6.2.2 Peter Lake Drainage

Five replicate samples were collected from a single station in Peter Lake in 1998 (Figure 6-5; Appendix C, Table C1-9). The samples were analyzed for moisture content, particle size, total organic carbon, total nitrogen, total cyanide, and total metals. In general, all parameters were similar among the samples. Sediment moisture ranged from 31 to 41%. The sediments had similar proportions of sand and silt with clay ranging from 7.5 to 10.3%. Total organic carbon concentrations varied between 0.36 and 0.51%. Total nitrogen ranged between 0.03 and 0.05%. Total cyanide concentrations ranged from 2.1 to 2.9 mg/kg dw, with one sample at less than the detection limit of 0.5 mg/kg dw.

Total metals concentrations were generally below the applicable aquatic life guidelines with the exception of arsenic (all 5 samples). Arsenic concentrations ranged from 6.2 to 8 mg/kg dw, higher than the ISQG of 5.9 mg/kg dw.

6.2.3 Atulik Lake Drainage

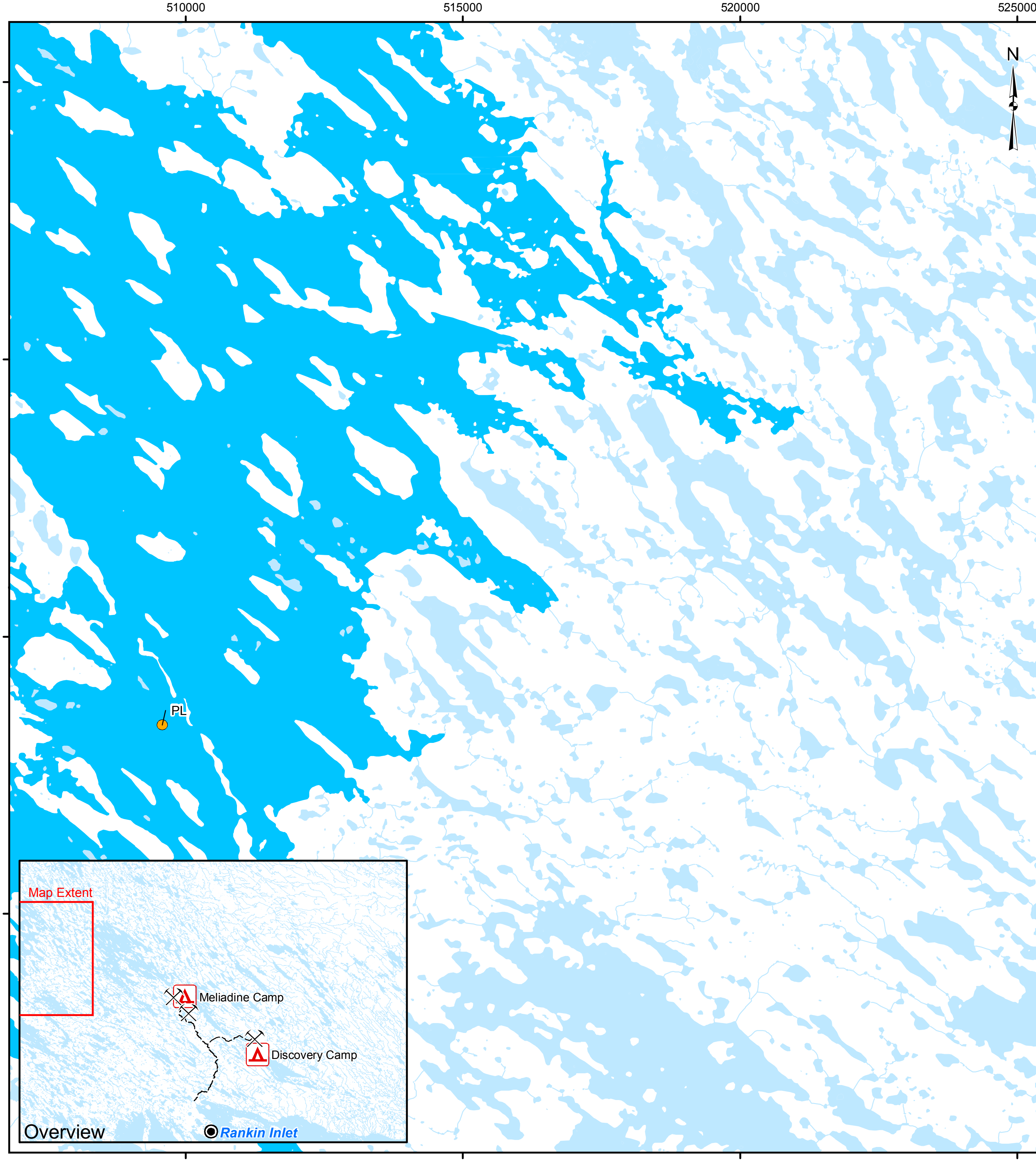
Sediment samples were collected from 2 lakes in the Atulik Lake drainage basin between 1994 and 2009 (Figure 6-6; Appendix C, Table C1-10):

- DI1 (1994, 2008; also known as Chickenhead Lake); and
- DI5 (1995; located in the north of the basin).

Particle size distribution, total organic carbon, and cyanide were only analyzed in the sediment samples from Lake DI1 collected in 2008. These sediments were dominated by sand (76 to 78%) with low clay content (2 to 4%). Total organic carbon was similar among these samples at 1.2 to 1.6%. Total cyanide concentrations ranged from 1.0 to 1.8 mg/kg dw.

Moisture content was noticeably lower in the 1994 and 1995 samples at 14 and 20%, respectively, compared to 56 to 59% in the 2008 samples. This trend was observed in other areas, suggesting that the moisture content data reported by Dillon (1994, 1995) were calculated differently than in more recent studies.

Total metals concentrations were generally below the applicable aquatic life guidelines with the exception of arsenic (5 out of 6 samples) and chromium (1 out of 6 samples). Arsenic concentrations ranged from 5.22 to 10.4 mg/kg dw, and 5 samples had concentrations that were higher than the ISQG of 5.9 mg/kg dw. The ISQG for chromium (37.3 mg/kg dw) was exceeded in one sample from lake DI5 (40.4 mg/kg dw). In addition, the detection limit for cadmium in the 1995 sample (2.0 mg/kg dw) from lake DI5 was higher than the ISQG of 0.6 mg/kg dw.



LEGEND

- Sediment Sampling Location
- Camp
- Proposed Mine Site
- Proposed Road
- Watercourse
- Sampled Waterbody
- Waterbody

2,500 0 2,500

SCALE 1:100,000 METRES

REFERENCE

Base data obtained from Comaplex Minerals Corporation. Water quality data obtained from the field.
Projection: UTM Zone 15 Datum: NAD 83

DRAFT

PROJECT

COMAPLEX MINERALS CORP

COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

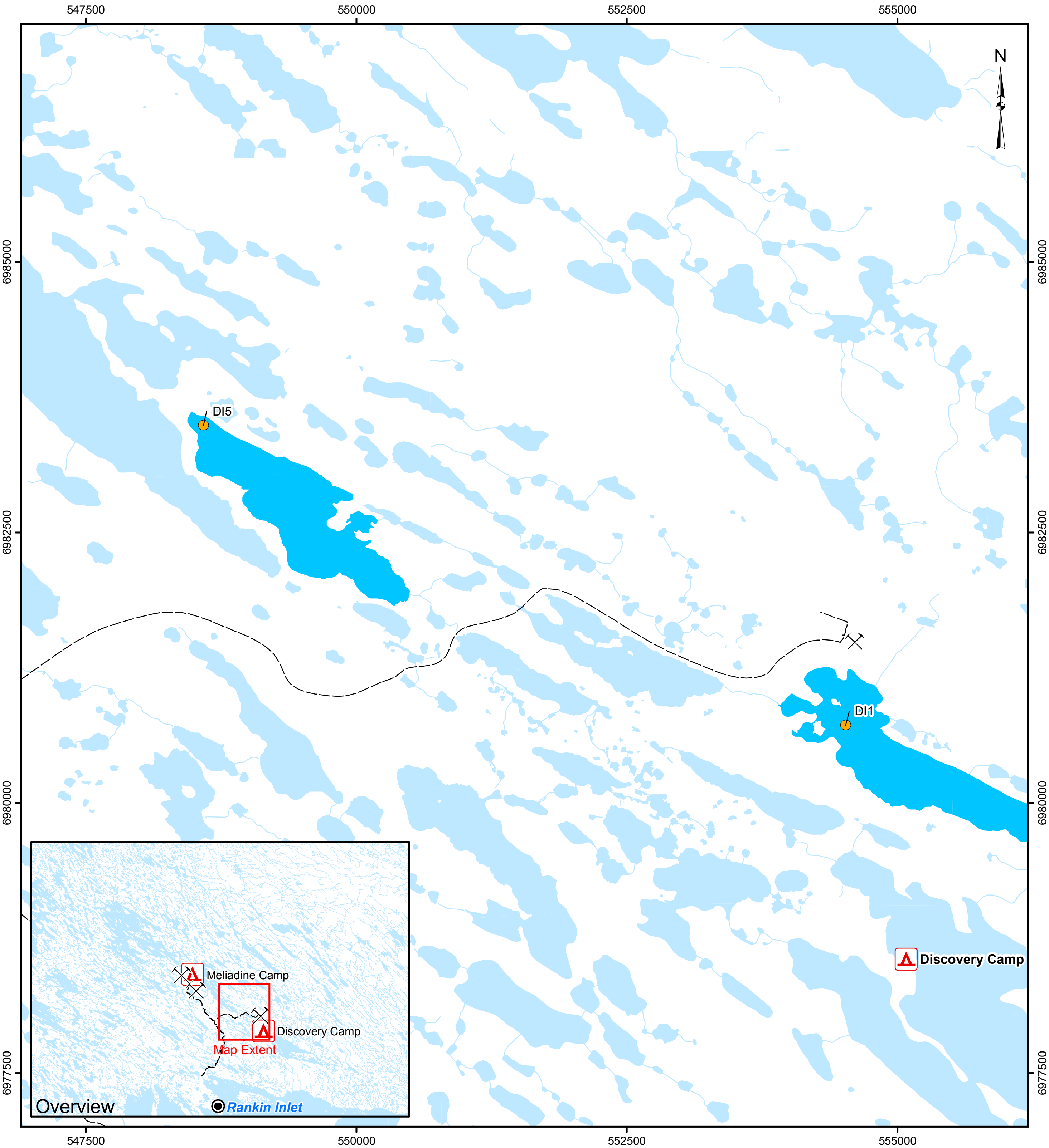
TITLE

SEDIMENT QUALITY SAMPLING LOCATIONS IN PETER LAKE BASIN

Golder Associates
Edmonton, Alberta

PROJECT NO. 09-1373-0010			PHASE No. 1000	
DESIGN	KS	06 Oct. 2009	SCALE AS SHOWN	REV. 0
GIS	CDB	06 Oct. 2009		
CHECK	KS	27 Oct. 2009	FIGURE 6-5	
REVIEW	PMC	27 Oct. 2009		

N:\Bur-Graphics\Projects\2007\1373\07-1373-0055\Mapping\MXD\2009\WaterQuality\figure_06-05_sediment-sampling-peter-lake-basin.mxd



LEGEND

- Sediment Sampling Location
- Camp
- Proposed Mine Site
- Proposed Road
- Watercourse
- Sampled Waterbody
- Waterbody

1,250 0 1,250

SCALE 1:50,000 METRES

REFERENCE

DRAFT

Base data obtained from Comaplex Minerals Corporation. Water quality data obtained from the field.
Projection: UTM Zone 15 Datum: NAD 83

PROJECT

COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

SEDIMENT QUALITY SAMPLING LOCATIONS IN ATULIK LAKE BASIN

Golder Associates
Edmonton, Alberta

PROJECT NO. 09-1373-0010			PHASE No. 1000	
DESIGN	KS	06 Oct. 2009	SCALE AS SHOWN	REV. 0
GIS	CDB	06 Oct. 2009		
CHECK	KS	27 Oct. 2009	**FIGURE 6-6**	
REVIEW	PMC	27 Oct. 2009		

N:\Bur-Graphics\Projects\2007\1373\07-1373-0055\Mapping\MXD\2009\WaterQuality\figure_06-06_sediment-sampling-atulik-lake-basin.mxd

6.3 Hudson Bay

Five replicate samples were collected in 1998 from a single station in Hudson Bay to assess sediment chemistry in the marine ecosystem (Appendix C, Table C1-11). The sediments were dominated by silt (67 to 70%) with low clay content (4.2 to 4.8%). Sediment moisture ranged between 12 and 34%. Total organic carbon concentrations ranged from 0.4 to 0.5%. Total nitrogen ranged from 0.03 to 0.04%. Total cyanide concentrations ranged from less than detection limit (0.5 mg/kg dw) to 1 mg/kg dw. Total metals concentrations were below the applicable guidelines for the protection of marine aquatic life. Concentrations of PAHs were below detection limits; however, the detection limits for acenaphthene, acenaphthylene and dibenzo(a,h)anthracene were above the marine ISQG. Total extractable hydrocarbons ranged from 8 to 22 mg/kg dw.

6.4 Summary and Conclusions

Lake sediments in the study area consisted primarily of the sandy or silty fraction with a wide range of moisture contents. Concentrations of TOC were also variable across sites. Arsenic, chromium, and copper concentrations frequently exceeded ISQGs. Arsenic concentrations occasionally exceeded the associated PEL. Concentrations of individual PAHs were either less than detection limits or less than corresponding ISQGs with the exception of one sediment sample (from lake A8) that had a naphthalene concentration of 0.06 mg/kg dw, which was higher than the ISQG of 0.0346 mg/kg dw. Total volatile and total extractable hydrocarbons were detected in most samples. Chlorinated pesticides were analyzed in stations located in the east, south, and west basins of Meliadine Lake. Detectable concentrations of pp-DDT, pp-DDD, pp-DDE, and quintozine were recorded in the east basin, whereas traces of Aroclor 1254 were found in the west basin sediments.

7.0 AQUATIC HABITAT

Aquatic habitat was surveyed at numerous streams, lakes and ponds in the Meliadine Study Area from 1997 to 2009. Investigations included ground and aerial surveys to assess habitat quality of streams, bathymetric surveys of selected lakes, continuous recordings of water temperature in streams and lakes, collection of in-situ water quality data and measurements of vertical distribution of temperature and dissolved oxygen in lakes. Most of the aquatic habitat assessments were carried out during 1997 and 1998. The sampling effort in the recent years varied with the specific objectives of the investigations and focused on site locations in close proximity to the proposed mine development.

7.1 Methods

7.1.1 Stream Habitat

7.1.1.1 Ground Surveys

In total, 68 ground surveys were conducted at 31 streams within the Peninsula basins (Figure 7-1). Aquatic habitat was surveyed mainly during 1997 (n=51) and 1998 (n=15) in several small streams within Basins A, B, D, F, and G. Additional surveys were conducted in 2004 (Stream J0-1) and in 2009 (Stream A5-6). The purpose of the surveys was to assess habitat suitability for fish use with special reference to fish movements and spawning and/or rearing potential. Surveys were conducted mainly during spring field sessions; however, representative stream sections also were evaluated during the summer and fall seasons.

The RL&L Environmental Services Ltd. habitat classification and coding system (Appendix D1) was used to identify and map individual habitat types. Parameters surveyed included substrate, habitat type (e.g., riffles, pools, runs), instream cover, channel width and depth, and presence of barriers to fish movement. In 1997, all stream sections were assessed separately at each segment of distinct habitat type, and subsequently weighted means (based on the contribution of individual habitat type to the overall stream area) were calculated for each habitat parameter to describe average conditions for the stream as a whole. In 1998 and later, it was deemed impractical to identify and map individual habitat types in small streams as they were often less than 1 m in length. Instead, surveyed streams were subdivided into homogeneous reaches (i.e., stream sections that featured similar gradient, channel type, substrate, and habitat type distribution) with habitat parameters reflecting average conditions within each reach. Subsequently, weighted means (based on the contribution of individual reaches to the overall stream length) were calculated for each habitat parameter to describe average habitat conditions for each stream as a whole. Habitat conditions within lake inlets and outlets were also recorded; however, they were not included as part of the stream in the calculation of weighted means.

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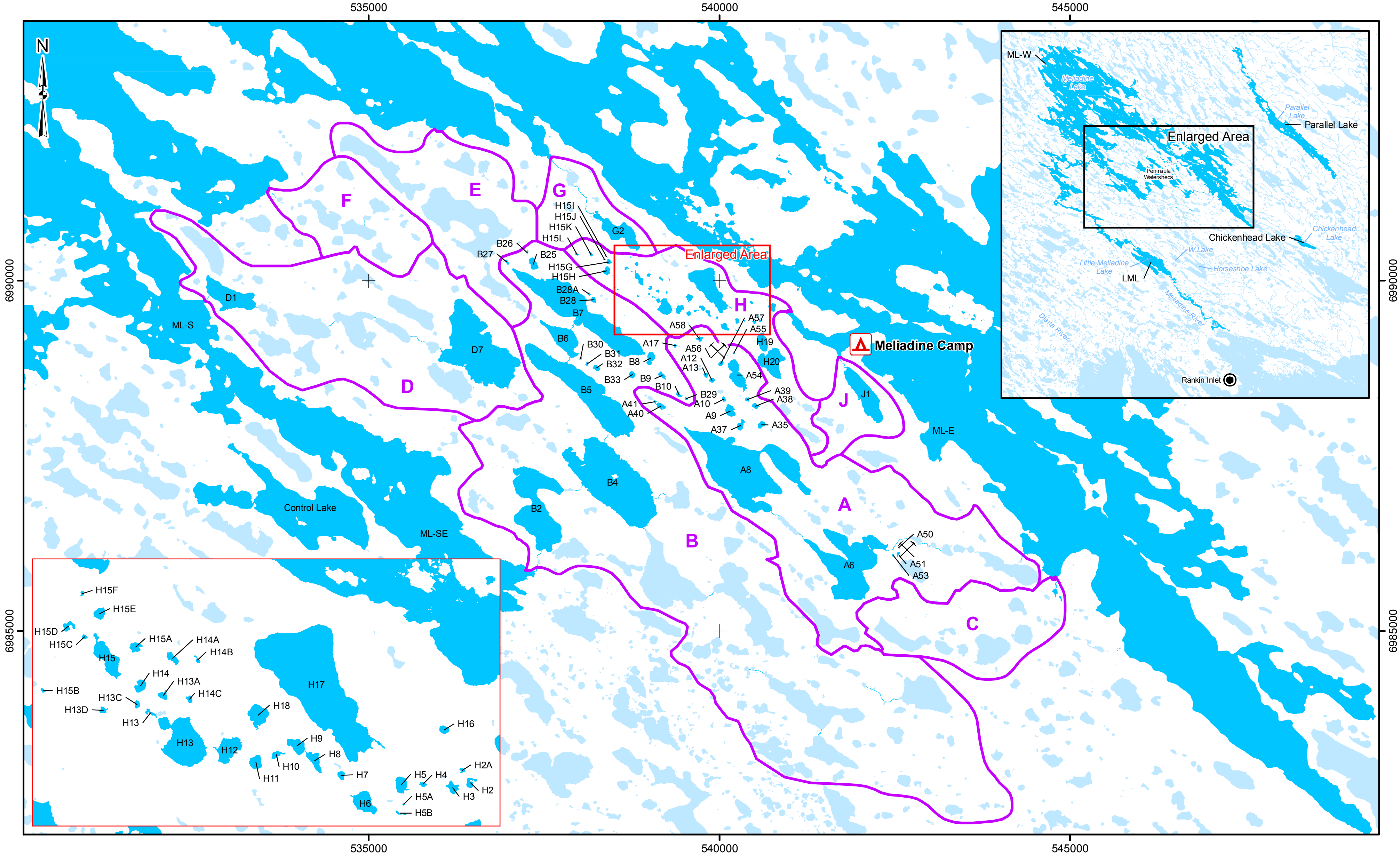

LEGEND

- Camp
- Proposed Mine Site
- Sampled Watercourse
- Sampled Waterbody
- Waterbody
- Watershed Boundary

REFERENCE

Base data obtained from Comaplex Minerals Corporation
Projection: UTM Zone 15 Datum: NAD 83

DRAFT

1.5 0 1.5
SCALE 1:75,000 KILOMETRES

PROJECT
COMAPLEX MINERALS CORP
COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
AQUATIC HABITAT SAMPLING LOCATIONS, 1997-2009

Golder Associates
Edmonton, Alberta

PROJECT No. 09-1373-0010			PHASE No. 1000	
DESIGN	RP	26 Nov. 2009	SCALE AS SHOWN	REV. 0
GIS	CDB	26 Nov. 2009	FIGURE 7-1	
CHECK				
REVIEW				

7.1.1.2 Aerial Survey

In addition to detailed habitat assessments performed at selected sites on the ground, a helicopter survey of 169 streams within the main Peninsula watersheds (A, B and D) was conducted on 21 June 1997. This was done to assess the potential suitability of the stream for Arctic Grayling spawning and/or rearing. Streams were assessed visually from the air and classified into one of the following 7 categories:

Class 0	dry or discontinuous watercourse; no defined stream channel
Class 1	dispersed flow through grass; no defined stream channel
Class 2	stream channel barely discernible; most flow dispersed over grass; substrate entirely organic
Class 3	well-defined stream channel; substrate mostly organic; gravel and cobble areas present but infrequent
Class 4	most of stream channel composed of coarse (gravel/cobble/boulder) substrate
Class 5	stream channel entirely composed of coarse substrate; limited holding areas (deeper pools)
Class 6	stream channel entirely composed of coarse substrate; holding areas present.

Streams designated as Classes 4 to 6 were considered to provide potential spawning and rearing habitat for Arctic Grayling, because of a combination of suitable substrate and adequate depth. Conversely, streams in Classes 0 to 2 were rated as low quality fish habitat. Class 3 streams were considered as marginal; however, small portions of these streams may provide potential spawning habitat.

7.1.2 Lake and Pond Habitat

7.1.2.1 Morphometry

Morphometric characteristics of the study area lakes and ponds (surface area, shoreline length, island area, and perimeter) were calculated from digitized maps using the MapInfo™ software package. Total areas of islands were presented separately (i.e., not included in the surface areas of lakes). Shoreline development indices were calculated using the following formula (from Wetzel 1983):

$$shoreline\ development = \text{shoreline length}/2\sqrt{(\pi * \text{surface area})}$$

For Peninsula ponds, area and shoreline perimeter (Appendix D8) length were calculated using ArcGIS 9.2 software based on data (1:50 000) available from the National Topographic Database.

7.1.2.2 Bathymetry

Bathymetric surveys of the east and south basins of Meliadine Lake and several Peninsula lakes (A6, A8, B2, B4, B5, B6, B7, D1 and D7) and ponds (A54, B9 and B10), were conducted in 1997 and 1998, to quantify lake volumes and the areas of littoral habitat. Additional surveys were carried out in 2008 and 2009 to estimate depth and volume characteristics of Chickenhead Lake and Lake J1.

In 1997, the bathymetric survey of the east basin of Meliadine Lake was performed using a Raytheon (Model DE719D MK2) echo sounder that provided a graphical (paper chart) and digital (ASCII format) output of depth measurements along cross sectional transects (*n*=182) within the surveyed basin. All transects were conducted at constant speeds and in straight lines between lakeshores; distances to shore and UTM coordinates (using a Garmin 45 GPS receiver) at the start and end of each transect were recorded. These data were subsequently used to assign geographic coordinates to all digital depth measurements. The resulting depth and location database was merged with the digital shoreline data and analyzed using Vertical Mapper™ software, which created isobaths at 2 m contour intervals. Lake area and volume calculations, as well as the bathymetric map of the basin, were obtained using MapInfo™ software.

In 1998, bathymetric surveys of the south basin of Meliadine Lake and Peninsula lakes were carried out using a Global Positioning System (GPS) to acquire accurate positional data. A Meridata™ (Model MD 100) echo sounder, which provided a digital (ASCII format) output of depth measurements, was connected as an external sensor to a Trimble™ Pro XL field receiver (rover) to simultaneously record depth and position data. A Trimble™ Pro XRB field receiver was used as the base station located at the exploration camp on Meliadine Lake. The base station collected continuous position data to be used later in correcting positional errors in the data set collected by the rover unit. This correcting of errors, or post processing, was accomplished using the Pathfinder Office™ software. The resulting depth and location database was merged with the digital shoreline data and analysed using Vertical Mapper™ software which generated isobaths at 0.5 m contour intervals (2 m intervals for Meliadine Lake). The computer-generated isobaths were then visually compared with the colour air photos (1:10 000 scale) and corrected in cases where the shallow water contours did not parallel the aerial image of the lake bottom. Lake area calculations were obtained by using MapInfo™ software. Lake volumes were calculated using the following formula (Wetzel 1983):

$$volume = h\frac{a1 + a2 + \sqrt{a1a2}}{3}$$

where h is the vertical depth of each stratum, a1 is the area of the upper surface, and a2 is the area of the lower surface of the stratum whose volume is to be determined. The procedure consisted of determining the volumes of each successive stratum and then summing these volumes to obtain the total volume of the lake.

Bathymetric surveys were also performed for Chickenhead Lake in 2008 and for Lake J1 in 2009. In 2008, the survey was performed using a Garmin GPSMap 298 model coupled to a depth sounder that collected depth measurements and location data simultaneously. In 2009, the bathymetric survey was performed using a Teledyne RDI Workhorse Rio Grande 1200 kHz Acoustic Doppler Current Profiler (ADCP) instrument with GPS integration capability. The ADCP instrument is an accurate, rapid-sampling current profiling system designed to operate from a moving platform (e.g., manned boat, tethered boat) that allows collection of real-time depth data. A Garmin Map 60 GPS unit was used in the same time to collect coordinates and store them in a track file. Raw data were filtered for missing parameters and other inconsistencies and further analyzed with ArcGIS software. Bathymetric maps and lake areas and volumes for different isobaths were produced for each lake.

7.1.2.3 Substrate

Lake substrates were evaluated at Lakes A6 and B7 in 2009 using a combination of visual observations, underwater surveys using an Aqua-Vu® underwater camera, and an Ekman dredge. In areas where water depth was < 1 m, visual surveys were used to assess habitat types. In deeper water (>1 m), an Aqua-Vu® was trolled behind a boat and the lake bottom was assessed by a biologist via the video monitor. The Ekman dredge was used to sample lake substrates at randomly chosen intervals to verify substrate composition. Pond substrates were assessed visually using a modified Wentworth scale as follows:

- Detritus decomposed organic matter;
- Fines <2 millimetres (mm) diameter;
- Gravel 2 to 64 mm;
- Cobble 65 to 256 mm; and
- Boulder >256 mm.

7.1.3 Water Temperature

During 1997, 1998, 1999, and 2000, temperature data loggers (Vemco™) were deployed in selected lakes and streams to record water temperatures and provide a comparative database of seasonal changes and daily temperature fluctuations within a wide range of waterbodies (Figure 7-2). In lakes, the temperature loggers were placed near shore at a depth of approximately 1.2 m. In streams, the temperature loggers were placed in the deepest part of the stream (between 0.4 and 1.2 m). Loggers were set to record water temperatures at 30 min intervals; the deployment history is described below for each study year.

1997

Eight temperature loggers were deployed on 14 to 15 June 1997 and 5 additional loggers were deployed on 12 July 1997 to increase the number of monitoring stations. All temperature loggers were retrieved on 1 September 1997. Upon inspection of the downloaded data, it was discovered that only one (Stream B1-2) of 13 loggers functioned properly.

1998

Four temperature loggers were deployed overwinter (13 September 1997 until 17 June 1998) in the shallow narrows between the east and central basins of Meliadine Lake (Figure 7-2). This was done to determine if the ice reached the lake bottom thereby separating the water in the east basin from the rest of the lake. One pair of loggers (2 units taped together) was deployed on the lake bottom at 0.8 m depth to provide control data (i.e., it was assumed that this pair would become frozen in the ice). The second pair of temperature loggers was placed on the lake bottom in the deepest area in the narrows (at 1.5 m depth). Both pairs of temperature loggers recorded water (or ice) temperatures simultaneously at 1 h intervals; these data were then used to calculate mean, minimum, and maximum daily temperatures.

During the open water period of 1998 (12 to 21 June until 30 September), 12 temperature loggers were deployed in 6 lakes (A8, B2, B5, ML-SE, ML-E, and PL) and 6 streams (A0-1, B1-2, B4-5, ML-PL, ML-MR, and MR-L) in the Meliadine Study Area. Two additional loggers were deployed in the middle of the east basin of Meliadine

Lake to compare temperatures at the surface and near the lake bottom. One temperature logger was suspended 1 m beneath the surface and the other was suspended directly below it a depth of 14 m (approximately 1 m above the lake bottom). Both loggers were set to record water temperatures simultaneously at 30 min intervals from 28 July to 4 September 1998.

1999

A seasonal water temperature monitoring program was conducted in 4 streams (A0-1, B1-2, ML-MR, and MR-L) and 4 lakes (A6, B2, ML-SE, and Control Lake) in the Meliadine Study Area (Figure 7-2). The loggers were deployed on 19 or 20 June 1999. Most were retrieved on 2 September 1999; however, one logger (ML-R) was operational until 12 September 1999.at 8 sites in the Meliadine Study Area

2000

A seasonal water temperature monitoring program was also conducted at 9 sites in the Meliadine Study Area in 2000. The main objective of the water temperature program was to expand the baseline data collected in 1997, 1998, and 1999 to provide a longer-term assessment of variability between waterbodies and years. The temperature loggers were deployed in 5 streams (A0-1, B1-2, ML-MR, ML-PL, and MR-L) and 4 lakes (A6, B2, ML-SE, and Control Lake) in the Meliadine Study Area (Figure 7-2). The monitoring period extended from mid-June until late September.

7.1.4 In-Situ Water Quality

In addition to the water samples collected for lab analyses, water temperature, conductivity and pH were measured in the field during investigations of fish and fish habitat. The water quality meters used in these studies included an Oakton™ WD-35607-10 conductivity meter (±0.1 µS/cm) and a Fisher Scientific Accumet™ 1001 pH meter (±0.01 pH unit). Water temperature was measured using a mercury thermometer (±0.5°C) or a water quality meter.

Vertical profiles (surface to near-bottom) of water temperature (±0.1°C) and dissolved oxygen concentrations (±0.1 mg/L) were measured in selected study area lakes during 6 periods:

- 17 to 24 July 1997;
- 16 to 23 August 1997;
- 24 to 27 April 1998;
- 17 to 29 July 1998;
- 22 August to 4 September 1998; and
- 18 to 19 July 1999.

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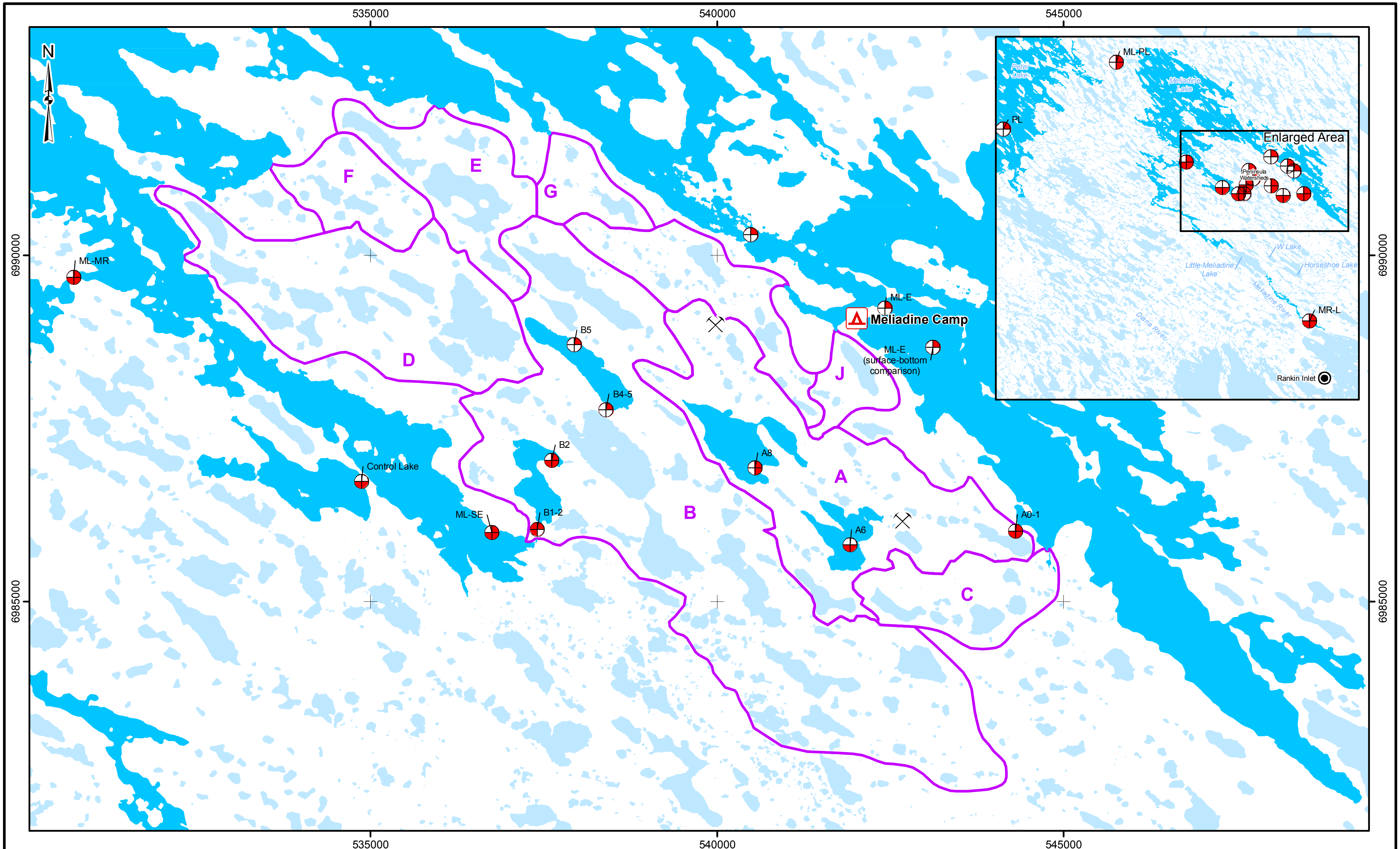

LEGEND

- Camp
- Proposed Mine Site
- Thermograph Location
- Sampled Watercourse
- Sampled Waterbody
- Waterbody
- Watershed Boundary
- 1997 / 1998 / 1999 / 2000 — Thermograph Location (Year Sampled)

1.5 0 1.5
SCALE 1:75,000 KILOMETRES

DRAFT

REFERENCE

Base data obtained from Comaplex Minerals Corporation
Projection: UTM Zone 15 Datum: NAD 83

PROJECT
COMAPLEX MINERALS CORP
COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE
WATER TEMPERATURE MONITORING LOCATIONS, 1997-2000

Golder Associates
Edmonton, Alberta

PROJECT No. 09-1373-0010			PHASE No. 1000	
DESIGN	RP	26 Nov. 2009	SCALE AS SHOWN	REV. 0
GIS	CDB	26 Nov. 2009	**FIGURE 7-2**	
CHECK				
REVIEW				

The profiles were measured at 0.5 or 1 m depth intervals using an Oxyguard^{TM} Handy Mark II dissolved oxygen and temperature meter. Water transparency (±0.1 m) was measured with a standard Secchi disk at each vertical profile location.

7.2 Stream Habitat

Detailed habitat measurements of the study area streams are provided in Appendices D2 to D4. Reach breaks at selected streams surveyed in 1998 are illustrated in Appendices D5a to D5j. The following sections briefly describe the habitat survey results for the Meliadine River and the Peninsula basin streams.

7.2.1 Meliadine River

River morphology, and hence habitat of the Meliadine River, varies greatly from its origin at the south basin of Meliadine Lake to the estuary at Hudson Bay. The outlet at Meliadine Lake (Site ML-MR) is characterized by a short channel (about 150 m in length) and high gradient (approximately 20 m/km), resulting in the predominance of riffle/rapid habitat (Appendix D4). Mean wetted channel width was 72 m, with the entire flow confined to a single channel. In spite of the large channel width, the outlet was shallow (mean depth of 0.5 m). A variety of habitat types including riffle-run-pool complexes were observed with habitat consisting primarily of riffles (57%) and shallow runs (32%). Pool habitat accounted for between 11% of habitat type by length. Habitats in excess of 0.5 m deep were not common and the maximum recorded depth was 0.75 m. The substrate consisted predominantly of coarse materials; boulders and cobbles accounted for 81% of substrate and gravel material was also common (19%). Because of high current velocities, fine particles were absent from the bed composition. Instream cover was limited to boulder gardens.

Downstream from ML-MR, the Meliadine River widens and slows, flowing through a series of lakes connected by short sections of riffle and rapid habitat. In the middle reaches, mid-way between Meliadine Lake and Hudson Bay, the river flows through Little Meliadine Lake, which features a deep (>14.8 m), long (about 5 km) and wide (about 1 km) basin with habitat comparable to that of Meliadine Lake.

Between Little Meliadine Lake and Hudson Bay, the river narrows and velocities increase to form more typical river habitats. At a site approximately 2 km upstream from the estuary, the river was confined to a single channel with a small rock-piles scattered throughout the reach. At the time of survey (June 2008), wetted widths ranged from 34 to 134 m and the flooded width of the river ranged from 58 to over 200 m. High flows precluded safe measurement of depth; however, depths were greater than 1.5 m along the periphery. Instream habitat consisted of run (72%), riffle (20%), and pool (8%) habitats. Substrate and instream habitat were difficult to gauge because the river was turbid; however, bank-side estimates suggested that substrates were dominated by boulder and cobble with gravel and fines present to lesser degrees. Aquatic plants were observed but uncommon.

7.2.2 Peninsula Basin Streams

7.2.2.1 Aerial Survey

An aerial survey of 169 streams within the Peninsula Basins A, B and D was conducted on 21 June 1997 to assess the distribution and relative frequency of streams with potential suitability for Arctic Grayling spawning and/or rearing. In total, only 24 streams (15%) were rated as Classes 4 to 6, indicating the presence of potential spawning habitat. Of the remaining 145 streams that were classified, 73% were designated as Classes 0 to 2 (low quality fish habitat). Class 3 streams, some of which may provide marginal spawning habitat, accounted for 12% (n = 21) of the total. Interbasin differences between the total percent of each class were observed;

however, they were generally minor and confined to the first 3 categories (i.e., Classes 0 to 2) of streams. Individual stream classifications are presented in Appendix D6a and the locations of the streams are provided in Appendices D6b to D6e. The data are summarized for each basin in Table 7-1.

Table 7-1: Aerial Classification of Small Streams within the Peninsula Basins, 21 June 1997

Habitat Quality	Class[a]	Number of Streams			Total	
		Basin A	Basin B	Basin D	Number	(%)
Low	0	14	13	1	28	17
	1	20	27	12	59	35
	2	6	20	11	37	22
Marginal	3	2	17	2	21	12
High	4	6	9	2	17	10
	5	2	3	1	6	4
	6	0	1	0	1	1
Total		**50**	**90**	**29**	**169**	**100**

[a] see Section 7.1.1.2 for class descriptions

7.2.2.2 Ground Surveys

In total, 68 habitat assessments were carried out at 31 streams in 1997, 1998, 2004, and 2009. Data for the streams in Basins A, B, D, F, G, H and J have been grouped and are summarized below by basin. Detailed transect data and summary information are provided in Appendices D2, D3 and D4. Breaks in habitat reaches for streams surveyed in 1998 (Appendix D4) are shown on aerial photographs in Appendices D5a to D5j.

Most (77%) streams featured 2 or more channel types. Confined channels were most common, however many streams had sections of flow separated into 2 or more channels. A small portion of the streams surveyed (7%) consisted almost entirely of dispersed flow over grass-covered terrain. In general, channel width was not an appropriate measure of the stream's size or discharge, especially for smaller streams, because of the highly braided character of many of the surveyed streams. Large channel widths were not directly correlated with high discharge as flow was often diverted through multiple channels or was dispersed over terrestrial vegetation with no defined channel observed.

Stream habitat was dominated by shallow runs in terms of both frequency of occurrence and abundance. Other habitat types encountered frequently included riffles and riffle/boulder garden combinations. High quality habitats (i.e., based on water depth and availability of cover for fish) were rare and occurred only in the form of pools and deeper run habitats, indicating that the majority of the habitat was shallow (i.e., <0.5 m in depth). Substantial portions of stream habitat (especially in the smallest streams) consisted of dispersed flow over grass suggesting limited potential to support fish through the year.

Substrate in most of the surveyed streams was dominated by organic materials, primarily grass. Coarse materials including cobble, boulder and gravel were also common and fine materials (e.g., silt and sand) were present in small amounts.

Peninsula Basin streams featured adequate cover for fish in approximately half of the channel area. Several types of cover were available, with boulder gardens, aquatic vegetation, and submerged terrestrial vegetation being the most abundant. Limited amounts of undercut or overhanging bank were also available.

Basin A Streams

Eight streams were surveyed within Basin A during 21 investigations. Streams A0-1, A1-2, A2-3, A3-4, A4-5, A6-7, and A7-8 were surveyed in June 1997 and June 1998. Streams A0-1, A6-7 and A7-8 were also surveyed in July 1997, whereas Stream A5-6 was surveyed 3 times (in June 1997, June 1998 and July 2009). Streams ranged in length from 37 m (A3-4) to 336 m (A5-6) with a mean length of 150 m. Mean widths varied from 2.7 m (A1-2) to 27.2 m (A7-8) with an average width of 8.5 m. Stream habitat was comparable among streams with the predominance of run habitat and occasional presence of riffles, flats and pools. Boulder gardens were recorded in 5 streams. Substrate composition was consistent among streams; on average cobble was dominant (57% by area), followed by boulder (18%), gravel (14%), organics (8%), and fines (4%).

Of note is Stream A5-6 because it is located in an area proposed to be altered during mine development. The stream is 336 m in length and is dominated by riffles, shallow runs, and boulder gardens with occasional flats. It has a maximum depth of 0.7 m. Cobble (43%) and organics (23%) dominated the substrates demonstrating the diverse habitats present in the stream. Gravel (13%) and cobble provided suitable spawning habitat for Arctic Grayling residing in nearby Lake A6. Instream cover was provided primarily by boulders (27%) with aquatic and overhanging vegetation and undercut banks present to a lesser degree. These features offer high quality habitat for Arctic Grayling rearing, as well as for forage fish such as Ninespine Stickleback and Slimy Sculpin.

Basin B Streams

In total, 28 habitat assessments were performed at 12 streams in Basin B (Appendices D3 and D4). Twelve streams were surveyed in June 1997, with repeat surveys conducted at 6 of the streams in July 1997 and 4 of the streams in August 1997. Additional surveys were conducted at Streams B0-1, B1-2, B3-4, B4-5, B5-6, and B6-7 in June 1998. The streams ranged in length from 58 m (D4-45) to 247 m (B4-5), with a mean length of 141 m. Mean widths varied from 0.8 m (B5-6) to 32.9 m (B4-36) with an average width of 5.9 m. Stream habitat was similar among the streams, with the predominance of run habitats interspersed with occasional riffles and pools. Boulder gardens were present in 7 streams and a small cascade was present in Stream B5-6. Substrate composition ranged somewhat among streams, more so than was observed in Basin A. For example, substrates in Stream B4-36 were composed almost entirely of organics (93%) whereas 78% of the stream bed at Stream B6-7 was cobble. On average, cobble was dominant (36.2% of total surveyed area), followed by boulder (22%), organics (22%), gravel (15%), and fines (5%).

Stream B6-7, the outlet from Lake B7, is notable because it is located in an area proposed to store mine tailings. The stream, 131 m in length, is dominated by shallow run habitat with occasional riffles and has a maximum depth of 0.5 m. Cobble (78%) and gravel (10%) dominate the substrates, providing spawning habitat for Arctic Grayling residing in nearby Lakes B6 and B7. Instream cover is provided primarily by boulders (65%) with aquatic and overhanging vegetation and undercut banks present to a lesser degree.

Basin D Streams

Streams surveyed in Basin D (*n*=14) included Streams D0-1, D1-2, D3-4, D4-5, D5-6, and D6-7. All surveys were conducted in 1997 (6 in June, with repeated surveys at 4 streams in July and 3 in August), except for

Stream D0-1 which was also resurveyed in June 1998. The streams ranged in length from 29 m (D4-5) to 268 m (D5-6), with a mean length of 111 m. Mean channel widths varied from 0.6 m (D1-2) to 32.0 m (D3-4). Streams were dominated by run habitat, with occasional riffles and pools. Similar to Basin B streams, cobble was the dominant substrate type (35% by area on average), followed by organics (28%), gravels (23%), boulder (12%), and fines (3%). Stream D3-4 is of note as substrates were composed entirely of organics.

Basin F Streams

Streams F0-1 and F5-6 were sampled in June 1997. The streams were approximately 168 and 78 m in length, respectively, with mean channel widths of 0.6 and 0.3 m. Stream habitat was dominated by run habitat with occasional riffles, pools, and a cascade in Stream F5-6. Substrates were dominated by organics (53% by area on average), followed by cobble (19%), gravel (15%), fines (8%), and boulder (6%).

Basin G Streams

Streams G0-1 and G1-2 were surveyed in June 1997. Each stream was approximately 240 m in length, with mean channel widths of 0.4 and 1.3 m, respectively. Stream habitat was dominated by runs with occasional riffles, pools, flats, and a cascade in Stream G0-1. Similar to Basin F streams, substrates were dominated by organics (66% by area on average), followed by gravel (16%), cobble (9%), fines (8%), and boulder (1%).

Basin H Streams

Streams in Basin H were unique in that they were primarily seasonal with flows relying heavily on snowmelt or large precipitation events. The length of time that streams flow decreased with distance upstream in the watershed. Typically, ponds at higher elevations in the basin (central and west portions of the basin) were small (e.g., H15a to H15l) as were the connections between them. These narrow (<1.0 m width), shallow (<0.5 m) streams flow for short periods of time and were the first to dry among basin streams. Channels were poorly defined with no bed or bank with water flowed over terrestrial vegetation. Streams lower in the watershed (e.g., H05-17) were somewhat more defined with some sections of substrate and defined channel banks owing to longer periods of flow during snowmelt and after precipitation events.

These streams provide seasonal access for fish (e.g., Ninespine Stickleback) to Basin H ponds from Meliadine Lake. The extent to which fish move throughout the basin likely varies annually and is a direct result of the timing and extent of flows in the small streams connecting Basin H ponds. If streams flow for longer periods of time, fish will have more opportunities to move into more areas of the watershed. However, small ponds in upper area of the watershed may dry and all ponds freeze to bottom in winter. Therefore, these seasonal movements of fish into the watershed do not result in the establishment of permanent populations.

Basin J Streams

The only stream investigated in Basin J was Stream J0-1, which connects Lake J1 to Meliadine Lake; it was surveyed in July 2004. The stream was approximately 200 m in length with and average channel width of 3.1 m and a maximum depth of 0.8 m. Stream habitat was dominated by run habitat with occasional riffles, pools and flats. Substrates were dominated by organics (81% by area), followed by fines (16%) and gravel, cobble, and boulder at <2%.

7.3 Lake Habitat

Lake habitat in the study area included large lakes such as Meliadine and Peter lakes as well several much smaller lakes on a Peninsula of Meliadine Lake and one in the Atulik River drainage. Investigations focused on characterizing morphometry, bathymetry, and substrate. The purpose of the investigations was to collect baseline information in areas potentially affected by mine development and/or activity and to provide a regional context. The following sections present the results separately for the large lakes, Peninsula lakes and Chickenhead Lake. Bathymetric data and maps are provided in Appendices D7a-o.

7.3.1 Large Lakes

7.3.1.1 Morphometry

The morphometric characteristics of Meliadine, Little Meliadine and Peter lakes (based on 1:50 000 NTS maps and air photo interpretations) are summarized in Table 7-2.

Table 7-2: Morphometric Characteristics of Large Lakes in the Meliadine Study Area

Water-body	Surface Area (ha)	Volume ($m^3 \times 10^3$)	Depth (m)		Shoreline Length (km)			Shoreline Development Index	Islands	
			Mean	Max.	Mainland	Islands	Total		n	Area (ha)
ML	10689	n.d.	n.d.	n.d.	269.8	195.3	465.1	12.7	243	1288.8
ML-E	2212	98 851	4.5	21.2	73.2	30.3	103.5	6.4	29	206.3
ML-S	1195	48 429	4.3	22.2	50.8	17.9	68.7	5.8	37	53.8
PL	15025	n.d.	n.d.	23.5 [a]	289.4	278.7	568.1	13.1	299	2216.0
LML	496	n.d.	n.d.	>14.8	19.6	2.7	22.3	2.8	7	8.0

[a] Maximum encountered depth in Peter Lake (Kidd et al. 1998).

n.d. = not determined.

Of the large lakes in the Meliadine Study Area, Peter Lake was the largest (15 025 ha) and the deepest (23.5 m). Little Meliadine Lake was the smallest with a surface area of 496 ha and a maximum depth exceeding 14.8 m. The large number of islands within Meliadine and Peter lakes (243 and 299, respectively) resulted in high shoreline development indices for these lakes (12.7 and 13.1, respectively). In contrast, the shoreline development index of Little Meliadine Lake was considerably lower (2.8), due to more regular shoreline and fewer islands.

7.3.1.2 Bathymetry

East Basin of Meliadine Lake

The bathymetric survey of the east basin of Meliadine Lake was carried out during 25 to 29 July 1997. Based on 182 cross-sectional transects, a bathymetric map of the basin was produced (Appendix D7b). The east basin of Meliadine Lake (2212 ha) contributes approximately 21% to the entire area of the lake. It is separated from the rest of the lake by a shallow and narrow area (up to 2.3 m deep, 100 to 300 m wide, and 800 m long) that features numerous rocky islands and reefs. This constriction may result in separation of the east basin from the rest of the lake if sufficient ice cover (up to 2.5 m in depth) were to impede or restrict flow between the basins during winter.

A large esker bisects the east basin along its northwest to southeast orientation. The lowest areas along the esker's ridge are submerged to form a chain of 12 elongated islands. The lake basin southwest of the esker is approximately 11 km long, 1 km wide, and almost devoid of islands. A "trench" of at least 8 m in depth follows most of the esker's length; it contains 2 isolated "holes" that exceed 18 m in depth. The area northeast of the esker is generally shallower and features numerous bays, extensive peninsulas, and large islands; however, it also contains the deepest point (21.3 m) within the surveyed area.

The total volume of the east basin of Meliadine Lake was estimated at 98 851 x 10^3 m^3. About one third of this volume is contributed by lake areas that are less than 2 m in depth (Table 7-3). This indicates a considerable reduction in lake volume during the winter months, when these areas may freeze to the bottom. Owing to the high shoreline development index (6.4) and the shallow nature of the lake, the littoral zones (i.e., less than 6 m in depth) contribute approximately 66% to the lake's area (Figure 7-3). Although "deep-water" regions (10 m or more in depth) were frequently encountered throughout the surveyed basin, their contribution to the total area was small (5.5%). The mean depth of the east basin was estimated at 4.5 m (Table 7-2).

Table 7-3: Vertical Distribution of Lake Area and Volume in the East and South Basins of Meliadine Lake

Depth (m)	Meliadine Lake - East Basin				Meliadine Lake - South Basin			
	Area		Volume		Area		Volume	
	(ha)	*(%)*	(m^3 x 10^3)	*(%)*	(ha)	*(%)*	(m^3 x 10^3)	*(%)*
>0	2211.6	*100.0*	98 851.1	*100.0*	1135.1	*100.0*	48 428.9	*100.0*
>2	1561.3	*70.6*	63 931.8	*64.7*	777.4	*68.5*	29 416.9	*60.7*
>4	1138.9	*51.5*	37 119.6	*37.6*	497.5	*43.8*	16 772.2	*34.6*
>6	749.1	*33.9*	18 320.4	*18.5*	322.2	*28.4*	8 639.5	*17.8*
>8	372.2	*16.8*	7 382.6	*7.5*	175.6	*15.5*	3 735.6	*7.7*
>10	120.7	*5.5*	2 908.6	*2.9*	79.1	*7.0*	1 251.7	*2.6*
>12	57.1	*2.6*	1 331.8	*1.4*	15.6	*1.4*	386.5	*0.8*
>14	30.3	*1.4*	474.3	*0.48*	8.0	*0.7*	155.5	*0.3*
>16	10.8	*0.49*	93.4	*0.09*	2.8	*0.2*	52.4	*0.1*
>18	1.4	*0.06*	12.3	*0.01*	1.2	*0.1*	14.2	*0.03*
>20	0.2	*0.01*	0.3	*<0.01*	0.19	*0.02*	2.0	*0.004*
>22	-	-	-	-	0.02	*<0.01*	0.14	*<0.001*

Note: % = percentage, ha= hectare.

South Basin of Meliadine Lake

The bathymetric survey of the south basin of Meliadine Lake was carried out in July 1998, resulting in a bathymetric map presented in Appendix D7c. The south basin of Meliadine Lake (1135 ha) contributes approximately 11% to the entire area of the lake. The basin is approximately 12 km long, up to 1.5 km wide, and exhibits a northwest to southeast orientation. Whereas the southeast end of the basin is generally shallow (less than 4 m deep), the northwest sections feature more extensive areas of water deeper than 8 m. Isolated "holes" that exceed 14 m in depth were encountered; however, they contributed only 0.7% to the total basin area. The deepest “hole” within the surveyed area was 22.2 m deep; it was located approximately 3 km southeast of the outflow into the Meliadine River.

The total volume of the south basin of Meliadine Lake was estimated at 48 429 x 10^3 m^3. Similar to the east basin of the lake, more than one third of this volume is contributed by areas that are less than 2 m in depth (Table 7-3). Owing to the shallow nature of the south basin, the littoral zones (i.e., less than 6 m in depth) contribute approximately 72% to the lake’s area. Although “deep-water” regions (10 m or more in depth) were frequently encountered throughout the surveyed basin, their contribution to the total area was small (7.0%). The mean depth of the south basin was estimated at 4.3 m. The hypsographic (i.e., depth-area) curve of the south basin of Meliadine Lake is compared to the east basin in Figure 7-3.

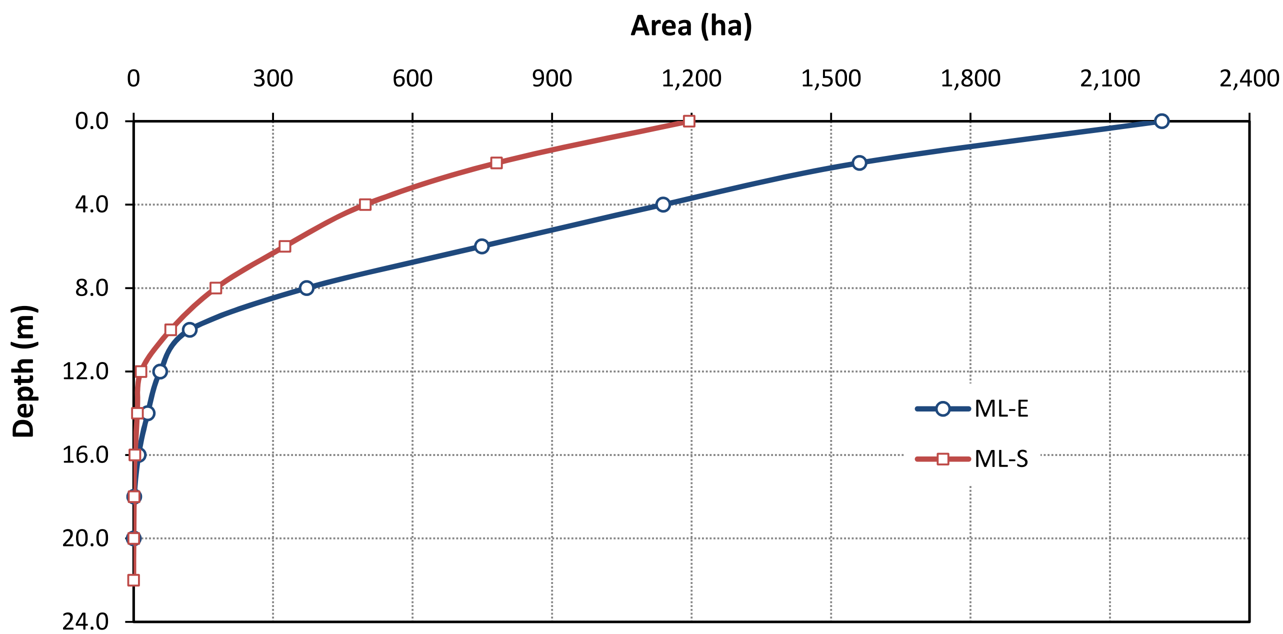

Figure 7-3: Depth-Area Curves for the East (ML-E) and South (ML-S) Basins of Meliadine Lake

7.3.1.3 Substrate

Substrate in Meliadine Lake was characterized by coarse materials consisting of a boulder/cobble mix along the shallow areas close to shore. Transition areas, consisting of fine organic materials interspersed among cobble were common throughout most of the lake. Substrates within the deep sections of the lake were composed entirely of fine organic substrates and silt.

7.3.2 Peninsula Lakes

7.3.2.1 Morphometry

The morphometric characteristics of the Peninsula basin lakes (based on bathymetric surveys and 1:50 000 NTS maps and air photo interpretations) are summarized in Table 7-4.

Table 7-4: Morphometric Characteristics of Surveyed Lakes and Ponds in the Peninsula Basins of the Meliadine Study Area

Water-body	Surface Area (ha)	Volume ($m^3 \times 10^3$)	Depth (m)		Shoreline Length (km)			Shoreline Development Index	Islands	
			Mean	Max.	Mainland	Islands	Total		n	Area (ha)
A1	14.8	n.d.	n.d.	2.0	2.2	0.0	2.2	1.6	0	0.0
A6	54.6	839.3	1.5	4.3	5.6	0.2	5.8	2.2	2	0.1
A8	89.7	1419.3	1.6	4.2	7.5	0.0	7.5	2.3	0	0.0
A54	6.2	35.5	0.6	1.3	1.4	0.0	1.4	1.5	0	0.0
B2	48.9	777.1	1.6	3.4	4.6	0.0	4.6	1.9	0	0.0
B4	86.2	753.5	0.9	2.4	5	0.5	5.5	1.7	4	0.5
B5	55.9	872.8	1.6	3.4	4.9	0.0	4.9	1.9	0	0.0
B6	11.9	165.4	1.4	4.0	1.8	0.0	1.8	1.5	0	0.0
B7	58.1	852.5	1.5	5.1	5.3	0.1	5.5	2.0	2	0.0
B9	0.6	5.0	0.8	1.3	0.4	0.0	0.4	1.4	0	0.0
B10	0.4	1.3	0.3	0.8	0.3	0.0	0.3	1.3	0	0.0
D1	17.8	217.6	1.2	2.5	2.3	0.0	2.3	1.5	0	0.0
D3	14.7	n.d.	n.d.	2.3	1.7	0.0	1.7	1.3	0	0.0
D4	17.1	n.d.	n.d.	2.5[a]	2.2	0.1	2.3	1.6	1	0.1
D5	6.2	n.d.	n.d.	2.0	1.3	0.0	1.3	1.5	0	0.0
D7	72.5	1183.4	1.6	2.8	5.2	0.0	5.2	1.7	0	0.0
G2	11.9	n.d.	n.d.	2.5	2.1	0.0	2.1	1.7	0	0.0
Control	123.2	n.d.	n.d.	>4.3	9.3	0.5	9.8	2.5	1	0.7

[a] from Hubert and Associates Ltd. (1996)
n.d. = not determined, m = metre, km = kilometre, ha= hectare

With a surface area of 89.7 ha, Lake A8 is the largest waterbody among the Peninsula lakes; it is also one of only 6 lakes that have a maximum depth exceeding 3.0 m. The shoreline development indices were low, ranging from 1.3 to 2.5, reflecting the relatively straight shores (without pronounced bays or peninsulas) and few islands.

7.3.2.2 Bathymetry

The bathymetric maps of selected Peninsula lakes and ponds (A6, A8, A54, B2, B4, B5, B6, B7, B9, B10, D1, D7 and J1) are presented in Appendices D7d to D7p. The surveyed Peninsula lakes ranged from 11.9 ha (Lake B6) to 89.7 ha (Lake A8) in surface area and were relatively shallow (mean depths ranged from 0.9 m in Lake B4 to 1.6 m in akes B5 and D7. Only 4 lakes had depths of 4.0 m or greater; the deepest spot within the Peninsula lakes was recorded in Lake B7 (5.1 m). Most of lake volume is contributed by the surface 2 m layer of water. When the ice cover exceeds 2 m in depth, as is often the case during late winter (Hubert and Associates Ltd. 1996), the under-ice water volume is greatly reduced and the lake may freeze to the bottom. This is likely a frequent occurrence in lakes B4, J1 and D1, where only 0.6, 0.9 and 2.9% of total volume is contributed by zones deeper than 2 m (Appendix D7a). The proportions of deep water zones are higher in Lakes B7, B6, A6, A8, B2, and B5 (from 9.0 to 17.8% of total lake volume) and appear to be sufficient to allow fish to overwinter. Vertical distributions of lake area and volume within the Peninsula waterbodies are presented in Appendix D7a, the corresponding hypsographic (i.e., depth-area) curves are plotted in Figure 7-4.

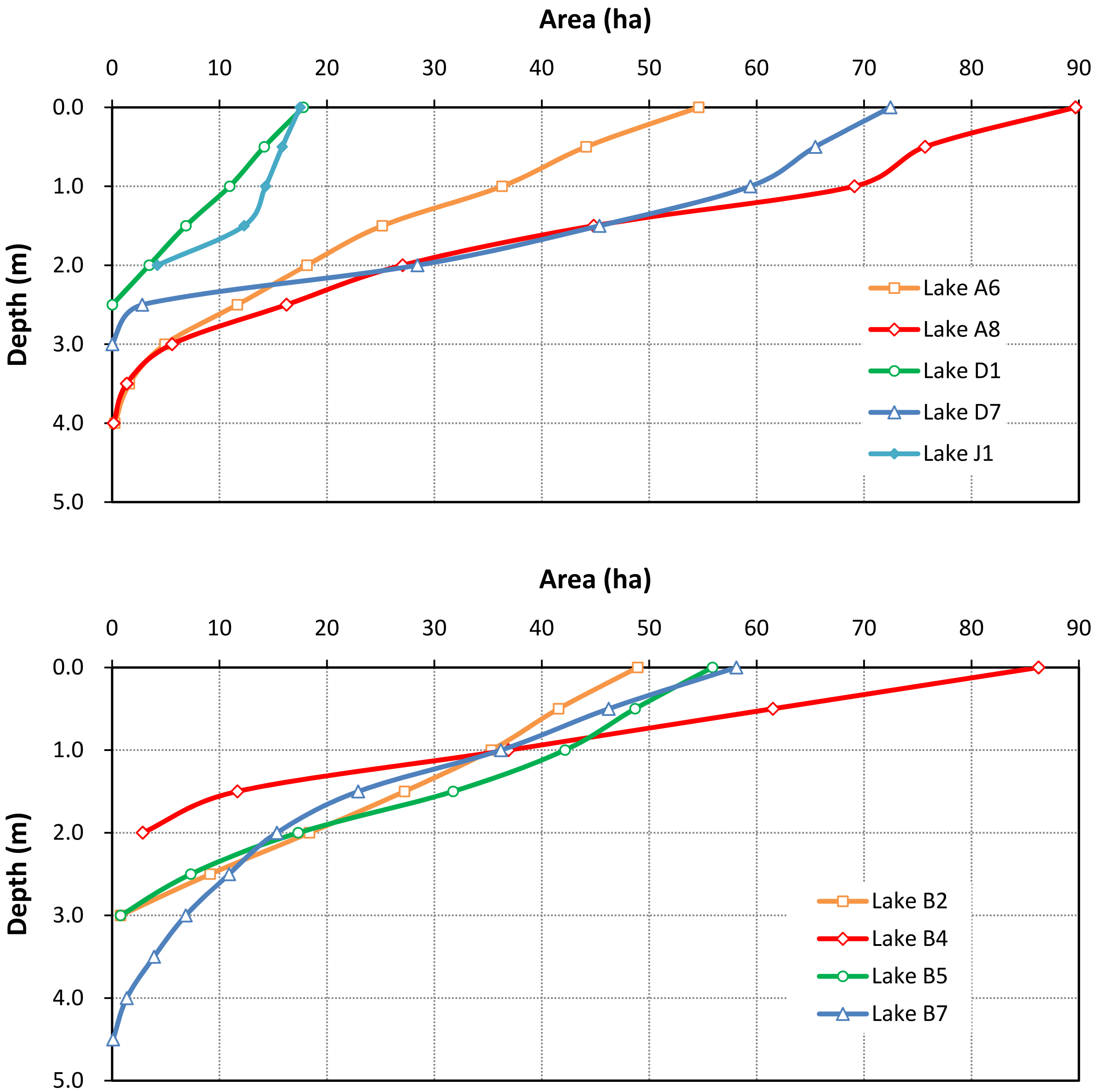

Figure 7-4: Depth-Area Curves for Peninsula Lakes

7.3.3 Chickenhead Lake

Chickenhead Lake in the Atulik River drainage is 135.5 ha in area, has a maximum surveyed depth of 8.9 m, a mean depth of 1.7 m, and contains approximately 2 324 x 10^3 m^3 of water. The bathymetric map of Chickenhead Lake (Appendix D7q) shows a wide variety of potential habitats for fish. Shallow areas (<1 m) are prevalent along the lake's periphery, especially in the western portion, and areas of moderate depth (1 to 4 m) are scattered throughout the lake. There is one area of substantial depth (>8 m) located in the north-central area of the lake. Hypsographic data for Chickenhead Lake is presented in Figure 7-5.

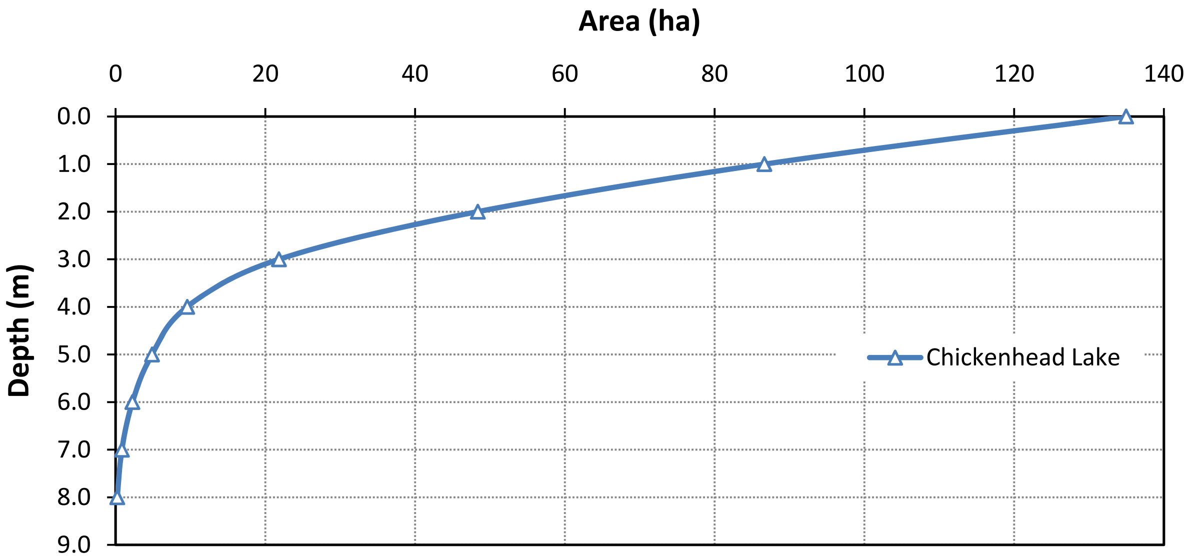

Figure 7-5: Depth-Area Curve for Chickenhead Lake

7.3.3.1 Substrates

Detailed substrate surveys were conducted in Lake B7 and the east bay of Lake A6 in July 2009 to support quantification of habitat units for the no-net-loss plan. Both of these waterbodies are proposed to be directly affected by the mine development.

Lake B7

Substrate in Lake B7 consisted mostly (63% of total area) of coarse materials such as exposed bedrock, boulder, and cobble (Figure 7-6). Fine materials comprised 20% of the total area, while the fine/coarse mix substrate accounted for the remaining 17% of the total area. The fine/coarse substrate mix was often a transition zone between the coarse and fine sediment types. On a finer scale, coarse substrates at <2 m accounted for 62% of the total lake area. Organic material was predominant at the 2 to 4 m depth zones and comprised 16% of the total area. The fine/coarse substrate mix was present at depths of less than 2 m (10% of total area) and 2 to 4 m (8% of total area). Fine materials were the only substrate type detected at depths greater than 4 m and comprised 2% of the total lake area.

Substrates in B7 provide habitat for spawning and rearing for multiple fish species. Coarse substrates around the perimeter of the lake and across the majority of the east end of the lake provide interstitial spaces for rearing of young Arctic Grayling, Burbot, Cisco and Ninespine Stickleback. Patches of sand which lie among the coarse substrate may provide suitable spawning habitat for Burbot and Cisco. Arctic Grayling do not spawn within the lake but have been documented spawning in the outlet from B7 to B6 (B6-7). Depth of over 4 m in the centre of the lake provide adequate areas for overwintering.

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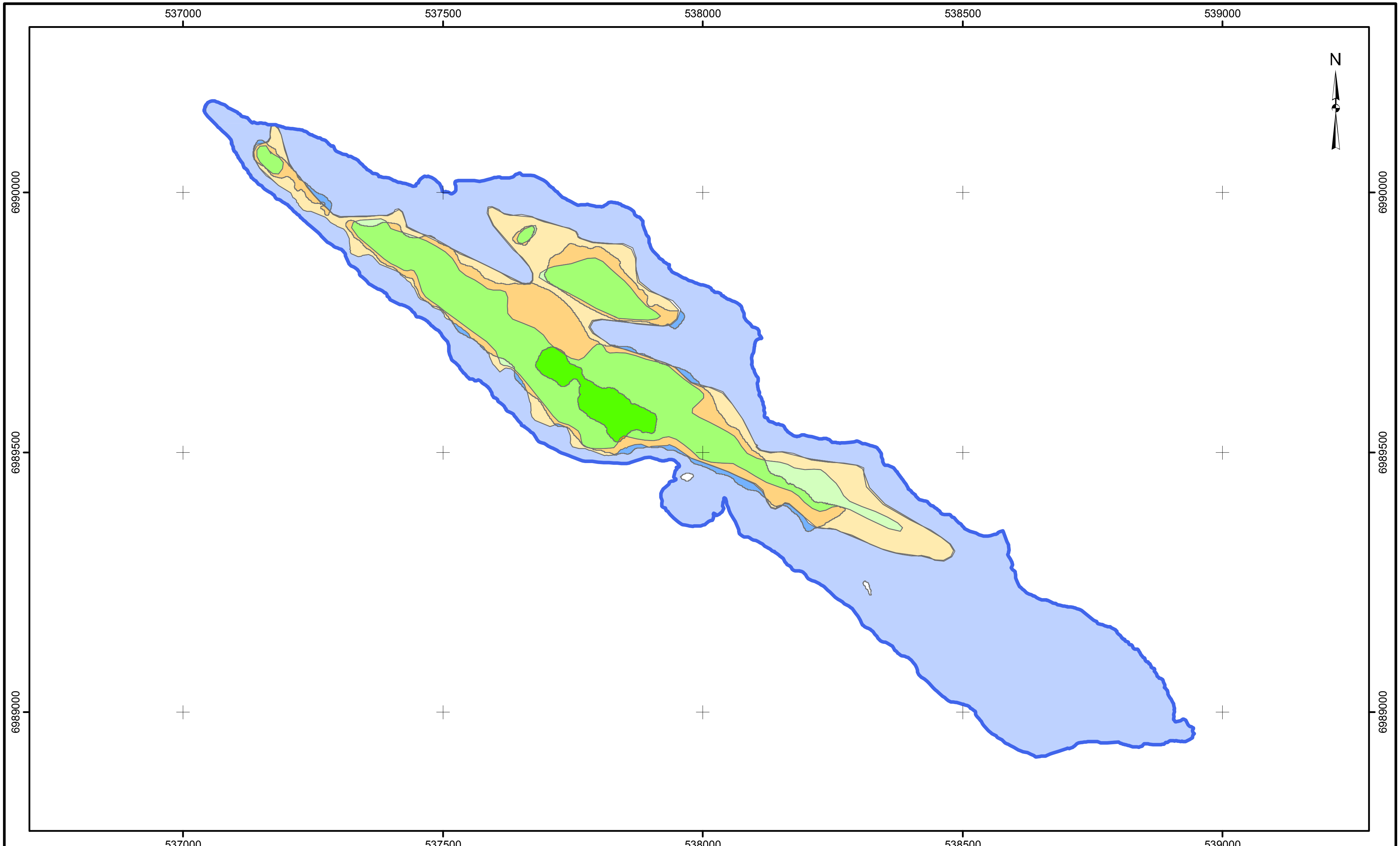

LEGEND

- Fine Substrate (0 - 2 m)
- Fine Substrate (2 - 4 m)
- Fine Substrate (> 4 m)
- Coarse Substrate (0 - 2 m)
- Coarse Substrate (2 - 4 m)
- Fine/Coarse Mix Substrate (0 - 2 m)
- Fine/Coarse Mix Substrate (2 - 4 m)
- Fine/Coarse Mix Substrate (> 4 m)

200 0 200

SCALE 1:10,000 METRES

DRAFT

REFERENCE

Base data obtained from Comaplex Minerals Corporation

Projection: UTM Zone 15 Datum: NAD 83

PROJECT

COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

SUBSTRATE MAP OF LAKE B7

Golder Associates
Edmonton, Alberta

PROJECT No. 09-1373-0010			PHASE No. 1000	
DESIGN	CC	12 Nov. 2009	SCALE AS SHOWN	REV. 0
GIS	CDB	12 Nov. 2009		
CHECK			**FIGURE 7-6**	
REVIEW				

East Bay of Lake A6

The east bay in Lake A6 consisted predominately of coarse substrates consisting of boulder and cobble, interspersed with finer organic materials (Figure 7-7). Average depths range from 0 2 m, however a deep hole (i.e. 3.1 m) exists near the north side of the bay. The coarse substrates may provide rearing habitat for species such as Arctic Grayling, Cisco, and Threespine and Ninespine Stickleback.

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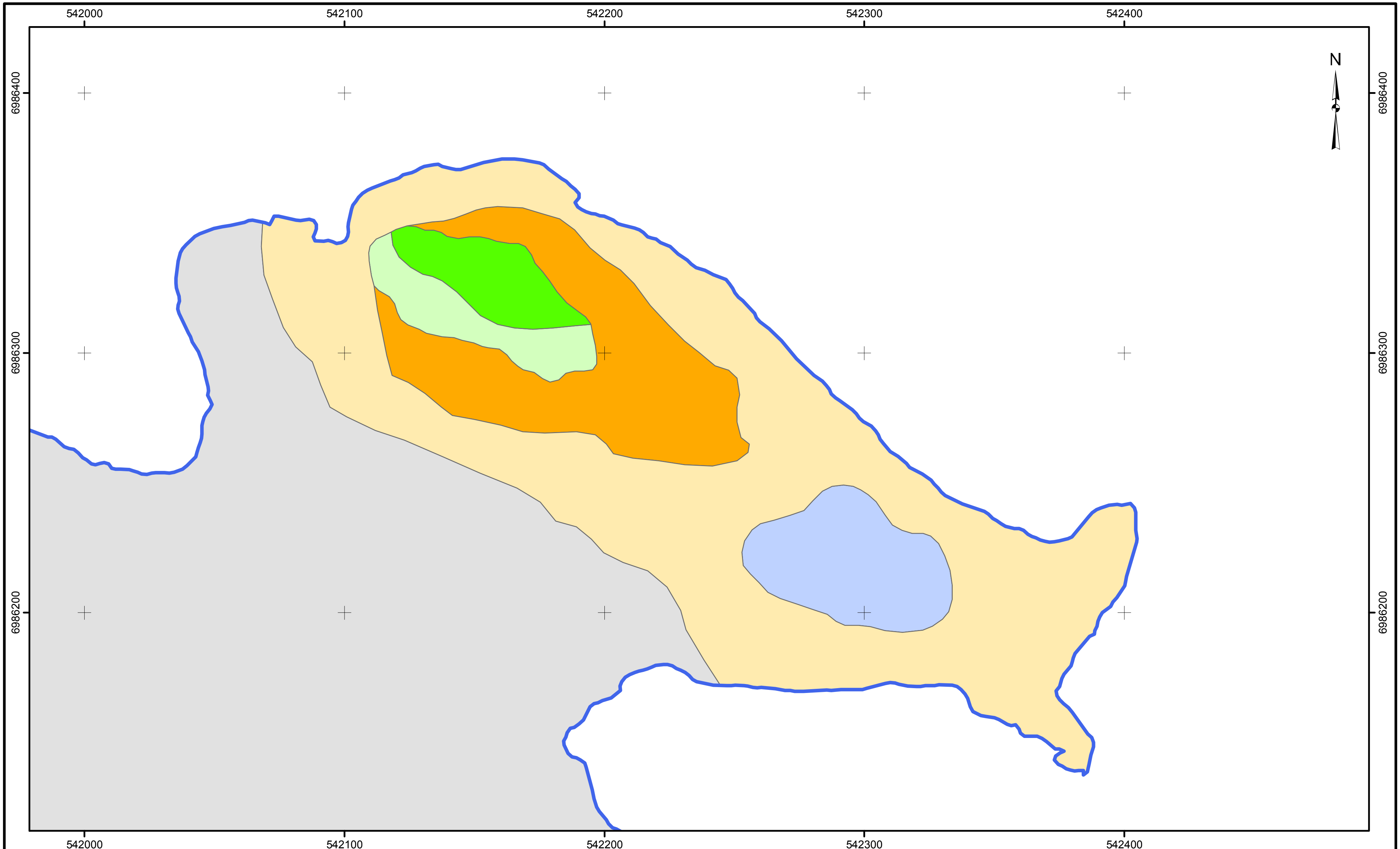

LEGEND

- Fine Substrate (0 - 2 m)
- Fine Substrate (2 - 4 m)
- Coarse Substrate (1 - 3 m)
- Fine/Coarse Mix Substrate (0 - 2 m)
- Fine/Coarse Mix Substrate (2 - 4 m)
- Not Sampled

40 0 40

SCALE 1:2,000 METRES

DRAFT

REFERENCE

Base data obtained from Comaplex Minerals Corporation
Projection: UTM Zone 15 Datum: NAD 83

PROJECT

COMAPLEX MINERALS CORP

COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

SUBSTRATE MAP OF EAST BAY OF LAKE B7

Golder Associates
Edmonton, Alberta

PROJECT No. 09-1373-0010			PHASE No. 1000	
DESIGN	CC	16 Nov. 2009	SCALE AS SHOWN	REV. 0
GIS	CDB	16 Nov. 2009	**FIGURE 7-7**	
CHECK				
REVIEW				

7.4 Pond Habitat

In total, 95 assessments were conducted at 73 ponds located within or near proposed mine developments in Peninsula basins. Investigations occurred during summer in 1998 (*n*=5), 2008 (*n*=37), and 2009 (*n*=53) in Basins A, B, and H. Data on area, perimeter, maximum depth, substrate, cover and basic water quality in these ponds are presented in Appendix D8.

Basin H ponds were studied disproportionately more than other Peninsula basin ponds (41 out of 73 ponds studied) because they lie within an area proposed to be used by one of the alternative options to store mine tailings. In 2008, 20 ponds (H1 to H20) were sampled to assess fish presence and describe aquatic habitat in general terms. In 2009, a more thorough survey was conducted and more detailed habitat data were collected. In addition to collecting similar data as in 2008, visual surveys were conducted to categorize and quantify pond substrate and make observations regarding habitat quality and available cover for fish. These observations were then used to assess habitat potential for overwintering, movement, spawning, and rearing by fish. Cover types were described as a proportion of available cover rather than proportions of pond area. Digital photos were taken to supplement site descriptions.

The majority of the ponds investigated were small and shallow with little potential to support fish for an extended period of time. Pond areas ranged from 0.031 ha (H2a) to 15.8 ha (H17); however, most (72%) ponds were smaller than 0.4 ha. The maximum depths encountered ranged from 0.05 m (H15i) to 1.7 m (H17); most (56%) of the ponds did not exceed 0.5 m in maximum depth. Based on these shallow depths, all of the studied ponds ponds most likely freeze to bottom during winter. The ponds were warm (up to 27.6 °C) and well-oxygenated owing to shallow depth and wind-induced mixing (Table 7-5). Conductivity and pH values were highly variable.

Table 7-5: Summary of Water Quality Data Collected from Peninsula Ponds, 1998, 2008, and 2009

Parameter	Sample Size	Mean	SD	Range
Temperature (°C)	95	18.8	3.1	13.6 - 27.6
Conductivity (µS/cm)	95	216.2	290.2	31 - 2007
pH	95	7.7	0.9	5.04 - 9.02
Dissolved Oxygen (% saturation)	21	105.3	9.4	89 - 126

Pond substrates consisted predominately (67.4%) of fine-scale substrates including organics, fines, and to a lesser extent, sand (Figure 7-8). Coarse substrates were less common and were dominated by boulders (17.2%); gravel (5%) and cobble (10.5%) comprised only a small portion of the pond substrate. Typically, small ponds (e.g., H7) were dominated by fine substrates with occasional boulders or cobble shoals scattered throughout. Gravel and/or cobble were often observed along pond margins. In contrast, larger ponds (e.g., B25) were dominated by coarse substrates, more typically observed in Peninsula lakes.