98 - Rec'd via e-mail Feb 14/03

EA-SnapLake

From: SWilbur@entrix.com

Sent: Friday, February 14, 2003 5:21 PM

To: EA-SnapLake

Cc: 'Football Adeline (E-mail) ' (E-mail); Alan Ehrlich; Anne Wilson (E-mail); 'Lutselk'e Agatha (E-mail) ' (E-mail); ''Government Akaitcho (E-mail) ' (E-mail) ' (E-mail); 'DFO David (E-mail) ' (E-mail); 'Matt Bender (E-mail) ' (E-mail); Bridgette Larocque; 'NSMA Bob Turner (E-mail) ' (E-mail); 'Tim Byers (E-mail) ' (E-mail); 'CARC (E-mail) ' (E-mail); 'Chuck. Blyth (E-mail) ' (E-mail); Colleen English (E-mail); 'CPAWS (E-mail) ' (E-mail); 'Julie Dahl (E-mail) ' (E-mail); Dawn' 'Kelly (E-mail); 'Dennis Bevington (E-mail) ' (E-mail); 'Chris (E-mail) ' (E-mail); 'John Donihee (E-mail2) ' (E-mail); 'John Donihee (E-mail) ' (E-mail); 'Ecology North (E-mail) ' (E-mail); 'Eric Denholm (E-mail) ' (E-mail); 'Roy Ellis (E-mail) ' (E-mail); 'YK Chamber of Commerce (E-mail) ' (E-mail); 'Fairman Fraser (E-mail) ' (E-mail); 'Galbraith Empson (E-mail) ' (E-mail); 'Rae-Edzo Metis Local #64 (E-mail) ' (E-mail); 'Gavin_More (E-mail) ' (E-mail); Lisa Best (E-mail); Glenda Fratton (E-mail); 'Tamara Hamilton (E-mail) ' (E-mail); 'Golder Machtans Hillary (E-mail) ' (E-mail); Jason Lepine (E-mail); 'Jagtar_Sandhu (E-mail) ' (E-mail); Jason McNeill (E-mail); 'Joan Freeman (E-mail) ' (E-mail); 'Janet Hutchison (E-mail) (E-mail) ' (E-mail); 'John McConnell (E-mail) ' (E-mail); John Ramsey (E-mail); 'Judy Langford (E-mail) ' (E-mail); 'Jennifer Keith (E-mail) ' (E-mail); 'Kevin Ledrew (E-mail) ' (E-mail); 'S. Kristyn (E-mail) ' (E-mail); 'DFO Marc Lange (E-mail) ' (E-mail); 'Wha Ti First Nation (E-mail) ' (E-mail); 'Letha MacLachlan letha (E-mail) ' (E-mail); 'Golder Green Leslie (E-mail) ' (E-mail); 'Mark Dahl (E-mail) ' (E-mail); 'Mike Fournier [Yel] (E-mail) ' (E-mail); 'Chamber of mines ED (E-mail) ' (E-mail); 'General MVLWB (E-mail) ' (E-mail); 'Nick Lawson (E-mail) ' (E-mail); 'WWF - Peter J. Ewins (E-mail) ' (E-mail); Rachel Crapeau (E-mail); 'Sue I. (E-mail) ' (E-mail); 'Lutsel K'é Dene First Nation (E-mail) ' (E-mail); Robin Johnstone (E-mail); Roland Semjanovs; 'Nunavut Impact Review Board (E-mail) ' (E-mail); 'Sierra Legal Defence Fund (E-mail 2) ' (E-mail); 'Morison Steve (E-mail) ' (E-mail); 'Doug Soloway (E-mail) ' (E-mail); 'Stephen Harbicht (E-mail) ' (E-mail); 'Steve Mathews (E-mail) ' (E-mail); 'Health Canada 2 (E-mail) ' (E-mail); 'Mary Tapsell (E-mail) ' (E-mail); 'WWF Tony Y. (E-mail) ' (E-mail); 'Tony Pearse (E-mail) ' (E-mail); Vern Christensen, Executive Director; 'J. Michael Thoms NSMA (E-mail) ' (E-mail); 'LKDFN Wildlife Lands Environment Ctte (E-mail) ' (E-mail); 'Buddy Williams (E-mail) ' (E-mail); 'William (Bill) Carpenter (E-mail) ' (E-mail)

Subject: Re: update note

Glenda - in response to requests from reviewers, please accept the following revised technical report which now has page numbers and proper headers; there were no other substantive changes made. Cheers,

Steve Wilbur
ENTRIX, Inc.

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ENTRIX

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Since 1984 – Environmental Excellence

February 14, 2003
Project No. 390501

Mackenzie Valley Environmental Impact Review Board
Box 938, 5102-50th Avenue
Yellowknife, NT X1A 2N7

Attention: Glenda Fratton

Re: Technical Report
DeBeers Snap Lake Development

Dear Glenda:

Please find attached the technical report for submission to the Mackenzie Valley Environmental Impact Review Board (Board), entitled "Assessment of the Proposed DeBeer's Snap Lake Diamond Project." This report was prepared on behalf of the Dogrib Treaty 11 Council. We have attempted to follow the report outline provided by the Board in late January 2003, but due to time constraints, available resources and for brevity sake we have deviated from the requested format it in a few places.

Please note that the additional plain language summary of the technical report will be sent under separate cover.

Please call me at (604) 943-4598 if you require additional information.

Yours very truly,

ENTRIX, Inc.

per:

Stephen C. Wilbur, Ph.D., P.Geo.
Senior Consultant

...\projects\Dogrib - DeBeers\Technical Report\390501- cvr ltr to MVEIRB1.doc

cc: Ted Blondin, Dogrib Treaty 11 Council
Art Pape, Pape and Salter
Tony Pearse

Plain Language Summary Report for Submission to the Mackenzie Valley Environmental Impact Review Board Assessment of the Proposed DeBeer's Snap Lake Diamond Project February 14, 2003

On behalf of the The Dogrib Treaty 11 Council, ENTRIX, Inc. has prepared this plain language summary report pertaining to our technical review of environmental issues associated with the proposed DeBeer's Snap Lake Diamond Mine. The following general subjects were reviewed: 1) Groundwater, 2) Snap Lake Water Quality, 3) Fish and Aquatic Resources, 4) Wildlife, and 5) Geotechnical Issues.

The conclusions reached here were arrived at based on reviews of various technical documents prepared by DeBeers, government agencies or other interested parties. Also, the conclusions are based on information provided during various technical sessions conducted in Yellowknife last year. These report compliments the detailed technical report also submitted to the Mackenzie Valley Environmental Impact Review Board on February 14, 2003.

GROUNDWATER

There is much uncertainty in the estimation of water that will enter the mine workings during operation of the mine. There is currently enough uncertainty regarding the characterization of groundwater in the area of the mine, and in the associated groundwater analyses to raise questions about the validity of the impacts analysis. With respect to the regional groundwater, although it is even less understood the implications and resulting impacts are less important.

DeBeers has stated that they would flood the mine workings before discharging untreated water. Thus, even with the uncertainties in their assessment, DeBeers is at a higher risk. A conclusion was reached during the technical sessions that at the worse case scenario, DeBeers would have more at stake (economic viability) if mine inflows were much higher than expected than there is risk to environment.

There is a general lack of groundwater quality data. There are few water samples from wells, and water samples were collected primarily of water entering the mine workings from above. Zones deeper than the exploration workings were not sampled. As a result, DeBeers does not have a clear picture of the quality of water that will need treating before they discharge to Snap Lake. This creates a further uncertainty in their ability to assess the effects of minewater discharge to Snap Lake.

We have recommended that additional data be collected and additional analyses (groundwater modeling) be conducted prior to commencing operation of the mine.

SNAP LAKE WATER QUALITY and AQUATIC RESOURCES

DeBeers will collect water from the mine and a variety of other sources. They have also developed a water management plan and water treatment system to handle this water. Ultimately, they plan to pump the treated water into Snap Lake over the entire duration of mining. DeBeers has evaluated the impacts of this discharge. As part of their assessment, they collected water quality and water resource data, including information on fish and nutrients in the lake. Their assessment concluded that there would be negligible impacts to fish and aquatic resources. We did not necessarily agree with some of their conclusions.

The biggest concern we had was in the method by which DeBeers assessed impacts, and in some cases we believe their assessment methodology was flawed. This was most obvious in that DeBeers did not assess the interactive effects occurring from the multiple parts of the mine development. As a result of the project many changes to the lake environment were predicted and include, to name a few:

- A fivefold increase in average concentration of total dissolved solids
- A large increase in average chloride concentration

- Similar increases in various metals
- Release of metals previously not in lake
- An increase in nutrient levels and algal productivity
- Zones within the lake with reduced dissolved oxygen concentrations (possibly lethal to lake trout)
- A potential loss of fish abundance or change in various species abundance
- A Loss of existing fish habitat
- Reduced quality of over-wintering fish habitat
- Overall total change in water quality characteristics

These changes all could lead to a fundamental change in the overall aquatic ecosystem of the lake.

DeBeers argued that because all of these changes are happening on a "large" lake, the ecosystem will be hardy enough to maintain itself. We disagree and conclude that the results will have a significant environmental effect. It is not clear whether all the effects will be adverse, but DeBeers must first demonstrate that there are potential beneficial effects of these changes (e.g., perhaps the increased productivity might result in higher fish abundance) are bigger than the obvious negative effects.

We recommended that they reassess the potential impacts to Snap Lake with respect to all the potential interactive effects, and determine whether an individual, species, community and habitat can experience these overall changes without negative sublethal as well as lethal effects.

We also recommended that they determine if any long-term dependence by the aquatic community to these artificial changes would develop, and assess what would happen when mining stopped.

TERRESTRIAL WILDLIFE

Our main concern was in the lack of confidence that we had in DeBeers' ability to predict impacts to caribou, grizzly bears, wolverines, and possibly raptors because of a lack of baseline data. This concern also applied to cumulative effects. That is, if the individual parts of the ecosystem are not well understood, it is not possible to make reliable estimates of how an entire network of wildlife and their habitats will be affected.

It appears that De Beers has been taking a reactive or passive approach rather than a pro-active approach, at least with regard to collecting baseline data on terrestrial wildlife, and in terms of cooperating with knowledgeable sources to improve the reliability of their impact predictions. It also remains questionable as to whether it is the responsibility of GNWT or De Beers to develop more practical and sensitive methods for determining the relative abundance of wolverines in the project area, or to further develop baseline information for caribou.

We recommended that De Beers take greater initiative and approach the appropriate authorities (e.g., RWED for caribou, grizzly bears, wolverines) in order to ensure that their impact models are as robust as possible. It is also important that they are perceived to be doing so, not only by the review agencies, but by the public as well.

GEOTECHNICAL ISSUES

We have specific concerns related to the structure and operation of some of the proposed mine facilities including seepage volumes and quality from the North Pile, short-term and long-term North Pile temperature conditions, water in the processed kimberlite, and in the catching efficiency of the ditch placed around the North Pile. but in general do not consider these major issues. These concerns can most likely be dealt with during the licensing stage.

Technical Report for Submission
to the Mackenzie Valley Environmental Impact Review Board
Assessment of the Proposed DeBeer's Snap Lake Diamond Project
Dogrib Treaty 11 Council, February 14, 2003

INTRODUCTION

On behalf of the The Dogrib Treaty 11 Council, ENTRIX, Inc. is pleased to offer the following technical comments on the Environmental Assessment Report for the proposed DeBeer's Snap Lake Diamond Mine We have conducted a technical review of documents pertaining to the Snap Lake project with regard to the following general subjects:

- Groundwater
- Snap Lake Water Quality
- Aquatic Resources (fish and aquatic habitat)
- Terrestrial Wildlife
- Geotechnical Issues

Specific comments follow. Where no comments have been offered, we have no major concerns at this time. This does not include potential issues outside the areas of our review (e.g., socio-economics, cultural resources, etc.).

The conclusions and comments reiterated here have been developed over the last several months based on our review of various relevant sections of the Environmental Assessment, the three rounds of Information Requests including DeBeers' responses to these requests, and reviews of summary notes (including the GeoNorth summaries and breakout sessions) taken during several rounds of Technical Sessions that have been conducted in Yellowknife in April, October and November 2002. Due to time constraints and available resources, and for brevity sake, we have not identified the specific references that are germane to each comment, but have attempted to follow the report outline provided by the Mackenzie Valley Environmental Impact Review Board in late January 2003.

SPECIFIC COMMENTS

1.0 GROUNDWATER

1.1 Groundwater – Predicting Mine Water Inflows

DeBeer's Conclusions:

DeBeers has modeled inflows to the mine over the course of operations to predict the amount of water that will require treatment. The groundwater modeling assumed that surrounding lake levels serve as a boundary condition that establish a "regional water table" and therefore provide a static framework throughout the entire modeling period (mine life). In addition, AEP mine workings within the saturated zone have provided opportunities to measure inflows from specific subsurface zones. Further, a "leakance factor" (e.g., a value assigned to each drain node to account for local resistance to groundwater flow, or aka a fudge factor) was developed to help calibrate the model.

Essentially, there were two calibrations: a) adjusting hydraulic stresses to match the regional water table represented by lake levels, and b) inducing changes in water levels. DeBeers recognizes that this second type of calibration cannot yet be fully conducted because the stresses have not been large enough. Therefore, calibration to mine inflows was done for times and zones for which there was data.

DeBeers then used modeled volumes (and flow rates) of water generated from within the mine over the course of operational life of the mine for further applications. Because of the wate quality characteristics, these inflow volumes would need to be treated before discharge to Snap Lake. When estimating the potential volumes of water to be treated they used the expected flows only and did not consider a higher flow scenario, even though there is quite a bit of uncertainty (have not really calibrated model) in the predicted inflows. Ultimately, the estimate of mine inflow has a direct bearing on water treatment, effluent discharge rates and lake water quality.

Our Conclusions:

There is much uncertainty in the current model framework. Calibration is incomplete, has been conducted for only a small portion of the rock mass modeled, and may not be representative of conditions that will be encountered when mine workings are fully expanded during operations. The hydraulic connection of the "regional" lake water levels and hydraulic stresses within the mine workings has not been demonstrated (i.e., no long-term stress tests have been conducted).

There is currently enough uncertainty regarding the characterization of hydrogeology in the Local Study Area (LSA), and in the associated groundwater modeling to raise questions about the validity of the impacts analysis (from predicting mine inflows to characterizing, characterizing groundwater quality, and assessing the local and regional framework).

With respect to the regional flow system, although not well understood and at best hypothetical at this point due to very little supporting data, it appears that DeBeers has assessed the worst-case scenario, that is, has assumed a potential discharge into North Lake. It is recognized that this may not be the case at all, such that subsurface flow may likely continue beyond the North Lakes to a discharge point farther down-gradient. Although, there is no way to validate their hypothesis with the available data or with existing well distribution (do not have vertical head data, or flow conditions in sub-permafrost, nor likelihood of effective fracture-flow connectivity), the conservative premise provides a basis for impact assessment.

Rationale / Evidence:

Predicting or modeling mine inflow water quantities should be supported by a reasonable amount of baseline data that characterizes groundwater occurrence, gradients, flow and travel time. Currently, the model input is lacking a sufficient amount of head data, water level data, borehole logs and well completions, thermistor strings, hydrogeologic characterization, and fracture flow characteriztion. As a result, the model uncertainties are quite high, specifically due to the inability to calibrate to known conditions. The calibration step is dependent on a *leakance factor*, which is parameter difficult to tie to physical basis. Further, there are assumptions regarding depth and interconnectedness of taliks, effective fracture porosity and the assumed anistropy (for fault and non-fault), and fracture orientations that are supported by only a few examples.

Ultimately, the volume/rate of mine inflow will effect treatment volume/rate. DeBeers has stated that they would flood mine workings before discharging untreated volumes. Thus, if these values are underestimated, DeBeers is at a higher risk. This suggests that DeBeers would be conservative as a general rule to protect their economic interests, and actually overestimate inflows. A conclusion was reached during the technical sessions (i.e., hydrogeology breakout session) that at the worse case scenario, DeBeers would have more at stake (economic viability) if mine inflows were much higher than expected than there is risk to environment.

Recommendation(s):

There is an intermediate level of risk, however, where the mine could be experiencing flows somewhat above the expected (i.e., currently modeled) conditions, and then treatment and discharge volumes would be somewhat greater than expected/modeled/impact assessed rate before the contingency to flood the workings is adopted. A "safe" limit should be examined. That is, model higher than expected mine inflows, and determine the practical limits of treatment volume/rate and effluent volume/rate.

Contingencies for this scenario should be developed as part of the water license. In addition, field data collection and hydrogeologic characterization should continue prior to and during mine construction, and during operation (i.e., new holes, etc in addition to a monitoring program) to reduce the existing uncertainties..

A more robust characterization of hydrogeology in the LSA developed with more field information (e.g., surveyed lake water levels, installation of observation and test wells, conducting long-term stress tests to demonstrate hydraulic connection and estimate hydraulic parameters), will reduce the uncertainty in modeling, yield supporting rationale to conduct appropriate sensitivity analyses, and provide a sounder basis to defend the current impact assessment.

1.2 Groundwater - Water Quality

Reference: ToR line # __, EA Report Section __ (p. __), IR # __, etc

DeBeer's Conclusions:

DeBeers contends that measured concentrations of various groundwater constituents (e.g., chloride, phosphorus and TDS) that characterize mine inflow chemistry are appropriate for impact assessment, and the concentrations measured in wells between Snap Lake and North Lake were similar to the average range measured in Snap Lake (i.e., the data falls within ±1 standard deviation observed in granite boreholes), although the concentrations near North Lake were relatively higher. These higher concentrations at depth in the North Lake area were attributed to the expected groundwater flow directions (i.e., they hypothesize that groundwater to North Lake flows upward and groundwater from Snap Lake flows downward, and that as a result concentrations in discharge areas, like North Lake, would be generally high).

DeBeers used average concentrations to represent the water that would enter the mine workings from various levels or depths. By assuming that water chemistry of granites varied around the calculated mean, the mean concentrations of various constituents could be used to account for the relative concentrations of water flowing into mine. DeBeers used average values of connate water that evidently drained from the top 160 m of the mine area to represent the general water chemistry that would be expected from mine inflow. Further, chloride was used to represent other constituents, as it was assumed that chloride is the main parameter that would change with depth.

Our Rationale/Evidence and Conclusions:

The argument regarding the observation of the distribution of chloride concentrations is circular. If the regional flow model was deduced from the observation of higher chloride concentrations found in the North Lake area, then that being said, the opposite (which is indicated above) cannot be said, that is, the higher chloride concentrations found in the North Lakes area are due to groundwater flow.

Although, the North Lake area data set has in general higher overall concentrations, the range and means are not represented appropriately, but reflects an overall variation in groundwater chemistry. There is not enough data to describe spatial or temporal trends in groundwater quality due to groundwater flow. It should be expected that as the mine proceeds to deeper zones, water will enter at different depths and flow rates. In general, it is well established that groundwater chemical concentrations increase with depth due to decreased flow and/or longer residence within the rock mass. Thus, utilizing averages for values of chloride and phosphorous, for example, in the inflow model does not necessarily give the best representation of what to expect over time.

There is a general lack of baseline mine inflow water quality data. There are few water samples from wells, and the data is primarily representative of flows to workings from shallow depths. Deeper zones (> 160 m) are not represented. The modeled concentrations then, are not representative of the influent that will be treated nor of the effluent discharged to Snap Lake. It is possible that the concentrations and total loadings of constituents like chloride, phosphorus and certain metals (and other dissolved components) are significantly underestimated. Thus, the uncertainty in evaluating estimates of effects on Snap Lake is too high.

Recommendation(s):

The groundwater model is used to predict the chemistry of discharge water into North Lake and into mine. The predictions are not as critical for regional flow assessment, but is very important for the local flow system. The chemical characteristics of effluent will be controlled primarily by the chemistry of mine water inflow, and there is not enough data to support using only average values at this point. For conservatism we should be modeling and expecting values at least one standard deviation above average and this value should also be varied over time to represent the variation of groundwater quality with depth, rock-type and with distance to the inflow location.

Our recommendation is, prior to operation, conduct a review of the available information (including literature sources) and determine what the possible ranges of concentrations for various constituents, and then re-run the GoldSim model with higher levels of, for example, chloride, phosphorous, total dissolved solids and other ions of concern with respect to aquatic life. Additional groundwater quality data that is representative of the deeper zones to be mine should also be collected to support the characterization of possible ranges of constituent concentrations.

2.0 SNAP LAKE WATER QUALITY

2.1 Snap Lake Water Quality – Phosphorus Issues

DeBeer's Conclusions:

In the EA, DeBeers used the results of algal modeling to represent the phosphorus cycle and evaluate changes to the phosphorus. DeBeers stated that one would observe a greater loss of phosphorous from the water column, from either a higher settling rate or from more algae in the water column taking up more phosphorous. In the model, settling rate was not varied. The model result suggested that total amount of phosphorous would not increase, but would become more bioavailable. According to the model, with stimulated algae growth, more phosphorous settles out of the water column. Because phosphorous becomes more available, more goes into algae and therefore more algae settles out. Hence the alagal model achieves a new balance and the system creates a new equilibrium.

According to DeBeers, phosphorous settles and collects in the lake bottom. Phosphorous may then be taken up by grazers and later released into the water column. Although the current model does not show that release of phosphorous into the water column, the model is calibrated (looking at a net loss of nutrients to sediment) without including the effects of phosphorous loss due to settling.

DeBeers provides a mean of 10 ug/L for phosphorous concentration based on approximately 30 samples of groundwater inflow. When the mean was calculated, they looked at not only ground water inflow, but also at advanced exploration project observances. Concentrations for model input were adjusted based on additional values taken from weekly or more frequent samples taken during the advanced exploration project.

Our Conclusions:

Modeled phosphorus concentrations based on available data are suspect because the data set is not sufficient to estimate variations in phosphorus over the life of the mine.

The estimates of the proportions of dissolved (including organic and orthophosphate components) of total phosphorus are similarly not supported by a sufficient baseline data set.

The algal model that predicts phosphorus consumption and the conceptual phosphorus model that describes the phosphorus balance cycle) has not been completely assessed (i.e., re-release after consumption or settling has not been considered).

We have participated in the recent (Monday February 10, 2002) teleconference in which the phosphorus inputs and algal modeling were re-evaluated. At this current time, we have not had sufficient opportunity to evaluate whether the premises and modeling scenarios will fully resolve all the issues.

Recommendation(s):

We concur with the on-going strategies to re-evaluate phosphorus issues, but will not re-iterate them here for brevity.

2.2 Snap Lake Water Quality - Dissolved Oxygen

DeBeer's Conclusions:

The winter sampling data indicate a range of dissolved oxygen (DO) of between 5.0 to 8.0 mg/L. It was also demonstrated that in the deeper areas of lakes where current is slower and circulation is limited, DO decreases with depth. Based on the RMA11 model results, DeBeers concluded that as a result of effluent discharge and resultant mixing with lake water, DO values will be seasonally depressed. Throughout most of the lake, DO concentrations would be are expected to be greater than the CCME guideline of 5.5 mg/L, but the deeper areas of the lake could drop below the CCME guideline to as low as 3.0 mg/L. During winter, the expected DO levels in these areas would range from 3.0 to 7.0 mg/L. The values would be at their minimum in the early spring prior to breakup.

DeBeers concluded in the EA that there would be a low environmental consequence due to this seasonal effect primarily because they interpreted their model findings to indicate that only a small portion (< 1%) of the lake would be affected.

DeBeers indicated that benthic invertebrates have much lower oxygen requirements, and that CCME guidelines use the fish requirements, because fish require the most oxygen (fish being the most sensitive). According to DeBeers, there are not CCME guidelines for anything other than fish.

DeBeers insists that the low level of oxygen is limited to deep areas of the lake and the overall impact to Snap Lake is low due to spatial and temporal limits into the deep areas. Further, Snap Lake is a larger lake so that over-wintering habitat is not as important as in small lakes where fish are restricted to one space only (i.e., the one deep hole is important because fish are restricted to that hole due to ice cover). In the larger Snap Lake, DeBeers indicates that there is access to other areas because the lake is large (fish are not restricted to that hole and there is more depth of water and movement under ice). They support this by stating that during winter, foraging is better in shallower areas. So in essence these depressed DO zones are not critical for fish in relation to over-wintering habitat.

According to DeBeers, the selection of over-wintering habitat is not necessarily dependent on depth, but is also dependent on foraging, temperature and DO. They insisted that people would fish for lake trout during winter in shallower waters.

Our Rationale / Evidence and Conclusions:

DeBeers has not shown which areas of the lake will have depressed DO, for what length of time, how big these areas are, and which species will be affected. Further, if there are deep holes with low DO, it is unsure how fish will utilize these zones, whether they will avoid the low oxygen areas or whether they will swim through them. This could be construed as a temporary loss of fish habitat.

The seasonally recurrent oxygen deficient environment is a concerned about, since lower thresholds (from a concentration and areal portion perspective) have not been evaluated. Because fish are the most sensitive, the level is set at 5.5 mg/L, but when the DO level goes below this guideline to 3.0, some less sensitive organisms may now be affected. In essence, the potential impact is broader and could potentially effect more aquatic species.

It is also possible that the deep areas are critical to over-wintering for particular species but that these oxygen-depressed zones may have lethal and sublethal effects on fish. Certain fish may habitually seek deep fish habitat. The effects of these zones must be evaluated separately and not as a function of the entire lake.

In contrast to DeBeers statement regarding fish preference, according to a YDFN elder at the technical session (Isadore), fish go deeper as it gets colder.

Recommendations:

DeBeers should provide the area and volume of the lake of depressed DO conditions that will be below the CCME guidelines. Identify the duration, zones of impact (e.g., isocontours during late winter) and potential species affected.

With respect to the whole lake, if oxygen levels drop below 5.5 mg/L in any area of the lake, this is an alteration in fish habitat, which must be considered a negative impact. This should also be considered in context to other components of the EA process (as it relates to interactive and additive impacts from other elements of the project), and not just external to the EA process in terms of compensation. Further, the loss should not be evaluated with respect to the entire lake, since the habitat quality and habitat type is not uniform throughout the lake.

2.3 Snap Lake Water Quality - Total Dissolved Solids

DeBeer's Conclusions:

Current baseline data indicate that average total dissolved solids (TDS) of Snap Lake water ranges from about 50 to 70 mg/L. DeBeers also presented analyses of mine inflow; the average TDS used for mine water was 900 mg/L ± 450 mg/L. Modeling (RMA 11) results suggest that after treatment and discharge through the diffuser average TDS over the entire lake will increase to approximately 330 mg/L during mining. DeBeers has indicated that it assessed a potential shift in community structure due to this increased TDS as a negligible consequence because no specific criteria were exceeded.

DeBeers assessed the effects of TDS on lake trout by evaluating their preferred range. According to DeBeers, however, there is no public data on the effects of increased TDS on lake trout. They supported there impact assessment by stating that a number of trout are very capable of going in and out of salt water, that, for example, salmonids are a species very tolerant of saline conditions throughout their life cycle.

Our Rationale / Evidence and Conclusions:

The assessment, which was based on average TDS concentrations, has many shortcomings. The estimate for mine influent (to treatment) is based primarily on groundwater quality data (discussed above in section 1.3) which is not represented by samples from deeper zones where much of the mining will take place in later years. Influent TDS could easily be 1.5X greater than expected from these deeper zones. Also, temporal variations in TDS will occur throughout the lifetime of the mine as a consequence of variations in groundwater and influent chemistry, variations in treatment results leading to variations in effluent chemistry, and seasonal changes in lake circulation (i.e., ice cover presence). Spatial variations in TDS will result from the embayments, arms and deeper waters that have limited circulation with the main lake body. The effect will be greatest during late winter just prior to breakup.

The assessment must consider reasonable estimates of the zones and areas where lake habitat will be exposed to higher (maximum) stresses. Large changes in the levels of TDS may have significant impacts on the resident lake trout populations.

Regarding TDS effects on lake trout, and in the absence of criteria, it does not appear that there was consideration made regarding the sublethal effects of a fivefold increase of TDS. For example, because of their dependence on osmotic stresses, lake trout as a freshwater species may be at a higher risk of change as they can be sensitive to large shifts in salinity. Anadromous salmonids should not be used for comparison purposes (as purported by DeBeers) when evaluating the effect of increased TDS on freshwater lake trout.

Further, there is a concern regarding results of change in TDS and abundance of various major ions. It would have been logical to assess the effects of changes in the community and their resulting interactions with the aquatic community at least on a ecological risk basis.

Recommendation(s):

Effects analysis were conducted with regard to specific criteria only. Because there were no TDS specific criteria for aquatic life, an assessment of these affects should be done following other benchmarks or risk criteria. Additionally, the effects analysis must consider the rate of change and the absolute value of change for both the operating phase and reclamation phase. Certain species, like lake trout, may be subject to sublethal effects. A conservative assessment then would entail some sort of risk analysis for each species, aquatic community and habitat. The risk analysis should be based on reported cases in the literature, or in the absence of relevant references, various sublethal toxicity tests should be considered.

2.4 Snap Lake Water Quality - Chlorine

DeBeer's Conclusions:

The work done to predict maximum average chlorine concentration levels (i.e., 135 mg/L) that would result in the lake from long-term effluent discharge was based in part on the advanced exploration project results. DeBeers claims that the level of activity that would affect results (i.e., yield high chlorine concentrations) was higher than would be expected during full mine operations, and so the predictions are conservative. They are confident in their predictions that the values are likely higher than will occur during operation.

In the case of chlorine, an additional level of conservatism was applied, such that they used the expected value (or mean concentration of their sample set) for the majority of compounds, but conservatively used one standard deviation above the expected level for the chlorine assessment.

Our Rationale / Evidence and Conclusions:

The uncertainty associated with the predicted maximum average chlorine concentration is higher than DeBeers suggests, and the predicted value is too close to the aquatic life benchmark (cited for British Columbia) of 150 mg/L to be considered conservative. The value assumed for the modeling was based on water samples collected from the mine workings, which terminated around a depth of 160m. It is well established that TDS and chlorine concentrations increase with depth due to the nature of connate water in low flow groundwater conditions. Data from the North Lakes study agree with this trend. The chlorine values used in the model are not representative of mine inflows when the mine is deeper, and as a result, effluent disharges will have higher chlorine concentrations than DeBeers has assumed. Thus, it is possible that the average chlorine concentration will exceed the BC guideline. Further, because of poor circulation during ice cover and limited circulation in embayments and arms, chlorine concentrations will not be uniform throughout the lake during late winter. Even in the best scenario, certain areas at specific times may show exceedances.

Recommendation(s):

As part of further hydrogeologic and groundwater quality characterization, continue to collect and analyze water samples that are truly representative of the deeper zones to be mined.

Consider modeling assuming higher values of chlorine in the effluent.

Reassess impacts based on all the potential spatial (i.e., non-uniformity of lake habitat) and temporal (i.e., seasonal and long-term) variations.

2.5 Snap Lake Water Quality – Concerns Related to Nutrients

We have concerns that the thermal differences or increases in food associated with the mixing zone (i.e., near the diffuser) may act as fish attractants causing vulnerabilities. These attractive nuisances may also have long-term repercussions or dependability on warmer effluent. For example, what happens to the aquatic community (especially temperature sensitive species like lake trout) when effluent discharge is terminated?

There was no quantitative assessment of the changes in relation to nutrient addition.

It is unclear how the amount of nutrient release from sediments was considered in the algal modeling. DeBeers conclusions regarding phosphorus seem counterintuitive for Snap Lake, which is phosphorus limited. It appears to make more sense that with an increase of algal biomass to sediments, an increase in release of nutrients from sediments (i.e., phosphorus) would occur.

Recommendation(s):

At this time, we have not developed specific recommendations for our concerns but may provide them at the hearings.

2.6 Snap Lake Water Quality - Effluent Discharge and Total Loadings to Snap Lake

DeBeer's Conclusions:

DeBeers used only the "expected" flows determined from the groundwater modeling for input to the CORMIX and RMA 11modeling to estimate effluent flows and effluent concentrations. They also suggested that if mine inflows were higher, constituent loading and flows would not be directly related. They contend that as flow rates into the mine increase, a larger and larger proportion of the inflow would be expected to emanate from the overlying Snap Lake (which has lower ionic concentrations than groundwater). Because the majority of mass (ie. metals) comes from groundwater, with proportional increase in inflows, the proportion of loading would be smaller due to the increase in volumes.

DeBeers considers that they have been conservative in assuming minewater discharge concentrations, and so believe that the potential effects have been addressed for project, and the current model is effective.

The CORMIX model was used to calculate the area around the diffuser (with a 230 m radius) where the maximum concentrations would exceed site-specific benchmarks at any time during the life of the mine. This radius around the diffuser was estimated to be approximately 1% of the entire lake. Based on this relatively small area, DeBeers is confident that impacts to aquatic organisms within the lake would be negligible. According to DeBeers, for most substances, the impacts would be significantly lower than 1% (eg. cadmium). For the purposes of the EA, they assumed that treatment would reduce TSS and metals accordingly. As a result, DeBeers did not look beyond the level of treatment proposed, as they considered that effects did not warrant it.

Our Conclusions:

As stated in section 1.1, the mine inflow volumes and rates were estimated by the groundwater model, which has a high degree of uncertainty. Modeling only the expected values does not seem justified for assessing potential environmental impacts. It is possible that the inflows and loadings will be substantially higher than expected.

Also, there is not an immediate one-to one relation between increased flow and reduced concentration. The hydraulic connection between Snap Lake and the underlying workings is not immediate; there will be a lag time between when increased flows are first "felt" due to hydraulic stresses and when water will migrate from Snap Lake to the workings. The assumption that the water will arrive with increased dissolution is also not well-founded. There will be chemical gradients within fracture porosity that could result in increased concentration with downward flow. Also, at the working face, discharging water will contact fine particles which will contribute to dissolution (and some particles may be small enough to pass through filters).

Recommendations:

Provide a quantitative assessment of how a range in expected flows with a range in constituent concentrations will effect effluent concentrations. The answers provided to date have been primarily qualitative, but a more quantitative evaluation is needed to assess impacts. Currently, there is no quantitative argument to demonstrate what the impacts of increases in flows would be, and there is too much uncertainty in what the influent chemistry will be.

The opportunity and efficiency of reducing impacts should be further evaluated. For example, water treatment in combination with controlled releases may be able to reduce the 230 m mixing zone and reduce the rate and amount of long-term increases in ionic constituents.

2.7 Snap Lake Water Quality - Plume in Snap Lake

DeBeer's Conclusions:

According to DeBeers, the RMA 11 model can predict the areas of impact.....: % area shown on map represents an actual modeled area predicted by the RMA model. Circulation in Snap Lake is accounted for. A discharge turbulent condition pulls in water from the surrounding area and equilibrates TDS levels between discharge and ambient water. In open water, there is enough turbulence in water column to maintain this mixing. In winter, due to ice cover, mixing is somewhat different. The density difference is small and there will be initial mixing under ice (only initial mixing was accounted for), but as discharge moves away settling will occur and will cause slightly higher TDS levels (in open water) moving down and away from the discharge area.

DeBeers used a three-step process in their assessment to evaluate the scale of impacts:

1. If the parameter concentration was below guideline, then no further assessment was needed.
2. If the parameter concentration effluent was exceeded, then determine what it would be at mixing zone boundary; if then below the guideline, no further assessment.
3. If exceeded guideline at mixing zone boundary, further assessed of impacts was necessary.

Our Rationale / Evidence and Conclusions:

Because of the relatively shallow depth of Snap Lake and the resultant mixing of shallow and deep waters, the two-dimensional RMA 11 model satisfactorily simulates summer conditions in the majority of the lake, but the model may not be appropriate to simulate conditions during winter with ice cover. It is apparent that during winter there will be a higher concentration of TDS moving along the deeper areas of the lake. Thus, there are uncertainties with the modeling used to predict effects.

Because of the north arm of Snap Lake's relatively narrow geometry and limited ability to circulate with the main body of Snap Lake, it is not apparent how the north arm was modeled effectively, especially during winter conditions. It would have seemed more appropriate to exclude the north arm from modeling circulation during this time (and in effect reduce the lake volume available for dilution).

DeBeers three-step process for evaluating impacts does not consider the potential long-term chronic effects to organisms, nor the potential interactive effects from various constituents. These issues are more completely dealt with and recommendations are provided in section 3._

3.0 AQUATIC RESOURCES

3.1 Aquatic Resources - Baseline

DeBeer's Conclusions:

DeBeers strategy for baseline data collection was based on a step by step process. First, they evaluated available information to provide an overview of the biophysical conditions. Once that was completed, they identified the area (e.g., lake or stream) with potential for effect, and then identified what detailed information (i.e., variables to be measured) was needed to define a monitoring program to identify the change. They could then design baseline and monitoring programs that could measure and monitor that change through time.

DeBeers established criteria specific to fish-bearing ecosystems (i.e. runoff and nutrient supply), and also evaluated water quality, and potential pathways for change (sediment release, air deposition, dust etc.). Where they did not collect baseline data, they made assumptions about the presence of organisms based on habitat. For example, in S-27, they assumed that there were fish present and they evaluated the potential effects at the ecosystem level based on all the potential pathways for changes that could affect the aquatic ecosystem.

Further, with other smaller water bodies that were assumed to not have fish, they were understood to provide a food supply. Within their ecosystem perspective, they examined the size of sub-basins (amount of interception) and also determined whether the watershed was isolated, or how much of the Snap Lake watershed area was impacted.

Our Rationale / Evidence and Conclusions:

In essence, it appears that DeBeers predetermined where the impacts were going to be when determining where to collect baseline data.

With respect to DeBeers' strategy for baseline data collection and their ability to evaluate changes over time, it seems more relevant that if baseline data (i.e, zooplankton etc.) have not been collected and evaluated, then there will be no benchmark to measure the changes that could occur in these areas (i.e., water bodies). In general, if baseline data have not been collected from a particular area or a certain type of baseline data has not been collected (i.e., collected water quality data only but no zooplankton data), then one cannot determine or assess whether an impact has occurred. One may be able to guess about the impacts based on assumptions that fish or food supply was present, but the change will not be measurable or quantifiable.

As part of the rationale for characterizing biological or physical processes, all relevant baseline data must be collected. One cannot assume that all the impacts are known. A control point must be established first to assess the hypothesis. More aggressive data collecting in areas of obvious impact, potential areas of impact, and in areas of no impact is necessary to determine impacts and develop a sound monitoring program.

Recommendation(s):

DeBeers baseline strategy resulted in insufficient amount of baseline data. The insufficiency can be rectified by collecting additional data (and all relevant types of data) in all potentially affected water bodies, as well as from water bodies where no effects are expected (i.e., establish control stations prior to development activities). If this was already done, the uncertainty in the impacts assessment would have been reduced. At this point, the additional information will prove invaluable for developing effective Surveillance Network and Aquatic Effects Monitoring Programs. There is, however, a negative consequence of DeBeers baseline data collection strategy. True representation of baseline conditions may now be compromised, as activities in the Snap Lake area have already begun.

3.2 Aquatic Resources – Impacts to Aquatic Community

DeBeer's Conclusions:

De Beers stated that effects up to 20% of the aquatic community would not adversely affect aquatic ecosystem function, and references (Suter, et al, 1995) to support their assumption. De Beers also references Bruce and Versteeg (1992) to assert that a 20% effect on a population will have little overall impact relative to natural variability in community and population structure and function.

DeBeers considers that they defined effects based on species and area of effect and then brought it to another level of conservatism. They used the HC20 and then assumed that higher magnified effects would have to be over 20% of lake. Then they reduced the portion to 1% that could be affected. In this way they were trying to make sure that their assumptions were protective of organisms and that ultimately provided for a high degree of confidence in their effects assessment (e.g., assignment of negligible or low consequence).

Our Conclusions:

With respect to DeBeers's first assumption, the basis for Suter's 20% threshold is not ground-truthed in northern ecosystems, which do not necessarily have comparable ecosystem dynamics (i.e., diversity, abundance, etc.). The 20% threshold actually refers to a species or a community. Once 20% of the species is destroyed there is a concern. Thus, DeBeers reduced this benchmark for assessment to only 1% to be conservative, but instead focused on populations and lake areas. There is a big difference between % of species affected and % of area.

With respect to DeBeers' second assumption effects, it is not necessarily logical to leap from a 20% threshold in populations (in this case *Ceriodaphnia dubia* is the most sensitive species) and apply the same threshold to ecosystems, especially when ecosystems lack diversity and are less robust to change (i.e., as with northern ecosystems). Finally, De Beers' claim that organisms will flow in and out of an ecological system and have niche overlap may not be valid for northern environments where there is a limited diversity and species abundance.

The current assessment is flawed primarily because the analysis treats the lake as uniform with respect to fish and aquatic habitat. For example, the north arm of the lake has lower fish habitat value. On the other hand, certain portions of the lake may be disproportionately crucial to fish habitat. By considering the lake uniform, sensitive habitats are not explicitly considered.

Similarly, with respect to lake circulation and water quality, the assessment also considers the lake to be fully mixed. Since species diversity is typically exhibited by very small zones in lake ecosystems, this assumption cannot be valid.

Rationale / Evidence:

The impacts assessment is based on the assumption of the 20% threshold, which may not be applicable for RSA and in subarctic, in general. DeBeers has claimed conservatism by reducing their benchmark to 1%, but the level of conservatism is not substantiated for northern lake ecosystems. A more robust analysis is needed to reduce uncertainty in assessing impacts.

Many studies in other lake systems have demonstrated otherwise. Are there data to support the uniformity of distribution of this species in this lake which would then be supportive of the 20% threshold. The overall impact rating consideration of 'spatial scale' is not supported well (see second sentence of this response). It is akin to a mixing zone in a lake. The response regarding magnitude of effects is not comforting. The toxicity data referenced for *Ceriodaphnia* appear to come from literature values, so it is unclear if the tests conducted were relevant to the site conditions. Their response suggests that chronic toxicity is not considered "lethal", when in fact the difference between acute and chronic is principally temporal – not an effects qualifier per se.

Recommendation(s):

Regarding the assumption of uniformity of habitat, effects should not be evaluated with respect to total lake area. Relative zones of aquatic habitat quality within the lake should be identified and defined based on measurable indicators. Then the assessment should examine how both specific impacts and combinations of impacts might affect each zone type. In essence this requires recognition of spatial heterogeneity of the lake before proceeding with the impact analysis. For example, answer the following types of questions: How are lake shorelines affected? How is overwintering habitat affected? Are there certain zones that will be affected greater (i.e., deeper portions of lake close to diffuser) or lessor (i.e., effluent discharge during ice cover may not have great affect on north arm because of limited circulation) than others? The potential impact is then evaluated with respect to magnitude, duration, frequency, etc as outlined in EA. This procedure will address how specific impacts might effect the higher quality habitat and thus reduce the uncertainty in assessing impacts.

3.3 Aquatic Resources - Additive and Synergistic Effects of Mining Operations on Snap Lake Water Quality and Aquatic Resources

DeBeer's Conclusion:

According to DeBeers, they have not systematically evaluated all potential interactive effects of the project, but focused their assessments on areas where there was geographical overlap, and where there were measurable effects (i.e., specific criteria were exceeded). Their approach throughout the environmental assessment process, was to look for measurable pathways (i.e., linkages between an organism and then an exceedance of a particular criteria) and then assess the impact of this exceedance. In the absence of criteria, they indicated that they used an ecosystem approach. For example, for small lakes with no baseline data on fish, they assumed that fish were present and then evaluated the potential effects at the ecosystem level based on all the potential pathways for changes that could affect the aquatic ecosystem.

They considered this methodology also to be sufficient in evaluating cumulative effects. During the technical sessions, DeBeers apparently attributed some of the difficulty in assessing interactive and cumulative effects to the belief that the methodologies for these levels of assessment is a developing science, and that not everything is measurable. They did not want to go beyond the mandate of the EA, which according to the MVEIRB and the Terms of Reference, recognizes the CEAA's Cumulative Effects Assessment Practitioners Guide as protocol. However, there is no set guideline for conducting an environmental assessment (primarily because the range and types of assessments is too broad), but the CEA Act (June 23, 1992) mandates that the proponents and overseeing governments must ensure that any project that is to be carried out in Canada or on federal lands does not cause significant adverse environmental effects.

Further, it also appears that during the Technical Sessions, it was not clear on how the MVEIRB or DeBeers classified interactive effects within the Terms of Reference for the EA. The conclusion at the sessions that was stated was that assessment of interactive effects within the project were not explicitly mandated by the board in the EA Terms of Reference. In general, the board has adopted the CEA guide for cumulative effects assessment. The EA Terms of Reference and the CEA guide are the two documents that provide direction for the cumulative effects assessment for the Snap Lake EA.

Our Conclusion:

It is apparent that DeBeers has not addressed the issue of interactive effects of multiple stressors of the mine development itself. It is unclear how the MVEIRB views this.

Notwithstanding outstanding issues with the cumulative effects assessment, interactive effects are an integral component of any environmental impacts assessment process, whether the need for them is stated explicitly or not. All environmental assessments should be taken to at least that level. One might consider the impacts where there are obvious interactive effects from, for example, developing a recreational centre on the shore of a pristine lake. This centre might consist of a boat ramp, a marina, a swimming area, a fishing area and have eating/lodging facilities. Over time the interactive effects are obvious: certainly swimmers will have to avoid heavy boat use areas, which pose as deterrents to fish activity. The fish population would in turn might be reduce because of degraded water quality. The reduced fish abundance might result in decreased use of water by the indigenous predators (e.g., bear), while the exogenous rodent population has soared attracting different predators (e.g., coyote).

In this case, without evaluating the interactive effects, one might have concluded that because the marina was small in comparison to the lake, and there were no expected exceedances of any criteria, the overall impacts would be negligible. The linkage process results in a partitioning of the project components and by consequence ignores the potential additive and synergistic effects of the various individual components of the project. In this case, the Snap Lake project is composed of many independent elements and some of these elements have complex characteristics so that all the interactive components may not be obvious. They are still present, though, and need to be evaluated.

Rationale / Evidence:

It appears that there were two levels of assessment in the EA, project and cumulative. DeBeers has apparently interpreted this to mean local assessment and regional assessment, respectively. The project in itself has many elements of which there are interactive effects. It is implicit that any environmental assessment evaluate all aspects of the project, and interactions of project elements. Further, it is also implicit that an environmental assessment be conducted at the ecosystem level as well as the individual component level. None of this is strictly part of a cumulative effects assessment, but could be construed based on the interpretation of the character of the project (i.e., is the project one-dimensional or multi-dimensional). The proposed Snap Lake Diamond Mine is a development (i.e., multi-dimensional) with for example (but not limited to), waste rock piles, processed kimberlite, runoff collection ponds, roads, facility buildings, waste management facilities, water collection ditches and treatment ponds commingling multiple water from various sources, water treatment facilities, and effluent discharge through a diffuser.

There is a major concern about the process in which DeBeers has assessed impacts by partitioning the assessments of various issues or disciplines (i.e., the linkage process). This partitioning loses site of the whole and potential interactive, additive and synergistic effects between individual or combinations of individual components, and in particular those that have been described as negligible or low environmental consequence (in some cases with relatively high uncertainty). DeBeers concludes this based on the assumption that they can ascribe with a reasonable amount of certainty that they know enough about maintaining ecological "health" of Snap Lake aquatic resources. These changes or impacts to the aquatic community of many and include (to name a few, or not limited to):

- A fivefold increase in average concentration of total dissolved solids
- A large increase in average chloride concentration
- Similar increases in various cations (e.g., metals)
- Release of metals previously not in lake
- The potential release of ARD from North Pile seepage
- An increase in nutrient levels with associated change in algal productivity
- An increase in the TN/TP ratio (25:1 to 1000:1)
- Overall reduced dissolved oxygen levels throughout lake during winter
- Depressed (below aquatic life criteria) dissolved oxygen zones during winter
- A potential loss of fish abundance or change in various species abundance
- Loss of existing habitat associated with the diffuser and dilution zone
- Reduced quality of deeper zones for over-wintering habitat
- Possible attractive nuisance of warmer effluent near the diffuser
- Loss of lakes flowing to Snap Lake
- Loss of food supply to Snap Lake by destruction of tributary lakes/streams

- Overall total change in water quality characteristics

These all lead to a change in the overall aquatic ecosystem (i.e., possible shifts in photoplankton and zooplankton community structure), and the results of this affect the terrestrial and aviary communities, a natural product of the interdependence of aquatic and terrestrial ecosystems.

It appears that DeBeers is arguing that because all of these changes are happening on a "large" lake – the ecosystem resilience (or internal buffers to change) is high or strong enough to maintain itself. This approach fails to recognize and assign a relative importance to the fact that the overall ecosystem characteristics and function will substantially change. This is a significant environmental effect. In order to not consider the effect adverse or not, DeBeers must first demonstrate that any potential beneficial effects of these changes (e.g., perhaps the increased productivity and change in community structure can be considered positive effects if sensitive species are not extirpated) outweigh the obvious negative effects.

As another example where the linkage determination and impact analysis is in question, consider the potential impact on fish abundance. Within the EA, Key Question – F4 (page 9-369): What Impacts Will the Snap Lake Project Have on Fish Abundance? In this case, the analysis is directly related (or linked) to two previous analyses regarding fish health and fish habitat. Since DeBeers concluded that a negligible magnitude of impacts were predicted for all potential pathways linked to fish health and fish habitat in Snap Lake, they reasoned that the linkage to fish abundance was invalid and therefore there was no impact. There are two assumptions here, the first one assumes that they have correctly evaluated the magnitude of impacts to fish health and fish habitat and secondly the magnitude of interactive impacts is also negligible.

From a practical perspective, a significant change in fish abundance is perhaps the most important end result. An analysis of this potential effect must be conducted independently of all previous chain of assumptions, interpretations and conclusions. A complete and inclusive analysis for prediction of the impact must be conducted. This would include the additive and synergistic effects of all the physical and ecological changes from the Project (even ones considered to have singularly small but still measurable changes). Rather than looking at all of the potential impacts and attempting to determine a resulting impact on fish populations, the analysis presented by DeBeers is the opposite. It appears that the direction proposed by DeBeers is to eliminate all of the small or "negligible impacts" from the analysis. Worse yet, it appears that overall fish abundance changes are only considered if two or more individual impacts are present. This makes no sense from a biological or practical perspective.

During the technical sessions, YDFN elders recognized the need to address interactive effects and cumulative effects. With respect to the additive effects (from cumulative and interactive components) of the project(s) on Snap Lake – the elders are concerned that the localized cumulative effects (eg. effects on animals that eat fish) are not being considered. Further, if the water became "contaminated," they know that trappers will avoid these areas because the animals also know not to go there.

Recommendation(s):

Evaluate the interactive effects by examining the ecosystem as a whole, and quantitatively define what the the levels of changes are. Evaluate stressors at all levels, and determine whether an individual, species, community and habitat can experience these overall changes and rate of change without negative sublethal as well as lethal effects. For example, in the absence of specific criteria, determine the impacts to lake trout if they were subjected to all of the changed conditions listed above. Conduct a review of relevant documents that have evaluated these types of threshold effects (at both lethal and sublethal levels) to support conclusions. Evaluate all possible changes in the lake simultaneously at the individual, species, community and habitat level.

Determine long-term dependence of the aquatic community to these artificial changes and evaluate what would happen when effluent discharge is terminated. For example, answer the following types of questions. Will there be a massive fish die off because the fish slowly acclimated to an environment which is no longer sustained? Or will the change back to baseline be slow? Will the lake fully recover to predevelopment conditions? What will the resultant community be like? Will terrestrial wildlife become dependent on a more productive aquatic environment, which will create an attractive nuisance to the area?

Further, provide a practical and scientific based approach to predict changes in, for example, fish, phytoplankton and zooplanton populations. From these results, reassess residual impacts and corresponding mitigation.

4.0 TERRESTRIAL WILDLIFE

Our Concerns:

The main issue is the lack of confidence in predicting impacts to caribou, grizzly bears, wolverines, and possibly raptors due to a lack of baseline data. This also applies to cumulative effects: if the individual components of an ecosystem are not well understood, it is not possible to make reliable estimates of how an entire network of living organisms and their habitats will be affected. On the other hand, even if the major components have been well studied, it is important not to study them in isolation, but to consider them in relation to their interactions with other species and the environment they inhabit. This would also require taking into account the effects of other projects, particularly species with large home ranges.

It appears that De Beers has been taking a reactive or passive approach rather than a pro-active approach, at least with regard to collecting baseline data on terrestrial wildlife, and in terms of cooperating with knowledgeable sources to improve the reliability of their impact predictions. It also remains questionable as to whether it is the responsibility of GNWT or De Beers to develop more practical and sensitive methods for determining the relative abundance of wolverines in the project area, or to further develop baseline information for caribou.

Caribou: RWED stated on day five of the November 2002 Technical Sessions in Yellowknife that they did not agree with De Beers' confidence levels regarding environmental consequences caribou, noting that De Beers had not used existing baseline information (e.g., collar information) to its full capacity. RWED further noted that they would be glad to work with De Beers to include appropriate information and to share models.

Grizzly Bears: De Beers has noted that the sampling design for more elusive species with larger home ranges must rely on long-term data, and that baseline data on grizzly bears, wolverines and raptors has continued to be collected in 2001 and 2002. In the day-five Technical Session, they further noted that they had produced a report for monitoring in 2001 (submitted to RWED) though it has not been circulated as of yet – it will be placed on public registry and the same will be done for the 2002 report.

Wolverines:

It remains questionable whether two 100-km transects, conducted in April of 1999 and 2000, can produce reliable estimates of wolverine distribution and abundance in the project area. De Beers noted that it has continued to collect baseline data on wolverines in 2001 and 2002, but it is not know if the same methodology was used. If the baseline data is lacking, or if methodologies are not sound, impacts cannot be reliably predicted.

Recommendations

It is recommended that De Beers take greater initiative and approach the appropriate authorities (e.g., RWED for caribou, grizzly bears, wolverines) in order to ensure that their impact models are as robust as possible, rather than sitting back and waiting for the experts and specialists to approach them. It is also important that they are perceived to be doing so, not only by the review agencies, but by the public as well.

5.0 GEOTECHNICAL ISSUES - Concerns

Due to time constraints and for brevity, we have listed specific geotechnical concerns, but in general do not consider these major issues. The concerns can most likely be dealt with during the licensing stage.

North Pile Seepage:

It is unclear what the thermal conditions of the north pile will be, and whether or not major unfrozen zones could contribute to ARD problems.

There is a concern regarding the estimate of anticipated seasonal and annual seepage that might occur from the North Pile, and whether there are sufficient contingencies developed at this time to prevent discharges to Snap Lake.

It is not clear what the relevant concentrations of ARD-related constituents within the seepage would be due to an unspecified cryoconcentration effects.

We are not convinced that ditch efficiency will be as high as 90%, and that they will work effectively throughout the seasonal changes.

If the pile is not kept frozen, it is unclear how much water would be need to be managed.

North Pile Thermal Conditions

The temperature database used in the modeling for the North Pile may not be appropriate. There is a concern that long-term climate warming effects will adversely effect conditions within the pile and yield high rates of seepage during post-closure times.

The issue of cryoconcentration is one that is not completely resolved because rate of salt rejection from ice layers depends on freezing rate. At the moment the freezing rates of the pile are not understood sufficiently for analysis. Contingencies have not been developed to handle the unpredictable consequences of changes to seepage water quality (i.e., an accurate prediction of water quality emanating from the pile is dependent on accurately estimating the amount of cryoconcentration). This is more of a concern if the pile will not be frozen.

The rate of freezing of the North Pile is not well understood. At this time, a reliable estimate of seepage from the pile cannot be made, nor can an estimate be made of the potential release of water to Snap Lake (because ditch design and contingencies for design are not known).

PK Moisture Volume

The volume of natural water content within the paste will remain saturated in the paste once the material is free draining. It is unclear where the water will go if it drains.

North Pile Ditch Efficiency

We have concerns with that the ditch efficiency is optimistically high at 90% efficiency. Ditch efficiency is a function of dimensions, rock-type, fracture density, ice wedge density and seasonal changes in surface moisture conditions, to name a few. It is unclear how the 90% efficiency was estimated, and that this efficiency would likely vary spatially and temporally.

It is unclear how much seepage could ultimately bypass the ditch and enter Snap Lake. Contingencies for this scenario should be better developed.