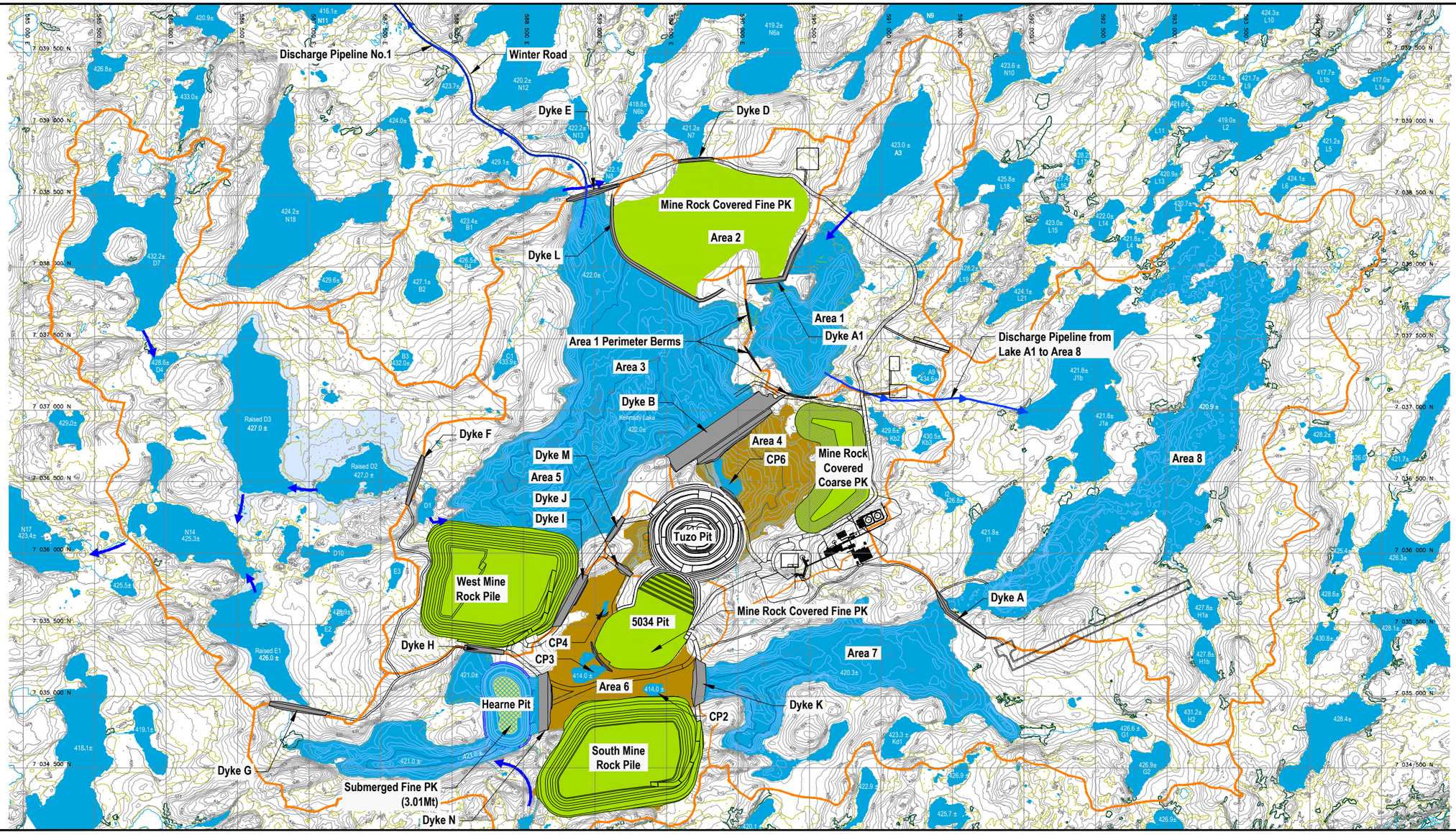


LEGEND

- 430 — Existing Ground Contours, 5m Index - 1m Intermediate
- 415 — Bathymetry Contours, 5m Index - 1m Intermediate
- CP — Collection Pond
- Winter Road
- Marsh Area
- Scrub
- Sub-watershed Boundary
- Drainage Flow Direction
- Discharge Pipeline
- Drained Area
- Flooded Areas
- Lake/Pond
- Mine Rock
- Submerged PK

NOTES

Base data source: EBA Figure 4.11 - Stage 8 - Water Management During Mine Operation Years 9 to 11 (2023 to 2025)
Source: Adapted from Figure 3.5-5 from De Beers 2010.

GAHCHO KUÉ PROJECT

Mining Operations Years 9 to 11 (2023 to 2025)

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
500 0 500 SCALE METRES		
FILE No: E2011-Fish-003-CAD		DATE: June 6, 2012
JOB No: 11-1365-0001	REVISION No: 5	Figure 3
OFFICE: GOLD - SAS	DRAWN: TAH/AL	CHECK: JF

G:\2011\1365\11-1365-0001 Gahcho Kue EIS Post-Submission\Mapping\MXD\Fish\E2011-Fish-003-CAD.dwg Oct 15, 2012 - 2:57pm

2.1.1 Dewatering of Kennady Lake

Fourteen dykes will be built to achieve the defined area for the controlled watershed (Figure 2). Perimeter dykes around Areas 2 to 7 will include Dykes A, A1, D, E, F, and G. The dewatering program will require construction of a water-retaining dyke (Dyke A) at the narrows between Area 7 and Area 8, effectively isolating Areas 2 through 7 of Kennady Lake from Area 8, which is the lake outlet. Once Dyke A is completed, water will be discharged out of Kennady Lake by pumping to Area 8 and to Lake N11. Dykes A1, E, F, and G will be constructed to divert water away from Kennady Lake. The diversions are required to reduce the volume of runoff entering the controlled areas (i.e., Areas 2 to 7) of Kennady Lake. As the level of water in Areas 2 to 7 decreases, the sills separating the northwest portions of the lake (Areas 2 to 5) from the areas above the 5034 and Hearne ore bodies (Areas 6 and 7) will be exposed. Isolating and dewatering portions of Kennady Lake will begin in Year 2 of construction, so that removal of overburden from above the 5034 kimberlite deposit can begin in a timely fashion.

Internal water retention dykes will be constructed isolating the northern portion of the lake (Area 2 to 5) from the southern portion of the lake (Areas 6 and 7), effectively splitting the partially dewatered lake into two major sections and allowing the complete drainage of the remaining water from Areas 6 and 7 into the northern part of the basin. Internal water retention dykes will include Dykes B, H, I, J, K, M, and N. Areas 3 and 5 will comprise the Water Management Pond. By the middle of Year 5, Dyke B will be constructed to separate Areas 3 and 4 of Kennady Lake. This activity will allow for the dewatering of the southern portion of Area 4, so that the Tuzo ore body can be mined. Once dewatering and internal dyke construction is complete, De Beers will look for an earlier opportunity to refill Area 7 in the mine plan.

2.1.2 Mine Rock Piles and Project Infrastructure

Area 2 of Kennady Lake will be dewatered as part of the initial partial dewatering of Areas 3 and 5. Area 2 will be isolated from Areas 3 and 5 by Dyke L, and will become part of the Fine PKC Facility (Figure 3). Dyke L will serve as a filter dyke between Areas 2 and 3. The west mine rock pile will be located within a southern portion of Area 5, the south mine rock pile will be located within a southern portion of Area 6 and the mine rock cover coarse PK will be located to the east of Area 4 (Figure 3).

A perimeter road and an airstrip will be constructed that will include watercourse crossings. Appropriate fish passage will be provided, where required. All stream crossing locations will be reclaimed at closure and channels of similar size and quality will be restored.

Table 1: Waterbodies and Watercourses Affected by the Gahcho Kué Project

Project Disturbance	Waterbodies (or Portions of Waterbodies) Affected	Watercourses (or Portions of Watercourses) Affected
Fine PKC Facility	Area 2 of Kennady Lake	Stream K1N1*
Coarse PK Pile	Area 4 of Kennady Lake, Lake Kb4	Stream Kb4*
West Mine Rock Pile	Area 5 of Kennady Lake, Lake Ka1	Stream D1, Stream Ka1*
South Mine Rock Pile	Area 6 of Kennady Lake	Stream F1*, Stream UNK4*
Hearne, Tuzo, and 5034 pits	Areas 4 and 6 of Kennady Lake	Stream UNK3*, Stream UNK5*, Stream UNK6*
Road between Hearne Pit and Dyke K	Area 6 of Kennady Lake	
Water Collection Pond Berms CP3, CP4, CP5 and CP6	Areas 4 and 6 of Kennady Lake	
Internal Dykes A, B, H, I, J, K, L, M, N	Kennady Lake	
Dyke A1		Stream A1*
Dyke D		Stream K1N1*
Dyke E		Stream B1
Dyke F		Stream D2
Dyke G		Stream E1
Dewatering of Kennady Lake	Kennady Lake (Areas 2 - 7) and Lake D1	Stream B1, Stream D2, Stream E1, Stream UNK1*, Stream UNK2*, Stream UNK3*
Flooding	Lake A1, Lake A2, Lake D2, Lake D3, Lake E1, Areas 3 and 5 of Kennady Lake	Stream A1, Stream A2, Stream A3, Stream A5*, Stream A8*, Stream A9*, Stream B1, Stream C1*, Stream D2, Stream D3, Stream D4, Stream D6*, Stream E1, Stream E2*, Stream UNK7*
Site Road		Stream A3, Stream A6*, Stream Kb1*, Stream Kb2*
Airstrip		Stream H1a
Building D		Stream A9*

* Flow paths determined to have no fish habitat (more information in Section 3.0).

2.1.3 Closure Water Management

A progressive reclamation strategy will be used, where portions of the lake are isolated and allowed to refill to natural water levels as early as possible. For example, De Beers will look for opportunities to refill Area 7 earlier than is currently stated in the mine plan. The closure water management plan requires controlled pumping of water from Lake N11 to Area 3 to reduce the time required to refill Kennady Lake. The required filling time is estimated to be approximately eight years of both pumping from Lake N11 and natural runoff accumulation.

Major steps for the closure water management plan include the following:

- Lowering the water elevations in all water storage areas within Areas 2 through 7 to 417.0 metres above sea level (masl) by siphoning the water from Areas 3 and 5, west of Area 6, and Area 7 to the mined-out Tuzo Pit after the end of mine life.

- Lowering sections of Dykes B, J, N, and K to an elevation of 417.0 m, a level below the expected restored lake level of 420.7 m, to allow flooding of the Tuzo Pit area.
- Placing erosion protection materials over the downstream natural channels (or engineered channel when required) to limit erosion along the flow paths to the mined-out Tuzo Pit.
- Breaching a section of Dyke E to allow the runoff water from the catchment area of Lakes B1 to B4 to flow into Area 3.
- Allowing the extra runoff water from Areas 3 and 5, west of Area 6, and Area 7 to flow over the breached sections of Dykes B, J, N, and K.
- Pumping water from Lake N11 to Area 3 for eight or more consecutive years (pending downstream flow mitigation requirements).
- Raising the water elevation in the entire basin to the original lake elevation of 420.7 masl in eight or more years (pending downstream flow mitigation requirements) after end of the mine operation.
- Breaching Dykes F and G, and re-establishing connections of the D and E watersheds to Kennady Lake.
- Removing the most north-western perimeter berm for Lake A1 to allow the lake to drain to Area 3.
- When the water quality meets criteria that allows Kennady Lake to be reconnected to the downstream watersheds, breaching Dyke A to connect the refilled areas to Area 8.

2.2 Fish-Out

A fish-out will be conducted to remove fish from Areas 2 to 7 of Kennady Lake and Lake D1 prior to and during dewatering. A Project-specific protocol will be developed prior to initiating the fish-out. The protocol will be designed to collect scientific information as appropriate and minimize the waste of fish. The DFO General Fish-out Protocol will be used as a guide, and sampling protocols will include the collection of biological information (e.g., length, weight, sex, maturity, fecundity, stomach contents, and removal of aging structures). The fish-out will be designed and implemented in consultation with DFO and local communities.

De Beers has initiated consultation on the fish-out with the local communities. As part of the protocol, harvested fish will be provided to local communities to avoid wasting of fish. A draft Fish-Out Plan was developed by De Beers in October 2012 that provides additional details on the fish-out plan. However, it is recognized additional consultation with DFO and Aboriginal groups will occur on the plan as part of the permitting process (De Beers 2012b).

2.3 Downstream Flows

As described in the Downstream Flow Mitigation Plan (Golder 2012d), mitigation measures will be implemented by pumping water to Area 8 during operations and closure to offset any project impacts in downstream habitats due to flow reductions. With consideration of the proposed mitigation measures, there will be no HADD in streams downstream of Kennady Lake, and, therefore, no compensation is required for the changes in downstream flow associated with the Project. Monitoring will be conducted to evaluate the mitigation, and adaptive management will be applied as required. At post-closure, downstream flow will return to near pre-development conditions.

3.0 DESCRIPTION OF AFFECTED WATERBODIES AND WATERCOURSES

Proposed mine developments will affect large areas of Kennady Lake and, as such, will affect multiple life stages of species of fish known to inhabit the lake, including lake trout (*Salvelinus namaycush*), round whitefish (*Prosopium cylindraceum*), Arctic grayling (*Thymallus arcticus*), northern pike (*Esox lucius*), burbot (*Lota lota*), lake chub (*Couesius plumbeus*), slimy sculpin (*Cottus cognatus*), and ninespine stickleback (*Pungitius pungitius*). Representative photographs of the affected waterbodies and watercourses are presented in Appendix A.

In northern lakes, habitat quality (during ice-free periods) is typically higher in littoral (shallow shoreline) areas. Littoral areas are more productive with respect to aquatic vegetation and insects and, therefore, offer increased foraging opportunities, cover, and spawning habitat for fish. Additionally, lake margins share habitat with inlet and outlet streams; these areas are important for fish that use streams for key life processes, such as rearing or spawning (e.g., Arctic grayling). In winter, these areas offer little to no habitat, as ice can form to depths of up to 2 m. Lake habitat in the 2 to 4 m depth range provides important fall spawning and overwintering habitat. In addition to remaining ice-free, these areas can be influenced by wave-generated currents during open water periods and typically contain substrates low in organics and fines, thereby providing important winter refugia and foraging opportunities for fish as well as providing suitable spawning substrates for several species. Lake habitats that are deeper than 4 m are typically used by large-bodied fish for holding, foraging and overwintering, and may provide spawning habitat for species (e.g., lake trout) that can spawn in deep areas where substrates are suitable.

The following provides a brief description of the fish communities and fish habitat in the waterbodies and watercourses that may be affected by the Project, and are included in the NNLP. The portion of each watershed described below only includes the areas affected by, or directly adjacent to the Project, as illustrated in Figures 2 and 3. The descriptions are based on field data collected for the Project. More details on fish communities and fish habitat and sources of information in the Project area can be found in the Fisheries and Aquatic Resources Baseline (Annex J and Addendum JJ [De Beers 2010]) and in the 2011 Fish and Aquatic Resources Supplemental Monitoring Report (Golder 2012a). Where relevant, data collected during the 2012 field surveys have been incorporated.

3.1 Waterbodies

A short summary of habitat conditions for waterbodies within the affected habitats is provided below. Table 2 summarizes fish sampling information for these waterbodies.

Table 2: Fish Species Captured and Sampling Date/Method for Waterbodies within Affected Habitats

Waterbody	Fish Species Captured	Sampling Date (Sampling Method)
Kennady Lake	ARGR, BURB, LKCH, LKTR, NNST, NRPK, RNWH, SLSC	Summer 1996 (AN, GN, MT, OB), Fall 1996 (AN, GN) Summer 1999 (GN, MT) Winter 2004 (AN), Summer 2004 (AN, EF, ES, GN, MT), Fall 2004 (AN, EF, GN) Spring 2005 (FF), Summer 2005 (EF) Summer 2010 (GN)
Lake D1	BURB, NRPK	Summer 2003 (MT), Spring 2004 (FF)
Lake D2	NRPK	Spring 2004 (FF), Summer 2004 (GN), Fall 2004 (EF) Summer 2007 (EF, GN, MT) Summer 2010 (GB, MT) Summer 2012 (EF, GN, MT)
Lake D3	BURB, LKTR, NRPK, SLSC	Summer 2004 (GN), Fall 2004 (EF) Summer 2007 (EF, GN, MT) Summer 2010 (GN, MT) Summer 2012 (EF, GN, MT)
Lake E1	NRPK, SLSC	Summer 2004 (GN), Fall 2004 (EF) Summer 2007 (EF, GN, MT) Summer 2010 (GN, MT) Summer 2012 (EF, GN, MT)
Lake E2	no fish captured	Summer 2003 (MT) Summer 2005 (EF) Summer 2012 (AN, EF)
Lake Ka1	no fish captured	Summer 2003 (MT) Summer 2005 (EF)
Lake Kb4	no fish captured	Summer 2003 (MT), Summer 2005 (EF)

Source: Annex J and Addendum JJ of the 2010 EIS (De Beers 2010); Golder 2012a; 2012 field survey results (Golder 2012b)

Notes:

Fish species: ARGR = Arctic grayling, BURB = burbot, LKCH = lake chub, LKTR = lake trout, LNSC = longnose sucker, NNST = ninespine stickleback, NRPK = northern pike, RNWH = round whitefish, SLSC = slimy sculpin.

Method: AN = angling, EF = backpack electrofishing, ES = boat electrofishing, FF = fish fence, GN = gill net, MT = minnow trap, OB = observed.

3.1.1 Kennady Lake

Kennady Lake (63° 26' N; 109° 12' W) is a small (approximately 814 hectares [ha]), headwater lake of the Lockhart River watershed with a mean depth of 5 m and a maximum depth of about 18 m. It is located approximately 280 km northeast of Yellowknife and about 140 km northeast of the Dene community of Łutselk'e on the eastern arm of Great Slave Lake. A low divide separates Kennady Lake from a series of small headwater lakes and streams to the immediate north. Discharge from Kennady Lake flows north to Lake 410 (approximately 12 km downstream from Kennady Lake) then through a series of small lakes and streams into Kirk Lake and eventually into Aylmer Lake on the mainstem drainage of the Lockhart River. The Lockhart River system drains into the north-eastern arm of Great Slave Lake.

In general, habitat in Kennady Lake can be classified into three types:

- shallow, nearshore littoral 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 subject to wave action that prevents excessive accumulation of sediments (i.e., greater than 2 m but less than 4 m); and
- deep, offshore habitat with substrate usually consisting of a uniform layer of loose, thick organic material and fine sediment (i.e., greater than 4 m).

Nearshore habitats (i.e., less than 4 m) comprise approximately 48 percent (%) (393 ha) of the total area of Kennady Lake. Most of this nearshore habitat (greater than 57%) has a low gradient extending from the wetted edge to deeper, greater than 4 m habitat. Two other general nearshore habitat morphologies are present in the lake but are less common. They include low gradient shorelines extending from the wetted edge to approximately the 2 m depth contour and then increasing in gradient to depths below 4 m, and high gradient shorelines extending immediately from the wetted edge to deeper greater than 4 m offshore habitat.

Twelve substrate categories, based on particle size standards for British Columbia (BC MELP 1998), have been identified in Kennady Lake (Annex J, Fisheries and Aquatic Resources Baseline). Habitat can also be classified into one of three gradient categories (i.e., slope from shoreline towards centre of lake) and one of three depth categories. Depth categories were differentiated by the typical annual ice depth (2 m) in Kennady Lake and the average depth of wind-generated currents (4 m). At depths less than 4 m, these wind-generated currents generally keep substrates clean by preventing the accumulation of silt and algae. Below 4 m depth, the effectiveness of these wind-generated currents is diminished, and substrates are typically embedded and/or algae covered.

Eight species of fish (i.e., Arctic grayling, burbot, northern pike, round whitefish, lake trout, lake chub, slimy sculpin, and ninespine stickleback) have been recorded within Kennady Lake (Table 2). A single longnose sucker (*Castostomus catostomus*) was reported captured in the spring of 2000 near the lake outlet (Annex J). It is believed this single fish was a stray from downstream habitats, given the susceptibility of longnose suckers to being caught by standard sampling methods. As such, Kennady Lake does not likely support a population of longnose sucker.

Area 8 is the easternmost basin of Kennady Lake and is just upstream of the L watershed. As Area 8 will not be dewatered, it is the only part of Kennady Lake that will sustain fish populations during the operational period. There is also potential for enhancement of habitat conditions in Area 8 through the placement of habitat enhancement features. The basin is long (approximately 4 km), narrow (typically less than 500 m wide), and generally less than 4 m deep (mean depth of 3 m). Two deep (greater than 8 m) holes exist in Area 8, but deep-water habitats represent only 14.8% of the total Area 8 basin area (142.2 ha). Nearshore habitats are more diverse than in other basins of Kennady Lake. Ninety-eight percent of all nearshore habitats less than 2 m deep have shallow gradients. Within this nearshore zone, 10 different substrate categories are present; however, most substrates are clean boulder/cobbles. Fines/organics are the most abundant substrate type at depths greater than 2 m. Aquatic vegetation is present in littoral areas of Area 8 and is typically found in shallow embayments along the southern shoreline and near the Kennady Lake outlet.

3.1.2 Unnamed Lakes in the D Watershed

3.1.2.1 Lake D1

Lake D1 has a surface area of 1.87 ha and a maximum depth of 3.8 m. The lake is dominated by low gradient, shallow habitat with substrate composed of more than 40% boulder that is highly embedded boulders overlain with a layer of fine sediment. Fish species recorded in Lake D1 include burbot and northern pike (Table 2).

3.1.2.2 Lake D2

Lake D2 is shallow, with a maximum depth of 1 m. It has a surface area of 12.5 ha. Substrate throughout the lake is mainly boulder with an overlying 0.30 m thick layer of organic sediments. There are also boulder substrates adjacent to the shore with a thin layer of sediments. A zone of sedges is located at the east end of the lake. Surrounding the entire lake is a 25 to 100 m zone of sedges that would be expected to be inundated during high water. Northern pike have been captured in Lake D2 (Table 2).

3.1.2.3 Lake D3

Lake D3 has a surface area of 38.4 ha. This lake is shallow, with a maximum depth of 2.5 m. Shoreline substrates are primarily ice scoured boulder and cobble with inorganic silt patches. The shoreline is of low gradient with a 0.5 to 1 m fringe of sedges found along the majority of the lake. The north and south ends of the lake are particularly shallow. The central deeper portion of the lake has a substrate consisting of boulders with an overlying layer of organic fines. Fish species that have been recorded in the lake include burbot, lake trout, northern pike, and slimy sculpin (Table 2).

3.1.3 Unnamed Lakes in the E Watershed

3.1.3.1 Lake E1

Lake E1 has a surface area of 20.2 ha and is comprised of three basins separated by shoals. The northern basin has a maximum depth of 2.2 m and a moderately steep shoreline composed of bedrock/boulder and cobbles. The central basin has a maximum depth of 3.4 m. The southernmost basin has a maximum depth of 3 m. The shoals separating the basins are 0.75 m deep and are composed of ice scoured boulders and cobbles. The western shoreline of the central basin is moderately steep and composed of a boulder and cobble substrate. The eastern shoreline of the central basin has a shallow gradient, with shoreline characteristics similar to the western shoreline. Shoreline areas have a fringe of emergent vegetation and overhanging vegetation around the perimeter of the lake. Fish species recorded in Lake E1 include northern pike and slimy sculpin (Table 2).

3.1.3.2 Lake E2

Lake E2 is a very shallow lake with no discernible outflow channel. The lake has a surface area of 3.02 ha and has a maximum measured depth of 0.4 m. The shoreline is composed primarily of boulders, with organic fines present. The shoreline is surrounded by a fringe of sedges about 0.5 m to 1.0 m wide. The substrate in the southernmost basin has fewer fines and is mostly comprised of clean boulder substrate with no sedges. The substrate in the main waterbody, excluding the shoreline, is composed of boulders with an overlying layer of organic silt (0.30 m thick). Fish have not been captured in Lake E2 (Table 2), and it is considered to be a non-fish bearing lake (Annex J).

3.1.4 Unnamed Lakes in the Ka Watershed

3.1.4.1 Lake Ka1

Lake Ka1 is a small, one hectare lake with a maximum observed depth of 1 m (Annex J). The substrate in Lake Ka1 consists of boulders overlain with organic fines. There is emergent vegetation along the shoreline of the lake, with some areas of exposed boulders also present. Fish have not been captured in Lake Ka1 (Table 2), and it is considered to be a non-fish bearing lake (Annex J).

3.1.5 Unnamed Lakes in the Kb Watershed

3.1.5.1 Lake Kb4

Lake Kb4 is a small, one hectare lake, with a maximum depth of 1.2 m. The substrate is composed of mostly organics with some intermittent boulders. There is emergent vegetation along the lake shoreline. The lake bottom deepens quickly away from the shoreline. No fish have been captured in Lake Kb4 (Table 2), and it is considered to be a non-fish bearing lake (Annex J).

3.2 Watercourse Segments

A short summary of habitat conditions for streams within the affected habitats is provided below. Table 3 summarizes fish sampling information for these streams.

3.2.1 Unnamed Streams in the A watershed

3.2.1.1 Stream A1

Stream A1 is 100 m in length, connecting Lake A1 and Area 2 of Kennady Lake. The overall gradient is close to 0%. The stream is characterized by generally well defined banks and, at the time of the survey, had a mean channel width of 3.9 m. The channel is occasionally braided, within a maximum floodplain of 20.1 m in width. Depth averages 0.37 m, and substrates are predominantly boulders, with fines present. Moderate quality Arctic grayling spawning habitat is present in sections of the stream with gravel substrate. High quality northern pike spawning habitat is present due to the instream aquatic vegetation. The stream provides fish passage between Kennady Lake and Lake A1. The stream maintains flow in summer, providing rearing and feeding habitat. Arctic grayling, burbot, northern pike, lake chub, ninespine stickleback, and slimy sculpin have been captured in this stream (Table 3).

3.2.1.2 Stream A2

Stream A2 is a short (20 m in length), low-gradient (~0%) stream connecting Lake A2 and Lake A1. The channel is well defined with a width of approximately 5.4 m. Habitat is primarily boulder garden, with glides and riffles present. The bed material is predominantly boulder, with cobbles, fines and organic material present. Moderate quality Arctic grayling spawning habitat is present in sections of the stream with gravel substrate. High quality northern pike spawning habitat is present due to the presence of instream aquatic vegetation. Fish passage is possible between Lakes A2 and A1. The stream maintains flow in summer, and would provide suitable rearing habitat. Arctic grayling, burbot, and northern pike have been captured in Stream A2.

3.2.1.3 Stream A3

Stream A3 is 276 m in length, with an overall gradient of 0.6%. The watercourse has sections with defined flow through a single channel, sections with braided channels, as well as sections with dispersed flow and no defined channel. Banks are primarily well defined, but there are sections with poorly defined banks. In June 2012, Stream A3 had wetted widths ranging from 0.58 to 2.1 m and channel widths ranging from 1.05 to 2.2 m; the maximum depth observed was 0.28 m. Habitat is primarily glides and pools. Bed material is predominantly composed of fines/organics. Limited or nil potential spawning habitat is present for Arctic grayling and northern pike due to the lack of suitable gravel substrate and emergent vegetation. Although there are sections with undefined channel, fish passage would be possible between Lake A2 and A3. The stream maintains flow in summer, and would provide some rearing habitat. Arctic grayling, lake trout, northern pike, burbot, and ninespine stickleback have been captured in Stream A3.

Table 3: Fish Species Captured and Sampling Date/Method for Streams within Affected Habitats

Stream	Fish Species Captured	Sampling Date (Sampling Method)
A1	ARGR, BURB, LKCH, NNST, NRPK, SLSC	Summer 1999 (EF) Spring 2004 (MT, FF) Summer 2007 (EF)
A2	ARGR, BURB, NRPK	Spring 1996 (AN) Summer 1996 (OB) Spring 2000 (FF)
A3	ARGR, BURB, LKTR, NNST, NRPK	Spring 1996 (AN, EF) Spring 2004 (FF, MT) Summer 2004 (EF)
A5	not sampled[(a)]	-
A6	not sampled[(a)]	-
A8	not sampled[(a)]	-
A9	not sampled[(a)]	-
B1	ARGR	Summer 1996 (EF) Summer 1999 (EF) Spring 2000 (FF) Spring 2004 (FF)
C1	not sampled[(a)]	-
D1	ARGR, NNST	Spring 1996 (EF) Spring 2000 (FF)
D2	ARGR, BURB, NRPK, SLSC	Summer 1996 (EF) Spring 2004 (FF)
D3	not sampled	-
D4	SLSC	Summer 2004 (EF)
E1	ARGR, BURB, NNST, NRPK	Spring 1996 (EF) Summer 1999 (EF) Spring 2000 (FF) Spring 2004 (MT, FF)
E2	not sampled[(a)]	-
F1	not sampled[(a)]	-
H1a	NNST, NRPK	Spring 1996 (AN, EF) Spring 2004 (FF)
Ka1	not sampled[(a)]	-
Kb1	not sampled[(a)]	-
Kb2	not sampled[(a)]	-
Kb4	not sampled[(a)]	-
Kd1	NNST	Spring 1996 (EF)

Source: Annex J and Addendum JJ of the 2010 EIS (De Beers 2010);

Notes:

Fish species: ARGR = Arctic grayling, BURB = burbot, LKCH = lake chub, LKTR = lake trout, LNSC = longnose sucker, NNST = ninespine stickleback, NRPK = northern pike, RNWH = round whitefish, SLSC = slimy sculpin.

Method: AN = angling, EF = backpack electrofishing, FF = fish fence, MT = minnow trap, OB = observed.

[(a)] not sufficient water or flow for sampling.

3.2.1.4 Stream A5

Stream A5 does not provide any suitable fish habitat, as it lacks a defined channel, and is dry or consists of disconnected, shallow wetted sections in spring or fall. No fish passage would be possible between Lake A1 and Lake A5.

3.2.1.5 Stream A6

Stream A6 does not provide suitable fish habitat, as it has dispersed flow through inundated terrestrial vegetation and lacks a defined channel. Near the outflow of Lake A6, there was a short section with poorly defined banks and shallow depths (i.e., 0.10 m). However, no fish passage would be possible between Lake A5 and Lake A6 due to very shallow depths and sections with subsurface flow.

3.2.1.6 Stream A8

Stream A8 does not provide any suitable fish habitat, as it lacks a defined channel. At the time of the June 2012 survey, the area consisted of a low depression between the lakes, which was completely overgrown with terrestrial vegetation. Most of the area was dry except for small, isolated pockets of standing water present at the lower end of the site. No fish passage would be possible between Lake A1 and A8.

3.2.1.7 Stream A9

Stream A9 does not provide any suitable fish habitat, as it lacks a defined channel. At the time of the June 2012 survey, the area consisted of a low depression between the two lakes, which was completely overgrown with terrestrial vegetation. No fish passage would be possible between Lake A8 and A9.

3.2.2 Unnamed Streams in the B watershed

3.2.2.1 Stream B1

Stream B1 is 94 m in length and consists of a narrow channel flowing through a shallow depression in the tundra. Overall gradient is 5.1%. The stream is characterized by a generally well defined channel averaging 3.0 m in width, within a 6.3 m floodplain. Depth averages 0.29 m, and substrates are predominantly boulders, with cobbles and gravels present. Habitat is primarily riffles, interspersed with sections of glides. Moderate quality Arctic grayling spawning habitat is present in sections of the stream with gravel substrate. No spawning habitat is present for northern pike. The stream provides fish passage between Kennady Lake and Lake B1. The stream maintains some flow in summer, providing limited rearing habitat. Arctic grayling have been captured in this stream (Table 3).

3.2.3 Unnamed Streams in the C watershed

3.2.3.1 Stream C1

Stream C1 does not provide any suitable fish habitat as it lacks defined banks, and is dry or consists of disconnected, shallow wetted sections in spring or fall. No fish access would be possible from Kennady Lake to Lake C1.

3.2.4 Unnamed Streams in the D Watershed

3.2.4.1 Stream D1

Stream D1 is 118 m in length, with an overall gradient of 0.3%. The stream is characterized by a narrow, well defined channel averaging 1.2 m in width, within a floodplain 7.4 m wide. Bed material is primarily boulder, with some cobble and gravels present. Habitat is primarily runs, with some small riffle sections. Moderate quality Arctic grayling spawning habitat is present in sections of the stream with gravel substrate. No spawning habitat is present for northern pike; however, this stream provides access to the upstream D lakes (primarily D2 and D3), which are used by northern pike for spawning and rearing. The stream maintains flow in summer, and would provide suitable rearing habitat. Arctic grayling and ninespine stickleback have been captured in this stream (Table 3).

3.2.4.2 Stream D2

Stream D2 is 228 m in length, with an overall gradient of 1.4%. The stream has well defined banks with a channel width of 2.4 m and a mean depth of 0.48 m. Habitat is primarily glide, interspersed with some riffles and pools. Bed material is composed of fines and boulders, with some cobbles and gravels present. Moderate quality Arctic grayling spawning habitat is present in sections of the stream with gravel substrate. Low quality spawning habitat is present for northern pike due to the limited instream vegetation. The stream provides fish passage between Lake D1 and Lake D2. Flow is maintained in summer, and the stream would provide suitable rearing habitat. Arctic grayling, burbot, northern pike, and slimy sculpin stickleback have been captured in this stream (Table 2).

3.2.4.3 Stream D3

Stream D3 is 97 m in length, with an overall gradient of 2.3%. The watercourse has a channel width of 2.4 m, with generally poorly defined stream banks. Substrate is primarily cobble with boulder. Habitat is composed of glides, interspersed with riffles and pools. Moderate quality Arctic grayling spawning habitat is present, but limited by the paucity of gravel in the stream. Low to moderate quality spawning habitat is present for northern pike. The stream provides fish passage between Lake D2 and Lake D3, with flow being maintained in summer. Stream D3 has not been sampled, but fish distribution is assumed based on species captured in the watershed.

3.2.4.4 Stream D4

Stream D4 is 428 m in length, with an overall gradient of 0.5%. The stream is characterized by a well defined channel through a depression in the tundra with an average gulley width of 2.6 m. Mean bankfull depth is 0.9 m and mean channel width of 1.2 m. The habitat composition in Stream D4 is a series of glide and pool units. The channel is heavily vegetated with sedges, willows (*Salix sp.*), and dwarf birch (*Betula nana*). Substrate is dominated by fines, with small components of gravel, cobble, and boulder habitat. At Lake D4, the stream widens into a braided channel; mean width is 3.1 m, with a floodplain width of 10.1 m. Stream D4 provides low to moderate northern pike spawning habitat that exists in association with wetlands at the head waters of Stream D4. Small areas of potential spawning habitat for Arctic grayling are available, but use is considered unlikely. In addition, Stream D4 provides access to upstream lakes of catchment D. Slimy sculpin have been captured in this stream.

3.2.4.5 Stream D6

Stream D6 consists of an area of periodically wetted tundra. No defined channel is present, no fish habitat exists, and no upstream passage is possible at this location.

3.2.5 Unnamed Streams in the E Watershed

3.2.5.1 Stream E1

Stream E1 is 426 m in length, with an overall gradient of 1.1%. The watercourse has a channel width of 1.4 m, within a wide floodplain of 29.9 m. The watercourse has sections with multiple channels. Substrate is primarily organic material, with boulder, cobbles, and fines also present. Moderate quality Arctic grayling spawning habitat is present in sections of the stream with gravel substrate, primarily near the confluence with Kennady Lake and at the upper end of the stream. Low quality spawning habitat is present for northern pike limited by instream aquatic vegetation. The stream provides fish passage between Area 6 of Kennady Lake and Lake E1. Flow is maintained in summer, and the stream would provide suitable rearing habitat. Arctic grayling, burbot, northern pike, and ninespine stickleback have been captured in Stream E1.

3.2.5.2 Stream E2

Stream E2 does not provide suitable fish habitat. A braided, poorly defined channel is present for 81 m downstream of Lake E2, characterized by heavy willow vegetation and fine substrates. Floodplain width averages 11.7 m. Flow also seeps out of Lake E2 north of this location. Thereafter, the channel is generally poorly defined, with predominantly fine substrates, and flows through an area of spruce (*Picea sp.*) and willow trees. Short sections of braided defined channel are present, characterized by boulder substrates. Flow is subterranean at many locations, and no fish passage is possible. The final 77 m of the stream section is a wetland area 48.4 m in width. Although short sections of braided, defined channel are present, fish passage is not possible between Lakes E2 and E1, because flow is subterranean beneath boulders near Lake E1. No fish sampling has been conducted in Stream E2.

3.2.6 Unnamed Streams in the F Watershed

3.2.6.1 Stream F1

Stream F1 does not provide any suitable fish habitat as it is dry or consists of disconnected, shallow wetted sections in spring or fall. Fish passage would not be possible from Kennady Lake to Lake F1.

3.2.7 Unnamed Streams in the H Watershed

3.2.7.1 Stream H1a

Stream H1a flows for a distance of 331 m from Lake H1a to Area 8 of Kennady Lake, with an overall gradient of 2.1%. The overall habitat quality rating was considered low, due to the limited instream habitat. Summer flow is generally confined in a narrow channel with a mean channel width of 0.6 m, with water flowing between and under boulders. No spawning habitat is present for Arctic grayling due to the lack of gravel riffles in spring. Limited vegetation is present for northern pike spawning. However, Stream H1a has sufficient flow in spring to allow fish passage to upstream lakes (Annex J). Ninespine stickleback and northern pike have been captured in the stream, and slimy sculpin and ninespine stickleback have been captured in the upstream lake (Lake H1a); however, no fish were captured moving within the stream during the 2004 spring fish fence study.

3.2.8 Unnamed Streams in the K Watershed

3.2.8.1 Stream Ka1

Stream Ka1 does not provide any suitable fish habitat as it lacks a defined channel, and is dry or consists of disconnected, shallow wetted sections in spring or fall. No access for fish would be possible from Kennady Lake to Lake Ka1.

3.2.8.2 Stream Kb1

Stream Kb1 does not provide suitable fish habitat, as it is dry or consists of disconnected wetted sections in spring or fall. The watercourse has poorly defined banks with disconnected, shallow, wetted sections during periods of high flow. No fish passage would be possible from Kennady Lake to Lake Kb1.

3.2.8.3 Stream Kb2

Stream Kb2 does not provide suitable fish habitat, as no visible channel was present at the time of the survey. No fish passage would be possible between Lakes Kb1 and Kb2.

3.2.8.4 Stream Kb4

Stream Kb4 does not provide suitable fish habitat, as it is dry or consists of disconnected wetted sections in spring or fall. The watercourse has poorly defined banks with disconnected, shallow, wetted sections during periods of high flow. No fish passage would be possible from Kennady Lake to Lake Kb4.

3.2.8.5 Stream Kd1

The total channel length of Stream Kd1 is 138 m, with an overall gradient of 1.4%. The stream channel connects Lake Kd1 and Area 7 of Kennady Lake. The watercourse has a channel width of 1.0 m, with generally well defined stream banks. Substrate is predominantly boulder, with organic material present. Habitat is composed of runs and glides, with limited pool habitat. Overall habitat quality is considered low due to the narrow channel and low water depths (i.e., 0.10 m at the time of the survey). Fish passage between Kennady Lake and Lake Kd1 may be possible in years with high water levels in spring. Ninespine stickleback have been captured in the stream.

4.0 ASSESSMENT OF HABITAT LOSSES

Definition of the requirements for fish habitat offsets, as well as assessment of potential compensation options for the Project, required a thorough understanding of the fish communities present as well as an accurate assessment of the available habitat. This information was used to determine the quantity and quality of fish habitat specific to the target species and life stages. The following information was required to complete this assessment:

- A description of the physical characteristics of the area before and after the alterations, including the depth and substrate composition.
- Determination of the fish species that may use the habitat before and after the alterations.
- Knowledge of the habitat requirements of each fish species including specific requirements during various life stages (e.g., spawning, rearing, migration).
- Determination of the total surface area (i.e., m^2 or ha) of habitat that will be lost, altered or disturbed.

4.1 Habitat Suitability Modelling Approach

For losses associated with lakes, a Habitat Evaluation Procedures (HEP) type of approach (U.S. FWS 1980) will be used as an accounting system to document habitat quality and quantity. Habitat quality was defined by Habitat Suitability Indices (HSI), which rank the importance of available habitat for specific species and life stages of fish. Under HEP-type analysis procedures, an HSI value (between 0 and 1) is determined for each species using a certain habitat type.

Multiplication of the habitat quality (as represented by the HSI) by the habitat quantity (surface area) results in the area of habitat losses and gains, as well as the habitat suitability based on the HSI models, integrated into Habitat Units (HUs). For each fish species, HUs are calculated as the product of the area lost for each habitat category and suitability of that habitat category for each life-history stage present. Similarly, HUs for the areas of enhanced habitat or newly developed habitat are calculated for each habitat category and suitability of that habitat category for each life-history stage present. The method for integrating HUs across species and at different locations is currently being developed in consultation with DFO.

Comparison of the HUs lost as a result of the alterations with the HUs gained through development of compensation habitats can be used to assess the degree to which the no net loss principle is achieved. For example, the HUs lost can be compared to the HUs gained to determine the compensation ratio achieved. Once compensation options are finalized, the HUs will be calculated.

4.1.1 Habitat Suitability Index (HSI) Models

To assess the losses associated with the Project on fish habitat and the relative gain in habitat developed through habitat compensation, Habitat Suitability Index (HSI) models will be used to evaluate the quantity and quality of lake habitat lost. HUs can potentially also be used to evaluate the quantity and quality of habitat gained to help determine if no net loss if fish habitat has been conceptually achieved.

As described in Section 3.II.4.2 of the CCP, the HSI models used for the Project were updated versions of the HSI models developed for northern fish populations by Diavik (1998), which were originally based on a modified HEP method developed by US Fish and Wildlife. The HSI models were developed from literature and professional judgement regarding habitat preferences and life-history requirements. Similar models have been

used at other mining projects in NWT and Nunavut, including the Lac De Gras (Diavik 1998), Snap Lake (De Beers 2002), Jericho (Mainstream Aquatics 2004), Doris North (Golder 2005), and Meadowbank (Cumberland Resources 2005) mines, although each project has developed models specific to their application and no two projects have used exactly the same set of models.

In the North, there are no established and uniformly accepted regional HSI models. For each Project, existing models are adjusted as required for the specific habitats and fish species to be affected. Part of the process for the development of the no net loss plan is the consultation with DFO on the models to be used for the Project. The models currently applied for the Project have been updated primarily from the models developed for Snap Lake (De Beers 2002). Some habitats and species assessed for Gahcho Kué were not included in the Snap Lake assessment, and new models were developed based on general life history requirements for fish species in the north (Richardson et al. 2001; Evans et al. 2002; Stewart et al. 2007a; Stewart et al. 2007b; amongst others) and professional judgement. In moving forward from the CCP to the NNLP, it has been important that there is technical agreement on the models to provide a level of confidence amongst parties that the proposed compensation will adequately offset the habitat losses associated with the Project. Adjustments to the HSI models might still occur during the permitting phase, and the models are likely to be revisited and revised in the future with results from compensation monitoring. Nevertheless, any changes would be applied equally to habitat losses and gains.

For lakes, the HSI models were used to quantify the suitability of habitat categories for various life-history stages, and for each fish species present on a scale of 0 (unsuitable) to 1 (optimal). The habitat suitability values assigned by the models are based on the following rating system:

- unsuitable: 0.00;
- below average: 0.25;
- average: 0.50;
- above average: 0.75; and
- optimal: 1.00.

The HSI models were used to determine habitat suitability for the following life-history stages of fish species present:

- spawning/nursery stage, considering the suitability of habitat used by fish for spawning and embryo development;
- rearing stage, considering the suitability of habitat used by young-of-the-year and small-bodied juveniles for foraging and refuge from predators;
- foraging stage, considering the suitability of habitat used by adult fish for feeding; and
- overwintering stage, considering the suitability of habitat used by all fish during the winter.

Habitat suitability indices were determined for all permanently lost, physically altered or dewatered waterbodies and for the eight fish species known to occur in the Project area, which include lake trout, round whitefish, Arctic grayling, northern pike, burbot, lake chub, slimy sculpin, and ninespine stickleback. Some habitat categories did

not have a suitability value, and a new value was assigned based on similar habitat conditions using professional judgement. The models that are currently being applied for the Project are presented in Appendix B.

4.2 Quantification of Habitat Loss in Waterbodies

4.2.1 Fish Distribution

For Kennady Lake, quantification of habitat loss will be determined for all eight species documented. For lakes in the A watershed, lake chub were not included in the assessment since the species has not been documented in that watershed. While a single longnose sucker has been observed near the outlet of Kennady Lake, it is believed this single fish was a stray from downstream habitats and that Kennady Lake does not support a population of longnose sucker (De Beers 2010, Section 3.II.3.1 and Annex J). Because of this, longnose sucker were not included in the calculations of habitat suitability.

The fish species distribution for the waterbodies affected by the Project is shown in Table 4. An assumed distribution is developed to fill in the gaps of baseline field programs and to assign fish to locations where the distribution is reasonably likely based on the suitability of the habitat and connection with adjacent habitat areas where the species has been documented. The distribution of each species was developed separately, but assigning an assumed fish distribution followed some general guidelines, including extending a distribution to all lakes downstream of a documented capture location; and extending the distribution one reach upstream, where habitat was deemed suitable, of the farthest upstream documented location.

Table 4: Species Distribution within Affected Habitats

Fish Species	Lake			
	Kennady Lake	Lake D1	Lake Ka1	Lake Kb4
Arctic grayling	■			
Burbot	■	■		
Lake chub	■			
Lake trout	■	◊		
Ninespine stickleback	■			
Northern pike	■	■		
Round whitefish	■			
Slimy sculpin	■	◊		

Notes: ■ – documented fish presence; ◊ - assumed fish presence; grey shading – assumed absent

4.2.2 Waterbody Habitat Area Affected

The affected habitat areas during mining include portions of Kennady Lake and adjacent lakes within the Kennady Lake watershed that will be permanently lost, portions that will be physically altered after dewatering and later submerged in the refilled Kennady Lake, and portions that will be dewatered (or partially dewatered) but not otherwise physically altered before being submerged in the refilled Kennady Lake (Figure 4). The affected habitat areas include the following:

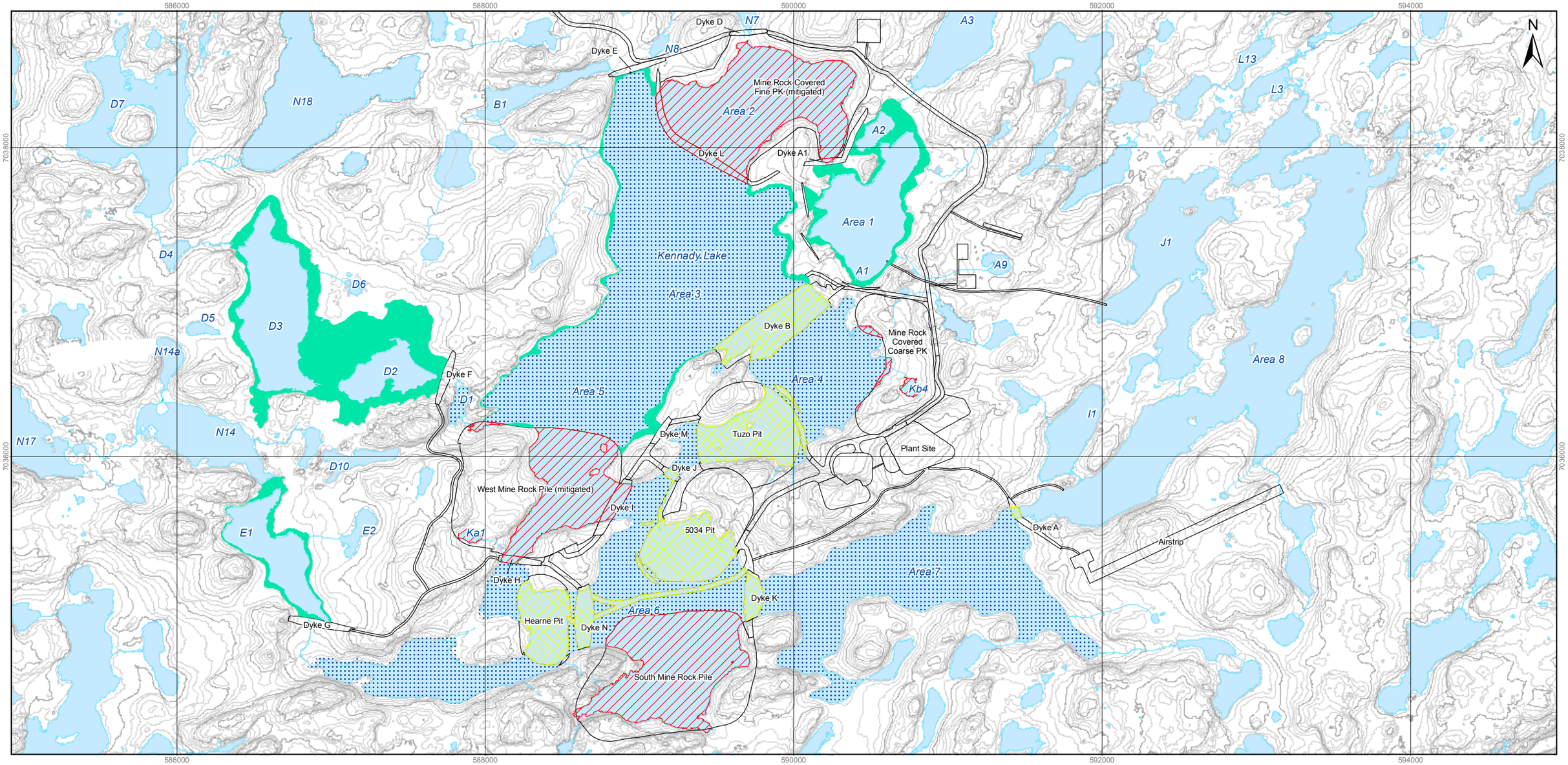
- Habitat Destruction – portions of Kennady Lake and adjacent lakes and watercourses within the Kennady Lake watershed that will be permanently lost by the south and west mine rock piles, Fine PKC Facility, coarse PK pile, and dykes H, I and L;
- Habitat Alteration – portions of Kennady Lake and adjacent watercourses that will be physically altered after dewatering and later submerged and reconnected in the refilled Kennady Lake (e.g., pit areas, roads, airstrip, and remaining dykes reclaimed or breached at closure); and
- Habitat Disruption – portions of Kennady Lake and adjacent lakes and watercourses that will be dewatered (or partially dewatered) but not otherwise physically manipulated before being submerged in the refilled Kennady Lake.

In addition to the affected areas noted above, several lakes will have increased water levels during mine operations. These include Lakes A1/A2, D2, D3, and E1. Lake D1 will be affected due to the normal flow from D2 to D1 being blocked by Dyke F. Water levels in Lakes D2, D3, and E1 will be sufficient to divert their flows to the N watershed during operations. Water levels in Lakes A1/A2 will be managed via a pipeline to Lake J1b.

The areas affected by the Project categorized by the type of loss category is provided in Table 5 and summarized below.

Table 5: Areas of Habitat Loss by Loss Category

Loss Category	Area [ha]		
	Kennady Lake	Adjacent Waterbodies	Total
Habitat Destruction	156.9	2.0	**158.9**
Habitat Alteration	84.1	0.0	**84.1**
Habitat Disruption	427.5	1.9	**429.4**
Total	**668.5**	**3.9**	**672.4**



LEGEND

- Watercourse
- Index Contour (5m interval)
- Intermediate Contour (1m interval)
- Waterbody
- A1 Lake Identifier
- Project Footprint

Affected Waterbody Category

- Altered Fish Habitat
- Operational Flooded Area
- Permanently Lost Fish Habitat
- Temporary Disruption

NOTES

Base Data Source: Eagle Mapping Ltd.

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GAHCHO KUÉ PROJECT

Permanent and Operational Lost or Altered Fish Habitat Areas - Waterbodies

PROJECTION: UTM Zone 12	DATUM: NAD83	De Beers Canada
Scale: 1:25,000 (250 125 0 250 500 Meters)		
FILE No: E2011-Fish-020-GIS		DATE: October 11, 2012
JOB NO: 11-1365-0012	REVISION NO: 1	Figure 4
OFFICE: GOLD-CAL	DRAWN: DC / CHECK: KC	