for cold-water fish species, such as lake trout and round whitefish, than under baseline conditions.

The Project is expected to have low or negligible effects on aquatic health in Kennady Lake from changes in the chemical constituents of water quality; therefore, no effects to fish populations or communities are expected to occur from changes in aquatic health.

Kennady Lake Recovery

An aquatic ecosystem will develop within Kennady Lake after refilling and reconnection of its basins. The physical and chemical environment in Kennady Lake is expected to be in a state that will allow re-establishment of an aquatic ecosystem, although the re-established communities may differ from pre-development communities.

The expected time frame for recovery of the phytoplankton community is estimated to be approximately five years after refilling is complete, taking into account that the community will begin to develop during the refilling period. Zooplankton community development is predicted to follow recovery of the phytoplankton community (i.e., likely within five to ten years of Kennady Lake being completely refilled). The increased nutrient levels in the refilled Kennady Lake will facilitate community development and result in a more productive plankton community. Recovery of the benthic invertebrate community in Kennady Lake is expected to be slower than that of the plankton communities, with an estimated time for recovery of about ten years after refilling is complete. The benthic invertebrate community is expected to be different from the community that currently exists in Kennady Lake and in surrounding lakes; the community will likely be of higher abundance and biomass, reflecting the more productive nature of the lake, and will likely be dominated by midges and aquatic worms.

The re-establishment of the fish community within Kennady Lake, and the speed at which it will occur, will depend on the ability of fish to re-colonize the refilled lake, the habitat conditions within the lake, and how succession takes place within the refilled system after it has been fully connected to the surrounding environment. It is expected that a fish community will become re-established in Kennady Lake.

The B, D, and E watersheds are likely to be the primary source of initial migrants into the refilled lake. As conditions improve, and water depths increase, the early migrants will become permanently established. The increase in primary productivity may also result in increased growth and production of these small-bodied forage fish species. During refilling, exclusion measures will be used to limit the initial migration of large-bodied fish into the lake. Following the removal of Dyke A, fish will also enter from Area 8. The final fish community of Kennady Lake will likely continue to be characterized by low species richness (less than 10 species), consisting of a small-bodied forage fish community (e.g., lake chub, slimy sculpin, ninespine stickleback) and large-bodied species, such as Arctic grayling, northern pike, burbot, round whitefish, lake trout, and possibly longnose sucker. Total lake standing stock and annual production may be increased over what currently exists in the lake. It is expected that the fish species assemblage (i.e., fish species present) within Kennady Lake will be similar to pre-Project conditions, but that due to biotic and abiotic factors, the community structure (i.e., relative abundances of the species) may differ. Mesotrophic conditions are likely to be more favourable to northern pike, burbot and Arctic grayling, than cold-water species, such as lake trout and round whitefish. As such, the relative abundances of the large-bodied fish species are likely to change from baseline conditions.

Overall, it is the life history attributes of large-bodied predatory fish species that will ultimately determine the duration of the complete recovery of the Kennady Lake aquatic ecosystem. Northern pike are expected to re-establish a stable, self-sustaining population in Kennady Lake later than Arctic grayling or burbot (i.e., approximately 50 to 60 years following the complete refilling of Kennady Lake). It is expected that lake trout will also require a long time to re-establish a stable, self-sustaining population (i.e., approximately 60 to 75 years following the complete refilling of Kennady Lake).

Long-term Effects to Downstream Watershed

The aquatic ecosystem, including fish populations, downstream of Kennady Lake is expected to reach a new equilibrium post-closure (i.e., when the flow path from Area 7 to Area 8 is reconnected after Kennady Lake has refilled). A stable, aquatic ecosystem is expected to be present in the watershed downstream of Kennady Lake in the long-term.

Long-Term Effects to Hydrology

Watersheds downstream of Kennady Lake will return to near baseline conditions, but will be affected by the post-closure hydrological regime of the Kennady Lake watershed, which includes a small increase in mean annual water yield and a slight increase in flood peak discharges. The effects of these changes to downstream watersheds will be progressively reduced with increased distance downstream from Kennady Lake as more watershed areas contribute to runoff, which acts to attenuate the magnitude of change. The post-closure hydrological regimes of the N11 and upstream watersheds is expected to be almost identical to the baseline conditions, with the post-closure hydrological regime of the N1 watershed affected to a negligible extent by the permanent diversion of the A watershed.

Long-Term Effects to Water Quality

In Lake N11, water quality will return to similar to baseline conditions in the long-term. Phosphorus concentrations are projected to increase in the Interlakes downstream of Area 8, but decline with distance as inflows from the L and M watersheds dilute the concentrations. Lakes along the main flow path in the L and M watersheds are predicted to be mesotrophic in lake trophic status. Increases in primary productivity may have some implications regarding water column oxygen dynamics. For the lakes with depths greater than 6 m with overwintering habitat for fish (i.e., Lakes M3 and M4), dissolved oxygen concentrations will remain sufficient to support aquatic life. As the small lakes in the L watershed and M watershed, upstream of Lake M3, are currently subject to low under-ice dissolved oxygen levels with nil or limited overwintering habitat for fish, potential increases in winter oxygen depletion due to nutrient enrichment would not be expected to change the overwintering capability or suitability of these small lakes.

In Lake 410, TDS and all major ions are predicted to remain above background conditions but below levels that would affect aquatic health. In post-closure, nitrogen concentrations in Lake 410 will increase several years after the removal of dyke A and then decline to near background concentrations. Concentrations of phosphorus are predicted to slightly increase in Lake 410. Increases during operations and several years into closure are associated with pumped discharge from the WMP to Lake N11; increases several years into post-closure will follow the removal of Dyke A and the reconnection of Kennady Lake to the downstream lakes. A slight increase in primary productivity would be expected in Lake 410; however, the trophic status would remain oligotrophic.

Most trace metals in Lake 410 are predicted to return to near-background conditions in the long-term. However, antimony, arsenic, boron, molybdenum, silver, strontium, uranium, and vanadium are predicted to increase and reach long-term steady state concentrations more than double baseline concentrations. As geochemical sources are the primary contributors of these metals, the majority of total concentrations will be in the dissolved form. None of these metals are predicted to exceed guidelines at any time.

Long-Term Effects to Aquatic Health

Negligible long-term effects to aquatic health in waterbodies downstream of Kennady Lake were predicted from changes in the chemical constituents of water quality for post-closure.

Long-Term Effects to Fish and Fish Habitat

In the downstream watersheds, flows and water levels will return to near baseline conditions. Reconnection of Area 8 to Areas 2 to 7 of Kennady Lake is predicted to result in a rapid increase in nutrient concentrations in the L and M watershed, along the flow-path to Lake 410. These predictions are indicative of a gradient in lake trophic status from mesotrophic in the L watershed to oligotrophic in Lake 410, with a corresponding gradient of effects on lower trophic communities. In downstream lakes, increased primary and secondary productivity are expected. An increase in benthic invertebrate abundance and biomass, as well as a shift in benthic invertebrate community composition, is also likely to occur. Because of the increased food base, there may also be increased growth and production in large-bodied fish species. For some lakes, there may be reductions in overwintering habitat availability or suitability at post-closure for fish species remaining throughout the winter. Rearing and feeding habitat would likely be enhanced due to the increased food base. Effects in Lake 410 are expected to be lower in magnitude, with corresponding smaller changes in productivity, lower trophic communities, and fish production.

Streams in the L and M watersheds will also experience nutrient enrichment, with corresponding changes in lower trophic communities and fish production, reflecting the gradient in nutrient concentrations. Although changes in the resident benthic invertebrate communities are expected, a negative effect is unlikely due to the increased food supply. Although there may be reduced suitability and availability of spawning habitat immediately downstream of Kennady Lake due to increased benthic algal growth on streambed substrates, it is expected that streams downstream will continue to provide Arctic grayling spawning and rearing habitat.

The Project is expected to have negligible effects on aquatic health in waterbodies downstream of Kennady Lake (i.e., Lake N11 and Lake 410) from changes in chemical constituents of water quality; therefore, no effects to fish populations or communities are expected to occur from changes in aquatic health.

Long-term Effects to Wildlife and Human Use

Long-term Effects to Wildlife Health

The ecological risk assessment predicted no impacts for caribou, carnivores, moose, and muskoxen health associated with exposure to chemicals from the Project. The ecological risk assessment indicated that effects to aquatic-dependant birds (i.e., waterfowl and shorebirds) could occur as a result of boron levels in Kennady Lake after refilling. The ecological risk assessment was completed with conservative assumptions, which correspond to an extreme condition that has a low likelihood of occurring. De Beers is committed to further study of this potential issue, and will incorporate mitigative strategies into the Project design to the extent required to maintain boron levels in Kennady Lake below those that may be of environmental concern.

Long-term Effects to Wildlife Habitat

Progressive reclamation will be integrated into mine planning; however, not all the upland areas will be reclaimed. The mine rock piles, Coarse PK Pile, and Fine PKC Facility will be permanent features on the landscape, covering approximately 303 ha. Overall, the long-term effects to wildlife habitat are localized and expected to have a minor influence on habitat quantity and quality for wildlife relative to baseline conditions.

For species with large home ranges (e.g., caribou, grizzly bear, wolverine), the change in habitat is likely not detectable (i.e., less than 0.01% change). For species with smaller home ranges (e.g., nesting songbirds and shorebirds), the changes are likely detectable but expected to have minor influence on reproduction in the populations. Therefore, the long-term residual effects to the persistence of wildlife populations are predicted to be negligible.

Effects of a Decrease in Open Water Area to Wildlife Habitat

The overall decrease in the surface area of open water in the Kennady Lake watershed beyond closure will primarily affect habitat for water birds (e.g., waterfowl, loons, and grebes) and shore birds whose important habitats include vegetation communities with a wetter moisture regime including shallow and deep water, sedge wetlands, and riparian habitats. Long-term residual effects from the Project on water birds and shore birds are anticipated to be negligible in magnitude.

Long-term Effects to Human Health

The human health risk assessment indicated that the health of on-site workers and off-site traditional or recreational land users is not expected to be detrimentally affected by the changes to water quality that may occur as a result of Project activities. However, this statement is contingent on the results of further study and the implementation of mitigative strategies to the extent required to maintain exposure levels below those that would be of concern.

Residual Impact Classification

The classification was carried out on residual impacts (i.e., impacts with environmental design features and mitigation considered) for the residual aquatic effects. Residual impacts were classified for future conditions after 100 years from Project initiation. Projected impacts were then evaluated to determine if they were environmentally significant. Residual impacts were not predicted for wildlife in the long-term, and therefore have not been presented.

The projected long-term impacts of the Project on the suitability of water to support a viable and self-sustaining aquatic ecosystem are considered to be not environmentally significant for the Kennady Lake watershed, and its downstream watershed. Water quality is predicted to change; however, the potential for modelled substances to cause adverse effects to aquatic life was considered to be low or negligible. After reconnection with Kennady Lake, nutrient concentrations are predicted to be higher than during pre-development conditions in Kennady Lake and downstream, which may shift the trophic status up a level to mesotrophic. The projected increases in phosphorus will not pose a health risk to a viable and self-sustaining aquatic ecosystem, though it will likely be different to the pre-development ecosystem (i.e., a more productive ecosystem).

The projected long-term impacts on the abundance and persistence of Arctic grayling, lake trout, and northern pike are considered to be not environmentally significant for the Kennady Lake watershed as well as its downstream watershed. It is expected that self-sustaining populations of Arctic grayling, lake trout, and northern pike will become established in the refilled lake. During post-closure, flows and lake levels downstream of Kennady Lake will return to near baseline conditions. Nutrient enrichment after closure may also provide for improved productivity. All three fish species are expected to continue to persist in the watershed downstream of Kennady Lake in the long-term.

10.3 EXISTING ENVIRONMENT

The following section provides a brief description of existing conditions in Kennady Lake and places them into context with those of the surrounding environment, i.e., other lakes in the downstream watershed that may be useful for comparison (e.g., Lake N16, Lake 410, and Kirk Lake). Components of the existing environment that are discussed include surface water quantity, surface water quality, lower trophic levels, fish, and wildlife.

Existing conditions in Kennady Lake and in downstream systems have been discussed in Section 8 and Section 9, respectively, with supplementary information being provided in Annex H (Climate and Hydrology Baseline), Annex I (Water Quality Baseline), Annex J (Fisheries and Aquatic Resources Baseline), and Annex F (Wildlife Baseline). To limit redundancy, the following represents a summary of the key aspects of the information that has been reported in the preceding Key Lines of Inquiry.

10.3.1 Surface Water Quantity

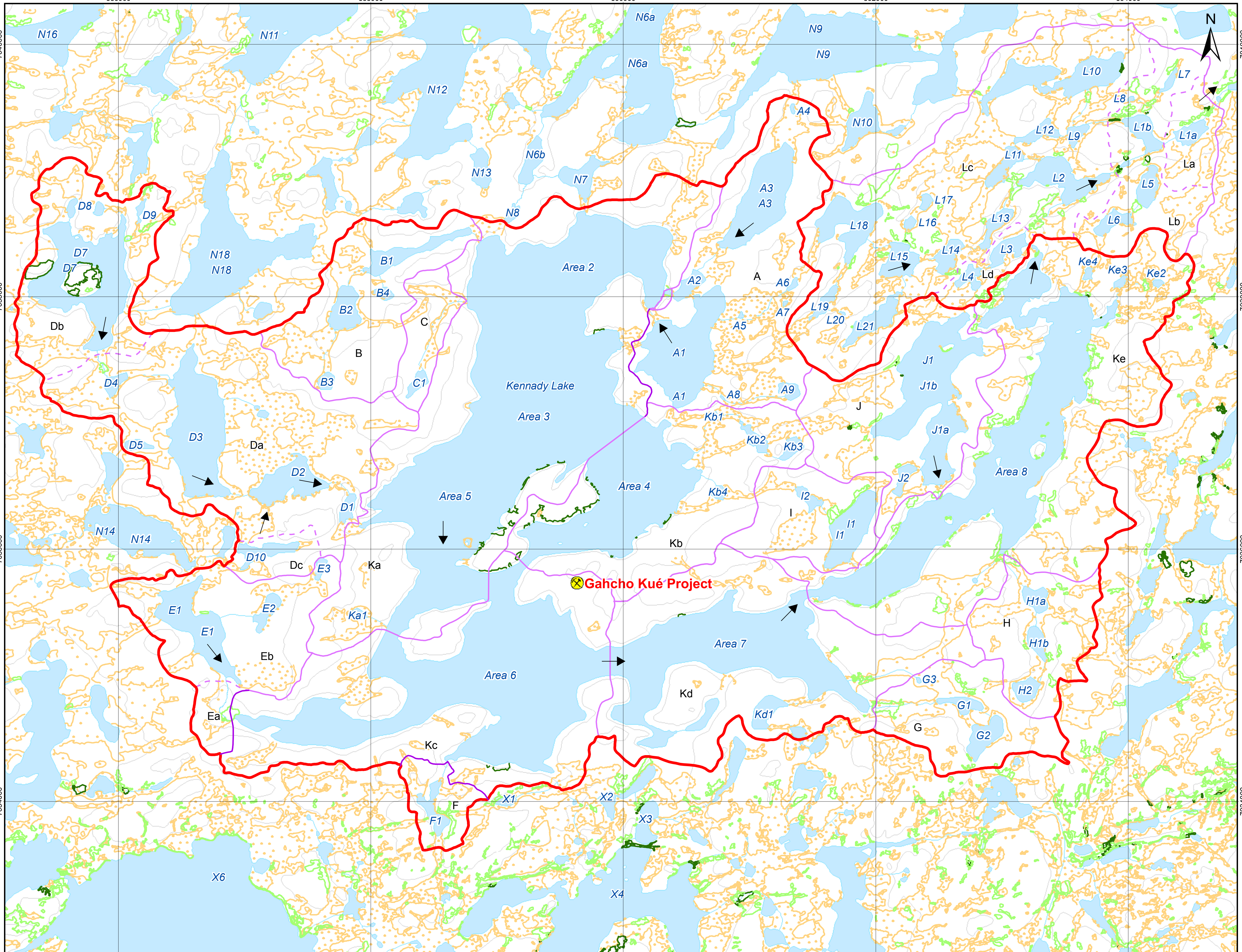
Kennady Lake is a small headwater lake within the Lockhart River system that consists of eight major areas (i.e., Areas 1 to 8) (Figure 10.3-1). Area 2 is located at the north end of the lake; Area 8 is located at the east end of the lake and contains the downstream outlet of the lake (Stream K5). The remaining areas between Area 2 and Area 8, numbered from the north to the southeast, make up the rest of Kennady Lake. Runoff to Kennady Lake arrives via ten sub-watersheds that have been labelled A through J, and five sub-watersheds labelled Ka through Ke (Figure 10.3-1). Each sub-watershed contains between one and ten small unnamed lakes, all of which eventually drain to Kennady Lake. Area 1 consists of most of sub-watershed A, including Lakes A1 and A2, but not Lake A3 (Figure 10.3-1).

Water exits Kennady Lake through Area 8, flowing northward into the L watershed (Figure 10.3-1). From there, it flows through the M watershed into Lake 410 (Figure 10.3-2). The N watershed, which is located to the north of the Kennady Lake watershed, also drains into Lake 410. The waters from the two watersheds mix in Lake 410, which drains northward through the P watershed into Kirk Lake and then into Aylmer Lake. Aylmer Lake is located on the main stem of the Lockhart River about midway along its length. The Lockhart River system drains into the north-eastern arm of Great Slave Lake (Figure 10.1-2).

Kennady Lake has a surface area of approximately 8.1 square kilometres (km^2). The maximum depth of Kennady Lake is in the order of 17.7 metres (m), and it has a mean depth of 4.7 m. The volume of Kennady Lake at a surface water elevation of 420.7 metres above sea level (masl) is 38.3 million cubic metres (Mm^3), and the average retention time is in the order of nine years. How the total volume of the lake changes in relation to variations in surface water elevation is shown in Figure 10.3-3.

Mean monthly discharge rates from Kennady Lake over the open water season vary from 0.03 cubic metres per second (m^3/s) in October to 0.75 m^3/s in June (Table 10.3-1). In comparison, mean monthly discharges from Lake N11 vary from 0.17 to 3.01 m^3/s over the open water season, which represents an increase of 360 to 500 percent (%) over those estimated at the outlet of Kennady Lake.

Mean monthly discharge rates from Lake 410 and Kirk Lake are also much larger than those of Kennady Lake. They range from 0.38 to 6.22 m^3/s at the outlet of Lake 410, while those at the outlet of Kirk Lake range from 0.88 to 11.5 m^3/s (Table 10.3-1). In other words, the mean monthly discharge from Lake 410 is 8 to 11 times larger than that of Kennady Lake, while that from Kirk Lake is 15 to 26 times larger than that of Kennady Lake.



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LEGEND

- Gahcho Kué Project
- Watercourse
- Waterbody
- Contour (10m interval)
- L Watershed Boundary
- L Watershed Interior Sub-watershed Boundary
- Kennady Lake Watershed Boundary
- Kennady Lake Sub-watershed Boundary
- Kennady Lake Interior Sub-watershed Boundary
- Drainage Direction
- Brush
- Fen
- Tree
- L18 Lake Identifier
- Ke Sub-watershed Identifier

NOTES

Base data source: National Topographic Base Data (NTDB) 1:50,000

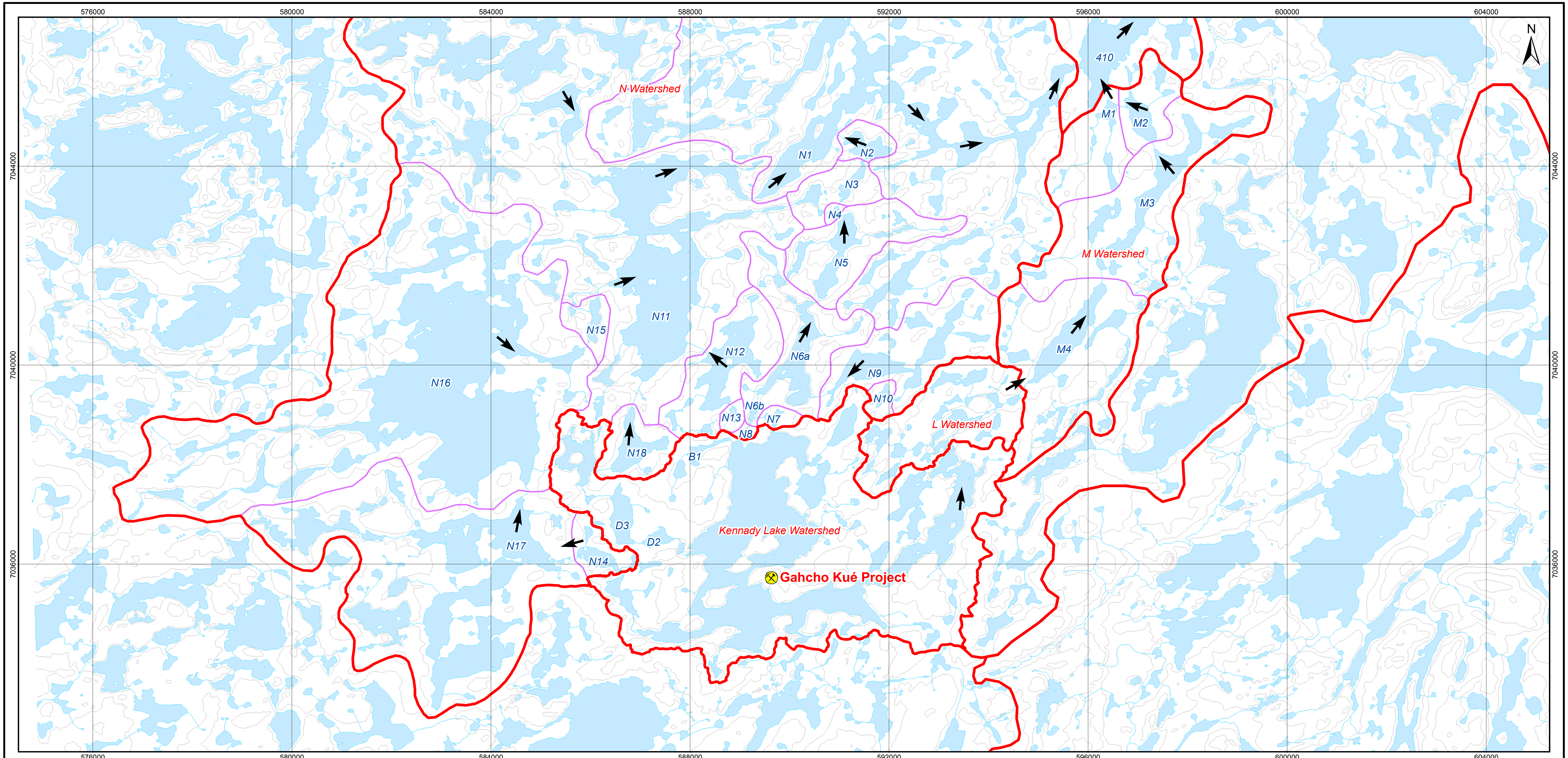
GAHCHO KUÉ PROJECT

Kennady Lake Watershed and L Watershed

PROJECTION: UTM Zone 12	DATUM: NAD83
Scale: 1:30,000 (500 250 0 500 Metres)	
FILE No: KLOI-10-003-GIS	DATE: December 22, 2010
JOB NO: 09-1365-1004	REVISION NO: 1
OFFICE: GOLD-CAL	DRAWN: SK — CHECK: JF

DE BEERS CANADA

Figure 10.3-1



LEGEND

- Gahcho Kué Project
- Watercourse
- Waterbody
- Contour (10m interval)
- Sub-Watershed Boundary
- Watershed Boundary
- Drainage Direction

NOTES

Base data source: National Topographic Base Data (NTDB) 1:50,000

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GAHCHO KUÉ PROJECT

M and N Watersheds

PROJECTION:	DATUM:
UTM Zone 12	NAD83

Scale: 1:75,000

1 0.5 0 1

Kilometres

DE BEERS CANADA

FILE No:	DATE:
KLOI-10-004-GIS	December 22, 2010

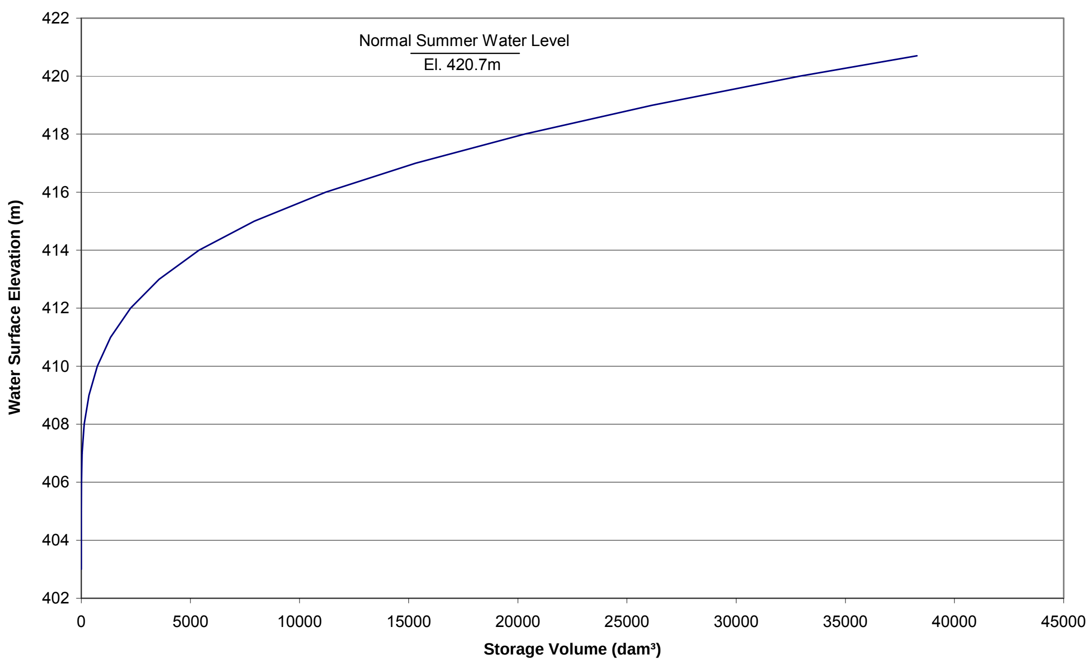
JOB NO:	REVISION NO:
09-1365-1004	5

OFFICE:	DRAWN:	CHECK:
GOLD-CAL	SK	JF

Figure 10.3-2

Similar differences exist among watershed sizes. The Kennady Lake watershed is approximately 32.5 square kilometres (km^2) in area, as measured at the outlet of Area 8. The area of the N watershed, as measured at the outlet of Lake N1, is on the order of 183 km^2. Those of Lake 410 and Kirk Lake are approximately 256 and 739 km^2, respectively. The Kennady Lake watershed, therefore, represents approximately 13% of the Lake 410 watershed and 4% of the Kirk Lake watershed (Table 10.3-2). As a result, the hydrology of Kennady Lake has a limited influence on the hydrology of Lake 410 and on that of other systems located downstream of Lake 410, including Kirk Lake, Aylmer Lake, and Great Slave Lake.

Figure 10.3-3 Kennady Lake Stage-Storage Curve



From Annex H (Climate and Hydrology Baseline).
m = metre; dam^3 = cubic decametre; El. = elevation.

Table 10.3-1 Average Daily Discharge Released from Kennady Lake and Other Select Waterbodies

Lake	Month				
	June	July	August	September	October
Average Daily Flow (m^3/s)					
Kennady Lake	0.75	0.45	0.26	0.15	0.03
Lake N11	3.01	1.62	1.06	0.66	0.17
Lake 410	6.22	3.98	2.43	1.56	0.38
Kirk Lake	11.5	11.8	6.90	3.84	0.88
Expressed as a Percentage of the Discharge from Kennady Lake (%)					
Kennady Lake	100	100	100	100	100
Lake N11	400	360	400	450	500
Lake 410	830	890	920	1,060	1,100
Kirk Lake	1,540	2,630	2,610	2,610	2,550

Based on information presented in Annex H (Climate and Hydrology Baseline).
m^3/s = cubic metres per second; % = percent.

Table 10.3-2 Watershed Areas for Kennady Lake and Other Select Waterbodies

Lake	Watershed Area (km^2)	Percentage of Total Watershed Represented by Kennady Lake Watershed (%)
Kennady Lake	32.5	100
Lake N1	183	-[(a)]
Lake 410	256	13
Kirk Lake	739	4

(a) The Kennady Lake watershed is adjacent to, not within, the N watershed, so it does not represent a portion of the N watershed.
km^2 = square kilometres; % = percent.

10.3.2 Surface Water Quality

10.3.2.1 Temperature and Dissolved Oxygen

Based on data collected between 1999 and 2010, Kennady Lake tends to be inversely stratified in winter under-ice conditions. Water temperatures are generally near 0 degrees Celsius (°C) immediately below the ice, gradually increasing with depth to a maximum water temperature of approximately 4°C. This trend is illustrated (Figure 10.3-4a) using data collected from Area 2 to Area 8.

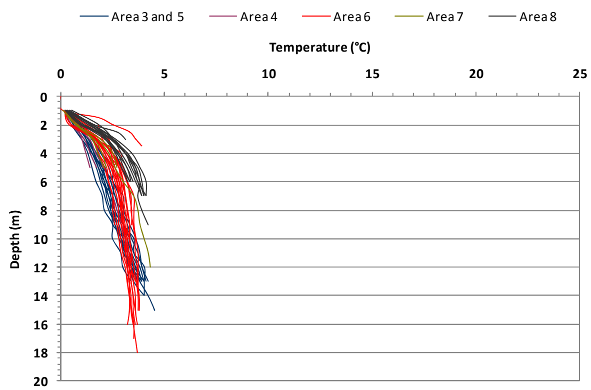
In contrast, during the open water season, water temperatures tend to be more uniform with depth, although some thermal stratification can occasionally be observed (see Figure 10.3-5a). Water temperatures are notably warmer during the open-water period, ranging from 3 to 17°C, in comparison to the colder temperatures observed under-ice (i.e., 0 to 4°C).

Dissolved oxygen (DO) levels in Kennady Lake tend to follow a similar pattern. During the open-water period, DO concentrations are generally uniform throughout the water column, ranging from 9 to 16.5 milligrams per litre (mg/L) (Figure 10.3-5c). In winter, DO levels just under the ice also tend to be high, ranging from 12.8 to 20 mg/L (Figure 10.3-4). However, in contrast to the open water season, DO concentrations under the ice decreased with depth, and anoxic conditions (i.e., DO concentrations less than 2 mg/L) developed in the late winter in the deepest sections of the lake below a depth of 12 m.

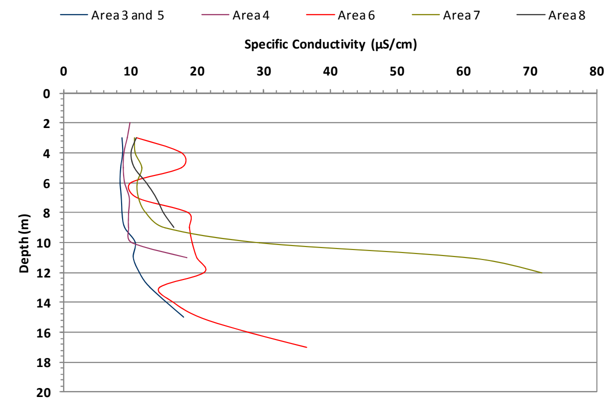
The patterns observed in Kennady Lake, with respect to water temperatures and DO levels, are characteristic of those observed in other waterbodies in the area. For example, inverse stratification has been observed during under-ice conditions in lakes N16 and 410, as reported in Annex I (Water Quality Baseline) and Addendum II (2010 Water Quality Baseline). Inverse stratification is no longer apparent during the open water season; water temperatures tend to be more uniform with depth, ranging from 5 to 18°C. Similarly, in winter, DO concentrations in Lakes N16 and 410 generally decrease with depth, with anoxic conditions developing near the lake bottom. However, once the lake surface is free of ice, DO levels become more uniform with depth, because of wind-driven mixing.

Figure 10.3-4 Under-ice Profiles for Kennady Lake (Area 3 to Area 8), 1998 to 2010

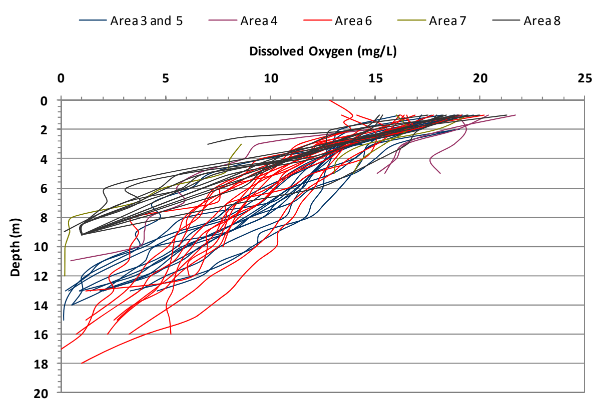
a) Temperature



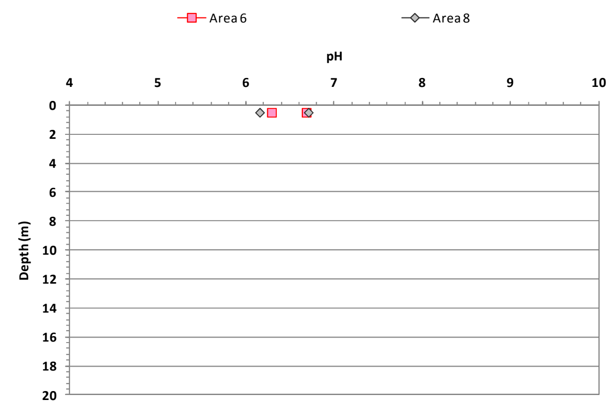
b) Conductivity



c) Dissolved Oxygen



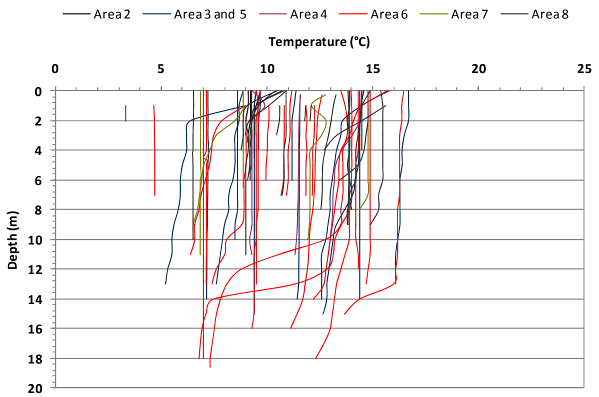
d) pH



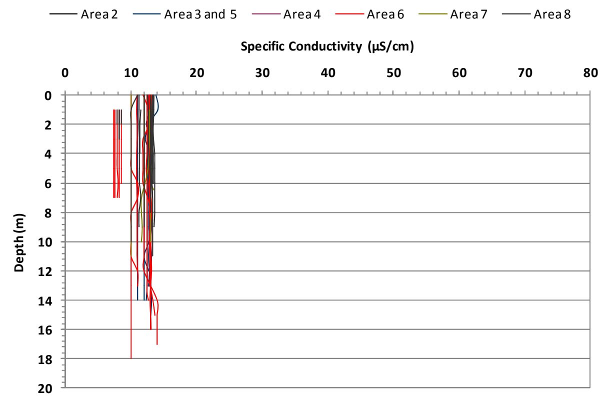
m = metre, °C = degrees Celcius, µS/cm = micro Siemens per Centimetre, mg/L = milligrams per litre.

Figure 10.3-5 Open Water Profiles for Kennady Lake (Area 2 to Area 8), 1998 to 2010

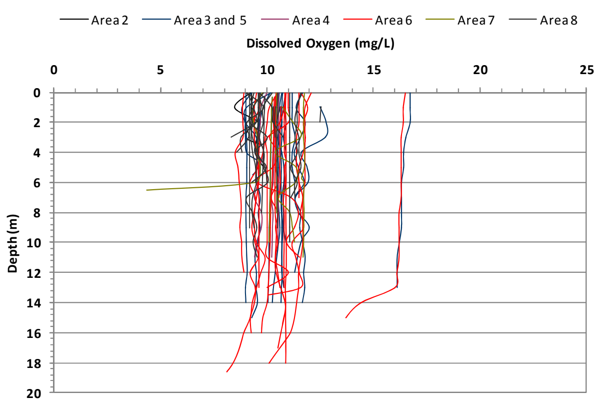
a) Temperature



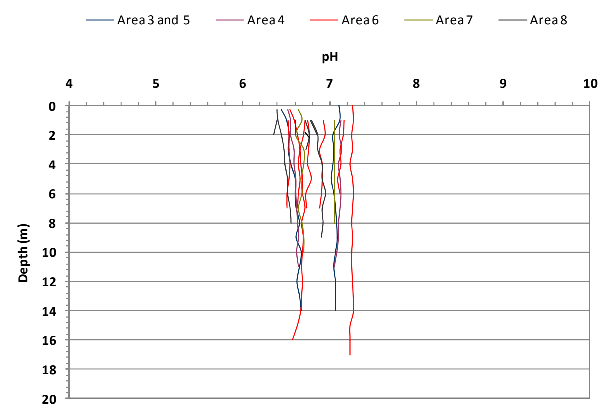
b) Specific Conductivity



c) Dissolved Oxygen



d) pH



m = metre, °C = degrees Celcius, µS/cm = micro Siemens per Centimetre, mg/L = milligrams per litre.

10.3.2.2 Total Dissolved and Suspended Solids

Concentrations of total dissolved solids (TDS) in Kennady Lake tend to be low during both under-ice and open water conditions, ranging from 1 to 32 mg/L (Table 10.3-3). Based on the information reported in Annex I (Water Quality Baseline) and Annex II (2010 Water Quality Baseline), bicarbonate is generally the dominant anion, and calcium is the dominant cation. Total suspended solids (TSS) concentrations tend to be similarly low, often below analytical detection limits during ice-cover conditions. During the open water season, TSS levels can increase up to 27 mg/L, although such levels are generally the exception. Historically, most TSS measurements taken during the open water season have been at or below the analytical detection limit.

The TDS levels under open water conditions in neighbouring systems are generally similarly low, ranging from, less than <10 to 52 mg/L in Lake 410, Kirk Lake, and lakes in the N watershed (including Lake N16) (Table 10.3-3). The same is true for TSS; concentrations of TSS in Lake 410, Kirk Lake, and lakes in the N watershed (including Lake N16) generally ranged from less than 1 to 10 mg/L, comparable to concentrations observed in Kennady Lake.

10.3.2.3 Nutrients

Concentrations of ammonia, and nitrate and nitrite in Kennady Lake are predominantly below their respective detection limits during open water conditions. The concentrations of all three nutrients typically increase in under-ice conditions, being higher in winter than at other times of the year (Table 10.3-3). Total phosphorus (TP) concentrations tend to be more variable in under-ice conditions than during open water conditions, but the highest TP concentrations generally occur during the open-water period. Based on the observed nutrient concentrations, Kennady Lake would be classified as an oligotrophic lake with low biological productivity.

Table 10.3-3 Range in the Concentrations of Various Substances Observed in Kennady Lake, Lake 410, Kirk Lake, and Lakes in the N Watershed, Including Lake N16, 1995 to 2010

Parameter Name	Unit	Kennady Lake		Lakes in the N Watershed	Lake 410 Summary	Kirk Lake
		Under-Ice (1996 - 2004)	Open Water (1995 - 2010)	(1998 - 2010)	(2004 - 2010)	(2005 - 2010)
Conventional Parameters						
Total Dissolved Solids	mg/L	3 - 27 (n=78)	1 - 32 (n=78)	5 - 52 (n=31)	10 - 26 (n=14)	<10 - <10 (n=3)
Total Suspended Solids	mg/L	<1 - 18 (n=138)	<0.1 - 27 (n=52)	1 - 10 (n=31)	1 - 3 (n=14)	-
Nutrients						
Nitrate + Nitrite	mg N/L	0.006 - 0.34 (n=80)	<0.003 - 0.078 (n=15)	<0.003 - 0.006 (n=10)	<0.003 - <0.003 (n=4)	-
Nitrogen - Ammonia	mg N/L	0.0025 - 0.062 (n=159)	0.005 - 0.063 (n=76)	<0.005 - 0.22 (n=31)	<0.05 - <0.1 (n=14)	<0.05 - <0.1 (n=3)
Phosphorus, total	mg/L	<0.001 – 0.010 (n=112)	<0.020 – 0.006 (n=68)	0.005 – 0.118 (n=31)	0.004 – 0.071 (n=14)	0.003 – 0.052 (n=3)
Total Metals						
Aluminum	µg/L	3.2 - 51 (n=165)	2.5 - 730(n=87)	6 - 482(n=31)	6 - 55 (n=14)	17 - 23 (n=3)
Antimony	µg/L	0.015 - 0.72 (n=165)	<0.02 - 15 (n=87)	<0.02 - 0.02 (n=31)	<0.02 - 0.5 (n=14)	-
Cadmium	µg/L	<0.02 - 0.05 (n=165)	<0.002 - 0.0023 (n=87)	<0.002 - 0.011 (n=32)	<0.002 - 0.0033 (n=14)	-
Chromium	µg/L	<0.06 - 0.78 (n=165)	<0.06 - 1.5 (n=87)	<0.1 - 1.2 (n=31)	<0.1 - <0.9 (n=14)	-
Copper	µg/L	0.3 - 311 (n=165)	0.28 - 8 (n=87)	0.4 - 7 (n=31)	0.45 - 1.8 (n=14)	0.5 - 1.5 (n=3)
Iron	µg/L	2.5 - 433(n=165)	10 - 195 (n=87)	18 - 250 (n=31)	30 - 186 (n=14)	5 - 70 (n=3)
Manganese	µg/L	0.5 - 378 (n=165)	2 - 36 (n=87)	1 - 26 (n=31)	0.5 - 8.6 (n=14)	0.5 - 3.4 (n=3)
Mercury	µg/L	<0.01 - 0.02 (n=162)	<0.0006 - 0.07 (n=73)	<0.0006 - 0.01 (n=32)	<0.0006 - 0.006 (n=14)	-
Selenium	µg/L	<0.1 - 0.2 (n=165)	<0.01 - 3 (n=87)	<0.04 - <10 (n=31)	<0.04 - <10 (n=14)	<0.04 - <0.8 (n=3)
Silver	µg/L	<0.01 - 0.88 (n=165)	<0.01 - 0.0036 (n=87)	0.0005 - 0.01 (n=32)	<0.2 - 0.0056 (n=14)	-
Zinc	µg/L	0.8 - 14 (n=165)	0.1 - 63 (n=87)	0.6 - 14 (n=31)	0.5 - 24 (n=14)	1 - 17 (n=3)

Based on the information reported in Annex I (Water Quality Baseline), and Addendum II (2010 Water Quality Baseline).

mg/L = milligrams per litre; mg N/L = milligrams nitrogen per litre; µg/L = micrograms per litre; n = number of samples; < = less than.

In general, concentrations of ammonia, nitrate and nitrite, and TP in lakes in the N watershed, Lake 410, and Kirk Lake are near or below analytical detection limits during the open water season (Table 10.3-3). In these systems, detectable levels of ammonia have been observed during open water conditions, as they have been in Kennady Lake. Downstream lakes, like Kennady Lake, are oligotrophic, and they generally experience low biological productivity.

10.3.2.4 Metals

Individual total metals (e.g., aluminum, manganese, and iron) can be detected in Kennady Lake (Table 10.3-3), although generally at low levels. Other total metals (e.g., chromium, copper, and silver) can also occasionally be detected in Kennady Lake, and, as discussed in Annex I (Water Quality Baseline) and presented in Addendum II (2010 Water Quality Baseline), are included with a range of metals that have been observed at concentrations in excess of water quality guidelines (i.e., total aluminum, antimony, cadmium, chromium, copper, iron, manganese, mercury, selenium, silver, and zinc). The presence of concentrations of total metals in excess of guidelines is not indicative of a compromised system; they result from natural variability in the environment to which local flora and fauna have adapted.

The concentrations of total metals observed in Lake 410, Kirk Lake, and lakes in the N watershed generally fall within the range of those observed in Kennady Lake, with total aluminum, cadmium, chromium, copper, iron, and zinc levels occasionally being present at concentrations in excess of Guidelines for Canadian Drinking Water Quality (Health Canada 2006) and Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 2006).

10.3.2.5 Sediment Quality

The composition of the lake bed sediment in Kennady Lake, Lake N16, Lake 410 and Kirk Lake primarily consists of sand, with some silt, and minor amounts of clay.

In Kennady Lake, phosphate levels in the bed sediment range from approximately 21 to 148 micrograms per gram (μg/g), while nitrate levels are generally near or below the method detection limit of 1.0 μg/g (Table 10.3-4). Iron and aluminum are the main metal constituents of the fine bed sediment, and the concentrations of arsenic, cadmium, chromium, copper, and zinc exceeded the Interim Sediment Quality Guideline (CCME 1999), as reported in Annex I (Water Quality Baseline) and Addendum II (2010 Water Quality Baseline).

Similar to Kennady Lake, phosphate concentrations in Lake N16 sediment range from 18 to 83 μg/g, while nitrate concentrations tend to be near or below the method detection limit of 1.0 µg/g (Table 10.3-4). Phosphate and nitrate concentrations in Lake 410 are also within the range of concentrations for Kennady Lake (Table 10.3-4).

The dominant metal species present in the Lake 410 and Kirk Lake bed sediments are iron and aluminum. Concentrations of magnesium and calcium are generally similar to those observed in Kennady Lake; however, concentrations of aluminum and iron are highest in Kennady Lake. The concentrations of other metals present in the bed sediments tend to be comparable to those observed in Kennady Lake, although sample size is limited.

Table 10.3-4 Range of Concentrations Observed in Bed Sediments Collected from Kennady Lake, Lakes N16, Lake 410, and Kirk Lake, 1995 to 2005

Substance	Waterbody			
	Kennady Lake	N 16	L410	Kirk
Texture				
Sand (%)	70 (n=1)	80 to 93 (n=2)	73 (n=1)	61 (n=1)
Silt (%)	28 (n=1)	6 to 18 (n=2)	24 (n=1)	35 (n=1)
Clay (%)	2 (n=1)	<1 to 2 (n=2)	3 (n=1)	4 (n=1)
Nutrients				
Nitrate (µg/g)	<1 to 1 (n=5)	<1 to 1 (n=2)	<1 (n=1)	-
Phosphate (µg/g)	20.6 to 148 (n=5)	17.9 to 83.4 (n=2)	74.6 (n=1)	-
phosphorus (µg/g)	7 to 2450 (n=10)	9 to 997 (n=4)	23 to 839 (n=2)	642 (n=1)
Total Metals				
Aluminum (µg/g)	12,300 to 22,100 (n=5)	10,900 to 11,200 (n=2)	10300 (n=1)	10,500 to 15,000 (n=2)
Arsenic (µg/g)	3 to 8.7 (n=10)	<1 to 3.2 (n=3)	2 to 4.2 (n=2)	1.4 to 3 (n=2)
Cadmium (µg/g)	0.3 to 0.7 (n=10)	<1 to 1 (n=3)	0.3 to 0.3 (n=2)	<1 to 1 (n=2)
Calcium (µg/g)	2,700 to 4,380 (n=5)	1,810 to 2,490 (n=2)	5,030 (n=1)	2,650 to 3,700 (n=2)
Chromium (µg/g)	27.8 to 41 (n=10)	7 to 27.2 (n=3)	22.3 to 79 (n=2)	35 to 36.4 (n=2)
Copper (µg/g)	47 to 110 (n=10)	7 to 53.2 (n=3)	40 to 59.4 (n=2)	29.3 to 31 (n=2)
Iron (µg/g)	29,600 to 69,500 (n=5)	18,100 to 23,900 (n=2)	263,00 (n=1)	15,400 to 16,400 (n=2)
Magnesium (µg/g)	3,300 to 5,060 (n=5)	3,420 to 4,930 (n=2)	3,470 (n=1)	5,130 to 6,900 (n=2)
Manganese (µg/g)	234 to 525 (n=5)	174 to 217 (n=2)	209 (n=1)	167 to 171 (n=2)
Mercury (µg/g)	<1 to 1 (n=10)	<1 to 1 (n=3)	<1 to 1 (n=2)	<1 to 1 (n=2)
Zinc (µg/g)	65 to 157 (n=10)	11 to 167 (n=3)	50 to 76.5 (n=2)	66 to 73 (n=2)

Based on the information reported in Annex I (Water Quality Baseline) and Addendum II (2010 Water Quality Baseline).
% = percent; µg/g = microgram per gram; < = less than; n = number of samples; - = no data.

10.3.2.6 Conclusion

The quality of the water and sediment in Kennady Lake is similar to that in adjacent and downstream systems.

10.3.3 Lower Trophic Levels

10.3.3.1 Plankton

10.3.3.1.1 Phytoplankton and Chlorophyll a

Based on studies conducted in 2004, 2005, and 2007, six major taxonomic groups of phytoplankton are present in Kennady Lake. They include cyanobacteria, Chlorophyta, Chrysophyta, Cryptophyta, Bacillariophyceae, and Pyrrophyta. Although cyanobacteria tend to be the most abundant taxonomic group in Kennady Lake, they accounted for only a small proportion of the total phytoplankton biomass present in the lake in 2004 (Figure 10.3-6). The typically low contribution of cyanobacteria to total phytoplankton biomass is reflective of small sized species with a low biovolume. This was not observed in 2007, when cyanobacteria were slightly less dominant in terms of abundance, but more dominant in terms of biomass compared to 2004.

In terms of total biomass, Chrysophyta and Bacillariophyceae (in 2004) and cyanobacteria (in 2007) dominated the phytoplankton community in Area 3 through Area 7 (Figure 10.3-6). Area 8 was dominated by Cryptophyta in 2004 and Chrysophyta in 2007. Differences in the composition of the phytoplankton community between Area 8 and other areas of Kennady Lake may be a reflection of the different physical conditions that exist in the different basins. Area 8 is shallower and generally narrower than the other four basins. In addition, Area 8 likely experiences higher internal currents and faster flushing rates, because of its location relative to the Kennady Lake outlet (Stream K5).

Although the phytoplankton communities of Lake N16, Lake 410, and Kirk Lake contain the same major taxa as observed in Kennady Lake, the relative contributions of these taxa to total biomass are different, and vary by year. Depending on the year of sampling, cyanobacteria or Chrysophyta were the most abundant taxonomic group in these lakes. Cyanobacteria accounted for only a small proportion of the total phytoplankton biomass in these lakes in 2004, but contributed more to total biomass in 2007 (Figure 10.3-6). These trends mirror those found in Kennady Lake.

Based on field studies conducted in 2004 and 2007, chlorophyll *a* concentrations in Kennady Lake are generally consistent among the eight areas and between seasons, ranging from 0.7 to 1.7 micrograms per litre (μg/L), with mean values close to 1 μg/L. Chlorophyll *a* concentrations are similarly low in Lake N16, Lake 410, and Kirk Lake, with occasionally elevated concentrations close to 2 μg/L in Lake 410 and Kirk Lake. Chlorophyll *a* concentrations in the order of 1.0 μg/L are characteristic of oligotrophic lakes, and they are consistent with lakes of similar trophic status in the Slave Geological Province, between the southern Yukon Territory and the Tuktoyaktuk Peninsula, and between Yellowknife and Contwoyto Lake (as reported by Pienitz et al. 1997a,b).

10.3.3.1.2 Zooplankton

The zooplankton community of Kennady Lake generally consists of representatives of four major taxonomic groups: Rotifera, Cladocera (water fleas), Calanoida (calanoid copepods), and Cyclopoida (cyclopoid copepods), along with immature copepods (copepod nauplii). Based on relative abundance, community composition is similar across the eight areas of Kennady Lake (Figure 10.3-7). Community composition based on biomass tends to be more variable among areas (Figure 10.3-8). Whereas total abundance was dominated by Calanoida (2004) or Rotifera (2007), total biomass was dominated by Cladocera or Calanoida (2004) or Calanoida (2007).

The same taxonomic groups present in Kennady Lake can be found in Lake N16, Lake 410, and Kirk Lake. The relative abundance of each group in these lakes tended to be similar to that in Kennady Lake within each year, although Kirk Lake contained a higher proportion of copepod nauplii in 2005, and Lake 410 contained a lower proportion of Cyclopoida in 2007, compared to the previous year of sampling (Figure 10.3-7). Year-to-year variation in community composition based on abundance is considerable in these lakes. Relative biomass among the four lakes is also variable, although Cladocera and Calanoida generally dominate the zooplankton communities in all four lakes (Figure 10.3-8).

Figure 10.3-6 Relative Biomass of Major Phytoplankton Taxa in Kennady Lake, Lake N16, Lake 410, and Kirk Lake, 2004 to 2007

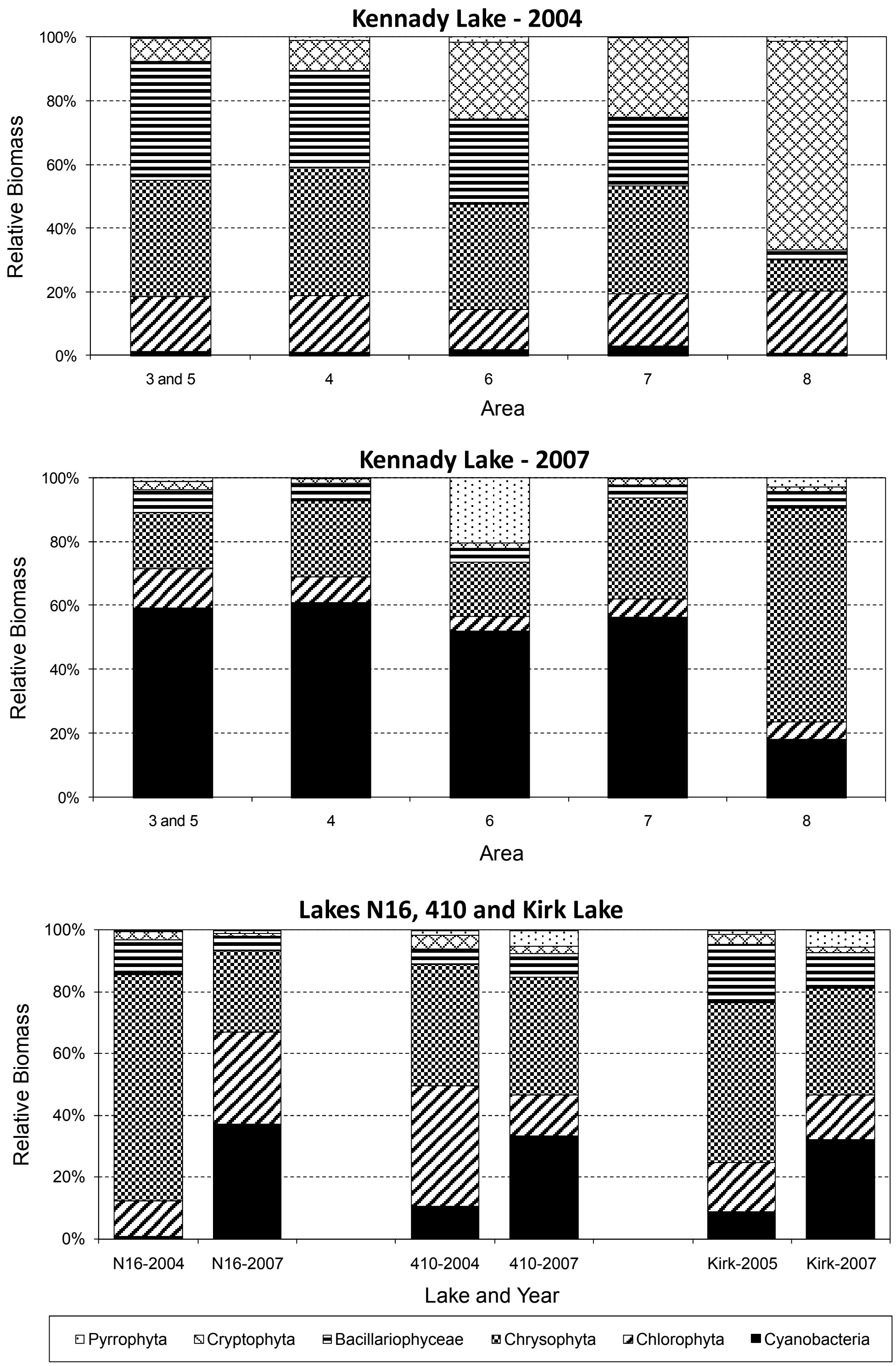


Figure 10.3-7 Relative Abundance of Major Zooplankton Taxa in Kennady Lake, Lake N16, Lake 410, and Kirk Lake, 2004 to 2007

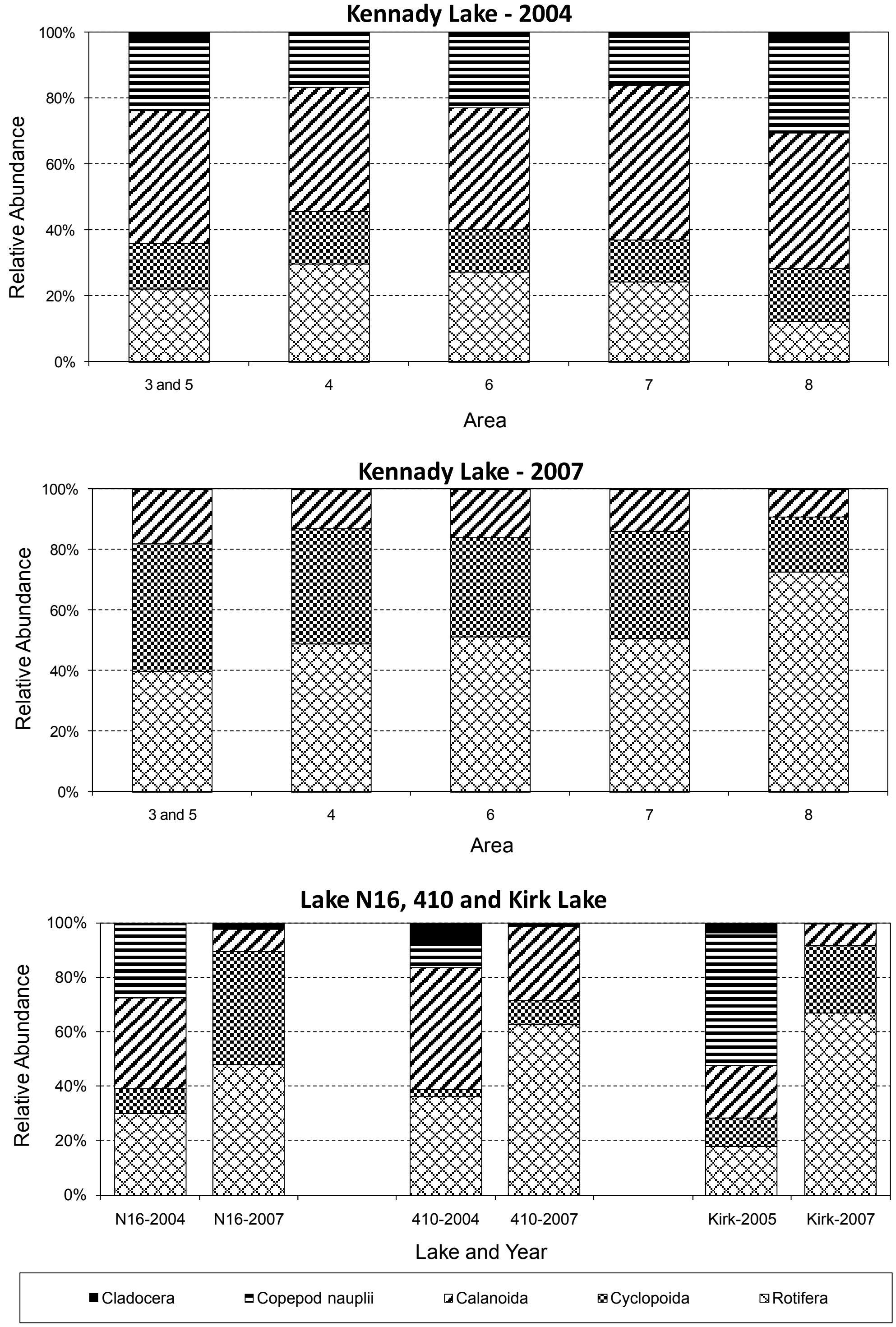
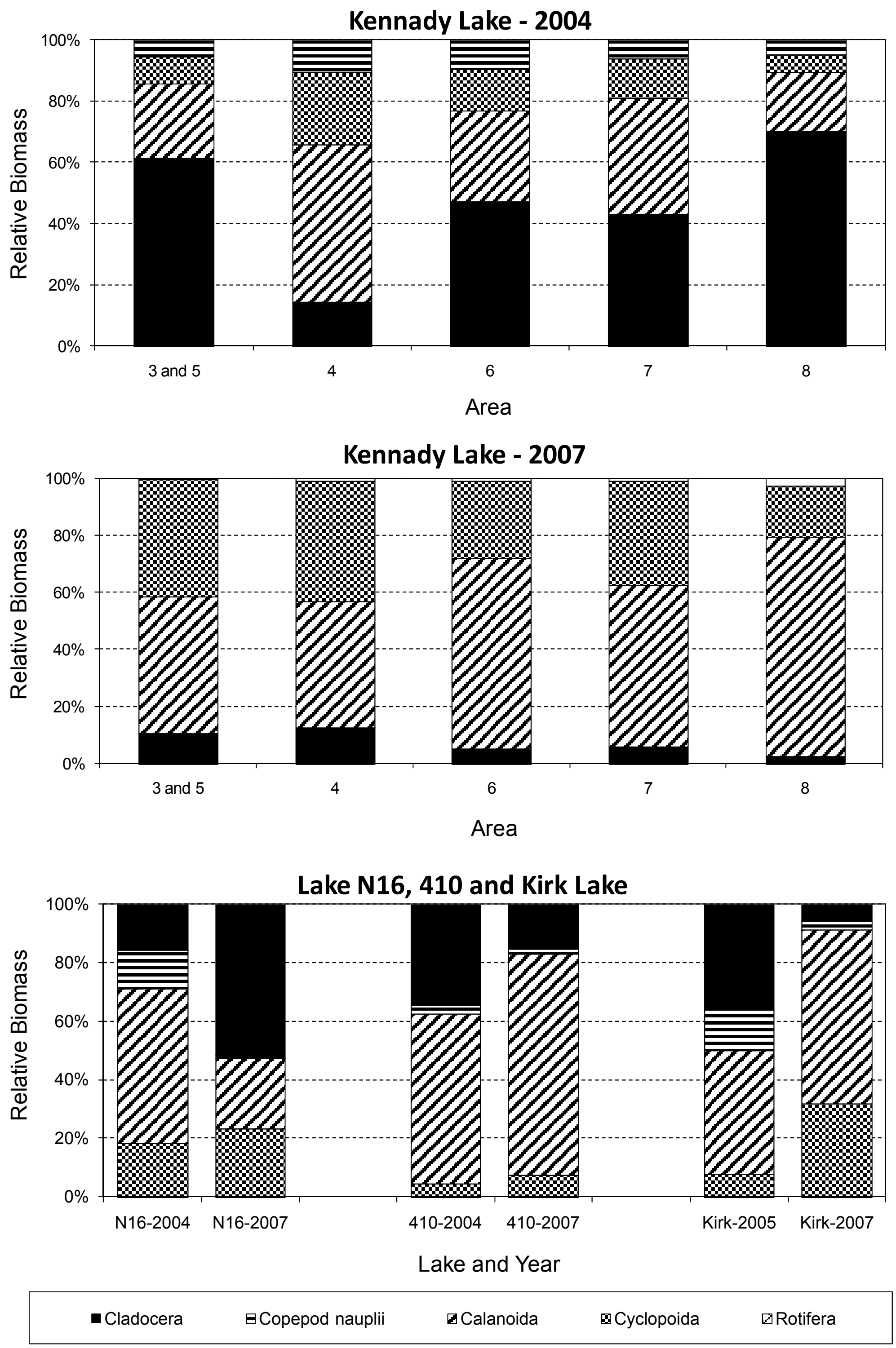


Figure 10.3-8 Relative Biomass of Major Zooplankton Taxa in Kennady Lake, Lake N16, Lake 410, and Kirk Lake, 2004 to 2007



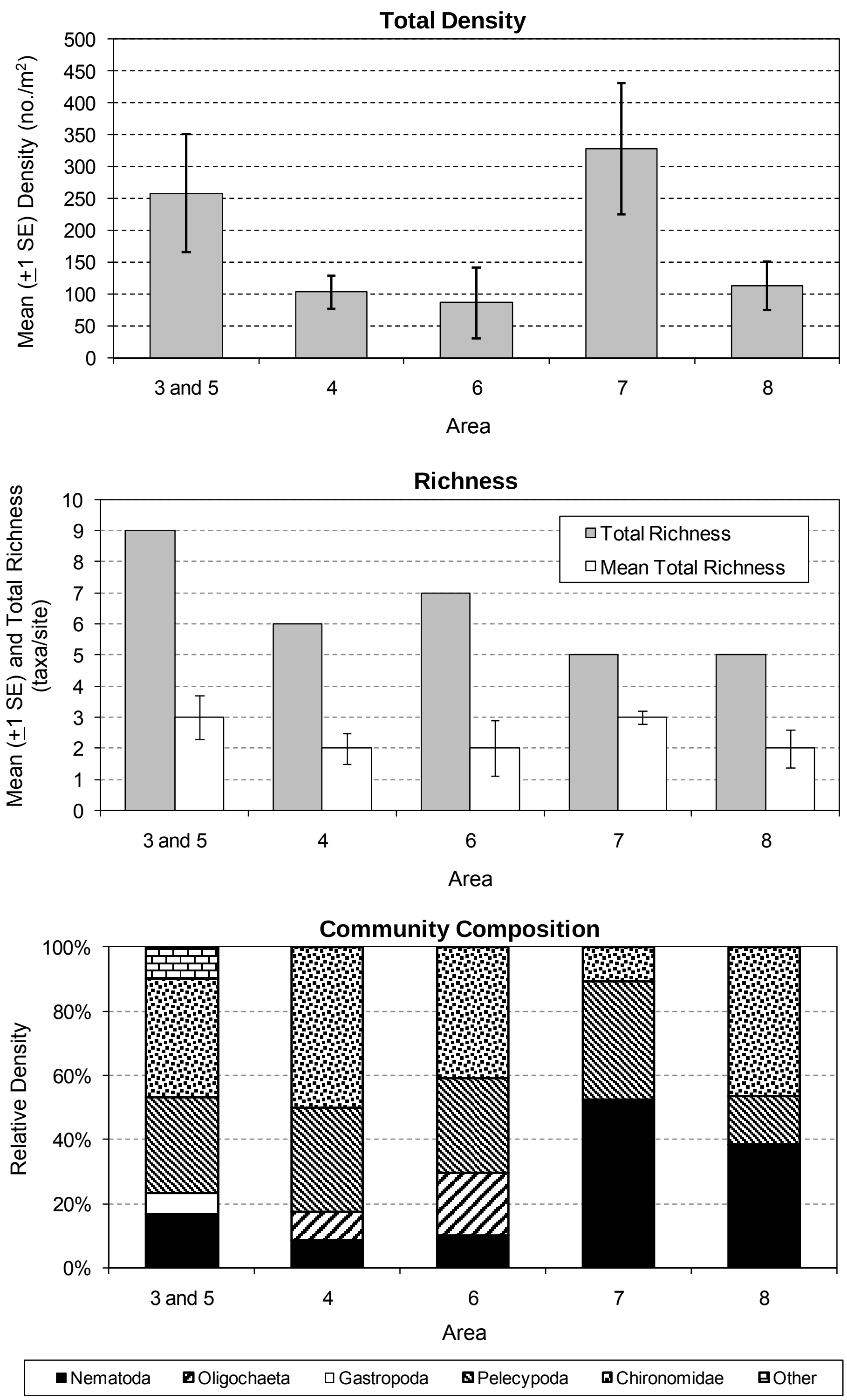
10.3.3.2 Benthic Invertebrates

Based on surveys completed in August and September of 2004, and Fall 2007, benthic invertebrate densities in Kennady Lake are generally low (Figures 10.3-9, 10.3-10, and 10.3-11). Shallow littoral areas appear to support a denser benthic invertebrate community than deeper mid-lake areas, as commonly observed in sub-arctic lakes. The shallow sites also tend to support a more diverse community than the deeper sites, as shown by generally higher richness values. Dominant benthic invertebrates in Kennady Lake include midges (Chironomidae) and roundworms (Nematoda; only in Area 7 in 2004). Other common invertebrate groups include fingernail clams (Sphaeriidae), aquatic worms (Oligochaeta) and snails (Gastropoda).

In 2004, the benthic invertebrate communities in Lakes N16 and 410 were similar to that of Kennady Lake, and were characterized by low density and richness, and dominance by midges (Figure 10.3-12). Additional baseline sampling in 2007 at four sites in Lake N16 documented considerable variation in total density and richness (Figure 10.3-13), likely reflecting habitat variation, and similar community composition to that observed in 2004.

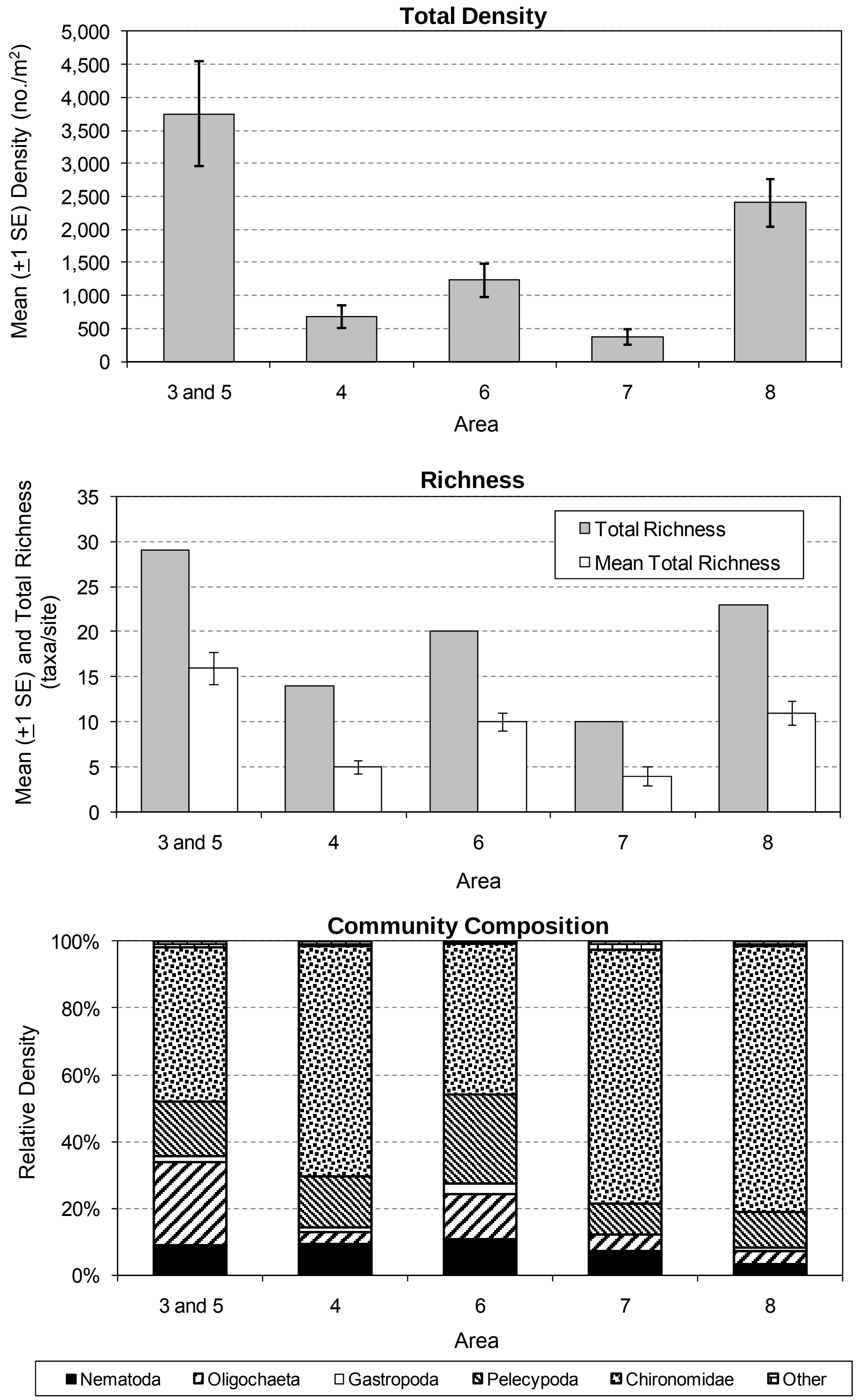
Stream benthic communities sampled in summer 2005 downstream of Kennady Lake were characterized by low to moderate density and richness. Common benthic invertebrates in these streams included hydras, mites, and larvae of midges and blackflies. Stream sites sampled downstream of Kennady Lake in fall 2007 were characterized by low density and moderate richness (Figure 10.3-14). In 2007, the stream benthic community was dominated by midges (Chironomidae). Caddisflies (Trichoptera) were also common. The “other taxa” group, which included hydras (Hydrozoa), snails, true bugs (Hemiptera), beetles (Coleoptera), and other true flies (other Diptera), accounted for up to about 20% of the benthic invertebrate community at various stream sites in 2007.

Figure 10.3-9 Total Abundance, Richness, and Community Composition of Benthic Invertebrates at Deep Water Sites in Kennady Lake, August 2004



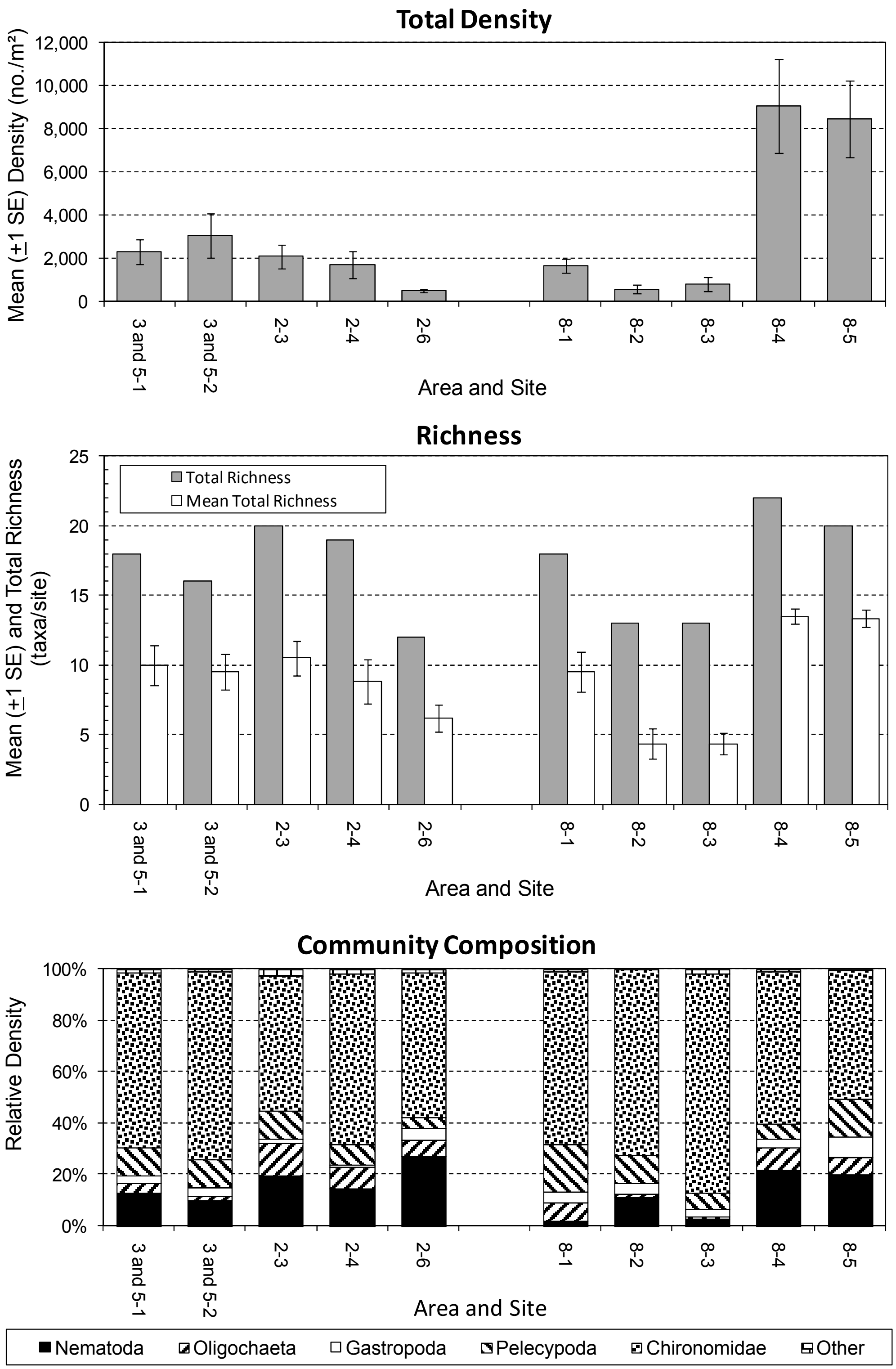
$\pm$ = plus or minus; SE = standard error; no./m^2 = number of organisms per square metre; % = percent.

Figure 10.3-10 Total Abundance, Richness, and Community Composition of Benthic Invertebrates at Shallow Water Sites in Kennady Lake, September 2004



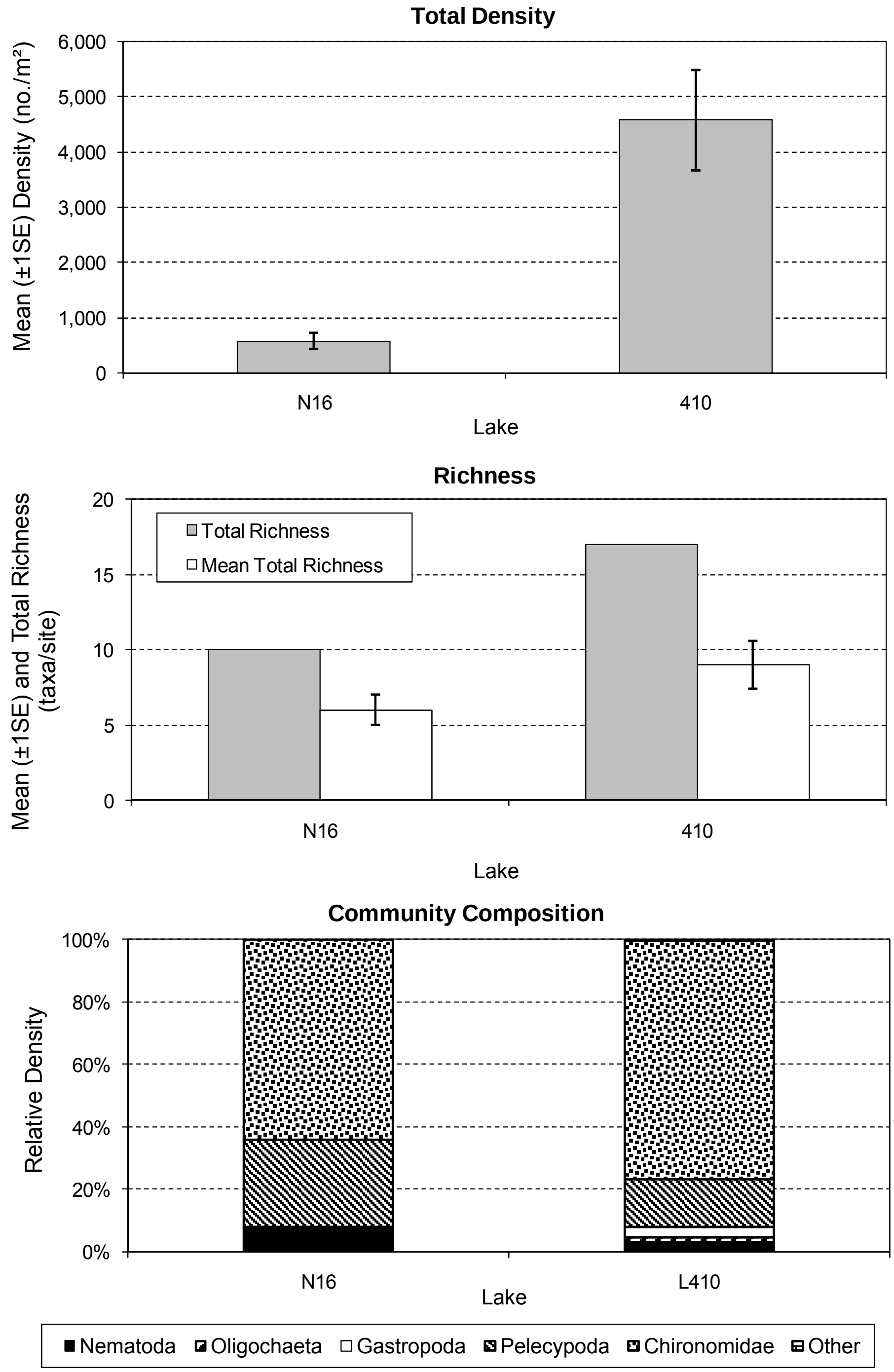
$\underline{+}$ = plus or minus; SE = standard error; no./m^2 = number of organisms per square metre; % = percent.

Figure 10.3-11 Total Abundance, Richness, and Community Composition of Benthic Invertebrates in Kennady Lake, Fall 2007



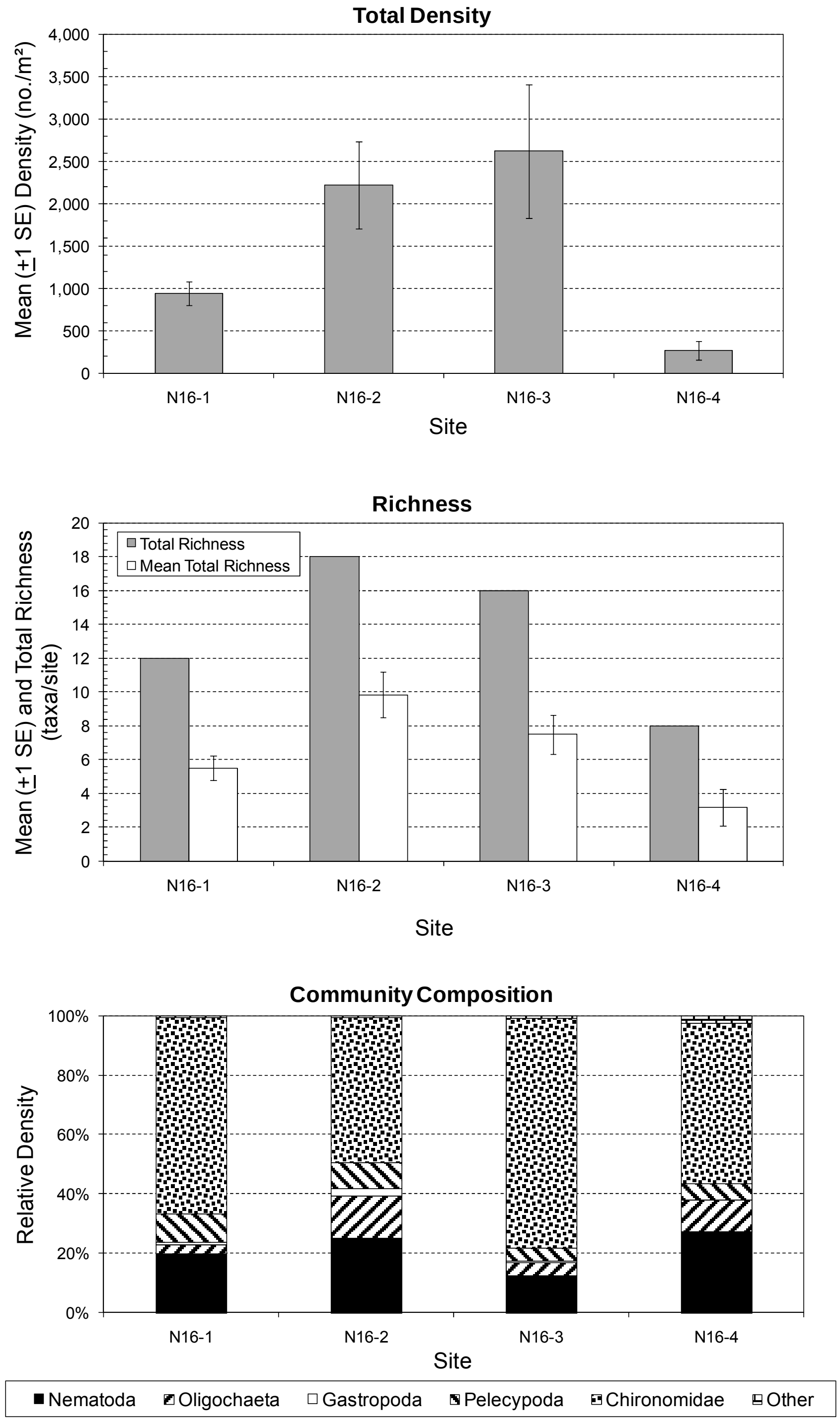
± = plus or minus; SE = standard error; no./m^2 = number of organisms per square metre; % = percent.

Figure 10.3-12 Total Abundance, Richness, and Community Composition of Benthic Invertebrates in Lake N16 and Lake 410, September 2004



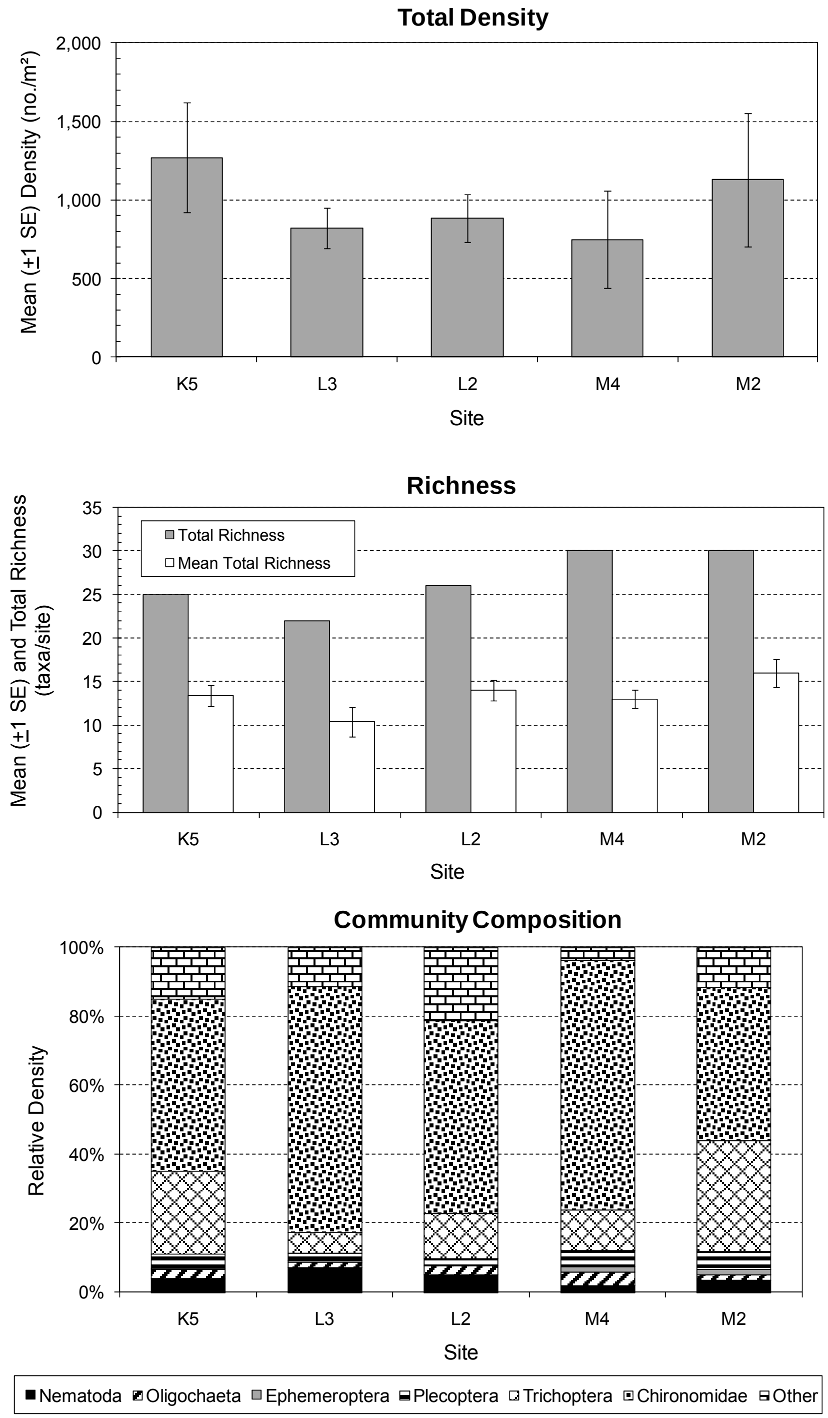
± = plus or minus; SE = standard error; no./m^2 = number of organisms per square metre; % = percent.

Figure 10.3-13 Total Abundance, Richness, and Community Composition of Benthic Invertebrates in Lake N16, Fall 2007



± = plus or minus; SE = standard error; no./m² = number of organisms per square metre; % = percent.

Figure 10.3-14 Total Abundance, Richness, and Community Composition of Benthic Invertebrates in Streams Downstream of Kennady Lake, Fall 2007



$\underline{+}$ = plus or minus; SE = standard error; no./m^2 = number of organisms per square metre; % = percent.

10.3.4 Fish

10.3.4.1 Aquatic Habitat

Lakes

Kennady Lake is a small (815 ha), oligotrophic, tundra lake that is comprised of interconnected basins. Kennady Lake has been divided into Areas 2 to 8 (Figure 10.3-1). Together, the main basins of Kennady Lake (i.e., Areas 2 to 7) comprise approximately 82% of the total lake area. Area 8, located at the outlet of Kennady Lake, is shallow (average depth is less than 4 m), long (about 4 km), and narrow (less than 500 m wide), and accounts for the remaining 18%.

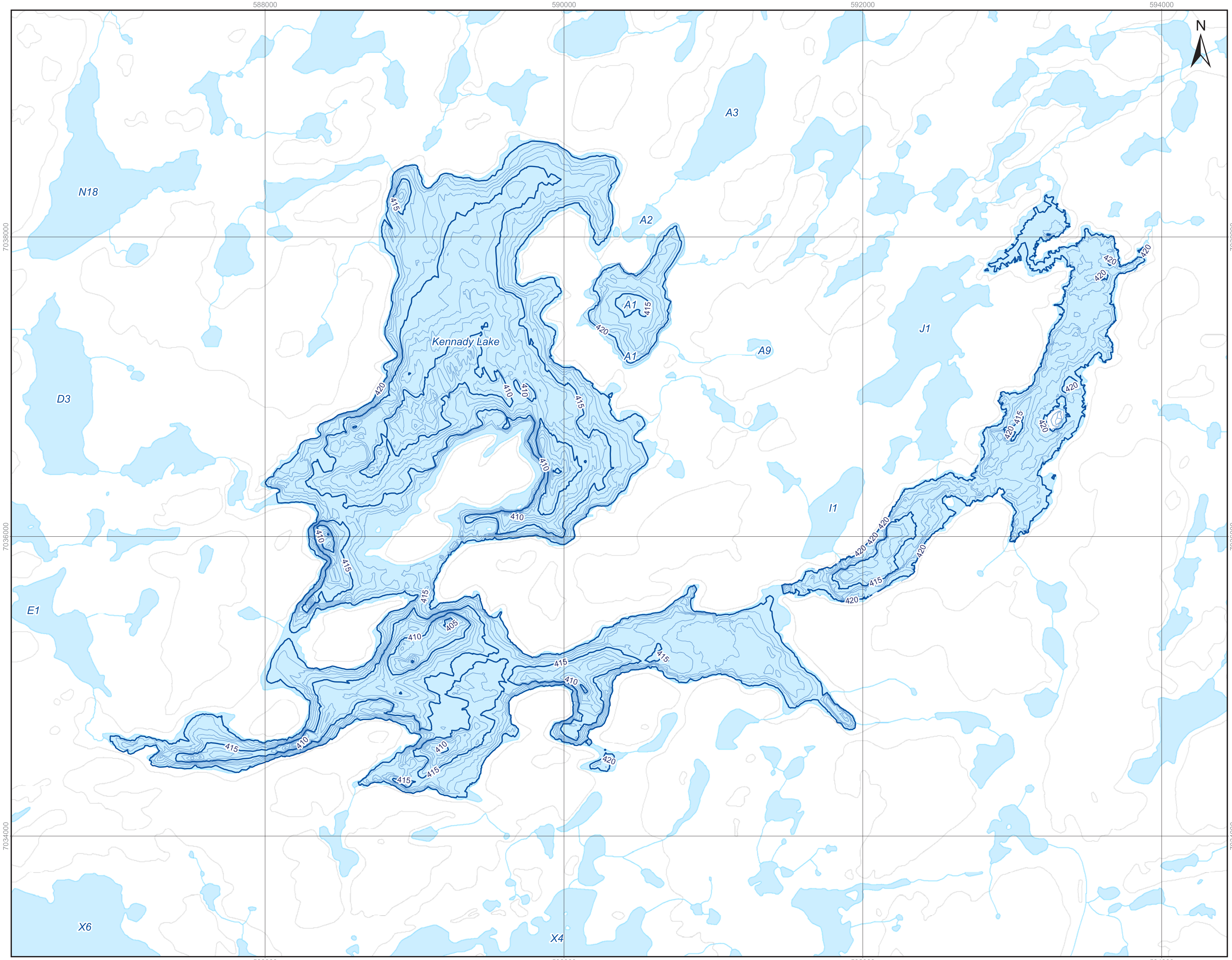
Kennady Lake has a mean depth of 5 m and a maximum depth of 18 m. A large proportion of Kennady Lake tends to be relatively shallow (i.e., less than 4 m deep), including virtually all of Area 8 (Figure 10.3-15). The deeper portions of the lake tend to occur in Areas 3, 4, and 5, with some deep areas located in Area 6.

In general, habitat in Kennady Lake can be classified into three types based on depth and dominant substrate type:

- shallow, nearshore habitat within the zone of freezing and ice scour (i.e., less than 2 m deep);
- nearshore habitat deeper than the zone of ice scour but where wave action prevents excessive accumulation of sediments (i.e., greater than 2 m but less than 4 m); and
- deep (greater than 4 m), offshore habitat with substrate usually consisting of a uniform layer of loose, thick organic material and fine sediment.

Each of the three categories can be subdivided into additional groups, based on substrate type, as shown in Figures 10.3-16 to 10.3-19.

Most of the nearshore habitat present in Kennady Lake (i.e., 88%) has a shallow gradient of less than 10 degrees. Shorelines are dominated by boulder and cobble substrates, with bedrock being present in some locations (Figures 10.3-16 to 10.3-19). As water depths increase, the boulder and cobble substrate typically becomes more embedded with fine substrates.



LEGEND

- Watercourse
- Waterbody
- Bathymetry Contour (1m interval)
- Bathymetry Contour (5m interval)
- Contour (10m interval)

NOTES

Base data source: National Topographic Base Data (NTDB) 1:50,000

GAHCHO KUÉ PROJECT

Kennady Lake and Lake A1 Bathymetry

PROJECTION: UTM Zone 12	DATUM: NAD83

Scale: 1:25,000

500 250 0 500

Metres

DE BEERS CANADA

FILE No: B-Hydro-018-GIS		DATE: October 21, 2010
JOB NO: 09-1365-1004	REVISION NO: 1	
OFFICE: GOLD-CAL	DRAWN: JH	CHECK: NS

Figure 10.3-15

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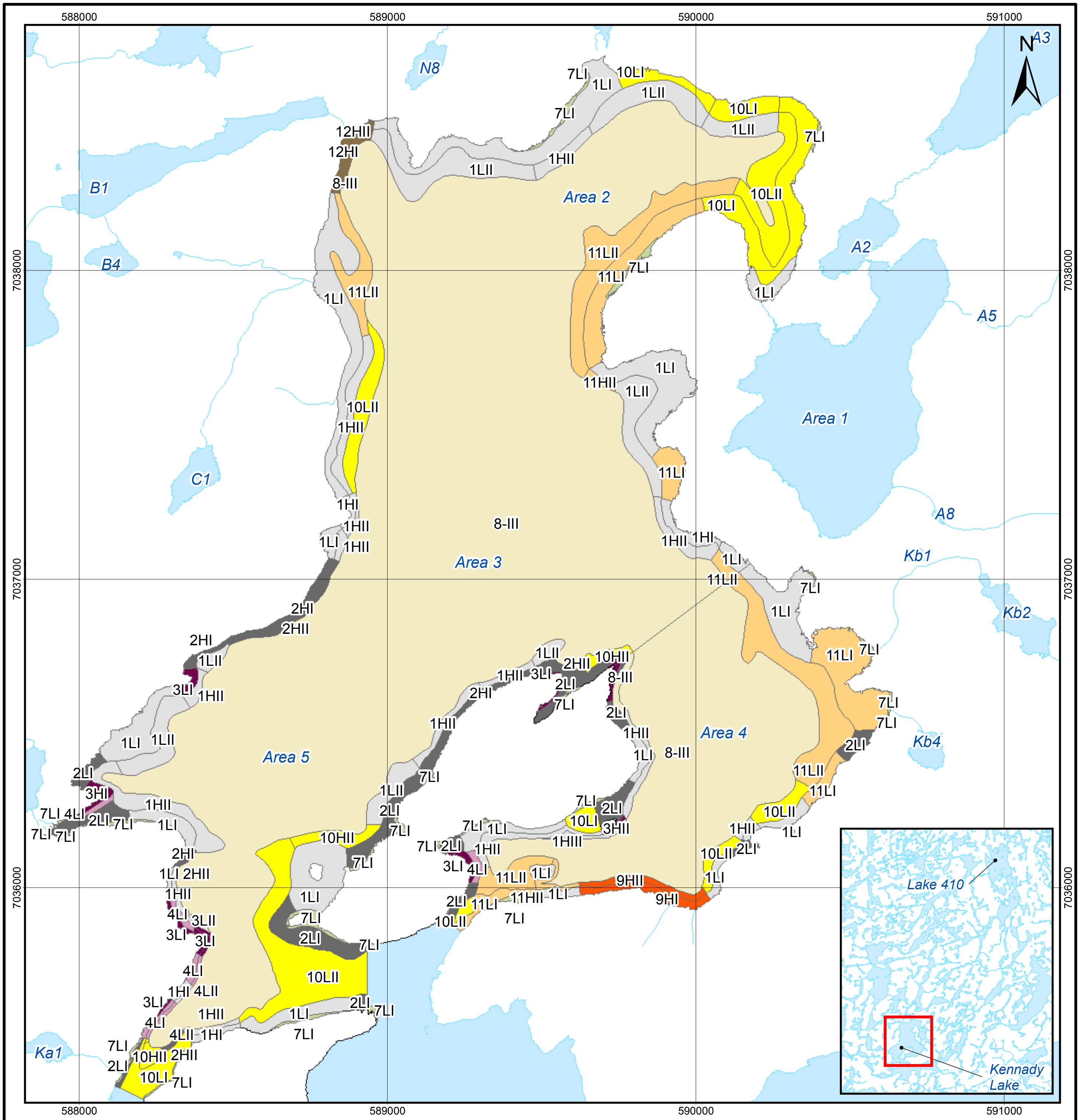

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LEGEND

Watercourse
Waterbody
Area 1 Kennady Lake Area Identifier
C1 Lake Identifier

Aquatic Habitat Label

8LI
Depth Category
Gradient Category
Substrate Category

Substrate Category

1 Boulder/Cobble
2 Boulder
3 Bedrock
4 Bedrock/Boulder
5 Bedrock/Cobble
6 Vegetation/Organics
7 Vegetation/Boulder
8 Fines/Organics
9 Cobble/Gravel
10 Boulder/Fines
11 Cobble/Fines
12 Boulder/Gravel

Gradient Category

H High
L Low
\- Unknown

Depth Category

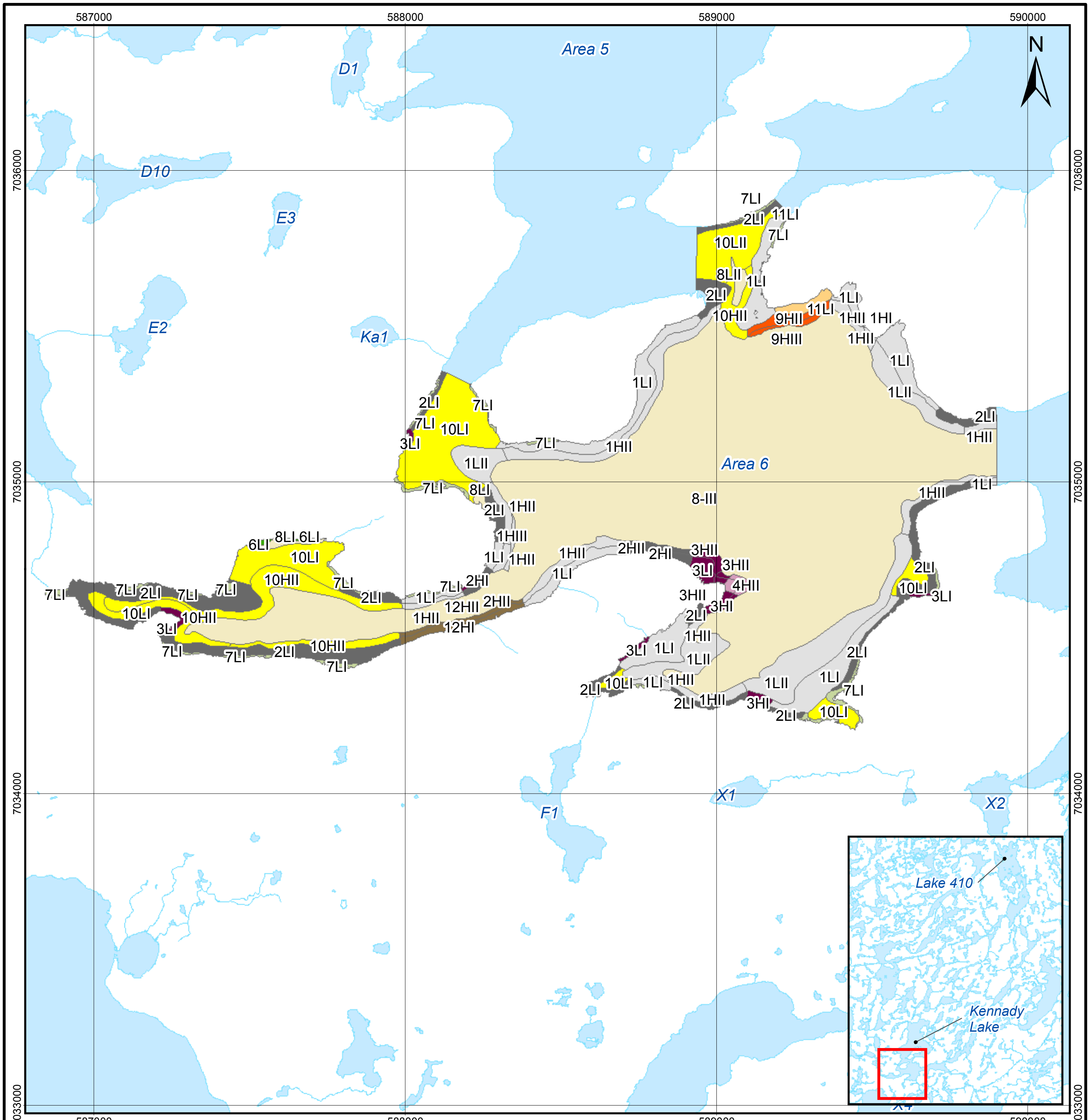
I 0 - 2 m
II 2 -4 m
III > 4 m
\- Unknown

NOTES
Base Data Source: Eagle Mapping Ltd.

GAHCHO KUÉ PROJECT

Aquatic Habitat in Areas 2, 3, 4, and 5 of Kennady Lake

PROJECTION: UTM Zone 12	DATUM: NAD83	DE BEERS CANADA
Scale: 1:18,000 (200 100 0 200 Metres)		
FILE No: KLOI-10-005-GIS		DATE: December 22, 2010
JOB NO: 09-1365-1004	REVISION NO: 1	
OFFICE: GOLD-CAL	DRAWN: SK / CHECK: JF	**Figure 10.3-16**



LEGEND

Watercourse
Waterbody
Area 6 Kennady Lake Area Identifier
D1 Lake Identifier

Aquatic Habitat Label

8LI
Depth Category
Gradient Category
Substrate Category

Substrate Category

1 Boulder/Cobble
2 Boulder
3 Bedrock
4 Bedrock/Boulder
5 Bedrock/Cobble
6 Vegetation/Organics
7 Vegetation/Boulder
8 Fines/Organics
9 Cobble/Gravel
10 Boulder/Fines
11 Cobble/Fines
12 Boulder/Gravel

Gradient Category

H High
L Low
\- Unknown

Depth Category

I 0 - 2 m
II 2 -4 m
III > 4 m
\- Unknown

NOTES
Base Data Source: Eagle Mapping Ltd.

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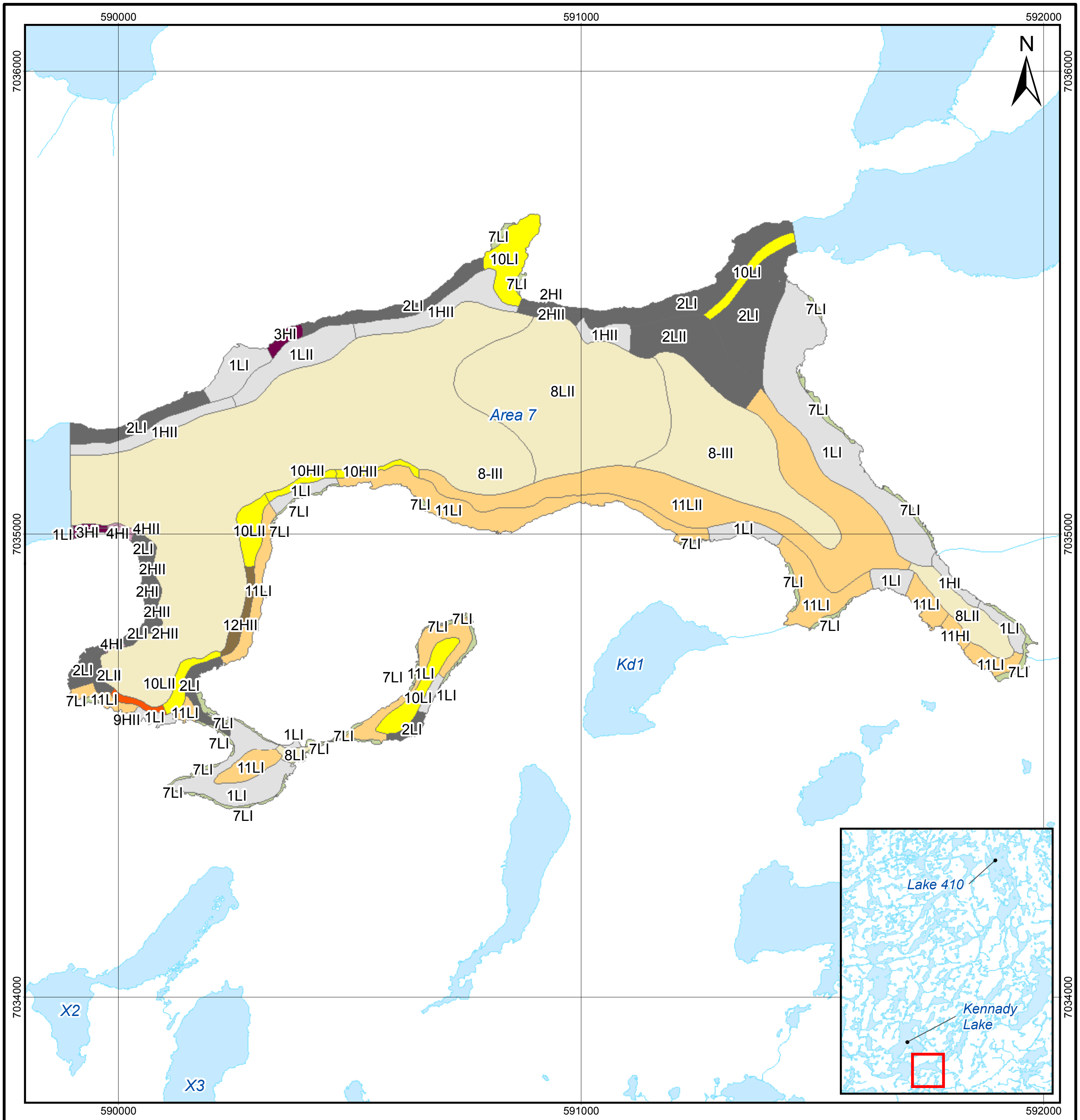
GAHCHO KUÉ PROJECT

Aquatic Habitat in Area 6 of Kennady Lake

PROJECTION: UTM Zone 12	DATUM: NAD83	DE BEERS CANADA
Scale: 1:18,000 (200 100 0 200 Metres)		
FILE No: KLOI-10-006-GIS		DATE: December 22, 2010
JOB NO: 09-1365-1004	REVISION NO: 1	Figure 10.3-17
OFFICE: GOLD-CAL	DRAWN: SK	CHECK: JF



LEGEND

- Watercourse
- Waterbody
- *Area 7* Kennady Lake Area Identifier
- *A1* Lake Identifier

Aquatic Habitat Label

8LI
- Depth Category
- Gradient Category
- Substrate Category

Substrate Category

- 1 Boulder/Cobble
- 2 Boulder
- 3 Bedrock
- 4 Bedrock/Boulder
- 5 Bedrock/Cobble
- 6 Vegetation/Organics
- 7 Vegetation/Boulder
- 8 Fines/Organics
- 9 Cobble/Gravel
- 10 Boulder/Fines
- 11 Cobble/Fines
- 12 Boulder/Gravel

Gradient Category

- H High
- L Low
- \- Unknown

Depth Category

- I 0 - 2 m
- II 2 -4 m
- III > 4 m
- \- Unknown

NOTES

Base Data Source: Eagle Mapping Ltd.

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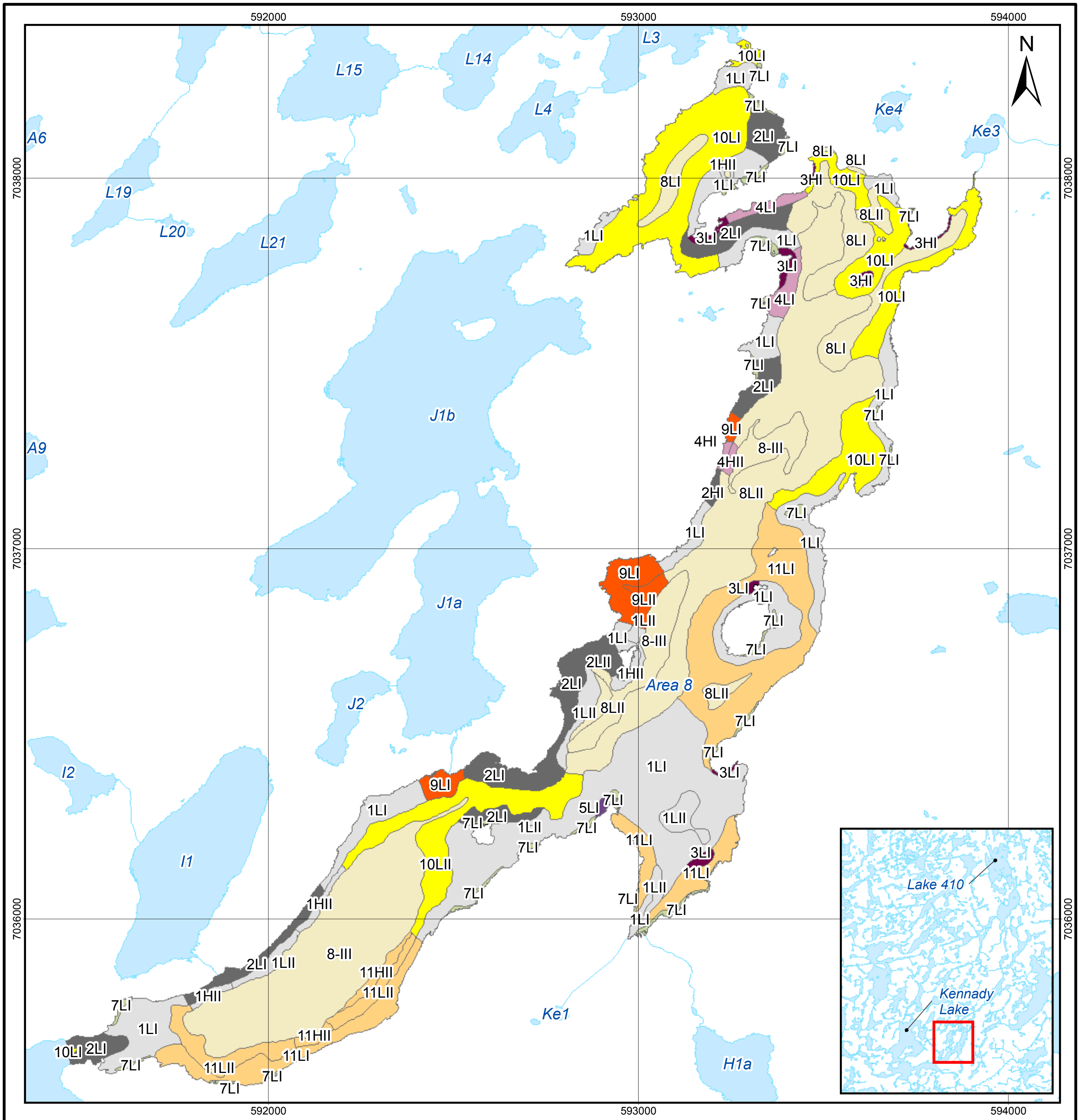
GAHCHO KUÉ PROJECT

Aquatic Habitat in Area 7 of Kennady Lake

PROJECTION: UTM Zone 12	DATUM: NAD83
Scale: 1:12,000 (200 100 0 200 Metres)	
FILE No: KLOI-10-007-GIS	DATE: December 22, 2010
JOB NO: 09-1365-1004	REVISION NO: 1
OFFICE: GOLD-CAL	DRAWN: SK / CHECK: JF

De Beers Canada

Figure 10.3-18



LEGEND

Watercourse
Waterbody
A1 Lake Identifier

Aquatic Habitat Label

8LI
Depth Category
Gradient Category
Substrate Category

Substrate Category

1 Boulder/Cobble
2 Boulder
3 Bedrock
4 Bedrock/Boulder
5 Bedrock/Cobble
6 Vegetation/Organics
7 Vegetation/Boulder
8 Fines/Organics
9 Cobble/Gravel
10 Boulder/Fines
11 Cobble/Fines
12 Boulder/Gravel

Gradient Category

H High
L Low
- Unknown

Depth Category

I 0 - 2 m
II 2 -4 m
III > 4 m
- Unknown

NOTES
Base Data Source: Eagle Mapping Ltd.

GAHCHO KUÉ PROJECT

Aquatic Habitat in Area 8 of Kennady Lake

PROJECTION: UTM Zone 12	DATUM: NAD83		
Scale: 1:15,000 (200 100 0 200 Metres)			
FILE No: KLOI-10-008-GIS		DATE: December 22, 2010	
JOB NO: 09-1365-1004	REVISION NO: 1		
OFFICE: GOLD-CAL	DRAWN: SK	CHECK: JF	**Figure 10.3-19**

DE BEERS CANADA

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Annual ice thickness in Kennady Lake is typically up to 2 m and substrates in nearshore areas less than 2 m deep are subjected to ice scour each winter. In Kennady Lake, 60% of all nearshore habitat falls within this ice scour zone, making it effectively unusable by fall spawning fish species such as lake trout and round whitefish for spawning and egg development.

In the deep-water zones of Kennady Lake, substrates are typically comprised of a thick layer of fine sediment. The sediment consists mainly of sand and silt, with minor amounts of clay.

Aquatic vegetation has a very limited presence in Kennady Lake. As shown in Figures 10.3-16 to 10.3-19, it tends to exist in small isolated pockets around the periphery of the lake where fine substrates accumulate. The pockets commonly occur at the mouths of the small tributaries that flow into Kennady Lake, although aquatic vegetation can be found in other shallow areas of the lake as well (Figure 10.3-18).

Lake N16 is a headwater lake of the Lockhart River located approximately 4 km northwest of Kennady Lake in the N watershed. Lake N16 drains to Lake 410 via Lakes N15, N11, and N1. Lake N16 has shoreline habitat that is similar to Kennady Lake. Boulder/cobble substrates dominate most shoreline areas and clean substrates are generally found down to the 4 m depth contour. Similar to Kennady Lake, bed sediment in the deeper portions of tends to be composed mainly of sand and silt, with minor amounts of clay.

Lake 410 is a 579 ha lake, located approximately 12 km downstream of Kennady Lake. Lake 410 receives inflow from two sources: from the Kennady Lake watershed, and from the much larger N watershed. For its size, Lake 410 is shallow, having a mean depth of approximately 4 m. The deepest spot in Lake 410 is in the narrows between its northern and southern basins where water is up to 9 m deep. Large boulders are common throughout the lake, even in offshore areas, and silt covered boulders dominate the shoreline substrates. Bed sediment in the deeper portions of tends to be composed mainly of sand and silt, with minor amounts of clay.

Kirk Lake is located approximately 25 km downstream of Kennady Lake. Kirk Lake has a surface area of 6,418 ha and a watershed area of 739 km^2. All water in the LSA drains into the southern basin of Kirk Lake. The southern basin of Kirk Lake has a relatively consistent depth (3.5 m), with a sand/silt substrate lakebed composition. Shoreline habitat is predominantly boulder/cobble substrates, but sandy beaches exist. Bed sediment in the deeper portions of tends to be composed mainly of sand and silt, with minor amounts of clay.

Streams

Kennady Lake is naturally drained at the eastern end of Area 8 through a series of streams and small lakes. Streams downstream of Kennady Lake to Lake 410 typically have a low gradient (less than 1%), are shallow (less than 50 cm deep), and are comprised of braided channels with low (less than 0.5 m) banks and large angular boulders. Gravel substrates are rare but do exist in small patches in some streams. In spring, water typically flows over stream banks and floods extensive areas of riparian tundra. In summer and fall when flows are lowest, water is generally confined to one main channel and, in most areas, is limited to flows between and under boulders.

Streams north of Kennady Lake (N9 to N2) drain a series of small headwater lakes into Lake N1 downstream, which also receives drainage from watersheds (N18 to N11) to the west and northwest side of Kennady Lake. Typical of headwater streams in the LSA, these streams generally have a low gradient and consist of multiple braided channels with large angular boulders and cobble substrates.

Streams downstream of Lake 410 are substantially wider (about 50 m wide) and deeper (greater than 1 m) than streams between Kennady Lake and Lake 410. This is because Lake 410 has two inlets and receives approximately 80% of its inflow from the adjacent N watershed.

10.3.4.2 Fish Community

Lakes

Eight species of fish are known to be present in Kennady Lake (Table 10.3-5). Based on gillnet catch data (Annex J, Fisheries and Aquatic Resources Baseline), round whitefish are the most abundant fish species in Kennady Lake, comprising between 48% and 71% of the total catch. Lake trout are the second most abundant species (about 20% of the total catch) and are the top predator in the lake. Based on population estimates conducted in 2004, there is a 95% probability that the lake trout population in Kennady Lake exceeds 2,300 individual fish. The hydro-acoustic survey conducted in summer 2010 refined the population estimates, and calculated a mean density of 13.4 lake trout per hectare (or a lake trout population of 10,925 fish) (Addendum JJ).

Arctic grayling are also present, along with small populations of northern pike and burbot. The northern pike population in Kennady Lake is small due to the paucity of aquatic vegetation in the lake. Lake chub are the most abundant forage fish species. Ninespine stickleback and slimy sculpin, two other species of forage fish, are also found in the littoral areas of the lake. A single longnose sucker was observed in the spring of 2000 near the lake outlet. It is believed this single fish was a stray from downstream habitats and that Kennady Lake does not support a population of longnose sucker (Annex J).

Table 10.3-5 Fish Species Captured in Kennady Lake, Lake N16, Lake 410, and Kirk Lake

Common Name	Scientific Name	Kennady Lake	Lake N16	Lake 410	Kirk Lake
Arctic grayling	*Thymallus arcticus*	√			
Burbot	*Lota lota*	√	√	√	
Lake chub	*Couesius plumbeus*	√	√	√	
Cisco	*Coregonus artedi*		√	√	√
Lake trout	*Salvelinus namaycush*	√	√	√	√
Lake whitefish	*Coregonus clupeaformis*				√
Longnose sucker[(a)]	*Catostomus catostomus*		√		
Ninespine stickleback	*Pungitius pungitius*	√	√		
Northern pike	*Esox lucius*	√		√	√
Round whitefish	*Prosopium cylindraceum*	√	√	√	√
Slimy sculpin	*Cottus cognatus*	√	√	√	
White sucker[(a)]	*Catostomus commersonii*		√		

(a) Of sucker species, only longnose sucker was captured in Lake N16 in 1996 and only white sucker in 1999. This is the only reported instance of white sucker in the watershed upstream of Kirk Lake and, therefore, may potentially be a misidentification.

Nine species of fish are known to be present in Lake N16. Six of the nine species are common between Lake N16 and Kennady Lake, and they include lake trout, round whitefish, burbot, lake chub, ninespine stickleback, and slimy sculpin (Table 10.3-5). Northern pike and Arctic grayling have not been captured in Lake N16, although Arctic grayling were recorded in the inlet and outlet streams. Cisco are also present in Lake N16 but not in Kennady Lake. Lake N16 is also known to support populations of longnose sucker and possibly white sucker.

Lake 410 and Kennady Lake share six common species, which include burbot, lake chub, lake trout, northern pike, round whitefish, and slimy sculpin (Table 10.3-5). The only other fish species known to reside in Lake 410 is cisco, which can also be found in Lake N16. Based on catch records, the most abundant fish species in Lake 410 include lake trout, round whitefish, and cisco. Arctic grayling and sucker species have not been captured in Lake 410. As reported for Kennady Lake and Lake N16, the total catch-per-unit-effort in littoral areas of Lake 410 was low.

In summer 2005, the gillnetting catch in Kirk Lake was dominated by lake whitefish and lake trout, with smaller numbers of northern pike, round whitefish,