

A Review of the 2013 Diavik Diamond Mine Wildlife Monitoring Report

Prepared for

Environmental Monitoring Advisory Board

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Prepared by



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Executive Summary

Summary and Recommendations

In this review on behalf of The Environmental Monitoring Advisory Board (EMAB or the Board), Management and Solutions in Environmental Science (MSES) assesses the procedures and results of the Wildlife Monitoring Report 2013 (WMR). The annual data collection is mandated to follow a Wildlife Monitoring Program (WMP), developed in 2002, which determined the testable questions and the objectives that need to be addressed through the life of the project. In the course of the past 11 years, MSES reviewed the WMRs to evaluate how the WMP was and is adhered to. In the course of 2010, MSES participated in several communications with Diavik Diamond Mine Inc. (DDMI) and other parties where a number of recommendations were discussed in workshops and other venues to adapt the data collection in light of current information (Handley 2010). These recommendations, in part, altered the objectives of the 2002 WMP which are now reflected in the WMRs since 2011.

The overall disturbance of vegetation types remained at or below predicted levels in 2013, with three ELC types, riparian shrub, esker complex and bedrock complex, at or slightly exceeding the predicted loss. The exceedences existed from previous years.

The 2013 WMR included a “2013 Comprehensive Vegetation and Lichen Monitoring Program” report in Appendix A. The vegetation and lichen monitoring programs concluded that the mine may be having local-scale effects on plant species composition and that metal concentrations in lichen were statistically higher near the mine than farther away, though lower overall in 2013 compared to 2010.

Caribou aerial surveys were not required in 2013 and DDMI recommended they be further postponed in favour of other, as yet, undetermined studies. The new aerial survey schedule (a result of the workshop described by Handley 2010) was designed to test whether or not caribou occurrence (zone of influence) changes with changes in mine activity. Boulanger et al. (2012) conclude a zone of influence of 14 km and the 2013 WMR does not propose to re-analyze the data. We do not criticise the analysis completed by Boulanger et al. (2012) in terms of the validity of the 14 km ZOI. However, we question the interpretation of the “zone of influence”. We think the 14 km distance actually demonstrates an aggregation of caribou that would not exist without the mines.

In accordance with recommendations from a workshop in 2009 with ENR and other mines and monitoring boards (Handley 2010), DDMI adapted its monitoring program for caribou in 2010 by coordinating with BHP-Billiton’s Ekati mine and implementing ground observations of caribou behaviour for 2010. DDMI continued ground-based behavioural observations in 2013 in cooperation with the Ekati Mine. DDMI will undertake analyses of ground-based behavioural data when sufficient data are available.

In 2012, caribou distribution followed the predicted pattern for the northern (spring) migration; caribou deflected west of East Island. However, for the southern migration, collared caribou were further north than usual and remained north of the mine site through March 31st, 2013. The methods applied for this part of monitoring are adequate.

As far as grizzly bear habitat loss and mortality is concerned, both effects remain at or below predicted levels. The methods applied for this part of monitoring are adequate. However, there seems to be an increasing trend in the number of grizzly bear observations near the mine over time. No DNA fingerprinting results from the hair snagging program were presented.

Wolverine snow tracking data from past years appears to indicate potential attraction by wolverine to the mine site. An increase in the frequency that transects are surveyed, as proposed by DDMI, would assist in evaluating whether this is a real trend in wolverine abundance and distribution. DDMI will continue to participate in the DNA program next scheduled for data collection in 2014.

We concur with the new objectives adopted by DDMI for falcons which reflect the discussions of the 2009 workshop. The new focus on contributing data to the Canadian Peregrine Falcon Survey (CPFS), in particular, is a good initiative. Two peregrine falcon mortalities were recorded on the mine site in 2013.

Water birds used mine-altered water bodies, but were not detected earlier at mine-altered water bodies compared to East and West bays. DDMI and the Canadian Wildlife Service (CWS) agreed that the waterfowl monitoring program would be discontinued at this time, but CWS did recommend that DDMI consider re-starting the waterbird/shorebird monitoring program at the mine reclamation stage. We are in agreement with these recommendations.

In 2012, Diavik added a wind farm (four turbines) intended to reduce Diavik's diesel consumption and greenhouse-gas emissions. No bird mortalities were recorded during the voluntarily implemented 2013 monitoring program. We are in agreement with the recommendation to discontinue this monitoring program and to instead monitor for bird mortalities as part of the overall site compliance monitoring program.

The attractants on the Waste Transfer Area (WTA) appear to be at lower levels in 2013 compared to 2012. Fox sightings in the WTA appear to have stabilized in 2013. We are in agreement with the recommendation to reduce the frequency of inspections at the landfill. The higher occurrence of fox, together with the potential increase in grizzly bears and wolverine occurrence, near the mine, may suggest an increased attraction to the mine by carnivores and scavengers in more recent years.

Overall, the measurements taken adequately address the predictions at hand. The analysis of the data yields a great deal of credible information about the effectiveness of mitigation measures. We generally agree with DDMI's recommendations submitted in their 2013 WMR. There are, however, some highlights for the Boards' consideration; several are re-stated here from previous yearly reviews as they await future detailed data analyses. We recommend that the following issues be addressed:

1. Please consider how the information gained from various caribou datasets could be used in terms of mitigation for the Diavik mine in particular and for other future projects in the region in general.
2. Please give careful consideration to the interpretation of the 14 km ZOI presented in Boulanger et al. (2012). The 14 km distance may actually demonstrate an aggregation of caribou that would not exist without the mines.

3. Please provide detailed explanation and justification as to why aerial surveys have been postponed “in favour of other studies”. Please provide details on what “other studies” would examine mechanisms that may cause caribou to avoid the mine.
4. Please address the following in future detailed analysis of caribou occurrence and behavioural data:
 - a. Please justify the pooling of caribou behavioural data across years and any assumptions made in future analyses.
 - b. Why does occurrence of caribou appear to be lower at distances farther than 14 km?
 - c. Why is there the same effect before Diavik was built (given that the years 1998/99 show the same ZOI “effect” as the years after the mine was built)?
 - d. Clarify if “probability of occurrence” indicates caribou densities, as opposed to simply the number of caribou in each distance category.
 - e. Testing changes in caribou behaviour over time. This will require an increased sample size of behavioural observations to allow for an analysis of behavioural changes over time.
5. Please justify the use of maximum average number of employees to reflect level of mining activity, possibly through correlation analyses with noise, construction, vehicle, and aircraft variables.
6. Please consider an analysis of the indirect (in addition to the currently presented direct) footprint effect on caribou habitat for understanding the true effects on caribou and for determining future mitigation measures. This is particularly relevant given the effects of dust deposition on local plant species composition and elevated metal concentrations in lichen near the mine.
7. Please provide a discussion of the potential causes of the departure from the prediction regarding the southern migration of caribou and potential response actions.
8. Please consider maintaining a schedule for surveying the mine site, roads, rock piles, and Processed Kimberlite for caribou presence.
9. In future detailed data analyses, please relate caribou and wolverine track densities to the land area in each distance category.
10. Please give careful consideration to the possibility that grizzly bears may be becoming habituated and their presence on the site may be on the rise. Please provide a detailed analysis of grizzly bear data.
11. Please give careful consideration to the possibility that wolverine may be becoming habituated and their presence on the site may be on the rise. Please provide a detailed analysis of wolverine data.
12. Please evaluate whether the levelling-off of fox observations in the WTA persists in future years.
13. Please discuss the results showing an effect of the mine on vegetation structure in reclamation and revegetation studies and discuss the implications for wildlife recolonization in terms of the

likelihood for re-establishment of natural or pre-disturbance vegetation and wildlife communities.

14. Please provide details of future monitoring plans for lichen, such as frequency and timing of monitoring.
15. Please provide responses to the detailed questions and comments (presented in bold font) in the body of this review report.
16. Except for our recommendations listed above, we are in agreement with the recommendations listed in the 2013 WMR and do not recommend any actions additional to providing the information requested above.
17. We recommend that the Board accept the 2013 WMR with the understanding that the above listed questions and recommendations will be addressed in communications and workshops by DDMI in the coming year. Furthermore, we understand that detailed data analyses are required, as identified in our review, and that these analyses will be conducted in the near future.

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1.0 Introduction

The Environmental Monitoring Advisory Board (EMAB or the Board) for the Diavik Diamond Mine Inc. (DDMI) Project requested that Management and Solutions in Environmental Science Inc. (MSES) review and assess the procedures and results of the 2013 Wildlife Monitoring Report (WMR). The WMR communicates the findings of surveys conducted during 2013 as well as DDMI's recommendations for future activities.

The annual data collection is mandated to follow a Wildlife Monitoring Program (WMP), developed in 2002, which determined the testable questions and the objectives that need to be addressed through the life of the project. In the course of the past 11 years, MSES reviewed the WMRs to evaluate how the WMP was and is adhered to. In the course of 2010, MSES participated in several communications with DDMI and other parties where a number of recommendations were discussed in workshops and other venues to adapt the data collection in light of current information (Handley 2010). These recommendations, in part, altered the objectives of the 2002 WMP which are now reflected in the WMRs since 2011.

Based on its annual reviews of past WMRs and detailed data analyses, MSES submitted numerous recommendations for EMAB and DDMI to consider. The present report takes past recommendations and discussions as well as the altered WMP objectives into account. Here, we review how DDMI addressed the above discussions and previous recommendations in the 2013 WMR.

In our review below, for the ease of identifying our recommendations and requests, we highlight the **text in bold** where we specifically request actions from DDMI.

2.0 General Observations

2.1 Objectives of the Wildlife Monitoring Program

The objectives of the WMP v.2 were developed in 2002 and DDMI has anchored its monitoring reports on these objectives. For more clarity, below we re-state the objectives set forth in the WMP v. 2 of 2002 to emphasize that these objectives are the foundation and focus of our review, and that the methods and results in the 2013 WMR, are reviewed in light of these objectives, as amended in 2010.

“The objectives of the wildlife monitoring program are to:

- a. Verify the accuracy of the predicted effects determined in the Environmental Effects Report (Wildlife 1998) and the Comprehensive Study Report (June 1999); and*
- b. Ensure that management and mitigation measures for wildlife and wildlife habitat are effective in preventing significant adverse impacts to wildlife.”*

These objectives are the foundation and focus of our past and current reviews, relating the methods and results in the 2013 WMR to what we believe is the ultimate goal of monitoring, namely the understanding and alleviating of effects of the project. However, a number of specific questions that have been tested in the course of the years of monitoring have been found to be either largely answered or

ineffective for the testing of mitigation effectiveness, prompting discussions about adapting the objectives of data collection in light of current information (Handley 2010). DDMI addressed the new objectives of the program in the WMR 2013, where appropriate. Specifically, the new barren ground caribou and grizzly bear monitoring program objectives are to test whether or not caribou occurrence and grizzly bear presence change with changes in mine activity. The new objectives of the falcon monitoring program are to contribute data to the Canadian Peregrine Falcon Survey (CPFS), determine nest success and deterrent effort effectiveness, and determine cause of any mine-related raptor mortalities.

2.2 The State of Current Information

The WMR 2013 did not present any new detailed wildlife data analyses. It appears that some detailed analyses were conducted outside of the WMR (e.g. Boulanger et al. 2012) and others are awaiting the availability of sufficient data to perform the appropriate analyses (e.g. caribou behaviour, grizzly DNA).

For the reader of this review, however, we re-state some of the highlights in previous years reviews (MSES 2013) as this is the current best available information on trends and data quality:

- The detailed analyses conducted in past years are generally well presented and informative. We would like to note that some of the recommendations made in previous years have been incorporated into past analyses. We would like to commend the authors for including more detail in the analytical results than in previous years.
- Based on previous detailed analyses, the general findings for caribou remain relatively unchanged, namely that there appears to be a ZOI for caribou occurrence where caribou are more likely to occur at about 14 km from the mine than closer to the mine. A potentially important finding was that caribou groups with calves spend less time feeding and resting within 5 km of the mine than farther away. This suggests that caribou behaviour and potentially the energy balance of young caribou is affected within that distance. DDMI will undertake additional analyses of ground-based behavioural data when sufficient data are available.
- For grizzly bears and wolverine, no particular new information was found compared to previous years. Both mortality and habitat loss remain at or below the levels predicted. The most recent monitoring data seem to suggest that the occurrence of both grizzly bears and wolverine are higher near the mine than farther away. Future detailed data analyses should test whether these observations indicate a real trend. The grizzly bear hair-snagging program DNA results should address a new, regional scale question about the bear population.
- Recent monitoring data seem to indicate that fox presence at the WTA may be levelling off at a higher occurrence than has been recorded in early years, but this should be confirmed with continued monitoring. The higher occurrence of fox, together with the potential increase in grizzly bears and wolverine occurrence, near the mine, may suggest an increased attraction to the mine by carnivores and scavengers in more recent years.
- For falcons the new objectives seem reasonable as they potentially contribute to a better regional understanding of falcon populations.

- There are no new findings regarding the abundance and species composition of waterfowl and shorebirds. It was agreed that the waterfowl monitoring program would be discontinued at this time, but CWS did recommend that DDMI consider re-starting the waterbird/shorebird monitoring program at the mine reclamation stage.

While DDMI has incorporated some of our recommendations or questions from previous years, others remain unaddressed. Table 1 summarizes the current status of our 2013 recommendations.

Table 1: Actions by DDMI in Response to 2013 Recommendations

2013 Recommendation/Question	Action by DDMI
Vegetation and Wildlife Habitat	
Discuss the revegetation program in light of the current findings [initially high plant productivity of some plots in which productivity did not seem to lead to the highest plant density and cover; the majority of shrub cuttings died]. Will it be possible to reclaim disturbed areas as expected (or desired), or does the information of lower than expected vegetation performance imply that vegetation may not return as expected?	The 2011 revegetation report provided some very useful information. The experimental set and data analyses are adequate and proved credible results. DDMI should take the recommendations in the revegetation report as guidance in reclamation planning. There is no 2013 update regarding revegetation.
The issues investigated in the Dust Deposition to Lichen study should be integrated with the WMR lichen study. We recommend that details of future monitoring plans for lichen be provided, such as frequency and timing of monitoring, and integrated with the results provided in the WMR to form a comprehensive vegetation monitoring program.	A 2013 Comprehensive Vegetation and Lichen Monitoring Program report was provided in Appendix A of the 2013 WMR. While the report recommends that monitoring of PVP continue and that methods for the lichen sampling remain consistent, no further details were provided. See section 3.1 of this report for more details.
Barren-Ground Caribou	
Discuss the implications of a larger than expected effect on caribou for future environmental management.	No discussion was provided. The discussion of potential adaptive management measures is still open.
What is the actual size of the larger caribou ZOI, 14 or 28 km?	Boulanger et al. (2012) conclude a zone of influence of 14 km and the 2013 WMR does not propose to re-analyze the data. We do not criticise the analysis completed by Boulanger et al. (2012) in terms of the validity of the 14 km ZOI. However, we question the interpretation of the “zone of influence”. We think the 14 km distance actually demonstrates an aggregation of caribou that would not exist without the mines.
What is the effect of mine closure on caribou range re-establishment? Are data collected to date sufficient to show a change of caribou distribution in light of the uncertainty of the size of the large ZOI? Also current baseline (pre-disturbance) information is poor, rendering conclusions on changes from pre- to post-disturbance inconclusive. Does DDMI believe that the current data quality is sufficient to show a potential reversal of the effects after closure?	No discussion was provided. A ZOI of 14 km has been established, as presented in Boulanger et al. (2012). The issue was discussed verbally in 2013 and DDMI admitted that it is possible that the currently observed ZOIs may have always existed. DDMI confirmed that true baselines do not exist. Using TK instead was suggested for discussion.
Testing the changes in caribou behaviour will be critical for the new approach to testing the effects within the	Analysis of caribou behavioural data was undertaken in 2010 using data from all years. Caribou with young

<p>small (3-7 km) ZOI. Please provide an analysis of the behavioural data and comment on whether or not behavioural data collected previously can be used. How can the information on behaviour be used to adapt management actions at the mine and in the region? A detailed technical side-bar discussion may be useful for us to better understand the assumptions and expectations by DDMI.</p>	<p>changed feed and rest less with 5 km of the mine. Analyses or discussion supporting the combination of all years of caribou behavioural data were not provided. Assumptions were not provided. A discussion on “How can the information on behaviour be used to adapt management actions at the mine” was not provided. There is no 2013 update regarding caribou behaviour. Data were insufficient for analysis.</p>
<p>Can DDMI elaborate on why it no longer believes that behavioural data from aircraft are useful?</p>	<p>No discussion was provided.</p>
<p>We recommend that the ideas to evaluate caribou health and to ask traditional knowledge holders about the behaviours that should be included in the observation protocol should be carefully considered, particularly from the point of view that the health of wide ranging animals are a result of many factors that occur in the region through which they range. Future discussions about these ideas could be fruitful.</p>	<p>No discussion was provided.</p>
<p>Is group composition data not collected anymore?</p>	<p>Group composition data was collected in 2013. Further analysis will be undertaken when sufficient data are available. Data were insufficient within 5 km of mining activities.</p>
<p>Testing the distribution and abundance of caribou with careful consideration of the confounding factors of land area and land pattern in each of the zones would be beneficial. A useful number to interpret the caribou abundance results may be a density of caribou on the land area. Is DDMI willing to present such numbers during the next presentation of results?</p>	<p>Caribou density does not appear to have been used in any of the analyses in 2013, particularly in relation to land area. The issue was discussed verbally in 2013 and DDMI agreed to provide density numbers for caribou.</p>
<p>DDMI concludes that 2,549 caribou were observed in the Diavik wildlife study area. Please clarify if this number is based on the 15 % coverage. If so, then wouldn't this mean that there was a higher density of caribou observed in 2009 compared to previous years because in previous years a larger area was surveyed (having used a 4 km interval between transects before 2009)?</p>	<p>DDMI acknowledge verbally (phone conversation in Summer 2010) that this may be the case but no discussion of this potential confounding issue was presented in the 2013 WMR.</p>
<p>We suggest that an analysis of the indirect (in addition to the currently presented direct) footprint effect on caribou habitat may be useful for understanding the true effects on caribou and for determining future mitigation measures.</p>	<p>No discussion was provided in the 2013 WMR. A 2013 Comprehensive Vegetation and Lichen Monitoring Program report was provided in Appendix A of the 2013 WMR. This report does not discuss indirect impacts to caribou habitat.</p>
<p>DDMI should justify the use of maximum average number of employees to reflect level of mining activity, possibly through correlation analyses with noise, construction, vehicle, and aircraft variables.</p>	<p>No discussion was provided.</p>
<p>DDMI should discuss potential causes and response action, if necessary, for a slight departure from predictions regarding caribou migration patterns.</p>	<p>No discussion was provided.</p>

Grizzly Bear	
We recommend that the hair sampling program be continued, even if other mines do not commit to it.	We are still awaiting DNA fingerprinting results from the grizzly bear hair snagging program.
Please give careful consideration to the possibility that bears may be becoming habituated and their presence on the site may be on the rise.	Grizzly bear observations were lower in 2013 than 2012. However, there still seems to be an overall increasing trend in grizzly bear observations near the mine site. No discussion was provided.
Wolverine	
We do not believe that the data have been analyzed rigorously enough to draw any conclusions on whether or not track density is lower near the mine than farther away. As we noted above for caribou, densities need to be related to the land area in each distance category. We recommend that such an analysis be done in the next report on the comprehensive data analysis.	Wolverine density does not appear to have been used in any of the analyses in 2013 in relation to land area and distance categories. The issue was discussed verbally in 2013 and DDMI agreed to provide density numbers for wolverine.
Please give careful consideration to the possibility that wolverine may be becoming habituated and their presence on the site may be on the rise.	No discussion was provided.
Waste Monitoring	
The only puzzling finding of the food attractant monitoring is the apparent increase of foxes on site. Can DDMI discuss the possible causes for this increase?	The issue was discussed verbally, but no resolution appears to exist at present. In 2013, fox observations appear to have stabilized in the WTA.
Waterfowl	
We have noted that the data collected on waterfowl diversity, abundance, and pond use is very detailed and could potentially be used for adequate effects monitoring, if control sites existed.	In 2013, it was agreed between DDMI and the Canadian Wildlife Service (CWS) that the waterfowl monitoring program would be discontinued at this time. CWS recommended that DDMI consider re-starting the waterfowl monitoring program at the mine reclamation stage.

3.0 Specific Observations

3.1 Vegetation and Wildlife Habitat

There was a very minor change to the Project footprint in 2013. The additional footprint occurred adjacent to the existing airstrip. The overall disturbance of vegetation types remained at or below predicted levels in 2013, with three ELC types, riparian shrub, esker complex and bedrock complex, at or slightly exceeding the predicted loss. The exceedences existed from previous years. DDMI will continue to monitor habitat loss.

The 2013 WMR included a “2013 Comprehensive Vegetation and Lichen Monitoring Program” report in Appendix A. The vegetation and lichen monitoring programs assess if dust deposition from the Mine is altering the abundance and richness of plant species.

The vegetation monitoring program utilizes permanent vegetation plots (PVP) established adjacent to the Mine site (mine plots) and on the West Island and mainland (reference plots). Dust deposition rates were found to be higher near the mine than farther away; however, the total dust deposition rate for all gauges in 2013 was lower than that observed in 2008. The permanent vegetation plot analysis suggests that indeed vegetation composition, in particular lichen cover, is altered near the mine. There are fewer lichen but more grasses, forbs and vegetation litter near the mine. The report concludes that “*the Mine may be having local-scale effects on plant species composition*”. The report does not suggest any strategies that could mitigate these effects. **Please consider if and how these potential project effects could be mitigated.**

The lichen monitoring program evaluates metal uptake in lichen, near and far from the mine site, due to dust deposition from mining activities. The analysis of metal concentrations in lichen found that nearly all assessed parameters were statistically higher near the mine than farther away. However, most measured parameters had significantly lower concentrations in 2013 than 2010. Interestingly, Appendix A stated that mercury had the opposite trend with concentrations being statistically lower near the mine than farther away in both 2010 and 2013. No discussion on this finding was presented. **Please discuss possible causes of this pattern in mercury concentrations and what effects this may have on caribou ingesting lichen far from the mine.**

In late 2011 we had the opportunity to review the study addressing Dust Deposition to Lichen (MSES 2011). Last year we recommended that the lichen study results be integrated with the vegetation study included in the WMR to form a comprehensive vegetation monitoring program. The 2013 Comprehensive Vegetation and Lichen Monitoring Program report appears to be the result of this recommendation. While some of the questions proposed in the Dust Deposition to Lichen review (MSES 2011) were addressed the 2013 Comprehensive Vegetation and Lichen Monitoring Program report (Appendix A), others remain unanswered. Table 2 presents a high-level summary of the current status of issues and concerns with the dust deposition to lichen study.

Table 2: Actions by DDMI in Response to 2011 Recommendations on the dust deposition to lichen study

Issues and Concerns (MSES 2011)	2013 Status (WMR Appendix A)
The finding that lichens sampled from four locations within 10 km of the EKATI diamond mine had mean metal concentrations greater than others sampled in the far-field suggests that it may be difficult to find locations in the study area that are remote enough to be unaffected by mine emissions. We recommend that cumulative effects of emissions be investigated.	Cumulative effects have not been evaluated.
The study appears to assume that caribou ingest all lichen species at the same rate. Exposure risk values may be affected by caribou ingesting preferentially either high- or low-concentrating lichen species. We recommend that future studies investigate the possibility of selective foraging by caribou and how selective foraging may affect exposure values.	“...the emphasis of the sampling method was to collect lichen that caribou eat, and not necessarily on obtaining the same ratio of species in each sample.” This suggests that the ingestion of different lichen species by caribou was taken into consideration in the sampling methods, to a degree. However, this approach does not allow for a quantitative consideration of caribou ingestion rates for different lichen species. Quantitative data on caribou ingestion rates for lichen should be taken into

	consideration in the analysis of risk exposure.
We recommend that the rationale be provided for the selection of the far-field sampling area. How was the distance for the far-field sampling area determined? Is the far-field sampling area intended to represent a control area, beyond the limit of Mine dust carried by wind? Are there dustfall monitoring gauges in the far-field sampling area?	No explanation was provided for selection of the far-field sampling area. The 2013 report indicated that the “far-field area is more representative of background conditions”, but it is not clear if this is considered a true control area or not. It does not appear that dustfall monitoring gauges were present in the far-field.
Please discuss the implications of combining different lichen species into a single sample, the effect of the substrate on lichen metal concentrations, and the effect of the removal of lichen during sampling on future sampling/monitoring.	No explanation was provided for how the different species may affect the average metal concentrations in the samples taken. This potentially obscures the exposure risk for caribou.
We recommend that the results of the two-tailed t-tests and Wilcoxon-Mann-Whitney tests be presented in the report. Further discussion regarding the source of variability in the relative percent differences (RPDs) would assist us in understanding whether metal concentrations were measured three times from identical lichen material or from three separate samples with different species mixes.	“At each location, the sample was gently mixed to form a composite, and then split into two separate samples, which were analyzed separately for metals.” Results of statistical analyses for Lichen Chemistry were provided. The methods described confirm the above concern about obscuring exposure risk for caribou.
We recommend that details of future monitoring plans for lichen be provided, such as frequency and timing of monitoring. It is not clear if either the cumulative effects of mine developments in the region or climate change will be assessed in future monitoring.	While the report recommends that monitoring of PVP continue and that methods for the lichen sampling remain consistent, no further details were provided and no indication was given that cumulative effects or climate change will be assessed in the future.
The risk assessment does not include information on any changes in the concentrations of metals present in caribou and humans pre- and post-exposure or how these levels of metals relate to the health of either caribou or humans. Inclusion of this information would strengthen the report’s conclusions.	This information was not included. The 2013 report concluded that “a follow up risk assessment based on 2013 data is not required, as it is expected that metal concentrations are still within safe levels for caribou”. The expectation that metal concentrations are within safe levels for caribou (and humans) is opinion and unsupported by data.

3.2 Barren-Ground Caribou

The 2013 WMR indicates that direct summer caribou habitat loss remains at or below predicted levels. The 2011 and 2013 studies by DDMI on dust deposition and metal uptake by lichen indicate that lichen are affected through the absorption of metals for a considerable distance from the mine (also see MSES 2011). Although the studies concluded that there is no significant health risk to caribou, we raised some methodological issues which may potentially change the conclusions. Moreover, the WMR Permanent Vegetation Plot study from 2013 indicated that vegetation composition, most notably, lichen abundance, is changed beyond the footprint of the mine. Consequently, caribou habitat is changed through both abundance and quality of forage. While the 2013 WMR focuses on the loss of habitat from the direct footprint of the mine (this focus reflects the prediction in the Environmental Effects Report of 1998), the lichen studies indicate that the effects on habitat loss go beyond just the footprint. As in 2012, we suggest that an analysis of the indirect (in addition to the currently presented direct)

footprint effect on caribou habitat may be useful for understanding the true effects on caribou and for determining future mitigation measures.

Caribou aerial surveys were not required in 2013 and no analysis of aerial survey data (three-year comprehensive analysis) was completed. The originally proposed aerial survey schedule, three continuous years followed by two years off, was designed to test whether or not caribou occurrence (zone of influence) changes with changes in mine activity. According to the aerial survey schedule, 2013 should have been the second continuous year of aerial surveys, but Ekati and Diavik requested to omit the ZOI requirement for caribou monitoring in 2013. ENR approved the request. Instead, the WMR relies on the results of a recent analysis of aerial survey data completed by Boulanger et al. (2012). The WMR concludes that re-analysis of the same data analyzed by Boulanger et al. (2012) is unlikely to change results or conclusions. Last year we had recommended that “DDMI undertake further analyses when sufficient data are available or when three years of consecutive aerial surveys have been completed”. We do not criticise the analysis completed by Boulanger et al. (2012) in terms of the validity of the 14 km ZOI. However, we question the interpretation of the “zone of influence”. We think the 14 km distance actually demonstrates an aggregation of caribou that would not exist without the mines. This is because caribou likely avoid the vicinity of the mine, move farther away, and, as a result, aggregate at some distance. It appears that the aggregation occurs at about 14 km, according to Boulanger et al.’s (2012) analysis. This aggregation phenomenon has been recently documented for woodland caribou (Fortin et al. 2013). The significance of this finding is that the aggregation at 14 km is not the baseline where caribou occur at “normal” densities, it is an artifact of industrial disturbance. Rather, the baseline is farther away, at a distance that is past the 14 km aggregation.

In accordance with recommendations from a workshop in 2009 with ENR and other mines and monitoring boards (Handley 2010), DDMI adapted its monitoring program for caribou in 2010 by coordinating with BHP-Billiton’s Ekati mine and implementing ground observations of caribou behaviour for 2010. Ground-based behavioural observations were conducted in 2013 in cooperation with the Ekati Mine. DDMI will undertake analyses of ground-based behavioural data when sufficient data are available. Insufficient data are available to assess how caribou behaviour changes with distance from the mine. A summary of the mean percent time caribou spent exhibiting each type of behaviour over all distance categories was provided for 2013. Given that analyses of change in behaviour with distance are still planned for the future, we re-state, for the future record, that analyses of data should address the following:

- **Justify any pooling of data across years and what, if any, assumptions were made.**
- **Reconcile behavioural observations with the occurrence of caribou: does behaviour change with distance as occurrence does, i.e. is behaviour “normalized” past the zone of influence of 14 km?**
- **Why does occurrence of caribou appear to be lower past that distance?**
- **Why is there the same effect before Diavik was built (given that the years 1998/99 show the same ZOI “effect” as the years after the mine was built)?**
- **Clarify if “probability of occurrence” indicates caribou densities, as opposed to simply the number of caribou in each distance category.**

- **How can the information gained from the various caribou analyses be used to develop mitigation measures if there is a larger than predicted effect of the mine on caribou?**
- **DDMI should justify the use of maximum average number of employees to reflect level of mining activity, possibly through correlation analyses with noise, construction, vehicle, and aircraft variables.**

In 2012, caribou distribution followed the predicted pattern for the northern (spring) migration; caribou mostly deflected west of East Island. However, for the southern migration, collared caribou were further north than usual and remained north of the mine site through March 31st, 2013. **DDMI should discuss potential causes and if any response action is warranted for this minor departure from predictions.**

As far as caribou mortality is concerned, the effect remains at or below predicted levels. The methods applied for this part of monitoring are adequate. Overall, the mean population size of the Bathurst caribou herd has decreased between 1996 (349,000) and 2012 (35,000). To support recovery of all barren-ground caribou herds, the NWT barren-ground caribou management strategy was developed. As a component of this strategy, Diavik has provided in-kind support for a study on wolf-caribou dynamics on the summer range of the Bathurst caribou herd.

In 2012, DDMI recommended that alternative survey methods and survey frequency for future assessment of caribou occurrence relative to the mine site, roads, rock piles, and Processed Kimberlite Containment (PKC) be evaluated. One reason for this recommendation was to enable surveyors to visually observe areas with no obstructions. It was not clear if this was achieved for 2013. This year, DDMI has recommended a reduced survey frequency dependent on incidental caribou observations near the mine site (Section 3.8.1). **We suggest that these surveys continue at least bi-weekly to ensure no caribou are present in areas that are visually obstructed to on-site staff.**

DDMI recommended the postponement of aerial surveys as they do not provide feedback on the operation and adaptive management of the mine site (Section 3.8.1 of 2013 WMR). The revised impact prediction from Handley (2010) is “To determine whether the zone of influence changes in relation to Mine activity”. **We recommend DDMI provide a more detailed explanation and justification as to why they propose postponement of aerial surveys “in favour of other studies”. DDMI should also indicate what “other studies” would examine mechanisms that may cause caribou to avoid the mine.**

DDMI recommended that monitoring of caribou behaviour focus at distances between 2 and 30 km of the mine site. We are in agreement with this recommendation.

3.3 Grizzly Bears

As far as grizzly bear habitat loss and mortality is concerned, both effects remain at or below predicted levels. The methods applied for this part of monitoring are adequate.

There is an increasing trend in the number of grizzly bear observations over time (Figure 1a). One reason for this could be that an increase in the number of people on site could result in more observations, yet there does not appear to be a trend in the number of people on site over time (Figure 1b).

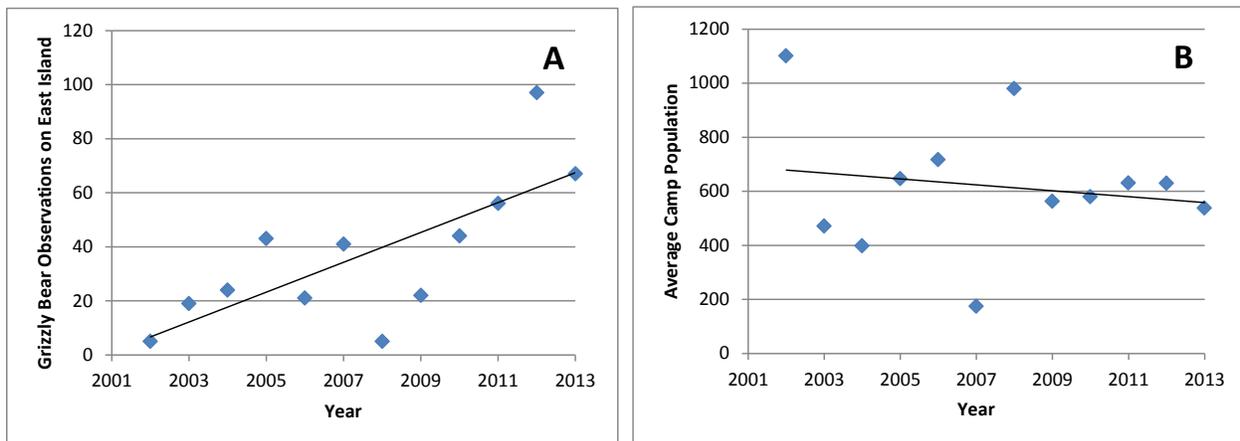


Figure 1: a) Grizzly bear observations related to observation year. b) Average camp population related to observation year (data from Table 7 of the WMR 2013).

DDMI suspects that a sow and two cubs wintered on East Island during the winter of 2011/2012. This may account for the higher number of observations in 2011 and 2012 and we do not see a decrease in grizzly bear observation in 2013. However, grizzly bear relocations had to be implemented in both 2012 and 2013. The increase in bear sightings in more recent years may also be a function of DDMI's change in management approach to not deter grizzly bears "if they mind their own business" (Annual Board Meeting, May 30, 2012). Bear deterrent activities appear to have resumed in 2013 and there were 19 occasions when a helicopter was used as a deterrent. **Given the increase in grizzly bear observations near the mine, DDMI should increase vigilance and future years of data collection should be used to evaluate whether the re-instated deterrent system is effective at reducing grizzly bear presence near the mine.**

The revised impact prediction, proposed by Handley (2010), for the presence of bears relative to mine activities is useful and should be tested in the years to come. This prediction changes the focus from testing the ZOI to testing effects of mine activity. We support DDMI's continued involvement in the grizzly bear hair-snagging program which is designed to address the new, regional scale question about the bear population. Preliminary results on the number of hair samples collected in the 2013 season are presented and we await the results of the DNA fingerprinting exercise which would presumably test the revised impact prediction regarding relative abundance and distribution of grizzly bears in the study area over time. **We recommend EMAB review the DNA fingerprinting results of the grizzly bear hair snagging program once available.**

3.4 Wolverine

Wolverine snow tracking data from past years may indicate potential attraction by wolverine to the mine site. Data from Table 9 appear to indicate an increasing trend in the wolverine track density index (TDI) over time. In 2012, a mean track index was provided within and outside of a 10 km zone around the mine, but a similar comparison was not provided for 2013. The 2012 data showed a higher mean wolverine TDI within a 10 km zone. Given the increasing trend in TDI over time and the higher mean TDI within 10 km of the mine in 2012, we repeat our recommendations from our review of the 2012 WMR: **Future analyses should test whether these observations indicate a real trend. We recommend DDMI discuss the potential causes and consequences of possible increases in wolverine near the mine site and over time.**

There are some differences in the presented track index (tracks/km) values between the 2012 (Table 5-1) and 2013 (Table 9) WMRs. These differences may simply be due to rounding error; however, **we recommend the discrepancies in the data between the years be explained to ensure the correct information is being presented and considered in the monitoring program.**

No relocations or mortality of wolverine were reported on-site. This appears to support the prediction that mining related mortalities are not expected to alter wolverine population parameters in the Lac de Gras area.

The DNA sampling program was not conducted in 2012 or 2013. We support DDMI's intentions to continue participation in the DNA program in 2014. We concur with DDMI's recommendation to increase the frequency that transects are surveyed during wolverine snow track surveys.

3.5 Falcons

There do not appear to be any new findings or changes of note regarding the presence and productivity of Falcons. Two peregrine falcon mortalities were recorded on the mine site in 2013 and were reported to Environment and Natural Resources (ENR). **DDMI should discuss whether any adaptive management measures are necessary to reduce the likelihood of mine-related falcon mortality in the future.** We concur with DDMI's recommendation to continue Pit Wall/Mine Infrastructure monitoring for nesting raptors and to continue providing nest site occupancy and productivity data to the Canadian Peregrine Falcon Survey (CPFS).

3.6 Waterfowl

Habitat utilization by water birds was examined for mine-altered water bodies and East and West bays. Water birds used mine-altered water bodies, but were not detected earlier at mine-altered water bodies compared to East and West bays.

In past years, DDMI has evaluated predictions relating to waterfowl habitat loss, presence, and habitat utilization. The 2012 WMR recommended a review and evaluation of the current waterfowl program to see if any improvements could be implemented. A meeting was held between DDMI and the Canadian

Wildlife Service (CWS) in December 2013 to discuss the waterfowl program. It was agreed that the waterfowl monitoring program would be discontinued at this time, but CWS did recommend that DDMI consider re-starting the waterbird/shorebird monitoring program at the mine reclamation stage.

In past years, we have noted that the data collected on waterfowl diversity, abundance, and pond use is very detailed and could potentially be used for adequate effects monitoring, if control sites existed. However, given the lack of control sites, the habitat utilization analysis in the 2013 WMR, and the analyses presented in Appendix L of the 2013 WMR, we agree that future detailed analyses of the waterfowl data are not likely to provide any greater insight into the effects of the mine on waterfowl. The recommendation to discontinue the waterbird/shorebird monitoring program at this time is therefore acceptable to us. We concur with the CWS recommendation regarding reinstating the waterbird/shorebird monitoring program at the mine reclamation stage. We also concur with the 2013 WMR recommendation to investigate contributing shorebird/waterfowl data to regional monitoring databases.

3.7 Windfarm

In 2012, Diavik added a wind farm (four turbines) intended to reduce Diavik's diesel consumption and greenhouse-gas emissions. Diavik voluntarily implemented a post-construction monitoring program in 2013 to assess the potential direct impacts the wind farm may have on birds.

No bird mortalities were recorded during the 2013 monitoring program. We commend DDMI for voluntarily implementing the monitoring program. Given the low likelihood of avian-turbine strikes, due to location and size of the wind farm, and the absence of bird mortalities in 2013, we concur with DDMI's recommendation to discontinue monitoring the wind farm using 2013 methods and to instead monitor for bird mortalities as part of the overall site compliance monitoring program.

3.8 Waste Monitoring

The attractants (food and food packaging) on the Waste Transfer Area (WTA) and Landfill area appear to be at lower levels in 2013 compared to 2012 (the tabular presentation of data in the 2013 WMR makes it difficult to confirm). The overall effect of waste management is rather positive. We commend DDMI for its efforts which probably led to the low attraction effect on wolverine and bears in the past. However, there seem to be trends showing that grizzly bear and wolverine occurrences near the mine are higher than farther away. **DDMI may need to explore the reasons for this in light of possible other attractants.**

Overall, many wildlife observations and sign have been decreasing over time. While fox observations looked to be steadily increasing in the WTA since 2009, they appear to have levelled off in 2013 (the tabular presentation of data in the 2013 WMR makes it difficult to confirm). **We recommend DDMI evaluate whether this levelling-off of fox observations in the WTA persists in future years.**

Given the relatively low number of wildlife observation at the landfill, we concur with the recommendation to reduce the frequency of inspections at the landfill. No recommendation was made

regarding the frequency of WTA inspections and we recommend that the current inspection schedule be maintained for the WTA.

4.0 Closure

The review of the 2013 WMR reported herein presents the conclusions arrived at by MSES. As last year, we note with satisfaction that the communications we were involved in with DDMI, since our review of the past years, were useful in improving our understanding of the monitoring work conducted by DDMI. We note that several recommendations and requests from previous years were not responded to by DDMI (Table 1). Some of our recommendations may be best addressed during detailed data analyses using multiple years of new data. We hope that future communications will lead to further clarification on several details of the 2013 WMR. Our views are submitted to EMAB for its consideration of potential recommendations and actions.

5.0 References

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