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October 22, 2012

MVEIRB File Number: EIR0607-001

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Re: Technical Report – De Beers Canada Gahcho Kue Diamond Mine Project- EIR0607-001

Aboriginal Affairs and Northern Development Canada (AANDC) is pleased to submit the attached technical report to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) on the proposed De Beers Canada Gahcho Kue Diamond Project - EIR0607-001.

AANDC would like to thank the Board for the opportunity to present our technical review of the proposed Gahcho Kue Diamond Mine. The Department looks forward to presenting its technical intervention at the upcoming public hearings.

If you have any questions about this technical report, please do not hesitate to contact Mr. Nathen Richea at (867) 669-2657 or Nathen.Richea@aandc.gc.ca or Mr. Paul Green at (867) 669-2402 or Paul.Green@aandc.gc.ca .

Sincerely,

Robert Jenkins
A/Director
Renewable Resources and Environment

ABORIGINAL AFFAIRS AND NORTHERN DEVELOPMENT CANADA
TECHNICAL REPORT

for

DE BEERS CANADA
PROPOSED GAHCHO KUE DIAMOND MINE PROJECT
EIR0607-001

October 22, 2012

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NON TECHNICAL SUMMARY

Aboriginal Affairs and Northern Development Canada (AANDC) has legislated responsibilities for water management and protection that stem from the *Northwest Territories Waters Act* (NWTWA). AANDC provides expert technical advice to regional resource management boards and is a Responsible Minister under the *Mackenzie Valley Resource Management Act* (MVRMA).

AANDC and its retained experts have completed a technical review of the documents related to the Environmental Impact Review (EIR) of De Beers Canada's proposed Gahcho Kue Project up to and including the responses to the first round of Information Request responses on April 06, 2012. Documents submitted subsequent to the second round of information requests (June 05, 2012) have been reviewed by AANDC only.

In this report, AANDC provides specific comments on the following three topics:

1. Water Quality Objectives (WQO)
2. Aquatic Effects Monitoring Program (AEMP)
3. Closure and Reclamation (CRP)

Where possible, AANDC has provided recommendations to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) to assist in its decision making process.

INTRODUCTION

AANDC has a mandated responsibility to protect the environment and promote sustainable development in the Northwest Territories. AANDC's legislated responsibilities for water management and protection stem from the *Northwest Territories Waters Act* (NWTWA). AANDC provides expert technical advice to regional resource management boards and is a Responsible Minister under the *Mackenzie Valley Resource Management Act* (MVRMA).

In our departmental capacity as an expert advisor, AANDC has completed a technical review of the documents related to the Environmental Impact Review (EIR) of De Beers Canada's proposed Gahcho Kue Project up to and including September 14, 2012. AANDC has focused its review and technical report solely on the water-related aspects of the proposed project. Within this technical report, the Department will discuss its concerns and present any recommendations regarding:

1. Water Quality Objectives (WQO)
2. Aquatic Effects Monitoring Program (AEMP)
3. Closure and Reclamation

In conducting our review, AANDC participated in two rounds of information request, one technical session, and two meetings (June/Sept 2012) directly with the proponent, in an attempt to resolve issues identified herein.

Where possible, AANDC has provided recommendations to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) to assist in its decision making process. The Department respectfully requests that all its recommendations be placed as measures within the Report of Environmental Impact Review.

Site Specific Water Quality Objectives

Issue:

De Beers has proposed Water Quality Objectives (WQO) for the Gahcho Kue Diamond Mine Project, as described in a September 14, 2012 technical memorandum submitted to the Mackenzie Valley Environmental Impact Review Board. The memo proposes two types of objectives:

1. narrative objectives that articulate the water management goals for the project; and,
2. numerical objectives that, if met, should ensure that the narrative goals are achieved.

Two sets of objectives are presented: one for Lake N11 that would apply during construction and operations, and a second set that would apply to Kennady Lake post-closure. WQO have not been developed for Area 8 during construction or operations since water from Kennady Lake and Area A1 that will be discharged to Area 8 during de-watering are expected to possess similar chemistry to Area 8.

The numerical WQOs provided in the September 14, 2012, memo were established using the following protocol:

1. Where the maximum modeled concentration of an analyte, per the water quality model, falls within the range of regional baseline (i.e. below the maximum observed concentration) then the maximum observed baseline concentration is adopted as the objective.
2. Where the maximum modeled concentration of an analyte, per the water quality model, exceeds the range of regional baseline (i.e. greater than the maximum observed concentration) then the CCME Water Quality Guideline for the Protection of Freshwater Aquatic Life is adopted as the objective.
3. Where the maximum modeled concentration of an analyte, per the water quality model, exceeds the range of regional baseline (i.e. greater than the maximum observed concentration) and the CCME Water Quality Guideline for the Protection of Freshwater Aquatic Life, then the maximum observed baseline concentration is adopted as the objective.

The maximum modeled concentrations are compared against regional baseline data: median, minimum and maximum. Where applicable, CCME parameters are modified for exposure and toxicity modifying factors (ETMFs) including hardness. Several different hardness values are apparently used, per the notes in Tables 1 and 2 of the Sept 14, 2012 memo, but the values used generally fall in the slightly to moderately hard range.

Note: the Proponent's submissions differentiate between WQO and Aquatic Effects Monitoring Plan (AEMP) Benchmarks. AANDC understands that De Beers makes the distinction to identify those parameters for which an EQC may be required during the regulatory phase, i.e. parameters assigned a WQO may require an EQC. For the purposes of the this intervention, AANDC refers to all assessment concentrations as WQO, or "site-specific water quality objectives (SSWQO), in the sense that both the proposed WQO and AEMP Benchmarks provide an indication of the "Standard for Water" which will be maintained in the downstream receiving environment.

References:

1. Terms of Reference Section 4.1.2 Key Lines of Inquiry: Water Quality and Fish in Kennady Lake;
2. Terms of Reference Section 4.1.3 Key Lines of Inquiry: Downstream Water Effects
3. DAR Section 3.0 Project Description;
4. DAR Section 8.0 KLOI: Water Quality and Fish in Kennady Lake;
5. DAR Section 9.0 KLOI: Downstream Water Effects;
6. DAR Appendix 8.I Water Quality Model Report;
7. DAR Appendix 8.II Metal Leaching and Acid/Alkaline Rock Drainage;
8. DAR Appendix 8.III Time Series Plots Construction, Operations and Closure and Post-closure;
9. DAR Appendix 8.IV Derivation of Chronic Effects Benchmarks (Aquatic Health);
10. DAR Appendix 8.V Empirical Dissolved Oxygen Modelling;
11. DAR Appendix 9.I Time Series Plots – Construction and Operations;
12. DAR Appendix 7.VII Site Specific Water Quality Objectives;
13. DAR Appendix 11.I Effects of the NICO Project on Surface Water Quality;
14. Technical Memorandum: Water Quality Objectives (WQO) and Sediment Quality Objective (SQO) for the Proposed Gahcho Kue Project – Recommendations, Golder Associates, September 14, 2012;
15. Technical Memorandum: Water Quality Objectives (WQO) and Sediment Quality Objectives (SQO) for the Proposed Gahcho Kue Project – Initial Development Process, Golder Associates, June 27, 2012;
16. Response to IR AANDC_1, IR AANDC_2, IR AANDC_3, IR AANDC_4, IR AANDC_9, IR AANDC_10, IR AANDC 2-1 and IR AANDC 2-2.

Developer Conclusion:

The Proponent identifies that the WQO are used for screening, with two possible conclusions:

- if measured concentrations of measured parameters are below their respective

guideline, objective or benchmark there is no concern for potential toxicity to exposed aquatic fauna; or

- if concentrations are above their respective guideline, objective or benchmark, there is potential for toxicity to exposed aquatic fauna and additional investigations are required to determine whether this could realistically occur.

Interim WQO, to be used as a basis for further screening and for EQC, are proposed for fluoride, barium, beryllium, chromium and vanadium (whole lake mixed) in Kennady Lake and for beryllium in Lake N11 (at the edge of a 200 m initial dilution zone (IDZ)).

Nutrients are not expected to be an issue for this project since, per the water management plan, a large portion of the residual nitrogen mass in the water management pond will be transferred to the Tuzo Pit as part of the plan to refill Kennady Lake.

All parameters will be subject to ongoing screening as part of the anticipated AEMP.

Review Conclusion:

AANDC views WQO, or SSWQOs, as the “Standard for Water” which should be maintained in order to preserve the present and future integrity and uses of an aquatic ecosystem. Consequently, WQOs must consider a number of factors such as use of the aquatic ecosystem, existing background concentrations, or objectives that may be reasonably achieved through the use of Best Management Practices and effluent treatment technologies.

AANDC is in general agreement with the protocol used by De Beers to set WQO, however AANDC is concerned with several of the assumptions used when implementing the protocol. AANDC maintains that increases in contaminant concentrations in the receiving environment should be minimized in order to provide the greatest confidence that impacts from a project will also be minimized.

Rationale:

Two terms are commonly used in the context of effluent discharged from a development: WQO and Effluent Quality Criteria (EQC). EQC represent a regulatory limit that applies at a company’s last point of control, which is typically the end of the effluent discharge pipe. WQOs are described above as the desired “Standard for Water” at the edge of a predefined mixing zone and beyond (i.e., the downstream aquatic ecosystem).

To derive EQCs, WQOs set for the edge of the downstream “assessment boundary” or

mixing zone are typically used to back-calculate EQC to allow for dilution factors associated with effluent dispersion. Effluent mixing within the mixing zone reduces concentrations of parameters down to the WQO level at the edge of the boundary. Therefore, if a company is meeting their EQCs at the point of discharge then, in principle, the downstream SSWQOs will also be consistently achieved.

AANDC acknowledges that setting EQCs is a regulatory requirement; however, AANDC believes that the "Standard for Water" downstream of a discharge should be determined in the EA phase. AANDC believes the SSWQO derivation process facilitates the assessment of potential adverse effects from the Project.

AANDC recommends that the derivation of SSWQOs for a receiving waterbody should consider both environmental and social factors that may include, but are not limited to:

- Natural background concentrations.
- Existing human use of the water (such as for drinking or fishing).
- Assimilation/mixing capacity.
- Long-term Chronic Toxicity exposure in the receiving environment,
- Single and joint-action toxicity of analytes being released,
- Degradation, transport and sequestration mechanisms.
- Chemical characteristics that modify toxicity (such as hardness, pH, organic matter, etc.).
- Protecting ecosystem diversity which will provide protection for critical species such as ecological "keystone" species.

These factors determine if, how, and to what extent the receiving water can accept contaminants.

Regarding determining appropriate SSWQOs for the Gahcho Kue Diamond Mine Project, a number of national and NWT specific policy documents provide guidance. These documents include: the NWT Water Strategy, the Mackenzie Valley Land and Water Board Water and Effluent Quality Management Policy, and, documents produced by the Canadian Council of Minister's of the Environment (CCME). Selected concepts for water protection and preservation provided in these documents that require consideration when establishing WQOs, include:

> *"Waters that flow into, within or through the NWT are substantially unaltered in quality, quantity and rates of flow." – Goal of the NWT Water Stewardship Strategy* (AANDC and GNWT, 2010)

"For waters of superior quality or that support valuable biological resources, the CCME non-degradation policy states that the degradation of the existing water quality should always be avoided." (CCME, 1999)

"Residents of the NWT have expressed a desire to lead in the area of water stewardship. This means setting high standards to hold residents and others responsible and accountable." (AANDC and GNWT, 2010, Section 1.3, pg 9)

"*Pollution Prevention: The use of processes, practices, materials, products, or energy that avoid or minimize the creation of pollutants and waste and reduce overall risk to human health and the environment." (MVLWB, 2011, Guiding Principle of WEQMP)*

"*The Boards expects Developers to identify and implement waste prevention and/or minimization measures, whenever feasible."* (MVLWB, 2011).

*"Note that in accordance with the Boards' objective to minimize waste discharge, proponents are expected to minimize and, where feasible, to prevent waste from entering water in the NWT. Therefore, and consistent with the CCME nondegradation policy, the Boards may set EQC that are more stringent than what is necessary to meet water quality standards in the receiving environment." (*MVLWB, 2011)

These principles speak to the practice of minimizing impacts to the receiving aquatic ecosystem by limiting the amount of waste discharged and therefore minimizing the degradation of receiving water quality. Smaller changes in receiving water quality provide greater confidence that the important components of the receiving aquatic ecosystem will be preserved.

The proponent has proposed narrative statements that articulate their overall goals for water quality objectives from the proposed Gahcho Kue mine. AANDC has reviewed the proponent's statements and is of the opinion that additional detail is required to guide WQO development and identify the specific level of protection these values are intended to provide to the downstream receiving environment. To this end, AANDC proposes the following narrative statements:

- Water quality changes due to mining activities will not significantly affect benthic macro-invertebrate and plankton abundance, taxonomic richness or diversity.
- Water quality changes due to mining activities will not significantly alter fish abundance or diversity or fish consumption at current levels.
- Water quality changes due to mining activities will not negatively affect areas utilized as traditional drinking water sources.
- Water quality changes due to mining activities will not significantly affect

mammals or wildfowl using the area as a drinking water, food source or habitat, or the current ability for people to harvest these animals.
- Prior to re-connection with the surrounding watershed, water and sediment quality in Kennady Lake will be adequate to support a viable and self-sustaining ecosystem that is compatible with the regional watershed and maintains traditional use of the area.

As noted previously, AANDC has identified some concerns with how the Proponent has implemented their WQO protocol. These concerns are described below and include the following:

- Use of regional baseline values as the basis for assessing the potential changes in water quality due to project activities;
- Using the elevated hardness values that result from project activities when accounting for exposure and toxicity modifying factors (ETMFs) during WQO derivation;
- Defaulting to CCME guideline levels in the event that projected parameter concentrations exceed maximum background concentrations; and
- AANDC is specifically concerned with the WQO proposed for mercury.

Tables 1 and 2 in the September 14, 2012 technical memorandum use regional background concentrations for comparison against maximum whole lake mixed concentrations in Kennady Lake and at the edge of a 200 m IDZ in Lake N11. The maximum regional baseline concentration is adopted as the WQO for a number of parameters. AANDC notes that the maximum concentration in the dataset, in many cases, exceeds the median concentration by an order of magnitude or more. While variation in water quality is expected, AANDC is uncertain whether the maximum reported concentrations truly represent the current baseline water quality in Kennady Lake and Lake N11. AANDC submits that the actual baseline concentrations from Kennady Lake and Lake N11 should be used for establishing SSWQO as these two waterbodies represent the immediate receiving environment.

The maximum hardness value reported in the regional baseline is 14 mg/L as $CaCO_3$. However, hardness values used to calculate the hardness dependant CCME guideline values in Tables 1 and 2 of the September 14, 2012 memo are variable, but are greater than 14 mg/L. The hardness of the water in the receiving environment is predicted to increase as a result of mining activities, and the Developer proposes that the elevated hardness concentration be used when setting WQO for Lake N11 and Kennady Lake. Section 5.3 of the September 14, 2012 memo proposes that WQO should be revised on an ongoing basis as the hardness increases over the life of mine. AANDC cautions that adjusting SSWQO and EQC based on the degree of influence the effluent discharge has on the receiving environment (i.e., increased hardness) will lead to higher effluent concentrations through time in the receiving environment, both in Kennady Lake and downstream, and the requirement to continually raise EQCs throughout the life of the

project. This concept is in direct opposition to pollution prevention principles and the utilization of best management practices such as source control, as outlined in the Mackenzie Valley Land and Water Board Water (MVLWB) and Effluent Quality Management Policy.

The MVLWB's Effluent Quality Management Policy identifies eight Guiding Principles, including Pollution Prevention, which speak to minimizing the creation of pollutants and waste. This Guiding Principle carries forward into the Policy's Objectives for Regulating the Deposit of Waste, one of which is that the amount of waste to be deposited to the receiving environment is minimized. Waste minimization is further referenced in the Policy's waste minimization hierarchy where waste discharge is identified as a last resort, to be used only after implementing source reduction, reuse/recycling and treatment. In AANDC's view, the intent of the MVLWB's Policy, as described, would not be met under the scenario suggested by the proponent.

Regarding the proponent's WQO protocol, if the maximum predicted concentration for a parameter exceeds the maximum baseline value but is less than the CCME Guideline value, the CCME Guideline value is adopted as the objective. In some instances the maximum baseline value is close to the CCME Guideline and, therefore, adopting the CCME Guideline is likely appropriate. However, in other instances the maximum predicted concentration is less than the CCME value by an order of magnitude or more. In such instances AANDC submits that, in accordance with the principles of pollution prevention and the CCME non-degradation policy noted previously, a value that falls between the maximum predicted concentration and the CCME Guideline should be used instead of defaulting to the CCME Guideline value.

AANDC has a specific concern with the proponent's proposed WQO for mercury. As per the above protocol, the maximum measured baseline value of 0.00009 mg/L is proposed as the objective. The CCME guideline for mercury is 0.000026 mg/L and the reported regional median background concentration is 0.000004 mg/L. The CCME guideline value is to protect against toxicity alone, and does not account for bioaccumulation and biomagnifications of mercury in fish tissues. Therefore, the proposed objective may not provide protection for consumers of fish. The EIS has identified that fish tissue mercury concentrations in fish caught in Kennady Lake already exceed USEPA screening criteria for human consumption. As such, efforts should be made to minimize increases to mercury in downstream the receiving environment as a result of project activities. Further, research has suggested linkages between eutrophication and the methylation of naturally occurring mercury. Methylation of mercury results in increased amounts of mercury being available for bioaccumulation and biomagnifications in tissues. This has not been taken into account by the proponent when establishing its SSWQO for mercury.

The maximum projected mercury concentrations as a result of the project are 0.00001 mg/L for Kennady Lake and 0.0000062 mg/L for Lake N11. As noted previously, AANDC does not know how the regional maximum baseline mercury concentrations compare to the natural mercury concentrations in Kennady Lake and Lake N11, but it appears that the maximum predicted concentrations will remain below the CCME guideline. Therefore, AANDC submits that the SSWQO for mercury should either align with the maximum projected mercury concentrations as a result of the project, or be set at the upper range of naturally existing background concentrations in Lake N11 and Kennady Lake. AANDC recognizes both proposed approaches will fall below CCME guidance, however, additional conservatism in regards to potential bioaccumulation and biomagnification of mercury will be provided, which as mentioned above, are not accounted for in the CCME value.

As with any WQO, the collection of sound and defensible environmental information may justify the modification of these values in the future, if and only if, the intended downstream level of protection is maintained.

Based on the above discussion, AANDC makes the following recommendations regarding SSWQOs for the proposed Gahcho Kue Diamond Mine Project:

RECOMMENDATION #1

AANDC recommends that the Report of EA should include narrative statements that describe the level of protection to be afforded the aquatic receiving environment. These statements could include:

- ***Water quality changes due to mining activities will not significantly affect benthic macro-invertebrate and plankton abundance, taxonomic richness or diversity.***
- ***Water quality changes due to mining activities will not significantly alter fish abundance or diversity or fish consumption at current levels.***
- ***Water quality changes due to mining activities will not negatively affect areas utilized as traditional drinking water sources.***
- ***Water quality changes due to mining activities will not significantly affect mammals or wildfowl using the area as a drinking water, food source or habitat, or the current ability for people to harvest these animals.***
- ***Prior to re-connection with the surrounding watershed, water and sediment quality in Kennady Lake will be adequate to support a viable and self-sustaining ecosystem that is compatible with the regional watershed and maintains traditional use of the area.***

RECOMMENDATION #2

AANDC recommends that specific baseline values, as opposed to regional baseline values, should be used when deriving SSWQOs for Kennady Lake and Lake N11.

RECOMMENDATION #3

AANDC recommends that the hardness concentration used for calculating hardness dependant SSWQOs should reflect the existing baseline hardness concentration and not the altered conditions predicted as a result of mining activities.

RECOMMENDATION #4

AANDC recommends that, when deriving SSWQOs, the lowest level reasonably achievable (considering requirements for operational flexibility) should be selected instead of defaulting to existing generic guideline values.

RECOMMENDATION #5

AANDC recommends that the SSWQO for mercury should either align with the maximum predicted mercury concentrations as a result of the project and/or within the range of naturally occurring background concentrations in Kennady Lake and Lake N11.

Aquatic Effects Monitoring Program (AEMP) and Adaptive Management

Issue:

An aquatic effects monitoring will be developed for the project, however there is not a clear commitment to follow AANDC's Aquatic Effects Monitoring Program Guidelines.

References:

1. DAR Section 8.0 KLOI: Water Quality and Fish in Kennady Lake; and
2. DAR Section 9.0 KLOI: Downstream Water Effects;

Developer Conclusion:

Effects monitoring programs will include an Aquatic Effects Monitoring Program (AEMP). De Beers will develop the scope of the AEMP in consultation with regulators and interested parties. It is anticipated that the AEMP will include water flow, water quality and sediment quality components, along with components focused on lower trophic communities (i.e., plankton and benthic invertebrates), fish and fish habitat. Sampling areas are likely to be located in the Kennady Lake watershed, potentially affected areas of the N watershed and the A, B, D, and E watersheds, Lake 410, and Kirk Lake, and a suitable reference lake. Components of the AEMP will be developed according to a common, statistically-based study design incorporating regulatory guidance and current scientific principles related to aquatic monitoring.

Reviewer Conclusion:

AANDC agrees with the Developer that an AEMP is required for the Gahcho Kue Diamond Mine Project, and is encouraged by the indication that De Beers will work with regulators and interested parties to develop the scope. However, AANDC would like to see a stronger commitment to follow AANDC's "Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories – 2009" (AEMP Guidelines).

Rationale:

AANDC believes that the 2009 AEMP Guidelines provide a solid basis for first identifying the potential for and then monitoring project related effects to the downstream receiving environment. This first goal is critical to the AEMP design and is directly related to the effects assessment that is developed in the EA. Also, and of equal importance, the AEMP provides a mechanism for incorporating Traditional Knowledge in an efficient and effective manner. Further, AANDC's AEMP guidelines provide a mechanism to develop and include Adaptive Management, or what is referred

to as a Management Response Framework, with specific linkages to monitoring results and action levels. These key aspects are intended to streamline the AEMP development process and ensure that all interests and needs are effectively met.

AANDC's AEMP guidelines define an eight-step process for designing and conducting monitoring of the water environment. This step-by-step process is referred to as the AEMP framework. AANDC believes that this framework should be followed during the development of the final AEMP for the Gahcho Kue Diamond Mine Project.

STEP 1: IDENTIFICATION OF ISSUES AND CONCERNS

The first step in the AEMP development process involves identifying issues and concerns regarding the water environment that Aboriginal governments/organizations and interested parties may have about a development project. By asking for input from all interested parties at this stage, a preliminary list of stressors that may be of concern is documented and the Developer can make changes to the project description while considering the issues and concerns. This process would include formulating appropriate statements about the acceptable level of change in the downstream environment as a result of the project.

STEP 2: PROBLEM FORMULATION FOR AQUATIC EFFECTS MONITORING

During the second step, the final list of possible stressors is completed, and then each stressor is looked at to see if it could have effects on the water environment or human health. Next, the ways a stressor can affect the water environment need to be determined (such as elevated levels of a chemical changing the quality of the water). The parts of the water environment that could be affected, such as fish, plants, birds, sediment, water quality, need to be recorded. These are called receptors. Diagrams are prepared that show how each stressor is linked to parts of the water environment that could be affected. These diagrams are called conceptual site models. These models are then used to identify the parts of the water environment that need to be protected and what will be measured to determine if the water environment is being adequately protected.

STEP 3: DEVELOPMENT OF DATA QUALITY OBJECTIVES AND CONCEPTUAL STUDY DESIGN

This step of the process identifies the important parts of an AEMP and helps determine what the monitoring program will look like. This step also determines what types of information and how much data are needed to evaluate the effects of the development project on the water environment. The levels of stressors that would harm the water environment (called Action Levels) are identified. The data quality objectives also describe how the AEMP results will be used to determine if the

development project has caused negative effects on the water environment.

STEP 4: DEVELOPMENT OF DETAILED AEMP DESIGN

Step four in the AEMP development process builds on the conceptual study design to develop a detailed AEMP design through:

- Selection of an appropriate monitoring program design;
- Selection of sampling locations;
- Confirmation of appropriate effects sizes;
- Determination of necessary sample sizes; and,
- Identification of appropriate sampling frequencies.

A variety of design options are available for AEMPs in the NWT. All of these designs rely on comparison of data collected in an exposed area(s) (i.e., impacted areas) to data collected in an unexposed area (i.e., reference area).

STEP 5: DOCUMENTATION AND VERIFICATION OF THE SAMPLING DESIGN

Various plans will be prepared during this step to describe the procedures to be followed by the people conducting field sampling since it is important that the data is collected properly. There will be specific guidance for all field work (to collect high quality data and information), and a plan to make sure the people collecting samples or visiting the site take all safety precautions necessary. Changes to any of these plans by the Developer should be reviewed by interested parties and approved by the regulatory boards.

STEP 6: IMPLEMENTATION OF THE AEMP

This step begins following the approval of the AEMP by the regulatory board. It involves the collection of environmental samples, Traditional Knowledge, and other information and the analysis of the results to produce data (for example, laboratory measurements for water quality data). The plans developed in Step 5 must be carefully followed for all types of data and information collection.

STEP 7: EVALUATION, COMPILATION, ANALYSIS, INTERPRETATION AND REPORTING OF AEMP RESULTS

Once data and information have been collected under the AEMP (both Traditional Knowledge and western science based), it needs to be evaluated, compiled, analyzed, interpreted and reported by the Developer. This data is compared to baseline data to see if there are changes.

STEP 8: APPLICATION OF AEMP RESULTS WITHIN A MANAGEMENT RESPONSE FRAMEWORK

Management response, also commonly known as adaptive management, is a way to continually improve the management of the development project by learning from the information collected year after year by the AEMP. For example, the results of the AEMP could lead to a change in the amount or location of waste that is released from a development project, if the AEMP results show that a certain chemical being discharged had a negative effect on the water environment.

AANDC provides the following recommendation in regards to aquatic effects monitoring and adaptive management, and looks forward to working with the Developer and other interested parties in designing a comprehensive and appropriate AEMP and Management Response Framework.

Recommendation #6

***AANDC recommends that De Beers Canada be required to follow the "Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories, June 2009" in the development of its Aquatic Effects Monitoring Program, action levels, and related Management Response Framework for the Gahcho Kue Diamond Mine Project*.**

Closure and Reclamation

Issue:

At the end of mining the WMP will refill and will be reconnected to the surrounding watersheds. The time required for the WMP to recover to form a sustainable ecosystem is on the order of 70 years from the end of Project operations.

References:

1. DAR Section 10 KLOI: Long-Term Biophysical Effects, Closure and Reclamation;
2. IR AANDC_5, IR AANDC_21.

Developer Conclusion:

During operations, Kennady Lake will be disconnected from the surrounding hydrologic regime and used as a water management pond (WMP). At the end of operations, the water in the WMP, containing elevated nutrient, ionic, cationic and metal parameters, will be transferred to the Tuzo Pit and the WMP will be reconnected to surrounding watersheds and will be allowed to re-fill. The rate of re-filling will be supplemented through active pumping of water from Lake N11.

Poor quality water stored in the pits will form a chemocline and will have limited impact on overall water quality within the reconnected WMP.

Portions of the West Mine Rock Pile, South Mine Rock Pile, Coarse PK Facility and Fine PK Containment Facility will be in contact with the WMP water, but impacts to overall water quality will be acceptable.

The WMP will recover to the point where it forms a sustainable ecosystem over a period of approximately 70 years from end of Project operations.

Reviewer Conclusion:

AANDC's position on closure and reclamation related issues are based upon the "Mine Site Reclamation Policy for the Northwest Territories, Indian and Northern Affairs Canada, 2002". This policy was developed in response to a number of insolvencies and abandoned mine properties for which the Crown assumed environmental liability of the sites. The Policy describes the Department's expectations regarding mine site reclamation and forms the basis of a second document, AANDC's Mine Site Reclamation Guidelines for the Northwest Territories.

Several of the principles contained within the Reclamation Policy are of particular importance for the proposed Gahcho Kue Diamond Mine Project, including the following:

> *"Following mine closure, mining companies or their future owners should continue to be responsible for the site, including the remediation of any additional environmental complications which develop."*
>
> *"The total financial security for final reclamation required at any time during the life of the mine should be equal to the total outstanding reclamation liability for land and water combined"*
>
> *"The required standard of reclamation should be based on the 1994 Whitehorse Mining Initiative definition: "returning mine sites and affected areas to viable and, wherever practicable, self sustaining ecosystems that are compatible with a healthy environment and with human activities.""*

Rationale:

AANDC's primary concerns related to the closure of the proposed Gahcho Kue Diamond Mine Project relate to the post-closure water quality in the WMP and the time required for the WMP to re-integrate into the local ecosystem. One of the proponent's water management goals is that the water quality in the WMP, post closure, will support a viable aquatic ecosystem. AANDC submits that the water quality in the WMP post-closure should be sufficient not only to support a viable ecosystem, but to support a a viable and self-sustaining ecosystem that is compatible with the regional watershed and maintains traditional use of the area before the WMP is reconnected to the downstream watershed.

The proponent has used a model to predict whole lake mixed water quality concentrations for the WMP post closure. AANDC notes that these predictions are based upon assumptions about the volume and quality of leachate generated by the waste rock and processed kimberlite storage piles that will be in direct contact with WMP water and on the stability of the chemocline that should develop in the submerged pits. AANDC notes that having waste rock and process kimberlite piles in direct contact with a water body is not typical practice at northern mine sites. Depending upon the accuracy of the model assumptions, final water quality in the WMP may differ from predicted values.

AANDC is uncertain whether the final post-closure WMP water quality will support a viable and self-sustaining ecosystem that is compatible with the regional watershed and maintains traditional use of the area. On-going monitoring and adaptive management

will be required during the re-filling process to ensure that the water quality goals for the WMP are met prior to re-connection with the downstream watershed.

A key element of the water quality in the WMP post-closure is the successful establishment of a chemocline in the pits that will be filled with WMP water prior to allowing freshwater to enter the WMP. A good understanding of potential site-specific failure mechanisms (e.g. climactic, geotechnical, etc.) that could lead to disruption of the chemocline and mixing of the poor quality pit water with better quality surface water should be developed during the operational phase of the project. Any identified design or mitigation measures that could enhance chemocline stability should be implemented during the operational and early post-closure phases of the project. If, during operations, investigations lead to uncertainty in the creation of a chemocline or the stability of the chemocline in perpetuity, contingency options would be required and implemented, such as water treatment and additional mine site adaptive management controls.

In considering these points, AANDC makes the following recommendations regarding the proposed closure scenario Gahcho Kue Project:

RECOMMENDATION #7

AANDC recommends that water quality be closely monitored during the re-filling process, and adaptive management be implemented as required to ensure that the final water quality is sufficient to support a viable and self-sustaining ecosystem that is compatible with the regional watershed and maintains traditional use of the area prior to reconnecting the WMP to the downstream watersheds.

RECOMMENDATION #8

AANDC recommends that a key element of the closure planning process, during operations, should be to identify potential mechanisms through which full lake mixing could occur (e.g. weather, pit wall slumping, etc.) and use the results of ongoing investigations and study to implement measures such that chemocline stability will be enhanced.

RECOMMENDATION #9

AANDC recommends that a key element of the closure planning process, during operations, should be to identify and develop methods to reduce the period of time required for recovery of the WMP.

RECOMMENDATION #10

AANDC recommends that closure goals and objectives be developed for the WMP that must be met prior to and following reconnection with the downstream environment. These closure goals and objectives would be developed in consultation with Aboriginal groups, interested parties and regulators.

CONCLUDING REMARKS

De Beers Canada is proposing the development of a diamond mine, situated at Kennady Lake in the Northwest Territories. AANDC and its retained experts has conducted a high level technical review of the proposed project. Where possible, AANDC has provided recommendations to the Mackenzie Valley Environmental Review Board to assist in their decision-making process.

AANDC has provided recommendations within this report that relate to water quality with the intent of minimizing potential impacts from the proposed development both in magnitude and temporal extent. Setting SSWQOs with the goal of maintaining existing water quality, to the extent feasible, will minimize the potential effects and provide a higher level of confidence that Kennady Lake and the downstream aquatic receiving environment will see minimal impacts.

AANDC thanks the Board for providing an opportunity to participate in this process, and looks forward to the Board's decision on this project.

SUMMARY OF RECOMMENDATIONS

Site Specific Water Quality Objectives and Effluent Quality Criteria

RECOMMENDATION #1

AANDC recommends that the Report of EA should include narrative statements that describe the level of protection to be afforded the aquatic receiving environment. These statements could include:

- *Water quality changes due to mining activities will not significantly affect benthic macro-invertebrate and plankton abundance, taxonomic richness or diversity.*
- *Water quality changes due to mining activities will not significantly alter fish abundance or diversity or fish consumption at current levels.*
- *Water quality changes due to mining activities will not negatively affect areas utilized as traditional drinking water sources.*
- *Water quality changes due to mining activities will not significantly affect mammals or wildfowl using the area as a drinking water, food source or habitat, or the current ability for people to harvest these animals.*
- *Prior to re-connection with the surrounding watershed, water and sediment quality in Kennady Lake will be adequate to support a viable and self-sustaining ecosystem that is compatible with the regional watershed and maintains traditional use of the area.*

RECOMMENDATION #2

AANDC recommends that specific baseline values, as opposed to regional baseline values, should be used when deriving SSWQOs for Kennady Lake and Lake N11.

RECOMMENDATION #3

AANDC recommends that the hardness concentration used for calculating hardness dependant SSWQOs should reflect the existing baseline hardness concentration and not the altered conditions predicted as a result of mining activities.

RECOMMENDATION #4

AANDC recommends that, when deriving SSWQOs, the lowest level reasonably achievable (considering requirements for operational flexibility) should be selected instead of defaulting to existing generic guideline values.

RECOMMENDATION #5

AANDC recommends that the SSWQO for mercury should either align with the maximum predicted mercury concentrations as a result of the project and/or within the range of naturally occurring background concentrations in Kennady Lake and Lake N11.

Aquatic Effects Monitoring Program (AEMP) and Adaptive Management

Recommendation #6

AANDC recommends that De Beers Canada be required to follow the "Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories, June 2009" in the development of its Aquatic Effects Monitoring Program, action levels, and related Management Response Framework for the Gahcho Kue Diamond Mine Project.

Closure and Reclamation

RECOMMENDATION #7

AANDC recommends that water quality be closely monitored during the re-filling process, and adaptive management be implemented as required to ensure that the final water quality is sufficient to support a viable and self-sustaining ecosystem that is compatible with the regional watershed and maintains traditional use of the area prior to reconnecting the WMP to the downstream watersheds.

RECOMMENDATION #8

AANDC recommends that a key element of the closure planning process, during operations, should be to identify potential mechanisms through which full lake mixing could occur (e.g. weather, pit wall slumping, etc.) and use the results of ongoing investigations and study to implement measures such that chemocline stability will be enhanced.

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AANDC recommends that a key element of the closure planning process, during operations, should be to identify and develop methods to reduce the period of time required for recovery of the WMP.

<u>RECOMMENDATION #10</u>

AANDC recommends that closure goals and objectives be developed for the WMP that must be met prior to and following reconnection with the downstream environment. These closure goals and objectives would be developed in consultation with Aboriginal groups, interested parties and regulators.

REFERENCES

AANDC and GNWT, 2010. Northern Voices, Northern Waters – The NWT Water Stewardship Strategy.

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