SENES Consultants Limited

1275 West 6th Avenue
Suite 300
Vancouver, BC
Canada V6H 1A6

Tel: (604) 685-1612
Fax: (604) 685-2327
E-mail: senes@senesbc.ca
Web Site: http://www.senes.ca

38115

16 April 2004

Independent Environmental Monitoring Agency
5004 Franklin Avenue
YK, NWT X1A 2N8

Attention: Carole Mills, Manager

Re: Peer Review of Proposed Update to EKATI Mine's Air Dispersion Modelling Assessment

Dear Ms. Mills:

As requested, I have reviewed the proposed methodology for updating the EKATI mine's air dispersion modelling assessment as described by Rescan Environmental Services Limited in the letter to BHP Billiton Diamonds Inc. (BHPB) dated 5 February 2004. This review has been prepared taking into consideration the recommendations for the EKATI mine's air quality management and monitoring plan submitted by IEMA to BHPB in a letter dated 2 July 2003. Specifically, the IEMA recommended that BHPB:

> *"Conduct new air dispersion modelling using updated data on air emissions, adjusting the boundary of mining activities to a more ecologically appropriate zone, and employing a more recent dispersion model that can incorporate particulate deposition."*

My comments on the individual issues in the proposed modelling methodology follow the same order as presented by Rescan.

Model Selection

After considering three possible models (ISC3, AERMOD and CALPUFF), Rescan concluded that the ISC3 model was the preferred model to be used for the EKATI mine assessment. Rescan rejected the AERMOD model because the U.S. Environmental Protection Agency (U.S. EPA) has deferred the decision to replace the ISC3 model as the primary regulatory model for most applications until a future date. The U.S. EPA's deferral for adopting the AERMOD model for regulatory applications is based on continued difficulties in demonstrating the model's capabilities as compared with ISC3 and CALPUFF. Nevertheless, it should be noted that the U.S. EPA released a revised version of AERMOD on March 19, 2004. The revision includes improvements to the wet deposition algorithm in the model.

Rescan's rationale for rejecting the CALPUFF model appears to be based on the fact that the U.S. EPA has approved use of the model for short range applications (<50 km) in those situations where complex terrain or wind flows are a significant factor. However, it should be obvious that if the CALPUFF model can handle complex air flow patterns at short distances, then it can also model dispersion for simple transport situations as well. Indeed, SENES and many other consulting companies have used the CALPUFF model in simple terrain situations for numerous regulatory applications in both Canada and the United States. Therefore, in my opinion, Rescan's reason for choosing the ISC3 model as the preferred model over the CALPUFF model is not valid.

Based on past experience, both the CALPUFF and the ISCST3 models are suitable for application in this kind of assessment. In addition, both models have been successfully validated and applied by SENES in a wide variety of applications, including applications similar to the present one. However, there are specific capabilities in the CALPUFF model that may make it more appropriate to use this model instead of ISC3 which Rescan has not taken into consideration in making its choice in favour of ISC3.

The primary reasons for using the ISC3 model are:

1. ISC3 has an open pit algorithm that is suitable for estimating emissions from mining operations. The algorithm accounts for re-circulation of airflow within the pit cavity which reduces the quantity of pollutants emitted above the mine pit rim.
2. ISC3 is a simpler model and easier to use than CALPUFF, especially for a modeller who is unfamiliar with the CALPUFF model. There is a long learning curve to running the CALPUFF model, and an inexperienced modeller is more likely to make a mistake running the CALPUFF model than in running the ISC3 model.

By comparison, the CALPUFF model has the following advantages:

1. The meteorological processor CALMET can use regional scale 3-dimensional meteorological data from prognostic meteorological models in data-sparse areas.

Although there is a meteorological station near the mine for obtaining surface data, there is very little information on upper air data in this region. However, as an alternative, upper air data could also be derived from a sophisticated meteorological model called Eta which is capable of representing large-scale 3-dimensional regional air flow in the region of the EKATI mine. The Eta model is run operationally at the National Center for Environmental Prediction (NCEP) in Boulder, Colorado, and the model's large scale (40 km) fields are available for purchase. This resolution would be sufficient for obtaining upper air data for use in the CALPUFF model.

2. CALPUFF can handle time-varying emission inputs to more accurately simulate source activity for intermittent emission sources. Whereas the ISC3 model accepts only one emission rate for each source in each model run, a different emission rate can be specified for each hour of the day in the CALPUFF model. For sources whose emissions vary over the course of the day, the input to the ISC3 model must either reflect the maximum hourly emission rate, or the average hourly emission rate, assuming that the total daily emissions are evenly distributed over all hours of the day. The first approach leads to overestimating 24-hour average concentrations, while the second approach underestimates short-term hourly averaged concentrations. The question for the proposed modelling of the EKATI mine operations is to what extent are the emissions from mine operations constant, intermittent or a mixture of some constant and some intermittent sources? If a substantial portion of the emissions at the mine come from time-varying emission sources, it will be easier to achieve a more accurate representation of emissions using the CALPUFF model than using ISC3.

3. The effects of an open pit on limiting emissions above the pit rim can be simulated in CALPUFF by incorporating the pit contours into the digital terrain data inputs to CALPUFF. While this would take more work than using the ISC3 open pit algorithm, it should not be viewed as a limitation of the CALPUFF model.

4. Line sources such as roads can be effectively modelled in CALPUFF using the buoyant line source algorithm, so long an adjustment for initial mixing is made to a long area source. The same type of adjustment must also be made when modelling emissions from roadways using the line source algorithm in ISC3.

5. CALPUFF is designed to model pollutant dispersion under very low wind speeds (<1 m/s) and for diffusion under stagnation conditions (<0.5 m/s), whereas ISC3 must assume minimum wind speeds of 1 m/s. Thus, CALPUFF is better suited than ISC3 to estimating emission impacts during periods of extremely stable conditions in winter.

6. CALPUFF is suitable for modelling sulphate (SO_4) and nitrate (NO_3) formation from emissions of SO_2 and NO_x, as well as subsequent SO_4 and NO_3 deposition over long range transport distances (e.g., 50-500 km). However, significant (20-30%) underestimation of SO_4 deposition rates have been reported. Comments made by attendees to the 7th conference on air quality modelling in June 2000 noted that the chemical transformation algorithms in CALPUFF are out of date (i.e., the model underpredicts sulphate formation), and that the aqueous phase chemistry algorithms that have been recently installed in the model code are too new and untested to be trusted for applications involving air quality related values (AQRV). While these limitations are acknowledged by the U.S. EPA, the latter agency has concluded that these limitations do not preclude the U.S. EPA from recommending the use of CALPUFF for long range transport assessments of Prevention of Significant Deterioration (PSD) increment consumption in Class I areas. By comparison, the ISC3 model has no capability to model sulphate and nitrate formation.

While either model could be used in the present application for the EKATI mine, the CALPUFF model has some distinct advantages over ISC3 that should not be discounted. Of the advantages listed above, the primary ones would relate to the ability to incorporate regional scale upper air data, to better simulate time-varying emission sources, to simulate sulphate and nitrate deposition, and to simulate dispersion under very low wind speeds. In comparisons between ISC3 and CALPUFF, it has been reported[1] that the CALPUFF model predicts higher concentrations than ISC3 for stack emissions in non-steady-state atmospheric conditions, with greater differences for higher stacks. On the other hand, CALPUFF was reported by the U.S. EPA to generally predict lower concentrations for area source emissions, and SENES has confirmed this observation in modelling assessments that we have completed comparing results for the two models.

Consequently, the choice of which model should be the preferred model for use at the EKATI mine is not quite as simple as was presented by Rescan in their proposed methodology. Different results can be expected, depending on which model is chosen. Although Rescan is correct in stating that some parts of the ISC3 model were last updated in 2002, the fact remains that the fundamental dispersion equations within ISC3 are based on our understanding of atmospheric physics in the 1970's. The ISC3 model would already have been replaced by AERMOD were it not for the continuing problems encountered in completing development of AERMOD. The CALPUFF model incorporates more up-to-date science on dispersion than ISC3. In my opinion, this fact, plus a number of the advantages listed above, should be factored

---

[1] U.S. Environmental Protection Agency 1998. *A Comparison of CALPUFF with ISC3.* Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-454/R-98-020.

into any final decision on the proposed modelling methodology for the EKATI mine. Overall, I believe that the CALPUFF model would be a better choice for this assessment.

Meteorological Data

The meteorological data to be used will, in part, be determined by the ultimate choice of which dispersion model to use. For the purposes of this review, I will mostly comment on the information provided by Rescan which is relevant to its proposed use of the ISC3 model.

First of all, I should also like to draw attention to the lack of any descriptive information about the siting and exposure of the Koala meteorological station in both Rescan's proposed methodology and in the previous dispersion modelling analysis conducted in 1995. From the information provided to me to date, I cannot even tell where the station is located relative to the mine pit or camp. I drew attention to the lack of this information in my review of the proposed Air Quality Management and Monitoring Plan in 2003. Specifically, I recommended that: *"As a quality assurance check for the Koala meteorological station, BHPB should provide a description (or pictures) of the station and the surrounding terrain. This is needed to ensure that the data collected at this station are valid for any future dispersion modelling studies that might be required."*

In addition to a description of the location and exposure of the meteorological instruments, BHPB should provide a description of the instrumentation being used, the data recording protocols, and a history of maintenance and calibration procedures to ensure that the station has been properly maintained and operated.

Rescan proposes to use one year of meteorological data from the Koala meteorological station which has been in operation since 1993. The rationale for using the 2003 data set is that this is the most complete year of data collected at the site. The "regulatory completeness" requirement is 90% (i.e., if there is more than 10% missing data, it cannot be used for regulatory modelling). The following rules define "regulatory completeness":

- Lost data due to calibrations or other quality assurance procedures is considered missing data.
- A variable is not missing if data from a backup, collocated sensor is available.
- Site-specific measurements for use in stability classification are considered equivalent such that the 90% requirement applies to stability and not to the measurements (e.g. σ_E and σ_A) used for estimating stability.

- The 90% requirement applies on a monthly basis such that 12 consecutive months with 90% recovery are required for an acceptable one-year data base.
- The 90% requirement applies to each of the variables wind direction, wind speed, stability, and temperature and to the joint recovery of wind direction, wind speed, and stability.
- The 90% requirement for temperature may be relaxed to 80% if justification is provided demonstrating that critical concentration estimates are not affected by the uncertainty in any ambient temperature estimate.

From the data presented by Rescan in Table 1 of their proposed methodology, two additional years of data (1996 and 2002) meet the nominal requirement for regulatory completeness in that they have over 90% data recovery. However, all three years of data (1996, 2002 and 2003) would first have to be evaluated using the U.S. EPA's Meteorological Processor for Regulatory Models (MPRM) in order to determine whether **any** of the three years meet all of the requirements for regulatory completeness listed above. Furthermore, the percent availability of the data listed by Rescan is based on calendar years. Depending on when the data gaps occur in any given year, it may be feasible to select portions of the data records which include 12 consecutive months of good quality data (e.g. June-to-June or August-to-August). If more than one year of data can be obtained in this way, then the modelling analysis should be conducted for more than one year of meteorological data in order to incorporate year-to-year variability in meteorological variables. Although one year of meteorological data is considered a minimum requirement for regulatory modelling purposes, it is also recognized that up to five years of data is preferable if that data is available. On the other hand, if the dispersion modelling is conducted using the CALPUFF model, with regional scale upper air data derived from the Eta model, it may not be feasible to run the model for more than one year of meteorological data.

With respect to mixing heights, Rescan has proposed using the same mixing heights that were used for the 1995 dispersion modelling analysis. These are listed in Table 2 of Rescan's proposed methodology. The mixing heights were calculated based on published data from regional meteorological stations at Baker Lake, Normal Wells, Fort Smith and Coppermine using the Holzworth method. If the simple ISC3 modelling approach continues to be used, there is new reference document for mixing heights that should be used instead of the study by Portelli (1977)[2]. It is "*A Mixing Height Climatology for North America (1987-1991)*" prepared for Environment Canada, Alberta Environment and the Ontario Ministry of the Environment by SENES Consultants Limited in March 1997. This document gives both the morning minimum and the afternoon maximum mixing heights by month for all of North America. The report also

---

[2] Portelli, R.V. 1977. *Mixing Heights, Wind Speeds and Ventilation Coefficients for Canada (Climatological Studies No. 31).* Report prepared for Fisheries and Environment Canada, Atmospheric Environment Service, Downsview, ON.

outlines problems with the Holzworth method which indicate that the Holzworth method substantially overestimates the minimum mixing height in all locations in North America except over the Rocky Mountains, and suggests a revised approach using the CALMET meteorological model used with the CALPUFF dispersion model. If the CALPUFF model is to be used for the dispersion modelling analysis, then upper air data could be derived from regional scale meteorological models such as Eta for a specific year instead of relying on climatological averages for mixing heights.

With respect to atmospheric stability, I concur with the approach of using the Sigma-Theta method proposed by Rescan.

Terrain Data

Rescan proposes to use the same terrain grid and receptor grid that were used for the 1995 modelling analysis, with expansion of the grid southward to incorporate Diavik. Unfortunately, insufficient information is provided by Rescan to judge whether the grid spacing will be sufficient to ensure that peak ground level concentrations are not underestimated due to the choice of grid resolution. Figure 2.5-4 of the 1995 modelling assessment shows a nested grid approach around the open pit and main camp areas, with very coarse grid resolutions beyond a distance of 2.5 km from the mine pit and beyond about 1 km from the main camp area. For the mine site, the grid resolution appears to be as follows:

100 m grid spacing for the first 500 m from the pit;
250 m grid spacing within 500-1000 m from the pit;
500 m grid spacing within 1000-2500 m from the pit;
5 km grid spacing beyond 2500 m from the pit;

For the main camp area, the grid resolution appears to have been:

100 m grid spacing for the first 500 m from the camp;
1000 m grid spacing within 500-5000 m from the camp;
5 km grid spacing beyond 5000 m from the camp.

Whereas I agree with the choice of a 100 m grid resolution for areas closest to the source, I feel that this resolution should be used for a greater distance than the 500 m proposed by Rescan. Similarly, in my opinion, the use of 500 m grid resolution beyond 1000 m from the mine pit and 1000 m grid resolution beyond 500 m from the main camp area is too coarse. Given the presence of stack sources over 30 m in height at the main camp (Process Plant and Recovery

Plant), maximum impacts may occur at a distance greater than 500 m from the camp, and might therefore be underestimated through the use of a coarse grid resolution.

Selecting grid spacing often represents a compromise between computer processing time and preventing underestimation of peak concentrations by the use of too coarse grid resolutions. One approach recommended for selecting an appropriate grid resolution by regulators in New Zealand[3] is that the model be run with increasingly smaller grid spacing near the location of predicted peak concentrations until halving the grid spacing effects a change in predicted peak ground level concentration of less than 10%. In my opinion, Rescan should reconsider its plan of using the 1995 receptor grid and propose an alternative grid that ensures peak concentrations will not be underestimated.

Source Data

I concur with Rescan's proposal that the emission inventory be reviewed prior to the start of any dispersion modelling analysis. However, I do not agree with their proposal to exclude ammonia emissions from the assessment. Ammonia deposition can have a detrimental effect on some terrestrial ecosystems, and the proposed air quality modelling analysis should consider those impacts, consistent with the need to assess impacts due to sulphate and nitrate deposition.

Cumulative Effects Assessment

I concur with the need to include other sources of emission in the area such as the Diavik mine operations. However, as I am unfamiliar with the Diavik mine site, I cannot comment on the additional sources that would be considered in the cumulative impacts assessment.

Modelling for Deposition

Rescan has proposed to exclude any deposition modelling from the dispersion modelling analysis because it is claimed that default values for surface characteristics such as albedo, Bowen ratio, friction velocity and surface roughness length are only available for typical cultivated lands with average moisture, but are not available for the arctic tundra surrounding the EKATI site. This is quite simply not true. Suitable default values for tundra are listed in Table 4-45 of the CALMET user's manual.

---

[3] National Institute of Water and Atmospheric Research, Aurora Pacific Limited and Earth Tech Inc. 2002. (Draft) *Good Practice Guide for Atmospheric Dispersion Modelling.* Prepared for the Ministry of Environment, Wellington, NZ, Air Quality Technical Report No. 27.

Suitable default parameter values for tundra and snow or ice covered surfaces are listed below.

Parameter	Tundra	Perennial Snow or Ice
Surface roughness (m)	0.20	0.20
Albedo	0.30	0.70
Bowen ratio	0.5	0.5
Soil heat flux parameter (W/m^2)	0.15	0.15
Anthropogenic heat flux	0.0	0.0
Leaf area index	0.0	0.0

The extended land use categories in CALMET can be further subdivided for tundra conditions to include:

- shrub and brush tundra
- herbaceous tundra
- bare ground
- wet tundra
- mixed tundra.

The other two parameters that Rescan indicated could not be reasonably estimated for the EKATI site were friction velocity and Monin-Obukhov length. These parameter values are calculated within the CALMET model as a function of the albedo, Bowen ratio and surface roughness. Therefore, all of the required geophysical parameters can be determined for tundra conditions, although they may need to be varied by season to account for differences in snow cover in some months of the year.

As such, Rescan's conclusion that "*dry and wet deposition modelling could not be completed with a reasonable degree of accuracy to allow meaningful comparisons with snow chemistry data*" is not justified. Deposition modelling for tundra conditions can be easily accommodated within the CALMET/CALPUFF modelling system. If Rescan has concerns about the reliability of the default geophysical parameter values provided for tundra in CALMET, the most reasonable approach would be to conduct a sensitivity analysis on these parameters within CALMET/CALPUFF to determine the degree of uncertainty that may exist in the predicted deposition estimates. Excluding deposition from the proposed modelling analysis for the reasons provided by Rescan is simply not acceptable.

Ambient Air Quality Objectives

Rescan proposes to use the existing Canadian Ambient Air Quality Objectives, Canada-Wide Standards and NWT Ambient Air Quality Standards to determine the acceptability of the model predicted air quality impacts. For PM_{10} impacts, Rescan has listed the U.S. National Ambient Air Quality Standards of 150 $\mu g/m^3$ (24-hour average) and 50 $\mu g/m^3$ (annual average) in Table 5 of the proposed methodology. Notes at the bottom of the table indicate that both British Columbia and Newfoundland (as well as Ontario, California, the European Union, the United Kingdom, Australia and New Zealand) have adopted a PM_{10} objective of 50 $\mu g/m^3$ (24-hour average), but it is not clearly stated whether Rescan plans to use the U.S. PM_{10} standard or the objective adopted by the three Canadian provinces. This should be clarified beforehand.

I also feel that it is worth pointing out that the Canadian Federal objectives for SO_2 and NO_2 were first established in the 1970's, and are generally recognized as needing to be updated. For comparison purposes, I have listed the ambient air quality criteria currently in use or proposed for adoption in other jurisdictions (Tables 1 and 2). In particular, it should be noted that criteria being considered in Europe for annual average NO_2 and SO_2 concentrations are based on protection of vegetation, and these criteria are much more stringent than the current Federal objectives in Canada.

For forests and natural vegetation where the accumulated temperature sum above $+5^0$C is less than 1000^0C days per year, the World Health Organization (WHO)[4] currently recommends an annual average guideline value for SO_2 of 15 $\mu g/m^3$, and an annual mean of only 10 $\mu g/m^3$ for the protection of lichens. The lowest annual average SO_2 target for the protection of ecosystems is 5 $\mu g/m^3$ set by Sweden.

For NO_x (NO plus NO_2) impacts on vegetation, the WHO has suggested provisional critical values for both short term and long term concentrations of 75 $\mu g/m^3$ (24-hour average) and 30 $\mu g/m^3$ (annual average), respectively. The latter value for annual average NO_x concentrations compares with a target level of 20 $\mu g/m^3$ for annual average NO_2 concentrations established in Sweden for the protection of vegetation.

The WHO has also suggested provisional critical values for protection of vegetation from ammonia (NH_3) of 270 $\mu g/m^3$ as a 24-hour average, and 8 $\mu g/m^3$ as an annual average. Therefore, the proposal by Rescan to not include ammonia emissions in the air quality modelling analysis because there are no objectives established in Canada is not justified. The provisional

---

[4] World Health Organization 2000. *Air Quality Guidelines for Europe.* Second Edition. Regional Office for Europe, Copenhagen, WHO Regional Publications, European Series, No. 91.

objectives determined by the WHO provide one way of evaluating the potential significance of the ammonia emissions from the EKATI mine operation.

Baseline Ambient Air Quality

The baseline air quality concentrations listed by Rescan in Table 6 of their proposed methodology were derived from a 1998 report by Cirrus Consultants. As I have not received a copy of the Cirrus report for this review, I do not know how these values were determined and cannot comment on whether or not the baseline values are reasonable for the EKATI mine site.

Table 1
Air Quality Criteria for Sulphur Dioxide (SO_2)

Averaging Period	**Canada** (NAAQO)	**Ontario**	**Quebec**	**British Columbia**	**California**	**US** (NAAQS)	**European Union** (Limit Values)	**United Kingdom** (LAQM)	**Sweden** (Targets)	**WHO**	**New Zealand**	**Australia** (NEPM)
15 min								266		500		
1hr (Max. Desirable)	450			450					200			
1hr (Max. Acceptable)	900	690	1310	900	655		350	350			350	530
3 hr						1300						
24hr (Max. Desirable)	150	275		160					100			
24hr (Max. Acceptable)	300		290	260	105	365	125	125		125	120	210
annual (Max. Desirable)	30			25				20	5			
annual (Max. Acceptable)	60	55	50	50		80				50	50	50

🟦	not to be exceeded more than one day per year by 2013
🟨	not to be exceeded more than 35 times per year, by 2005
🟥	not to be exceeded more than 24 times per year, by 2004 in UK and 2005 in the EU
🟩	not to be exceeded more than 3 times per year, by 2004 in the UK and 2005 in the EU
🟧	objective, for protection of ecosystems, suggested 2000 but not adopted
🟩	98th percentile, by 2010
🟩	protection of vegetation, by 2005

Table 2
Air Quality Criteria for Nitrogen Dioxide (NO_2)

Averaging Period	**Canada** (NAAQO)	**Quebec**	**California**	**US** (NAAQS)	**European Union** (Limit Values)	**United Kingdom** (LAQM)	**Sweden** (Targets)	**WHO**	**Australia** (NEPM)	**New Zealand**
1hr (Max. Acceptable)	400	410	470	480	🟥 200	🟨 200		200	🟦 230	200
24hr (Max. Desirable)							🟫 100			
24hr (Max. Acceptable)	200	210								100
annual (Max. Desirable)	60					🟧 30				
annual (Max. Acceptable)	100	100		100	🟢 40	🟢 40	🟩 20	40	57	

🟥 not to be exceeded more than 18 times per year, by 2010
🟨 not to be exceeded more than 18 times per year, by 2005
🟦 not to be exceeded more than one day per year by 2013
🟧 based on protection of vegetation; objective proposed in 2000, but not adopted
🟫 98th percentile, by 2010
🟩 protection of vegetation, by 2010
🟢 by 2005 in UK, and 2010 in the European Union

Summary

After reviewing the proposed air dispersion modelling assessment plan prepared by Rescan, I have concluded that there are a number of areas where I either have concerns with the proposed approach or entirely disagree with Rescan. My specific concerns are as follows:

> *Model Selection:* While both the ISC3 and the CALPUFF models could be used to model emissions from the EKATI mine, the CALPUFF model offers some distinct advantages over the ISC3 model which should be considered before a final decision is made on which model will be used. However, if the CALPUFF model is determined to be the preferred model for the assessment, care must be taken to ensure that the person responsible for doing the modelling analysis has the necessary experience with the CALPUFF model to undertake the analysis.
>
> *Meteorological Data:* There is a need to document the instrumentation, instrument exposure, operation and maintenance of the Koala meteorological station as a first step in determining that the data collected at the site are suitable for modelling purposes. Any data that is to be used for modelling purposes must be evaluated using the U.S. EPA's MPRM program as part of the quality assurance/quality control process. I also think that Rescan should evaluate the data to see if more than one year of suitable data can be derived from the historical data set, regardless of whether the consecutive data all falls within one calendar year.
>
> If the CALPUFF model is chosen as the preferred model for the analysis, regional scale upper air data can be derived from the Eta model. If the decision remains to use the simpler modelling techniques of the ISC3 model, the mixing height data for the analysis should be obtained from the more up-to-date report prepared by SENES for Environment Canada in 1997.
>
> *Terrain Data:* I have concerns about the resolution of the proposed receptor grid in the vicinity of both the mine pit and main camp. It is my recommendation that Rescan investigate increasing the resolution of the grid in those areas where maximum predicted concentrations are most likely to occur.
>
> *Source Data:* I concur with the proposal to review the source emission inventory before doing any dispersion modelling. I thoroughly disagree with Rescan's proposal to exclude ammonia emissions from consideration in the assessment.

Modelling for Deposition: Rescan is entirely incorrect in stating that representative default values are not available for key geophysical parameters required to conduct deposition modelling. Representative default values for tundra are available in the CALMET/CALPUFF modelling system. If Rescan has concerns about the accuracy of results derived from using the default values, the most appropriate approach would be to conduct a sensitivity analysis to determine what effect changing these parameters would have on predicted deposition rates. Since the CALPUFF model can also estimate the formation of sulphates and nitrates, it would be feasible to conduct deposition modelling of these contaminants, as well as for particulate matter and ammonia.

Ambient Air Quality Objectives: It is not clear to me whether Rescan is proposing to use the U.S. standards for PM_{10} or the PM_{10} objectives that have been adopted by three provinces in Canada (as well as several other jurisdictions). In addition, due to the fact that the current Federal objectives for SO_2 and NO_2 were established a long time ago, they may not reflect current understanding of the effects of these pollutants on human health or ecosystems. For potential impacts on ecosystems, consideration should be given to the more stringent critical values and targets that have been determined by the WHO and by some European jurisdictions. The WHO's provisional critical values for the protection of vegetation from ammonia may also serve as useful criteria for evaluating the potential significance of ammonia emissions.

Baseline Ambient Air Quality: In the absence of any information on the derivation of the baseline concentrations proposed by Rescan, I cannot comment on the appropriateness of these values for the proposed assessment. I would recommend that the methodology used to derive the baseline values be reviewed before they are adopted for the EKATI mine site.

Please do not hesitate to call me if you have any questions about the information provided in this review, or require additional information about my comments.

Yours very truly,
SENES Consultants Limited

Bohdan (Dan) Hrebenyk, M.Sc.
Senior Environmental Scientist
Manager, BC Office