Little Atlin Lake Pike Habitat Mapping and Water Temperature Monitoring

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EXECUTIVE SUMMARY

EDI Environmental Dynamics, in partnership with the Carcross/Tagish Renewable Resources Council, initiated a fish habitat monitoring program on Little Atlin Lake during 2023. The monitoring program included establishing water temperature monitoring and mapping northern pike habitat in Little Atlin Lake. The work conducted during 2023 will help to inform future fish population monitoring and management efforts on the lake.

Offshore submerged temperature moorings were deployed in both the northern (main) and southern basins of Little Atlin Lake in March 2023. The moorings remain deployed and will continue to collect continuous water temperature data until downloaded.

Northern pike habitat mapping fieldwork was completed in August 2023 during the peak of the summer growing season. Mapping was completed to identify summer rearing and spring spawning habitat extents and locations on the lake. The methods used for the mapping involved aquatic vegetation transects, point of interest investigations, and mini drone aerial photographs to classify vegetation communities and presumed habitat associations present in Little Atlin Lake. Areas that represent habitat for different life stages of northern pike in Little Atlin Lake were then mapped, using information collected in the field.

ACKNOWLEDGEMENTS

This project was managed by Andrew Serack (Executive Director) of the Carcross/Tagish Renewable Resources Council. Don Toews (RRC Chair) along with Cameron Sinclair (Government of Yukon, Senior Fisheries Biologist) provided valuable information on project direction and objectives. This project was completed within the Traditional Territory of the Carcross/Tagish First Nation (C/TFN) and the Taku River Tlingit First Nation.

AUTHORSHIP

Team members from EDI Environmental Dynamics Inc. who contributed to preparing this report include:

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EDI personnel involved in the fieldwork component of the project included: Joel MacFabe (water temperature moorings), Jonathan Lowey and Denny Bohmer (habitat mapping). Tyler Obediah (C/TFN) also assisted with the water temperature mooring deployment component of the project.

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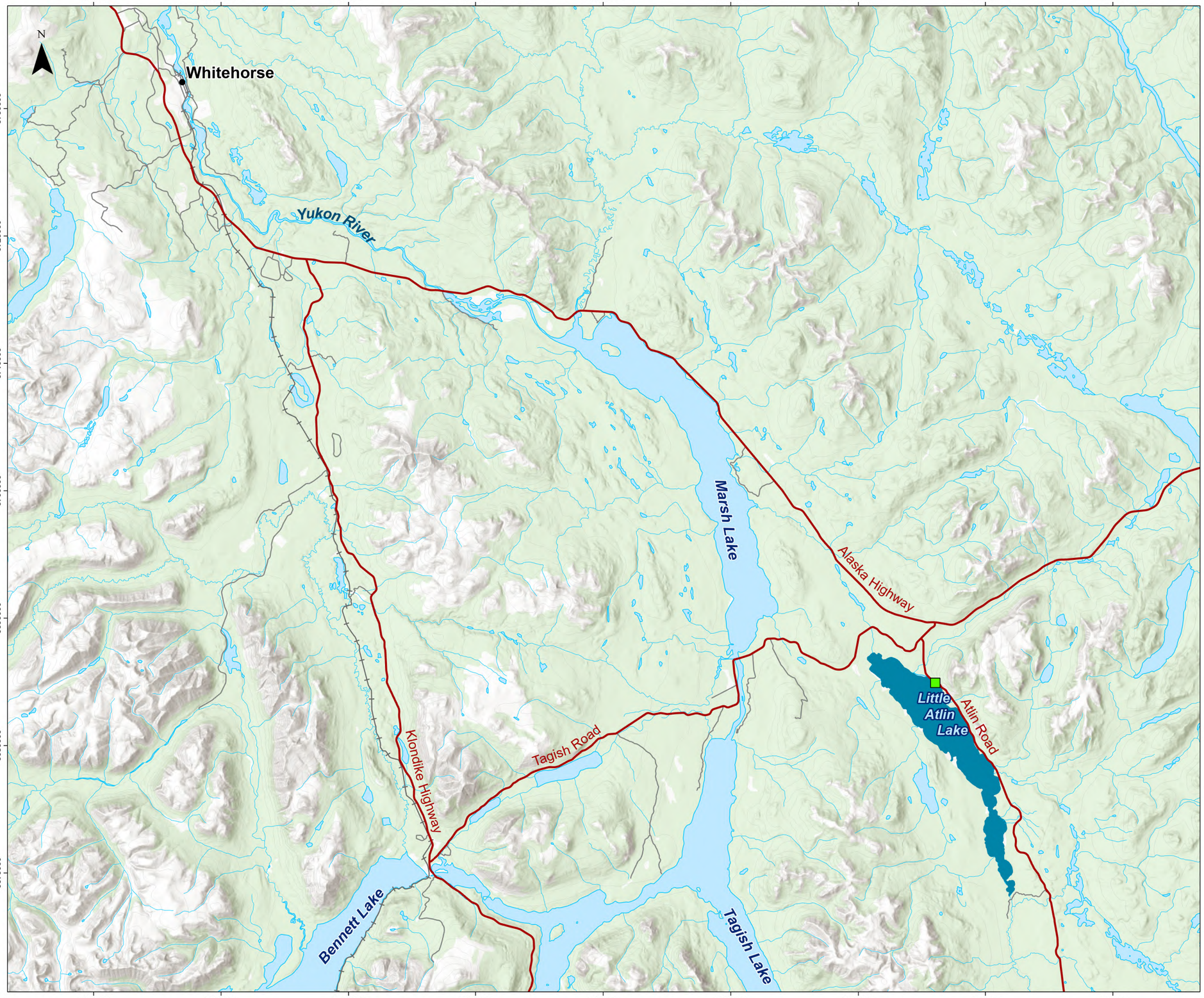
1 INTRODUCTION

Little Atlin Lake is located in the south-central Yukon approximately 92 kilometers to the south-east of Whitehorse, Yukon (Map 1) and within the Traditional Territory of the Carcross/Tagish First Nation (C/TFN) and the Taku River Tlingit First Nation (TRTFN). Little Atlin lake is a popular location for recreational fishing given its proximity to communities and its relatively easy access, with northern pike (*Esox lucius*), lake whitefish (*Coregonus clupeaformis*), and lake trout (*Salvelinus namaycush*) being the most sought-after species. Little Atlin lake is recognized as a high-quality northern pike fishery that, due to its proximity to Whitehorse, can receive a high amount of fishing pressure from local anglers. Concerns have been raised in recent years regarding the sustainability of the pike fishery and status of the population amid broader concerns about the potential effects of catch and release of large pike on the lake.

The current project was developed collaboratively by EDI, the Carcross/Tagish Renewable Resources Council (C/TRRC) and Government of Yukon in order to help inform future fish population surveys on Little Atlin Lake and to inform future management efforts. The 2023 project involved two primary components: water temperature monitoring, and northern pike habitat mapping. The water temperature monitoring was included in order to help determine the extent of suitable summer habitat for lake trout which may be limited in the lake to relatively warm summer water temperatures. The northern pike habitat mapping component was included to help inform future pike population assessment on the lake and to provide a benchmark of current habitat conditions for future comparisons in combination with population status information.

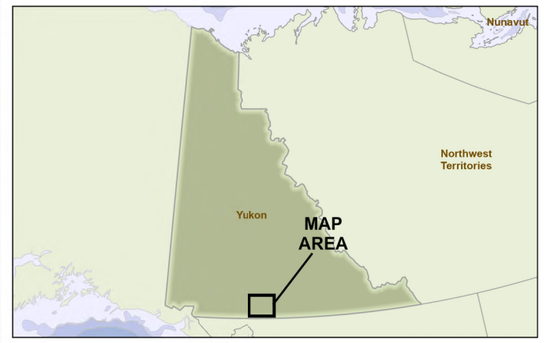
A number of fish species are known to be present in Little Atlin Lake including lake trout, northern pike, lake whitefish, round whitefish (*Prosopium cylindraceum*), Arctic grayling (*Thymallus arcticus*), longnose sucker (*Catostomus catostomus*), burbot (*Lota lota*), and slimy sculpin (*Cottus cognatus*) (Fisheries and Oceans Canada 2024).

Little Atlin Lake
Overview Map



Legend

- Boat Launch
- Highway
- Road
- Rail
- Watercourse
- Waterbody
- Little Atlin Lake



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Map Scale = 1:300,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 8N

Data Sources
• Main Basemap. Digital Road Atlas and Canvec 250K and World Hillshade: Esri, USGS

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to verify this map is free of errors. Data have been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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2 METHODS

2.1 WATER QUALITY MONITORING

Water quality monitoring was initiated on March 20, 2023, to investigate overwinter water quality and monitor summer conditions and turnover in Little Atlin Lake. Water quality data is being monitored to gain insight into fish species habitat availability in Little Atlin Lake, particularly the availability of summer habitat availability for lake trout.

2.1.1 TEMPERATURE MOORINGS

Temperature moorings were deployed to monitor seasonal trends in water temperature across a range of depths in Little Atlin Lake. Offshore water temperature moorings were installed in two locations in Little Atlin Lake in March 2023 and were programmed to collect hourly water temperatures (Table 1; Map 2).

Each mooring consists of a 47 lb weight attached to a mainline constructed of 0.65 cm diameter Amsteel braided line. Two sealed plastic floats, each 0.28 m in diameter were affixed to the top of the mooring to provide flotation and keep the mooring in a vertical upright position. Hobo Tidbit V2® temperature loggers were affixed at 4.0 m intervals along the length of the mainline. Moorings were constructed so that the floats would sit below the bottom surface of the ice and 2.0 m below the surface of the water so as to not interfere with recreational boaters.

Table 1. Little Atlin Lake offshore water temperature mooring site details.

Site	Location (Decimal Degrees)	Area	Number of Loggers	Deployment Depth	Data Collection Period
LA-1	60.272213, -133.993333	northern basin	11	41.8	May 20, 2023, to *current*
LA-2	60.189895, -133.900498	southern basin	4	16.7	May 20, 2023, to *current*

2.1.2 DISSOLVED OXYGEN TEMPERATURE PROFILES

A dissolved oxygen–water temperature profile was collected at both basin monitoring sites (LA-1 & LA-2) during temperature mooring deployment to investigate overwinter levels of dissolved oxygen and temperature. In situ dissolved oxygen and water temperature were collected using a YSI ProODO water quality multimeter. Measurements were collected from the water/ice surface to just above the lakebed at 1.0 m intervals. Results were graphed to discern if anoxic conditions were occurring in Little Atlin Lake.

2.1.3 IN SITU WATER QUALITY

In situ water quality was collected alongside pike habitat mapping fieldwork. Water quality measurements were collected using a YSI ProPlus multimeter and an Oakton T-100 turbidity meter. Water quality parameters collected during summer pike habitat mapping fieldwork included surface water temperature, dissolved oxygen, specific conductivity, and turbidity.

2.2 NORTHERN PIKE HABITAT MAPPING

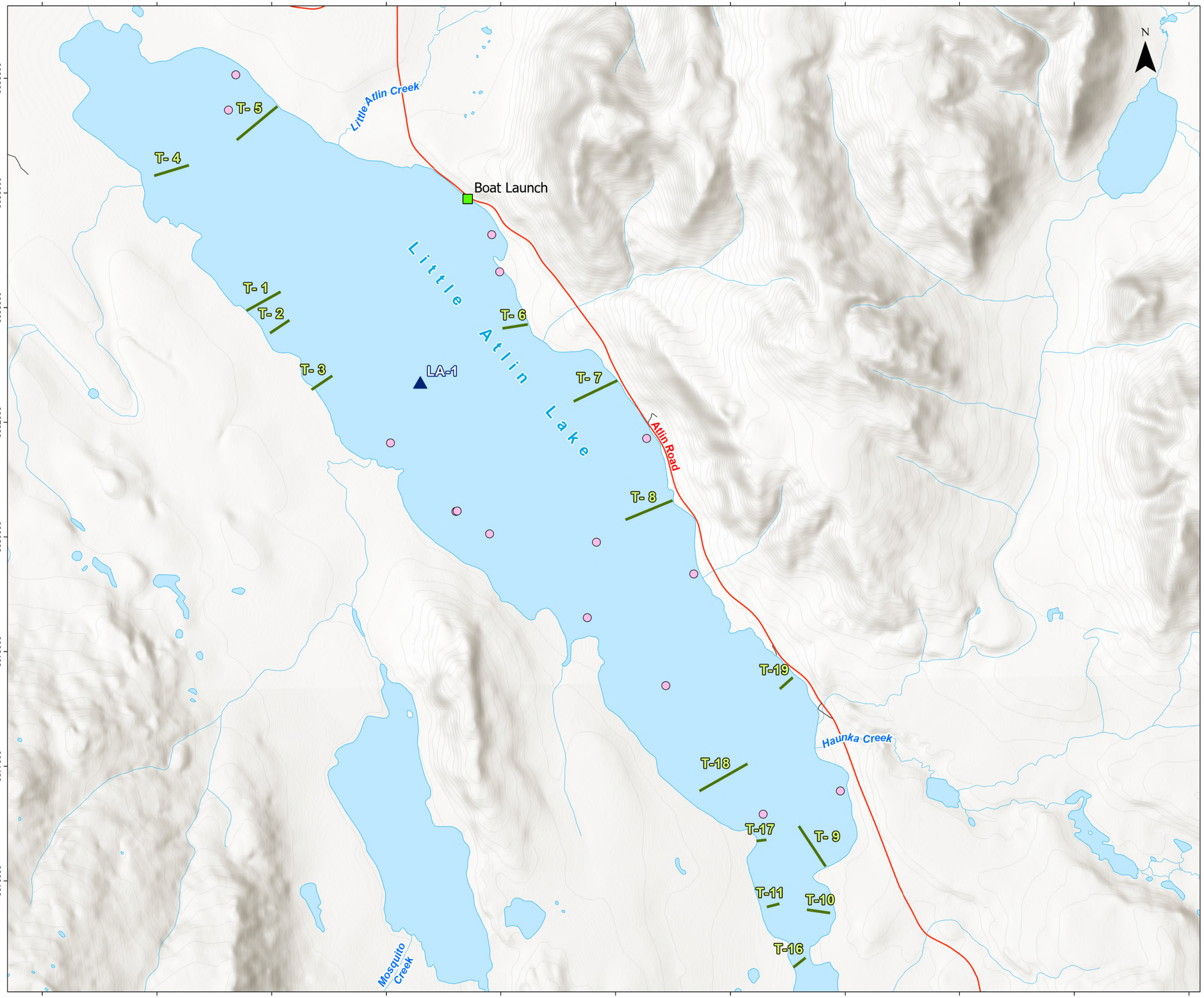
Summer northern pike habitat mapping fieldwork focused on mapping juvenile and adult rearing and probable pike spawning habitat in Little Atlin Lake. Northern pike habitat mapping fieldwork was completed over five days from August 24 to 28, 2023. Habitat mapping was completed from a boat by conducting a series of transects from shore perpendicular to the shoreline out into the deeper open water. During transects crews stopped regularly to investigate changes in depth and vegetation community composition. Depth measurements were collected with a Garmin ECHOMAP sonar and transducer. Vegetation communities were directly observed where possible and were otherwise sampled and investigated using a modified vegetation rake (Photo 1). Lakebed substrate was sampled along transects using an Eckman grab sampler which also collected some vegetation samples. Transects were generally concluded when vegetation was no longer encountered with the vegetation rake or Eckman grab sampler. Vegetation percent cover and species composition was estimated by viewing vegetation associations from a boat and inferring composition using the results of vegetation rake sampling.

Photo 1. Modified 'vegetation rake' for sampling aquatic vegetation in Little Atlin Lake (August 26, 2023).

Aquatic vegetation was identified to species where possible and common plant community associations were grouped together into broad habitat types to map pike habitat for Little Atlin Lake through the sampling of 19 vegetation transects throughout the lake (Map 2, Map 3). Vegetation transects were spaced to sample a variety of shoreline areas and habitat types present and were generally evenly spaced around the perimeter of the lake to maximize pike habitat mapping applicability. A number of separate points of interest (POIs, n=30) were also investigated. Points of interest were investigated to supplement vegetation transect data collection, provide a rapid assessment of habitat types, and confirm assumptions of vegetation communities likely to be encountered given the patterns observed from vegetation surveys and transects.

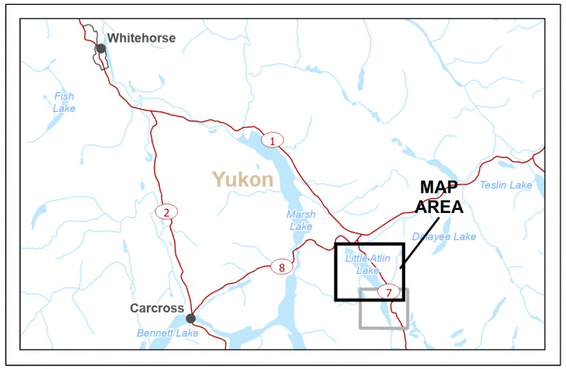
Transect data was incorporated with bathymetry data (provided by Government of Yukon) to map habitat types. Site photos were collected of shoreline, vegetation and substrate samples at each transect location. A Mavic mini drone was used to collect aerial images at a number of transect locations to aid habitat mapping.

Little Atlin Lake northern pike habitat mapping and water quality monitoring locations (north basin)



Legend

- Basin Monitoring Location
- Points of Interest
- Aquatic Vegetation Transect
- Primary Road
- Secondary Road
- Watercourse
- Waterbody



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Map Projection: NAD 1983 UTM Zone 8N

Data Sources
• Main Basemap. Canvec 50K and World Hillshade: Esri, USGS, FEMA

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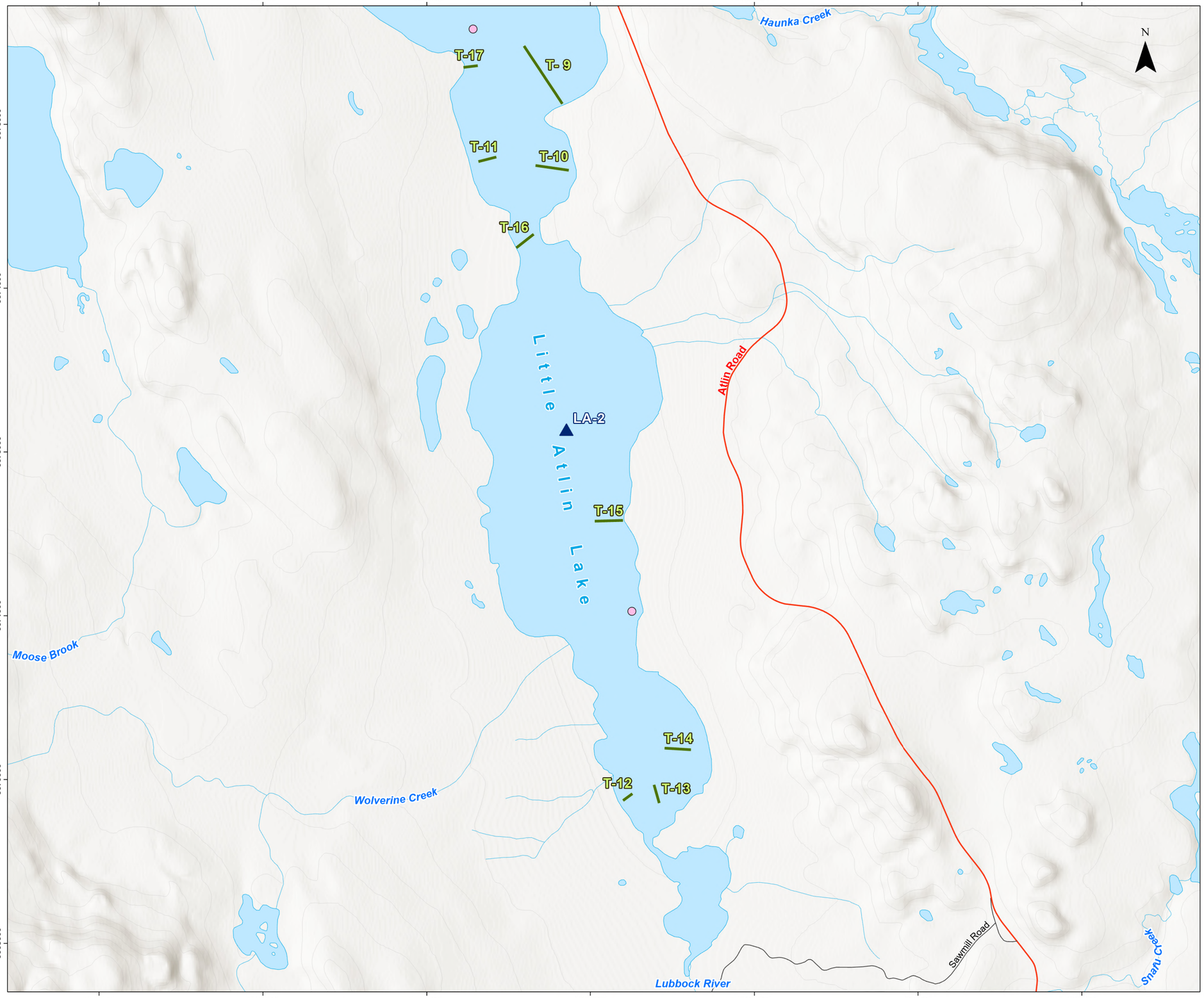
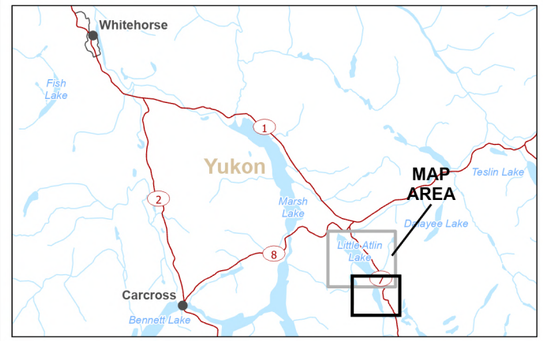
Little Atlin Lake northern pike habitat mapping and water quality monitoring locations (south basin)



Legend

- Basin Monitoring Location
- Points of Interest
- Aquatic Vegetation Transect
- Primary Road
- Secondary Road
- Watercourse
- Waterbody



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Data Sources
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3 RESULTS

3.1 WATER QUALITY MONITORING

3.1.1 TEMPERATURE MOORINGS

Water temperature moorings remain deployed in Little Atlin Lake and at the time this report was prepared, have not yet been retreived. The temperature loggers (Hobo Tidbit V2®) are typically able to record data for more than one season (up to 3+ years, depending on logging frequency). The temperature moorings should be retrieved in the summer or winter of 2024/2025. Moorings could then be re-deployed with new loggers, but the existing loggers should be downloaded to safeguard against recorded data becoming lost and/or corrupted.

3.1.2 DISSOLVED OXYGEN TEMPERATURE PROFILES

Dissolved oxygen and water temperature profiles collected on March 20, 2023, indicated that the water quality in Little Atlin lake was sufficient in both the northern and southern basins to support a diverse fish assemblage (Figure 1 and Figure 2). Levels of dissolved oxygen in the northern basin started to become slightly anoxic beyond 32 meters depth (Figure 1). In the southern basin levels of dissolved oxygen were above 6.0 mg/L throughout the entire water column (Figure 2). Overall measurements of dissolved oxygen indicate overwintering conditions in Little Atlin Lake are sufficient to support a diverse fish assemblage and are above CCME guidelines (CCME Canadian Council of Ministers of the Environment 1999). These results suggest that although some areas of Little Atlin Lake support extensive vegetation growth during the open water season this does not necessarily translate to anoxic overwinter conditions in the main body of Little Atlin Lake. This assessment did not consider shallow littoral areas of the lake which may be more susceptible to anoxic winter conditions as a result of aquatic vegetation die-off and decomposition.

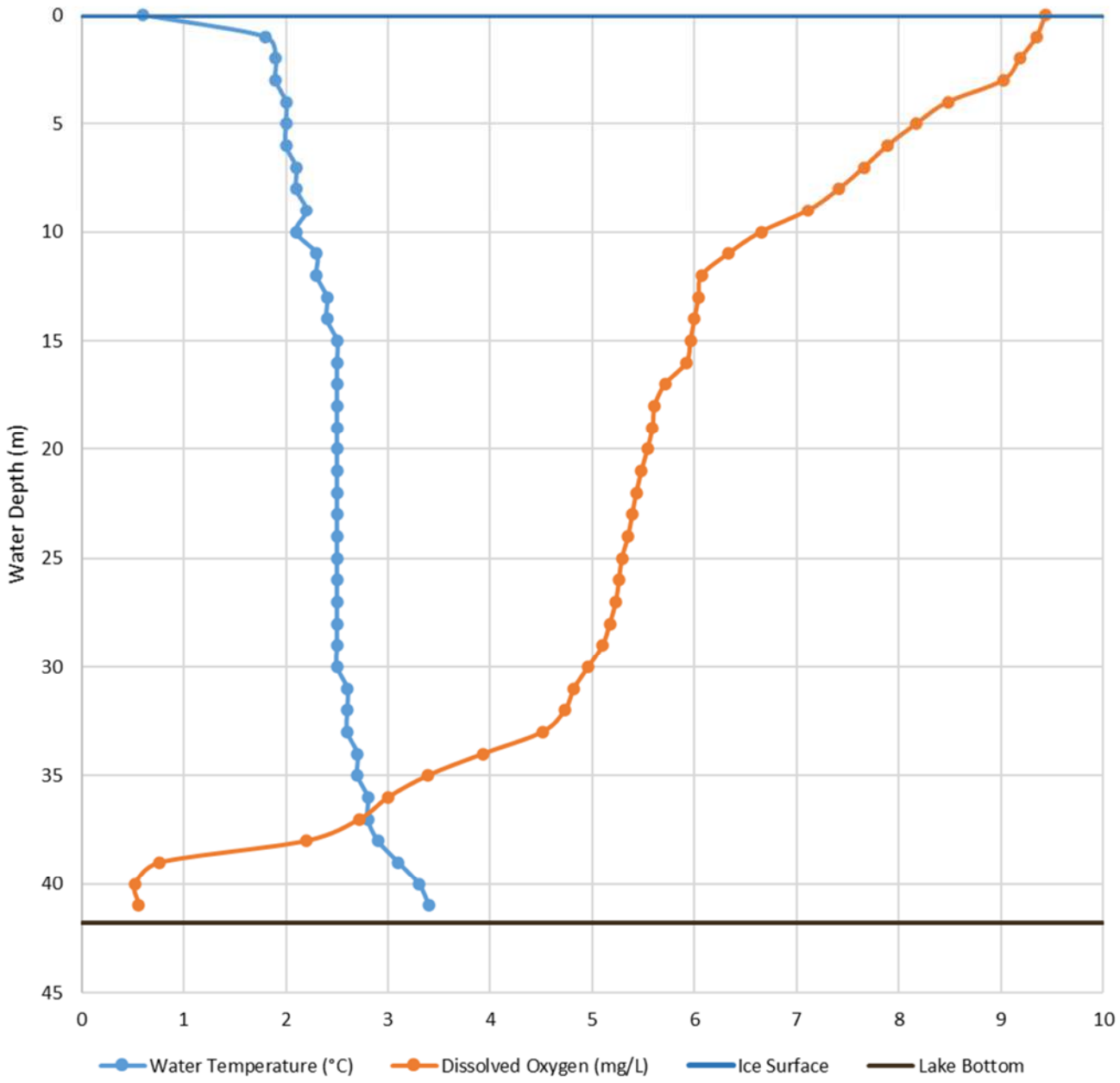


Figure 1. Dissolved oxygen–temperature profile at site LA-1 in the northern basin of Little Atlin Lake on March 20, 2023.

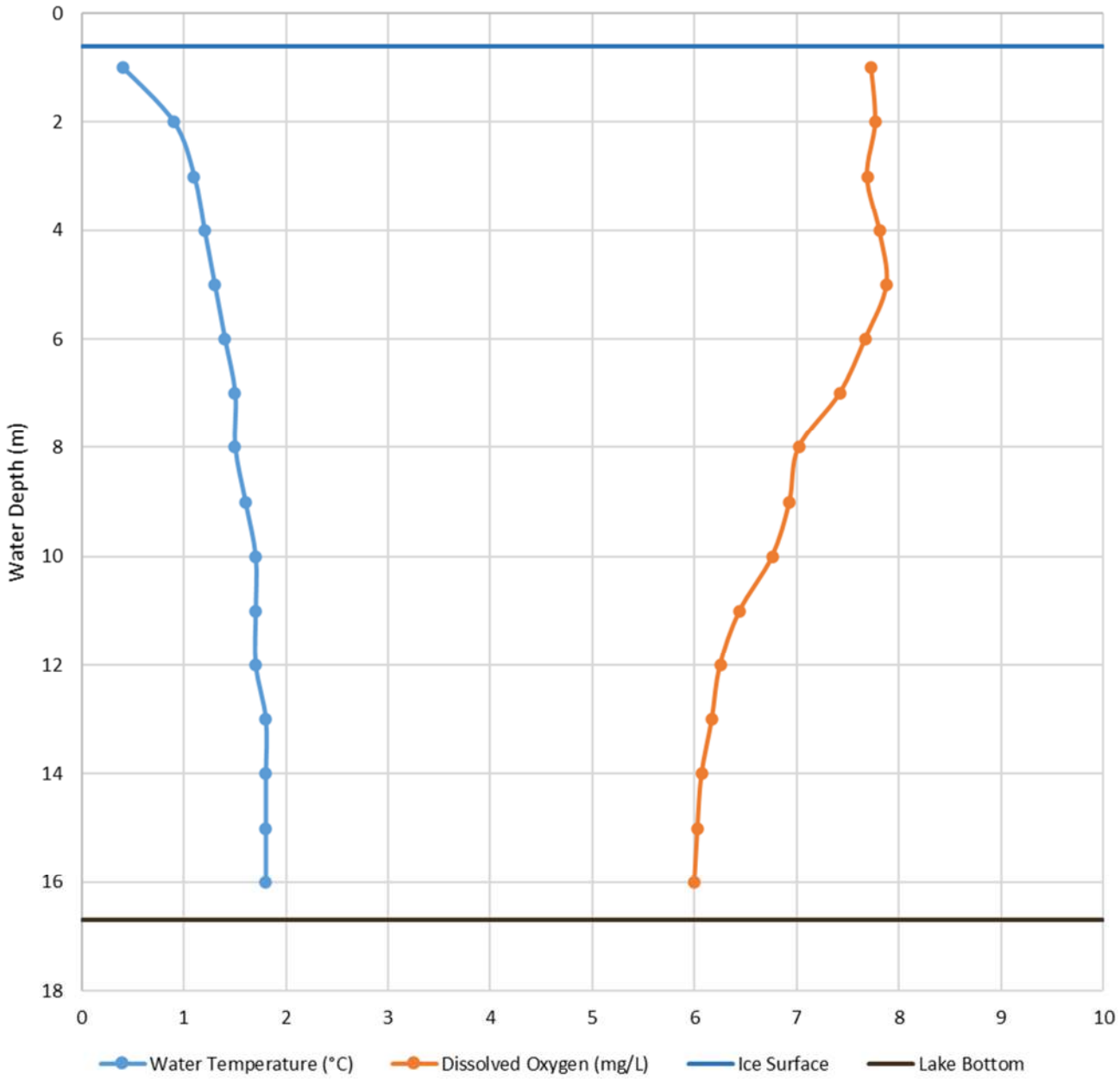


Figure 2. Dissolved oxygen–temperature profile at site LA-2 in the southern basin of Little Atlin Lake on March 20, 2023.

3.1.3 IN SITU WATER QUALITY

In situ water quality measurements were collected from representative locations during summer pike habitat mapping fieldwork (Table 2). Surface water temperatures ranged between 15.7 and 17.5 °C. Other water quality parameters including measurements of turbidity, conductivity, and dissolved oxygen were similar between sites.

Table 2. In situ water quality measurements from Little Atlin Lake during summer pike habitat mapping.

Site	Date	Time	Temperature (°C)	Dissolved Oxygen		Specific Conductivity (µs/cm)	Turbidity (NTU)
				(%)	(mg/L)		
T-4	24-Aug-2023	14:20	17.5	-	-	276.1	1.45
T-12	26-Aug-2023	11:50	16.9	109.0	10.55	238.7	1.84
T-15	26-Aug-2023	13:50	16.1	105.2	10.35	256.4	1.85
T-17	27-Aug-2023	11:30	15.7	103.4	10.28	273.6	1.63
POI-1064	27-Aug-2023	13:00	15.7	105.9	10.54	275.5	1.41

3.2 NORTHERN PIKE HABITAT MAPPING

The first step in mapping northern pike habitat in Little Atlin Lake was defining and categorizing different vegetation communities based on observations from vegetation transects and surveyed points of interest. The following vegetation associations are described below and were used to map habitat types throughout the lake. The spatial extent of the various habitat types is provided at the end of this section.

3.2.1 SHORELINE MARSH HABITAT

The shoreline vegetation community present along Little Atlin Lake is relatively consistent, with tussocks of sedges (*Carex* sp.) comprising the majority the shoreline marsh habitat. This shoreline marsh habitat type is characterized by high cover of sedges, with lower cover of grasses, herbs, and some willows/alders also present.

The shoreline marsh habitat type is often observed surrounding channels or connected to pools of open water where terrestrial vegetation appears to be encroaching into the wetted perimeter of Little Atlin Lake. The habitat type was distinguished by being dry and able to walk upon during August fieldwork which was a distinct difference to the typical emergent aquatic vegetation habitat present on the lake proper. However, the sedge tussock shoreline marsh habitat type and the emergent aquatic vegetation habitat type typically grow adjacent to each other and can overlap to varying degrees making the distinction between the two types difficult at times. While the shoreline marsh habitat type is abundant around the perimeter of Little Atlin Lake this habitat was found to be primarily dry and unwetted during August surveys and as such was not mapped as part of 2023 Little Atlin Lake pike habitat mapping. However, it is possible that during periods of higher water, northern pike may use some areas of this vegetation type to spawn when water levels are higher.

Photo 2. A view of the shoreline marsh habitat type and typical *Carex sp.* tussocks in the background of the photo with the horsetail emergent aquatic vegetation type in the foreground (August 26, 2023).

3.2.2 EMERGENT AQUATIC VEGETATION HABITAT

The emergent aquatic vegetation habitat type in Little Atlin Lake was characterized by high cover of water horsetail (*Equisetum fluviatile*) (Photo 2 and Photo 3). This emergent aquatic vegetation habitat was not easily distinguished from satellite imagery and was instead digitized using a combination of transect results, site photographs, and drone photographs taken from around the lake perimeter during 2023 fieldwork. The emergent vegetation type was commonly encountered on the lake and was frequently observed in sheltered bays and points, likely growing in similar areas each year and remaining wetted for the duration of the open-water season. The emergent vegetation community and occurred in water ranging between 0.6 m and 0.95 m deep (Photo 4). Submerged vegetation was also common in this type, including *Chara*, pondweeds (*Potamogeton* spp.), and common water-milfoil (*Myriophyllum sibiricum*).

Photo 3. Emergent aquatic vegetation growing in patches along Little Atlin Lake (August 26, 2023).

Photo 4. The emergent vegetation community in Little Atlin Lake showing standing water present throughout the horsetail stems which exist on a gradient of cover and density (August 27, 2023).

3.2.3 CHARA FLATS / SHALLOW BENCH HABITAT

Large shallow benches are a unique and widespread feature in Little Atlin Lake. The shallow benches occur quite frequently around the entire perimeter of the lake and extend anywhere from a few meters to upwards of 700 m from shore into the main basins of the lake.

These shallow benches were primarily comprised of dominant *Chara* growth (Photo 5 and Photo 7) or fines with little vegetation present (Photo 6 and Photo 8). In instances where these shelves occur at depths deeper than 0.75 m *Chara* growth was generally extensive and exhibited healthier and taller growth (Photo 5). In shallower water *Chara* appeared to be somewhat stunted (Photo 6). In most instances where a distinct shallow water (<2.5 m) shelf was present in Little Atlin Lake extensive *Chara* growth was present and either continuous or patchily distributed out to a depth of approximately 5.0 m. Functionally the tall or sparse stunted *Chara* dominated shallow bench habitat in Little Atlin Lake appears to function in a similar manner with little habitat complexity. The size of the shallow benches may provide separation between juvenile and adult northern pike rearing habitat in Little Atlin Lake as adults are expected to occur primarily outside of these flats with juveniels rearing on the shallow end of these flats along the margins of the emergent aquatic vegetation habitat type. Other species such as northern arrowhead (*Sagittaria cuneata*), thread-leaved pondweed (*Stuckenia filiformis*), and common water-milfoil occurred infrequently in this habitat type and at low cover (<25%) when present.

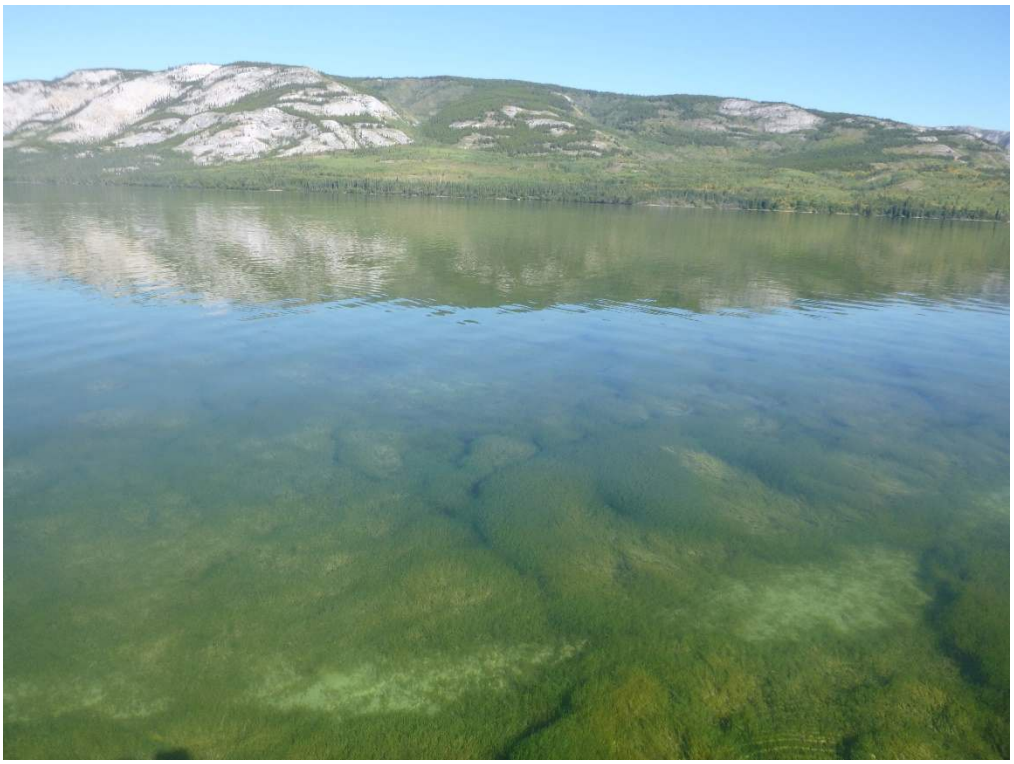


Photo 5. Typical healthy growth of *Chara* in carpets along the flats and benches of Little Atlin Lake (August 28, 2023).

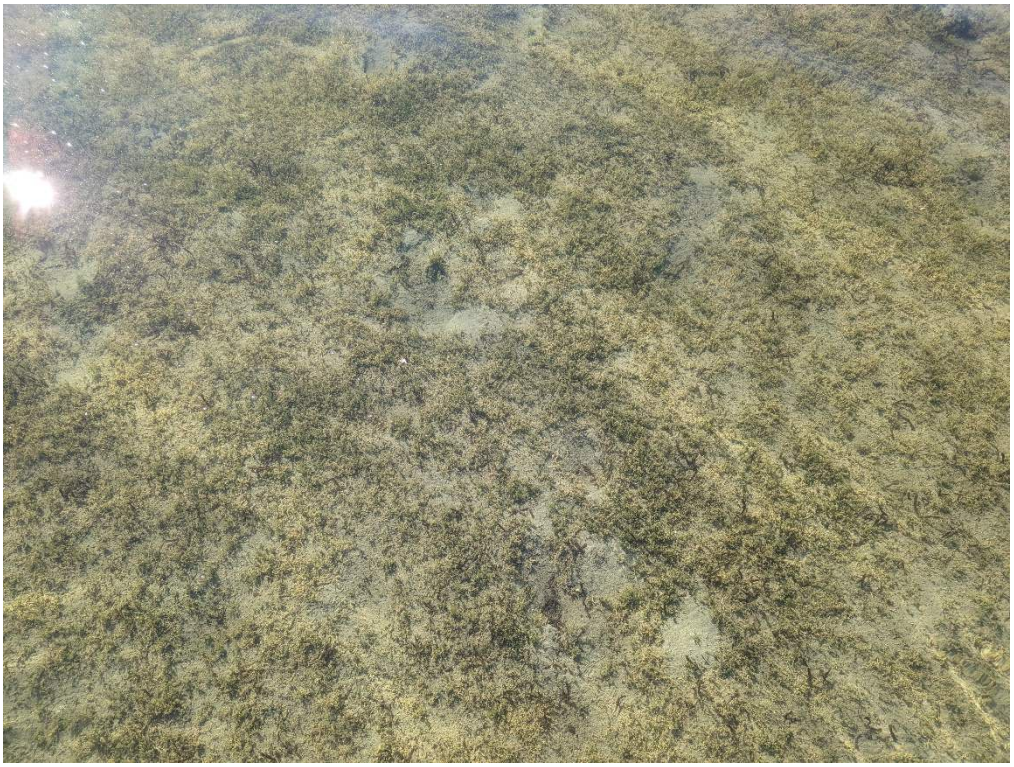


Photo 6. Example of sparse, stunted *Chara* grow on the shallow benches of Little Atlin Lake (August 26, 2023).

Photo 7. Aerial view of extensive *Chara* growth along a shallow bench (August 26, 2023).

Photo 8. Aerial view of patchy and sparse *Chara* growth along a shallow bench (August 26, 2023).

3.2.4 MEDIUM HEIGHT AQUATIC VEGETATION HABITAT

There were some instances where the growth of other aquatic vegetation occurred in patches within the larger flats and bench habitat in Little Atlin Lake (Photo 9). Even in instances when a medium height vegetation community was present it was usually with a patchy distribution within a larger *Chara* flats community (Photo 10). The medium submergent vegetation communities could not be readily distinguished from imagery or photos as vegetation density and coverage were relatively low (<25% cover) on a broad scale. As such, this vegetation association/habitat type was not mapped during 2023 pike habitat mapping. However, it would likely represent micro-habitat associations and areas with higher than typical habitat utilization by juvenile and adult northern pike rearing in Little Atlin Lake. Vegetation in these patches was highly variable but often contained some combination of pondweeds and water-milfoil with *Chara*.

Photo 9. Aerial view of patches of medium aquatic vegetation (foreground) growing on a shallow bench in Little Atlin Lake (August 28, 2023).

Photo 10. Closer view of a medium vegetation community on Little Atlin Lake encountered during fieldwork (August 26, 2023).

3.2.5 TALL SUBMERGENT AQUATIC VEGETATION HABITAT

The tall submergent aquatic vegetation habitat in Little Atlin Lake occurs regularly in a narrow 1.0 to 5.0 m wide band at the top or leading edge of drop offs, primarily formed at the edge of the shallow water benches present throughout the lake (Photo 11 and Photo 12). The tall vegetation community typically occurred at a depth of 4.0 m but could occur anywhere between 2.5 to 6.5 m water depth and appeared to be strongly associated with the start of a drop off. Adult northern pike were frequently observed associated with the tall submergent aquatic vegetation community during 2023 vegetation surveys. Species composition appeared to be rich and varied but was often dominated by some combination of white-stem pondweed (*Potamogeton praelongus*), Richardson's pondweed (*Potamogeton richardsonii*), thread-leaved pondweed, and common water-milfoil.

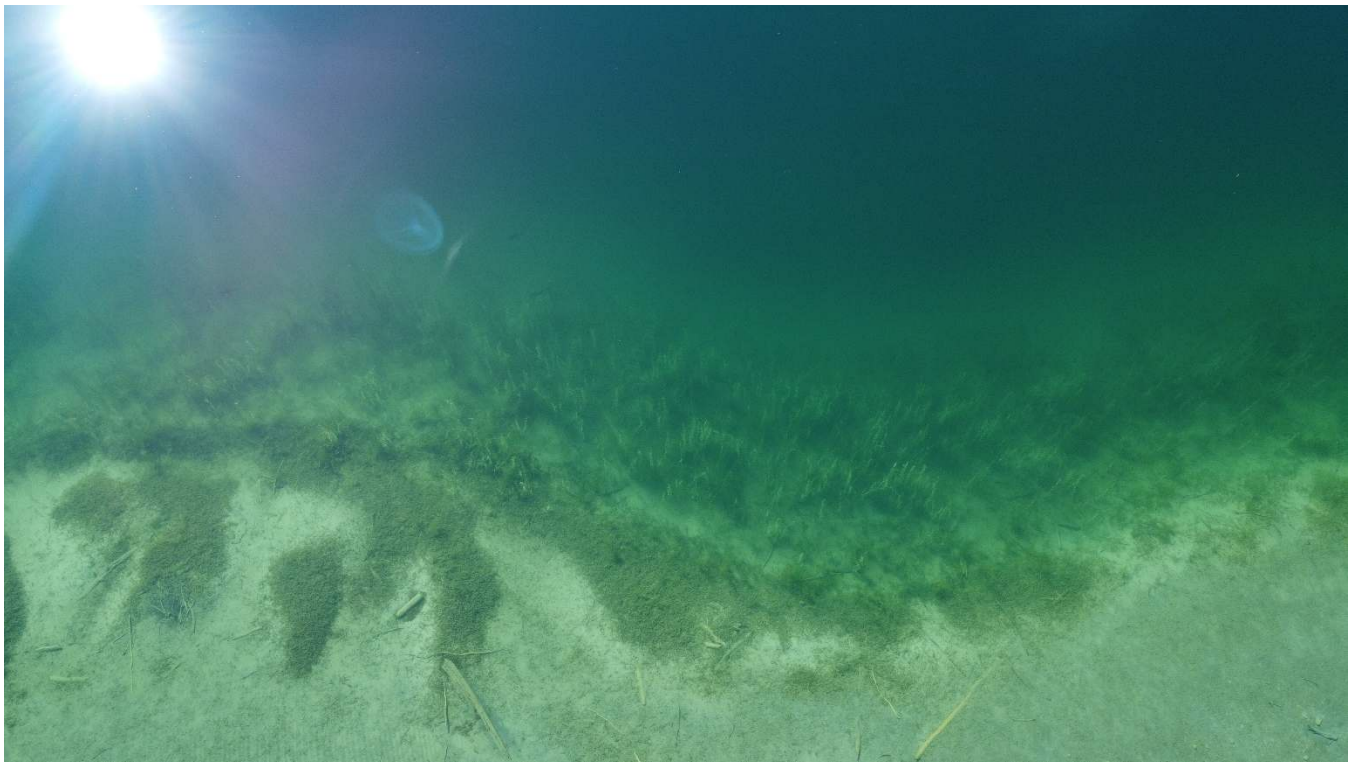


Photo 11. Aerial view of the tall submergent aquatic plant community growing along the top edge of a drop off in Little Atlin Lake (August 27, 2023).

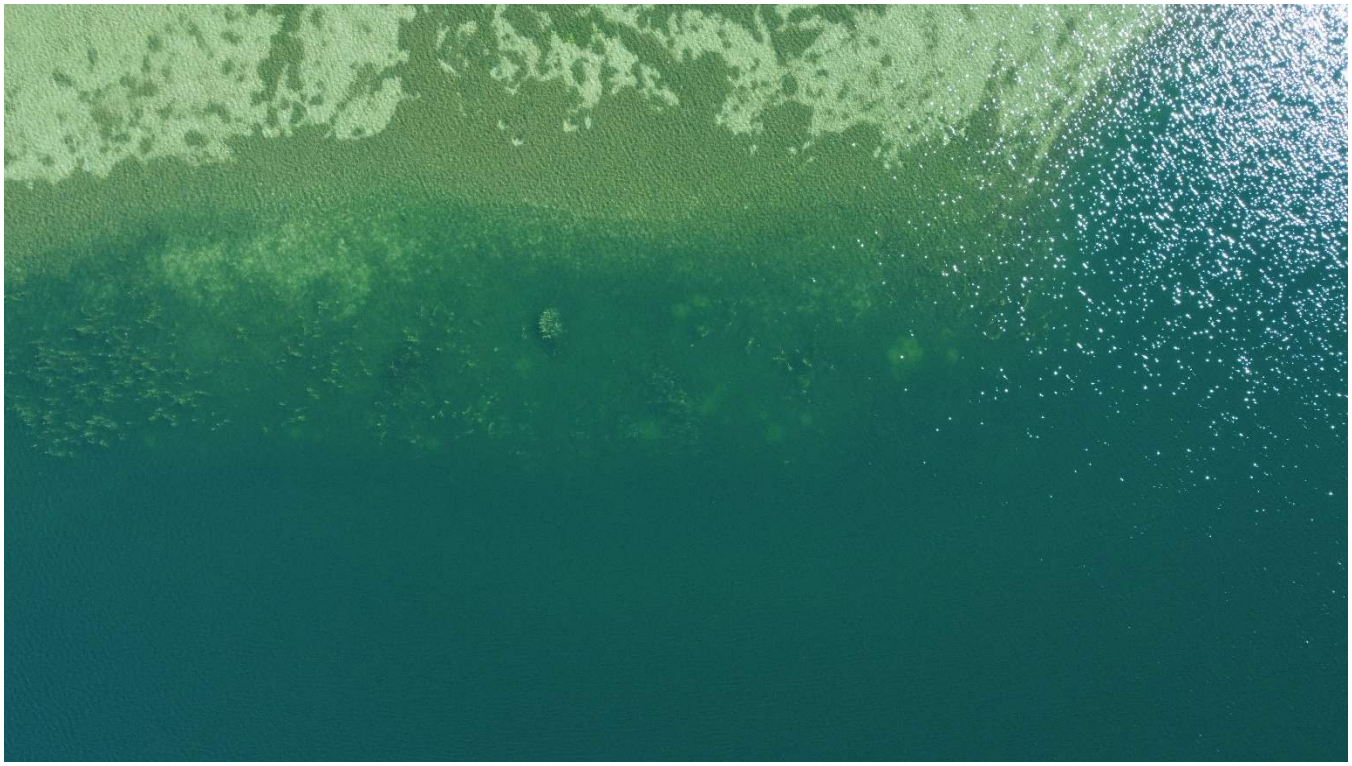


Photo 12. Aerial view of the tall submergent aquatic plant community growing in a narrow band along the top edge of a drop off in Little Atlin Lake (August 26, 2023).

3.2.6 OPEN WATER HABITAT

In water deeper than 8.0 m, no to very sparce vegetation was collected using either the modified vegetation rake or an Eckman grab sampler. Beyond 8.0 m water depth the substrate of Little Atlin Lake was found to be incredibly consistent and was comprised entirely of differing densities of accumulated fines (Photo 13). When some texture was present in substrate samples it was largely due to gastropod shell fragments or small bits of *Chara* or moss embedded in the matrix of accumulated lakebed fines. As such all habitat in Little Atlin Lake deeper than 8.0 m was classified as open water habitat. However, it is recognized different depths likely correspond to different use and presence by the different species of fish present in the lake.

Photo 13. Typical Eckman grab sample of open water lakebed substrate (August 27, 2023).

3.2.7 VEGETATION COMMUNITIES

A total of 33 vegetation species were documented during habitat mapping on Little Atlin Lake in 2023. Many species were present in more than one vegetation community association/habitat type. However, some differences in species composition between the different habitat type can be seen (Table 3). The emergent aquatic vegetation habitat had the highest species richness with 18 different species observed during 2023 surveys. Many of the species observed in the *Chara* flats/shallow bench habitat type overlap with the medium height aquatic vegetation. All patches of the medium height aquatic vegetation community were observed within the depth strata of the *Chara* flats/shallow bench type and typically occurred as isolated patches within that habitat type. Survey effort during 2023 was focused on aquatic habitat and vegetation, observations of

shoreline vegetation were not as thorough as those in fully wetted zones. The species list presented for the shoreline marsh type is likely less complete than for the other habitat types (Table 3). Many species found in the shoreline marsh habitat were exclusive to that type. This would be expected given the difference in water regime as compared to the other types. Three species listed on a watch or track list with the Yukon Conservation Data Center were encountered. One species (*Bidens cernua*) was encountered in the shoreline marsh type, and the other two (*Ruppia cirrhosa, Sagittaria cuneata*) were encountered in the *Chara* flats/shallow bench type. Aquatic vegetation common names and photographs of aquatic vegetation are provided in Appendix A.

Table 3. Vegetation species encountered in each habitat type during 2023 fieldwork.

Species	Shoreline Marsh	Emergent Aquatic Vegetation	*Chara* Flats/ Shallow Bench	Medium Height Aquatic Vegetation	Tall Submergent Aquatic Vegetation	Open Water
Algae	•	•	•	•	•	•
Bidens cernua[1]	•					
Calamgrostis canadensis	•					
Callitriche hermaphroditica						•
Carex aquatilis	•					
Carex utriculata	•					
Chara sp.		•	•	•	•	•
Cicuta maculata	•	•				
Comarum palustre	•					
Eleocharis acicularis		•	•	•		
Equisetum fluviatile		•				
Hippuris vulgaris		•		•		
Lemna minor		•				
Lemna trisulca		•				
Lomatogonium rotatum	•					
Moss sp.	•	•	•	•		•
Myriophyllum sibiricum		•		•		
Potamogeton friesii				•	•	
Potamogeton gramineus	•	•		•		
Potamogeton praelongus				•	•	
Potamogeton pusillus				•		
Potamogeton richardsonii		•	•	•	•	
Potamogeton zosteriformis		•	•	•	•	
Ricciocarpos natans		•				
Rumex occidentalis	•					
Ruppia cirrhosa[1]			•			

Species	Shoreline Marsh	Emergent Aquatic Vegetation	*Chara* Flats/ Shallow Bench	Medium Height Aquatic Vegetation	Tall Submergent Aquatic Vegetation	Open Water
Sagittaria cuneata[1]			•			
Salix spp.	•					
Sparganium angustifolium		•				
Stuckenia filiformis		•	•	•	•	
Stuckenia pectinata			•			
Utricularia vulgaris		•	•			
Utricularia intermedia		•				
Number of species:	**12**	**18**	**11**	**13**	**7**	**4**

[1] Species of conservation concern tracked or on a watch list with the Yukon Conservation Data Center.

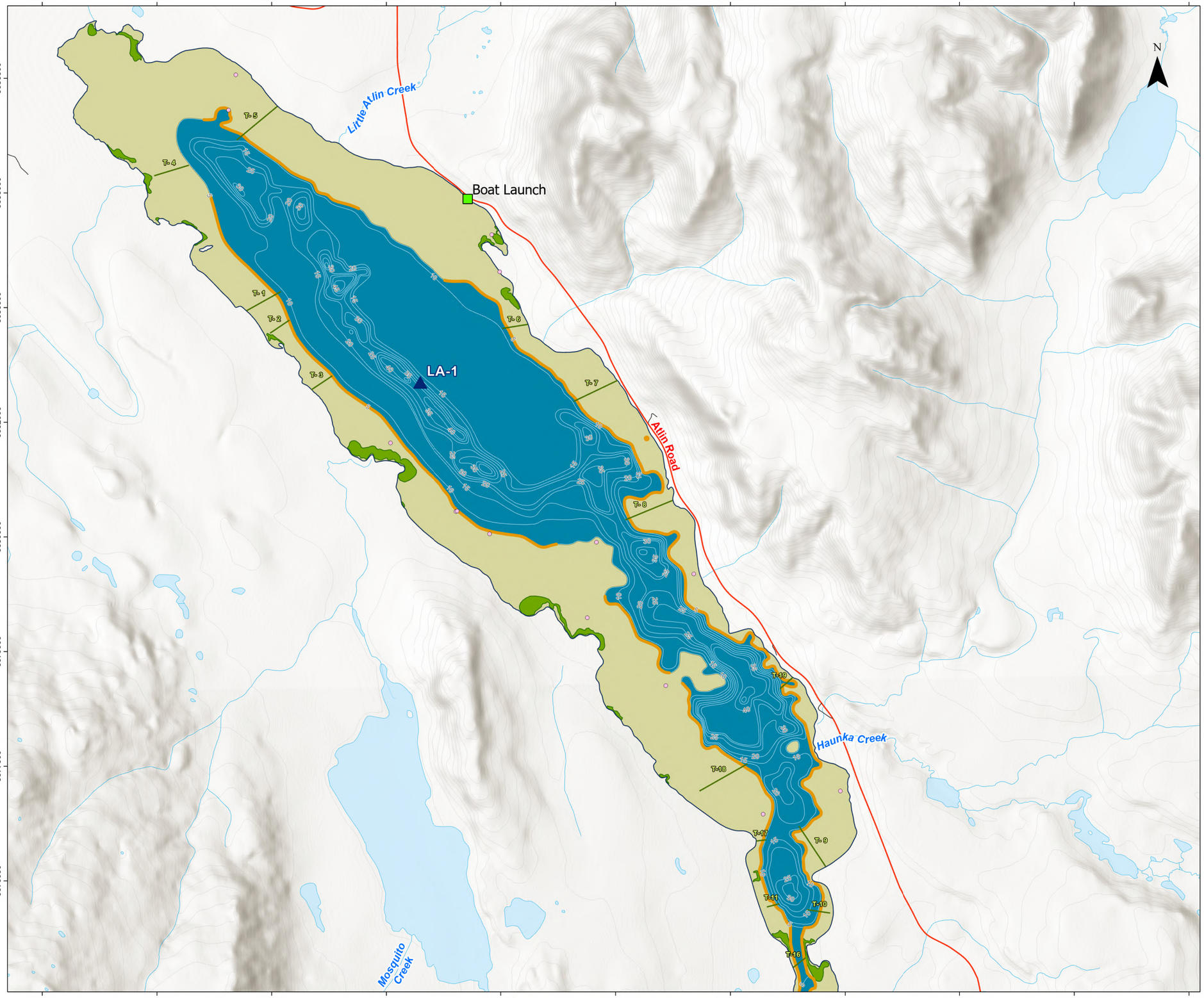
3.2.8 SUMMARY

Vegetation associations were used in conjunction with vegetation transect and point of interest survey data to map the distribution of northern pike habitat on Little Atlin Lake. Just under half of the total area of Little Atlin Lake (47.8%) was determined to be open water with the *Chara* flats/shallow bench habitat being the most common area with aquatic vegetation (49.3% of the total lake; Table 4). It is important to note that the distribution of tall aquatic vegetation may be underrepresented as a result of small patches of this habitat occurring at a fine scale within the *Chara* flats/shallow bench habitat.

Table 4. Summary of northern pike habitat mapping on Little Atlin Lake.

Pike Habitat	Habitat Type (ha)	Percent of Surface Area (%)
Emergent Aquatic Vegetation	96	2.4 %
Chara Flats / Shallow Bench	1,985	49.3%
Tall Submergent Vegetation	21	0.5%
Open Water	1,928	47.8%
Total	4,030	100.0%

Northern pike habitat mapping results on Little Atlin Lake (north basin)

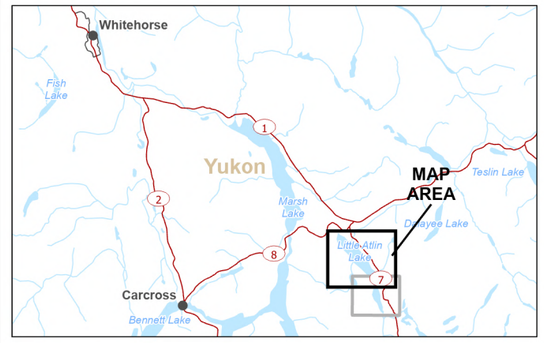


Legend

- Points of Interest
- Basin Monitoring Location
- Boat Launch
- Aquatic Vegetation Transect
- Primary Road
- Secondary Road
- Shoreline
- Bathymetry (each 5m)
- Watercourse
- Waterbody

Habitat Types

- Emergent Aquatic Vegetation
- Chara Flats/Shallow Bench
- Open Water
- Tall Submergent Aquatic Vegetation



0 500 1,000 1,500 2,000
Metres

Map Scale = 1:50,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 8N

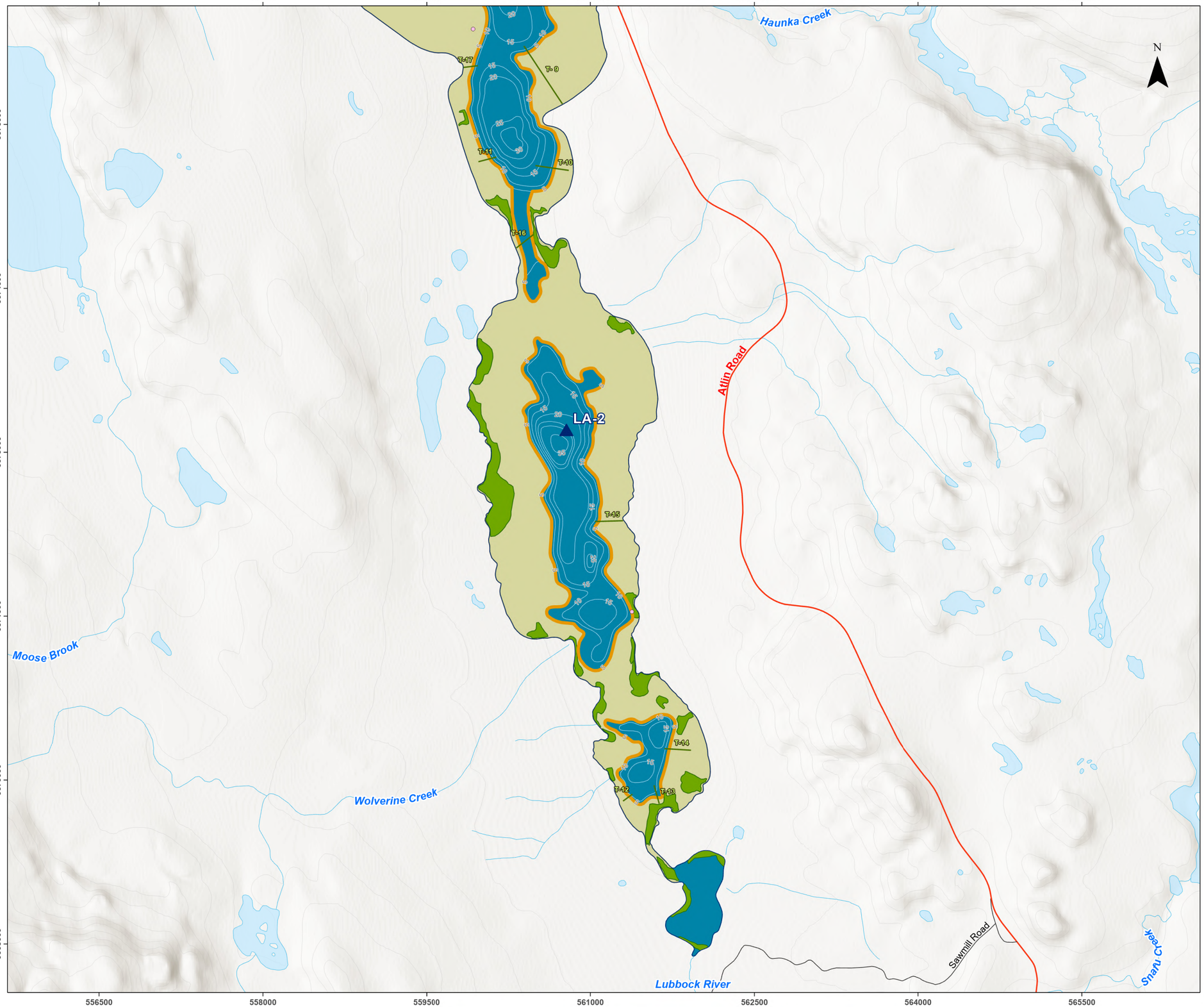
Data Sources
• Main Basemap. Canvec 50K and World Hillshade: Esri, USGS, FEMA

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to verify this map is free of errors. Data have been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

Drawn:	Checked:	Map 4	Date: 2/29/2024
Y. Navarro	JL / BS		

Path: L:\PROJECTS\2023\WH23Y0105_CTRRC_LittleAtlin\23Y0105_mapping.aprx\23Y0105_Map03_Habitat_20240229

Northern pike habitat mapping results on Little Atlin Lake (south basin)

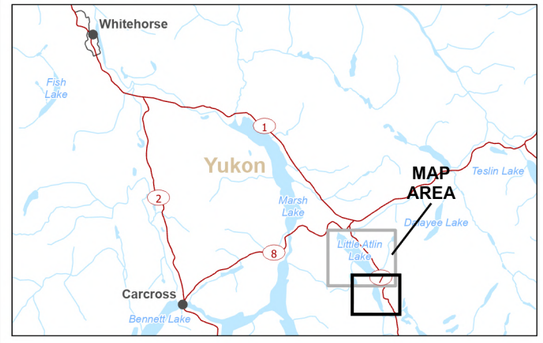


Legend

- Points of Interest
- Basin Monitoring Location
- Aquatic Vegetation Transect
- Primary Road
- Secondary Road
- Shoreline
- Bathymetry (each 5m)
- Watercourse
- Waterbody

Habitat Types

- Emergent Aquatic Vegetation
- Chara Flats/Shallow Bench
- Open Water
- Tall Submergent Aquatic Vegetation



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Data Sources
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Disclaimer
EDI Environmental Dynamics Inc. has made every effort to verify this map is free of errors. Data have been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

Drawn:	Checked:	Map 5	Date: 2/29/2024
Y. Navarro	JL / BS		

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4 DISCUSSION

4.1 WATER QUALITY MONITORING

The establishment of a water quality and fish habitat monitoring program on Little Atlin Lake is important to describe the existing fish habitat availability across a range of seasonal conditions. Ongoing water temperature monitoring will help to describe the habitat available to fish species present in Little Atlin Lake, namely temperature sensitive and limited species such as lake trout. Future analysis of temperature mooring data will be used to help inform species management on Little Atlin Lake.

The March 2023 dissolved oxygen–temperature profiles only identified a small amount of deep benthic aquatic habitat as being anoxic in Little Atlin Lake. However, it is possible shallower areas or areas with extensive summer aquatic vegetation growth could also become anoxic overwinter. Further investigations may be required to better determine the spatial and temporal extent of anoxic overwinter conditions on Little Atlin Lake.

4.2 PIKE HABITAT

It is important to note that the vegetation communities and associations described here are described and mapped as distinct units, but they exist on a spectrum of density and dominance. Additionally, northern pike habitat mapping results only describe the distribution of vegetation communities during a single growing season, and it is not known whether these communities and their corresponding extents vary seasonally or from year to year.

Northern pike occur over a wide range of habitat, typically inhabiting shallower water in the spring and fall and deeper cooler water at the height of summer (Scott and Crossman 1973). The optimum temperature for growth in northern pike decreases with age such that smaller pike are more tolerant of lower oxygen environments than larger individuals (Casselman and Lewis 1996). Changes in vegetation associations also occur with growth where spawning pike prefer emergent vegetation, fry prefer emergent and floating vegetation, and adults prefer submergent vegetation (Casselman and Lewis 1996).

Northern pike spawn in the spring immediately after ice off (Scott and Crossman 1973). Northern pike prefer to spawn on grasses and sedges (species with a small basal area) but other vegetation is also used (Casselman and Lewis 1996). Spawning pike have been shown to use *Chara* in some lakes but this likely represents spawning on available vegetation as opposed to preferred habitat (Mccarraher and Thomas 1972).

Young northern pike will remain in spawning areas for several weeks after hatching (Scott and Crossman 1973), and tend to prefer submerged vegetation with some emergent and floating vegetation interspersed (Casselman and Lewis 1996). This likely includes both emergent and shallow bench aquatic habitat in Little Atlin Lake. The morphology of Little Atlin Lake with large shallow benches that extend for long distances into the body of the lake may also help to spatially separate northern pike juveniles from adults during growth,

limiting intraspecific competition and cannibalization. Northern spawning and juvenile rearing habitat appear extensive and widespread in Little Atlin Lake.

Adult northern pike are visual ambush predators (Casselman and Lewis 1996) and omnivorous carnivores that will eat anything they can engulf (Scott and Crossman 1973). Adult pike presence is related to cover with larger individuals most commonly observed in the macrophyte open water boundary (Casselman and Lewis 1996). This is consistent with pike observations during 2023 vegetation surveys which frequently observed adult northern pike associated with the drop off tall vegetation community in Little Atlin Lake. Although some adult northern pike were occasionally observed in shallow areas with emergent or medium submergent vegetation, adult northern pike were most frequently observed utilizing the habitat at drop offs and the tall submergent aquatic vegetation community.

5 REFERENCES

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APPENDICES

APPENDIX A COMMON NAMES AND PHOTOGRAPHS OF VEGETATION SPECIES

Appendix Table A-1. List of vegetation species encountered during transects and at points of interest investigations on Little Atlin Lake in 2023.

Common Name	Species name
Algae	Algae
Nodding beggarticks	*Bidens cernua*
Bluejoint reedgrass	*Calamgrostis canadensis*
Northern water-starwort	*Callitriche hermaphroditica*
Water sedge	*Carex aquatilis*
Northern beaked sedge	*Carex utriculata*
Stonewort	*Chara* sp.
Spotted water hemlock	*Cicuta maculata*
Marsh cinquefoil	*Comarum palustre*
Least Spike-rush	*Eleocharis acicularis*
Water horsetail	*Equisetum fluviatile*
Common Mares-tail	*Hippuris vulgaris*
Common duckweed	*Lemna minor*
Star duckweed	*Lemna trisulca*
Marsh felwort	*Lomatogonium rotatum*
Moss	*Moss* sp.
Siberian water-milfoil	*Myriophyllum sibiricum*
Fries' pondweed	*Potamogeton friesii*
Grassy pondweed	*Potamogeton gramineus*
White-stem pondweed	*Potamogeton praelongus*
Small pondweed	*Potamogeton pusillus*
Richardson's pondweed	*Potamogeton richardsonii*
Flat-stemmed pondweed	*Potamogeton zosteriformis*
Purple-fringed Riccia	*Ricciocarpos natans*
Western dock	*Rumex occidentalis*
Spiral ditchgrass	*Ruppia cirrhosa*
Northern arrowhead	*Sagittaria cuneata*
Willows	*Salix* spp.
Narrow-leaved bur-reed	*Sparganium angustifolium*
Thread-leaved pondweed	*Stuckenia filiformis*
Sago pondweed	*Stuckenia pectinata*
Common bladderwort	*Utricularia vulgaris*
Flat-leaved bladderwort	*Utricularia intermedia*

Appendix Photo A-1. Water horsetail (*Equisetum fluviatile*) dominated emergent zone (August 26, 2023).

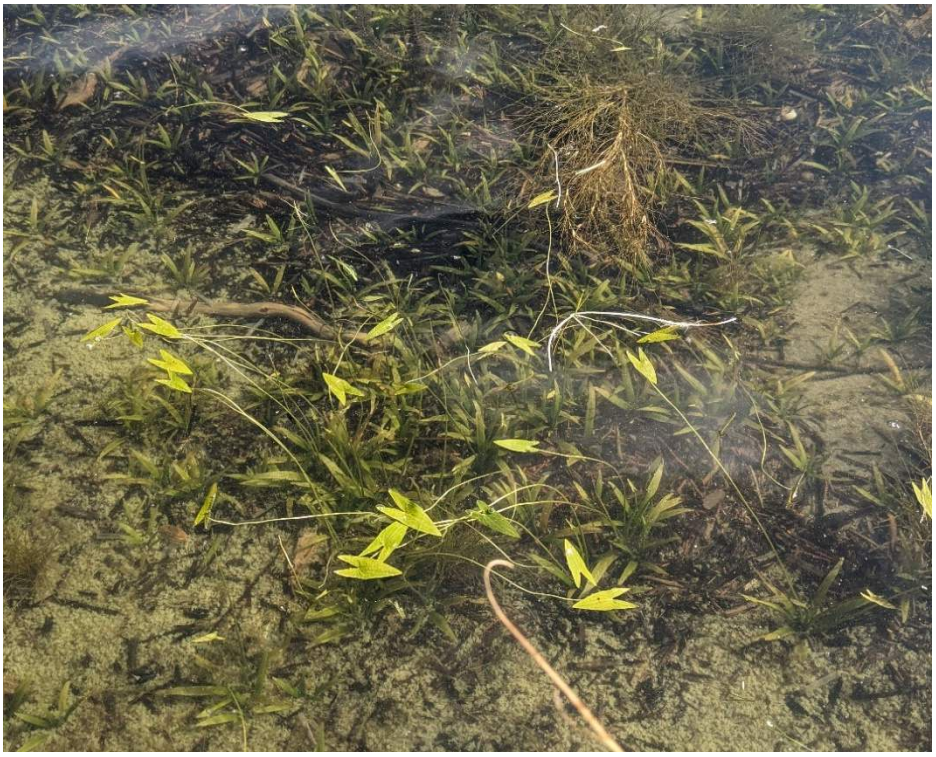
Appendix Photo A-2. *Chara* collected from an Eckman grab sample in Little Atlin Lake (August 26, 2023).

Appendix Photo A-3. A *Chara* carpet on a shallow bench in Little Atlin Lake with some other species present including Common mares-tail (*Hippuris vulgaris*) and Thread-leaved pondweed (*Stuckenia filiformis*) (August 27, 2023).

Appendix Photo A-4. Narrow bur-reed (*Sparganium angustifolium*) near the boat launch in Little Atlin Lake (Augsut 28, 2023).

Appendix Photo A-5. Spiral ditchgrass (*Ruppia cirrhosa*). Ranked S1 (Critically Imperilled) in Yukon by the Yukon Conservation Data Center. Only seen in one location during this project (August 28, 2023).

Appendix Photo A-6. Common mares-tail (left) and common water-milfoil (*Myriophyllum sibiricum*; right) collected from a rake drag (August 25, 2023).



Appendix Photo A-7. Northern arrowhead (*Sagittaria cuneata*) was encountered in several locations. Ranked S3 (Vulnerable) in the Yukon by the Yukon Conservation Data Center (August 24, 2023).