

Technical Memorandum

Date: October 4, 2012

File No: S110-01-04

Subject: Gahcho Kué Draft Fish-Out Plan

1. Introduction

At the May 2012 Technical Sessions, De Beers Canada Inc. (De Beers) committed to providing more detailed information on the fish-out plan for Kennady Lake as part of the proposed Gahcho Kué Project (Project). This technical memorandum provides additional details on the fish-out plan; however, it is considered as work-in-progress because additional consultation with Fisheries and Oceans Canada (DFO), the regulatory authority, is expected and is typically undertaken as part of the permitting process.

2. Background

The development of mines in northern Canada often results in disturbance or destruction of fish habitat due to the dewatering of lakes and subsequent mine activities (Tyson et al. 2011). When DFO authorizes such projects under the *Fisheries Act* Section 35(2), a fish-out is often required. Fish-outs have been performed at several mines in the Northwest Territories and Nunavut, such as BHP Billiton's Ekati diamond mine (Tyson and McCarthy 1997, Tyson 1998 a-d), Diavik Diamond Mines Inc. (Golder 2007) and Meadowbank Gold Project (Azimuth 2009). The necessity to dewater lakes to mine diamonds in the Northwest Territories stems from the diamond-bearing kimberlite pipes being typically located under lakes. Furthermore, for the Project, the orientation of the three diamond-bearing kimberlite pipes is vertical and thus the open pit mining is the preferred alternative to safely access the ore bodies (De Beers 2012a, 2012b). Therefore, a fish-out in conjunction with partial or complete de-watering is necessary.

De Beers is planning to develop the Project at Kennady Lake in the Northwest Territories. The mine plan involves mining diamonds from three kimberlite pipes that are primarily situated under Kennady Lake. The development of the Project will involve the dewatering of the main basins of Kennady Lake and Lake D1, and as such, a fish-out will be necessary (Figure 1). Dewatering will be facilitated through the construction of dykes to block outflowing and inflowing water to the lake. Water within Areas 2 to 7 of Kennady Lake will then be pumped out to Area 8 and to Lake N11 (Figure 2). Kennady Lake will be dewatered to the maximum extent possible without altering downstream receiving environments and is expected to lower the level of the lake by approximately 3 metres during the first year of de-watering. Dewatering is predicted to take 2 years

and will result in most of the water in Areas 6 and 7 being removed. For a more detailed description on the de-watering program, please refer to De Beers (2010, 2012a).

3. Objectives

Following the DFO technical report, “*General fish-out protocol for lakes and impoundments in the Northwest Territories and Nunavut*” (Tyson et al. 2011), the objectives of the fish-out of Areas 2 to 7 of Kennady Lake and Lake D1 will be as follows:

- to engage local communities and ensure that fish harvested during the fish-out are fully utilized by traditional resource users.
- to collect ecological information (biological, limnological, and habitat) on Arctic lakes in the Northwest Territories.
- to remove all fish from Areas 2 to 7 of Kennady Lake and Lake D1 prior to development of the Project.

4. Community Engagement

Six aboriginal groups have been engaged in the process of developing the fish-out plan. Representatives from the Lutsel K'e Dene First Nation (LKDFN), Deninu Kué First Nation (DKFN), Tlicho Government (TG), Yellowknives Dene First Nation (YKDFN), North Slave Métis Alliance (NSMA), and the Northwest Territories Métis Nation (NWTMN) were involved in several meetings and workshops. In particular, community visits in February 2012, Technical Sessions for the Environmental Impact Review of the Project in May 2012, and site workshops at the Gahcho Kué exploration camp in August 2012 served as key opportunities for aboriginal groups to provide input on the fish-out plan.

During these meetings the following recommendations were made:

- Representatives from the LKDFN, DKFN, YKDFN and TG expressed interest in having youth and elders involved in the fish-out.
- Fish harvested during the fish-out should be sent to communities to coincide with key cultural events such as Aboriginal Day.
- The NWTMN representatives suggested giving some of the harvested fish to commercial fishers in Hay River to sell.
- The YKDFN representatives suggested that fish could be transported to other lakes or transport fish to a nearby lake for temporary storage keeping fish alive until a plant could be constructed along the winter road and used as a commercial fishery.

This engagement record is part of a larger ongoing program to seek community input for the Project. The fish-out plan will continue to be discussed as a detailed sampling design is developed.

5. Project Management

The management of the fish-out program at the Project will consist of three groups of people: DFO habitat biologists, members from aboriginal communities, and De Beers (and their representatives). The habitat biologist for DFO will advise De Beers during the detailed sampling design of the fish-out program, be involved in regular updates with De Beers during the fish-out, receive the final reporting and ensure the data collected is entered into the Arctic aquatic database. De Beers, as the permit holder, will be responsible for overall project management, which will include work plans, schedules and budgets. De Beers will also provide an experienced Project Biologist to ensure technical requirements are met for the fish-out program. The Project Biologist will also oversee field crews, supervise field activities and data collection, ensure quality assurance/control, perform data analysis and prepare reports. Lastly, field technicians will be hired by De Beers with preference given to members from aboriginal communities. The field technicians will perform the actual fishing activities and will ensure that health and safety requirements are met. The field technicians will be responsible for cleaning and packaging fish for shipment to the respective aboriginal communities.

6. Components

The three primary components of the fish-out plan are fish community, aquatic biology/water quality/limnology, and physical habitat inventory. For each of these components, baseline data have been collected as part of the Environmental Impact Statement (EIS) (De Beers 2010), as well as for the ongoing development of the Aquatic Effects Monitoring Program (AEMP) as required for a class A water license by the Mackenzie Valley Land and Water Board (MVLWB).

Fish Community

The objective of the fish community component is to obtain accurate estimates of the fish community, including population estimates, size distributions, and age structures of the respective fish populations. Kennady Lake contains 8 species of fish: lake trout, Arctic grayling, round whitefish, northern pike, burbot, ninespine stickleback, lake chub, and slimy sculpin. Given the presence of large and small bodied fishes, different sampling gear will be required to perform the fish-out and these will be determined during the development of the detailed sampling design. It is anticipated that the fish-out will be broken down into two phases: the Catch-Per-Unit-Effort (CPUE) phase and the final removal phase (following Tyson et al. 2011). Both phases will be performed during the first year of construction activities (Year -2). Given that the de-watering phase is expected to take 2 years, the removal phase of the fish-out may continue during de-watering.

The detailed designs of the sampling plan are in development; however, the equipment type, fishing methods and fishing time will not change during the duration of the CPUE phase. The only factor that will increase throughout the CPUE phase will be effort, whereby greater effort (e.g., more gill net sets) will be applied as catch rates go down. In addition, the detailed schedule of the fish-out has not yet been developed and will depend on timeline of the regulatory phase of the Project, as well as other factors such as the timing of ice-off in the lakes. However, it will be performed in Year -2 of construction.

The data collected during the CPUE phase will be analyzed with inputs from the DFO habitat biologist and other fisheries experts. In general, the populations of fish in Kennady Lake will be estimated using cumulative catch (Leslie), cumulative effort (DeLury), and maximum-likelihood methods. However, given the tendency to bias estimates using the Leslie and DeLury methods, maximum-likelihood methods will be given priority (Gould and Pollack 1997).

The switch to the final removal phase will commence when fishing gear is saturated and no (or virtually no) fish are caught per 48 hours of effort. The goal of the removal phase is to remove all remaining fish from Areas 2 to 7 of Kennady Lake. Fishing gear will be altered to target the dominant size classes of fish left in the lake and sampling effort will remain high. Data from the final removal phase will also be incorporated into the CPUE phase by stratifying the effort during analysis. If necessary, the final removal phase can be continued during the second year of de-watering (Year -1 of construction) to increase the likelihood that all fish are removed.

The methods of fishing will be refined during the detailed sampling design. However, the CPUE phase will likely consist of gill netting using multi-panel gear. Since large fish are typically removed first, given their susceptibility to being caught in gill nets, trap nets and Gee minnow traps will likely be added during the final removal phase. Other gear that may be considered during the final removal phase would be seining and boat electrofishing. Given the presence of burbot in Kennady Lake, consideration may also be given to baited set lines. All gear will be checked and redeployed daily and will be kept consistent throughout the CPUE phase.

All fish that are removed will be counted, and noted by species and size class. For a subset of the overall sample for each species, the following additional information will be collected: length, weight, sex, maturity, reproductive status, aging structures taken and biological tissues collected (e.g., muscle tissue, stomachs, whole carcasses). The particular details of sample sizes for the subset will be determined during the development of the detailed sampling design.

Despite the suggestion from the YKDFN representatives regarding the transferring of fish to other water bodies, this is not recommended by DFO. Barrenland lakes, such as Kennady Lake and surrounding lakes, are nutrient poor (i.e., oligotrophic) and thus have relatively small populations of fishes (Wetzel 2001). Transferring of fish from Kennady Lake into another nearby lake would lead to added competition for limited

food resources (Matthews 1998). Since the goal of the fish-out program is to maximize the use of fish removed from Kennady Lake, it is unlikely that transferred fish would achieve that goal.

Aquatic Biology/ Water Quality/ Limnology

In addition to the baseline sampling that was conducted for the 2010 EIS (De Beers 2010) and 2012 EIS supplement (De Beers 2012), limnological and basic aquatic biological data will be collected during the fish-out. This will be incorporated into the Aquatic Effects Monitoring Plan (AEMP). Sampling will likely include physical limnology, water quality/nutrients, Chlorophyll a, zooplankton, and benthos. Sampling will be performed early in the CPUE phase as lower trophic levels can be adversely affected by intense harvest of large bodied fishes (Kitchell and Carpenter 1993).

Physical Habitat Inventory

An inventory of fish habitat in Kennady Lake has been collected as part of the baseline studies for the Project (Annex J, De Beers 2010). The inventory was used to quantify habitat losses during construction and operations of the Gahcho Kué Project in the draft No-Net-Loss Plan (Golder *In Prep*). The habitat inventory will be used in the detailed sampling design to determine appropriate sampling coverage during the fish-out. In addition, the habitat mapping will be ground-truthed and refined once Kennady Lake is dewatered.

7. Project timing

All activities associated with the fish-out of Areas 2 to 7 of Kennady Lake and Lake D1 will be conducted during the same open water season from late June through October. The fish-out on Kennady Lake will be performed once dyke A is built in Year -2 of construction, thus isolating Kennady Lake from downstream environments. If needed, the final removal phase can be extended into a second year during dewatering to ensure that remaining fish are removed.

8. Reporting

During the fish-out of Kennady Lake and Lake D1, a daily CPUE report will be submitted by the Project Biologist to the DFO habitat biologist detailing the catch statistics and amount of effort. This will be used by DFO to determine when the CPUE phase can transition into the final removal phase.

Following the completion of the fish-out, De Beers will provide DFO a summary data report. This report will include biological and survey data in addition to data analysis that illustrate the suitability, precision, and accuracy of the data. CPUE population estimates and comparisons to baseline will also be provided.

9. Potential Research Projects

Fisheries research projects have been suggested by DFO as part of the fish habitat compensation plan to achieve no-net-loss as per DFO's Policy of the Management of Fish Habitat (DFO 1986) and specifically to address the temporary disturbance to Kennady Lake while it is de-watered. The aim of the research is to

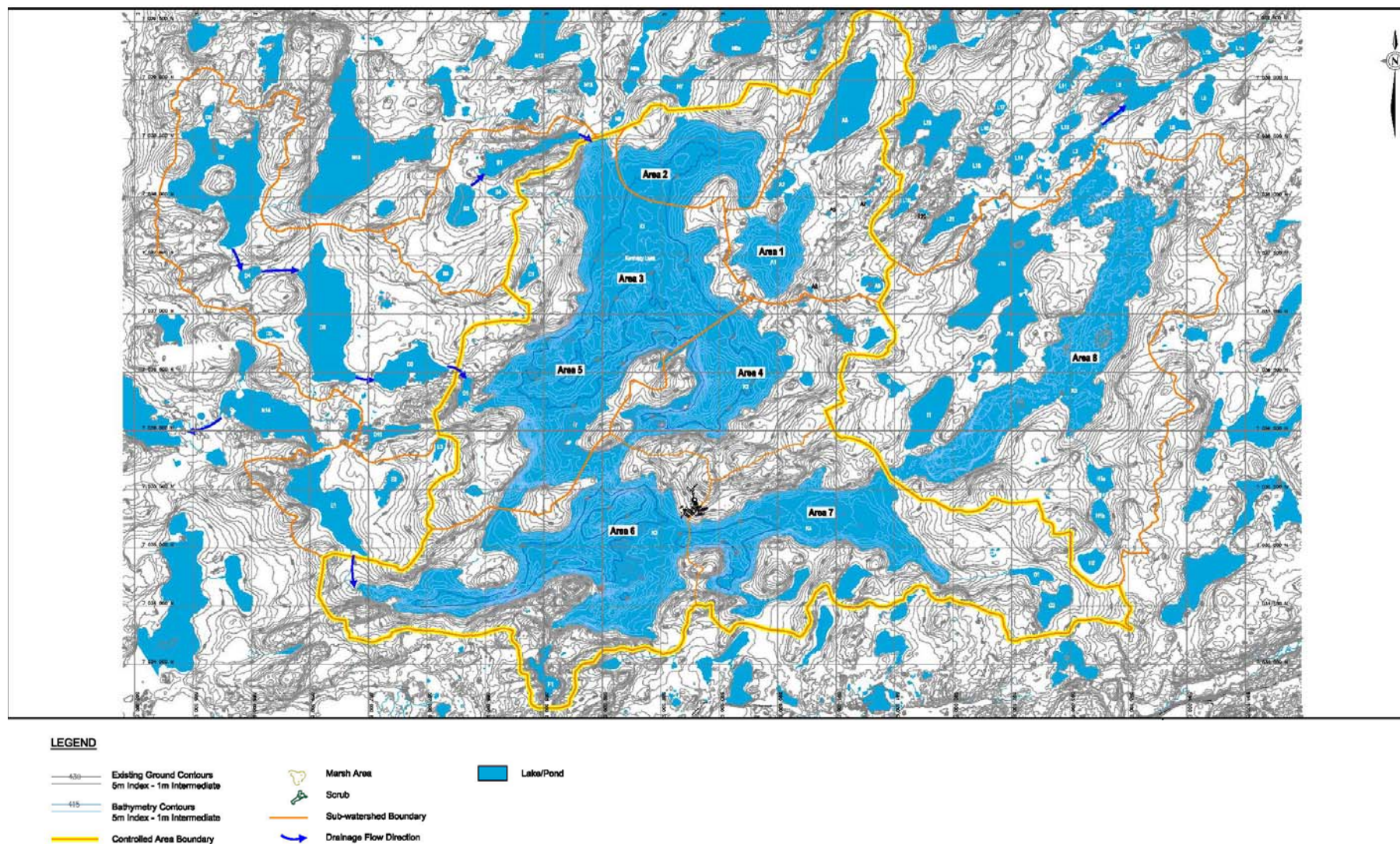
reduce uncertainty in the fish habitat compensation ratios. More broadly, the research is also intended to reduce uncertainty surrounding the Project and to fill knowledge gaps for northern fishes. DFO has suggested that De Beers fund research that contrasts and validates multiple methods of fish population estimation. The research would be carried out by universities (i.e., graduate students) prior to starting the CPUE phase of the fish-out and the results would be published in the primary scientific literature. De Beers is currently considering this option and will refine research projects with direction from DFO following the Environmental Impact Review phase of the project.

10. References

- Azimuth Consulting Group Inc. 2009. Meadowbank gold project: 2008 fish-out of the Northwest Arm of second Portage Lake. Prepared by Azimuth Consulting Group Inc. 194p.
- DFO (Fisheries and Oceans Canada). 1986. The Department of Fisheries and Oceans Policy for the Management of Fish Habitat. Presented to Parliament by the Minister of Fisheries and Oceans. October 7, 1986.
- De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.
- De Beers (De Beers Canada Inc.). 2012a. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board, Yellowknife, NWT, Canada.
- De Beers (De Beers Canada Inc.). 2012b. Detailed Alternatives Analysis. Submitted to the Mackenzie Valley Environmental Impact Review Board, Yellowknife, NWT, Canada.
- Golder Associates. 2007. Diavik Diamond Mines Inc.: A418 dike fish salvage program. 179pp.
- Golder Associates. *In Preparation*. Gahcho Kué draft no-net-loss plan (in progress). Technical memorandum for De Beers Canada Inc. Yellowknife, NT. 24pp.
- Gould, W.R., and K.H. Pollock. 1997. Catch-effort maximum likelihood estimation of important population parameters. Can. J. Fish. Aquat. Sci. 54:890-897.
- Kitchell, J.F., and S.R. Carpenter. 1993. Cascading trophic interactions. In: The Trophic Cascade in Lakes. Knight, S.S., and C.M. Cooper. 2008. Bias associated with sampling interval in removal method for fish population estimates. J. Int. Environ. Appl. Sci. 3:201-206.
- Matthews, W.J. 1998. Patterns in freshwater fish ecology. Kluwer Academic Publishers, New York. 755 p.

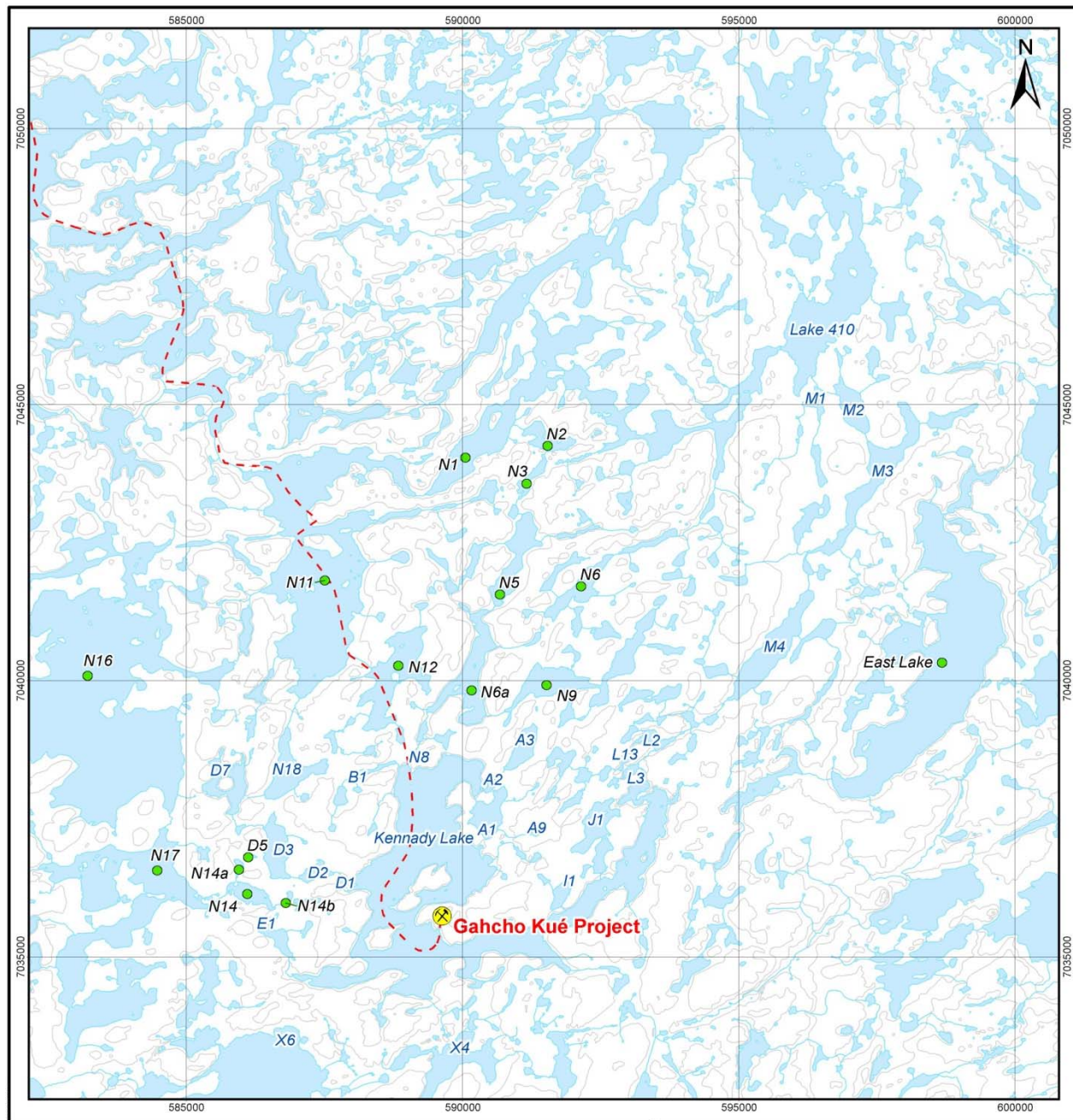
- Tyson, J.D., W.M. Tonn, S. Boss, and B.W. Hanna. 2011. General fish-out protocol for lakes and impoundments in the Northwest Territories and Nunavut. Canadian Technical Report of Fisheries and Aquatic Sciences 2935. 33p.
- Tyson, J.D. 1998a. Ekati Diamond Mine: 1997 lake fish-out program - Airstrip Lake data report. Prepared by Rescan Environmental Services Ltd. for BHP Diamonds Inc., Yellowknife, NT. 25 p. + 10 App.
- Tyson, J.D. 1998b. Ekati Diamond Mine: 1997 Lake Fish-out Program - Long Lake Data Report. Prepared by Rescan Environmental Services Ltd. for BHP Diamonds Inc., Yellowknife, NT. 50 p. + 13 App.
- Tyson, J.D. 1998c. Ekati Diamond Mine: 1997 Lake fish-out program - Koala Lake data report. Prepared by Rescan Environmental Services Ltd. for BHP Diamonds Inc., Yellowknife, NT. 50 p. + 18 App.
- Tyson, J.D. 1998d. Ekati Diamond Mine: 1997 Lake fish-out program - Misery Lake data report. Prepared by Rescan Environmental Services Ltd. for BHP Diamonds Inc., Yellowknife, NT. 20 p. + 6 App.
- Tyson, J.D., and M. McCarthy. 1997. Ekati Diamond Mine: 1997 lake fish-out program-Panda Lake data report. Prepared by Kam River Environmental Services and Rescan Environmental Services Ltd. for BHP Diamonds Inc., Yellowknife, NT. 84 p. + 36 App.
- Wetzel, R.G. 2001. Limnology: Lake and river ecosystems. 3rd Edition. Academic Press, San Diego. 1006 p.

Figures

Figure 1 Kennady Lake Sub-watersheds and Controlled Area Boundary

NOTES
 Base data source: EBA Figure 4.6 - Stage 2 - Water Management During Mine Operation Years 1 to 3 (2015 to 2017)
 Source: Adapted from Figure 3.2-2 of De Beers 2010.

A DIVISION OF DE BEERS CANADA INC.
 SUITE 300, 5102 – 50TH AVENUE, YELLOWKNIFE, NT X1A 3S8
 TEL 1(867)766-7344 / FAX 1(867) 766-7348
www.debeerscanada.com

Figure 2 Lake Locations**LEGEND**

- Gahcho Kué Project
- Winter Access Road
- Watercourse
- Waterbody
- Contour (10 m interval)
- Lake Limnology Sampling Site
- Lake Identifier

NOTES

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

A DIVISION OF DE BEERS CANADA INC.
 SUITE 300, 5102 – 50TH AVENUE, YELLOWKNIFE, NT X1A 3S8
 TEL 1(867)766-7344 / FAX 1(867) 766-7348
www.debeerscanada.com