduced flow created by boulders or channel irregularities, and zones with coarse gravel or mixed gravel–cobble substrate that offer both cover and foraging opportunities.

3.4.3 JULY SNORKELING SURVEYS

Snorkeling surveys were conducted exclusively in Connector Pond, where water depths and low velocities permitted safe underwater observation. Snorkelers followed slow, linear transects around the perimeter of the pond, remaining within close proximity to a crew member stationed on shore to maintain continuous visual and verbal contact for safety. While moving along these transects, the field crew documented all fish observed, including approximate size classes, species, and abundance.

3.5 HABITAT SUITABILITY INDEX ANALYSIS AND PREDICTION EVALUATION

Downstream habitat suitability for Arctic Grayling spawning and YOY rearing was evaluated following the Habitat Suitability Index (HSI) framework applied in WSP (2024) and in Larocque et al. (2014) and Hubert et al. (1985). For each life stage, field-derived hydraulic and habitat variables were converted to component HSI scores (0–1) and combined into composite indices to (i) characterize 2025 habitat quality and (ii) confirm whether observed conditions are consistent with predictions from previous downstream effects assessments (WSP 2024).

3.5.1 SPAWNING HABITAT SUITABILITY INDEX, CROSS-SECTION SCALE

Spawning habitat suitability was assessed at discharge transects GLO-01 and PLI-01, which are located within spawning habitats previously evaluated by WSP (2024). For each transect, average water velocity (m/s), maximum depth (m), and cross-sectional metrics (top width, flow area, average depth) were derived from the May discharge measurements as described in Section 3.2. Dominant substrate type and geomorphic habitat type (riffle vs run) were assigned using the habitat classification and substrate composition data collected for the overlapping habitat units (Section 3.1).

Average velocity and depth values were converted to spawning suitability scores using the curves in Larocque et al. (2014), and WSP (2024) which assign scores between 0 (unsuitable) and 1 (optimal). Substrate and habitat type suitability was scored using thresholds in Laroque et al. (2014) and WSP (2024). For each cross-section, a composite spawning HSI was then calculated as the geometric mean of the four component scores:

$$HSI_{\mathrm{Spawn}} = (HSI_{\mathrm{V}} \times HSI_{\mathrm{D}} \times HSI_{\mathrm{Sub}} \times HSI_{\mathrm{Hab}})^{1/4}$$

where:

$\mathrm{HSI}_{\mathrm{Spawn}}$ = composite habitat suitability index for spawning;

$\mathrm{HSI}_{\mathrm{V}}$ = suitability index for water velocity;

$\mathrm{HSI}_{\mathrm{D}}$ = suitability index for water depth;

$\mathrm{HSI}_{\mathrm{Sub}}$ = suitability index for substrate;

$\mathrm{HSI}_{\mathrm{Hab}}$ = suitability index for habitat/cover.

The resulting composite indices for 2025 observed conditions were compared with Baseline and Project spawning HSI values reported for the same cross-sections in WSP (2024) to confirm whether habitat suitability remained within the high-quality range and within the range of natural variability described in previous assessments.

3.5.2 YOUNG-OF-YEAR REARING HABITAT SUITABILITY INDEX, REACH SCALE

YOY rearing habitat suitability was evaluated at the reach scale for GLO and PLI reaches using July 2025 hydraulic and habitat data, corresponding to the primary YOY rearing period (Larocque et al. 2014; WSP 2024). YOY Arctic Grayling occupy a wide range of habitat types including shallow benches, low-velocity margins, and connected off-channel areas. Because their rearing success depends on the overall availability and distribution of these features across an entire reach, rather than on conditions at a single location, the reach provides the most appropriate spatial scale for model evaluation (Larocque et al. 2014; WSP 2024).

Consistent with the approach described in WSP (2024), YOY rearing HSI was calculated using reach-representative values for hydraulic and habitat variables, rather than evaluating individual habitat units. In the WSP assessment, reach-scale hydraulic conditions were derived from modelled average velocity and depth outputs under different flow scenarios, while dominant substrate type, fish cover type, and geomorphic habitat type were assigned at the reach scale based on mapped habitat characteristics.

In the present study, observed field measurements were used in place of modelled outputs. Average water velocity and maximum water depth measured at the July 2025 discharge cross-sections (GLO-01 and PLI-01) were used as reach-representative hydraulic inputs for YOY rearing HSI scoring. This deviation from WSP (2024) reflects the availability of site-specific field data and provides a direct characterization of rearing conditions under observed mid-summer low-flow conditions.

Substrate type, fish cover type, and geomorphic habitat type were assigned at the reach scale based on dominant conditions observed during habitat mapping surveys, consistent with the assumptions applied by WSP (2024) and Larocque et al. (2014). These variables were assumed to reasonably represent overall rearing habitat conditions within each reach.

YOY rearing suitability scores for velocity, depth, substrate, fish cover, and habitat type were assigned using the rearing HSI curves and classification tables provided in Larocque et al. (2014) and applied by WSP (2024). A composite YOY rearing HSI was then calculated for each reach as the geometric mean of the five component scores:

$$HSI_{\mathrm{YOY}} = (HSI_{\mathrm{V}} \times HSI_{\mathrm{D}} \times HSI_{\mathrm{Sub}} \times HSI_{\mathrm{Cover}} \times HSI_{\mathrm{Hab}})^{1/5}$$

where:

HSI_{YOY} = composite habitat suitability index for young-of-the-year life stage;

HSI_{V} = suitability index for water velocity;

HSI_{D} = suitability index for water depth;

HSI_{Sub} = suitability index for substrate;

HSI_{Cover} = suitability index for cover;

HSI_{Hab} = suitability index for habitat.

Composite 2025 rearing HSI values were then compared to the Baseline and Project YOY rearing HSI values reported by WSP (2024) for the GLO and PLI reaches. Differences were interpreted in the context of WSP’s classification framework, where changes <10% of baseline HSI and within the range between average and dry-year scenarios are considered low (non-measurable) effects on habitat suitability.

3.5.3 PREDICTION CONFIRMATION

Observed 2025 hydrological indices (discharge, depth, velocity, top width) and HSI results were evaluated against the predictions in the Back River Project Fish Offsetting Plan (B2Gold Nunavut 2025) and the downstream effects assessment (WSP 2024). The comparison focused on whether: (i) seasonal flow recession and cross-section hydraulics fell within the modelled range of Baseline and Project scenarios, and (ii) spawning and YOY rearing composite HSI values remained within the high-suitability range (>0.5) and within the natural variability range used in WSP (2024) to characterize effects of increased water withdrawals on Arctic Grayling habitat.

3.6 DATA MANAGEMENT AND QUALITY ASSURANCE QUALITY CONTROL

All measurements and observations were recorded on waterproof datasheets or an in-field tablet and transferred to digital format at the end of each field program. Quality assurance procedures involved cross-checking entries against field notes, verifying all discharge calculations, reviewing habitat classifications, and validating GPS coordinates. Drone imagery was used to confirm habitat boundaries and ensure consistency between aerial and ground-based interpretations. All data were compiled into a standardized dataset used to support subsequent analyses.

4. RESULTS

4.1 HABITAT CONDITIONS

4.1.1 GOOSE LAKE OUTLET

Five wetted habitat units were delineated in both May and July 2025, consisting of alternating riffle–run morphology typical of Arctic Grayling spawning and early-rearing environments. In May, wetted widths ranged from 42 to 61 m across all habitat units, mean depths of all habitat units ranged between 0.14 to 0.39 m, while flow ranged from 0.26 to 0.70 m/s across all habitat units (Table 4.1; Figure 4.1). These post-freshet hydraulic conditions provided full connectivity and suitable depths for upstream migration, spawning access, and egg incubation. Substrates in riffle units were primarily comprised of gravel, cobble, and boulder, while run units contained similar coarse composition with minor fines, supporting substrate conditions preferred for spawning and initial YOY emergence (Larocque et al. 2014). Boulder cover formed the primary structural refuge, with low instream vegetation typical of Arctic headwater streams during peak flows.

By July, the same five units remained wetted, but seasonal flow recession resulted in evident channel contraction. Mean wetted widths declined to 38 – 54 m across all habitat units, while mean depths of all habitat units declined to 0.14 – 0.20 m (Table 4.1; Figure 4.2). Flow velocities decreased to 0.13–0.60 m/s, consistent with the natural progression toward summer baseflow. Substrate composition shifted only slightly toward greater cobble exposure as water levels declined. Despite decreased depths and flows in the channel, connectivity to Connector Pond was maintained.

4.1.2 CONNECTOR POND

Connector Pond consisted of a single mapped pool unit during both sampling periods. In May, the fluvial length of the pond extended to approximately 359 m with a wetted with of 215 m (Table 4.1; Figure 4.3). Depth, measured at the existing staff gauge, was recorded at 1.40 m (Table 4.1; Figure 4.3). Substrate composition comprised of gravel (30%), cobble (20%), and boulder (45%), with only approximately 5% sand and fines. Habitat complexity was provided primarily by boulders and pool structure, offering refuge for fry moving downstream from GLO or upstream from PLI (Table 4.1; Figure 4.3).

In July, the overall length and wetted width of the pond remained similar (375 m and 230 m, respectively), while the staff gauge recorded a substantial seasonal decline in water depth to 0.09 m (Table 4.1; Figure 4.4) It is important to note that the depth recorded on the staff gauge does not reflect true pond depth, as the gauge is positioned near the outer edge of the pond where water is naturally shallow and more sensitive to seasonal recession and to water withdrawal. Our July snorkeling surveys demonstrated that the pond consists of deeper pool habitats (>1.5m), particularly farther away from the outer edge. Substrate composition remained coarse, comprising 35% gravel, 25% cobble, 30% boulder, and 10% sand and fines. Boulders and pool morphology continued to provide the dominant form of fish cover, maintaining functional nursery habitat despite reduced water levels (Table 4.1; Figure 4.4).

4.1.3 PROPELLER LAKE INLET

Three habitat units were present during both sampling periods. In May, across all habitat units, wetted widths ranged from 62 to 93 m, mean depths ranged from 0.27 to 0.44 m, and flow ranged from 0.39 to 0.75 m/s (Table 4.1; Figure 4.5). Substrates were primarily comprised of gravel, cobble, and boulder, providing both spawning substrate and structural cover.

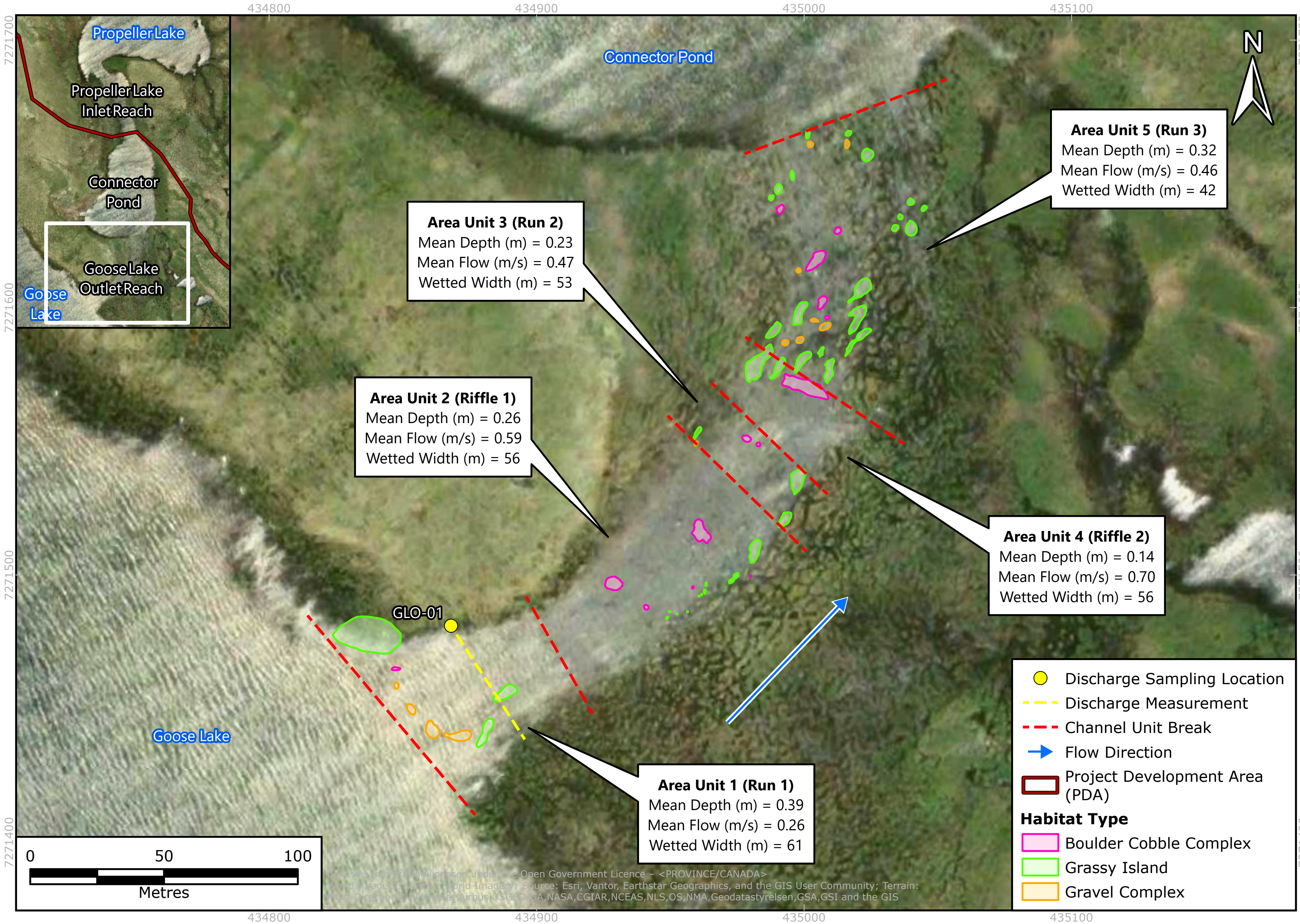
Seasonal flow recession by July narrowed wetted widths to 39–90 m and reduced mean depths to 0.16–0.23 m across all habitat units (Table 4.1; Figure 4.6). Flows across all habitat units decreased to 0.12 – 0.43 m/s but maintained connectivity to Propeller Lake. The dominance of coarse substrate was unchanged, preserving habitat complexity.

TABLE 4.1: HABITAT CHARACTERISTICS AND CHANNEL MORPHOLOGY ACROSS DOWNSTREAM MONITORING SITES (MAY AND JULY 2025)

Month	Area	Area Unit	Habitat Type	Length (m)	Wetted Width (m)	Slope (%)	Max Depth (m)	Mean Depth (m)	Mean Flow (m/s)	Substrate Composition				Fish Cover			
										Sand/ Fines (%)	Gravel (%)	Cobble (%)	Boulder (%)	Pool (%)	Boulder (%)	Instream Vegetation (%)	Overhanging Vegetation (%)
May	GLO	1	Run	43	61	0	0.55	0.39	0.26	20	50	25	5	0	5	10	0
		2	Riffle	79	56	1	0.30	0.26	0.59	5	30	20	45	0	45	0	0
		3	Run	16	53	0	0.30	0.23	0.47	5	30	20	45	0	45	5	0
		4	Riffle	25	56	2	0.20	0.14	0.70	5	30	20	45	0	45	5	0
		5	Run	76	42	1	0.43	0.32	0.46	5	40	35	20	0	20	5	0
	Connector Pond	1	Pool	359	215	0	1.40[a]	1.40[a]	-	5	30	20	45	50	45	5	0
	PLI	1	Run	62	62	1	0.54	0.44	0.46	5	30	25	40	0	40	5	0
		2	Riffle	79	63	1	0.32	0.27	0.75	5	35	30	30	0	30	5	0
		3	Run	115	93	1	0.51	0.31	0.39	10	35	25	30	0	30	10	0
July	GLO	1	Run	42	40	0	0.24	0.20	0.14	10	50	30	10	0	10	5	0
		2	Riffle	92	40	1	0.20	0.16	0.31	5	45	35	15	0	15	5	0
		3	Run	26	54	0	0.28	0.14	0.15	5	40	30	25	0	25	10	0
		4	Riffle	24	38	1	0.20	0.17	0.60	5	30	25	40	0	40	20	0
		5	Run	80	42	0.5	0.35	0.17	0.13	5	35	25	35	0	35	15	0
	Connector Pond	1	Pool	375	230	0	0.09[a]	0.09[a]	-	10	35	25	30	50	30	5	0
	PLI	1	Run	57	51	0	0.30	0.23	0.12	5	45	35	15	0	15	5	0
		2	Riffle	48	39	1	0.25	0.16	0.43	5	45	35	15	0	15	5	0
		3	Run	145	90	0	0.25	0.20	0.15	10	45	35	10	0	10	15	0

Notes: [a] measurements recorded as per staff gauge. (-) indicates not applicable data. Depth and flow were recorded at four evenly spaced points along a representative cross-section in each habitat unit at GLO and PLI, from which, mean depth and mean velocity were calculated.

FIGURE 4.1 GOOSE LAKE OUTLET HABITAT MAP IN MAY 2025



ERM

CLIENT: Client Name

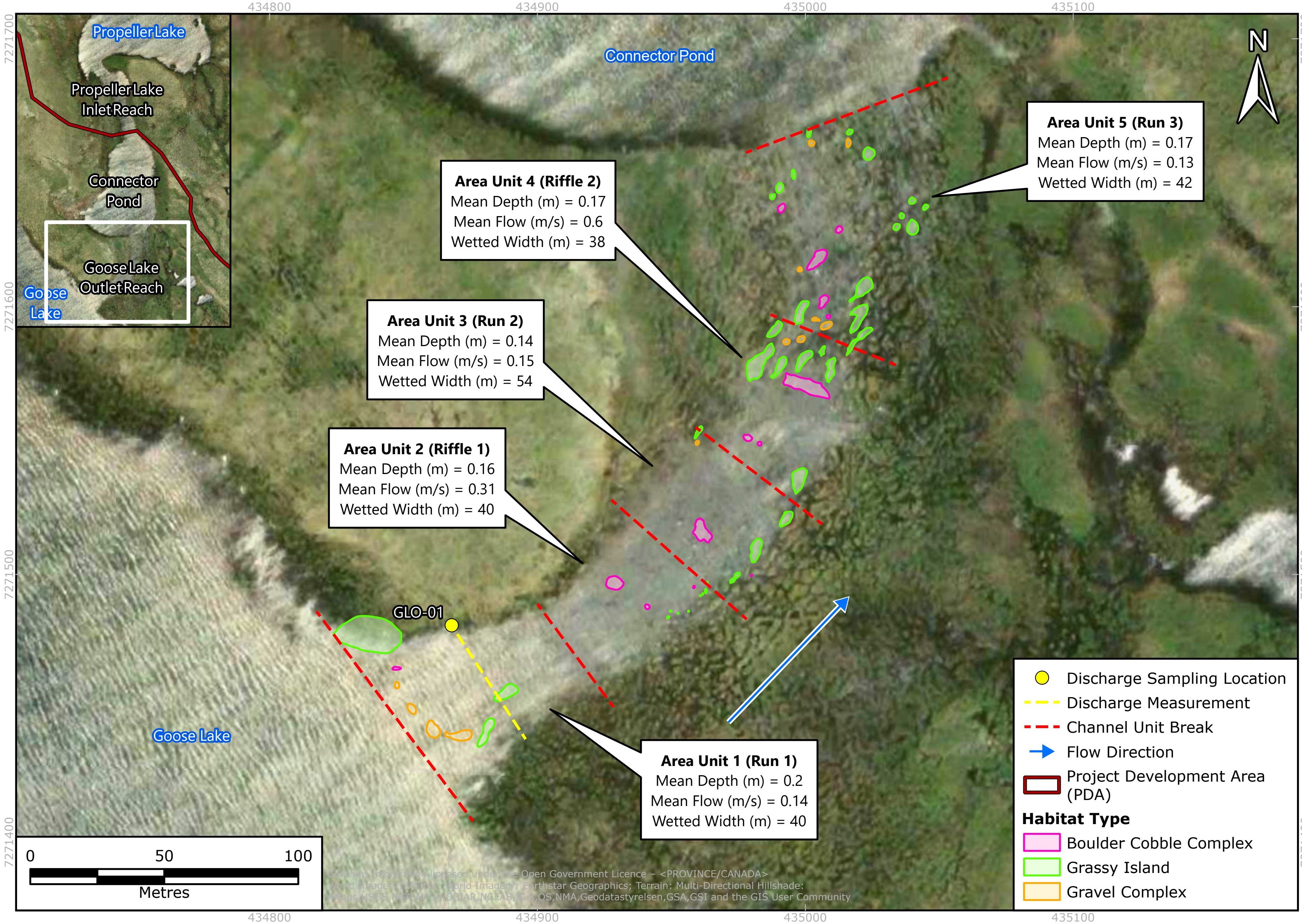
GIS NUMBER: BAC-10-136-02

DATE: 12/17/2025

PROJECTION: NAD 1983 UTM Zone 13N

SCALE: 1:2,000 when printed at 8.5x11

FIGURE 4.2 GOOSE LAKE OUTLET HABITAT MAP IN JULY 2025



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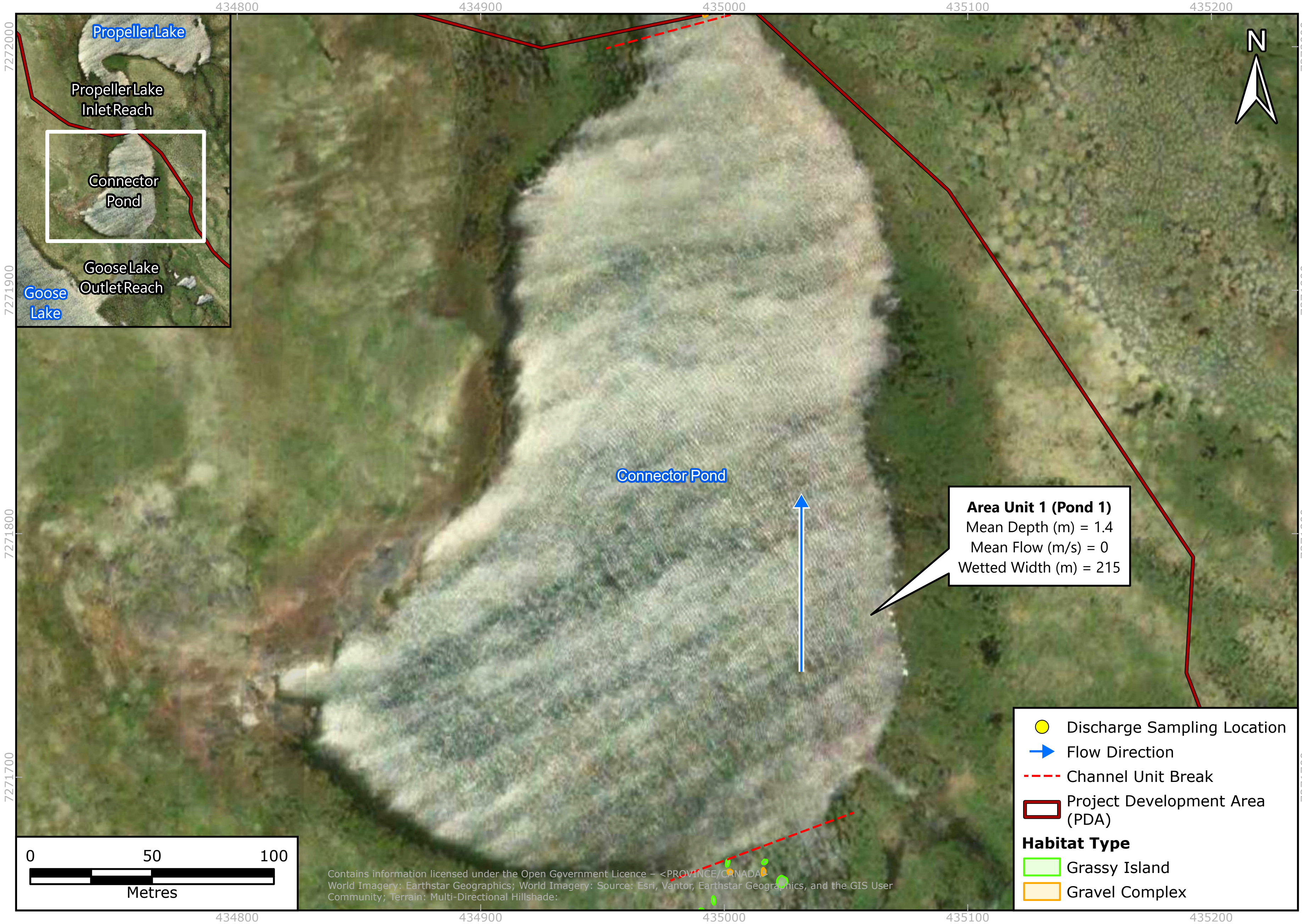
GIS NUMBER: BAC-10-136-03

DATE: 12/17/2025

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:2,000 when printed at 8.5x11

FIGURE 4.3 CONNECTOR POND HABITAT MAP IN MAY 2025



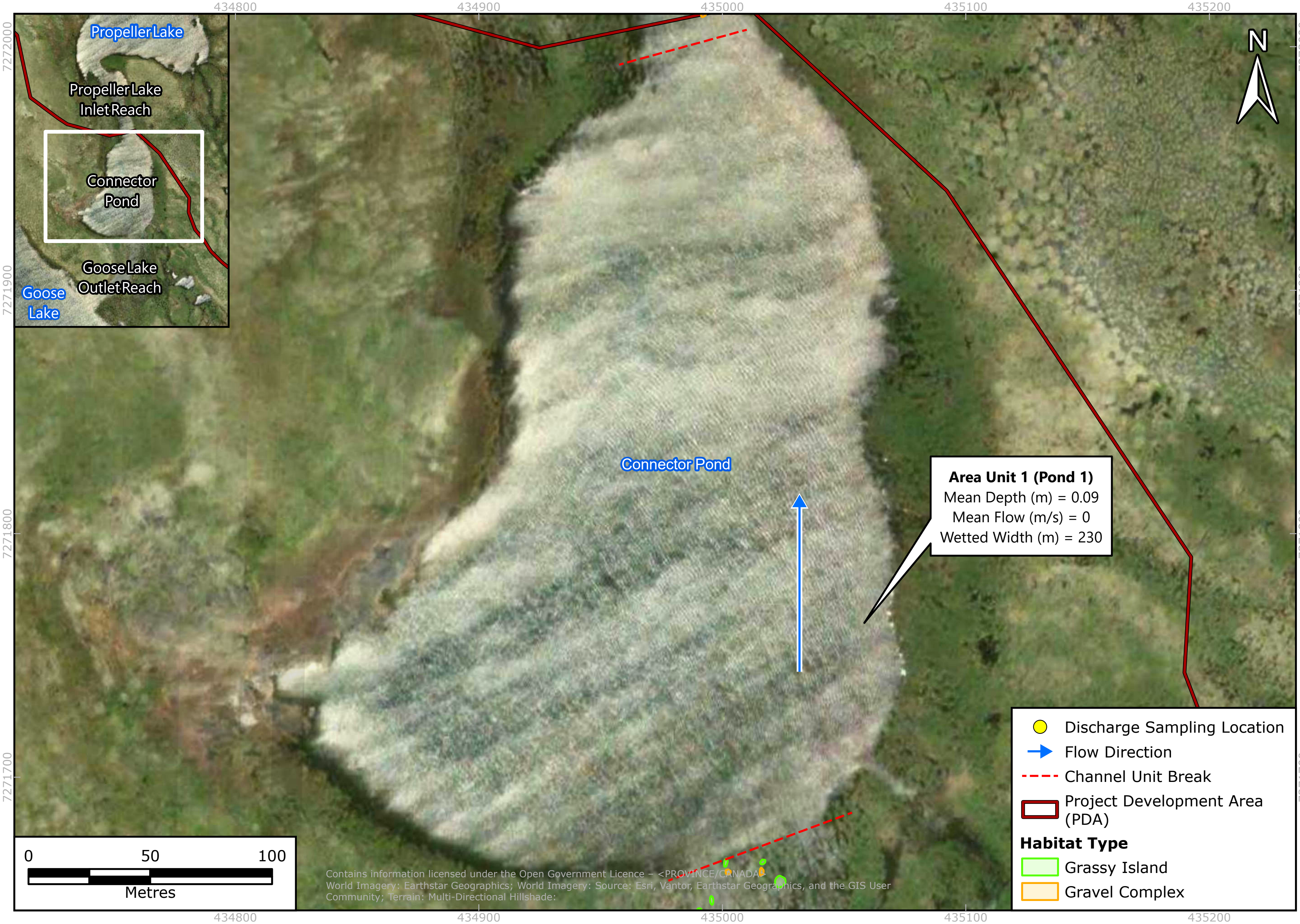
ERM

CLIENT: Client Name
GIS NUMBER: BAC-10-136-04

DATE: 12/17/2025

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:2,200 when printed at 8.5x11

FIGURE 4.4 CONNECTOR POND HABITAT MAP IN JULY 2025



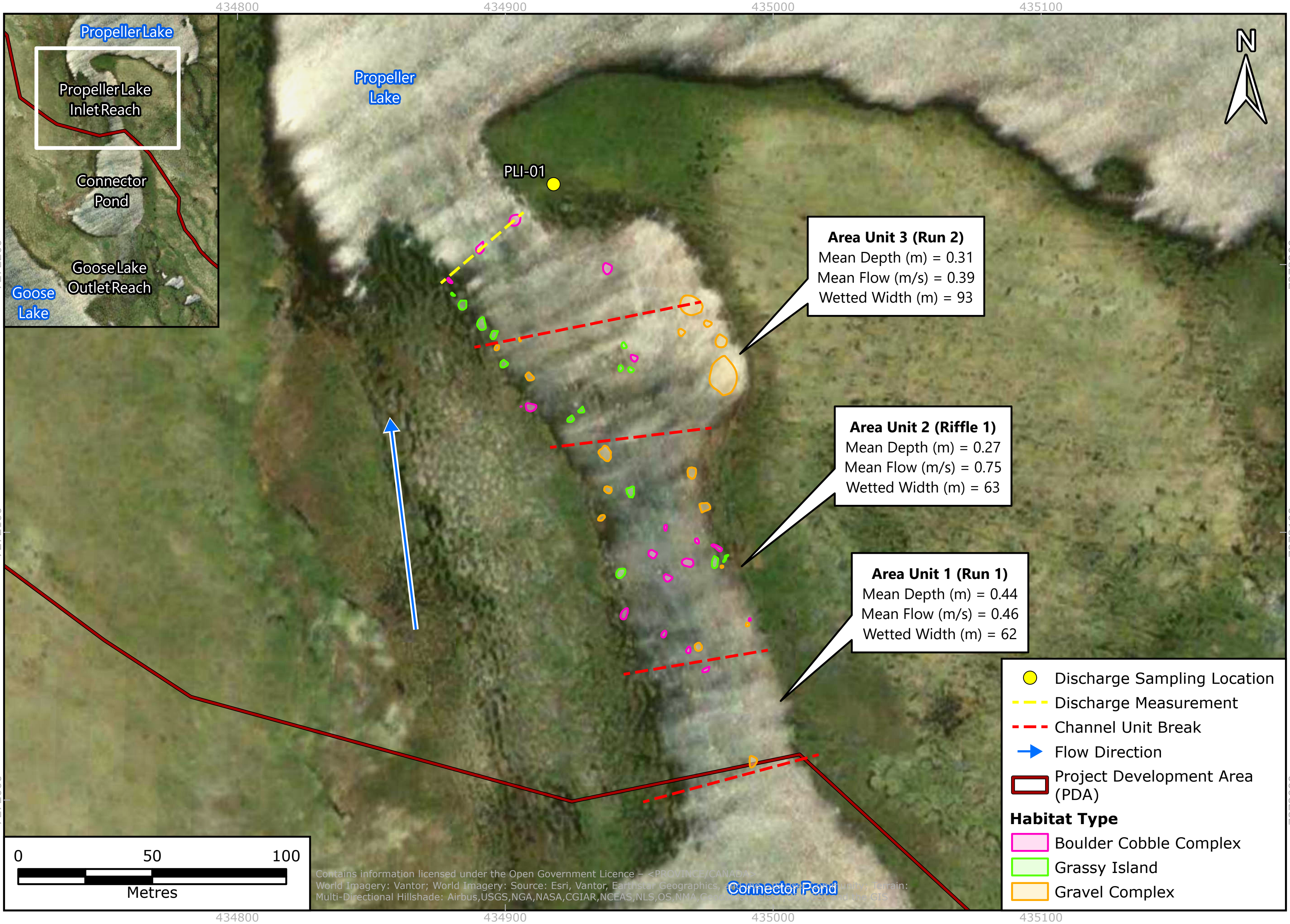
ERM

CLIENT: Client Name
GIS NUMBER: BAC-10-136-05

DATE: 12/17/2025

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:2,200 when printed at 8.5x11

FIGURE 4.5 PROPELLER LAKE INLET HABITAT MAP IN MAY 2025

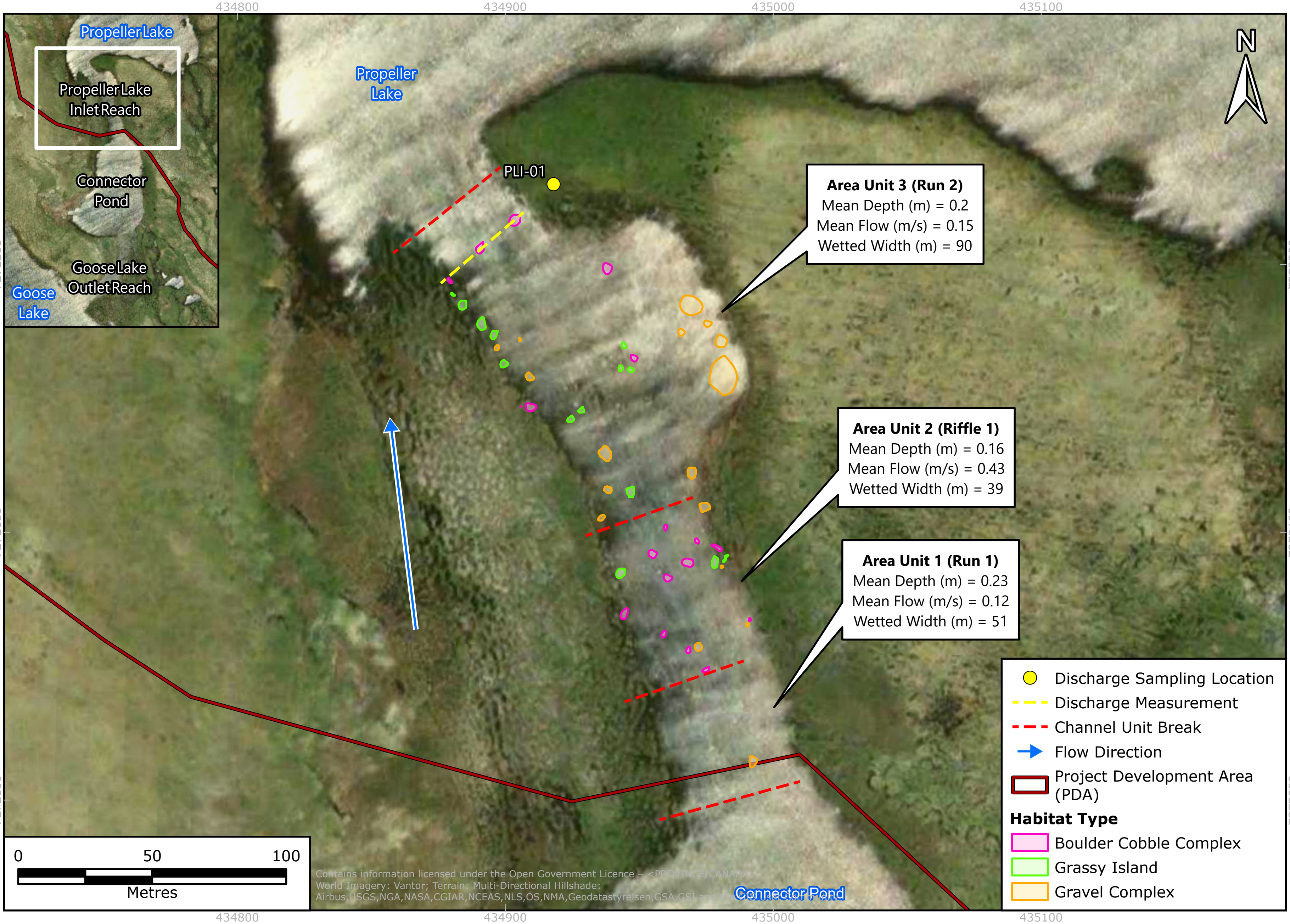


CLIENT: Client Name
GIS NUMBER: BAC-10-136-06

DATE: 12/17/2025

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:2,000 when printed at 8.5x11

FIGURE 4.6 PROPELLER LAKE INLET HABITAT MAP IN JULY 2025



ERM

CLIENT: Client Name
GIS NUMBER: BAC-10-136-07

DATE: 12/17/2025

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:2,000 when printed at 8.5x11

4.2 HYDROLOGICAL CONDITIONS

At GLO-01, discharge on May 30 was measured at 5.04 m^3/s, corresponding with elevated channel depths and velocities that enabled fully connected riffle–run sequences throughout the outlet (Table 4.2; Appendix A). By July 15, discharge had decreased to 0.88 m^3/s, representing an approximate 83% reduction from May conditions (Table 4.2; Appendix A). Despite this decline, flow remained continuous through all mapped habitat units, sustaining hydraulic connectivity to Connector Pond and maintaining shallow margin habitats used by newly emerged Arctic Grayling. Hydrological records from WSP (2025) indicate that ice-out occurred shortly before the late-May surveys and that peak freshet flows were reached just prior to sampling, confirming that all 2025 measurements represent post-freshet conditions.

At PLI-01, discharge similarly declined as the open-water season progressed. The May 31 measurement indicated a robust post-freshet flow of 8.24 m^3/s (Table 4.2; Appendix A). Flow had decreased to 0.94 m^3/s by July 16, a reduction of approximately 89% relative to May (Table 4.2; Appendix A). Although depths and velocities were lower, continuous flow persisted through the inlet, allowing YOY downstream movement into Propeller Lake and preserving rearing microhabitats in shallow channel margins.

Both reaches exceeded the 30% Mean Annual Discharge (MAD) threshold used in the Back River Project Fish Offsetting Plan (B2Gold Nunavut 2025) to evaluate minimum flow required to sustain fish passage and maintain YOY rearing habitat. This indicates that downstream habitat remained functional despite seasonal recession and operational water withdrawal. Timelapse and photos of GLO through the open water season are provided in Appendix B.

Overall, measured hydrological conditions in 2025 supports the prediction that water-withdrawal operations would not impair connectivity or reduce access to downstream Arctic Grayling habitat during sensitive life-stage periods.

TABLE 4.2: DISCHARGE AND CHANNEL HYDRAULIC MEASUREMENTS AT GOOSE LAKE OUTLET AND PROPELLER LAKE INLET (MAY AND JULY 2025)

Month	Station	Discharge (m^3/s)	Flow Area (m^2)	Mean Flow (m/s)	Top Width (m)	Max Depth (m)	Mean Depth (m)
May	GLO-01	5.04	16.4	0.29	50	0.58	0.32
	PLI-01	8.24	26.1	0.27	51	0.77	0.51
July	GLO-01	0.88	7.7	0.11	38	0.31	0.20
	PLI-01	0.94	11.6	0.08	32	0.53	0.36

4.3 WATER QUALITY

Water quality conditions generally reflected the expected seasonal progression from spring freshet to warmer mid-summer conditions. All areas recorded clear water during both field programs, with no observable turbidity and suspended sediment in the study reaches (Table 4.3).

4.3.1 GOOSE LAKE OUTLET

In May, water temperatures at the GLO ranged from 2.0 to 3.3°C, reflecting post–ice break-up conditions typical of early freshet. At the time of the survey, temperatures remained below those generally considered optimal for Arctic Grayling spawning (i.e., >4°C; Ford 1995). Dissolved oxygen (DO) levels were uniformly high (11.7–12.8 mg/L; 88–93% saturation), consistent with strong aeration in shallow riffle and run habitat. Conductivity values were low (32.6–35.3 µS/cm), typical of dilute arctic systems during freshet (Table 4.3).

By July, temperatures increased to 13.8–16.2°C, reflecting summer warming. Dissolved oxygen remained high enough to support of early rearing, ranging 9.2–10.9 mg/L (94–107% saturation). Conductivity increased to 51.7–59.7 µS/cm. pH values ranged from 7.1 to 8.0 (Table 4.3).

4.3.2 CONNECTOR POND

Connector Pond showed warmer conditions than the outlet channel in both periods. In May, temperature was 5.4°C and DO remained high (10.9 mg/L; 86% saturation). By July, temperature increased to 11.2°C, while DO declined to 7.0 mg/L (64% saturation). This reduction reflects reduced aeration and higher biological demand in lentic habitat as water levels dropped. Conductivity increased from 33.9 to 78.3 µS/cm (Table 4.3).

4.3.3 PROPELLER LAKE INLET

Propeller Lake Inlet provided similarly suitable aquatic conditions for spawning and early rearing. In May, temperatures were 3.9–4.3°C with DO concentrations of 12.2–12.6 mg/L (93–97% saturation). At the time of the survey, water temperatures were near conditions for spawning adult Arctic Grayling (greater than approximately 4°C). Conductivity ranged 30.7–35.1 µS/cm, again typical of dilute Arctic systems during freshet (Table 4.3).

By July, temperatures increased to 14.6–16.1°C and DO remained high (10.1–11.9 mg/L), reaching up to 117% saturation in shallow riffle areas. Conductivity also increased (63.1–65.2 µS/cm; Table 4.3). All observed values remained supportive of Arctic Grayling fry survival and foraging.

TABLE 4.3: WATER QUALITY CONDITIONS AT DOWNSTREAM MONITORING LOCATIONS DURING MAY AND JULY 2025

Month	Area	Area Unit	Water Quality						
			Clarity	Temp (°C)	pH	DO (mg/L)	DO (%)	Cond (µS/cm)	SPC (µS/cm)
May	GLO	1	Clear	3.3	-	11.7	87.7	32.6	55.5
		2	Clear	2.1	-	12.8	93.2	33.2	58.9
		3	Clear	2.2	-	12.5	91.0	33.5	59.3
		4	Clear	2.0	-	12.5	90.8	34.7	61.7
		5	Clear	2.1	-	12.5	90.8	35.3	62.9
	Connector Pond	1	Clear	5.4	-	10.9	86.3	33.9	54.1
	PLI	1	Clear	3.9	-	12.2	92.8	35.1	58.7
		2	Clear	4	-	12.5	95.6	30.7	51.3
		3	Clear	4.3	-	12.6	97.2	30.7	50.8
July	GLO	1	Clear	13.8	7.1	10.2	98.7	51.7	65.8
		2	Clear	14.5	8.0	10.9	107.4	56.7	71.0
		3	Clear	16.2	7.2	9.2	94.0	59.7	71.7
		4	Clear	15.1	7.9	10.2	101.5	58.1	71.6
		5	Clear	14.9	7.9	9.4	93.6	58.1	71.9
	Connector Pond	1	Clear	11.2	7.0	7.0	64.1	78.3	57.7
	PLI	1	Clear	15.9	7.6	10.1	103.8	6.0	65.1
		2	Clear	14.6	7.1	11.9	117.1	63.1	78.7
		3	Clear	16.1	6.9	11.6	112.3	65.2	78.6

Note: (-) indicates pH probe malfunction in May trip.

4.4 SPAWNING EVIDENCE, MAY EGG SURVEYS

4.4.1 GOOSE LAKE OUTLET

Kick-net substrate disturbance was conducted at multiple gravel-dominated riffle and run microhabitats in late May. No Arctic Grayling eggs or emergent fry were detected in any samples, despite the presence of habitat features consistent with documented spawning use in prior years (Table 4.4). Water temperatures were slightly below the minimum typically associated with Arctic Grayling spawning, suggesting that surveys may have been conducted early in the season, prior to the onset of spawning activity within the system.

4.4.2 CONNECTOR POND

No egg surveys were conducted in Connector Pond, consistent with its role as a rearing area and the absence of flowing, gravel-based hydraulics required to support Arctic Grayling spawning. Additionally, high water depths recorded during the May survey made the pond unsafe to wade, preventing the use of kick nets to disturb substrate to collect eggs (Table 4.4).

4.4.3 PROPELLER LAKE

Similar to GLO, kick-net sampling targeting gravel substrates revealed no Arctic Grayling eggs or fry in late May (Table 4.4). Physical habitat conditions were suitable for Grayling spawning. However, water temperatures were only slightly higher than minimum temperatures required for spawning and it is likely that surveys may have been conducted too early in the season, preceding spawning activity in the system.

4.5 JULY YOUNG-OF-YEAR ARCTIC GRAYLING OBSERVATIONS

4.5.1 GOOSE LAKE OUTLET

Young-of-Year (YOY) Arctic Grayling were observed in three of the five habitat units surveyed in July, with distribution concentrated in the central portion of the reach (Table 4.5; Photo 4.1). A total of 311 YOY and 28 juvenile Arctic Grayling were recorded across Units 2, 3, and 5, with the highest abundance in the mid-channel riffle (Unit 2; 198 YOY, 25 juveniles). Additional observations included 64 YOY in the adjacent run (Unit 3) and 49 YOY in the lower run (Unit 5), confirming active downstream movement and rearing throughout the reach. No YOY or juveniles were detected in Units 1 or 4, indicating reduced suitability for early-rearing conditions in those upstream areas. No other fish species were observed.

TABLE 4.4: EGG SURVEY FINDINGS ACROSS DOWNSTREAM HABITAT UNITS (GOOSE LAKE OUTLET AND PROPELLER LAKE INLET, MAY 2025).

Area	Area Unit	Habitat Type	UTM (Start)		UTM (End)		Egg Survey		
			Easting	Northing	Easting	Northing	Gravel Patches (#)	Mean Depth (m)	Egg Count
GLO	1	Run	434853	7271482	434891	7271493	4	0.42	0
	2	Riffle	434896	7271492	434950	7271560	0	-	-
	3	Run	434992	7271523	435003	7271534	0	-	-
	4	Riffle	424962	7271574	434978	7271589	0	-	-
	5	Run	434978	7271590	434978	7271590	7	0.24	0
Connector Pond	1	Pool	435052	7271678	435016	7272018	-	-	-
PLI	1	Run	435017	7272017	434995	7272072	3	0.40	0
	2	Riffle	434998	7272056	434975	7272133	6	0.24	0
	3	Run	434977	7272139	434973	7272185	10	0.27	0

PHOTO 4.1 YOUNG-OF-YEAR ARCTIC GRAYLING OBSERVED IN GOOSE LAKE OUTLET MICROHABITATS, JULY 2025

4.5.2 CONNECTOR POND

A total of 151 YOY and 2 juvenile Arctic Grayling were observed along the shallow margins of the pond (Table 4.5). Small-bodied species were also present, including two Ninespine Stickleback and four Slimy Sculpin, consistent with the pond's role as a stable nursery environment. The density and schooling behavior of YOY observed suggest that Connector Pond remains a primary rearing area following fry emergence and dispersal from GLO or PLI.

Snorkeling transects completed on July 16 provided additional confirmation of Arctic Grayling rearing use in deeper areas of the pond (Table 4.6). Across four transects totaling 642 m of coverage, three Arctic Grayling were observed (one juvenile, two YOY). Slimy Sculpin were also observed during the snorkel survey (three juveniles across two transects).

4.5.3 PROPELLER LAKE INLET

YOY Arctic Grayling were observed only within the lower-most run unit entering Propeller Lake (Table 4.5). Across the three inlet units surveyed, a total of 139 YOY and 3 juveniles were recorded in Unit 3, while no Grayling were detected in upstream Units 1 or 2. Sparse observations of other small-bodied species were limited to one Ninespine Stickleback in Unit 3.

TABLE 4.5: DOWNSTREAM FISH OBSERVATION RESULTS FOR GOOSE LAKE OUTLET, CONNECTOR POND, AND PROPELLER LAKE INLET (JULY 2025)

Area	Area Unit	Habitat Type	UTM (Start)		UTM (End)		Fish Observation			
			Easting	Northing	Easting	Northing	ARGY(YOY)	ARGY (Juv)	NSSB	SLSC
GLO	1	Run	434865	7271481	434900	7271489	0	0	0	0
	2	Riffle	434900	7271489	434978	7271548	198	25	0	0
	3	Run	434959	7271555	434970	7271566	64	2	0	0
	4	Riffle	434872	7271572	434989	7271585	0	0	0	0
	5	Run	434987	7271597	434989	7271663	49	1	0	0
Connector Pond	1	Pool	435044	7271681	435005	7272004	151	2	2	4
PLI	1	Run	435010	7272007	434989	7272052	0	0	0	0
	2	Riffle	434989	7272052	434970	7272113	0	0	0	0
	3	Run	434970	7272113	434898	7272235	139	3	1	0

Note: ARGY (YOY) denotes Arctic Grayling ≤50 mm; ARGY (Juv) denotes Arctic Grayling 51–100 mm. NSSB refers to Ninespine Stickleback and SLSC refers to Slimy Sculpin.

TABLE 4.6: SNORKELING FISH OBSERVATION RESULTS IN CONNECTOR POND (JULY 16, 2025)

Transect Number	Start UTM (13 W)		End UTM (13 W)		Time		Distance Covered (m)	Observations		
	Easting	Northing	Easting	Northing	Start	End		Species	No. Caught	Age Class
1	435042	7271692	435045	7271899	8:59	9:22	212	ARGY	1	Juv
2	435045	7271899	434927	7271906	9:23	9:26	80	SLSC	1	Juv
3	434045	7271906	434830	7271745	9:28	9:39	150	SLSC	2	Juv
4	434870	7271745	435045	7271899	9:42	9:52	200	ARGY	2	YOY

Note: Age class of YOY refer to fish > 50 mm; Juv refer to fish between 51 - 100 mm

4.6 HABITAT SUITABILITY INDEX EVALUATION

4.6.1 SPAWNING HABITAT SUITABILITY INDEX – MAY 2025

Spawning habitat suitability remained high in both downstream reaches during late-May post-freshet conditions (Table 4.7). Composite Habitat Suitability Index (HSI) scores were 0.95 at GLO-01 and PLI-01, reflecting a combination of optimal flow velocities (0.27–0.29 m/s), suitable depths for gravel-spawning (0.58–0.77 m), and strong dominance of gravel substrates—consistent with preferred Arctic Grayling spawning habitat. These results align closely with the baseline and Project-scenario HSI values reported by WSP (2024), which also characterized the GLO and PLI cross-sections as high-suitability spawning environments under natural seasonal flows. The 2025 observations demonstrate that hydraulic conditions necessary to support upstream migration, spawning, egg deposition, and incubation remained fully accessible under current water-withdrawal operations.

4.6.2 YOY REARING HABITAT SUITABILITY INDEX – JULY 2025

YOY rearing HSI scores, evaluated at the reach scale, were 0.40 for both GLO and PLI (Table 4.8). Velocity and depth conditions were strongly supportive of early rearing, with low-velocity (<0.20 m/s) shallow margins (0.31 – 0.53 m deep) dominating wetted habitat at both sites — consistent with preferred YOY habitat documented in the HSI literature (Larocque et al. 2014). Substrate composition also supported high suitability, with abundant cobble-gravel mixtures providing cover and foraging substrates.

The composite YOY rearing HSI values observed in July 2025 (0.40 at both GLO and PLI) are consistent with the range of baseline suitability reported by WSP (2024), which documented composite YOY HSI values of approximately 0.38 at the GLO Reach and 0.67 at the PLI. WSP (2024) attributed lower HSI values at the GLO primarily to geomorphic habitat classification rather than hydraulic or substrate limitations, noting that these values reflect typical downstream redistribution of YOY rather than constrained rearing conditions. Consistent with this interpretation, the July 2025 results fall within the normal range of baseline variability and do not indicate impaired YOY rearing suitability.

The dominant geomorphic habitat type (run) was the key factor reducing the composite HSI value. In the HSI scoring system, run units are conservatively assigned lower suitability values than riffles or off-channel rearing habitats. However, field observations indicated high abundance of YOY Grayling in run habitats (Table 4.5). In addition, YOY Grayling were observed at multiple contiguous units, indicating unhindered access and dispersal (Table 4.5). Furthermore, field observations found no evidence of disconnection or stranding risk. Taken together, these observations indicate that run-dominated habitat remained highly productive, despite the relatively low HSI scores calculated.

4.6.3 CONSISTENCY WITH PREDICTED OUTCOMES

The 2025 HSI findings are consistent with the predictions made in WSP (2024) and the Back River Project Offsetting Plan (B2Gold Nunavut, 2025). Composite spawning and rearing HSI scores remained within the range of baseline and Project-condition values previously modelled, indicating no measurable reduction in habitat suitability associated with operational water withdrawals (Tables 4.7 and 4.8). Habitat required to support both spawning and early rearing of Arctic Grayling remained fully accessible through post-emergence low-flow periods, with continuous hydraulic connectivity and abundant shallow rearing margins observed in both GLO and PLI.

In 2025, mean wetted width at GLO averaged 53.6 m in May and declined to 42.8 m in July across all habitat units, while at PLI, mean wetted width averaged 72.7 m in May and 60.0 m in July. These observed values align well with the wetted width ranges predicted by hydraulic modelling in WSP (2024). At GLO, modelled June wetted widths ranged from 53.5 to 71.0 m across baseline and Project scenarios, while modelled July values ranged from 25.2 to 41.4 m. Similarly, at PLI, modelled June wetted widths ranged from 57.6 to 65.4 m, and July values ranged from 50.5 to 56.1 m across scenarios. Overall, observed 2025 wetted widths fell within, or exceed the predicted ranges for both reaches, indicating that habitat availability during the monitoring period were consistent with modelled expectations under both baseline and Project conditions.

YOY observations in July provided evidence that spawning and early rearing habitat remained functional during water withdrawal operations in 2025. GLO supported the highest observed abundance, with 311 YOY and 28 juveniles concentrated in mid- and downstream habitat units. Connector Pond supported a minimum of 151 YOY and multiple small-bodied species along shallow margins. At PLI, early rearing Grayling presence was restricted to the lower run unit adjacent to Propeller Lake, where 139 YOY and 3 juveniles were observed.

These results corroborate the predictions that Arctic Grayling habitat would remain intact under approved withdrawal volumes and would continue to function effectively throughout sensitive life stages.

TABLE 4.7: ARCTIC GRAYLING SPAWNING HSI VARIABLE INPUTS AND SCORES FOR GLI AND PLI CROSS-SECTIONS (MAY 2025)

Cross-Section	Life Stage	HSI Variable Input (Score in Brackets)				Predicted Average Composite HSI		Predicted 10-year dry Composite HSI		2025 Composite HSI
		Average Flow Velocity (m/s)	Max Water Depth (m)	Dominant Substrate Type	Dominant Habitat Type	Baseline	Project	Baseline	Project	
GLO	Spawning	0.29 (1)	0.58 (1)	Gravel (1)	Run (0.8)	0.95	0.95	0.95	0.95	0.95
PLI	Spawning	0.27 (1)	0.77 (1)	Gravel (1)	Run (0.8)	0.81	0.79	0.75	0.66	0.95

TABLE 4.8: ARCTIC GRAYLING YOY HSI VARIABLE INPUTS AND SCORES FOR GLO AND PLI CROSS-SECTIONS (JULY 2025)

Cross-Section	Life Stage	HSI Variable Input (Score in Brackets)					Predicted Average Composite HSI		Predicted 10-year dry Composite HSI		2025 Composite HSI
		Average Flow Velocity (m/s)	Max Water Depth (m)	Dominant Substrate Type	Dominant Habitat Type	Dominant Fish Cover	Baseline	Project	Baseline	Project	
GLO	YOY	0.11 (1)	0.31 (1)	Gravel (1)	Run (0.01)	Boulder (1)	0.38	0.38	0.38	0.38	0.4
PLI	YOY	0.08 (1)	0.53 (1)	Gravel (1)	Run (0.01)	Boulder (1)	0.67	0.67	0.67	0.67	0.4

5. SUMMARY

The 2025 Goose Lake Downstream Fish and Fish Habitat Monitoring Program was completed in late May and mid-July to evaluate hydrology, habitat conditions, and early-rearing Arctic Grayling use within the GLO, Connector Pond, and PLI. The program was implemented in accordance with the amended *Fisheries Act* Authorization (FAA; Condition 3.2.3) and Section 4.7 of the Back River Project Fish Offsetting Plan and fulfills the associated monitoring and reporting requirements for water withdrawals from Goose Lake. These watercourses provide the primary downstream pathway from Goose Lake and contain spawning and nursery habitats that have the potential to be influenced by seasonal water withdrawal. Field methods included habitat mapping, hydrological measurements, spawning surveys, shoreline YOY counts, snorkeling in deeper areas of Connector Pond, and supporting water quality monitoring.

Across both survey periods, GLO and PLI maintained connected riffle–run habitats with coarse substrates suitable for Arctic Grayling spawning and fry emergence. Discharge at GLO declined by 83% from May to July, while PLI declined by 89% from May to July. These seasonal declines are consistent with natural post-freshet recession and fell within the modelled range of Project-affected flows described in WSP (2024). Water quality remained suitable for incubation, emergence, and early rearing across all monitored locations.

No Arctic Grayling eggs were observed at either spawning reach during kick-net surveys in late May, which may reflect survey timing relative to local ice break-up or a shift in the spatial distribution of spawning activity in 2025. However, YOY observations in July confirmed successful spawning and recruitment within the system. Goose Lake Outlet supported the highest observed abundance, with 311 YOY and 28 juveniles concentrated in mid- and downstream habitat units. Connector Pond functioned as an important nursery environment, supporting 151 YOY and multiple small-bodied species along shallow margins, further validated by snorkeling surveys that confirmed use of deeper littoral areas. At PLI, early-rearing Grayling presence was restricted to the lower run unit adjacent to Propeller Lake, where 139 YOY and 3 juveniles were observed.

Habitat Suitability Index (HSI) analysis corroborated these findings. Spawning HSI values remained high (0.95 at both GLO-01 and PLI-01), confirming that gravel-dominated substrates, favourable velocities, and suitable depths persisted under spring flow conditions. YOY rearing HSI scores for both reaches (0.40) reflect a conservative scoring outcome driven by the dominance of run habitat. However, field observations confirmed a strong presence of Arctic Grayling YOY, indicating that these habitats remained functional during early rearing. This pattern is consistent with WSP (2024), which attributed lower YOY HSI values to geomorphic habitat classification rather than hydraulic or substrate limitations, and did not identify these values as indicative of impaired rearing conditions. All HSI results remained within the expected range of natural conditions (WSP 2024), validating predictions that 2025 water withdrawals would not measurably alter spawning or rearing suitability.

Both reaches exceeded the 30% Mean Annual Discharge (MAD) threshold used in the Back River Project Fish Offsetting Plan (B2Gold Nunavut 2025) at the time of the surveys, confirming that minimum flows were sustained for spawning and rearing habitat. Additional details on flows through the open water period are summarized in the WSP companion report. Flow monitoring confirmed that downstream habitat remained functional despite seasonal recession and operational water withdrawal.

Collectively, the 2025 monitoring results confirm that the Goose Lake downstream system continues to support key life stages of Arctic Grayling through mid-summer despite natural declines in flow. No adverse effects on downstream fish habitat suitability were observed under current water-withdrawal operations.

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APPENDIX A: DISCHARGE DATA 2025

TABLE 1: GOOSE LAKE OUTLET, MAY 30 2025

No.	Distance from right bank (m)	Depth (m)	Flow (m/s)	Area of each Segment (m^2)	Discharge of each Segment (m^3/s)
1	1	0.23	0.105	0.23	0.02415
2	2	0.23	0.0314	0.23	0.007222
3	3	0.56	0.0776	0.56	0.043456
4	4	0.3	0.374	0.3	0.1122
5	5	0.45	0.385	0.45	0.17325
6	6	0.5	0.346	0.5	0.173
7	7	0.44	0.398	0.44	0.17512
8	8	0.38	0.335	0.38	0.1273
9	9	0.42	0.374	0.42	0.15708
10	10	0.44	0.365	0.44	0.1606
11	11	0.46	0.475	0.46	0.2185
12	12	0.58	0.451	0.58	0.26158
13	13	0.57	0.303	0.57	0.17271
14	14	0.35	0.336	0.35	0.1176
15	15	0.42	0.368	0.42	0.15456
16	16	0.41	0.340	0.41	0.1394
17	17	0.36	0.431	0.36	0.15516
18	18	0.39	0.360	0.39	0.1404
19	19	0.44	0.453	0.44	0.19932
20	20	0.31	0.277	0.31	0.08587
21	21	0.4	0.253	0.4	0.1012
22	22	0.44	0.234	0.44	0.10296
23	23	0.33	0.288	0.33	0.09504
24	24	0.32	0.404	0.32	0.12928
25	25	0.23	0.478	0.23	0.10994
26	26	0.25	0.469	0.25	0.11725
27	27	0.4	0.407	0.4	0.1628
28	28	0.35	0.378	0.35	0.1323

No.	Distance from right bank (m)	Depth (m)	Flow (m/s)	Area of each Segment (m^2)	Discharge of each Segment (m^3/s)
29	29	0.26	0.314	0.26	0.08164
30	30	0.25	0.433	0.25	0.10825
31	31	0.36	0.298	0.36	0.10728
32	32	0.31	0.471	0.31	0.14601
33	33	0.26	0.486	0.26	0.12636
34	34	0.28	0.280	0.28	0.0784
35	35	0.25	0.410	0.25	0.1025
36	36	0.31	0.178	0.31	0.05518
37	37	0.21	0.439	0.21	0.09219
38	38	0.28	0.279	0.28	0.07812
39	39	0.15	0.202	0.15	0.0303
40	40	0.18	0.200	0.18	0.036
41	41	0.32	0.192	0.32	0.06144
42	42	0.14	0.201	0.14	0.02814
43	43	0.21	0.082	0.21	0.01722
44	44	0.2	0.142	0.2	0.0284
45	45	0.3	0.112	0.3	0.0336
46	46	0.24	0.151	0.24	0.03624
47	47	0.3	0.095	0.3	0.0285
48	48	0.12	0.067	0.12	0.00804
49	49	0.15	0.015	0.15	0.00225
50	50	0.1	0.031	0.1	0.0031
Total discharge (m^3/s)			5.038408		

Area of each segment = distance of each segment * depth
Discharge of each segment = flow * area
Total discharge = sum of the discharge of each segment
UTM start: 434868E 7271481N, end 434890E 7271431N

TABLE 2: PROPPERLLER INLET, MAY 31 2025

No.	Distance from left bank (m)	Depth (m)	Flow (m/s)	Area of each Segment (m2)	Discharge of each Segment (m^3/s)
1	1	0.12	0.0095	0.12	0.00114
2	2	0.14	0.021	0.14	0.00294
3	3	0.15	0.0361	0.15	0.005415
4	4	0.23	0.105	0.23	0.02415
5	5	0.32	0.174	0.32	0.05568
6	6	0.34	0.286	0.34	0.09724
7	7	0.46	0.158	0.46	0.07268
8	8	0.62	0.271	0.62	0.16802
9	9	0.45	0.266	0.45	0.1197
10	10	0.48	0.269	0.48	0.12912
11	11	0.57	0.315	0.57	0.17955
12	12	0.71	0.192	0.71	0.13632
13	13	0.58	0.344	0.58	0.19952
14	14	0.6	0.452	0.6	0.2712
15	15	0.72	0.301	0.72	0.21672
16	16	0.64	0.350	0.64	0.224
17	17	0.53	0.369	0.53	0.19557
18	18	0.57	0.300	0.57	0.171
19	19	0.67	0.371	0.67	0.24857
20	20	0.74	0.251	0.74	0.18574
21	21	0.75	0.459	0.75	0.34425
22	22	0.69	0.344	0.69	0.23736
23	23	0.67	0.479	0.67	0.32093
24	24	0.65	0.424	0.65	0.2756
25	25	0.67	0.339	0.67	0.22713
26	26	0.72	0.411	0.72	0.29592
27	27	0.75	0.374	0.75	0.2805
28	28	0.77	0.369	0.77	0.28413

No.	Distance from left bank (m)	Depth (m)	Flow (m/s)	Area of each Segment (m2)	Discharge of each Segment (m^3/s)
29	29	0.7	0.382	0.7	0.2674
30	30	0.69	0.424	0.69	0.29256
31	31	0.61	0.384	0.61	0.23424
32	32	0.63	0.391	0.63	0.24633
33	33	0.64	0.383	0.64	0.24512
34	34	0.61	0.482	0.61	0.29402
35	35	0.56	0.471	0.56	0.26376
36	36	0.55	0.363	0.55	0.19965
37	37	0.59	0.416	0.59	0.24544
38	38	0.52	0.290	0.52	0.1508
39	39	0.52	0.295	0.52	0.1534
40	40	0.54	0.237	0.54	0.12798
41	41	0.5	0.267	0.5	0.1335
42	42	0.36	0.135	0.36	0.0486
43	43	0.31	0.383	0.31	0.11873
44	44	0.51	0.357	0.51	0.18207
45	45	0.4	0.0924	0.4	0.03696
46	46	0.18	0.0016	0.18	0.000288
47	47	0.37	0.0172	0.37	0.006364
48	48	0.24	0.055	0.24	0.0132
49	49	0.27	0.0297	0.27	0.008019
50	50	0.36	0.0169	0.36	0.006084
51	51	0.09	0.0001	0.09	0.000009
Total discharge (m3/s)			8.244619		

Area of each segment = distance of each segment * depth
Discharge of each segment = flow * area
Total discharge = sum of the discharge of each segment
UTM start: 434918E 7272230N, end 434874E 7272190N

TABLE 3: GOOSE LAKE OUTLET, JULY 15 2025

No.	Distance from right bank (m)	Depth (m)	Flow (m/s)	Area of each Segment (m^2)	Discharge of each Segment (m^3/s)
1	1	0.31	0.1326	0.31	0.041106
2	2	0.31	0.1688	0.31	0.052328
3	3	0.31	0.1638	0.31	0.050778
4	4	0.27	0.1084	0.27	0.029268
5	5	0.26	0.1519	0.26	0.039494
6	6	0.26	0.16	0.26	0.0416
7	7	0.25	0.16	0.25	0.04
8	8	0.19	0.1154	0.19	0.021926
9	9	0.24	0.1852	0.24	0.044448
10	10	0.28	0.1135	0.28	0.03178
11	11	0.26	0.1472	0.26	0.038272
12	12	0.24	0.1272	0.24	0.030528
13	13	0.21	0.1304	0.21	0.027384
14	14	0.14	0.1313	0.14	0.018382
15	15	0.17	0.1438	0.17	0.024446
16	16	0.16	0.1103	0.16	0.017648
17	17	0.16	0.0887	0.16	0.014192
18	18	0.24	0.112	0.24	0.026976
19	19	0.21	0.1067	0.21	0.022407
20	20	0.15	0.0816	0.15	0.01224
21	21	0.22	0.1495	0.22	0.03289
22	22	0.2	0.1272	0.2	0.02544
23	23	0.13	0.0814	0.13	0.010582
24	24	0.27	0.0837	0.27	0.022599
25	25	0.2	0.0653	0.2	0.01306
26	26	0.17	0.0859	0.17	0.014603
27	27	0.27	0.1114	0.27	0.030078
28	28	0.27	0.085	0.27	0.02295

No.	Distance from right bank (m)	Depth (m)	Flow (m/s)	Area of each Segment (m^2)	Discharge of each Segment (m^3/s)
29	29	0.12	0.0589	0.12	0.007068
30	30	0.11	0.0859	0.11	0.009449
31	31	0.11	0.0743	0.11	0.008173
32	32	0.27	0.0818	0.27	0.022086
33	33	0.15	0.0488	0.15	0.00732
34	34	0.12	0.0249	0.12	0.002988
35	35	0.14	0.0542	0.14	0.007588
36	36	0.12	0.0415	0.12	0.00498
37	37	0.1	0.0497	0.1	0.00497
38	38	0.15	0.050	0.15	0.007515
Total discharge (m^3/s)					0.879542

Area of each segment = distance of each segment * depth
Discharge of each segment = flow * area
Total discharge = sum of the discharge of each segment
UTM start: 434868E 7271481N, end 434890E 7271431N

TABLE 4: PROPELLER INLET, JULY 16 2026

No.	Distance from left bank (m)	Depth (m)	Flow (m/s)	Area of each Segment (m^2)	Discharge of each Segment (m^3/s)
1	1	0.3	0.0177	0.3	0.00531
2	2	0.22	0.0715	0.22	0.01573
3	3	0.29	0.0607	0.29	0.017603
4	4	0.2	0.0566	0.2	0.01132
5	5	0.43	0.0459	0.43	0.019737
6	6	0.3	0.0623	0.3	0.01869
7	7	0.29	0.0699	0.29	0.020271
8	8	0.41	0.08656	0.41	0.0354896
9	9	0.35	0.1072	0.35	0.03752
10	10	0.53	0.1015	0.53	0.053795
11	11	0.45	0.0425	0.45	0.019125
12	12	0.46	0.0716	0.46	0.032936
13	13	0.4	0.071	0.4	0.0284
14	14	0.39	0.1215	0.39	0.047385
15	15	0.4	0.0756	0.4	0.03024
16	16	0.39	0.103	0.39	0.040209
17	17	0.43	0.1033	0.43	0.044419
18	18	0.43	0.105	0.43	0.045279
19	19	0.49	0.1081	0.49	0.052969
20	20	0.44	0.0841	0.44	0.037004
21	21	0.45	0.0898	0.45	0.04041
22	22	0.42	0.0725	0.42	0.03045
23	23	0.41	0.0604	0.41	0.024764
24	24	0.38	0.0857	0.38	0.032566
25	25	0.35	0.0804	0.35	0.02814
26	26	0.39	0.0562	0.39	0.021918
27	27	0.38	0.0986	0.38	0.037468
28	28	0.32	0.073	0.32	0.02336

No.	Distance from left bank (m)	Depth (m)	Flow (m/s)	Area of each Segment (m^2)	Discharge of each Segment (m^3/s)
29	29	0.26	0.1075	0.26	0.02795
30	30	0.22	0.0989	0.22	0.021758
31	31	0.22	0.1045	0.22	0.02299
32	32	0.22	0.0556	0.22	0.012232
Total discharge (m^3/s)					0.9374376

Area of each segment = distance of each segment * depth
Discharge of each segment = flow * area
Total discharge = sum of the discharge of each segment
UTM start: 434918E 7272230N, end 434874E 7272190

APPENDIX B: GLO WILDLIFE CAMERA PHOTOGRAPHS AND TIMELAPSE

PHOTO 1: 2025-06-09

PHOTO 2: 2025-07-01

PHOTO 3: 2025-07-15

PHOTO 4: 2025-08-01

PHOTO 5: 2025-08-15