10 March 2017

DIAVIK DIAMOND MINES (2012) INC.

2016 Wildlife Monitoring Report

Submitted to:
Diavik Diamond Mines (2012) Inc.
PO Box 2498
300 - 5201 50th Avenue
Yellowknife, NT
1XA 2P8, Canada

Attention: Mr. David Wells

REPORT

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Executive Summary

As a requirement of the Environmental Agreement, Diavik Diamond Mines (2012) Inc. (DDMI) completes a Wildlife Monitoring Program (WMP) each year. The objective of the WMP is to collect information that will assist in determining if there are effects on wildlife in the study area and if these effects were accurately predicted in the Environmental Assessment. The WMP also collects data to determine the effectiveness of site-specific mitigation practices and the need for any modifications. The following report documents results collected for the 2016 WMP for the Diavik Diamond Mine (Mine) located at Lac de Gras, Northwest Territories (NWT). The data were collected according to procedures outlined in the Mine's Standard Operating Procedures. Where helpful, comparisons to the information gathered during the previous monitoring (2000 to 2015) and the pre-construction baseline (June 1995 to August 1997) have been included.

General observations for each program include the following.

Landscape Changes

- In 2016, the Mine footprint increased by 0.67 square kilometres (km^2). The total loss of terrestrial and aquatic habitats to date from mining activities (11.22 km^2) is below that predicted in the Environmental Effects Report (EER).

Barren-Ground Caribou

- The total caribou summer habitat loss to date is 2.79 habitat units, which remains below the prediction made in the EER.
- Caribou aerial surveys were not required or completed in 2016. DDMI is waiting for the recommendations and direction from the Department of Environment and Natural Resources, Government of the Northwest Territories (ENR) Zone of Influence Technical Task Group for guidelines on future caribou aerial surveys.
- Two ground-based caribou behavioural scanning observations were completed in 2016. Both observations occurred on caribou groups greater than 22 kilometres (km) from Mine infrastructure.
- There were no caribou injuries or mortalities reported in 2016.
- During 2016, the caribou traffic advisory remained at "No Concern" for the entire year, as caribou numbers on East Island did not exceed 100 at any given time.
- There was no action taken to herd caribou away from potential hazards in 2016.
- DDMI provided support to a NWT Cumulative Impact Monitoring Program to develop Bathurst caribou winter range habitat selection models, which was completed in April, 2016.

Grizzly Bear

- The total direct grizzly bear habitat loss to date is 8.13 km^2, which is below the amount predicted in the EER.
- Grizzly bear hair snagging studies were not undertaken in 2016. The long-term duration and frequency of this program has not been determined, but DDMI is planning for this program to occur in 2017.
- A total of 137 incidental observations of grizzly bears were recorded within and adjacent to the wildlife study area during 2016 from 25 April to 16 October.
- No grizzly bear injuries or mortalities occurred during 2016.

Wolverine

- The snow track survey was completed twice in 2016.
- The wolverine hair snagging program was not completed in 2016. The long-term duration and frequency of this program has not been determined.
- A total of 105 incidental observations of wolverine were recorded within and adjacent to the wildlife study area during 2016 from 6 January to 31 December. There were two relocations of wolverine in March as a result of repeated observations at site.
- A mortality to a wolverine was reported in 2016 when a carcass was discovered in an empty waste bin.

Raptors

- In 2016, the regional raptor nest monitoring surveys were not completed by ENR. These surveys are planned to take place every five years, with the next survey is scheduled for 2020.
- Pit Wall/Infrastructure surveys were conducted 7 May to 17 August 2016. Peregrine falcons were observed nesting at the site services building. No active raptor nests were observed on pit walls.
- A peregrine falcon carcass was found at the Mine near the main intersection for entry to the A21 area in 2016. There was very little left of the carcass upon discovery and the cause of death could not be determined.

Waste Management

- In 2016, the Landfill and Waste Transfer Area (WTA) were inspected once per week in the winter and summer. Inspections of the A21 Area were conducted every three days and inspections of the Underground occured once per week. During inspections staff identified and removed any improperly disposed waste and recorded all sign of wildlife or wildlife activity.
- Throughout 2016, 14,632 units of aluminum containers ($1,463.20) and 9,392 units of plastic containers ($939.20) were recycled and the total monetary value was donated to charity.
- During 2016, a total of 266,596 litres of waste oil were collected and burned in waste oil heat-generating boilers.
- In 2016, the wind farm generated 14,298 megawatt hours (MWh) of power, which represents an estimated diesel savings of 3.4 million litres.

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1.0 INTRODUCTION

1.1 Background

Diavik Diamond Mines (2012) Inc. (DDMI or Diavik) conducted wildlife baseline studies from 1995 to 1997. The information was used to describe ecological conditions in the Lac de Gras area in support of the Project Description and Environmental Assessment (DDMI 1998a, b). A Wildlife Monitoring Program (WMP) was developed as part of the Environmental Agreement for the Diavik Diamond Mine (Mine; DDMI 2002). Documents that were used in developing the WMP include the following:

- Comprehensive Study Report, Diavik Diamonds Project (The *Canadian Environmental Assessment Act* 1999).
- Environmental Assessment Overview, Diavik Diamonds Project (DDMI 1998c).
- Environmental Effects Report, Wildlife, Diavik Diamonds Project (DDMI 1998b).
- Wildlife Baseline Report, Diavik Diamonds Project (Penner 1998).

Monitoring by DDMI during construction and operation of the Mine has been used to test impact predictions in the EER (DDMI 1998a, b), evaluate the effectiveness of mitigation, and provide feedback for adaptive management. The WMP also considers wildlife issues of concern identified by communities and regulatory agencies.

Based on reviews and discussions among DDMI, communities and regulators, the WMP has evolved since the original design in response to trends observed in the data and changes to objectives, study designs and methods. Rationale for changes were based on the effectiveness of data to test impact predictions, community concerns, adaptive management principles and the establishment of regional monitoring programs. Further, community site visits occur annually and allow community members an opportunity to observe Mine operations.

Due to the large degree of natural variation inherent in ecosystems, it is often difficult to detect indirect effects with only one or two years of data. Therefore, a more comprehensive analysis and discussion of all data from the WMP has been completed every three years and submitted as a separate report. Separate reporting began in 2004 following requests for more formal statistical analysis of monitoring data by EMAB (EMAB 2004) and ENR (ENR 2004). Since 2010, WMP programs for caribou, grizzly bear and falcons have been suspended or removed (Marshall 2009, Handley 2010), which negates the need to complete statistical analyses. The current hair snagging programs completed for grizzly bear and wolverine are designed to evaluate cumulative effects and are contributed to the GNWT for this purpose. Of the studies completed in the most recent two comprehensive analysis reports in 2017 and 2014 (Golder 2014), the wolverine snow track monitoring is the only program at site that remains active and evaluates regional EER predictions. Based on the principles of adaptive management, DDMI will no longer complete an independent comprehensive analysis report for wildlife. Instead all comprehensive statistical analyses related to active monitoring programs will be included every three years in the annual WMP report, and would begin in 2020, if applicable. For the intermediate years, the annual reports present findings from that year, and summarize cumulative data collected up to that year. If critical issues become apparent in the shorter term, then a discussion of these issues is presented in annual reports.

1.2 Objectives

The overall objectives of the WMP are to:

- Collect information that will assist DDMI to determine if there are effects on wildlife and if these effects were accurately predicted in the EER.
- Determine the effectiveness of mitigation practices intended to limit Mine-related effects on wildlife and whether or not these practices and policies require modification.
- Detect effects that were not predicted in the EER.

Objectives specific to valued components are presented in the following sections.

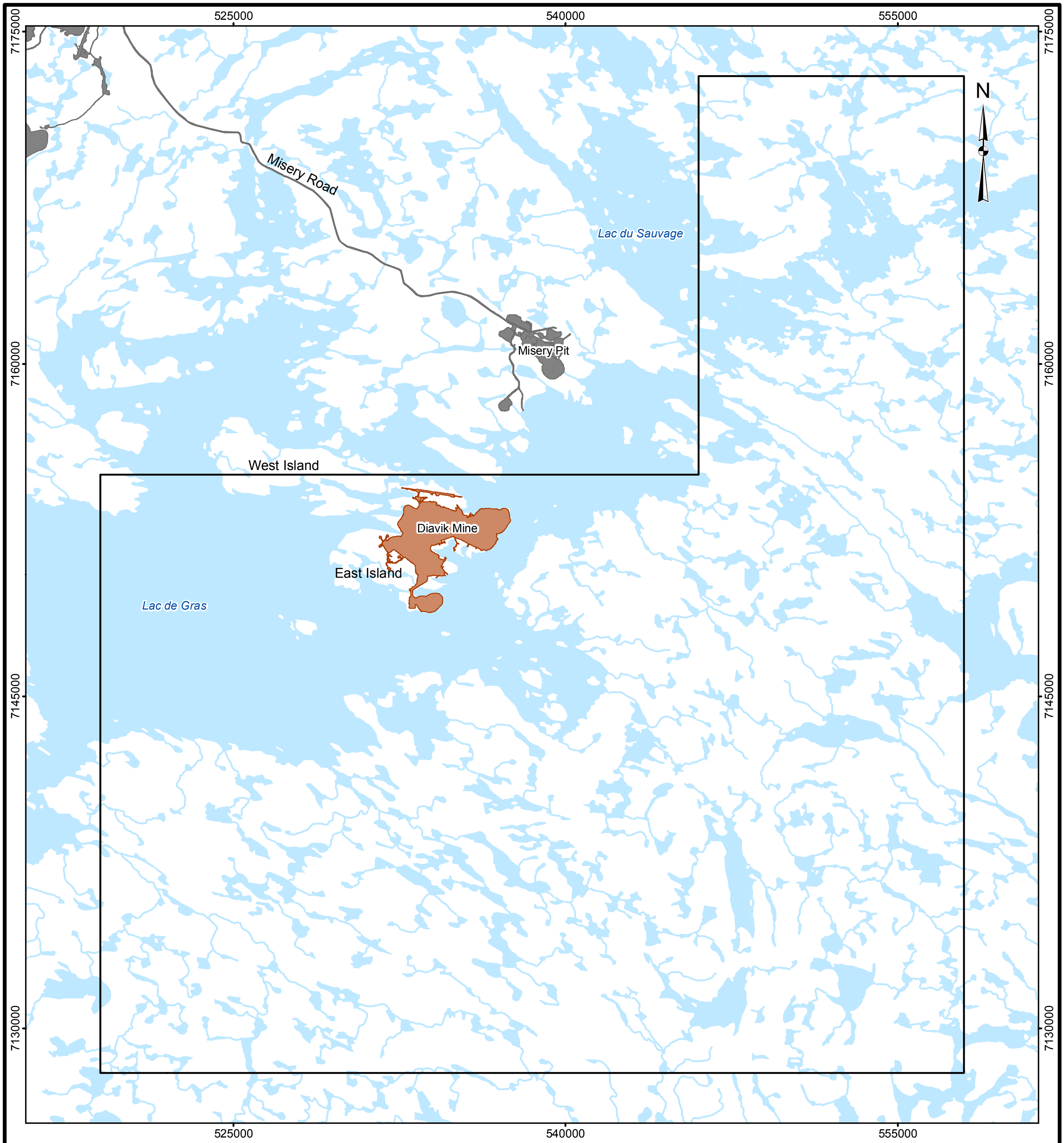
1.3 Study Area

The Mine is located on East Island in Lac de Gras (Figure 1). The wildlife study area is 1,200 square kilometres (km^2) and includes the East and West islands, aquatic habitats, many smaller islands in the northeast portion of Lac de Gras, and the mainland along the southern, eastern and northern shores of Lac de Gras. An extension to the northwest was made to include the Lac du Sauvage narrows, an important caribou migration corridor (Penner 1998). The local study area during baseline studies (Penner 1998) covered approximately 805 km^2.

The Mine includes accommodation facilities, operations buildings, haul roads, an airstrip, country rock piles, the A154 and A418 pits and dikes, current completed construction of the A21 dike, and all other infrastructure (Figure 2). In 2012 the Mine was expanded to include the wind farm and access roads to the wind farm. The majority of haul roads required for mining activities are complete.

1.4 Report Organization

Within each section of this report, data are presented that will be tracked over the life of the Mine. Recommendations for enhancement to the WMP are presented at the end of each section for consideration, and may be incorporated into the WMP for subsequent years. The WMP is an evolving program that will reflect recommendations during previous years, as well as advances in Mine development. Changes will be captured in annual revisions of the WMP.



LEGEND

☐ DIAVIK WILDLIFE STUDY AREA BOUNDARY
🟫 DIAVIK FOOTPRINT
⬛ EKATI FOOTPRINT
— WATERCOURSE
🟦 WATERBODY

10 0 10
SCALE 1:250,000 KILOMETRES

REFERENCE

BASE DATA: NTDB 1:250,000. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – CANADA.
DATUM: NAD83 PROJECTION: UTM ZONE 12

PROJECT
[redacted]
DIAVIK DIAMOND
MINES INC.

TITLE

DIAVIK WILDLIFE STUDY AREA

[redacted]

PROJECT		1648005	FILE No.
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GIS	VV	27 Feb. 2017	
CHECK	DC	27 Feb. 2017	**FIGURE: 1**
REVIEW	JV	27 Feb. 2017	

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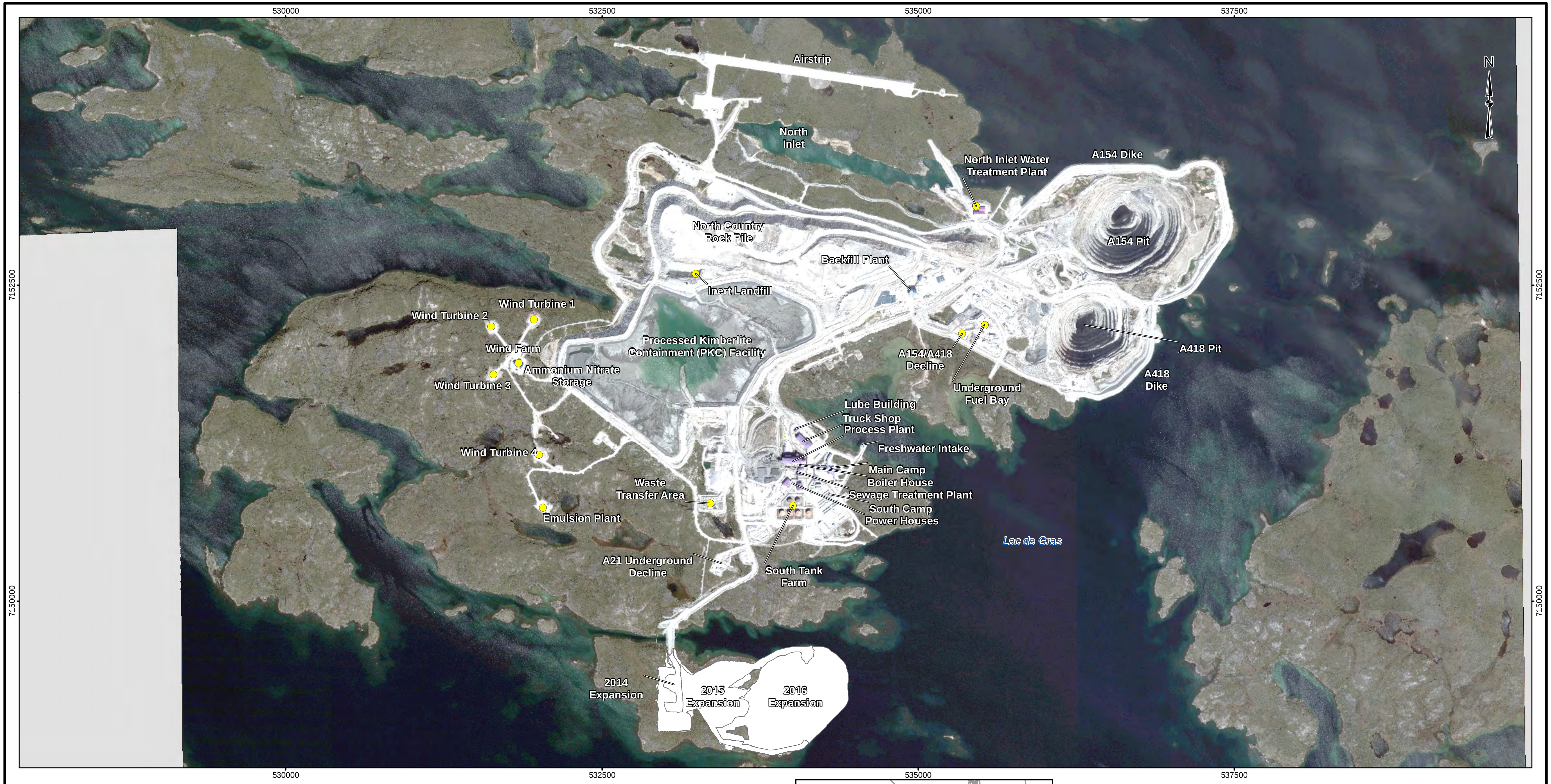
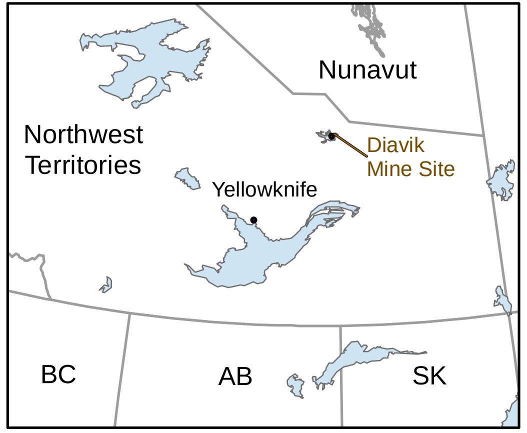


LEGEND

● INFRASTRUCTURE



1 0 1

SCALE 1:30,000 KILOMETRES

PROJECT

RioTinto

DIAVIK DIAMOND MINES INC.

TITLE

DIAVIK MINE SITE INFRASTRUCTURE, 2016

REFERENCE

2013 WORLDVIEW IMAGE OBTAINED FROM CLIENT.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

Golder Associates

PROJECT		1648005	FILE No.	
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GIS	VV	23 Feb. 2017	FIGURE: 2	
CHECK	DC	27 Feb. 2017		
REVIEW	JV	27 Feb. 2017		

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2.0 LANDSCAPE CHANGES

The scope of the landscape component of the WMP is to determine if vegetation and surface water loss is within the extent predicted in the EER (DDMI 1998b). East Island vegetation cover is predominantly characterized by heath tundra, and tussock/hummock landscape classes, but the Mine has also resulted in the loss of shallow and deep water. The main change from the Mine on the landscape is direct disturbance, which will be a long-term effect as the recovery of vegetation is slow in arctic environments (Burt 1997).

In addition, Diavik conducts ongoing monitoring to determine if dust from the Mine is affecting vegetation communities and lichen and soil chemistry near the Mine site. Permanent vegetation plots are assessed for vegetation species cover (relative abundance) and richness at Mine and reference sites. Metals concentrations are analyzed in lichen and soil samples near and far from the Mine. Vegetation, lichen and dust deposition monitoring data were collected in 2016 with help from Grace Martin from the Yellowknives Dene First Nation. A Comprehensive Vegetation and Lichen Analysis Report is generated every three years, which was completed in January 2017 and is included in Appendix I.

The objective of this component of the WMP is to:

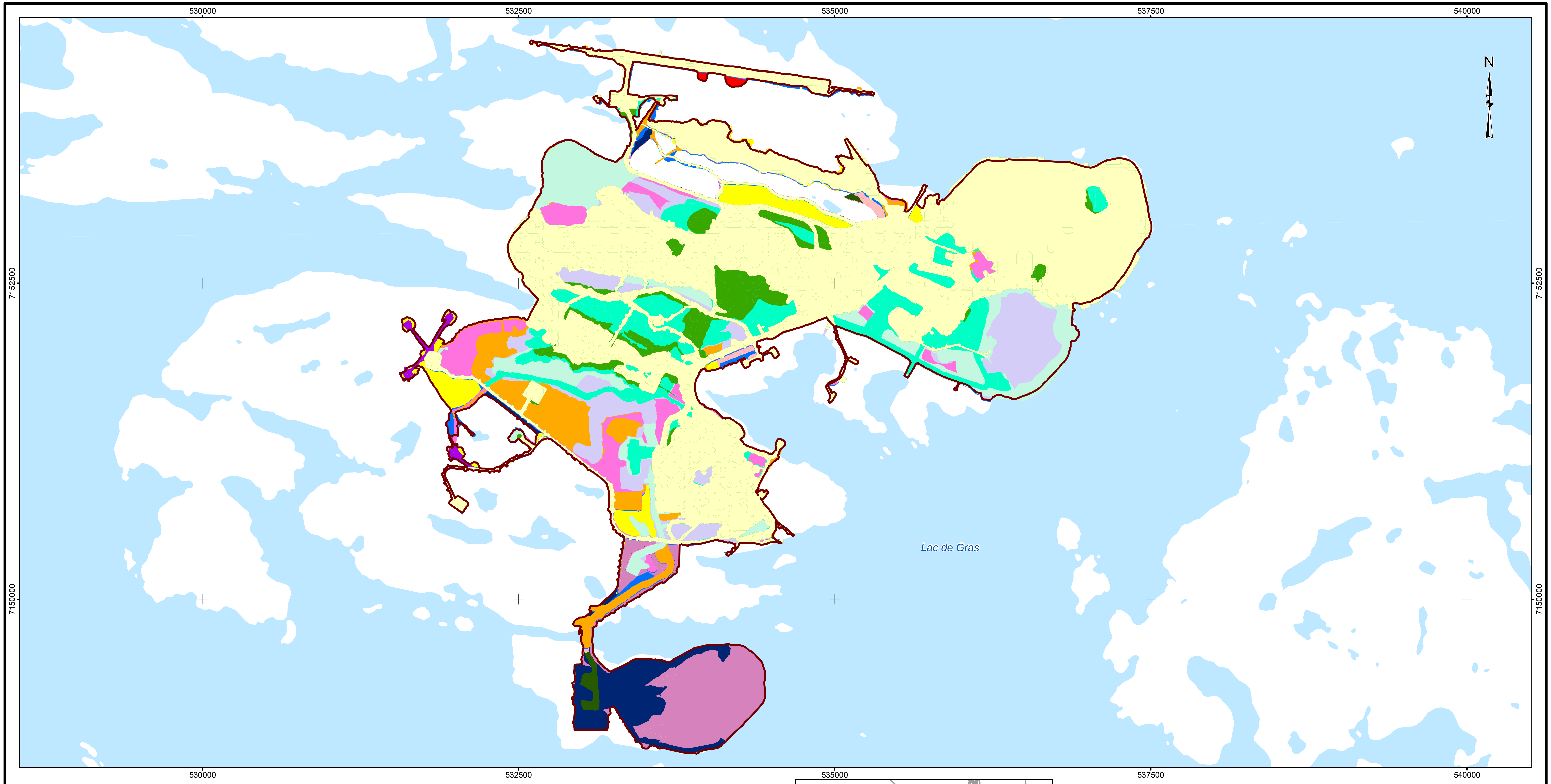
- determine if direct vegetation/habitat loss due to the Mine footprint exceeds the prediction of 12.67 km^2

2.1 Methods

A satellite image was obtained and used to update the area of the current Mine footprint. The image was laid over the Ecological Landscape Classification (ELC) developed by the Department of Environment and Natural Resources, Government of the Northwest Territories (ENR) (Matthews et al. 2001). Each ELC type disturbed by the Mine was selected and calculations were made to determine the area (km^2) of each habitat type replaced by the Mine footprint. Values provided for ELC unit loss are estimates based on the predicted Mine extent (DDMI 1998a), the actual Mine footprint, and the ELC classification (Matthews et al. 2001).

2.2 Results

As of December 2016, a total area of 11.22 km^2 has been altered since Mine construction in 2000. This represents a relative loss of 88.6% of the predicted landscape disturbance (DDMI 1998a). Land cover types at or slightly exceeding the predicted loss include riparian shrub, esker complex, bedrock complex and boulder complex (Table 1). In 2016, the ELC types that changed included heath tundra, heath bedrock, heath boulder, tussock/hummock, boulder complex, and shallow and deep water (Table 1). The annual geographic extent of landscape disturbed from the Mine footprint is illustrated in Figure 3.



LEGEND

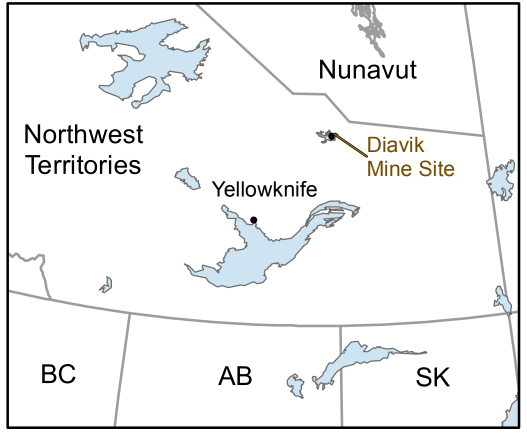
━	2016 MINE PERIMETER
🟦	WATERBODY

DISTURBANCE (2002-2015)

🟨	2002
🟩	2003
🟩	2004
🟩	2005
🟪	2006
🟧	2007
🟪	2008
🟦	2009
🟥	2010
🟪	2011
🟨	2012
🟥	2013
🟩	2014
🟦	2015
🟪	2016

REFERENCE

BASE DATA: CANVEC HYDROLOGY. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – CANADA.
PROJECTION: UTM ZONE 12 DATUM: NAD 83



1 0 1
SCALE 1:30,000 KILOMETRES

PROJECT
RioTinto
DIAVIK DIAMOND
MINES INC.

TITLE

MINE FOOTPRINT EXPANSION
BY YEAR, 2002 TO 2016

Golder Associates

PROJECT		1648005	FILE No.
DESIGN	KB	20 Dec. 2016	SCALE AS SHOWN REV. 0
GIS	VV	27 Feb. 2017	FIGURE: 3
CHECK	DC	27 Feb. 2017	
REVIEW	JV	27 Feb. 2017	

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Table 1: Total and Predicted Ecological Landscape Classification Unit Loss, 2000 to 2016

ELC Type	Total Area (km^2) Lost per Year															
	up to 2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Predicted[c]
Heath Tundra	1.45	1.89	2.02	2.38	2.62	2.76	2.93	2.97	3.03	3.00	3.01	3.20	3.20	3.24	3.42	3.52	3.68
Heath Bedrock (30% to 80%)	0.08	0.34	0.36	0.40	0.45	0.49	0.53	0.58	0.59	0.58	0.59	0.64	0.64	0.64	0.65	0.67	0.78
Health Boulder (30% to 80%)	0.26	0.64	0.73	0.96	1.07	1.24	1.43	1.49	1.52	1.5	1.53	1.62	1.63	1.63	1.72	1.75	1.89
Tussock/ Hummock	0.45	0.63	0.79	1.01	1.19	1.27	1.35	1.42	1.44	1.43	1.44	1.46	1.47	1.47	1.53	1.54	1.64
Sedge Wetland	0.02	0.03	0.04	0.09	0.16	0.16	0.17	0.21	0.21	0.21	0.21	0.22	0.22	0.22	0.23	0.23	0.26
Riparian Shrub	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Birch Seep and Shrub	0.03	0.05	0.06	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.11
Boulder Complex	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.05
Bedrock Complex	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07
Esker Complex	0.13	0.14	0.14	0.15	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16
Disturbed[b]	0	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Shallow Water	0.11	0.23	0.23	0.26	0.29	0.34	0.35	0.35	0.35	0.34	0.34	0.36	0.36	0.35	0.37	0.40	0.48
Deep Water	0.15	1.80	1.81	1.82	1.93	2.17	2.19	2.19	2.19	2.12	2.12	2.13	2.13	2.13	2.16	2.63	3.46
Total[a]	**3.12**	**5.88**	**6.32**	**7.30**	**8.15**	**8.86**	**9.40**	**9.66**	**9.78**	**9.65**	**9.71**	**10.1**	**10.12**	**10.15**	**10.55**	**11.22**	**12.67**

(a) Any discrepancies in totals across the rows results from the rounding of numbers in annual columns for presentation purposes.

(b) Disturbed includes areas that were already disturbed by exploration activities when the ELC was created.

(c) From DDMI 1998a.

km^2 = square kilometres; % = percent.

3.0 BARREN-GROUND CARIBOU

The Mine is within the spring (northern migration), summer and fall/rut seasonal ranges of the Bathurst caribou herd (Gunn et. al. 2002). Caribou of this herd may travel through the Lac de Gras area during the northern migration to the calving grounds, and forage and move through the area during the summer and fall periods, sometimes following shorelines and onto the West and East Islands. At the time of this report, caribou were present in the study area and caribou collar locations suggest these animals were most likely from the Beverly/Ahiak herd.

In 1996, the mean population size (± 95% confidence interval) of the Bathurst caribou herd was estimated at 349,000 ± 95,000 (Case et al. 1996; Gunn et al. 1997). The most recent population survey, completed by ENR in June 2015, estimated the number of animals to be from 16,000 to 22,000 (ENR 2017a). Although the Beverly and Ahiak herds are not monitored as intensively as the Bathurst herd, the last census for the Ahiak herd was in June of 2011 and estimated 71,000 individuals (ENR 2017b), like the Bathurst caribou these herds are believed to also be in decline as are a number of other circumArctic herds (Festa-Bianchet et al. 2011; Gunn et al. 2011). Barren-ground caribou (*Rangifer tarandus groenlandicus*) including the Bathurst and Beverly/Ahiak herds are designated as sensitive in the Northwest Territories (NWT) and are scheduled for reassessment by the NWT Species at Risk (SAR) Committee in March 2017 (NWT SAR 2017). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed barren-ground caribou in November 2016 as threatened (COSEWIC 2017). To support the recovery of all barren-ground caribou herds, the 2011 to 2015 NWT Barren-ground Caribou Management Strategy was developed (GNWT 2011). The overall goal of the strategy is to maintain numbers of caribou within their natural range of variation. The GNWT has outlined five objectives to obtain this goal:

- to engage co-management partners in monitoring and management of caribou
- to ensure appropriate, up-to-date information is available for management decisions
- to manage impacts of key factors affecting caribou that are within control
- to inform the public about the status of caribou and their role in management
- to maximize benefits from caribou for NWT residents

The strategy outlined the need to monitor the effects of predators on caribou as predation was considered a factor that could be managed. Wolves are the most important year-round predator of barren-ground caribou and knowledge of wolf numbers could help understand fluctuations in caribou populations and provide information required to support management decisions. A new barren-ground caribou management strategy for 2016 to 2020 is under development (ENR 2017c).

3.1 Habitat Loss

Physical alteration of the landscape reduces available caribou forage (DDMI 1998b). Habitat loss on East Island is expressed in habitat units (HUs) for caribou summer habitat. A habitat unit is the product of surface area and suitability of the habitat in that area to supply food for caribou and cover from predators (DDMI 1998b). Habitats were rated on a scale of 0 to 1 HUs for their capability to support caribou, with values greater than 0.30 regarded as highly suitable habitat and values less than 0.25 rated as low suitability for caribou. The area of each habitat type on East Island was multiplied by its habitat suitability value to determine the number of foraging habitat units available to caribou.

One objective of the caribou component of the WMP is to determine if direct summer habitat loss (in HUs) is greater than predicted. The impact prediction in the EER (DDMI 1998b) is:

- at full development, direct summer habitat loss from the project is predicted to equal 2.965 HUs

Dust deposition can also alter the landscape either by positively influencing vegetation vigour through deposition of nutrients and increased snowmelt rates, or by reducing plant growth by coating leaves and adversely changing soil chemistry. Either scenario can lead to a change in plant communities, and forage quality and quantity for caribou. Diavik also monitors for the effect of dust deposition on vegetation (including lichen) and soil chemistry (Section 2.0).

3.1.1 Methods

Using the ELC unit loss (Table 1), the area (km^2) of ELC lost was multiplied by its habitat suitability value (DDMI 1998b) to determine habitat units lost.

3.1.2 Results

Direct summer habitat loss to date from the Mine is approximately 2.79 HUs (Table 2). As noted above (Table 1), ELC unit loss is below the level predicted in the EER. Similarly, total direct losses of summer HUs for caribou are currently below that predicted in the EER.

Table 2: Caribou Summer Habitat Unit Loss to 2016

ELC Type	Habitat Suitability Value	ELC Loss to 2016 (km^2)	Habitat Unit Loss to 2016
Heath Tundra	0.37	3.52	1.302
Heath Boulder	0.40	1.75	0.700
Riparian Shrub	0.46	0.03	0.014
Bedrock Complex	0.27	0.07	0.019
Tussock/Hummock	0.30	1.54	0.462
Sedge Wetland	0.28	0.23	0.064
Esker Complex	0.30	0.17	0.051
Birch Seep and Shrub	0.11	0.10	0.011
Boulder Complex	0.21	0.05	0.011
Heath Bedrock	0.23	0.67	0.154
Total	**-**	**8.13**	**2.788**

Any discrepancies in totals result from the rounding of numbers for presentation purposes.

3.2 Changes to Movement

Miller and Gunn (1979) described disturbance in relation to wildlife as “the phenomenon, which resulted from the introduction of unfamiliar stimuli into an animal’s environment brought about by the presence of human activities”. Mining activities have the potential to decrease the use of habitat adjacent to human developments by caribou due to behavioural disturbance (DDMI 1998b; Golder 2011; Boulanger et al. 2012).

The current objective for this component of the WMP is to determine if the area around the Mine where caribou distribution is altered (the zone of influence [ZOI]) due to mining activities is greater or less than predicted. The following section summarizes the methods used and results obtained from surveys. The revised impact prediction presented by Handley (2010) is:

- to determine whether the zone of influence changes in relation to Mine activity

From 2002 through 2009, DDMI completed weekly aerial surveys, weather permitting, within a study area that surrounds the Mine. In 2009, the survey area was aligned with that of the Ekati Diamond Mine to improve sampling efficiencies while covering a larger area. In 2012, aerial surveys were conducted in collaboration with the Ekati Diamond Mine. DDMI and the Ekati Diamond Mine requested to omit the ZOI requirements for the caribou monitoring program in 2013; the request was approved by ENR on 2 May 2013. Caribou aerial surveys were not completed from 2014 through 2016.

3.3 Changes to Behaviour

Ground-based behavioural observations, or scan sampling, are conducted to provide data on changes in caribou behaviour as a function of distance from the Mine. Monitoring is conducted cooperatively with the Ekati Diamond Mine as they regularly have caribou close to the Ekati Mine infrastructure. Because the primary habitat within 5 km outside the Mine footprint is water, DDMI is focused on collecting scanning observations further from the mines. The revised impact prediction from Handley (2010) is:

- to determine if caribou behaviour changes with distance from the mines

3.3.1 Methods

Caribou groups were scanned every eight minutes for a minimum of four observations and a maximum of eight observations. For each scan, the number of animals exhibiting each type of behaviour was recorded (Murphy and Curatolo 1987). Individual caribou activities were recorded as feeding, bedded, standing, alert, walking, trotting or running. Individuals were classified as feeding when they were actually foraging or searching for food (i.e., walking with head down). The GPS location was recorded, and observations were conducted during the autumn when more caribou were passing through the area. Group composition was classified, and the number of animals in the group was recorded. The response variable is caribou behaviour, while the covariates include distance from Mine, group composition, and weather variables. In order to control for the effects of habitat, all observations were performed within one habitat type (tundra with <30% bedrock or boulders). For the scan observations, weather conditions such as wind speed and direction, temperature, and type of precipitation were documented.

Response of caribou to stressors was also assessed. In the event that a stressor was introduced during scan sampling, the observers noted the time and recorded the response of caribou to stressors as either no response, looked in the direction of the stressor, trotted or ran away. The reaction of the majority of the group was used in selecting the category. Estimated distance (m) from the stressor was also recorded. Stressors included type of wildlife, type of aircraft, type of vehicle, and blasts from pits. The observers then waited until the animals resumed their previous behaviour (usually 1 to 2 minutes), and would begin scanning observations again.

3.3.2 Results

Few caribou groups were observed in the study area in 2016 (Appendix A). As a result, scanning observations were collected on 2 caribou groups, all greater than 22 km from the Mine. Data analysis similar to that completed in Golder (2011) will be undertaken when more observations are obtained on caribou closer to the Diavik and Ekati mines.

3.4 Changes to Distribution

Deflection of caribou movements due to mining activities was also predicted (DDMI 1998b). Information collected from caribou collar locations is used to examine the distribution of caribou within the wildlife study area. Prior to 2015, only female caribou were collared. In 2015, ENR placed additional collars on male caribou. These observations are then compared with predicted trends in movement.

The impact prediction in the EER (DDMI 1998b) is:

- During the northern (spring) migration, caribou would be deflected west of East Island and during the southern migration (fall), caribou would move around the east side of Lac de Gras.

3.4.1 Methods

Data on the geographic location of collared cows and bulls was provided courtesy of ENR, and this information was used to illustrate the movement paths of the Bathurst caribou herd during the northern and southern migration periods.

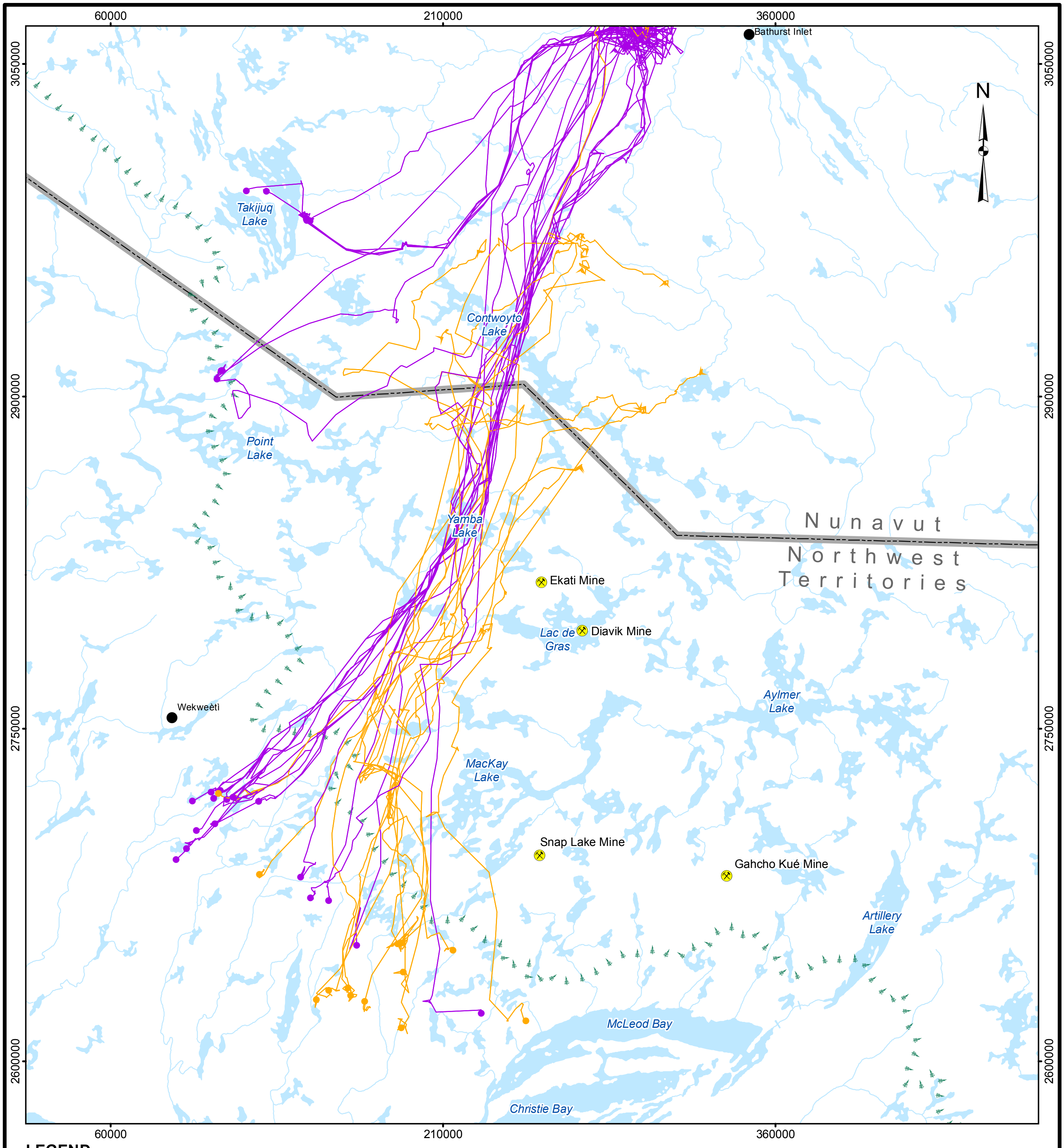
Movements of collared Bathurst caribou during the 2016 northern and southern migrations are included in this report, but are focused on caribou that are located within approximately 200 km of Lac de Gras and the Mine. The northern migration is defined by the period when Bathurst caribou cows leave the winter range in the forest, and migrate north to the calving grounds, typically in May (Gunn et al. 2002). The southern migration starts with the return from the calving and post-calving areas in July, and continues to the fall/rut period ending around 31 October (Gunn et al. 2002). However, as the result of range contraction with smaller herd size, Bathurst caribou are moving past the Lac de Gras region later in the year.

3.4.2 Results

Data from satellite-collared caribou show that during the northern migration 28 collared caribou (16 females, 12 males) traveled west and none traveled east of Lac de Gras, which supports the prediction in the EER (Figure 4). These results are also consistent with the long-term patterns observed since 1996, and further support the observation that the northern migration route of Bathurst caribou relative to the west and east side of Lac de Gras is influenced by their location on the winter range (Golder 2011).

During the southern migration, nine collared caribou (3 females, 6 males) traveled west and one female traveled east of Lac de Gras from July to 30 November 2016 (Figure 5). The results for 2016 are inconsistent with the prediction of eastern movement around Lac de Gras during the southern migration in the EER. However, across all years, 169 (73%) of 231 collared caribou moved west past Lac de Gras during the northern and 120 (63%) of 190 collared caribou moved east during the southern migrations past Lac de Gras, respectively (Golder 2017). Long-term caribou movement paths generally correspond to the predictions made in the EER (DDMI 1998).

The most recent comprehensive report showed that from 2009 to 2013, collared caribou females from the Bathurst herd have remained further north than historically recorded and arrived in the Lac de Gras area later in the year (Golder 2014), which is consistent with range contraction in declining herds (Bergerud et al. 1984, Valkenburg and Davis 1986, Messier et al. 1988). Caribou are considered sensitive to disturbance during the post-calving period because calves are maturing and still dependent on maternal cows. A northern shift during the post-calving period may be associated with a reduction in encounter rates with industrial activities in the Slave Geological Province (e.g., the Mine) and lower energetic costs for females and claves from human-related disturbance (Golder 2014).



LEGEND

⊗	EXISTING MINE
●	POPULATED PLACE
●→	NORTHERN MIGRATION OF FEMALES (APRIL 15 - JUNE 1)
●→	NORTHERN MIGRATION OF MALES (APRIL 15 - JUNE 1)
▬	TERRITORIAL BOUNDARY
⸙	TREELINE
—	WATERCOURSE
▭	WATERBODY

100 0 100

SCALE 1:2,500,000 KILOMETRES

REFERENCE

1. CARIBOU DATA SUPPLIED BY ENVIRONMENT AND NATURAL RESOURCES. 2016. NWT WILDLIFE MANAGEMENT INFORMATION SYSTEM. GOVERNMENT OF THE NWT, YELLOWKNIFE NT: PROJECT 39 – NORTH SLAVE – BATHURST CARIBOU GPS LOCATIONS 2008 TO PRESENT.
2. 1:2 MILLION SCALE BASE DATA FROM THE ATLAS OF CANADA; CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – CANADA. DATUM: NAD83 PROJECTION: NWT LAMBERT CONFORMAL CONIC

PROJECT

[redacted]

DIAVIK DIAMOND
MINES INC.

TITLE

NORTHERN MIGRATION OF BATHURST CARIBOU HERD, 2016

[redacted]

PROJECT		1648005	FILE No.	
DESIGN	KB	20 Dec. 2016	SCALE AS SHOWN	REV. 0
GIS	VV	27 Feb. 2017	FIGURE: 4	
CHECK	DC	27 Feb. 2017		
REVIEW	JV	27 Feb. 2017		

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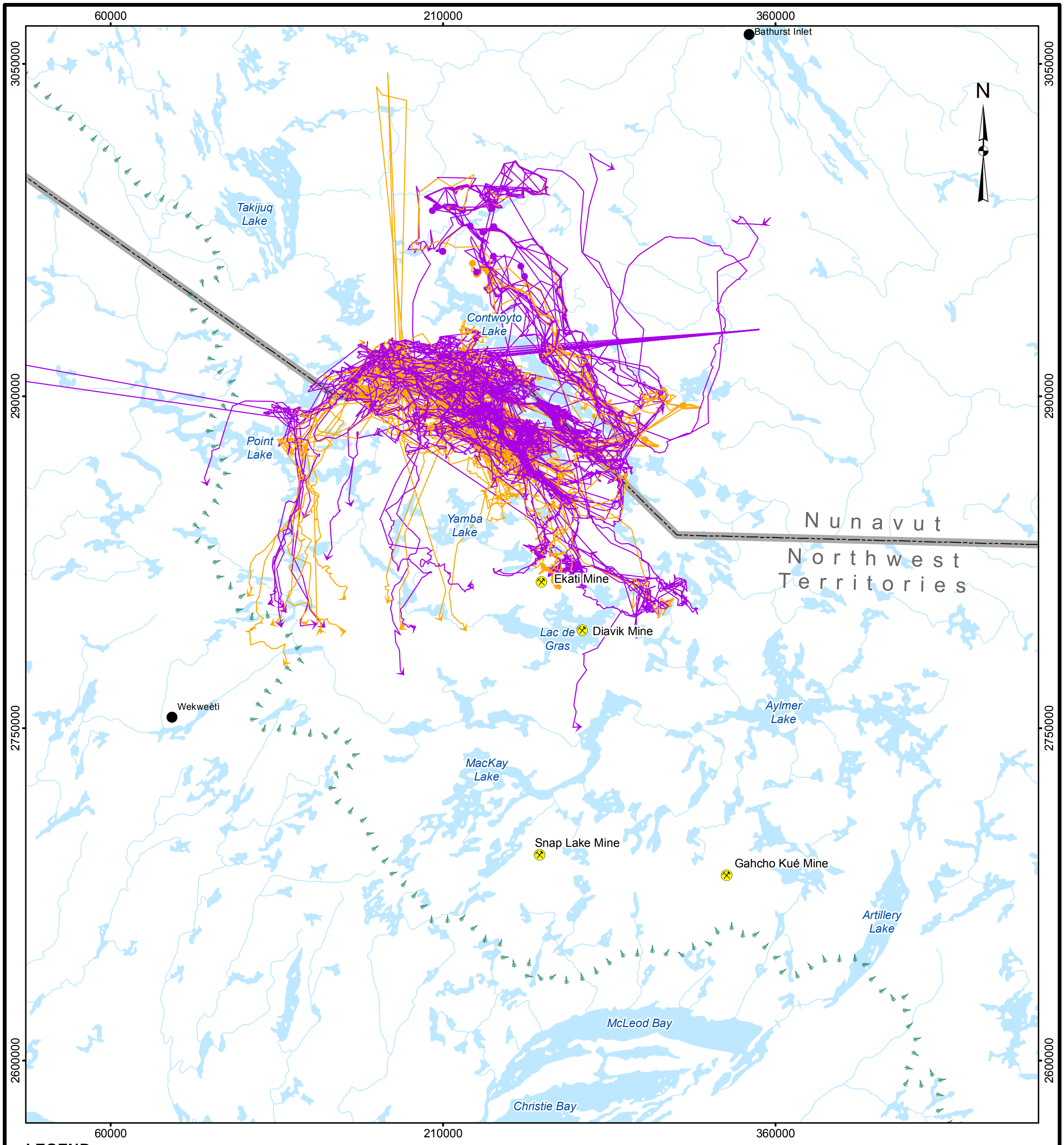

LEGEND

- ⚒ EXISTING MINE
- ● POPULATED PLACE
- ●→ SOUTHERN MIGRATION OF FEMALES (JULY 1 - NOVEMBER 30)
- ●→ SOUTHERN MIGRATION OF MALES (JULY 1 - NOVEMBER 30)
- ▬ TERRITORIAL BOUNDARY
- TREELINE
- WATERCOURSE
- ▨ WATERBODY

100 0 100

SCALE 1:2,500,000 KILOMETRES

REFERENCE

1. CARIBOU DATA SUPPLIED BY ENVIRONMENT AND NATURAL RESOURCES. 2016. NWT WILDLIFE MANAGEMENT INFORMATION SYSTEM. GOVERNMENT OF THE NWT, YELLOWKNIFE NT: PROJECT 39 – NORTH SLAVE – BATHURST CARIBOU GPS LOCATIONS 2008 TO PRESENT.
2. 1:2 MILLION SCALE BASE DATA FROM THE ATLAS OF CANADA; CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – CANADA. DATUM: NAD83 PROJECTION: NWT LAMBERT CONFORMAL CONIC

PROJECT

[redacted]

DIAVIK DIAMOND
MINES INC.

TITLE

SOUTHERN MIGRATION OF BATHURST CARIBOU HERD, 2016

[redacted]

PROJECT		1648005	FILE No.	
DESIGN	KB	20 Dec. 2016	SCALE AS SHOWN	REV. 0
GIS	VV	27 Feb. 2017	FIGURE: 5	
CHECK	DC	27 Feb. 2017		
REVIEW	JV	27 Feb. 2017		

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3.5 Incidents and Mortalities

Mineral development in the Bathurst caribou herd range created concerns about increased mortality, which include vehicle collisions, aircraft collisions, and accidents associated with caribou in hazardous areas around mining activities (DDMI 1998b). Mitigation practices and policies have been implemented to reduce the potential for mortalities such as, wildlife have the right-of-way on all roads, communicating the presence of caribou via radio, and the caribou traffic advisory. The objective for this program is to determine if the number of caribou deaths or injuries associated with the Mine is greater than predicted. The following section summarizes the methods applied and the results produced from incident reporting and road observations. The impact prediction in the EER (DDMI 1998b) is:

- Mine-related mortality is expected to be low

3.5.1 Methods

Mine-related incidents and mortalities are reported to the Environment Department for documentation in a detailed incident investigation for immediate follow-up (Appendix B). All caribou mortalities are reported immediately to ENR, and ENR is consulted for follow-up mitigation and disposal procedures. The information is tabulated and provided for annual comparisons.

3.5.2 Results

In 2016, there were no Mine-related caribou incidents, mortalities or natural caribou mortalities that were officially recorded (Table 3). The only Mine-related caribou mortality reported to date occurred in 2004.

Table 3: Caribou Mortalities on East Island, Baseline to 2016

	Baseline[a]	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Natural Caribou Mortalities on East Island	8	7	1	1	0	2	0	0	1	0	0	0	1	1	1	1	0	0
Mine-related Mortalities	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

(a) Includes data from 1995 to 1997.

3.6 Caribou Advisory

The objective of the Caribou Advisory Monitoring program is to make certain that workers are aware of the approximate numbers of caribou on and near East Island, which is related to the potential for interactions between caribou and mining activities. This raises general awareness so that employees are alert to the likelihood that mitigation could be triggered. The number of animals on the island and in specific areas dictates the type of mitigation practices that will be undertaken (e.g., haul road closure, speed reduction).

3.6.1 Methods

Various methods were used to determine whether or not animals were present in the vicinity of East Island, which included reports from pilots and workers, and using the satellite collar locations provided by ENR. If animals were reported in the general area, ground surveys were initiated. Ground-based surveys are completed by Environment personnel travelling in vehicles along the haul roads twice per day during a caribou advisory and documenting approximate caribou numbers. Caribou road surveys, and PKC and rock pile monitoring surveys were discontinued on a scheduled basis in 2014 because they were ineffective at detecting caribou at the Mine that were not already detected and reported to Environment Department staff by Mine site employees, environment staff completing other monitoring programs, and pilots.

3.6.2 Results

In 2016, caribou numbers on the East Island did not exceed two animals at any given time; therefore the caribou traffic advisory remained at “No Concern” for the entire year. There were ten incidental observations of caribou, totalling 12 individuals from February to August (Table 4). In total there were two incidents involving caribou at the Mine site. On 18 July, a caribou was observed on the airport runway. The caribou was deterred from the runway by two staff members on foot. A second caribou was observed on the airport runway on 28 July, which staff members were able to deter by truck. Photos of wildlife taken at the Mine are included in Appendix C.

Table 4: Caribou Incidental Observations on East Island, 2016

Date	Number	Location	Comments
12-Feb-2016	2	Running from N to SW in A21 Area	Approx 3-4 km out on ice
5-Jul-2016	1	West Island - spotted when looking for the resident bear	-
11-Jul-2016	1	Airport	-
13-Jul-2016	1	Airport	-
13-Jul-2016	1	Unspecified	-
18-Jul-2016	1	Airport Runway	-
20-Jul-2016	1	Airport	Dark caribou
25-Jul-2016	1	Airport	Dark caribou
28-Jul-2016	1	Airport Runway	Dark caribou
15-Aug-2016	1	N17 Laydown	Dark caribou
15-Aug-2016	1	Pond 2 dike	Dark caribou

3.7 Caribou Herding

When caribou are present on East Island their movements are monitored so that Mine site personnel are aware of their presence and location. Of particular importance from a safety perspective (both human and animal) is caribou presence near hazardous areas (such as the airstrip and blast areas). When caribou are sighted adjacent to potentially hazardous areas, DDMI implements its Standard Operation Procedure for caribou herding.

3.7.1 Methods

The method used to move caribou away from hazardous areas consists of the slow advancement of Environment Department staff behind the caribou, encouraging the movement of the animals in a safe direction.

3.7.2 Results

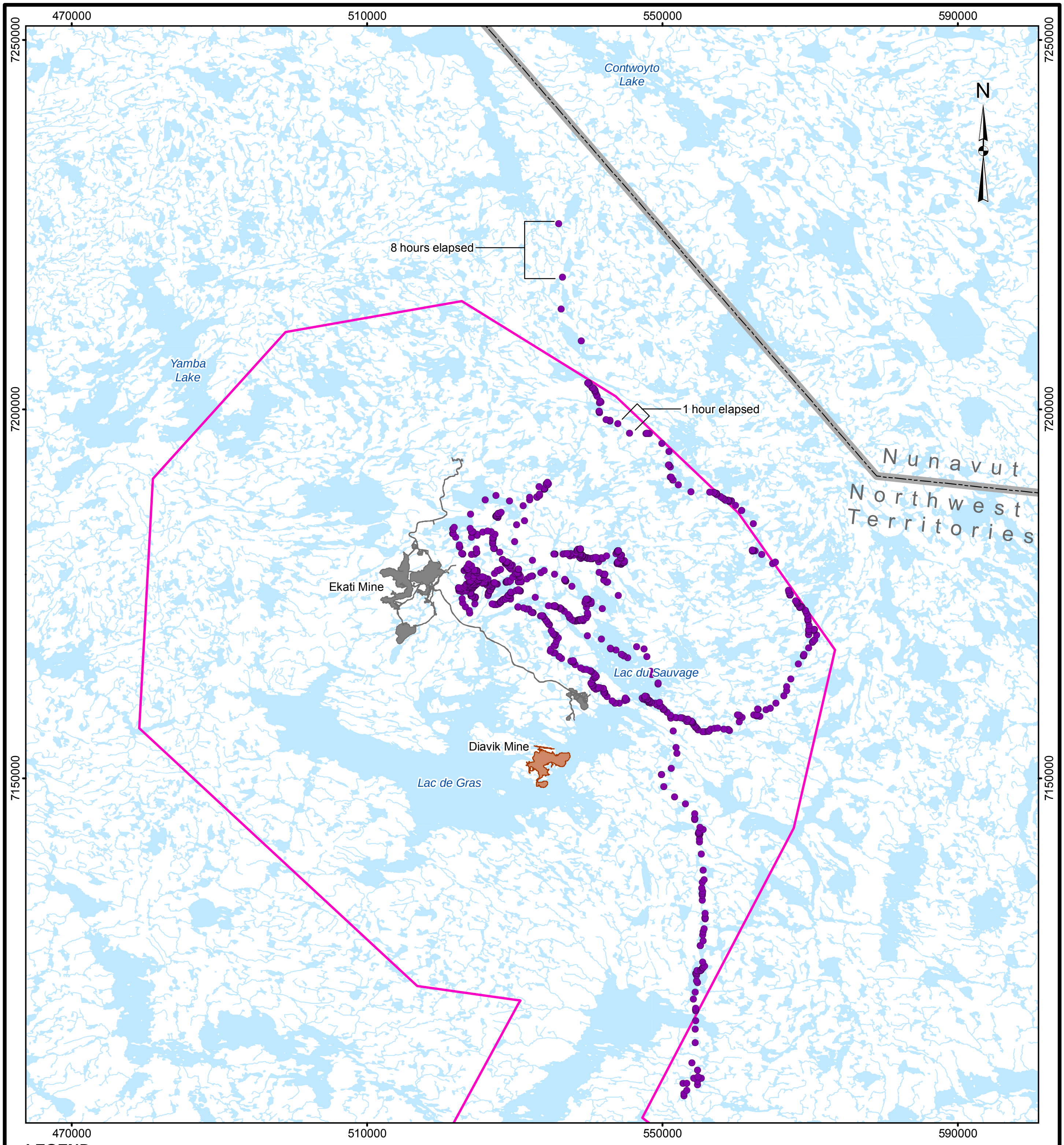
In 2016, there were two incidents involving caribou at the Mine site where herding was used (Section 3.6.2). In both cases staff were able to deter the caribou from the airport runway successfully.

3.8 Recommendations

In 2014, ENR led a Zone of Influence Technical Task Group (TTG) to discuss conditions under which aerial surveys should be resumed. DDMI is waiting for the recommendations and direction from the TTG for guidelines on future caribou aerial surveys. In 2015, DDMI provided financial support to the NWT Cumulative Impact Monitoring Program to develop Bathurst caribou winter range habitat selection models, which was completed in April, 2016. In 2016, DDMI provided financial support to ENR for the deployment of geofenced GPS collars. Geofenced collars are a new type of collar technology that results in a higher location frequency when a collared animal enters a georefenced area (i.e., the fence) (Figure 6). The higher location frequency will provide greater resolution about how caribou interact with mines or other developments. DDMI will continue to explore opportunities that support the GNWT Barren-ground Caribou Management Strategy (GNWT 2011) and other caribou population and range programs completed by ENR.

DDMI will continue to focus monitoring of caribou activity budgets that describe changes to behaviour at distances between 2 and 30 km of the Mine and the Ekati Mine. DDMI will continue to work with ENR to collaborate and assist with government led caribou monitoring and/or research where possible.

Based on the principles of adaptive management, DDMI will no longer complete an independent comprehensive analysis report for wildlife. Instead all comprehensive statistical analyses related to active monitoring programs will be included every three years in the annual WMP report, and would begin in 2020, if applicable.



20 0 20

SCALE 1:750,000 KILOMETRES

LEGEND

- ● CARIBOU GPS LOCATION (NOVEMBER 3 - DECEMBER 30)
- TERRITORIAL BOUNDARY
- WATERCOURSE
- 🟫 DIAVIK FOOTPRINT
- ⬛ EKATI FOOTPRINT
- ☐ GPS GEOFENCE BOUNDARY
- 🟦 WATERBODY

NOTE: FOR ILLUSTRATION PURPOSES ONLY ONE CARIBOU HAS BEEN SHOWN, FEMALE BGCA16121.

REFERENCE

1. 1:250,000 SCALE BASE DATA FROM THE ATLAS OF CANADA; CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE – CANADA.
2. GPS GEOFENCE BOUNDARY AND CARIBOU DATA OBTAINED FROM ENVIRONMENT AND NATURAL RESOURCES. 2016. NWT WILDLIFE MANAGEMENT INFORMATION SYSTEM. GOVERNMENT OF THE NWT, YELLOWKNIFE NT: PROJECT 39 – NORTH SLAVE – BATHURST CARIBOU GPS LOCATIONS 2008 TO PRESENT.

DATUM: NAD83 PROJECTION: UTM ZONE 12

PROJECT

RioTinto DIAVIK DIAMOND MINES INC.

TITLE

CHANGE IN LOCATION FREQUENCY OF A GEOFENCED COLLAR

Golder Associates

PROJECT		1648005	FILE No.
DESIGN	DC	20 Dec. 2016	SCALE AS SHOWN REV. 0
GIS	VV	27 Feb. 2017	FIGURE: 6
CHECK	DC	27 Feb. 2017	
REVIEW	JV	27 Feb. 2017	

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4.0 GRIZZLY BEAR

The barren-ground grizzly bear (*Ursus arctos*) ranges throughout most of the NWT. The western population of grizzly bear is currently listed as a species of special concern by COSEWIC, and is scheduled for assessment by the NWT SAR Committee in March 2017 (NWT SAR 2017).

Grizzly bears have low population densities, low reproductive rates and are sensitive to human activity (DDMI 1998b; McLoughlin et al. 1999). While some grizzly bears may avoid mineral developments, others may be attracted to human activity through odours associated with development (Gau and Case 1999; Johnson et al. 2005).

Impacts to grizzly bears from mining may occur through direct habitat loss, habitat suitability reduction and direct mortality. The focus of the monitoring program is to estimate direct habitat loss, monitor grizzly bear presence and distribution, and report Mine-related mortalities.

4.1 Habitat Loss

Grizzly bears use a wide variety of vegetation and habitats types. Studies of grizzly bears in the NWT have led to understanding their seasonal habitat preferences (McLoughlin et al. 2002). Loss of habitat may result in negative effects on grizzly bears. The objective of this component of the WMP is to determine if direct habitat loss for grizzly bear from the Mine footprint is within the prediction in the EER (DDMI 1998b):

- At full development, direct terrestrial habitat loss for grizzly bear from the project is predicted to be 8.67 km^2.

4.1.1 Methods

Methods used to determine grizzly bear habitat loss are similar to that described in Section 2.1; grizzly bear habitat is assumed to include all terrestrial habitats (i.e., all landscape types in Table 1 except for deep water, shallow water and disturbed area).

4.1.2 Results

Cumulative direct grizzly bear habitat loss resulting from the Mine in 2016 was 8.13 km^2, which is below that predicted in the EER.

4.2 Presence and Distribution

Mining activities can impact the presence of grizzly bears due to disturbance and habitat loss (DDMI 1998b). Vegetation loss and changes to caribou distribution from mining activities may also influence the presence, abundance and distribution of grizzly bears (Gau and Case 1999; Johnson et al. 2005).

Monitoring is completed to determine if mining activities influence the presence of grizzly bears in the study area. The predicted effect is:

- Mine development is not predicted to influence the presence of grizzly bears in the area.

The revised monitoring objective in Handley (2010) is to:

- Determine if Mine-related activities influence the relative abundance and distribution of grizzly bears in the study area over time.

In 2010, a pilot study using a hair snagging technique was initiated to assess its effectiveness in determining grizzly bear abundance in the DDMI wildlife study area. In April 2012, a request was made on behalf of DDMI, BHP Billiton Canada and De Beers Canada Inc. to undertake a joint grizzly bear hair snagging program that encompassed Ekati, Diavik, Snap Lake and Gahcho Kué (Rescan 2013a). Following discussions and clarification of methods (Rescan 2013b), the program was initiated in June 2012 using a standard set of sampling protocols. At the March 2013 Wildlife Monitoring Workshop hosted by the GNWT, the monitoring objective for grizzly bear was revised to:

- Provide estimates of grizzly bear abundance and distribution in the study area over time (GNWT 2013a).

4.2.1 Grizzly Bear Hair Snagging Program

4.2.1.1 Methods

Diavik, Snap Lake, Gahcho Kué and Ekati mines jointly completed the regional grizzly bear hair snagging program. The study area consisted of a northern section, sampled by the Diavik and Ekati mines (ERM Rescan 2014), and a southern section, sampled by Snap Lake and Gahcho Kué (Jessen et al. 2014). The northern section was sampled in 2012 and 2013, and included 113 stations, arranged in a grid pattern spaced at approximately 12 km by 12 km (ERM Rescan 2014). A wooden tripod with a fixed base and the legs wrapped in barbed wire was used to collect grizzly bear hair for DNA analysis. The wooden tripod was placed in high quality grizzly bear habitat (e.g., esker, riparian area, upland meadow, wetland meadow), to increase the likelihood of capturing grizzly bear hair. Traditional knowledge was included in determining high quality habitat for site selection (Rescan 2014). Non-reward lures (e.g., cured cows blood, fish oil, seal oil and sweeter scented oils) were used to attract the bears to the tripods. The lures were poured on the top of the posts and down the legs, and in the centre of the ground to encourage a bear to squeeze between the legs. The posts were not relocated between each sampling period, but a novel scent combination was used each session to prevent habituation.

At the end of each session, all grizzly bear hair was removed from the tripod and placed in a paper envelope. Each grouping of hair was stored separately, and supporting information such as the tripod identification, date, and location on tripod were recorded. The hair samples were sent to Wildlife Genetics International for DNA fingerprinting.

4.2.1.2 Results

Results of the 2012 and 2013 hair snagging program are provided in ERM Rescan (2014). Analysis of these data indicated a stable or increasing abundance of grizzly bears in the northern section relative to monitoring completed in the late 1990’s. The hair snagging program was not undertaken from 2014 through 2016, but is next scheduled to occur in 2017. The long-term frequency of this program has not been determined collaboratively during wildlife monitoring workshops hosted by ENR.

4.2.2 Incidental Observations

4.2.2.1 Methods

Incidental observations of grizzly bears are also recorded and are usually made by Mine staff and reported to the Environment Department. Typically, each independent grizzly bear observation is recorded, because it is usually not known if it is the same bear. As the number of incidental observations may be partially related to the number of people on site, the occurrences of incidental observations of grizzly bears was compared to the camp population.

4.2.2.2 Results

In 2016, there were a total of 137 independent incidental observations of grizzly bear on East Island from 25 April to 16 October. These sightings were observed over 94 days and included 14 observations of a sow with a blond-coloured cub (Table 5; Appendix D). While these observations are not collected systematically, and contain repeated observations, incidental observations provide an indication of the potential for wildlife incidents or problem wildlife. In 2016, there was an average of 625 people at the Mine. The number of incidental observations of grizzly bears does not appear to be influenced by the number of people on site (Spearman correlation r=-0.34, P=0.21); however, staff reporting incidental observations does foster an awareness of wildlife issues at the Mine (Table 5;Table 6).

Table 5: Average Camp Population and Number of Incidental Grizzly Bear Observations, 2002 to 2016

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Average Camp Population	1100	470	397	646	716	747	979	562	579	630	629	537	484	524	625
Grizzly Bear Observations on East Island	5	19	24	43	21	41	5	22	44	56	97	65	69	77	137

4.3 Incidents and Mortalities

Although there is some interaction between the Mine and grizzly bears, every effort is made to immediately report any animals that come into contact with the Mine. Bear awareness instruction is provided to employees, and has contributed to the timely reporting of bears approaching site, which limits unwanted interactions. Despite mitigation, Mine activities may lead to grizzly bear mortalities, injuries or relocations from year to year. The specific impact prediction in the EER (DDMI 1998b) is:

- Mortalities associated with mining activities are predicted to be 0.12 to 0.24 bears per year.

4.3.1 Methods

Mine-related incidents and mortalities are reported to the Environment Department for documentation in a detailed incident investigation for immediate follow-up. All grizzly bear mortalities are reported immediately to ENR, and ENR is consulted for follow-up mitigation and disposal procedures. If wildlife had to be deterred to reduce the risk of a wildlife-human incident, then all effort is made by the Environment staff to start with the least intrusive method available, and all deterrent actions are recorded.

4.3.2 Results

In 2016, there were no grizzly bear mortalities and no relocation events (Table 6). There were 137 incidental observations of grizzly bears resulting in 82 wildlife incident reports, and of these incidents 61 involved deterrent actions and 21 did not involve deterrent actions (Table 6). Deterrents used to encourage bears to move away from infrastructure included trucks, bear bangers, rubber bullets, cracker shells, screamers, whistlers, and air horns.

Construction began at the Mine in the year 2000. The calculated Mine mortality rate over the 17-year monitoring period is 0.06 bears per year, which is below the range predicted in the EER.

Table 6: Grizzly Bear Deterrent Actions, Incidents and Mortalities, 2000 to 2016

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Days with Bear Visitations on East Island	15	14	5	15	24	34	20	34	5	22	44	41	77	47	59(a)	56(b)	94(c)
Days Deterrent Actions were Utilized	10	8	2	6	20	23	8	20	3	18	40	31	65	40	39	27	50
Relocations	0	1	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0
Mortalities	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0

(a) Over 59 separate days, 69 grizzly bear observations were recorded.

(b) Over 56 separate days, 77 grizzly bear observations were recorded.

(c) Over 94 separate days, 137 grizzly bear observations were recorded.

4.4 Recommendations

DDMI participated in regional grizzly bear monitoring in collaboration with BHP Billiton and De Beers Canada Inc. in 2012 and 2013. The long-term duration and frequency of this program will be determined through review and discussion of program objectives and results at the next wildlife monitoring workshop hosted by ENR.

5.0 WOLVERINE

Wolverine (*Gulo gulo*) are annual residents in the Lac de Gras region (DDMI 1998b). Wolverine in the NWT are listed as special concern by COSEWIC, and is not considered a species at risk in the NWT, but has a general species rank of sensitive (NWT SAR 2017).

Wolverine home ranges have been estimated at 126 km^2 for adult females and 404 km^2 for adult males (Mulders 2000). The feeding behaviour of wolverine may result in their attraction to camps and habituation if they receive a food reward, which has been demonstrated during baseline, construction, and operations in the Lac de Gras area.

5.1 Presence and Distribution

The objective of this component of the WMP is to determine if mining activities are influencing the presence of wolverines in the study area, and the revised monitoring objective determined in Handley (2010) is to:

- provide estimates of wolverine abundance and distribution in the study area over time

To meet this objective, DDMI is currently participating in a joint research program coordinated among Dominion Diamond Ekati Corporation and the GNWT. This program involves hair sampling for DNA fingerprinting to estimate abundance of wolverine in the Lac de Gras region.

Wolverine presence around the Mine is monitored using the following systematic and anecdotal methods:

- snow track surveys
- hair snagging
- incidental observations at site

5.1.1 Snow Track Surveys

5.1.1.1 Methods

Snow track surveys began in 2003, and have been conducted with the assistance of a community member, when available. From 2003 to 2006, the study design and data collection used the experience of Inuit Qaujimajatuqangit (IQ) to locate transects and record wolverine snow tracks. This included surveys of 23 transects of variable length and distance from the Mine within a 1,270 km^2 area for wolverine tracks. In 2008, DDMI revised the previous wolverine track survey to increase statistical power to detect changes in wolverine occurrence in the study area. Design changes included the placement of 40 survey transects of equal length (4 km long, total length = 160 km) located in areas of preferred wolverine habitat including heath tundra and heath boulder habitat. The final locations of snow track survey transects were the result of a stratified random sampling process of potential locations in the study area, but some transects were relocated from Lac de Gras to areas of preferred wolverine habitat (based on IQ), including heath tundra and heath tundra boulder habitats.

Historically, each transect is driven once by a snowmobile in March or April and all wolverine tracks and other sign (e.g., digs and dens) are recorded. In 2015 and 2016, each transect was surveyed twice so that detection probability could be estimated and incorporated into analyses of relative activity and distribution.

The detection of snow tracks can be influenced by wind or snowfall. The effect of snowfall was estimated by determining the number of days from the survey date since the most recent snowfall. A wind threshold index was estimated by determining the number of days from the survey date since the mean hourly wind speed had reached 7.7 metres per second (m/s). A wind speed of 7.7 m/s is sufficient to move dry snow along the ground (Li and Pomeroy 1997). Track counts were adjusted for weather by using the minimum number of days since the most recent snowfall or threshold wind speed event. For each transect, a track density index (TDI) was calculated as the number of wolverine tracks per transect length per number of days since recent snowfall or threshold wind speed. Additional analysis on relative activity, which accounted for imperfect detection of snow tracks, was completed using the statistical analysis Program PRESENCE (Hines 2007). In this analysis, detection rates were derived as a function of the standardized number of days since weather threshold event.

5.1.1.2 Results

In 2016, 100 wolverine tracks were recorded during two surveys of all transects from 24 March to 17 April (Figure 7; Table 7). Snow tracks were observed on 47.5% of transects during the first survey and 62.5% of transects during the second survey. This resulted in a track index of 1.25 tracks per kilometre in both surveys and a grand mean (± 2SE) track density index (TDI) of 0.202 ± 0.091 wolverine tracks per kilometre per days since last weather threshold (Table 7; Appendix E). One dig was observed during the second snow track surveys. Mary Black from the Yellowknives Dene First Nation participated on both of the wolverine track surveys.

Statistical modelling of the snow track data to account for imperfect detection and weather indicated that the probability of snow track occurrence in the study area was 0.84 (95%CI: 0.57 to 0.95). Snow track detection was 0.65 (95%CI: 0.48 to 0.79), after accounting for effects of days since last snowfall. Future programs that include successful survey of all transects twice will help identify whether snow track detection rates vary through time.

Results from the most recent comprehensive analysis of snow track data indicate that TDI and occurrence of snow tracks have increased in the study area through time from 2003 to 2016 (Golder 2017). These patterns appear unrelated to the Mine, although both were negatively correlated with the amount of waste rock production. However, the direction of this association is not consistent with the expectation that wolverine are attracted to the Mine. Continued diligence with mitigation such as management of food waste and preventing access to on-site denning will be important to maintaining minimizing mine-related effects to wolverine.

Table 7: Wolverine Track Index and Mean Days Since Snow Fall, 2003 to 2016

Year	Survey Period	Number of Tracks	Distance Surveyed (km)	Mean Days Since Snowfall(a)	Mean Days Since Threshold Wind Speed(a)	Track Index (Tracks/km)	Mean Track Density Index (± 2SE)(b)
2003	10 – 12 Apr	13	148	2.2	2.1	0.09	0.046 ± 0.044
2004	16 – 24 Apr	22	148	4.0	4.6	0.15	0.061 ± 0.040
2004	2 – 8 Dec	10	148	3.9	2.5	0.07	0.048 ± 0.042
2005	30 – 31 Mar	7	148	7.5	3.9	0.05	0.026 ± 0.022
2005	7 – 12 Dec	18	148	2.4	3.5	0.12	0.106 ± 0.044
2006	30 Mar – 1 Apr	5	148	1.0	2.5	0.03	0.029 ± 0.010
2008(c)	30 Apr – 2 May	15	160	17.1	4.1	0.09	0.022 ± 0.011
2009	2 – 4 Apr	11	156	31.0	9.0	0.07	0.007 ± 0.005
2010(d)	-	-	-	-	-	-	-
2011	30 Mar – 3 Apr	23	156	0.9	6.7	0.15	0.167 ± 0.072
2012	28 Mar – 3 Apr	22	160	2.8	4.4	0.14	0.096 ± 0.065
2013	2 – 6 Apr	26	156	3.1	2.9	0.17	0.076 ± 0.043
2014	23 – 26 Mar	25	160	6.7	1.0	0.13	0.156 ± 0.082
2015	24 – 29 Mar	21	160	5.3	11.0	0.13	0.062 ± 0.049
	14 – 17 Apr	17	160	2.1	1.6	0.11	0.172 ± 0.130
2016	22 – 27 Mar	50	160	6.5	5.5	1.25	0.190 ± 0.129
	8 – 13 Apr	50	160	6.7	3.1	1.25	0.215 ± 0.099

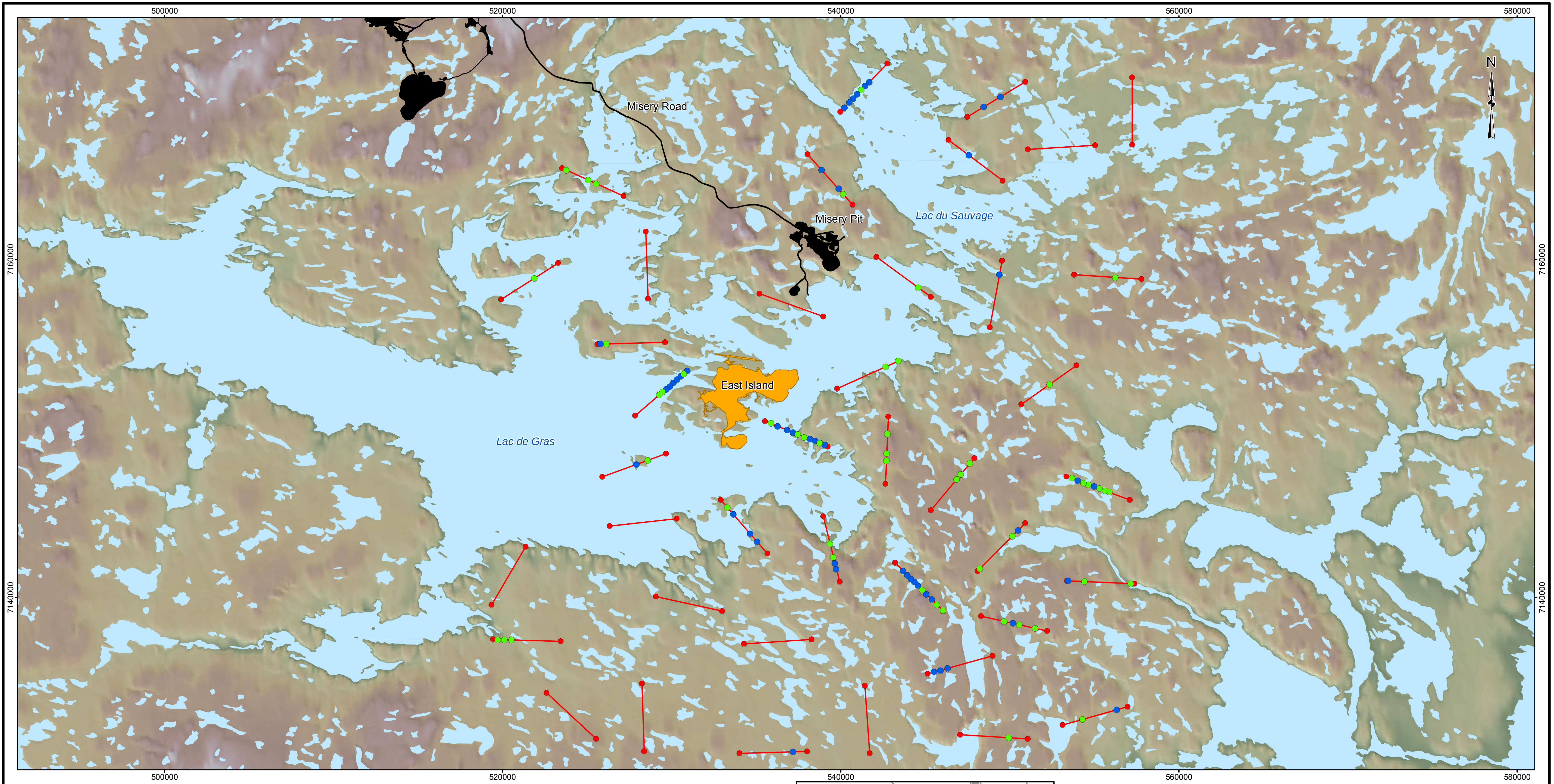
(a) Presented as a summary of the data used to calculate track densities. Wind threshold speed = 7.7 metres per second.

(b) For each transect, a track density index (TDI) was calculated as the number of wolverine tracks per transect length per number of days since recent snowfall or threshold wind speed. TDI is reported as mean Track Density Index ± 2 times the standard error (Appendix E).

(c) The new survey technique was introduced in 2008.

(d) Survey was not completed in 2010 due to community assistant not being available to participate in survey.

km = kilometres; tracks/km = tracks per kilometre; SE = standard error.



LEGEND

WOLVERINE TRACKS

●	SURVEY 1
●	SURVEY 2
●—●	TRANSECT
🟧	DIAVIK FOOTPRINT
■	EKATI FOOTPRINT
▭	WATERBODY

REFERENCE

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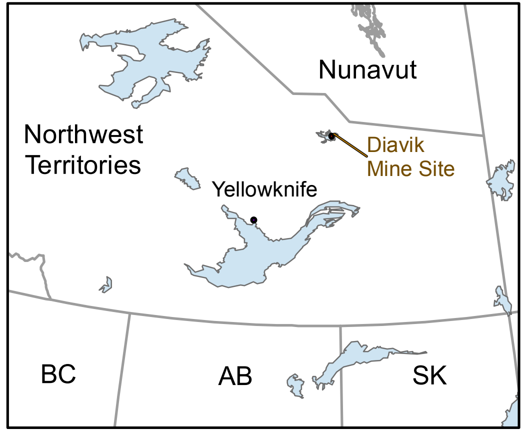
DATUM: NAD83 PROJECTION: UTM ZONE 12



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SCALE 1:225,000 KILOMETRES

PROJECT
RioTinto
DIAVIK DIAMOND MINES INC.

TITLE
WOLVERINE SNOW TRACK SURVEY, 2016

Golder Associates

PROJECT		1648005	FILE No.	
DESIGN	KB	20 Dec. 2016	SCALE AS SHOWN	REV. 0
GIS	VV	27 Feb. 2017	FIGURE: 7	
CHECK	DC	27 Feb. 2017		
REVIEW	JV	27 Feb. 2017		

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5.1.2 Hair Snagging

5.1.2.1 Methods

The wolverine hair snagging is a regional research program conducted in partnership with ENR and Dominion Diamond Ekati Corporation. This program is also conducted with the assistance of community members. The survey is carried out in March and April by snowmobile. A total of 134 posts constructed of 4”x 4” lumber in 5 foot lengths are erected across the DDMI study area in a 3 km by 3 km grid. Each post is spiral-wrapped in barbed wire, intended to snag hair from wolverine, and baited with a small portion of local meat and two types of commercially prepared lures (GNWT 2013b). Posts are surveyed in the order they are deployed and are removed after the second visit. Hair samples are submitted to Wildlife Genetics International for DNA fingerprinting to determine the sex and number of individuals in the study area.

5.1.2.2 Results

The wolverine hair snagging program was not completed in 2015 or 2016, and was last completed in 2014. The long-term duration and frequency of this program has not been determined collaboratively at wildlife monitoring workshops hosted by ENR. The schedule for future monitoring programs will be determined after the 2014 data summary analysis report from ENR is complete and reviewed.

5.1.2.3 Methods

Incidental observations of wolverine were also recorded and usually made by Mine staff and reported to the Environment Department. Typically, each independent wolverine observation was recorded, because it is usually not known if it is the same animal.

5.1.2.4 Results

In 2016, there were 105 independent incidental observations of wolverine on East Island (Appendix F). These sightings were observed over a total of 73 days from 6 January to 31 December. These observations are not collected systematically, and likely contain repeated observations of the same animal. It is believed that a large proportion of the incidental observations reported for wolverine in 2016 were of the same two individuals that were relocated on 6 March and 15 March (Section 5.2.2). Incidental observations provide an indication of the potential for wildlife incidents or problem wildlife. Wolverine incidental observations and reporting have slightly decreased in 2016 from 2015 (Table 8). There is no correlation between the number of incidental observations of wolverine and the number of people on site (Spearman correlation r=0.001); however, staff reporting incidental observations does foster an awareness of wildlife issues at the Mine (Table 8).

Table 8: Average Camp Population and Number of Incidental Wolverine Observations, 2002 to 2016

Year[(A)]	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Average Camp Population	1100	470	397	646	716	747	979	562	579	630	629	537	484	524	625
Wolverine Observations on East Island	4	38	14	43	31	19	46	21	28	4	11	3	6	118	105

(a) Monthly average camp population is not available for 2000 and 2001.

5.2 Incidents and Mortalities

Mortalities can occur if wolverines become habituated to mining activities resulting from efforts to locate food or shelter (DDMI 1998b). Diligent waste management, strictly enforced speed limits, and immediate reporting of wildlife sightings on East Island have limited the mortality of wolverine during the operational period of the Mine. To date, efforts have been focused on limiting Mine-related mortalities and associated changes to wolverine population parameters.

The prediction made in the EER was:

- Mine-related mortalities, if they occur, are not expected to alter wolverine population parameters in the Lac de Gras area.

5.2.1 Methods

Mine-related incidents and mortalities are reported to the Environment Department for documentation in a detailed incident investigation and through incident reports submitted by Mine staff. All wolverine mortalities are reported immediately to ENR, and ENR is consulted for follow-up mitigation and disposal procedures. If wildlife had to be deterred to reduce the risk of a wildlife-human incident, then all effort is made by the Environment staff to start with the least intrusive method available and all deterrent actions are recorded.

5.2.2 Results

In 2016, there were 12 incidents involving wolverine with four involving deterrent actions, two involving relocations and seven involving no action. A truck was used for all deterrent actions. Since 2000, five wolverines have been relocated and five mortalities have occurred at the Mine. There were two relocations and one mortality at the Mine in 2016 (Table 9). The wolverines were relocated on 6 March and 15 March. Relocation permits were obtained from ENR as a result of repeated observations of wolverine on site and (Appendix F) once trapped the wolverines were relocated to MacKay Lake. There were four incidents of wolverine trapped in bins in April, and three of these incidents occurred five days apart. The wolverine were able to escape once a plank was put into the bin. The fourth incident resulted in a mortality of a wolverine that was discovered in an empty bin in June. Site personnel were preparing to move a bin when a foul smell was detected and the Environment department was notified. The wolverine carcass was removed and it was estimated that it had been in there for several months. ENR was notified and determined that the carcass was not salvageable and should be incinerated. Resulting from this incident, the environment department re-educated the area staff on the importance of properly segregated waste and reminded them that all unused waste bins should be cleaned out and securely closed to prevent animals from becoming trapped.

Table 9: Wolverine Observations, Deterrents, Relocations and Mortalities, 2000 to 2016

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Days with Wolverine Visitations on East Island	25	36	4	38	14	43	31	19	46	21	28	4	11	3	6	83(b)	73(c)
Days Deterrent Actions were Utilized	9	10	0	1	1	5	2	1	17	1	0	0	1	0	0	4	6
Relocations	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Mortalities	0	1	0	0	0	0	0	0	1	0	0	0	2(a)	0	0	0	1

(a) Two wolverine mortalities occurred in 2012 at an off-site fish compensation program undertaken by DDMI.

(b) Over 83 separate days, 118 independent wolverine observations were recorded. It is believed that the majority of these observations were for the same wolverine which was relocated on 23 March 2015.

(c) Over 73 separate days, 105 independent wolverine observations were recorded.

5.3 Recommendations

Future monitoring of wolverine snow tracks will continue to include two rounds of surveys to determine whether detection rates of snow tracks vary through time. The Environment Department will continue to encourage staff to report wolverine and other wildlife sightings as these build awareness at site and help to prevent or limit incidents. The Environment Department will also work with site departments as a reminder about the importance of waste segregation and securing waste bins to prevent wildlife access.

Based on the principles of adaptive management, DDMI will no longer complete an independent comprehensive analysis report for wildlife. Instead all comprehensive statistical analyses related to active monitoring programs will be included every three years in the annual WMP report, and would begin in 2020, if applicable.

6.0 RAPTORS

Raptors (birds of prey) present in the study area include peregrine falcons, gyrfalcons, rough-legged hawks, snowy owls, and short-eared owls. COSEWIC and the Federal Species at Risk Act (SARA) consider the peregrine falcon (*Falco peregrinus tundrius)* as *Special Concern*; however, they currently have no status under NWT species at risk legislation but have a general species rank of sensitive (NWT SAR 2017). Peregrine falcon is scheduled for assessment by NWT SAR in March 2021 (NWT SAR 2017).

Habitat loss, sensory disturbance, and impacts to prey populations may influence raptors nesting in the Lac de Gras area. Mining activities may cause raptors to avoid the area and surrounding habitats. Mine-related changes in habitat quality can influence the presence and distribution of raptors. Impact predictions related to raptors (DDMI 1998a) were:

- Disturbance from the Mine and the associated zone of influence is not predicted to result in measurable impacts to the distribution of raptors in the study area.
- The Mine is not predicted to cause a measurable change in raptor presence in the study area.

Analysis of Diavik and Ekati peregrine falcon and gyrfalcon nest data from 1998 to 2010 determined that sensory disturbance was not influencing nest occupancy and success (Coulton et al. 2013). Instead, the study concluded that the patterns of use and success were associated with the spatial distribution of nest site quality and the age of nest sites, respectively, in the study area, which is consistent with findings from another long-term study (Wightman and Fuller 2005). The results confirmed the decisions at the 2010 Diamond Mine Wildlife Monitoring Workshop that annual collection of raptor nest occupancy and success in the study area should be removed from the WMP, and data collection should be focused on mitigating effects to raptors nesting in open pits and on Mine infrastructure. The Workshop also suggested contributing to broader regional monitoring programs.

The revised impact predictions presented in Handley (2010) are to:

- Determine nest site occupancy and productivity of historic peregrine falcon nest sites in the study area to contribute to the Canadian Peregrine Falcon Survey (CPFS), which monitors recovery of species and long-term population trends.
- Determine if pit walls or other infrastructure are utilized as nesting sites for raptors.
- Determine nest success in areas of development and document effectiveness of deterrent efforts that may be employed for nest relocations.
- Document and determine the cause of direct Mine-related mortalities of raptors.

6.1 Nest Site Occupancy

6.1.1 Methods

The CPFS is no longer completed; however, DDMI will still contribute surveys of nest use and success in the study area for regional monitoring by ENR and other researchers. Contribution of nest monitoring data to ENR for inclusion in regional and national databases, is scheduled for every five years and was last completed in 2015. The monitoring was conducted by ENR biologists and included surveys of known nest sites in early and late summer to determine nest use and the presence of hatchlings. The monitoring approach included a helicopter survey using fly-by techniques to minimize disturbance to nesting birds. The next regional survey is scheduled for 2020.

Falcons have been known to nest on Mine infrastructure and within the vertical rock faces of open pits at both the Mine and the Ekati Mine. Pit wall/infrastructure inspections at the Mine are conducted twice weekly during the nesting season. Pit walls and other infrastructure are inspected for nests and falcon nesting behaviour. If nests are found, the species occupying the nest is determined along with the presence of eggs and/or chicks. Deterrent actions are considered in consultation with ENR if the nest is in an area hazardous to the birds.

Pit wall/infrastructure inspections are completed at eight locations on the Mine site: A154 Pit area (Lookout #1 and #2), A418 Pit area (Lookout #1 and #2), South Tank Farm, Process Plant, Powerhouse (Lookout #1 and #2), Site Services Building, Boiler House and Backfill Plant. The survey is conducted by stopping at a clear vantage point and thoroughly scanning the area for any potential nesting locations.

6.1.2 Results

A total of 29 Pit Wall/infrastructure inspections were completed from 7 May until 17 August to determine use by raptors (Appendix G). Nests were considered active if they were observed to have eggs or fledglings. Once a nest was confirmed to no longer be active, no further inspections were undertaken. After 13 July, only the Site Services Building was surveyed. During the inspections, a peregrine falcon nesting site was confirmed at the Site Services Building and ravens were confirmed nesting at the Boiler House (Table 10). Potential nesting sites for peregrine falcons were observed at A418 Lookout #1 and #2, and A154 Lookout #1 and #2, but no nesting activity was observed. Rough-legged hawk were observed at A418 Lookout #1 and flying above A154 Lookout #1 and #2, but no nesting activity was reported. On 21 and 26 June an unknown species was observed perched on an old nest at A514 Lookout #2, but no nesting activity was reported.

Table 10: Active Nests Observed on Mine Infrastructure and Open Pits in 2016

Area	Species	Date	Observations
Site Services Building	Peregrine Falcon	10 May 2016	Three fledglings observed on 9 July and fledged on 8 August.
Boiler House	Common Raven	10 May 2016	Pair of ravens using old nest. Four fledglings observed in nest on 4 July and had left the nest by 26 June. No longer monitored after 27 July.

6.2 Incidents and Mortalities

6.2.1 Methods

Mine-related incidents that occur are reported to Environment Department staff through incident reports submitted by Mine staff. Environment Department staff follow up on any incident and complete the necessary documentation. ENR is consulted for mitigation and disposal procedures. This information is tabulated and provided for annual comparisons.

6.2.2 Results

There was one peregrine falcon mortality reported at the Mine in 2016. A peregrine falcon carcass was found near the main intersection for entry to the A21 area. The carcass had been picked clean by ravens and the cause of death could not be determined.

6.3 Recommendations

DDMI will continue Pit Wall/infrastructure monitoring for nesting raptors. The next regional nest monitoring is scheduled to occur in 2020 and will be completed by ENR. As well, ENR will continue to collect these data for entry into the regional Raptor Database. DDMI will discuss options with ENR for future monitoring.

7.0 WASTE MANAGEMENT

DDMI is committed to taking the necessary steps to collect, store, transport, and dispose of all waste generated by the Mine. These procedures are being conducted in a safe, efficient and environmentally compliant manner. The Waste Management Plan is an integral part of DDMI's Environmental Management System, and focuses on practical and positive management of waste.

The objectives of the Waste Management Plan include:

- creating a system for proper disposal of waste
- minimizing potentially adverse impacts on the physical and biological environment
- complying with Federal and NWT legislation

Mitigation practices include food waste incineration, categorical segregation of non-food waste for storage and subsequent removal from site, and on-site disposal and monitoring. In addition to these mitigation practices, DDMI has implemented recycling and renewable energy initiatives.

7.1 Waste Inspections

The DDMI Waste Management Plan outlines practices for waste disposal and mitigation actions. The 2014 Waste Management Plan was submitted on 16 January 2015 to the Wek'èezhìi Land and Water Board (WLWB) as part of the water license renewal under water license number W2015L2-0001 (WLWB 2015). An updated version of Waste Management Plan was submitted to the WLWB on 19 January 2016, and was implemented in 2016 (WLWB 2016). The Mobile Maintenance and Support Services Department maintains the various waste collection transfer and disposal points, inventories of bulk wastes, waste management datasheets and status of protective equipment and spill kits. This assists in evaluating the capacity of waste management facilities, planning for logistics associated with backhauling and requirements for any modifications to the system. In addition, Environment Department staff conduct waste inspections at the Waste Transfer Area (WTA) and Landfill twice per week during the winter and once per week in the summer. A site-wide compliance inspection and Underground inspection is completed on a weekly basis. Starting in May 2016, the A21 area was inspected every three days.

Waste Management staff identify problem areas and work with contractors and Mine employees to resolve any issues. Numbering and inspecting waste collection bins prior to pick up is an effective method of facilitating communication between Waste Management and Environment Department staff, and addressing issues within various departments. Efforts are made to identify improperly disposed waste in the large waste collection bins prior to collection; however, on occasion improperly disposed waste may end up in either the Landfill or the burn pit.

Incineration, segregation and storage of waste takes place at the WTA, which was established to provide proper handling and storage of waste on site. The facility is located on the south side of East Island. The WTA is a lined facility surrounded by a gated 3 m high chain link fence to control wind transportation of any litter and prevent most wildlife intrusion. Contained within the WTA are two incinerators for food waste, a burn pit for non-toxic/non-food contaminated burnable material, a contaminated soils containment area, a treated sewage containment area, as well as sea cans, sheds, and storage areas for drums, crates, bins and totes. Two water scrubbed incinerators were installed and operational in October 2012 and are located within the incinerator building. The majority of waste is inventoried and stored at the WTA while awaiting backhaul on the winter ice road.

On-site disposal of non-burnable wastes such as steel (ground support for underground mining), vent tubing, plastics, and glass currently occurs at the inert Landfill located within the Type 3 waste rock pile. Waste is pushed into a large depression and a gate was installed in an effort to limit uncontrolled dumping in this area. The location of the Landfill within the rock pile and traffic in the area will continue to discourage wildlife access to the Landfill, thereby limiting the availability of infrequently misdirected food and food packaging to animals.

7.1.1 Methods

Inspections of the WTA and the Landfill are conducted twice per week during the winter and once per week in the summer. Due to an oversight, these inspections only happened once per week in the winter in 2016 but the regular inspection schedule will return in 2017. Inspections of the A21 Area are conducted every three days and inspections of the Underground occur once per week. These inspections are to confirm that all waste segregation, storage and disposal procedures set out in the Waste Management Plan are being followed. Inspections consist of Environment Department staff walking the area of the WTA, Landfill, A21 Area, and Underground where safe to do so, and documenting the type and number of misdirected waste items, as well as wildlife species and sign that were present during the survey. Corrective actions at the WTA and Landfill area include notifying a WTA coordinator and transferring items to the appropriate disposal area. Corrective actions at the A21 Area and Underground include notifying the area supervisor to arrange for the transfer of items to the appropriate disposal area and additional worker education where required. All misdirected waste items found during inspections in the WTA and Landfill are sorted into the proper disposal area by Waste Management staff. For example, non-burnable material is removed from the incinerator waste stream and transferred to the designated area in the Landfill. Hazardous wastes are stored in the WTA until they can be shipped to licensed facilities off-site.

7.1.2 Results

Development of the underground Mine at the A154 and A418 in 2016 yielded 359,755 tonnes of mined waste rock and 2,224,344 tonnes of ore in 2016. The average monthly population at the Mine in 2016 was 625 people, with a daily range from 364 to 729 people (Table 5). During 2016, the WTA and Landfill were each surveyed on 52 occasions (7 January to 29 December), the A21 Area was surveyed 48 times (26 May to 31 December) and the Underground was surveyed 53 times (3 January to 29 December) (Table 11; Appendix H). A total of 100 misdirected waste items were found during WTA inspections; 453 items during Landfill inspections, 189 items at the A21 Area and 236 items at the waste segregation area of the Underground (Table 11). In the WTA, the most common misdirected waste item was oil contaminated waste (32 items), followed by food packaging (15 items) and aerosol cans (14 items). In the Landfill, the most common misdirected item was oil contaminated waste (225 items found), followed by food packaging (75 items found) and aerosol cans (27 items found). In the A21 Area, the most common misdirected waste item was food (105 items found), followed by oil contaminated waste (42 items found) and food packaging (37 items found). In the Underground area, the most common misdirected waste item was oil contaminated waste (119 items found), followed by food packaging (47 items found) and other (44 items found).

Considering the total amount of waste disposed (403,760 kg incinerated and 1,095.5 tonnes landfilled), the amount of misdirected waste is considered negligible. Improperly disposed items at the WTA and Landfill were reported to Waste Management staff for immediate rectification.

Table 11: Misdirected Waste at the Waste Transfer Area, Landfill, A21 Area and Underground, 2016

	Waste Transfer Area (n=52 surveys)		Landfill (n=52 surveys)		A21 Area (n=48 surveys)		Underground (n=53 Surveys)	
Misdirected Waste Type	**Total Number Found in all Inspections**	**Percent of Inspections**	**Total Number Found in all Inspections**	**Percent of Inspections**	**Total Number Found in all Inspections**	**Percent of Inspections**	**Total Number Found in all Inspections**	**Percent of Inspections**
Aerosol Cans	14	9.6	27	21.2	4	8.3	19	9.4
Batteries	0	0	1	1.9	0	0	0	0
Food	2	1.9	2	3.8	105	10.4	2	1.9
Food Packaging	15	15.4	75	46.2	37	18.75	47	32.1
Oil Contaminated Waste	32	7.7	225	30.8	42	14.6	119	41.5
Oil Products & Containers	0	0	1	1.9	1	2.1	5	3.8
Other	37	15.4	122	46.2	0	0	44	32.1
Total	**100**	**34.5**	**453**	**65.4**	**189**	**35.4**	**236**	**67.9**

Wildlife was observed on 15.4% of inspections of the WTA, 7.7% of inspections of the Landfill, 22.9% of inspections of the A21 Area and 9.4% of inspections of the Underground (Table 12). Wildlife sign was observed on 38.5%, 25.0%, 8.3% and 22.6% of inspections at the WTA, Landfill, A21 Area and Underground, respectively. The most common wildlife species observed during inspections were fox and wolverine. The most common wildlife sign observed were fox and unspecified tracks.

Table 12: Wildlife and Wildlife Sign in the Waste Transfer Area, Landfill, A21 Area and Underground, 2016

	Waste Transfer Area (n=52 surveys)			Landfill (n=52 surveys)			A21 Area (n=48 surveys)			Underground (n=53 Surveys)		
Species	**Number of Inspections with Wildlife Observations**	**Total Number of Individuals Observed**	**Number of Inspections with Wildlife Sign Observed**	**Number of Inspections with Wildlife Observations**	**Total Number of Individuals Observed**	**Number of Inspections with Wildlife Sign Observed**	**Number of Inspections with Wildlife Observations**	**Total Number of Individuals Observed**	**Number of Inspections with Wildlife Sign Observed**	**Number of Inspections with Wildlife Observations**	**Total Number of Individuals Observed**	**Number of Inspections with Wildlife Sign Observed**
Common Raven	1	1	0	1	2	0	0	0	0	0	0	0
Fox spp.	3	5	8	2	2	6	9	11	2	3	3	8
Wolverine	0	0	4	0	0	1	3	3	0	2	2	1
Wolf	0	0	0	0	0	1	0	0	0	0	0	0
Unspecified	4	7	8	2	1	5	0	0	0	0	0	4
Total	**8**	**13**	**20**	**5**	**5**	**13**	**12**	**14**	**2**	**5**	**5**	**13**

spp. =species.

7.2 Recycling Initiatives

During 2008, DDMI implemented an employee-driven recycling program for plastic bottles and aluminium cans generated on site. Throughout 2016, 14,632 units of aluminum containers ($1,463.20) and 9,392 units of plastic containers ($939.20) were recycled and the total monetary value was donated to the Yellowknife Stanton Hospital Foundation. To date, the total proceeds since the inception of the employee-driven recycling program has generated $24,632.

During 2016, approximately 266,596 litres of waste oil was collected to be used in the waste oil boiler that was commissioned in the second quarter of 2014. Since the boiler was commissioned, 567,137 litres of waste oil was burned to create heat rather than being shipped off-site.

In addition, a number of waste materials generated on-site are shipped off-site using winter road backhauls. DDMI is committed to maximizing recycling opportunities for wastes generated from Mine operations that cannot be disposed of on site. Items shipped for recycling include:

- used oil, oil filters and grease
- used glycol
- aerosol cans
- batteries (lead-acid and dry cell)
- expired/waste fuel (e.g., Jet B)
- oil-based paint
- absorbents

DDMI will continue to increase recycling opportunities, and reduce waste streams generated at the Mine site.

7.3 Renewable Energy

The wind farm became operational on 28 September 2012 and it was predicted that it would reduce Mine diesel consumption by 10%, as well as greenhouse-gas emissions by 12,000 tonnes of carbon dioxide annually. During the fourth year of operation, the wind farm generated 14,298 megawatt hours (MWh) of power, which represents 7.6% of the total power generated in 2016 and an estimated diesel savings of 3.4 million litres (Figure 8). In 2016, 7.6% of total power use was wind power, and the peak amount of total power used made up of wind power was 56.4%. The wind farm offset an estimated 9,030 tonnes of carbon dioxide emissions in 2016. From 2005 through 2016, the annual diesel fuel consumption at the Mine has ranged from 55,573,000 litres to 73,449,006 litres. In 2016, the total fuel consumption was 72,030,733 litres.

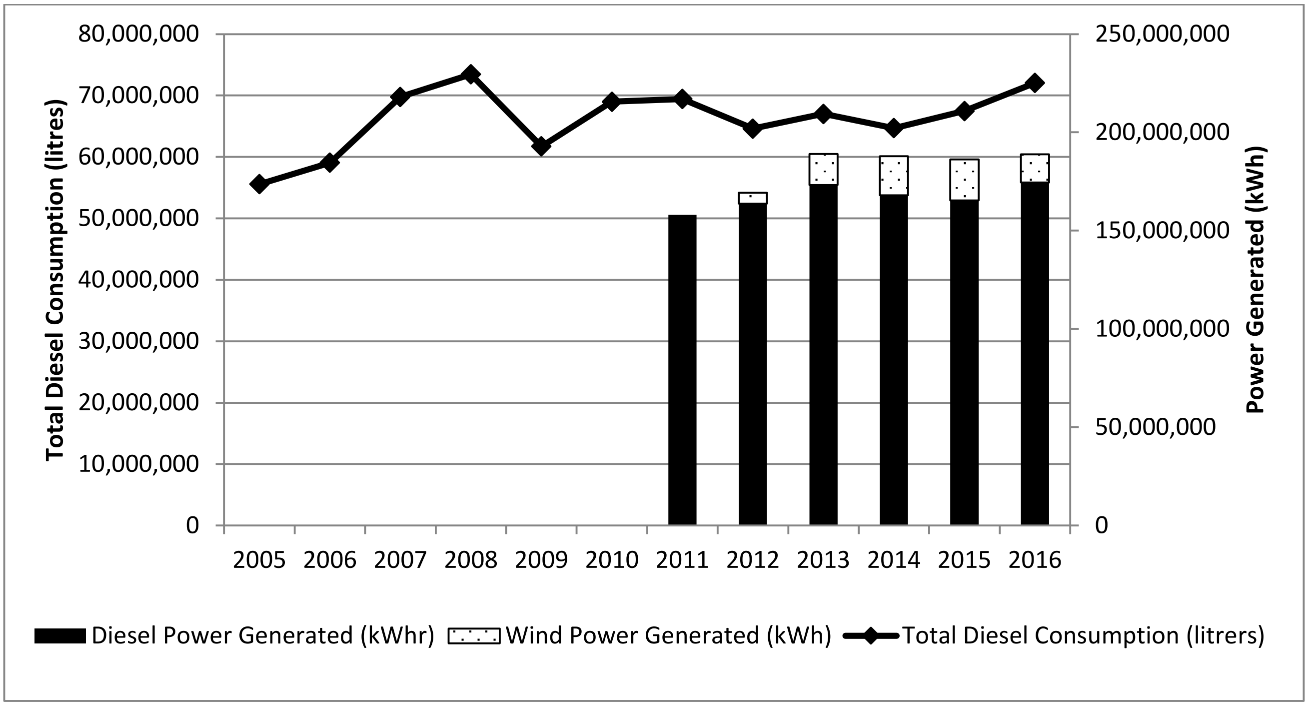

Figure 8: Annual Diavik Power Generation and Diesel Consumption

7.4 Recommendations

Procedures and mitigation strategies currently in place have been relatively successful at limiting wildlife interactions in the WTA and Landfill. While foxes, ravens and wolverine appear to be frequenting the WTA and Landfill, A21 Area and Underground, these animals are natural scavengers and will continue to be present throughout the Mine’s life. DDMI will continue to monitor the WTA and Landfill at the frequency of twice per week in the winter and once per week in the summer, the A21 Area every three days, and the Underground once per week during the year. DDMI remains committed to carrying out employee education programs related to waste handling.

8.0 CLOSURE

We trust the above meets your present requirements. If you have any questions or requirements, please contact the undersigned.

GOLDER ASSOCIATES LTD.

Prepared By	Reviewed By
Kelly Bourassa	Daniel W. Coulton
Kelly Bourassa, BSc Wildlife Biologist	Dan Coulton, PhD Wildlife Biologist
	John Virgl
	John Virgl, PhD Principal, Senior Ecologist

EN/KB/DC/JV/bb/kp/it

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APPENDIX A

Caribou Behavioural Observations Summary, 2016

Caribou Behavoural Observations Summary, 2016

Date	Time	Location	UTM (12W NAD 83)		Group Size	Composition[(a)]
			Easting	Northing		
2016-Sept-6	16:08	30 km north west of Diavik	525187	7180323	7	F/M
2016-Sept-8	17:40	23 km south west of Diavik	547419	7172546	54	F/M/C

a) F = adult female; M = adult male; C = Calves.

km=kilometres.

APPENDIX B

Wildlife Mortality Incident Reports, 2016

Wildlife Report - 2016

Audit Title (Animal - yyyy-mm-dd - Location)
2016-01-16 - Rusty Blackbird

Document No.
WildlifeReport000048

18/01/16

Completed on
19/01/16

Disclaimer

The assessors believe the information contained within this risk assessment report to be correct at the time of printing. The assessors do not accept responsibility for any consequences arising from the use of the information herein. The report is based on matters which were observed or came to the attention of the assessors during the day of the assessment and should not be relied upon as an exhaustive record of all possible risks or hazards that may exist or potential improvements that can be made.

Information on the latest workers compensation and OHS / WHS laws can be found at the relevant State WorkCover / WorkSafe Authority.

Confidentiality Statement

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Table of Contents

Audit

Question	Response	Details
Wildlife Report		
Type of Wildlife Report	General sighting / Other	
Report Type	Mortality	
Wildlife Mortality		
Enter Initial Time of Report	16/01/16 09:30 AM	
Department/Individual Who Reported Mortality:	Maintenance	
Environment On Scene		
Environment at Call-out Location	16/01/16 09:00 AM	
Location	Mod 6 at the FAR. Coordinates 0536346-7152581	
Animal Type	Other	
Description of Animal/Scene	Rusty Blackbird	
Photo of Scene		
 Appendix 1  Appendix 2  Appendix 3  Appendix 4  Appendix 5		
Estimated Time of Death	Weeks	
Environment Off Scene		
End of Environment Call-out	18/01/16 08:30 AM	
Final Location of Carcass	Incinerated	
Closure & Sign-off		
Wildlife Report Complete	On	

Question	Response	Details

Media

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Appendix 5

Wildlife Report - 2016

Audit Title (Animal - yyyy-mm-dd - Location)
Fox Fatality - 2016-02-09 - North Haul Road

Document No.
WildlifeReport000010

09/02/16

Completed on
09/02/16

Disclaimer

Confidentiality Statement

Table of Contents

Audit

Question	Response	Details
Wildlife Report		
Type of Wildlife Report	General sighting / Other	
Report Type	Mortality	
Wildlife Mortality		
Enter Initial Time of Report	09/02/16 01:50 PM	
Department/Individual Who Reported Mortality:	Sheldon - Pit Ops	
Environment On Scene		
Environment at Call-out Location	09/02/16 02:00 PM	
Location	North Haul Road just North of PKC muster before single lane 830E haul traffic.	
Animal Type	Fox	
Description of Animal/Scene	Fox hit by vehicle traffic. Body found in center of haul road. Actual time or cause of death unknown but it occurred very close to the time of reporting because the body was still warm.	
Photo of Scene		
 Appendix 1		
Estimated Time of Death	Hours	
Environment Off Scene		
End of Environment Call-out	09/02/16 02:20 PM	
Final Location of Carcass	Freezer in Environment Lab.	

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<tr><td>Signature</td><td colspan="2">SS</td><td>09/02/16 02:54 PM</td><td>Digitally signed by Sean Sinclair
DN: cn=Sean Sinclair, o, ou, email=sean.sinclair@riotinto.com, c=US
Date: 2016.02.09 14:53:46 -07'00'</td></tr>
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Media

Appendix 1

DIAVIK
DIAMOND MINES INC.

Wildlife Report - 2016

Audit Title (Animal - yyyy-mm-dd - Location)
Wolverine - 2016-04-05 -SCAP

Document No.
WildlifeReport000062

2016-06-05

Completed on
2016-06-06, 9:38 AM

Score
1/1 - 100%

Audit - 1/1 - 100%

Question	Response	Details
Wildlife Report		
Type of Wildlife Report	🟩 General sighting / Other	
Report Type	🟥 Mortality	
Wildlife Mortality		
Enter Initial Time of Report	2016-06-04, 5:02 PM	
Department/Individual Who Reported Mortality:	A21 - Rod	
Environment On Scene		
Environment at Call-out Location	2016-06-05, 4:30 PM	
Location	SCAP Fabrication Yard	
Animal Type	Wolverine	
Description of Animal/Scene	The A21 Supervisor contacted Environment and said they were about to move a bin and notice a smell coming from it, so they perked inside and the was a dead fox in the bin. Environment went to the site the following day to retrieve the animal. The bin was inspected and a dead Wolverine was curled up in the bottom of a bin. The only other thing in the bin was some plastic. The wolverine was medium sized, it appeared to be fairly intact and the odour was not overpowering. A hook was used to retrieve the animal and it was placed into a bag and taken back to the office and placed onto a freezer. The A21 Supervisor indicated the bin was staged in the area around January. It is uncertain as to when the animal got into the bin. The Environment Supervisor contacted ENR and was was authorized to incinerate the carcass.	
Photo of Scene		
 Appendix 1  Appendix 2  Appendix 3  Appendix 4  Appendix 5		
Estimated Time of Death	Months	

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<tr><td>End of Environment Call-out</td><td colspan="3">2016-06-05, 5:30 PM</td></tr>
<tr><td>Final Location of Carcass</td><td colspan="3">Carcass will be incinerated</td></tr>
<tr><td colspan="3">Closure & Sign-off</td><td>Score (1/1) 100%</td></tr>
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<tr><td>Signature</td><td>Dianne Dul</td><td>2016-06-06
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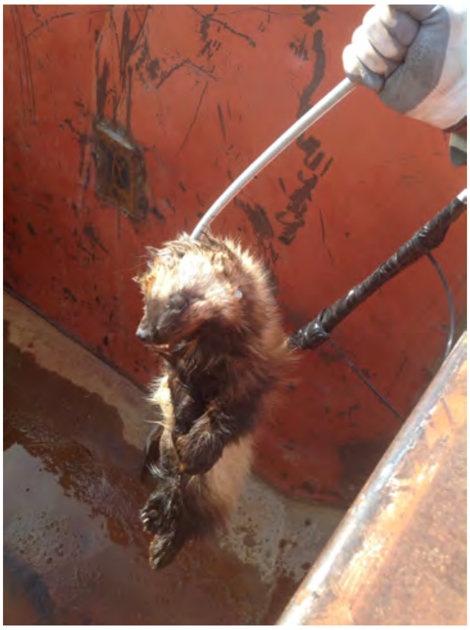
Media

Appendix 1

Appendix 2

Appendix 3

Appendix 4



Appendix 5

Wildlife Report - 2016

Audit Title (Animal - yyyy-mm-dd - Location)
Sicsic - 2016-08-04

Document No.
WildlifeReport000126

04 Aug 2016

Completed on
06 Aug 2016

Score
1/1.0 - 100.00%

Disclaimer

Confidentiality Statement

Table of Contents

Audit - 1/1 100.00%

Question	Response	Details
Wildlife Report		
Type of Wildlife Report	General sighting / Other	
Report Type	Mortality	
Wildlife Mortality		
Enter Initial Time of Report	04 Aug 2016 10:00 AM	
Department/Individual Who Reported Mortality:	Don Dougay	
Environment On Scene		
Environment at Call-out Location	04 Aug 2016 01:45 PM	
Location	0534161 7150991	
Animal Type	Other	
Description of Animal/Scene	Dead Sicsic found on road across from Powerhouse 1, ENV on the scene at 1345. Animal double bagged. Showing signs of rigamortis but still warm.	
Photo of Scene  Appendix 1		
Estimated Time of Death	Hours	
Environment Off Scene		
End of Environment Call-out	04 Aug 2016 01:50 PM	
Final Location of Carcass	Incinerated at WTA	
Closure & Sign-off		Score (1/1) 100.00%
Wildlife Report Complete	On	

Question		Response	Details
Signature	Dianne Dul		D. Dul

Media

Appendix 1

Wildlife Report - 2016

Audit Title (Animal - yyyy-mm-dd - Location)
Peregrine Falcon - 2016-09-15 - A21 intersection

Document No.
WildlifeReport000147

15 Sep 2016

Completed on
15 Sep 2016

Score
1/1.0 - 100.00%

Disclaimer

Information on the latest workers compensation and OHS / WHS laws can be found at the relevant State WorkCover / WorkSafe Authority.

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Table of Contents

Audit - 1/1 100.00%

Question	Response	Details
Wildlife Report		
Type of Wildlife Report	General sighting / Other	
Report Type	Mortality	
Wildlife Mortality		
Enter Initial Time of Report	15 Sep 2016 08:00 AM	
Department/Individual Who Reported Mortality:	Jim Larkin	
Environment On Scene		
Environment at Call-out Location	15 Sep 2016 03:34 PM	
Location	A21 intersection	
Animal Type	Other	
Description of Animal/Scene	Peregrine Falcon carcass was found at the intersection when entering A21 area. Coordinates of area are 0533153, 7149409	
Photo of Scene  Appendix 1  Appendix 2		
Estimated Time of Death	Days	
Environment Off Scene		
End of Environment Call-out	15 Sep 2016 03:38 PM	
Final Location of Carcass	Freezer	
Closure & Sign-off		Score (1/1) 100.00%
Wildlife Report Complete	On	

Question	Response	Details
Signature	JG	

Media

Appendix 1

Appendix 2

Wildlife Report - 2016

Audit Title (Animal - yyyy-mm-dd - Location)
Arctic Hare - 2016-10-24 -South Haul Road

Document No.
WildlifeReport000151

24 Oct 2016

Completed on
24 Oct 2016

Score
1/1.0 - 100.00%

Disclaimer

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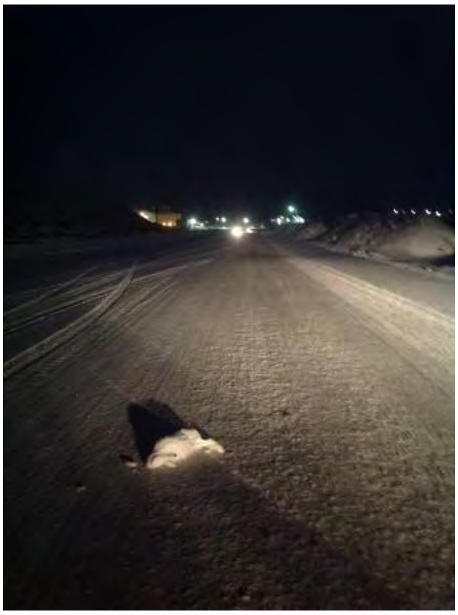
Table of Contents

Audit - 1/1 100.00%

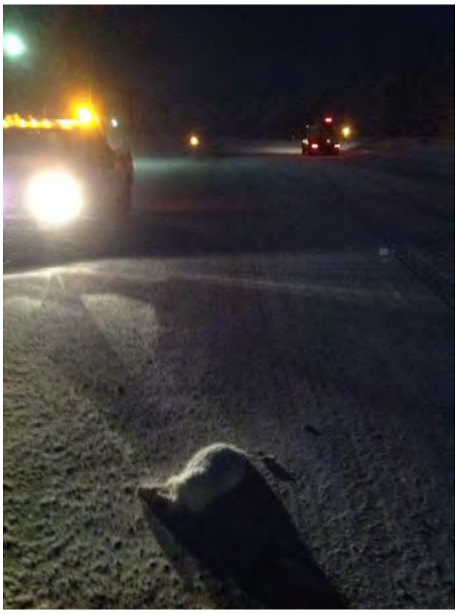
Question	Response	Details
Wildlife Report		
Type of Wildlife Report	🟩 General sighting / Other	
Report Type	🟥 Mortality	
Wildlife Mortality		
Enter Initial Time of Report	24 Oct 2016 07:00 AM	
Department/Individual Who Reported Mortality:	Site Services/ Neil Mercer	
Environment On Scene		
Environment at Call-out Location	24 Oct 2016 07:29 AM	
Location	South Haul Road 534166.76293543, 7151969.8304715	
Animal Type	Other	
Description of Animal/Scene	Arctic Hare on South Haul Road freshly killed. Bleeding from head. Cause of death is likely vehicle impact. Outside temp: -6 Body still limp. Estimated time of impact within the last 1.5 hrs	
Photo of Scene  Appendix 1  Appendix 2  Appendix 3		
Estimated Time of Death	Hours	
Environment Off Scene		
End of Environment Call-out	24 Oct 2016 07:45 AM	
Final Location of Carcass	Incinerator at Waste Transfer Area.	

Question	Response	Details	
Closure & Sign-off			Score (1/1) 100.00%
Wildlife Report Complete	On		
Signature	Stephen Marshall		

Media


Appendix 1


Appendix 2


Appendix 3

Wildlife Report - 2016

Audit Title (Animal - yyyy-mm-dd - Location)
Fox-2016-11-22-South Haul Road

Document No.
WildlifeReport000035

2016-11-23

Completed on
2016-11-23, 8:13 AM

Score
1/1 - 100%

Confidentiality Statement

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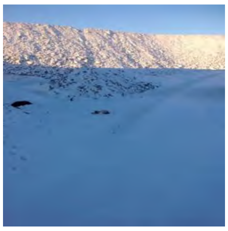
Table of Contents

Audit - 1/1 - 100%

Question	Response	Details
Wildlife Report		
Type of Wildlife Report	General sighting / Other	
Report Type	Mortality	
Wildlife Mortality		
Enter Initial Time of Report	2016-11-22, 12:40 PM	
Department/Individual Who Reported Mortality:	Underground Engineer/Erin	
Environment On Scene		
Environment at Call-out Location	2016-11-22, 1:12 PM	
Location	South Haul Road at Pond 5	
Animal Type	Fox	
Description of Animal/Scene	Adult Fox Front Half carcass (gender unknown) on South Haul Road at Pond 5 beside a Culvert. Two Living Foxes were beside the carcass There was no blood around the area and the cause of it dead is unknown The ground was covered with snow Environment shovel the carcass into a garbage bag and search the area for the other half but found nothing. The estimated time of death is unknown since everything is frozen at this time of the year	
Photo of Scene		
 Appendix 1  Appendix 2  Appendix 3  Appendix 4		
Estimated Time of Death	Days	
Environment Off Scene		
End of Environment Call-out	2016-11-22, 1:35 PM	

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8:07 AM</td><td></td></tr>
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Media

Appendix 1

Appendix 2

Appendix 3

Appendix 4

APPENDIX C

Site Wildlife Photos, 2016

Photograph 1: *Caribou*

Photograph 2: *Grizzly Bear*

Photograph 3: Wolverine

Photograph 4: Wolverine Tracks

Photograph 5: Arctic Hare

Photograph 6: Arctic Fox

Photograph 7: Wolf

APPENDIX D

Grizzly Bear Incidental Observations Summary, 2016

Date	Number of Animals	Characteristics of Animals	Location	Deterrents Used?
2016/04/25	2	Unknown	Two bears between tower 4 and emulsion plant	No
2016/04/28	2	Mother and Cub (Blond)	Two bears in PKC dump area	No
2016/04/29	2	Mother and Cub (Blond)	Two bears between PKC and Test Piles	No
2016/04/30	2	Mother and Cub (Blond)	Two bears near WTA	Yes
2016/05/01	2	Mother and Cub (Blond)	Two bears near Pond 5 and last seen on tundra near Shallow Bays	No
2016/05/02	2	Mother and Cub (Blond)	Two bears near Back Fill plant, then NI	Yes
2016/05/03	2	Mother and Cub (Blond)	North Inlet area	No
2016/05/04	2	Mother and Cub (Blond)	North Inlet west of the plant	No
2016/05/06	2	Sow and cub (Blond)	North Inlet towards the Airport	No
2016/05/07	2	Sow and cub (Blond)	North Inlet towards the Airport	No
2016/05/08	2	Sow and cub (Blond)	North Inlet towards the Airport	No
2016/05/09	2	Sow and cub (Blond)	Waste Rock Pile	No
2016/05/11	3	Sow and cub (Blond). Third bear medium-sized (no visual)	Magazine area	No
2016/05/11	2	Sow and cub (Blond)	Called in near Waste Transfer Area, last seen at Till Pile.	Yes
2016/05/16	2	Sow and Cub (Blond)	DPS 3 on A154 Dike	No
2016/05/16	2	Sow and Cub (Blond)	Approach 28, heading onto the ice	No
2016/05/17	1	Cub (blond from last summer)	Pond 5, Cub from last year	Yes
2016/05/18	1	Cub (blond from last summer)	Cub at crusher rom heading towards ring road	No
2016/05/21	1	Blond almost 2 yrs. in age	Cub from last summer	No
2016/05/22	3	New sow and cubs	Sow and cubs just showed up on site at the airport	No
2016/05/24	1	Single bear spotted, suspect that it is the cub from last summer	A21 area	No
2016/05/24	1	Single cub, possibly new cub	Airport by Helipad	No
2016/05/25	1	Dark brown, young grizzly	Airport	No
2016/05/26	1	Single grizzly	South of A21 Dike	No
2016/05/26	1	Single grizzly	By AN building travelling North	No
2016/05/27	1	Single dark brown grizzly	South of runway at airport	No
2016/05/29	1	Single grizzly cub (blond from last summer)	On the till pile	No
2016/05/29	1	Single grizzly cub (blond from last summer)	On North Country Rock Pile	No
2016/05/30	1	Brown Grizzly with a funny tuft of hair on its rump	Shallow Bay	Yes
2016/05/30	1	Blonde Sow	Single grizzly at A21	Yes
2016/06/02	1	Unknown	North of North Inlet	No
2016/06/02	1	Very blonde medium-sized bear, light brown front legs	Airport, at Backfill at 20:00	Yes
2016/06/03	1	Unknown	Walking towards North Inlet	No
2016/06/03	1	Very blonde medium-sized bear, light brown front legs	Backfill to Till Pile, back to Load Out Area	Yes
2016/06/03	1	Very blonde medium-sized bear, light brown front legs	Pond 13 to Pond 5 to Till Pile	Yes
2016/06/04	1	Very blonde medium-sized bear, light brown front legs	Airport then Pond 3 by pump, grazing in the area	No
2016/06/05	1	Very blonde medium-sized bear, light brown front legs	ROM Area At Lube Bay and headed over berm towards Rose Garden	Yes
2016/06/06	1	Unknown	Pond 5	No

Date	Number of Animals	Characteristics of Animals	Location	Deterrents Used?
2016/06/07	1	Very blonde medium-sized bear, light brown front legs	Rom Sizer Road, S of S Tank Farm, Pond 12A, MET Con	Yes
2016/06/08	1	Very blonde medium-sized bear, light brown front legs	Pond 10 to Pond 5, Pond 5 to South Cell tundra	Yes
2016/06/09	1	Very blonde medium-sized bear, light brown front legs	Pond 10, Rose Garden, A418 (into Pit), D1, A154 Fish Habitat	Yes
2016/06/10	1	Very blonde medium-sized bear, light brown front legs	Backfill, Pond 1, Metcon, A21, Main Accommodations Parking, Com Shack, Rose Garden, A418	Yes
2016/06/10	1	Brown-colored grizzly, medium-sized, funny looking bear	Hanging Tree, A154 Fish Habitat, A418	No
2016/06/11	1	Brown bear, medium-sized, funny looking	A418 Dike, Shallow Bay, A154 DPS1 Fish Habitat	No
2016/06/01	1	Very blonde medium-sized bear, light brown front legs	Backfill, Ring Road, Till Pile, Hanging Tree, Fish Habitat	Yes
2016/06/12	1	Very blonde medium-sized bear, light brown front legs	ROM, Pond 5, ROM, Met Con, WTA, Test Piles, Met Con	Yes
2016/06/12	1	Brown bear, medium-sized, funny looking	Between Airport and North Inlet WTP	No
2016/06/13	1	Very blonde medium-sized bear, light brown front legs	Process Plant Floor, Pond 5	Yes
2016/06/13	1	Brown bear, medium-sized, funny looking	Airport to Backfill Plant	No
2016/06/14	1	Brown bear, medium-sized, funny looking	Airport	No
2016/06/14	1	Very blonde medium-sized bear, light brown front legs	Pond 5, WTA, AN Road, Pond 4, Pond 3	Yes
2016/06/14	2	One male one female light blonde	North Inlet	No
2016/06/15	4	Two coupled bears both are light blond, one single small blonde, one larger dark brown bear	Metcon, pond 13, pond 5, north winter road approach, test piles, PKC, shallow bay, A418 dike	Yes
2016/06/16	2	Male and female light brown bears	South Haul Road crossed over onto tundra across from pond 5	Yes
2016/06/16	1	One small lighter brown bear. New to site	North winter road approach to batchplant	No
2016/06/16	1	Cub (blonde from last summer)	Pond 4	No
2016/06/16	1	Cub (blonde from last summer)	Single blonde cub	Yes
2016/06/16	2	Two coupled bear both are light blond, one single small blonde, one larger dark brown bear	Two adult bears in pond 13	Yes
2016/06/16	1	Medium-sized brown bear	Backfill plant	Yes
2016/06/17	1	Medium-sized brown bear	A418 fish habitat	No
2016/06/17	2	Two coupled bear both are light blond, one single small blonde, one larger dark brown bear	Two bears walking toward the hanging tree	No
2016/06/17	1	Cub (blonde from last summer)	Bear out by the emulsion plant	No
2016/06/17	1	Cub (blonde from last summer)	Bear in pond 4	Yes
2016/06/18	1	Large adult. Dark with blonde on shoulders	Bear at airport	No
2016/06/19	1	Large adult male	A418 fish habitat	Yes
2016/06/19	1	Medium-sized dark brown bear	Pond 13	Yes
2016/06/19	1	Large male adult blonde bear	Tundra side of Airport runway	No
2016/06/20	1	Cub (blonde from last summer)	Batch Plant	No
2016/06/20	1	Cub (blonde from last summer)	Back fill plant	No
2016/06/20	1	Adult male	Hanging tree	No
2016/06/20	1	Dark brown	Spotted by backfill plant	Yes
2016/06/20	1	Cub (blonde from last summer)	Leaving pond 5	Yes
2016/06/21	1	Medium blonde back brown legs	Behind SCAP fab shop	Yes
2016/06/22	1	Smaller Bear	Zone 1	No
2016/06/23	1	Brown	C-portal and Old Mine Dry	Yes
2016/06/23	1	Brown	Hanging Tree	Yes

Date	Number of Animals	Characteristics of Animals	Location	Deterrents Used?
2016/06/23	1	Cub (blonde from last summer)	Bear by backfill plant	No
2016/06/24	1	Adult male	Behind North Inlet Water Treatment Plant	No
2016/06/24	1	Cub (blonde from last summer)	By top of 154 pit road (tundra patch behind ERT training ground)	Yes
2016/06/26	1	Cub (blonde from last summer)	On the till pile	No
2016/06/30	1	Cub (blond from last summer)	Metcon/Process ROM/Pond 10	Yes
2016/06/30	1	Medium-size bear	A154 pit entrance near top bench	No
2016/07/01	1	Dark brown bear	Airport between runway and Airstrip	No
2016/07/01	1	Unknown	Pond 1	No
2016/07/01	1	Very blonde medium sized bear, light brown front legs	North Inlet heading towards North Inlet Water Treatment Plant	Yes
2016/07/02	1	Large brown bear with dark head	Backfill Plant Load Out Area to Upper Dump 7	Yes
2016/07/03	1	Large brown bear with dark head	Airport, Pond 1 & Pond 5	Yes
2016/07/03	1	Very blonde medium sized bear, light brown front legs	Backfill Plant, Pond , Old LDG Shop	Yes
2016/07/03	1	Very blonde medium sized bear, light brown front legs	Lube Building, Fresh Water Uptake, Pond 5	Yes
2016/07/04	1	Darker brown, medium, skinny with tuffs of hair	Process ROM, Metcon, Field Lab, Pond 5, PKC dump	Yes
2016/07/05	1	Blonde resident cub	S. Haul Rd toward Pond 5, Backfill, NC Rock Pile, North Inlet Water Treatment Plant, Airport, West Island Hill	Yes
2016/07/07	1	Large blonde bear with brown face and legs	Hanging Tree, NI Dike Road, Airport	Yes
2016/07/09	1	Unknown	D1 Lay-down	No
2016/07/16	1	Blond bear darker legs (resident bear)	N17	Yes
2016/07/19	1	Medium brown darker colour	A154 fish habitat	No
2016/07/16	2	Small blonde resident bear and larger brown bear	pond 5	Yes
2016/07/19	1	Small blonde resident bear	Airport	No
2016/07/20	1	Small blonde resident bear	Batch Plant	Yes
2016/07/21	1	Two-tone blonde/brown bear	Process ROM/Truck Shop/Pond 10/tundra south of com shack	Yes
2016/07/22	1	Small blonde resident bear	Backfill/Pond 1/North County Rock Pile berm	Yes
2016/07/24	1	Small blonde resident bear	Hanging Tree	Yes
2016/07/28	1	Blond bear with dark legs	Airport Road/North Inlet/Veg Plots/A418 Fish Habitat	Yes
2016/07/29	2	Dark bear with black patch, blond bear brown legs	ROM Road/South Haul Road/Pond 5/North Inlet/Rock Pile	No
2016/07/29	1	Dark face & Legs with black patch on butt	Main Camp, A21 Area x2 & WTA	Yes
2016/07/29	2	Dark bear with black patch, blond bear brown legs	Between North Inlet Water Treatment Plant and the airport (along the airport road)	No
2016/07/30	1	Dark face & Legs with black patch on butt	Hanging Tree to A154 Fish Habitat Area	Yes
2016/07/30	1	Dark bear with black patch, blond bear brown legs	Hanging Tree	No
2016/07/31	1	Dark bear with black patch, blond bear brown legs	Hanging Tree	No
2016/08/03	1	Unknown	Between BB dorm and warehouse	Yes
2016/08/04	1	Brown face, looks like it has light brown pants & darker brown markings inside back legs	South Winter Road Approach	No
2016/08/05	1	Brown face, looks like it has light brown pants & darker brown markings inside back legs	West Shallow Bay Area	Yes
2016/08/07	1	Dark Brown Large Grizzly	North Inlet	Yes
2016/08/08	1	Dark Brown Large Grizzly	West Shallow Bay Area	Yes
2016/08/09	1	Dark Brown Bear	C Dorm	No

Date	Number of Animals	Characteristics of Animals	Location	Deterrents Used?
2016/08/10	1	Dark Brown Bear	A418 Dike	No
2016/08/20	1	Brown adolescent	ERT training grounds	Yes
2016/08/21	1	Unknown	A21 Portal	No
2016/08/22	1	Small Brown	Airport	No
2016/08/25	1	Large brown bear with dark head	North Inlet West end near airport road	No
2016/08/25	1	Large brown bear with dark head	D1 > Batch Plant > E Shallow Bay	Yes
2016/08/26	1	Larger Bear darker blonde to brown in colour	Batch Plant	No
2016/08/28	1	Larger Bear darker blonde to brown in colour	Airport > North Inlet	No
2016/08/29	1	Dark brown-coloured medium-sized bear	A21 > A Portal > BB Dorm > Rose Garden	Yes
2016/08/30	1	Dark brown-coloured medium-sized bear	Shallow Bays > A418 > D1 > Fish Habitat > North Inlet/Runway East	No
2016/09/02	1	Large brown bear with blonde shoulders and head	Airport >North Inlet Water Treatment Plant>Airport	No
2016/09/03	1	Large brown bear with blonde shoulders and head	Airport	Yes
2016/09/07	1	Unknown	Bear was spotted around the Batch plant on night shift	No
2016/09/12	1	Large brown bear with darker brown legs	Backfill>Till Dump>ERT Training Grounds>A154 future fish habitat	Yes
2016/09/13	1	Dark brown-coloured medium-sized bear	Shallow bays/ Veg plots	No
2016/09/13	1	Dark brown-coloured medium-sized bear	Pond 1	Yes
2016/09/17	1	Unknown	NI West end near airport road	No
2016/09/18	1	Unknown	150m north of the runway at the airport	No
2016/09/29	1	Blonde medium-sized, dark around the face, possibly resident bear from earlier in the summer	Airport, south of helipad, South haul road	No
2016/09/30	1	Blonde medium-sized, dark around the face, possibly resident bear from earlier in the summer	S. Haul Rd >Pond5>Test Piles>Pond 12A	Yes
2016/10/08	1	Blonde medium-sized, dark around the face, possibly resident bear from earlier in the summer	Tundra between WTA and Alabama	No
2016/10/09	1	Blonde medium-sized, dark around the face, possibly resident bear from earlier in the summer	Tundra between WTA and Alabama	No
2016/10/16	1	Blonde medium-sized, dark around the face, possibly resident bear from earlier in the summer	Tundra between WTA and Alabama	No

APPENDIX E

Wolverine Snow Track Survey Results, 2016

APPENDIX E

Wolverine Snow Track Survey Results, 2016

Date	UTM Easting	UTM Northing	Snow Cover	Snow Condition	Days Since		Observation Type	Number of Individuals	Age of Track	Comments
					Last Snow	Last Wind				
2016/03/22	549599	7159073	100%	Packed	5	1	Tracks	1	Days	Packed Snow/ Adult
2016/03/22	553457	7141005	100%	Packed	5	1	Tracks	1	Weeks	Crystalized/ Packed
2016/03/22	554824	7146703	100%	Packed	5	1	Tracks	1	Weeks	Packed/ snow blown
2016/03/22	554025	7146924	100%	Packed	5	1	Tracks	1	Weeks	Packed/ snow blown
2016/03/22	550442	7144001	100%	Packed	5	1	Tracks	1	Weeks	Packed/ snow blown
2016/03/23	527872	7148018	100%	Packed	6	1	Tracks	1	Weeks	Packed snow
2016/03/23	530307	7152832	100%	Packed	6	1	Tracks	2	Weeks	Adult/ Packed snow
2016/03/23	530307	7152832	100%	Packed	6	1	Tracks	2	Weeks	Adult
2016/03/23	530443	7153020	100%	Packed	6	1	Tracks	1	Weeks	Adult/ Packed snow/ Tracks blown in
2016/03/23	530528	7153081	100%	Packed	6	1	Tracks	1	Weeks	Large adult/ Snow blown
2016/03/23	530544	7153095	100%	Packed	6	1	Tracks	1	Weeks	Large adult/ Snow blown
2016/03/23	530817	7153321	100%	Packed	6	1	Tracks	1	Weeks	Adult
2016/03/23	536364	7150130	100%	Packed	6	1	Tracks	1	Weeks	Packed/ Wind blown
2016/03/23	536944	7149948	100%	Packed	6	1	Tracks	1	Days	Young/ Packed/ Wind blown
2016/03/23	537546	7149790	100%	Packed	6	1	Tracks	2	Days	-
2016/03/23	537546	7149790	100%	Packed	6	1	Tracks	2	Days	Young animal/ Same cordinates. Possibly two different animals
2016/03/23	538108	7149407	100%	Packed	6	1	Tracks	1	Weeks	Packed/ Snow blown
2016/03/23	538394	7149284	100%	Packed	6	1	Tracks	1	Weeks	Adult
2016/03/23	539021	7149049	100%	Packed	6	1	Tracks	1	Days	Packed
2016/03/23	539108	7148999	100%	Packed	6	1	Tracks	1	Weeks	-
2016/03/23	537186	7130831	100%	Packed	6	1	Tracks	1	Days	Packed Snow/ Adult
2016/03/23	525756	7155050	100%	Packed	6	1	Tracks	1	Days	Packed Snow/ Adult
2016/03/25	540171	7169053	100%	Packed	7	1	Tracks	1	Weeks	Packed and blown snow/ Adult
2016/03/25	538918	7165342	100%	Packed	7	1	Tracks	1	Days	Packed and blown snow/ Adult
2016/03/25	540013	7164027	100%	Packed	7	1	Tracks	1	Weeks	Packed/ Adult
2016/03/25	547566	7166144	100%	Crystalized	7	1	Tracks	1	Weeks	Adult/ Crystalized
2016/03/25	548493	7168989	100%	Dry	7	1	Tracks	1	Weeks	Adult/ Dry
2016/03/25	549505	7169530	100%	Dry	7	1	Tracks	1	Days	Adult
2016/03/25	541141	7170041	100%	Crystalized	7	1	Tracks	1	Days	Adult
2016/03/25	541129	7170024	100%	Crystalized	7	1	Tracks	1	Weeks	Adult
2016/03/25	541050	7169950	100%	Crystalized	7	1	Tracks	1	Weeks	Adult
2016/03/25	540678	7169603	100%	Packed	7	1	Tracks	1	Days	Adult
2016/03/25	540477	7169408	100%	Crystalized	7	1	Tracks	1	Weeks	Adult
2016/03/27	550179	7138388	100%	Crystalized	9	2	Tracks	1	Weeks	Adult
2016/03/27	556329	7133313	100%	Crystalized	9	2	Tracks	1	Days	Adult
2016/03/27	545524	7135584	100%	Packed	9	2	Tracks	1	Weeks	Adult
2016/03/27	545608	7135619	100%	Packed	9	2	Tracks	1	Weeks	Adult

Date	UTM Easting	UTM Northing	Snow Cover	Snow Condition	Days Since		Observation Type	Number of Individuals	Age of Track	Comments
					Last Snow	Last Wind				
2016/03/27	546338	7135788	100%	Packed	9	2	Tracks	1	Days	Adult
2016/03/27	545372	7139876	100%	Packed	9	2	Tracks	1	Weeks	Adult
2016/03/27	544917	7140291	100%	Packed	9	2	Tracks	1	Days	Adult
2016/03/27	544579	7140571	100%	Packed	9	2	Tracks	1	Days	Adult
2016/03/27	544512	7140636	100%	Packed	9	2	Tracks	1	Days	Adult
2016/03/27	544378	7140833	100%	Packed	9	2	Tracks	1	Days	Adult
2016/03/27	544226	7140976	100%	Packed	9	2	Tracks	1	Days	Adult
2016/03/27	544089	7141074	100%	Packed	9	2	Tracks	1	Weeks	Adult
2016/03/27	539732	7141964	100%	Packed	9	2	Tracks	1	Days	Adult
2016/03/27	539687	7142125	100%	Packed	9	2	Tracks	1	Days	Adult
2016/03/27	535041	7143276	100%	Packed	9	2	Tracks	1	Days	Adult
2016/03/27	534609	7143742	100%	Packed	9	2	Tracks	1	Weeks	Adult
2016/03/27	533640	7144921	100%	Packed	9	2	Tracks	1	Days	Adult
2016/04/08	540989	7170130	100%	Powder	4	13	Tracks	1	Hours	Wolverine tracks (large). Wolf tracks (fresh) heading south & Fox tracks.
2016/04/08	540107	7163845	100%	Powder	4	13	Digs	1	Days	Wolverine tracks (5-7 days old) (large). Fox tracks & three Wolf tracks on transect (2 - fresh).
2016/04/09	552269	7152760	100%	Powder	5	1	Tracks	1	Days	Two Wolves on lake (1Black/1White) 1.41 km from WT14-1 on way to WT22-1. Wolf tracks at the end of the transect & fox tracks on transect.
2016/04/09	556244	7158782	100%	Powder	5	1	Tracks	1	Days	Moose at (554209 - 7159033). Wolf tracks(old) & fox tracks.
2016/04/09	544464	7158166	100%	Powder	5	1	Tracks	1	Days	Wolverine tracks (medium)
2016/04/09	543417	7153997	100%	Powder	5	1	Tracks	1	Days	Wolverine tracks (large)
2016/04/09	542686	7153606	100%	Powder	5	1	Tracks	1	Days	Wolverine tracks (medium)
2016/04/10	554422	7140902	100%	Powder	6	1	Tracks	1	Days	Medium size tracks
2016/04/10	557173	7140865	100%	Powder	6	1	Tracks	1	Weeks	Very old, filled with powder snow
2016/04/10	555453	7146447	100%	Powder	6	1	Tracks	1	Days	Small/Medium size tracks
2016/04/10	555217	7146569	100%	Powder	6	1	Tracks	1	Days	Small track (same animal)
2016/04/10	555070	7146588	100%	Powder	6	1	Tracks	1	Days	Small track (same animal)
2016/04/10	554374	7146846	100%	Powder	6	1	Tracks	1	Days	Small track (same animal)
2016/04/10	554153	7146908	100%	Powder	6	1	Tracks	1	Days	Small track
2016/04/10	553753	7146984	100%	Powder	6	1	Tracks	1	Days	Small track
2016/04/10	550080	7143710	100%	Powder	6	1	Tracks	1	Days	Small/Medium size tracks
2016/04/10	548204	7141739	100%	Powder	6	1	Tracks	1	Days	Medium size tracks
2016/04/10	546841	7146991	100%	Powder	6	1	Tracks	1	Days	Medium size tracks
2016/04/10	546913	7147032	100%	Powder	6	1	Tracks	1	Days	Medium size tracks
2016/04/10	547673	7147916	100%	Powder	6	1	Tracks	1	Days	Medium size tracks
2016/04/10	542628	7148089	100%	Powder	6	1	Tracks	1	Days	Medium size tracks

Date	UTM Easting	UTM Northing	Snow Cover	Snow Condition	Days Since		Observation Type	Number of Individuals	Age of Track	Comments
					Last Snow	Last Wind				
2016/04/10	542685	7148530	100%	Powder	6	1	Tracks	1	Days	Medium size tracks
2016/04/10	542773	7149704	100%	Powder	6	1	Tracks	2	Days	Adult and youth
2016/04/10	539021	7149046	100%	Powder	6	1	Tracks	1	Days	Large size
2016/04/10	537945	7149485	100%	Powder	6	1	Tracks	2	Days	Two sets of Medium sized tracks
2016/04/10	537808	7149587	100%	Powder	6	1	Tracks	1	Days	Medium size tracks
2016/04/10	536373	7150247	100%	Powder	6	1	Tracks	1	Weeks	Old Medium size tracks
2016/04/11	521859	7158931	100%	Powder	7	1	Tracks	1	Weeks	Medium size tracks, snow is crystalized
2016/04/11	523773	7165309	100%	Powder	7	1	Tracks	1	Days	Medium size tracks, snow is crystalized and wet urine mark as well.
2016/04/11	524981	7164552	100%	Powder	7	1	Tracks	1	Days	Medium size tracks, snow is crystalized and wet. Same travelling pair as above, following old skidoo tracks
2016/04/11	525604	716463	100%	Powder	7	1	Tracks	1	Days	Medium size tracks, snow is crystalized and wet, same track as above.
2016/04/11	525937	7154990	100%	Powder	7	1	Tracks	1	Days	Smaller tracks, snow is crystalized and wet, Wolf tracks on transect
2016/04/11	530734	7153239	100%	Powder	7	1	Tracks	1	Days	Medium tracks, snow is crystalized and wet, two sets of Wolf tracks on transect
2016/04/11	530133	7152728	100%	Powder	7	1	Tracks	1	Days	Medium tracks, snow is crystalized and wet
2016/04/11	530017	7152632	100%	Powder	7	1	Tracks	1	Days	Medium tracks, snow is crystalized and wet
2016/04/11	528589	7148128	100%	Packed	7	1	Tracks	1	Days	Medium tracks, snow is crystalized and wet
2016/04/12	554328	7132749	100%	Powder	8	2	Tracks	1	Days	Medium tracks, snow packed
2016/04/12	549947	7131703	100%	Packed	8	2	Tracks	1	Days	Snow powder
2016/04/12	551493	7138139	100%	Packed	8	2	Tracks	1	Days	Medium tracks, snow packed
2016/04/12	550560	7138305	100%	Packed	8	2	Tracks	1	Days	Medium tracks, snow packed, possibly the same animal as above
2016/04/12	549627	7138483	100%	Packed	8	2	Tracks	1	Days	Small tracks, snow packed
2016/04/12	546059	7139231	100%	Packed	8	2	Tracks	1	Days	Medium tracks, snow packed
2016/04/12	545423	7139935	100%	Packed	8	2	Tracks	1	Days	Snow packed, crystalized
2016/04/12	544860	7140500	100%	Packed	8	2	Tracks	1	Days	Snow packed
2016/04/12	539568	7142381	100%	Powder	8	2	Tracks	1	Days	Small tracks, snow powder over packed
2016/04/12	539275	7143145	100%	Powder	8	2	Tracks	1	Days	Snow powder over packed
2016/04/12	533212	7145274	100%	Powder	8	2	Tracks	1	Days	Snow crystalized
2016/04/13	519719	7137472	100%	Powder	9	1	Tracks	1	Days	Snow crystalized powder, plus fox tracks
2016/04/13	520097	7137459	100%	Powder	9	1	Tracks	1	Days	Snow crystalized powder
2016/04/13	520252	7137474	100%	Powder	9	1	Tracks	1	Days	Snow crystalized powder, plus fox tracks

APPENDIX F

Wolverine Incidental Observations Summary, 2016

Date	Animals	Location	Comments
2016/01/06	1	WTA	-
2016/01/06	1	UG Waste bin	-
2016/01/12	1	WTA around old incinerator and the Used barrel trailer	-
2016/01/14	1	UG, between to wooden bins by door to shop	-
2016/02/20	1	Haul road	Haul truck locked up brakes to avoid wolverine
2016/01/15	1	South Tank Farm then Truck Shop, then Main Accommodations	-
2016/01/16	1	Truck Shop	-
2016/01/17	1	WTA	-
2016/01/18	1	WTA	-
2016/01/18	1	WTA	Under empty barrel storage rack
2016/01/20	1	WTA around old incinerator and the Used barrel trailer, then Western Explosive Area then back to WTA	-
2016/01/21	1	WTA around old incinerator, then Western Explosive Area, then back at WTA	-
2016/01/22	1	WTA around old incinerator, then Western Explosive Area	-
2016/01/24	1	WTA by the barrel skid, then heading towards A21	-
2016/01/23	1	Warehouse Parking Lot	-
2016/01/25	1	Metcon Area	-
2016/01/26	1	WTA Area by skid	-
2016/01/27	1	WTA are by skid	-
2016/01/27	1	Running by A dorm and ERT training room	-
2016/01/27	1	Site Services vehicle line up	-
2016/02/04	1	Between Metcon and Power house 2	-
2016/02/06	1	Seafan Alley	-
2016/02/07	1	Airport heading north on lake	-
2016/02/08	1	Between Metcon and South Tank Farm	-
2016/02/11	1	Between WT and Haul Road	-
2016/02/12	2	Magazine by Wind Mills	-
2016/02/12	1	Sea can Ally & Metcon	-
2016/02/13	1	Moving around at the airport	-
2016/02/14	1	South Tank Farm	-
2016/02/14	2	Airport	-
2016/02/15	1	PKC then at WTA	-
2016/02/18	1	WTA then the Metcon	-
2016/02/20	1	Spotted in the Geology area, then reported at South Winter Road Approach	-
2016/02/24	1	South Tank Farm	-
2016/02/25	1	Metcon	Confirmed with Tracks
2016/02/26	1	Metcon	-
2016/03/05	1	Metcon	-
2016/03/06	1	Metcon	Relocated 100km south on ice road. See report for details.

Date	Animals	Location	Comments
2016/03/07	1	Metcon	-
2016/03/09	1	Sea Can Alley	-
2016/03/09	1	Metcon	-
2016/03/09	1	Sea Can Alley	-
2016/03/09	1	Burnable bin near UG refuelling area	-
2016/03/10	1	Truck shop	-
2016/03/10	1	DOC/South Camp	-
2016/03/11	1	sea can Alley > Metcon > STP > Warehouse Parking > Field Lab Parking > PKC	-
2016/03/15	2	WTA	In non-burnable bin
2016/03/15	1	Metcon/Powerhouse 1	Wolverine caught in trap relocated 100km from site
2016/03/16	1	WTA>Metcon>WR Staging>Warehouse>Com Shack>Backfill>UG Mine Dry	Trying to get back into bin in WTA
2016/03/19	1	Heading towards the AN Area	-
2016/03/21	1	Crossed road into Metcon	-
2016/03/24	1	Power house	South Side
2016/03/25	1	Between South Tank Farm and Metcon	-
2016/03/27	1	Near Process Plant	-
2016/03/28	1	Zone 1 and Dump 12	-
2016/03/30	1	Process Plant/Powerhouse	Security called in during night shift
2016/03/31	2	WTA	-
2016/03/31	1	Process and Powerhouse 2	-
2016/03/31	1	Main parking lot (truck shop)	-
2016/03/31	1	Site Service line	In the back of pick up 272
2016/04/01	2	WTA	Two Wolverines leaving the WTA. One went up the Test Piles and one to the Metcon
2016/04/01	1	Metcon laydown	-
2016/04/02	1	Metcon	Leaving Metcon heading toward A21
2016/04/10	1	Several locations	Very active on site
2016/04/11	1	Old LDG Shop	-
2016/04/11	1	South side of Truck Shop	-
2016/04/13	1	Old Mine Dry	Trapped in Non burn bin
2016/04/14	1	Several locations	Very active on site
2016/04/15	1	Several locations	Very active on site
2016/04/16	1	Several locations	Very active on site
2016/04/17	1	Old LDG Shop	Going in and out of bin 18, checked bin in am and found food waste
2016/04/17	1	Several locations	Very active on site
2016/04/18	1	Old Mine Dry	-
2016/04/18	1	Old LDG Shop	Trapped in bin 18 at Old LDG Shop, not there upon arrival
2016/04/19	1	Main Accommodations	In main entrance
2016/04/24	1	Several locations	Very active on site
2016/04/24	1	UG laydown	Wolverine stuck in tote

Date	Animals	Location	Comments
2016/04/25	1	Scap building	-
2016/04/26	1	A21 Area	-
2016/06/05	1	Scap Fabrication Yard	-
2016/06/05	1	A21 North Abutment Area	-
2016/10/21	1	South PKC	-
2016/10/22	1	Truck Shop>Shallow Bay Area	-
2016/10/22	1	Ice by light vehicle road into A21	-
2016/10/23	1	A21 Dike area	-
2016/10/23	1	A21 North Dike Area	-
2016/10/24	1	A21>A154 Dike>A418 Dike	-
2016/11/04	1	South Dike	On ice on E side
2016/11/06	1	A21	On ice S side
2016/11/06	1	On A154 Dike	-
2016/11/06	1	Between South camp and COM shack	-
2016/11/06	1	Steel laydown	-
2016/11/07	1	Raw Water inlet	Headed south
2016/11/07	1	South Winter Road Approach	-
2016/11/07	1	South of the South Tank Farm	-
2016/11/09	1	A154 pit entrance near top bench	-
2016/11/17	1	Scap Warehouse by LDG Shop	-
2016/11/17	1	North Mine Dry	-
2016/11/17	1	B-Wing Accommodations	-
2016/11/17	1	South Winter Road Approach	-
2016/11/17	1	A21 Dike area	-
2016/11/24	1	North Mine Dry, Winter road approach, north mine dry, South Dike A21	-
2016/12/01	1	Fueling station (heading towards WTA), ice between N and S Dike A21, Nuna laydown area	-
2016/12/03	1	WTP, Airport, N17 laydown	-
2016/12/31	1	WTA	-

APPENDIX G

Pit Wall/ Mine Infrastructure Raptor Survey Results, 2016

APPENDIX G
Pit Wall/Mine Infrastructure Raptor Survey Results, 2016

Date	Area	Method Used(a)	Bird Species	Number Observed	Confirm Active Nest (Y/N)	Potential Nesting (Y/N)	Young/Fledglings (Y/N)	Comments
7-May-16	A154 Lookout #1	L	peregrine falcon	1	N	Y	N	Peregrine falcon sighting on north side of A154. No coordinates taken.
7-May-16	Boiler House	D	raven	2	Y	Y	N	Active nest two ravens
10-May-16	A154 Lookout #2	L	rough-legged hawk	1	N	N	N	Old nest not active; rough-legged hawk flying approx. 300 m, SE of lookout
10-May-16	Boiler House	D	raven	2	Y	Y	N	Two ravens in the nest area
10-May-16	Site Services Line Up Area	D	peregrine falcon	2	Y	Y	N	One in nest, one perched on Truck shop
16-May-16	A154 Lookout #1	L	rough-legged hawk	1	N	N	N	Flying above pit
16-May-16	A154 Lookout #2	L	rough-legged hawk	1	N	N	N	Old nest not active, Soaring over pit
16-May-16	Boiler House	D	raven	2	Y	Y	U	Actively nesting
16-May-16	Site Services Line Up Area	D	peregrine falcon	1	N	Y	N	Peregrine falcon sitting on top of process plant
19-May-16	South Tank Farm	D	raven	1	N	N	N	Fly over
19-May-16	Powerhouse 2	D	raven	1	N	N	N	On ground eating something
19-May-16	Boiler House	D	raven	1	Y	N	N	No activity at the nest. One raven perched on Arctic Corridor
19-May-16	Site Services Line Up Area	D	peregrine falcon	2	Y	Y	N	One peregrine falcon nesting, One peregrine falcon fly over
22-May-16	A154 Lookout #2	L	peregrine falcon	2	N	N	N	Old nest not active
22-May-16	A418 Lookout #1	L	rough-legged hawk	2	N	N	N	200 m right pile of tires on right side of pit
22-May-16	Boiler House	D	raven	1	Y	Y	U	Maybe feeding in nest
22-May-16	Site Services Line Up Area	D	peregrine falcon	2	N	N	N	Fly over
25-May-16	A154 Lookout #1	L	peregrine falcon	1	N	Y	N	Fly over
25-May-16	A154 Lookout #2	L	peregrine falcon	2	N	N	N	Old nest not active. Fly over
25-May-16	A418 Lookout #1	L	peregrine falcon	2	N	N	N	One peregrine falcon perched, one peregrine falcon. Fly over.
25-May-16	Powerhouse 2	D	raven	1	N	N	N	Perched on corridor
25-May-16	Boiler House	D	raven	1	Y	Y	U	Spotted one raven in nest
25-May-16	Site Services Line Up Area	D	peregrine falcon	1	Y	Y	N	One peregrine falcon perched on Truck shop
28-May-16	A154 Lookout #2	L	raven	2	N	N	N	Old nest not active
28-May-16	A418 Lookout #2	L	peregrine falcon	2	Y	N	N	Flying in pit
28-May-16	Boiler House	D	raven	1	Y	Y	U	One raven in nest
28-May-16	Site Services Line Up Area	D	peregrine falcon	2	Y	Y	U	One peregrine falcon Fly over, one peregrine falcon in nest incubating
31-May-16	A154 Lookout #1	L	peregrine falcon	2	N	N	N	Two peregrine falcon Fly over and then perch below Lookout 1
31-May-16	Process Plant	D	peregrine falcon	1	N	N	N	One peregrine falcon on top of process plant
31-May-16	Boiler House	D	raven	1	Y	Y	U	One raven in nest
31-May-16	Site Services Line Up Area	D	peregrine falcon	1	Y	Y	U	One peregrine falcon in nest
4-Jun-16	A154 Lookout #1	L	raven	1	N	Y	N	Fly Over
4-Jun-16	Boiler House	D	raven	5	Y	y	4	Four young in the nest and one adult
4-Jun-16	Site Services Line Up Area	D	peregrine falcon	2	Y	Y	U	One on nest, One perched on exhaust pipe of Truck Shop
9-Jun-16	A418 Lookout #2	L	peregrine falcon	1	N	N	N	Heard a peregrine falcon but did not see him

Date	Area	Method Used[(a)]	Bird Species	Number Observed	Confirm Active Nest (Y/N)	Potential Nesting (Y/N)	Young/Fledglings (Y/N)	Comments
9-Jun-16	Boiler House	D	raven	2	Y	Y	2	Two ravens seen, two known chicks
9-Jun-16	Site Services Line Up Area	D	peregrine falcon	1	Y	Y	U	Female sitting on nest
12-Jun-16	Boiler House	D	raven	4	Y	Y	4	Four fledglings ready to fly
16-Jun-16	Boiler House	D	raven	1	Y	Y	Y	Could only see mom
16-Jun-16	Site Services Line Up Area	D	peregrine falcon	1	Y	Y	U	Peregrine falcon on nest
18-Jun-16	Boiler House	D	raven	2	Y	Y	2	Only two birds in the nest
18-Jun-16	Site Services Line Up Area	D	peregrine falcon	1	Y	Y	U	Peregrine falcon on nest
21-Jun-16	A154 Lookout #2	L	unknown	1	N	Y	N	Unknown Species in old nest
21-Jun-16	A418 Lookout #1	L	peregrine falcon	1	N	N	N	Heard a peregrine falcon, but can't see it
21-Jun-16	Boiler House	D	raven	3	Y	Y	3	Three raven in the nest
21-Jun-16	Site Services Line Up Area	D	peregrine falcon	1	Y	Y	U	One peregrine falcon on nest
26-Jun-16	A154 Lookout #2	L	unknown	1	N	Y	N	Unknown Species in old nest
26-Jun-16	A418 Lookout #1	L	peregrine falcon	1	N	N	N	–
26-Jun-16	Site Services Line Up Area	D	peregrine falcon	1	Y	Y	U	One peregrine falcon on nest
30-Jun-16	Site Services Line Up Area	D	peregrine falcon	2	Y	Y	U	One perched on nest, one perched on rock cliff
2-Jul-16	Site Services Line Up Area	D	peregrine falcon	4	Y	Y	2	One adult on nest, one adult on Process Building, two fledglings
9-Jul-16	Site Services Line Up Area	D	peregrine falcon	4	Y	Y	3	One adult on nest, three fledglings in nest
13-Jul-16	A154 Lookout #1	L	rough-legged hawk	1	N	N	N	Rough-legged hawk flying above pit
13-Jul-16	Site Services Line Up Area	D	peregrine falcon	4	NA	Y	3	One adult on nest, three fledglings in nest
15-Jul-16	Site Services Line Up Area	D	peregrine falcon	4	Y	Y	3	Three fledglings and one adult observed on the nest
18-Jul-16	Site Services Line Up Area	D	peregrine falcon	2	Y	Y	2	Only saw two fledglings in the nest
21-Jul-16	Site Services Line Up Area	D	peregrine falcon	3	Y	Y	2	Two fledglings in nest, one adult in area
24-Jul-16	Site Services Line Up Area	D	peregrine falcon	3	Y	Y	3	Three fledglings visible in nest
27-Jul-16	Site Services Line Up Area	D	peregrine falcon	3	Y	Y	3	Three fledglings visible in nest
30-Jul-16	Site Services Line Up Area	D	peregrine falcon	4	Y	Y	3	Three fledglings visible in nest, one adult on Truck Shop
8-Aug-16	Site Services Line Up Area	D	peregrine falcon	4	Y	Y	3	Three fledglings and one adult spotted in area Flying around the Process Plant and the Warehouse

(a) Method used to survey: L = look out scan, D = Driving.

N/A = information not available; Y = yes; N = no; – = none.

APPENDIX H

Waste Inspections Summary, 2016

Appendix H:
Waste Inspections Summary, 2016

Date	Location	Attractants				Wildlife				Wildlife Sign			
		Attractants Present?	Items	Number of Items Present	Comments	Wildlife Present?	Species	# of Individuals Observed	Wildlife Comments	Wildlife Sign Observed?	Wildlife Sign Observed Species	Wildlife Sign Type	Wildlife Sign Observed Comments
7-Jan-16	WTA	No	-	-	-	No	-	-	-	Yes	red fox	tracks	-
14-Jan-16	WTA	No	-	-	-	No	-	-	-	Yes	red fox	tracks	Fresh snow
21-Jan-16	WTA	No	-	-	-	No	-	-	-	Yes	red fox and wolverine	tracks	-
28-Jan-16	WTA	Yes	Unspecified	1	Other	No	-	-	-	No	-	-	-
4-Feb-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
11-Feb-16	WTA	No	-	-	Pit needs to be burned oily rags bins have been dumped	No	-	-	-	Yes	red fox and wolverine	tracks	-
18-Feb-16	WTA	No	-	-	Florescent lights on top of container	No	-	-	-	Yes	red fox and wolverine	tracks	-
25-Feb-16	WTA	Yes	Oil Contaminated Waste	10	Burn pit had gloves and rags	No	-	-	-	Yes	unspecified	-	-
3-Mar-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
10-Mar-16	WTA	No	-	-	Fresh snow no current tracks	No	-	-	-	No	-	-	-
17-Mar-16	WTA	No	-	-	Fresh snowfall, food waste containers still in bin	No	-	-	-	No	-	-	-
24-Mar-16	WTA	No	-	-	Burning today	No	-	-	-	Yes	unspecified	-	-
31-Mar-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
7-Apr-16	WTA	Yes	Other	1	Ready to burn, pit is full	No	-	-	-	Yes	unspecified	-	-
15-Apr-16	WTA	Yes	Aerosol Can	1	-	No	-	-	-	Yes	red fox and wolverine	tracks	-
21-Apr-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
28-Apr-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
5-May-16	WTA	No	-	-	Burn it has fair amount of water in it	No	-	-	-	No	-	-	-
12-May-16	WTA	No	-	-	Water in burn pit, water in land farm area	No	-	-	-	No	-	-	-
19-May-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
26-May-16	WTA	No	-	-	Area automatic door not closing, no other observations	No	-	-	-	No	-	-	-
2-Jun-16	WTA	Yes	Aerosol Can, Food Packaging, Oil Contaminated Waste	32	Ketchup bottle, barrel with aerosol cans & a cut off barrel as well, stacks of pails coated in grease	No	-	-	-	No	-	-	-
9-Jun-16	WTA	Yes	Food Packaging, Oil Contaminated Waste	3	-	No	-	-	-	No	-	-	-
16-Jun-16	WTA	Yes	Other	1	Used rag oil drum with cans still there. There was some precariously placed drums, there was a burnables bin that contained all non-burnables	No	-	-	-	No	-	-	-
25-Jun-16	WTA	Yes	Other	1	Plastic in burn pit	No	-	-	-	No	-	-	-

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		Attractants Present?	Items	Number of Items Present	Comments	Wildlife Present?	Species	# of Individuals Observed	Wildlife Comments	Wildlife Sign Observed?	Wildlife Sign Observed Species	Wildlife Sign Type	Wildlife Sign Observed Comments
30-Jun-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
7-Jul-16	WTA	No	-	-	Burn pit still smouldering	Yes	unspecified	-	-	Yes	unspecified	-	-
15-Jul-16	WTA	Yes	Aerosol Can, Food Packaging	2	Washed drum of food jars, Overfilled drum of aerosol cans	No	-	-	-	No	-	-	-
21-Jul-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
29-Jul-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
4-Aug-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
11-Aug-16	WTA	Yes	Aerosol Can, Food, Food Packaging, Other	34	Food package in non burnable bin, Bags of non burnable and chemicals in burnable pit, Aerosol Can in used rags bin	No	-	-	-	No	-	-	-
18-Aug-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
25-Aug-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
1-Sep-16	WTA	Yes	Aerosol Cans	2	Aerosol cans in non burn bin	No	-	-	-	No	-	-	-
8-Sep-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
15-Sep-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
22-Sep-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
29-Sep-16	WTA	Yes	Food Packaging	1	Empty chip bag in non burnable bins	No	-	-	-	No	-	-	-
7-Oct-16	WTA	Yes	Other	1	Burnable items in non burnable bin	No	-	-	-	Yes	unspecified	-	-
13-Oct-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
20-Oct-16	WTA	No	-	-	-	Yes	common raven	1	In burn pit	Yes	red fox	tracks	-
27-Oct-16	WTA	Yes	Food Packaging	5	-	No	-	-	-	Yes	unspecified	-	-
3-Nov-16	WTA	Yes	Oil Contaminated Waste	1	Oils and rags in a plastic bag in the oil rag area, bag of coverall and gloves in non burnable bin	Yes	red fox	2	In burn pit	Yes	unspecified	-	-
10-Nov-16	WTA	No	-	-	-	No	-	-	-	Yes	red fox	tracks	-
17-Nov-16	WTA	Yes	Other	1	Cardboard in non burn bin	Yes	unspecified	-	-	Yes	unspecified	-	-
24-Nov-16	WTA	Yes	Food Packaging, Other	4	Cereal boxes, air filter	2	red fox	2	In burn pit	Yes	unspecified	-	-
1-Dec-16	WTA	No	-	-	-	Yes	unspecified	-	-	Yes	unspecified	-	-
8-Dec-16	WTA	No	-	-	-	Yes	unspecified	-	-	Yes	unspecified	-	-
15-Dec-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
23-Dec-16	WTA	Yes	Food Packaging	1	In burn pit	Yes	red fox	1	In burn pit	Yes	unspecified	-	-
29-Dec-16	WTA	No	-	-	-	No	-	-	-	No	-	-	-
7-Jan-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
14-Jan-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
21-Jan-16	Landfill	1	Other	1	Concrete from Batch Plant	No	-	-	-	No	-	-	-
28-Jan-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
4-Feb-16	Landfill	No	-	-	-	No	-	-	-	Yes	red fox	tracks	-
11-Feb-16	Landfill	Yes	Aerosol Can, Food Packaging, Oil Contaminated Waste	9	Aerosol cans, gum package, cigarette package, gloves	No	-	-	-	Yes	red fox	tracks	-

Appendix H:
Waste Inspections Summary, 2016

Date	Location	Attractants				Wildlife				Wildlife Sign			
		Attractants Present?	Items	Number of Items Present	Comments	Wildlife Present?	Species	# of Individuals Observed	Wildlife Comments	Wildlife Sign Observed?	Wildlife Sign Observed Species	Wildlife Sign Type	Wildlife Sign Observed Comments
18-Feb-16	Landfill	Yes	Oil Contaminated Waste	5	Gloves	No	-	-	-	Yes	red fox	tracks	-
25-Feb-16	Landfill	No	-	-	Pushed in the last couple days	No	-	-	-	Yes	red fox	tracks	-
3-Mar-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
10-Mar-16	Landfill	Yes	Food Packaging, Oil Contaminated Waste	3	Gloves, gum packages	No	-	-	-	No	-	-	Fresh Snow
17-Mar-16	Landfill	Yes	Oil Contaminated Waste	5	Gloves, rags	No	-	-	-	No	-	-	Fresh Snow
24-Mar-16	Landfill	Yes	Food Packaging	3	Unspecified	No	-	-	-	Yes	unspecified	-	-
31-Mar-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
7-Apr-16	Landfill	Yes	Oil Contaminated Waste	6	Gloves, unspecified	No	-	-	-	Yes	unspecified	-	-
15-Apr-16	Landfill	Yes	Aerosol Cans, Food Packaging, Oil Contaminated Waste	33	Rags, gloves, spill pads, cranberry juice container, paper coffee cup	Yes	common raven	2	Flyover with something in its bill	Yes	red fox and wolverine	tracks	-
21-Apr-16	Landfill	No	-	-	Recently pushed	No	-	-	-	Yes	red fox and wolf	tracks	fresh
28-Apr-16	Landfill	Yes	Battery, Food Packaging, Other	3	Empty cigarette pack, unspecified	No	-	-	-	No	-	-	-
5-May-16	Landfill	Yes	Aerosol Can, Food Packaging, Oil Contaminated Waste, Other	8	Cigarette package, oily rags, aerosol can, fridges	No	-	-	-	No	-	-	-
12-May-16	Landfill	Yes	Food, Food Packaging, Oil Contaminated Waste, Other	35	Apple core, food wrappers, large garbage bag full of rags and gloves	No	-	-	-	No	-	-	-
19-May-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
26-May-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
2-Jun-16	Landfill	Yes	Oil Contaminated Waste	33	Three pails, more than 30 gloves	No	-	-	-	No	-	-	-
9-Jun-16	Landfill	Yes	Aerosol Cans, Food, Food Packaging, Oil Contaminated Waste, Other	77	Dye jars, acetone, cigarette package, unknown, cans, gum packages, paper coffee cup, rags, gloves	No	-	-	-	No	-	-	-
16-Jun-16	Landfill	No	-	-	Must have been turned over as there is no debris in here except for the old shack	No	-	-	-	No	-	-	-
25-Jun-16	Landfill	Yes	Food Packaging, Other	31	Nitrile gloves, work gloves	No	-	-	-	No	-	-	-

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Date	Location	Attractants				Wildlife				Wildlife Sign			
		Attractants Present?	Items	Number of Items Present	Comments	Wildlife Present?	Species	# of Individuals Observed	Wildlife Comments	Wildlife Sign Observed?	Wildlife Sign Observed Species	Wildlife Sign Type	Wildlife Sign Observed Comments
30-Jun-16	Landfill	Yes	Oil Contaminated Waste	5	Gate locked	No	-	-	-	No	-	-	-
7-Jul-16	Landfill	Yes	Food Packaging, Oil Contaminated Waste	3	-	No	-	-	-	No	-	-	-
15-Jul-16	Landfill	Yes	Food Packaging, Other	4	-	No	-	-	-	No	-	-	-
21-Jul-16	Landfill	No	-	-	No concerns	No	-	-	-	No	-	-	-
29-Jul-16	Landfill	Yes	Aerosol Cans, Food Packaging, Oil Contaminated Waste	42	Gloves, rags, aerosol cans, creamer bottle, chip bag, gum wrapper pop can	No	-	-	-	No	-	-	-
4-Aug-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
11-Aug-16	Landfill	Yes	Aerosol Cans, Food Packaging, Other	12	Gloves	No	-	-	-	No	-	-	-
18-Aug-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
25-Aug-16	Landfill	Yes	Food Packaging, Other	22	Sealant, gloves, rags	No	-	-	-	No	-	-	-
1-Sep-16	Landfill	Yes	Aerosol Cans, Food Packaging, Oil Contaminated Waste, Other	27	Granola wrapper, Pop can, coffee cup, aerosol, sodium filled light bulbs, rags, gloves, aerosol, silicon tubes	No	-	-	-	No	-	-	-
8-Sep-16	Landfill	Yes	Aerosol Cans, Food Packaging, Other	17	Cigarette package	No	-	-	-	No	-	-	-
15-Sep-16	Landfill	Yes	Aerosol Cans, Other	7	Removed aerosol can, air filters from surface and UG, Haul truck air filters	No	-	-	-	No	-	-	-
22-Sep-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
29-Sep-16	Landfill	Yes	Food Packaging, Other	9	Pop can, coffee cup, gloves	No	-	-	-	No	-	-	-
7-Oct-16	Landfill	Yes	Food Packaging, Other	10	Beverage containers, lunch bags, coffee creamer, gloves	Yes	fox spp.	1	-	Yes	unspecified	-	-
13-Oct-16	Landfill	Yes	Other	1	Burnables in non burnable bin	Yes	fox spp.	1	Sleeping in burn pit on the pile	Yes	fox spp.	tracks	-
20-Oct-16	Landfill	Yes	Food Packaging, Oil Contaminated Waste, Other	4	Water bottle, spill pads	No	-	-	-	No	-	-	-
27-Oct-16	Landfill	Yes	Food Packaging, Other	8	Chocolate bar wrappers, ziplock bags, pop can, Gatorade bottle	No	-	-	-	Yes	unspecified	-	-

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Date	Location	Attractants				Wildlife				Wildlife Sign			
		Attractants Present?	Items	Number of Items Present	Comments	Wildlife Present?	Species	# of Individuals Observed	Wildlife Comments	Wildlife Sign Observed?	Wildlife Sign Observed Species	Wildlife Sign Type	Wildlife Sign Observed Comments
3-Nov-16	Landfill	Yes	Food Packaging, Other	11	Gloves, coffee cups	No	-	-	-	Yes	unspecified	-	-
10-Nov-16	Landfill	Yes	Other	1	Furnace filters	No	-	-	-	No	-	-	-
17-Nov-16	Landfill	Yes	Aerosol Cans, Food Packaging, Oil Products and Containers, Other	13	Gloves, grease can, popcan, blue garbage bag full of coffee cups and rags, cigarette packages	Yes	unspecified	1	-	Yes	unspecified	-	-
24-Nov-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
1-Dec-16	Landfill	Yes	Aerosol Cans, Food Packaging, Other	3	Cigarette package	No	-	-	-	No	-	-	-
8-Dec-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
16-Dec-16	Landfill	Yes	Food Packaging, Other	6	Pickle beet jars	No	-	-	-	No	-	-	-
23-Dec-16	Landfill	Yes	Oil Contaminated Waste	3	Some oily rags/gloves	No	-	-	-	No	-	-	-
29-Dec-16	Landfill	No	-	-	-	No	-	-	-	No	-	-	-
26-May-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
2-Jun-16	A21 Area	Yes	Food	100	Mussel shells	No	-	-	-	No	-	-	-
9-Jun-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
17-Jun-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
24-Jun-16	A21 Area	Yes	Oil Products and Containers	1	Open vegetable oil based lubricant stored in unsecured bin	No	-	-	-	No	-	-	-
30-Jun-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
7-Jul-16	A21 Area	Yes	Aerosol Can, Food Packaging, Oil Contaminated Waste	30	Disposable coffee cups, coveralls, aerosol can, rags, gloves, water bottle	No	-	-	-	No	-	-	-
16-Jul-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
23-Jul-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
29-Jul-16	A21 Area	Yes	Food Packaging, Oil Contaminated Waste	7	Water bottle, juice bottle, paper cups, cup lid, oily ragss and used oil container	No	-	-	-	No	-	-	-
4-Aug-16	A21 Area	Yes	Food, Oil Contaminated Waste	4	Coffee cups, gloves and rags in burnable and non burnable waste bins	No	-	-	-	No	-	-	-
11-Aug-16	A21 Area	Yes	Food Packaging, Oil Contaminated Waste	21	Coffee cups, pop can, rags	No	-	-	-	No	-	-	-
18-Aug-16	A21 Area	Yes	Food Packaging	1	-	No	-	-	-	No	-	-	-
26-Aug-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
3-Sep-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-

Appendix H:
Waste Inspections Summary, 2016

Date	Location	Attractants				Wildlife				Wildlife Sign			
		Attractants Present?	Items	Number of Items Present	Comments	Wildlife Present?	Species	# of Individuals Observed	Wildlife Comments	Wildlife Sign Observed?	Wildlife Sign Observed Species	Wildlife Sign Type	Wildlife Sign Observed Comments
9-Sep-16	A21 Area	Yes	Food, Oil Contaminated Waste	4	Glove, rope in burnables bin. Food waste, dirty rags in non burnables bin.	Yes	fox spp.	1	-	No	-	-	-
15-Sep-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
22-Sep-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
29-Sep-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
6-Oct-16	A21 Area	Yes	Aerosol Can, Food Packaging	3	Coffee cups and Aerosol can	No	-	-	-	Yes	fox spp.	bite marks	-
13-Oct-16	A21 Area	Yes	Aerosol Can, Food Packaging	7	Coffee cups and Aerosol can	No	-	-	-	Yes	raven	-	Garbage Bag torn apart
14-Oct-16	A21 Area	Yes	Food	1	Food waste in tipper bins	Yes	fox spp.	1	-	No	-	-	-
17-Oct-16	A21 Area	yes	Food Packaging	2	Coffee cups	Yes	fox spp.	1	-	Yes	raven	-	Garbage Bag torn apart
20-Oct-16	A21 Area	No	-	-	-	Yes	fox spp.	1	-	No	-	-	-
23-Oct-16	A21 Area	Yes	Food, Oil Contaminated Waste	3	Food waste, rags	Yes	fox spp. and wolverine	2	-	Yes	fox spp.	tracks	-
26-Oct-16	A21 Area	Yes	Food Packaging	1	Coffee cup	Yes	fox spp.	2	-	No	-	-	-
29-Oct-16	A21 Area	Yes	Oil Contaminated Waste	2	gloves	No	-	-	-	No	-	-	-
1-Nov-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
4-Nov-16	A21 Area	No	-	-	-	Yes	wolverine	1	On ice near South Dike	No	-	-	-
7-Nov-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
10-Nov-16	A21 Area	Yes	Food Packaging	1	Pop Can	No	-	-	-	No	-	-	-
13-Nov-16	A21 Area	No	-	-	-	Yes	fox spp.	2	-	No	-	-	-
16-Nov-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
19-Nov-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
23-Nov-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
25-Nov-16	A21 Area	Yes	Aersol Can	1	Spray Can	No	-	-	-	No	-	-	-
28-Nov-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
1-Dec-16	A21 Area	No	-	-	-	Yes	wolverine	1	On ice near South Dike	No	-	-	-
4-Dec-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
7-Dec-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
10-Dec-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
13-Dec-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
16-Dec-16	A21 Area	No	-	-	-	Yes	red fox	1	Black Coloured	No	-	-	-
19-Dec-16	A21 Area	No	-	-	-	Yes	fox spp.	1	Attempting to enter Orange Building	No	-	-	-
22-Dec-16	A21 Area	No	-	-	-	Yes	fox spp.	2	-	No	-	-	-
25-Dec-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
28-Dec-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-
31-Dec-16	A21 Area	No	-	-	-	No	-	-	-	No	-	-	-

Appendix H:
Waste Inspections Summary, 2016

Date	Location	Attractants				Wildlife				Wildlife Sign			
		Attractants Present?	Items	Number of Items Present	Comments	Wildlife Present?	Species	# of Individuals Observed	Wildlife Comments	Wildlife Sign Observed?	Wildlife Sign Observed Species	Wildlife Sign Type	Wildlife Sign Observed Comments
3-Jan-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
10-Jan-16	Underground	Yes	Aerosol Can	1	-	No	-	-	-	No	-	-	-
17-Jan-16	Underground	No	-	-	-	No	-	-	-	Yes	Unspecified	-	-
24-Jan-16	Underground	No	-	-	-	No	-	-	-	Yes	red fox	tracks	-
31-Jan-16	Underground	No	-	-	-	Yes	red fox	1	Injured	Yes	red fox	tracks	-
7-Feb-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
14-Feb-16	Underground	Yes	Food Packaging, Oil Products and Containers, Other	8	Lunch bags, food container, coffee package	Yes	red fox	1	-	Yes	red fox	tracks	-
18-Feb-16	Underground	Yes	Food Packaging, Oil Products and Containers	8	Chip bags, lunch bag, gloves	No	-	-	-	Yes	red fox	tracks	-
25-Feb-16	Underground	Yes	Oil Contaminated Waste	2	Gloves	No	-	-	-	Yes	red fox	tracks	-
3-Mar-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
10-Mar-16	Underground	Yes	Oil Contaminated Waste	6	Grease tube, gloves, rags	No	-	-	-	No	-	-	-
17-Mar-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
24-Mar-16	Underground	Yes	Food Packaging, Oil Contaminated Waste	2	Unspecified	No	-	-	-	Yes	Unspecified	-	-
31-Mar-16	Underground	Yes	Other	3	Air filter and spill pad	No	-	-	-	No	-	-	-
8-Apr-16	Underground	Yes	Aerosol Can, Food Packaging, Oil contaminated Waste	17	Unspecified	No	-	-	-	Yes	Unspecified	-	-
15-Apr-16	Underground	Yes	Food, Food Packaging, Oil Contaminated Waste	10	Glove, rags, spill pad, cigarette package, chocolate bar wrapper, orange, apple core	Yes	wolverine	1	-	Yes	fox spp. and wolverine	tracks, chew marks	-
21-Apr-16	Underground	Yes	Oil Contaminated Waste	2	rags	No	-	-	-	Yes	fox spp. and wolverine	tracks	-
28-Apr-16	Underground	Yes	Aerosol can	1	Aerosol can	No	-	-	-	No	-	-	-
5-May-16	Underground	Yes	Food Packaging, Oil Contaminated Waste	8	Unspecified	No	-	-	-	No	-	-	-
12-May-16	Underground	Yes	Food Packaging, Oil Contaminated Waste, Other	35	Cigarette package, lunch bag, pop cans, condiment package, ziplock bag, gloves, rags	No	-	-	-	No	-	-	-
19-May-16	Underground	Yes	Food Packaging, Other	4	Pop can, gum package, gloves	No	-	-	-	No	-	-	-
26-May-16	Underground	Yes	Food Packaging, Other	4	Pop can, gloves	No	-	-	-	No	-	-	-

Appendix H:
Waste Inspections Summary, 2016

Date	Location	Attractants				Wildlife				Wildlife Sign			
		Attractants Present?	Items	Number of Items Present	Comments	Wildlife Present?	Species	# of Individuals Observed	Wildlife Comments	Wildlife Sign Observed?	Wildlife Sign Observed Species	Wildlife Sign Type	Wildlife Sign Observed Comments
2-Jun-16	Underground	Yes	Food Packaging, Oil Contaminated Waste, Other	20	Rags, gloves, creamer containers, cigarette package	No	-	-	-	No	-	-	-
9-Jun-16	Underground	Yes	Aerosol can, Oil Contaminated Waste	11	Aerosol can, rags, gloves	No	-	-	-	No	-	-	-
16-Jun-16	Underground	Yes	Oil Contaminated Waste, Other	13	Styrofoam, bubble wrap, gloves	No	-	-	-	No	-	-	-
25-Jun-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
30-Jun-16	Underground	Yes	Food Packaging, Oil Contaminated Waste, Other	5	rags, coveralls, juice container	No	-	-	-	No	-	-	-
7-Jul-16	Underground	Yes	Oil Contaminated Waste	1	Unspecified	No	-	-	-	No	-	-	-
15-Jul-16	Underground	Yes	Other	1	Glove	No	-	-	-	No	-	-	-
21-Jul-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
29-Jul-16	Underground	Yes	Aerosol Can, Oil Contaminated Waste	12	Gloves, rags	No	-	-	-	No	-	-	-
4-Aug-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
11-Aug-16	Underground	Yes	Other	4	Gloves, filter	No	-	-	-	No	-	-	-
18-Aug-16	Underground	Yes	Food Packaging, Other	2	Chip bag, plastics	No	-	-	-	No	-	-	-
25-Aug-16	Underground	Yes	Food Packaging, Other	13	Unspecified, gloves, rags	No	-	-	-	No	-	-	-
1-Sep-16	Underground	Yes	Food Packaging, Oil Contaminated Waste, Other	19	Gum packages, coffee cup, juice Jug, cigarette package, rags, gloves	No	-	-	-	No	-	-	-
8-Sep-16	Underground	Yes	Food Packaging, Oil Contaminated Waste, Other	6	Unspecified, air filters	No	-	-	-	No	-	-	-
15-Sep-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
22-Sep-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
29-Sep-16	Underground	Yes	Other	1	Glove	No	-	-	-	No	-	-	-
7-Oct-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
13-Oct-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
20-Oct-16	Underground	Yes	Oil Contaminated Waste, Other	2	Hoses, foam coil	No	-	-	-	No	-	-	-
27-Oct-16	Underground	Yes	Food Packaging	1	Unspecified	No	-	-	-	No	-	-	-
3-Nov-16	Underground	Yes	Oil Contaminated Waste	2	-	No	-	-	-	No	-	-	-
10-Nov-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-

Appendix H:
Waste Inspections Summary, 2016

Date	Location	Attractants				Wildlife				Wildlife Sign			
		Attractants Present?	Items	Number of Items Present	Comments	Wildlife Present?	Species	# of Individuals Observed	Wildlife Comments	Wildlife Sign Observed?	Wildlife Sign Observed Species	Wildlife Sign Type	Wildlife Sign Observed Comments
17-Nov-16	Underground	Yes	Oil Contaminated Waste, Oil Products and Containers	7	Paint can, paint tray, rags, gloves	No	-	-	-	No	-	-	-
24-Nov-16	Underground	Yes	Oil Contaminated Waste	1	Rag	Yes	wolverine	1	-	Yes	Unspecified	-	-
1-Dec-16	Underground	Yes	Other	1	Jacket	Yes	fox spp.	1	-	Yes	fox spp.	tracks	-
8-Dec-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-
15-Dec-16	Underground	Yes	Other	1	Gloves	No	-	-	-	No	-	-	-
23-Dec-16	Underground	Yes	Food Packaging, Oil Contaminated Waste	2	Lunch bag, rags	No	-	-	-	No	-	-	-
29-Dec-16	Underground	No	-	-	-	No	-	-	-	No	-	-	-

APPENDIX I

Comprehensive Vegetation and Lichen Monitoring Program, 2016

3 March 2017

REPORT ON

2016 Comprehensive Vegetation and Lichen Monitoring Program

Submitted to:
Diavik Diamond Mines (2012) Inc.
PO Box 2498
300-5201 50th Avenue
Yellowknife, NT
X1A 2P8, Canada

Attention: Mr. David Wells

Golder Reference Number: 1648005-1581-R-RevB-1000

Diavik PO Number: D03480

Work Plan Number: WP 486

Distribution:

1 Electronic Copy - Diavik Diamond Mines (2012) Inc.
1 Hard Copy - Golder Associates Ltd.

REPORT

Executive Summary

The Diavik Diamond Mine (the Mine) is located on East Island in Lac de Gras in the Northwest Territories. Diavik Diamond Mine Inc. (DDMI) conducts vegetation and lichen monitoring programs to assess if dust deposition from the Mine is altering the abundance (i.e., percent cover) and richness (i.e., number of species) of plant species in representative plant communities. The objectives of the 2016 vegetation and lichen monitoring programs were to assess the following:

- changes in plant species composition (species richness) and abundance (species percent cover) between mine and reference sites over time
- any detected changes in plant species composition and abundance would be qualitatively related to dust deposition
- differences or changes in lichen chemistry between near-field and far-field areas, and identification of possible implications associated with caribou health

The vegetation monitoring program focussed on permanent vegetation plots (PVP) that were established in two sites or areas: adjacent to the Mine site (mine plots), and on the West Island and mainland (reference plots) (Golder 2011a). Depending on the sampling year, there were 9 to 15 permanent vegetation plots in each area, with three to five PVP in each of three vegetation community types: Heath Tundra, Shrub and Tussock-Hummock. Plant species percent cover was estimated for all vascular plant species (such as sedges and grasses) and non-vascular plant species (such as lichens and mosses). Plant species data from 2006 to 2016 were compiled and graphically and statistically analyzed to assess differences in the number of plant species and percent cover of plant species between mine and reference sites among years.

Overall, the results of the analysis of dust deposition and vegetation data indicate differences in plant species abundance and composition in mine and reference plots over time are likely due to Mine-related effects, such as dust deposition. Natural variation in site conditions among PVPs prior to and after mining, annual variation in climate, foraging by caribou, surveyor variability and difficulty in detecting cryptic species have also probably influenced changes in plant species cover and richness. However, the direction and magnitude of the differences between mine and reference sites have remained largely consistent over the past 10 years, and with limited and small adverse effects. Importantly, the data show no trajectory towards a divergence in the previous and current observed temporal and spatial patterns of plant species abundance and composition. Based on the principles of adaptive management and the slow response of vegetation in the Arctic, it is recommended that this program be continued to confirm if the observed differences and changes in plant abundance and composition continue during mining operations; however, the sampling frequency should be reduced to once every 5 years.

Lichens were collected near and far from the Mine site for analysis of metals to determine if dust generated from mining activities is causing a measurable increase in metal concentrations near the mine site, and if concentrations have changed since they were first measured in 2010. Lichens were chosen because they are a preferred forage of caribou. They can also effectively and preferentially bioaccumulate airborne contaminants because of their lack of roots, large surface area, and long life span. Thus, analyzing metal concentrations in lichen provides "worst-case" exposure concentrations for assessment of risks to caribou. Elders have observed that caribou will avoid areas with dust on their forage by altering migration routes to target better quality forage (Tłı̨chǫ Government 2013). Science has also observed a potential link between total suspended particulates (which includes dust) near the Ekati and Diavik mines and local changes in abundance and distribution of caribou (Boulanger et al. 2012).

In 2010, two sampling areas were developed for the lichen monitoring program. A near-field area included stations surrounding the Mine site. The near-field area stations were generally located near existing dustfall collector stations. A far-field area was a concentric area 30 to 40 kilometres from the Mine site, and stations within this area were randomly selected prior to the start of the program. The original study design included 20 stations in each sampling area. During the 2013 program, Elders from the Tłı̨chǫ and Łutsel K'e communities and two researchers from the Tłı̨chǫ Research and Training Institute accompanied Golder and DDMI biologists during part of the sampling program. Based on their knowledge of caribou migration routes, the Elders selected an additional four stations for sampling: three in the near-field area (actually located 14 to 21 kilometres from the center of the Mine site), and one in the far-field area (southeast-east quadrant). In 2016, a far-far-field sampling area was used to collect lichen at three stations approximately 100 kilometres from the Mine site.

The Elders' traditional knowledge provided in 2013 remained important in 2016 for selecting specific sampling sites that were appropriate for caribou use. Although there was a random element to the station selection, the actual site of sampling was based on guidance from the Elders as to where the caribou eat (i.e., appropriate caribou habitat). Lichens identified by the Elders as those that would be consumed by caribou were recorded and collected for analysis.

Metals concentrations in lichen were graphically and statistically compared between near-field and far-field areas, and for the 2010, 2013 and 2016 sampling events. The analysis of metal concentrations in lichen confirmed the observations of the Elders that dust deposition was higher near the Mine as most of the parameters analyzed were significantly higher in lichens from the near-field area compared to the far-field area. However, most metals concentrations in lichens from the near-field area were also significantly lower in 2016 compared to 2010 and/or 2013. This reduction in concentrations may be due to the change in mining operations from above ground (open pit) to underground mining since 2012, resulting in an overall reduction in dust levels. Also, most metals concentrations in the far-far-field sampling area were similar to concentrations in the far-field sampling area.

The lichen monitoring program was designed to assess whether the increased metals uptake by lichen in the near-field area pose a risk to caribou health. A screening-level risk assessment was conducted in 2010 (Golder 2011b). The assessment used conservative assumptions to estimate exposure and effects to caribou, such as assuming that the caribou would reside in the near-field area throughout the year, and obtain all their food and water from this area. Despite these conservative assumptions, the risk estimates demonstrated no adverse effects to caribou health. Given that the majority of metals concentrations have decreased below concentrations reported in the 2010 risk assessment, a follow up risk assessment based on 2016 data is not required. Metal concentrations are predicted to remain within safe levels for caribou. Based on the principles of adaptive management, it is recommended that the sampling frequency for this study be reduced to once every 5 years to coincide with the suggested change in the vegetation monitoring program. Sampling frequency may resume on a 3-year cycle if dust deposition values exceed the upper 95% confidence interval for dustfall values on mine plots during the period of underground mining (approximately 400 mg/dm^2/y).

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1.0 INTRODUCTION

Dust deposition as a result of industrial development has the potential to cause localized effects on vegetation abundance and composition, and can also affect the quality of food resources for wildlife that eat plants. In 2013, the Tłı̨chǫ Government completed a traditional knowledge study on the potential effects from dust on caribou and caribou habitat. Comments from the Elders on lichen and vegetation conditions near the Diavik Diamond Mine (Mine) reflect that they noticed dust on the lichen near the Mine site, and they stated that dust reduced the quality of the forage for caribou (Tłı̨chǫ Government 2013). The Elders also stated that the caribou will avoid using the area close to the Mine as their migration route, because the caribou recognize the difference in lichen quality (by smell and taste).

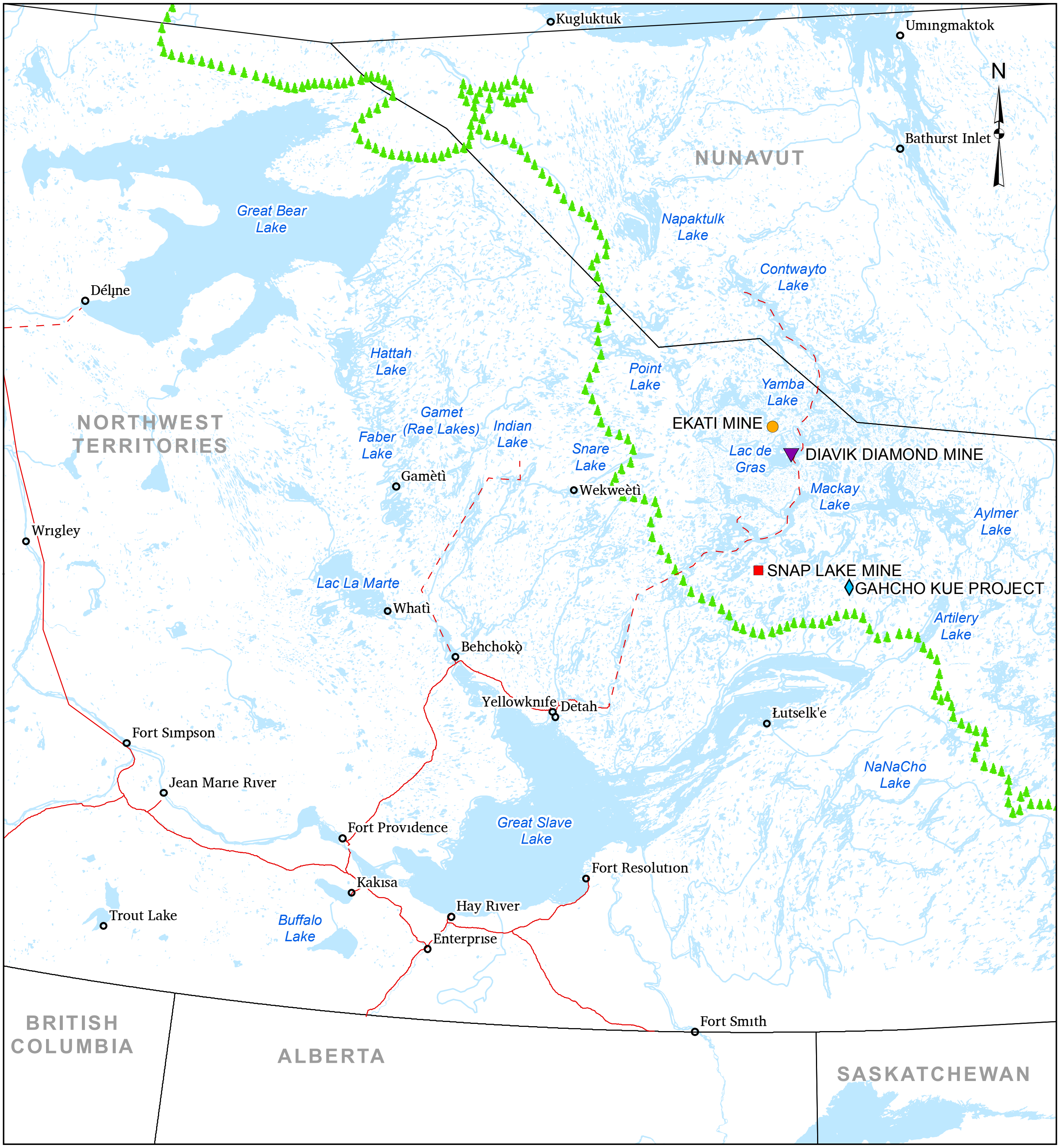
Long-term monitoring is fundamental for determining changes in plant community and ecosystem dynamics over time due to anthropogenic disturbance (Condit 1995; Dale et al. 2002). As such, Diavik Diamond Mines (2012) Inc. (DDMI) initiated a vegetation monitoring program in 2001, one year after construction began, to examine vegetation composition and abundance over time. The results of the monitoring would assist in developing appropriate and practical mitigation strategies if mining operations were having a strong adverse effect on tundra vegetation communities. Dustfall monitoring has also been conducted since 2002 as part of the environmental monitoring program. Chemical analysis of lichen was first completed by DDMI in 2005, and a more extensive monitoring program was implemented in 2010 to assess whether dust deposition generated increased metals concentrations in lichen, and subsequent possible health effects to caribou.

1.1 Background

The Mine is located on East Island, a 20 square kilometre (km^2) island in Lac de Gras, Northwest Territories, approximately 300 kilometres (km) northeast of Yellowknife (Figure 1.1-1). Lac de Gras is about 100 km north of the tree line in the central barren-ground tundra at the headwaters of the Coppermine River. This river, which flows north to the Arctic Ocean east of Kugluktuk, is 520 km long and has a drainage area of approximately 50,800 km^2. The area is remote, and major freight must be trucked over a seasonal winter road from Yellowknife. Worker access is by aircraft to the Mine's private airstrip.

The Mine involves the mining of four diamond-bearing kimberlite pipes. The pipes, designated as A154North, A154South, A418 and A21, are located directly off shore of East Island. All mining, diamond recovery, support activities and infrastructure are located on the East Island.

The Environmental Assessment for the Mine was submitted in 1998, and approved in 1999 by the Federal Government. Construction of the mine infrastructure began on East Island in 2000. A kimberlite processing plant, power plant, boiler plant, accommodation building, sewage treatment facility and administration/maintenance building were constructed on the south east part of the island. An airstrip is located on the northern edge of the island. In total the Mine site at full development was expected to have a footprint of 12.76 km^2; the current footprint is 11.6 km^2. Full production started in 2003 in open pits, and underground mining was added in 2008. By 2012, all mining was conducted underground.



LEGEND

- ○ COMMUNITY
- ALL WEATHER ROAD
- WINTER ROAD
- TREELINE
- WATERCOURSE
- WATERBODY
- ☐ PROVINCIAL / TERRITORIAL BOUNDARY
- ▼ DIAVIK DIAMOND MINE
- ● EKATI MINE
- ◆ GAHCHO KUÉ PROJECT
- ■ SNAP LAKE MINE

100 0 100

SCALE 1:5,000,000 KILOMETRES

REFERENCE

DATA © 2011 DMTI SPATIAL INC.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

PROJECT

DIAVIK™
DIAMOND MINES INC.

TITLE

LOCATION OF DIAVIK DIAMOND MINE

Golder Associates
Saskatoon, Saskatchewan

PROJECT		13-1328-0001
DESIGN		
GIS	LMR	26/02/14
CHECK	KS	14/03/14
REVIEW	JR	14/03/14

FILE No.

SCALE AS SHOWN REV. 0

FIGURE: 1.1-1

\\golder.gds\gal\Saskatoon\GIS\CLIENTS\DIAVIK\Figures\13-1328-0001\Phase 5000 - Veg Monitoring\Figure 1.1-1 - 13-1328-0001 Location of Diavik Diamond Mine.mxd

1.2 Purpose and Objectives

The purpose of the vegetation and lichen monitoring programs is to assess if dust deposition from the Mine is altering plant community structure and composition and if it is having an effect on lichen species. Lichen species represent one of the food sources for caribou and there is potential for lichen abundance to be altered in areas near the Mine site. Additionally, lichens have the potential to uptake metals and other chemicals that can adversely affect the health of caribou and other wildlife.

The vegetation and lichen monitoring programs include the following objectives.

- assess changes in plant species abundance (species percent cover) and composition (species richness) between mine and reference sites over time
- determine if any detected changes in plant species abundance and composition are qualitatively related to dust deposition
- identify differences or changes in lichen chemistry between near-field and far-field areas, and relate those changes to possible implications for caribou health

Additionally, the vegetation monitoring program provides a quantitative approach for testing and evaluating the predicted effects identified as part of the Environmental Effects Report (EER) for the Mine (DDMI 1998). Four measurement endpoints expressed as key questions and associated environmental effects predictions were identified in the EER for vegetation (Table 1.2-1).

Table 1.2-1: Key Questions and Associated Environmental Effects Predictions for Vegetation

Key Question	Environmental Effects Prediction
Key Question 1: How much vegetation/land cover would be directly affected by the proposed Project?	Predicted loss of 12.67 km2 of habitat.
Key Question 2: How would the structure of vegetation communities outside of the mine footprint be changed as a result of the proposed Project?	Increased dust deposition may lead to potential changes in vegetation.
Key Question 3: Would any rare or endangered species or communities be lost as a result of the proposed Project?	No effects predicted.
Key Question 4: Would there be changes to vegetation and/or terrain diversity as a result of the proposed Project?	Community level richness predicted to decrease by 14%. Species diversity and richness predicted to decrease by 44%.

km^2 = square kilometres.

An additional four key questions were developed for the lichen study to address community concerns about dust and its effect on caribou (Table 1.2-2). Lichen species that were of dietary importance to caribou (i.e., that caribou would prefer to eat), were preferentially collected and analyzed.

Table 1.2-2: Key Questions and Predictions for Lichen

Key Questions	Predictions
Is there metals uptake in lichen due to dust?	Yes.
Is there a difference between concentrations of metals in lichen near the Mine versus 30 to 40 kilometres (km) from the Mine?	Yes but no level estimated.
Are there differences between metal concentrations in lichen over years?	Concentrations in lichen are predicted to be similar over years.
Are concentrations of metals in lichen within a safe level for caribou?	Yes.

1.3 Previous Studies

1.3.1 Vegetation Surveys

Detailed vegetation data were initially collected in 2001 and have been typically collected every three years. In 2016, DDMI contracted Golder Associates Ltd. (Golder) to collect detailed vegetation data and provide a comprehensive analysis of changes in vegetation composition and abundance over time.

1.3.2 Lichen Chemistry

Chemical concentrations were measured in lichen collected near the Mine in three previous studies conducted in 2005, 2010, and 2013. Naeth and Wilkinson (2006) concluded that the Mine influences chemical concentrations in lichen collected in close proximity to the Mine site when compared to far-field locations 30 km and 60 km away. Similar results were found by Golder (2011b), who concluded that metals concentrations in lichen collected at near-field locations were higher than at far-field locations 30 to 40 km away, but were within a safe level for caribou to eat. Metals concentrations were reduced in 2013 compared to 2010, which may have been due to the reduction in dust deposition associated with moving mining underground (Golder 2014).

2.0 VEGETATION MONITORING PROGRAM

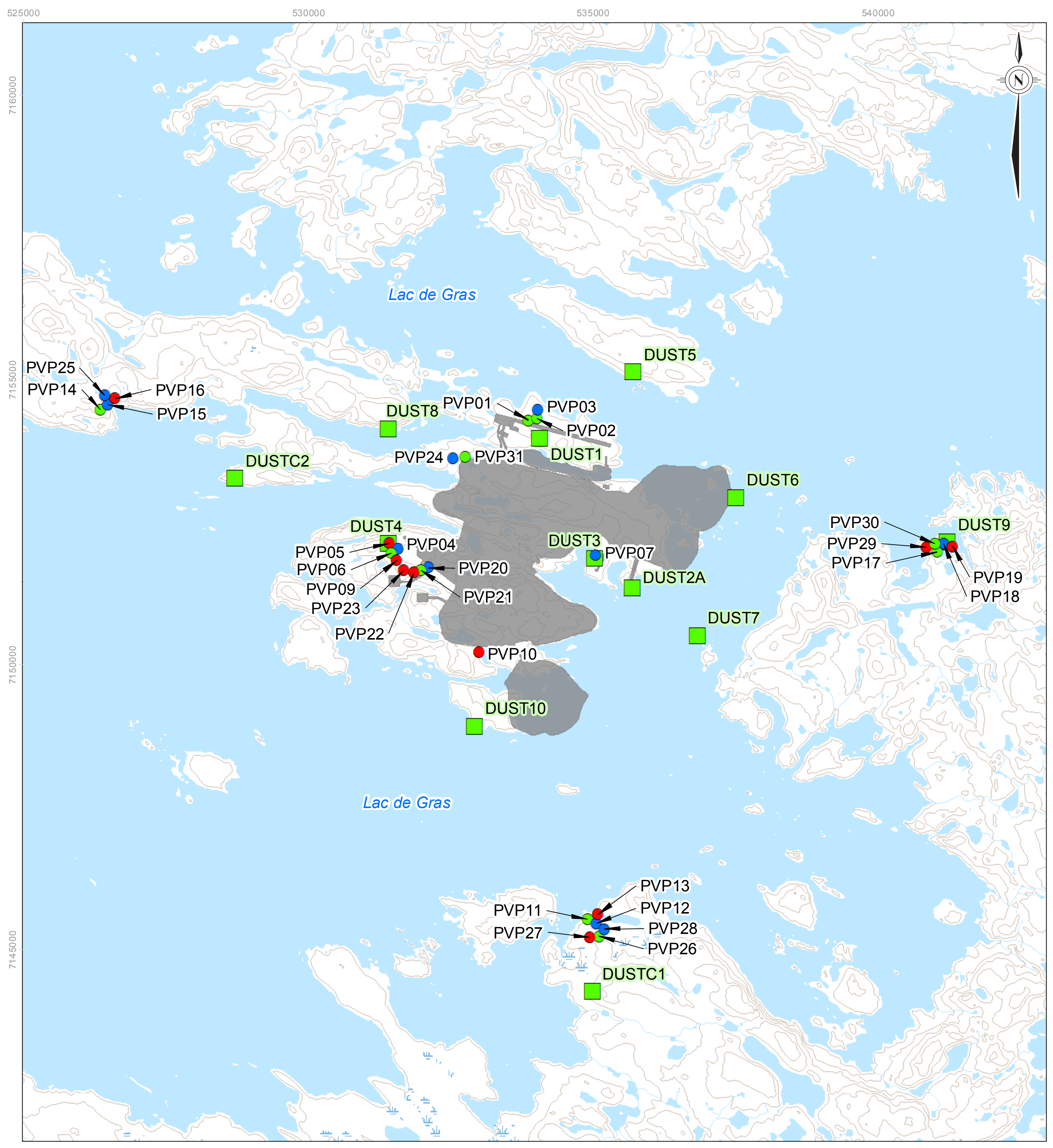
2.1 Study Area

Dust collector locations and permanent vegetation plots (PVP) were established adjacent to the Mine Site (mine plots), and on the West Island and the mainland (reference plots). Figure 2.2-1 shows the location of PVPs and dust collector sampling locations.

2.2 Methods

2.2.1 Dustfall Monitoring

Dust deposition data have been collected at each of 12 permanent monitoring gauges since 2002 at various locations around the Mine (Figure 2.2-1; Golder 2014). A determination of the annual rate of dust deposition (milligram per square decimetre per year [$mg/dm^2/y$]) was calculated based on the weight of the dust residue remaining, the sampling area of the gauge, and the number of days the monitoring gauge was deployed.



G:\CLIENTS\DIAVIK\Figures\13-1328-0001\Phase 5000 - Veg Monitoring\Figure 2.2-1 - 13-1328-0001 Permanent Veg Plot Sampling.mxd Date: 1/27/2017 9:59:07 AM

LEGEND

— WATERCOURSE

🟦 WATERBODY

🟩 DUSTFALL COLLECTOR

VEGETATION SAMPLE PLOT

- 🟢 HEATH TUNDRA
- 🔴 SHRUB
- 🔵 TUSSOCK-HUMMOCK

▨ DIAVIK FOOTPRINT

2 0 2

SCALE 1:100,000 KILOMETRES

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
NAD 83 UTM ZONE

PROJECT

DIAVIK DIAMOND MINES INC.™

TITLE

PERMANENT VEGETATION PLOT AND DUST COLLECTOR SAMPLING LOCATIONS

Golder Associates
Saskatoon, Saskatchewan

PROJECT		13-1328-0001	FILE No.	
DESIGN			SCALE AS SHOWN	REV. 0
GIS	SM/LR	26/02/14	**FIGURE: 2.2-1**	
CHECK	KS	14/03/14		
REVIEW	JR	14/03/14		

2.2.2 Vegetation Monitoring

2.2.2.1 Data Collection

Detailed vegetation data have been collected at Diavik since 2001. As described in Naeth and Wilkinson (2009) and Golder (2011a), 10 PVPs were initially established and sampled in 2001 (nine plots in the vicinity of the Mine and one reference plot located on the mainland) and re-sampled in 2004. The program was expanded in 2006 to include five additional mine plots, which were established to replace plots lost due to Mine expansion, and eight new reference plots at three locations off East Island. This provided an equal number of mine (N=9) and reference (N=9) plots, assigned equally among three vegetation communities (Heath Tundra, Shrub and Tussock-Hummock). In 2008, the program was further expanded to include 30 plots (15 mine plots and 15 reference plots) sampled in three vegetation communities (Table 2.2-1; Figure 2.2-1), which provides a more balanced design. A list of all plots sampled since 2001 is provided in Appendix A.

Table 2.2-1: Current Distribution of Plots by Vegetation Community

Vegetation Community	Number of Mine Plots	Number of Reference Plots
Heath Tundra	5	5
Shrub	5	5
Tussock-Hummock	5	5
Total	**15**	**15**

All 30 PVPs were visited by Christopher Shapka, Biologist, B.Sc. (Golder) and a DDMI Environment Technician over eight days from July 12 to 19, 2016. Data sampling methods followed previously established protocols (Naeth and Wilkinson 2009). Each PVP consisted of a 2 metre (m) by 2 m area that was subdivided into four, 1 square metre subplots. Starting at the northwest corner and working clockwise, a 1 m by 1 m quadrat frame with 10 centimetre (cm) increment markings on each side was used to estimate plant species percent cover for all vascular plant species rooted within the four subplots. Wherever possible, vascular plants were identified to the species level in the field; however, reference specimens were collected from the field for some species and later verified using Porsild and Cody (1980).

Non-vascular species such as lichens and bryophytes comprise a large portion of the species diversity in tundra environments and may be sensitive to disturbances, particularly dust deposition. As lichens and bryophytes were not identified to the species level in previous sampling years, a comprehensive sampling program of bryophyte and lichen species was initiated in 2013. Where possible, lichen and bryophyte species were identified in the field and percent cover estimates were obtained following the same procedures used for vascular plants. In contrast to 2013, comprehensive sampling of trace non-vascular species (<1% cover) was not completed in 2016, due to inconsistencies in sampling method replication and potential for spurious results. However, grab bag samples of lichen and bryophyte specimens were obtained at certain locations to capture difficult to identify species.

Lichen and bryophyte specimens were collected adjacent to, but not from within, each subplot. All unidentified collected specimens were sent to non-vascular plant experts for subsequent identification. Collected bryophyte samples were sent to Eleanor Edye (Consultant), a bryophyte specialist, and lichen samples were sent to Trevor Goward and Curtis Bjork (Enlichened Consulting Ltd.), who have over 20 years of experience identifying and classifying lichens in Canada. In general, scientific nomenclature and common names followed naming conventions consistent with the NatureServe on-line database (NatureServe 2013).

Additional parameters that were recorded for each quadrat included the percent ground cover of:

- total vegetation cover
- total rock lichen
- total terrestrial (ground) lichen
- total moss species
- fungi
- bare ground
- rock
- litter
- animal pellets

Plot boundaries were also re-staked and marked, and photographs were taken of each plot and associated quadrats.

2.2.3 Data Analysis

Analysis of Dust Deposition

The relationship between dust deposition rates and differences in plant species abundance and composition between mine and reference PVP sites is assessed qualitatively because the location of the dust deposition gauges are not directly correlated with PVP locations (Figure 2.2-1).

Previously (Golder 2014), dust deposition statistics were computed using arithmetic averages for the period of record (i.e., 2002 to 2013), and were divided into three Plot Type groups: ‘Mine’, ‘None’ and ‘Reference’. Analysis of dust deposition rates in the 2016 report have been updated as follows:

- Dust deposition rates are stratified into time periods to reflect changes in mining activities over time at the Diavik mine. The time period groups are as follows:
  - 2002 to 2005 (open pit mine construction and mining)
  - 2006 to 2009 (open pit mining and underground mine construction)
  - 2010 to 2013 (underground mining)
  - 2013 to 2016 (underground mining)
- Dust deposition rates at each station for the 2002 to 2016 period of record are best described using a log-normal distribution instead of a normal distribution, and the rates should be tabulated as geometric averages instead of arithmetic averages (Golder 2014). The exception is the data from Dust 05, which does not fit well by a normal or a log-normal distribution. This is due to the value recorded in 2004 (1,433 mg/dm^2/y), which is an apparent outlier (2002 to 2016 geometric mean at Dust 05 = 145 mg/dm^2/y).

- Geometric average dust deposition rates observed at gauges Dust 05 (without the outlier), Dust 09 and Dust 10 from 2002 to 2016 are indistinguishable from the pooled geometric average at reference gauges Dust C1 and Dust C2 when evaluated using a two-tailed Student’s T-test (P<0.05). This supports potentially combining deposition rate data from stations Dust 05 (None group) and Dust 10 (Mine group) into the Reference group of stations along with Dust 09. For consistency with previous reports, Dust 05 and Dust 10 have been retained in the None and Mine groups, respectively.

Analysis of Plant Species Abundance and Composition Data

Data analysis focused on evaluating trends and determining if there were statistical differences in vegetation abundance and composition between mine plots and reference plots among years. The variables measured included the following:

- change or difference in plant species abundance, as defined by mean percent species cover
- change or difference in plant species composition, as defined by plant species richness

Plant species data from 2001 and 2004 were reported in Golder (2011a), but the sampling design was biased towards mine plots and no numerical analysis could be completed. Thus, the analysis here is focused on data from 2006, 2008, 2010, 2013 and 2016 to investigate potential trends in plant species cover and richness over time relative to mine and reference plots. Data were compiled and assessed for consistency in plant species names, and checked for potential outliers that may represent misidentified species. Plant species that were only identified to the genus level were retained for analysis, while all unidentified species were excluded from the analysis. Additionally, the two subspecies of water sedge (Carex aquatilis var stans and Carex aquatilis var aquatilis) were combined into water sedge (Carex aquatilis), as it was not possible to separate out the varieties on every plot.

Analyses were run separately for each of the three vegetation community types (i.e., Heath Tundra, Shrub, and Tussock-Hummock); an effective approach to reduce the within-group (i.e., mine or reference areas) variability associated with plant species cover estimates and increase the power to detect meaningful trends between mine and reference plots. Prior to completing statistical analysis, all data were tested for normality and homogeneity of variance using Systat V.13.1 (Systat 2009). As some plant species cover data were not normally distributed, in order to meet the assumptions of statistical analysis, all plant species cover data were transformed using the arcsine of the square root of the percent cover. In addition, it was assumed that parametric tests would be sufficiently robust to detect trends in the differences in plant species composition and abundance between mine plots and reference plots and across years (Zar 1999). A summary of mean percent cover of plant species and ground vegetation on mine and reference plots for 2016 is provided in Appendix B. Similar data for 2006 to 2013 are provided in Golder (2014).

The level of statistical significance was set *a priori* at an alpha value of 0.10. Species cover estimates have a high degree of variation associated with natural factors and sampling methods (e.g., observer subjectivity). Therefore, an alpha value of 0.05 was believed to be too conservative, and would have increased the likelihood of not detecting a statistical effect (i.e., increased the probability of Type II error). For the purpose of detecting potential effects from mining activity, it was decided that an increased probability of a Type I error was preferable to a Type II error.

Because many plant species were present in trace amounts and there was considerable multicollinearity (i.e., correlation among two or more variables, in this case plant species cover) in the data, plant species cover values were pooled to yield percent cover by vegetation layer (i.e., shrub, forb, and grass) rather than individual species. For each plot, the total percent cover of shrubs, forbs, and grasses were determined by summing the individual species covers associated with each vegetation layer. As vegetation layer and ground cover abundance data were generally non-normally distributed, data were transformed using the arcsine of the square root of the percent cover. Total plant species richness was also determined for each plot and was also calculated for each vegetation layer. Species richness is determined by counting the total number of species present in a plot and is independent of species percent cover (Krebs 1989).

Lichen and bryophyte (moss) data were also analyzed using a similar approach to that used for analyzing the vascular plant species data. However, as many lichen and moss species were present in trace amounts, only select groups of lichen and moss species were retained for subsequent analyses and were rolled up to the genus level by summing the individual species covers associated with each genus (Table 2.2-2). Lichen and moss species groups were then selected for analyses based on their respective presence and abundance on plots, such that only those species groups present on greater than 10 plots and with greater than 1% cover on greater than or equal to 3 plots were retained for subsequent analyses. These criteria were chosen to allow the analysis to focus on those lichen and moss species groups that had sufficient presence and abundance on both mine and reference plots to allow comparisons to be made. Total lichen species richness and total moss species richness were also determined for each plot.

Table 2.2-2: Lichen and Moss Species Groupings for Analysis

Species Code	Scientific Name
Lichen Species Group	
BRYOSPP	*Bryocaulon divergens*
CETRSPP	*Cetraria delisei*
	Cetraria ericetorum
	Cetraria fastigiata
	Cetraria islandica ssp. *crispiformis*
	Cetraria islandica ssp. *islandica*
	Cetraria laevigata
	Cetraria nigricans
	Cetraria sepincola
CLADISP	*Cladonia mitis*
	Cladonia rangiferina
	Cladonia stellaris
	Cladonia stygia
FLAVSPP	*Flavocetraria cucullata*
	Flavocetraria nivalis
PELTSPP	*Peltigera aphthosa*
	Peltigera didactyla
	Peltigera kristinssonii
	Peltigera leucophlebia

Species Code	Scientific Name
Lichen Species Group	
	Peltigera malacea
	Peltigera polydactyla
	Peltigera scabrosa
	Peltigera sp.
Moss Species Group	
AULASPP	*Aulacomnium turgidum*
	Aulacomnium palustre
DICRSPP	*Dicranum elongatum*
	Dicranum fuscescens
	Dicranum groenlandicum
	Dicranum scoparium
	Dicranum sp.
	Dicranum undulatum
LIVERWORT	*liverwort species*
SPHASPP	*Sphagnum lenense*
	Sphagnum aongstroemii
	Sphagnum angustifolium
	Sphagnum capillifolium
	Sphagnum fuscum
	Sphagnum magellanicum
	Sphagnum obtusum
	Sphagnum sp.
	Sphagnum subsecundum
	Sphagnum warnstorfii
	Sphagnum wulfianum

Statistical analyses were completed using Systat V.13.1 (Systat 2009). Previously, analysis of plant species abundance and richness between mine and reference plots, by vegetation community, was completed for the current year, and then across sampling years to test for temporal trends. However, in the most recent comprehensive analysis report the following recommendations were given (Golder 2014):

- Remove the analysis of single year effects between mine and reference plots (i.e., 2016) in future monitoring reports. Using the two-way Repeated Measures Analysis of Variance (RM-ANOVA) is statistically more appropriate and robust method for detecting single (and multiple) year effects.
- Combine all the data from 2006 through most recent sampling period into one omnibus analysis. The use of all PVPs in one analysis would provide a more powerful approach to detecting temporal changes between mine and reference sites.

Therefore, vascular plant species abundance and richness (e.g. shrub, forb, graminoid, total vascular combining shrub, forb, and graminoid) on mine and reference sites were analyzed from 2008 to 2016, by vegetation community type (i.e., Heath Tundra, Shrub, and Tussock-Hummock) using RM-ANOVA. In addition, lichen and bryophyte data were analyzed using RM-ANOVA to investigate differences in mean species cover of selected lichen and bryophyte groups (from 2008 to 2016), and total species richness (2013 and 2016) between mine and reference sites (based on vegetation layers), stratified by vegetation community type. To meet the assumptions of the repeated measures analyses, 2006 data was excluded as sample sizes were different from 2008 to 2016. However, the mean ± 1 standard error (± 1SE) for 2006 data were calculated and plotted to provide graphical comparisons.

Multivariate analysis of 2016 data, specifically non-metric multidimensional scaling, was used to further evaluate potential differences in species composition (richness) between mine and reference sites. Multivariate analyses were completed using PC-ORD (McCune and Mefford 2011). Non-metric multidimensional scaling is an ordination technique that assesses the distribution of plots in plant species space, based on plant species composition data (McCune and Mefford 2011). Small distances between plots indicate that plots have greater similarities in plant community composition than plots that are positioned further apart. To reduce the variability in the data, only those plant species that occurred on two or more plots were included in the analysis. This reduced the effect of uncommon species on the ordination.

2.3 Results

2.3.1 Dust Deposition Rates

Arithmetic and geometric mean dust deposition rates from 2002 to 2016 indicate that dustfall is higher on near mine PVPs than reference PVPs (Table 2.3-1). As expected, due to the log-normal distribution of dust deposition data, average values using arithmetic means are greater than geometric mean values. Dust deposition rates during open pit mine construction and mining (2002 to 2005), and during open pit mining and underground mine construction (2006 to 2009) were higher than during the underground mining phase (2010 to present) (Figure 2.3-1). Dust deposition rates for PVP's located near the mine have had an average deposition rate of 380 mg/dm^2/y (95% CI = 300 to 470 mg/dm^2/y) over the 2002 to 2016 period of record. These deposition rates are four to five times higher than a deposition rate of 92 mg/dm^2/y (95% CI = 74 to 115 mg/dm^2/y) observed at the reference stations over the same time period.

Table 2.3-1: Summary Statistics of Dust Deposition Rates near the Diavik Mine, 2002 to 2016

Plot Type	Dust Gauge	Nearest PVP	Arithmetic Mean (mg/dm^2/y)	Geometric Mean (mg/dm^2/y)	Geometric 95% CI (mg/dm^2/y)
Mine	Dust 01	PVP01, PVP02, PVP03	530	490	400–600
	Dust 03	PVP07	1400	1100	780–1600
	Dust 04	PVP04, PVP05, PVP06, PVP09, PVP20, PVP21, PVP22, PVP23	430	320	220–480
	Dust 08	PVP24, PVP31	200	170	120–230
	Dust 10	PVP10	230	170	100–290
		Combined	**590**	**380**	**300–470**
None	Dust 2A		650	530	370–740
	Dust 05		220	150	100–210
	Dust 06		650	540	390–740
	Dust 07		280	240	180–310
		Combined	**450**	**320**	**250–390**
Reference	Dust 09	PVP17, PVP18, PVP19, PVP29, PVP30	140	110	65–160
	Dust C1	PVP11, PVP12, PVP13, PVP26, PVP27, PVP28	75	63	46–85
	Dust C2	PVP14, PVP15, PVP16, PVP25	150	120	84–170
		Combined	**120**	**92**	**74–120**

PVP = permanent vegetation plot; mg/dm2/y = milligrams per square meter per year; CI = confidence interval.

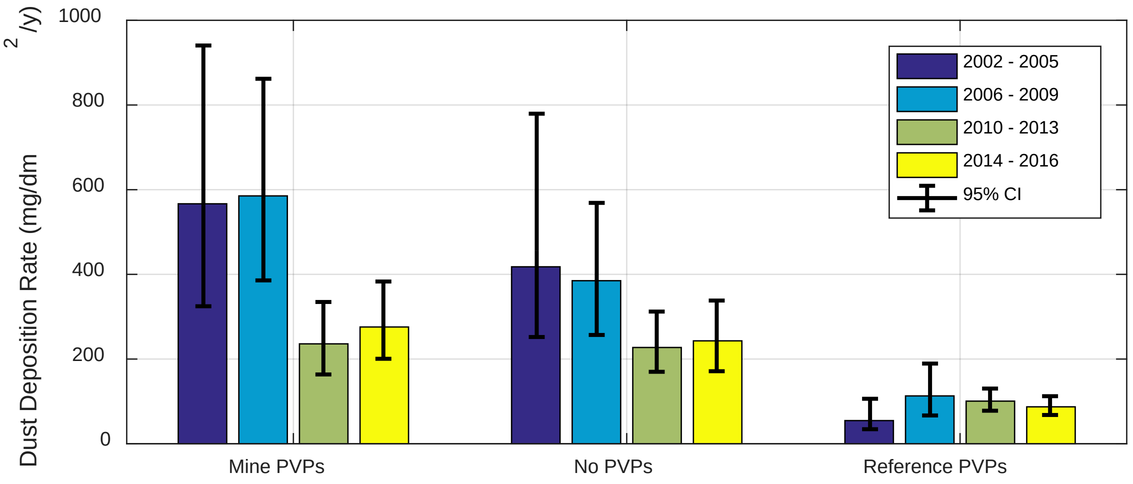


Figure 2.3-1: Geometric Average Dust Deposition Rates (mg/dm^2/y) near the Diavik Mine during Discrete Time Periods

Note: PVPs = Permanent Vegetation Plots (PVPs) Adjacent to Dustfall Gauges.

2.3.2 Vascular Plant Species Abundance and Composition

2.3.2.1 Mean Species Cover

Heath Tundra Vegetation Community

Mean total shrub cover did not differ significantly between mine and reference plots in the Heath Tundra community ($F_{1, 8}$ = 0.64, P = 0.45). However, shrub cover was significantly different among years ($F_{1, 8}$ = 34.31, P <0.01), and was greater in 2013 and 2016 compared to previous sampling periods (Appendix C, Figure C-1a). There was no significant interaction between year and plot type ($F_{1, 8}$ = 0.27, P = 0.61).

Mean total forb cover for mine plots was significantly greater than reference plots ($F_{1, 8}$ = 7.52, P= 0.03; Appendix C, Figure C-2a). However, forb cover did not differ significantly among years ($F_{1, 8}$ = 1.92, P = 0.20), and there was no significant interaction between year and plot type ($F_{1, 8}$ = 2.71, P = 0.14).

Mean total graminoid cover for mine plots was significantly greater than reference plots ($F_{1, 8}$ = 8.77, P = 0.02; Appendix C, Figure C-3a). However, mean total graminoid cover did not significantly vary among years ($F_{1, 8}$ = 0.88, P = 0.38), and cover was additive (i.e., no significant interaction) between mine and reference site across years ($F_{1, 8}$ = 0.39, P = 0.55).

In the Heath Tundra community, mean total litter cover did not differ significantly between mine and reference plots ($F_{1, 8}$ = 2.73, P = 0.14). However, litter cover did significantly change among years ($F_{1, 8}$ = 89.30, P <0.01), and was greater for mine plots in 2008 and 2010 relative to other sampling periods (Appendix C, Figure C-4a). There was also a significant interaction between year and plot type, which was mostly due to the larger difference between mine and reference site values in 2008 and 2010 relative to other years ($F_{1, 8}$ = 8.28, P = 0.02).

Shrub Vegetation Community

In the Shrub community, mean total shrub cover did not differ significantly between mine and reference plots ($F_{1, 8}$ = 1.29, P = 0.29). However, shrub cover was significantly different among years ($F_{1, 8}$ = 727.65, P <0.01). Similar to Heath Tundra, shrub cover was greater in 2013 and 2016 compared to previous years (Appendix C, Figure C-1b). There was also a significant interaction between year and plot type as shrub cover appeared to greater on mine plots than reference plots in 2013 and 2016 relative to other sampling periods ($F_{1, 8}$ = 33.26, P <0.01).

Similar to Heath Tundra, mean total forb cover on mine plots in the Shrub community was significantly greater than reference plots ($F_{1, 8}$ = 3.71, P= 0.09; Appendix C, Figure C-2b). Forb cover also showed significant inter-annual variation ($F_{1, 8}$ = 4.54, P = 0.07). There was no significant interaction between year and plot type ($F_{1, 8}$ = 1.79, P = 0.22).

Mean total graminoid cover for mine plots was significantly greater than reference plots ($F_{1, 8}$ = 10.74, P = 0.01; Appendix C, Figure C-3b), and varied significantly among years ($F_{1, 8}$ = 4.22, P = 0.07). There was also significant interaction between year and plot type, which was likely related to greater cover on mine plots than reference plots in 2013 and 2016 relative to previous years ($F_{1, 8}$ = 4.45, P = 0.07).

Mean total litter cover did not differ significantly between mine and reference plots in the Shrub community ($F_{1, 8}$ = 1.58, P = 0.24). However, litter cover showed significant year-to-year variability ($F_{1, 8}$ = 191.91, P <0.01; Appendix C, Figure C-4b), and was greater in 2008 and 2010 than other sampling periods. There was also a significant interaction between year and plot type ($F_{1, 8}$ = 4.27, P = 0.07).

Tussock-Hummock Vegetation Community

Similar to the Heath Tundra and Shrub communities, mean total shrub cover did not differ significantly between mine and reference plots in the Tussock-Hummock community ($F_{1, 8}$ = 0.12, P = 0.73; Appendix C, Figure C-1c), but was statistically greater in 2013 and 2016 than previous years ($F_{1, 8}$ =59.08, P <0.01). There was no significant interaction between year and plot type ($F_{1, 8}$ = 2.64, P = 0.14).

Mean total forb cover did not differ significantly between plot type ($F_{1, 8}$ = 0.96, P= 0.36) or among years ($F_{1, 8}$ = 2.50, P = 0.15), and was additive between mine and reference sites across years ($F_{1, 8}$ = 0.001, P = 0.97) (Appendix C, Figure C-2c).

Mean total graminoid cover did not differ significantly between mine and reference plots ($F_{1, 8}$ = 0.01, P = 0.91; Appendix C, Figure C-3c). Graminoid cover varied among years in the Tussock-Hummock community, and was at the designated level of statistical significance ($F_{1, 8}$ = 3.48, P = 0.10). There was also a significant interaction between year and plot type ($F_{1, 8}$ = 4.65, P = 0.06), which was likely related to greater graminoid cover on reference plots than mine plots in 2013 relative to the other sampling periods (Appendix C, Figure C-3c).

In contrast to Heath Tundra and Shrub communities, mean total litter cover differed significantly between mine and reference plots in the Tussock-Hummock community ($F_{1, 8}$ = 7.71, P = 0.02), and was greater on mine plots than reference plots, particularly in 2008 and 2010 (Appendix C, Figure C-4c). However, mean total litter cover did not differ among years ($F_{1, 8}$ = 3.26, P = 0.11). There was no significant interaction between year and plot type ($F_{1, 8}$ = 1.80, P = 0.22).

2.3.2.2 *Mean Species Richness*

Heath Tundra Vegetation Community

Mean total vascular plant species richness in mine plots was significantly higher than in reference plots in the Heath Tundra community ($F_{1,8}$ = 7.93, P = 0.02; Appendix D, Figure D-1a). However, vascular plant species richness did not differ significantly among years ($F_{1,8}$ = 1.32, P = 0.28), and there was no significant interaction between year and plot type ($F_{1,8}$ = 1.32, P = 0.28).

Mean total shrub species richness did not differ significantly between mine and reference plots ($F_{1,8}$ = 0.21, P = 0.66). Shrub species richness differed significantly among years, and showed an increasing trend over time in the Heath Tundra community ($F_{1,8}$ = 3.89, P = 0.08; Appendix D, Figure D-2a). There was no significant interaction between year and plot type ($F_{1,8}$ = 2.70, P = 0.14).

In the Heath Tundra community, mean total forb species richness in mine plots was significantly higher than in reference plots ($F_{1,8}$ = 6.23, P= 0.037; Appendix D, Figure D-3a). However, forb species richness did not vary significantly among years ($F_{1,8}$ = 1.19, P = 0.31), and there was no significant interaction between year and plot type ($F_{1,8}$ = 1.19, P = 0.31).

Mean total graminoid species richness in mine plots was significantly higher than in reference plots ($F_{1,8}$ = 21.36, P <0.01), and showed some inter-annual variation in the Heath Tundra community ($F_{1,8}$ = 4.97, P = 0.06; Appendix D, Figure D-4a). Graminoid species richness was also additive between mine and reference sites across years ($F_{1,8}$ = 0.26, P = 0.62).

Shrub Vegetation Community

In the Shrub community, mean total vascular plant species richness did not differ significantly between plot type ($F_{1,8}$ = 3.34, P = 0.11) or among years ($F_{1,8}$ = 1.13, P = 0.32). Also, there was no significant interaction between year and plot type ($F_{1,8}$ = 1.51, P = 0.25; Appendix D, Figure D-1b).

Similar to the Heath Tundra community, mean total shrub species richness did not differ significantly between mine and reference plots ($F_{1,8}$ = 0.62, P = 0.45), but showed a decreasing temporal trend in the Shrub community ($F_{1,8}$ = 8.20, P = 0.02; Appendix D, Figure D-2b). There was no significant interaction between year and plot type ($F_{1,8}$ = 2.44, P = 0.16).

Mean total forb species richness did not differ significantly between plot type ($F_{1,8}$ = 0.06, P= 0.82) or among years ($F_{1,8}$ = 1.28, P = 0.29) in the Shrub community. In addition, there was no significant interaction between year and plot type ($F_{1,8}$ = 0.72, P = 0.42; Appendix D, Figure D-3b).

Similar to the Heath Tundra community, mean total graminoid species richness in mine plots was significantly higher than in reference plots in the Shrub community ($F_{1,8}$ = 11.45, P = 0.01; Appendix D, Figure D-4b). However, graminoid species richness did not differ significantly among years ($F_{1,8}$ = 0.013, P = 0.91), and there was no significant interaction between year and plot type ($F_{1,8}$ = 0.12, P = 0.74).

Tussock-Hummock Vegetation Community

Mean total vascular plant species richness did not differ significantly between mine and reference plots in the Tussock-Hummock community ($F_{1,8}$ = 0.15, P = 0.71; Appendix D, Figure D-1c). In addition, vascular plant species richness was not statistically related to year ($F_{1,8}$ = 2.19, P = 0.18), and was additive between mine and reference plots across years ($F_{1,8}$ = 0.06, P = 0.81).

Similar to Heath Tundra and Shrub communities, mean total shrub species richness did not differ significantly between mine and reference plots in the Tussock-Hummock community ($F_{1,8}$ = 0.51, P = 0.50; Appendix D, Figure D-2c). Shrub species richness exhibited no significant variation among years ($F_{1,8}$ = 0.25, P = 0.63), and there was no significant interaction between year and plot type ($F_{1,8}$ = 0.01, P = 0.94).

In the Tussock-Hummock community, mean total forb species richness did not differ significantly between mine and reference plots ($F_{1,8}$ = 1.26, P= 0.29). However, forb species richness was statistically higher during 2010 to 2016, particularly in reference plots ($F_{1,8}$ = 6.82, P <0.01; Appendix D, Figure D-3c). There was no significant interaction between year and plot type ($F_{1,8}$ = 0.71, P = 0.56).

Mean total graminoid species richness did not differ significantly between plot type ($F_{1,8}$ = 0.32, P = 0.59) or across years ($F_{1,8}$ <0.01, P = 1.00). Also, variation in graminoid species richness was additive between mine and reference sites among years ($F_{1,8}$ = 0.03, P = 0.87; Appendix D, Figure D-4c).

2.3.3 Lichen and Moss Species Abundance and Composition

Heath Tundra Vegetation Community

In the Heath Tundra community, mean total lichen cover did not differ significantly between mine and reference plots ($F_{1,8}$ = 2.65, P = 0.14; Appendix C, Figure C-5a). Lichen cover also exhibited no significant variation among years ($F_{1,8}$ = 1.62, P = 0.24) and there was no significant interaction between year and plot type ($F_{1,8}$ = 0.56, P = 0.48).

Mean total lichen species richness did not differ significantly between mine and reference plots ($F_{1,8}$ = 0.33, P = 0.58), but species richness was statistically higher in 2013 than in 2016 ($F_{1,8}$ = 19.50, P <0.01; Appendix D, Figure D-5a). There was no significant interaction between year and plot type ($F_{1,8}$ = 1.45, P = 0.26).

Mean total bryophyte cover was significantly greater in mine plots than reference plots in the Heath Tundra community ($F_{1,8}$ = 7.32, P = 0.03; Appendix C, Figure C-6a). However, bryophyte cover did not differ significantly among years ($F_{1,8}$ = 0.10, P = 0.76), and there was no significant interaction between year and plot type ($F_{1,8}$ = 0.52, P = 0.49).

Mean total bryophyte species richness was significantly higher in mine plots than reference plots ($F_{1,8}$ = 3.61, P = 0.09). Similar to lichen, bryophyte species richness was significantly higher in 2013 than 2016 in the Heath Tundra community ($F_{1,8}$ = 9.80, P = 0.01; Appendix D, Figure D-6a). Variation in bryophyte species richness was additive between mine and reference sites among years ($F_{1,8}$ = 3.20, P = 0.11).

Shrub Vegetation Community

In the Shrub community, mean total lichen cover did not differ significantly between mine and reference plots ($F_{1, 8}$ = 2.54, P = 0.15; Appendix C, Figure C-5b). In addition, lichen cover did not change significantly among years ($F_{1, 8}$ = 0.78, P = 0.40), and there was no significant interaction between year and plot type ($F_{1, 8}$ = 1.15, P = 0.32).

Similar to the Heath Tundra community, mean total lichen species richness did not differ significantly between mine and reference plots ($F_{1, 8}$ = 1.23, P = 0.30), but was higher in 2013 than 2016 in the Shrub community ($F_{1, 8}$ = 29.17, P <0.01; Appendix D, Figure D-5b). Variation in lichen species richness was additive between mine and reference plots across years ($F_{1, 8}$ = 0.21, P = 0.66).

Mean total bryophyte cover did not differ significantly between plot type ($F_{1, 8}$ = 1.17, P = 0.31) or among years ($F_{1, 8}$ = 0.04, P = 0.84). However, there was a significant interaction between year and plot type, which may be partially related to larger values on reference plots in 2013 and 2016 ($F_{1, 8}$ = 17.17, P <0.01; Appendix C, Figure C-6b).

Mean total bryophyte species richness did not differ significantly between mine and reference plots in the Shrub community ($F_{1, 8}$ = 0.56, P = 0.47; Appendix D, Figure D-6b). In addition, there was no statistical difference in species richness between 2013 and 2016 ($F_{1, 8}$ = 1.16, P = 0.31), and no significant interaction between year and plot type ($F_{1, 8}$ = 0.65, P = 0.44).

Tussock-Hummock Vegetation Community

In the Tussock-Hummock community, mean total lichen cover did not differ significantly between mine and reference plots ($F_{1, 8}$ = 1.79, P = 0.22; Appendix C, Figure C-5c). Lichen cover also did not vary significantly among years ($F_{1, 8}$ = 1.21, P = 0.30), and there was no significant interaction between year and plot type ($F_{1, 8}$ = 0.03, P = 0.87).

Similar to Heath Tundra and Shrub communities, lichen species richness did not vary between mine and reference plots ($F_{1, 8}$ = 0.16, P = 0.70), but was higher in 2013 than 2016 in the Tussock-Hummock community ($F_{1, 8}$ = 15.07, P <0.01; Appendix D, Figure D-5c). There was also no significant interaction between year and plot type ($F_{1, 8}$ = 0.77, P = 0.41).

Mean total bryophyte cover did not differ between plot type ($F_{1, 8}$ = 0.73, P = 0.42) or among years ($F_{1, 8}$ = 0.18, P = 0.68), and was additive between mine and reference sites across time ($F_{1, 8}$ = 1.33, P = 0.28; Figure Appendix C, Figure C-6c).

Similar to the Shrub community, mean total bryophyte species richness did not differ significantly between mine and reference plots ($F_{1, 8}$ <0.01, P = 1.00) or between 2013 and 2016 in the Tussock-Hummock community ($F_{1, 8}$ = 2.21, P = 0.18). However, there was a significant interaction between year and plot type; the direction of species richness values changed for mine and reference sites from 2013 to 2016 ($F_{1, 8}$ = 7.64, P = 0.03; Appendix D, Figure D-6c).

2.3.4 Distribution of Vegetation Communities and Mine and Reference Sites Based on Plant Species Composition, 2016

Non-metric multidimensional scaling was used to plot and visually assess the ecological relationships between 2016 plots on mine and reference sites for each of the three vegetation community types, based on species composition data. Small distances between plots indicate the plots have greater similarities in plant community composition than plots that are positioned further apart. Key vegetation variables (i.e., percent cover for 31 plant species) were overlaid onto the plot ordination using blue points to depict the relative strengths of the relationships between plots and vegetation variables.

The results of the ordination show relatively strong groupings for mine and reference plots within a particular vegetation community, and spatial separation of vegetation communities, which is to be expected as plots were pre-stratified according to vegetation type (Figure 2.3-2). In addition, for the Tussock-Hummock vegetation community, mine and reference plots showed some degree of separation in species composition from Heath Tundra and Shrub communities. This relationship is indicated by the strong grouping of Tussock-Hummock reference and mine plots to the right side and middle along the Axis 1 of the ordination (Figure 2.3-2).

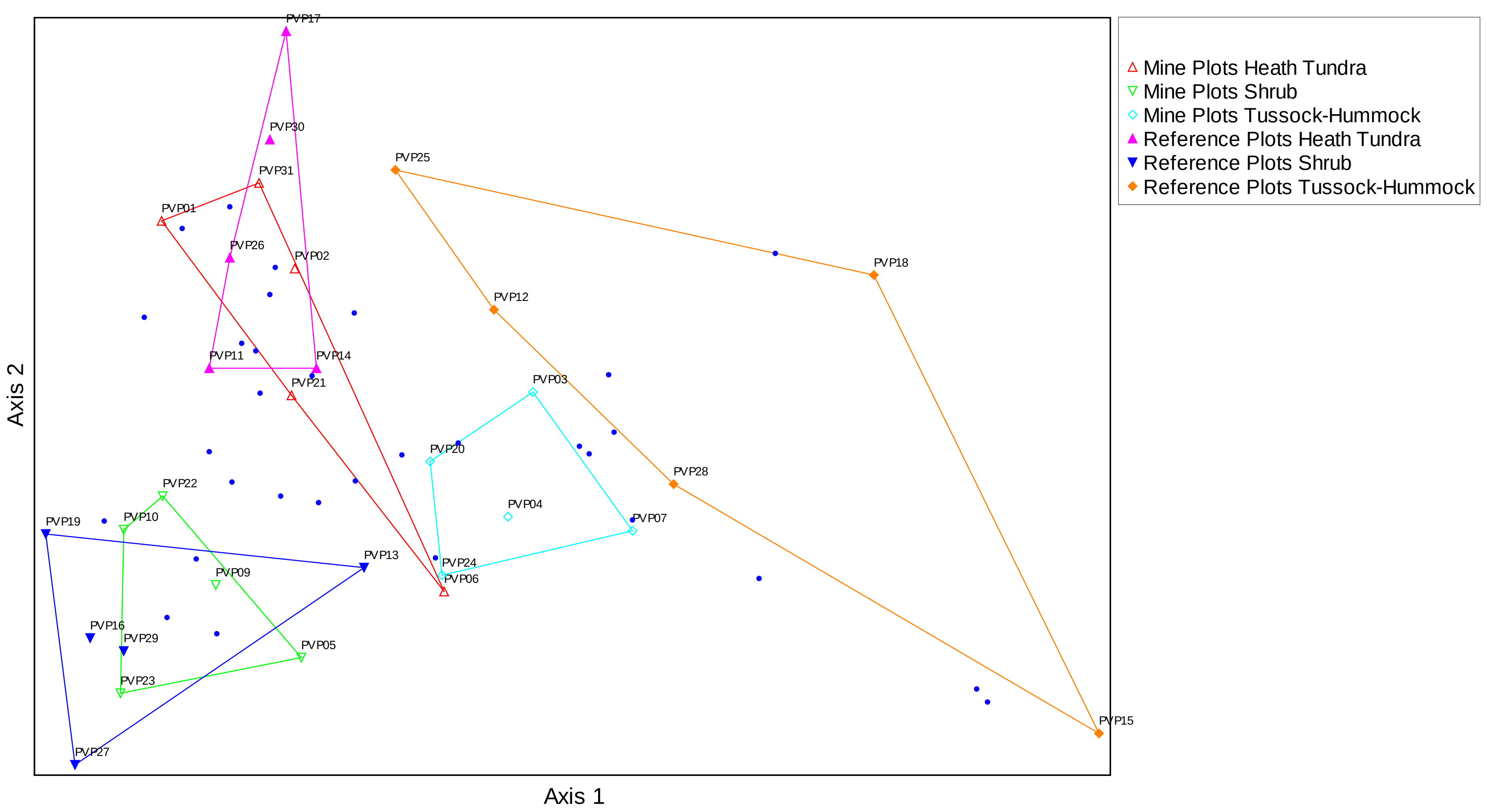


Figure 2.3-2: Non-metric Multidimensional Scaling Analysis of 2016 Plots in Plant Species Space

2.4 Discussion

The composition and dynamics of plant communities in arctic ecosystems are inherently variable, with seasonal differences in precipitation, temperature, nutrients, as well as herbivory, interspecific competition, and successional processes (Barbour et al. 1987). This natural variability poses difficulties in distinguishing changes in plant species abundance and composition that may occur as a result of mining activities from those due to natural factors or field sampling bias over time. Thus, long-term monitoring is fundamental to identifying changes to ecosystems, particularly in arctic environments where changes may accumulate slowly over time.

Typically, a before-after control-impact (BACI) design that includes the monitoring of control and impacted sites before and after the establishment of a disturbance is used to account for some of this variability (Smith 2006). Although a BACI design was not used, as permanent detailed vegetation sampling plots were established after the construction of the Mine, the vegetation monitoring program is robust enough to detect statistical changes in tundra vegetation composition and abundance. The RM-ANOVA (Zar 1999) used in this vegetation monitoring program allows for the statistical control of variation between sampling sites (PVPs or between subjects) that may be due to local site conditions prior to and after mining, and other factors such as climate. The method examines the variation within each sampling site through time (within subjects), which provides a robust test of the influence of annual and cumulative dust deposition from Mine-related activities and concurrent changes in natural factors.

The results of this single omnibus analysis were similar to patterns observed in previous monitoring reports (Golder 2011a, 2014). For all three vegetation communities, there was no statistically detectable difference in total shrub cover between mine and reference sites. However, shrub cover on mine and reference plots was greater in 2013 and 2016 relative to previous sampling periods, and the magnitude of the increase in the Shrub community was larger for mine plots. In Heath Tundra and Shrub vegetation communities, forb and graminoid cover on mine plots were significantly greater than reference plots, but no difference was detected between plot types for the Tussock-Hummock community. However, the ecological significance of this result is uncertain given the low abundance of forbs and particularly graminoids in Heath Tundra and Shrub communities. Although no distinct temporal patterns were evident, there was some significant inter-annual variation in forb and graminoid cover in the Shrub and Tussock-Hummock communities, and graminoid cover was greater on reference plots than mine plots in 2013 relative to other sampling periods.

Litter cover exhibited similar and opposite trends among vegetation communities with respect to changes between mine and reference plots and across time. In Heath Tundra and Shrub communities, litter cover was not statistically different between mine and reference sites, but appeared greater on mine plots in 2008 and 2010 (Appendix C, Figure C-4). On both mine and reference plots, litter cover was significantly greater in 2008 and 2010 than in 2006, 2013 and 2016 in the Heath Tundra and Shrub communities. For the Tussock-Hummock community, litter cover was statistically greater on mine plots, particularly in 2008 and 2010, but did not vary significantly among years. Reasons for greater litter cover in 2008 and 2010 are uncertain. Deposition of dust onto vegetation is known to cause a number of physiological and chemical responses in plant species, ranging from subtle changes in plant productivity (e.g., reduced photosynthesis or carbon uptake) to chlorosis or necrosis of the leaves that result in partial or complete defoliation of the plant (Spatt and Miller 1981). Dust may be partly responsible for greater litter cover on mine plots in 2008 and 2010, but does not explain the larger values on reference plots during the same sampling periods. Temporal changes in litter cover may be also related to temperature and/or moisture patterns. Future analyses could consider the incorporation of weather as the data set may be long enough to detect relationships between vegetation and climatic variables.

Among vegetation communities, total lichen cover was generally lower on mine than reference plots, but the difference was not statistically significant (Appendix C, Figure C-5). Bryophyte cover was significantly greater on mine plots in the Heath Tundra community, but no statistical differences between plot types were detected in the Shrub and Tussock-Hummock communities. Lichen and bryophyte cover did not vary significantly over time, except in the Shrub community where bryophyte cover on reference plots in 2013 and 2016 was greater than on mine plots.

Vascular plant species richness among vegetation communities was primarily comprised of shrub species; forb and graminoid taxa each contain about 1 to 3 species depending on the community. In the Heath Tundra community, total vascular plant species richness was significantly higher on mine plots than reference plots, but did not differ between plot types in the Shrub and Tussock-Hummock communities. Shrub and forb species richness was not statistically different between mine and reference sites, except that forb species richness was higher on mine plots in the Heath Tundra community. Similar to vascular plant abundance, species richness exhibited some degree of variation over time among the different vegetation communities. In the Heath Tundra and Shrub communities, shrub species richness on mine and reference plots showed temporally increasing and decreasing trends, respectively; however, no significant annual changes were detected in the Tussock-Hummock community. In contrast, forb species richness in Tussock-Hummock was higher during 2010 to 2016, particularly in reference plots, but did not vary among years in Heath Tundra and Shrub communities. Significant annual variation was detected for graminoid species richness in the Heath Tundra community but not the Shrub and Tussock-Hummock communities.

Lichen and bryophyte species richness did not differ between mine and reference sites, except for the Heath Tundra community where bryophyte species richness was higher on mine plots. Lichen species richness was similar on mine and reference plots, but decreased significantly from 2013 to 2016 for all vegetation communities. Part of this decrease in species richness was likely associated with the exclusion of trace species from the 2016 field surveys (Section 2.2.2.1). Bryophyte species richness in the Heath Tundra community significantly deceased on mine and reference plots from 2013 to 2016, but no temporal changes were detected in Shrub and Tussock-Hummock communities.

The results suggest that the Mine is likely having some local-scale effects on plant species abundance and composition. Most analyses showed that mine plots had greater vascular plant species cover and richness than reference plots. Although lichen cover was lower (but not statistically) on mine plots than reference plots, lichen and bryophyte species richness were not adversely affected on mine plots relative to reference plots. It is known that many lichen and moss species are especially sensitive to the effects of dust deposition, as they derive some of their moisture and nutrient requirements from the atmosphere and are vulnerable to the smothering effects of dust (Farmer 1993). Reduced lichen cover on mine plots may be associated with a greater potential for vascular plant species to become established, which may be contributing to the greater cover and richness of some vascular plant species on mine plots in some vegetation communities. Similar results have been reported from other studies investigating the effects of road dust on plant species composition (Forbes 1995; Auerbach et al. 1997; Meyers-Smith et al. 2006), where one of the major responses of vegetation to dust was a decrease in lichen species and a corresponding increase in graminoids. However, the results for the Mine have detected no strong, adverse temporal patterns in plant species abundance and composition. For example, lichen and bryophyte cover did not vary significantly over time, except in the Shrub community where bryophyte cover on reference plots in 2013 and 2016 was greater than on mine plots.

The vegetation (and wildlife) monitoring programs provide data for testing the predictions associated with Key Questions from the EER (Table 1.2-1; Section 1.2) (DDMI 1998). For Key Question 1, the current level of disturbance from the Mine footprint (11.6 km^2) is less than predicted in the EER (data from Wildlife Monitoring Program Report). No rare or endangered species or communities have been lost due to the Mine, which supports the prediction related to Key Question 3. Vegetation community structure, which includes plant species abundance and richness, has likely been altered due to dust deposition from the Mine, which supports the prediction for Key Question 2. Dust deposition rate has decreased on mine plots since 2010, although it is still approximately five times greater than reference sites (Figure 2.3-1). Additionally, effects from the Mine have resulted in some changes to plant community and species level diversity, as indicated by total vascular plant species richness that was 54% higher on Heath Tundra mine plots and 9% higher on Shrub mine plots compared to reference plots. This contrasts Key Question 4, which predicts a decrease of 44% in species richness (Table 1.2-1). The difference in species richness appears to be attributed to the higher number of graminoid species on mine plots in the Heath Tundra and Shrub communities.

Overall, the results of the analysis of dust deposition and vegetation data indicate differences in plant species abundance and composition in mine and reference plots over time are likely due to Mine-related effects, such as dust deposition. Natural variation in site conditions among PVPs prior to and after mining, annual variation in climate, foraging by caribou, surveyor variability and difficulty in detecting cryptic species have also probably influenced changes in plant species cover and richness. However, the direction and magnitude of the differences between mine and reference sites have remained largely consistent over the past 10 years, and with limited and small adverse effects. Other analyses have also demonstrated a decrease in metals concentrations in lichens sampled near the Mine site since 2010 (see Section 3). Importantly, the data show no trajectory towards a divergence in the previous and current observed temporal and spatial patterns of plant species abundance and composition. Based on the principles of adaptive management and the slow response of vegetation in the Arctic, it is recommended that this program be continued to confirm if the observed differences and changes in plant abundance and composition continue during mining operations; however, the sampling frequency should be reduced to once every 5 years.

2.5 Recommendations

The following recommendations are proposed for the vegetation monitoring program.

- Combine dust deposition data from stations Dust 05 (None group) and Dust 10 (Mine group) into the Reference group.
- Calculate average dust deposition rates using geometric means.
- Continue monitoring permanent vegetation plots to confirm if the observed differences and changes in plant species abundance and richness continue during mining operations; however, reduce the sampling frequency to once every 5 years.

3.0 LICHEN MONITORING PROGRAM

3.1 Study Objectives

The objective of the 2016 lichen sampling program was to collect lichen near and far from the Mine site for analysis of metals, metalloids, and non-metals[1] to determine if dust generated from mining activities is causing a measurable increase in concentrations of metals in lichen near the Mine site, and if metals concentrations in lichen have changed since they were measured in 2010 and 2013. Lichens were chosen because they are estimated to account for 87% to 90% of the diet for caribou (Thomas 1998). Lichens can also effectively and preferentially bioaccumulate airborne contaminants because of their lack of roots, large surface area, long life span, and high ion exchange capacity (Naeth and Wilkinson 2006). This allows lichens to provide “worst-case” exposure concentrations for assessment of health risks to caribou.

Soil samples were also collected at each lichen sampling location and were archived for possible future analysis if the results of the lichen chemistry indicated elevated metals concentrations relative to previous sampling events. The purpose of the soil sampling program was to incorporate exposure from inadvertent ingestion of soil by caribou while grazing on lichen.

3.2 Study Area

The study design includes three primary sampling zones. The first zone is the near-field area surrounding the Mine site. Twenty-three stations were chosen, including the initial 20 stations sampled in 2010 (Figure 3.1-1), and three additional stations identified as important caribou habitat by the Elders in 2013 (Tłı̨chǫ Government 2013) (Figure 3.1-2). The initial 20 stations selected in 2010 are distributed 0 to 6 km from the Mine; nine of which are located near long-term dustfall monitoring gauges (Golder 2011b). The three stations selected by the Elders in 2013 were located between the near-field and far-field areas at 14.0 to 20.6 km from the Mine.

The second zone is a far-field area, which is a concentric area 30 to 40 km from the Mine site. Twenty-one Stations, including 20 Initial Stations sampled in 2010, and one additional station identified as important caribou habitat by the Elders in 2013 (Tłı̨chǫ Government 2013), were selected throughout the zone (Figure 3.1-2). The initial 20 Stations were randomly selected. Four stations were preferentially distributed in the southern quadrant to offset the presence of Dominion Diamond Ekati Corporation’s (formerly BHP Billiton) EKATI™ Diamond Mine within the northwest quadrant of the far-field area. The four stations near EKATI in the northwest quadrant, from which data were excluded in the 2010 Risk Assessment (Golder 2011b), were not sampled in 2016. It should be noted that the southern quadrant is downwind (north and northeast prevailing winds) of the majority of mining activities.

In addition, three stations were sampled in 2016 in a far-far-field area approximately 100 km from the Mine site (Figure 3.1-3). Data collected from these stations were used to provide a benchmark for testing the applicability of using far-field stations as a reference for determining Mine-related changes in lichen chemistry in the near-field area.

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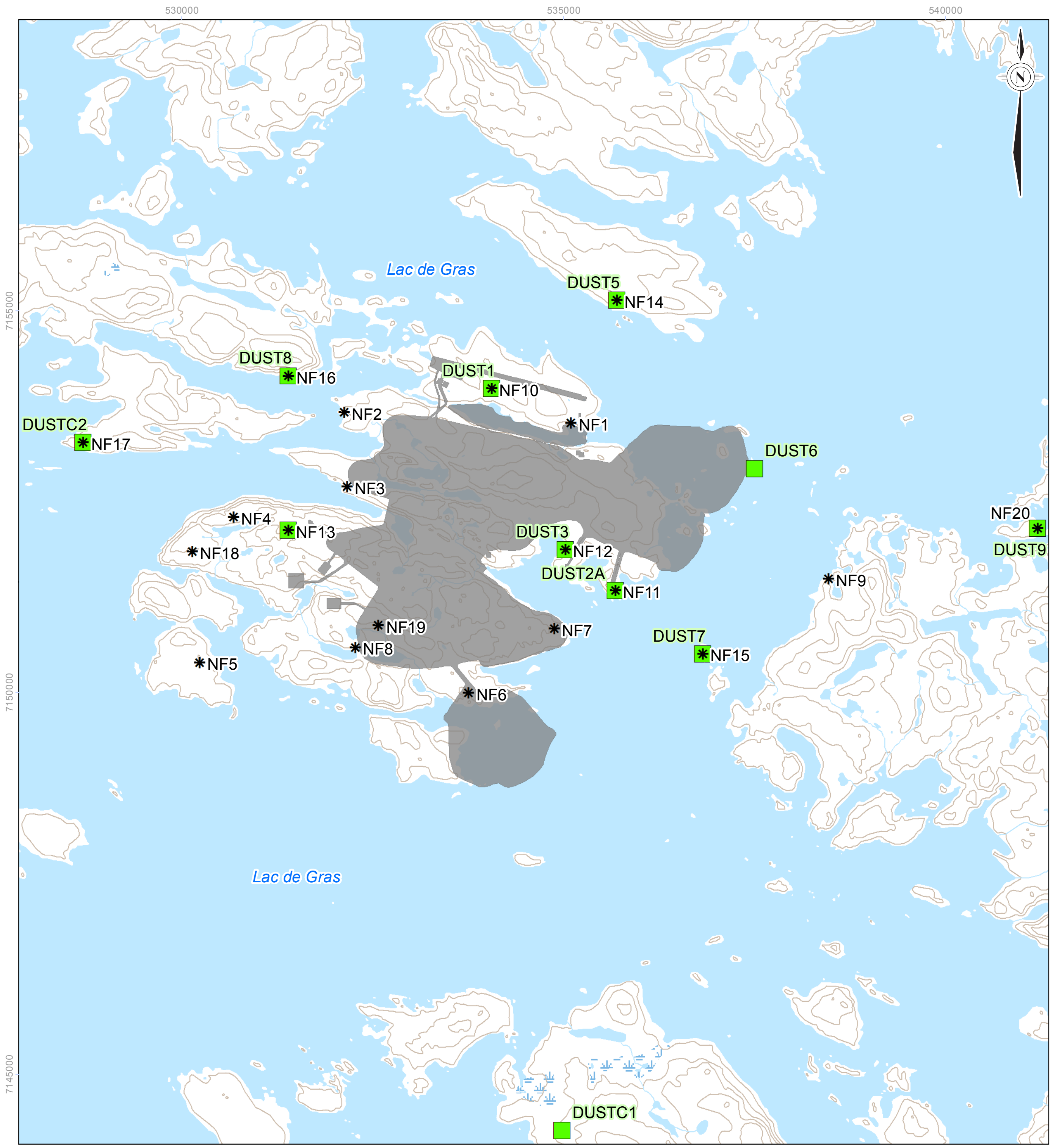
[1] Henceforth, metals, metalloids (e.g., arsenic), and non-metals (e.g., selenium) will be referred to as metals.



LEGEND

─ WATERCOURSE
🟦 WATERBODY
✱ LICHEN SAMPLING LOCATION
🟩 DUSTFALL COLLECTOR
▨ DIAVIK FOOTPRINT

1.5 0 1.5
SCALE 1:75,000 KILOMETRES

DRAFT

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
NAD 83 UTM ZONE

PROJECT
DIAVIK™
DIAMOND MINES INC.

TITLE
NEAR-FIELD AREA LICHEN AND SOIL SAMPLING LOCATIONS AND DUSTFALL COLLECTORS, 2016

Golder Associates

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DESIGN			SCALE AS SHOWN REV. A
GIS	ANK	22/11/16	**FIGURE: 3.1-1**
CHECK			
REVIEW			

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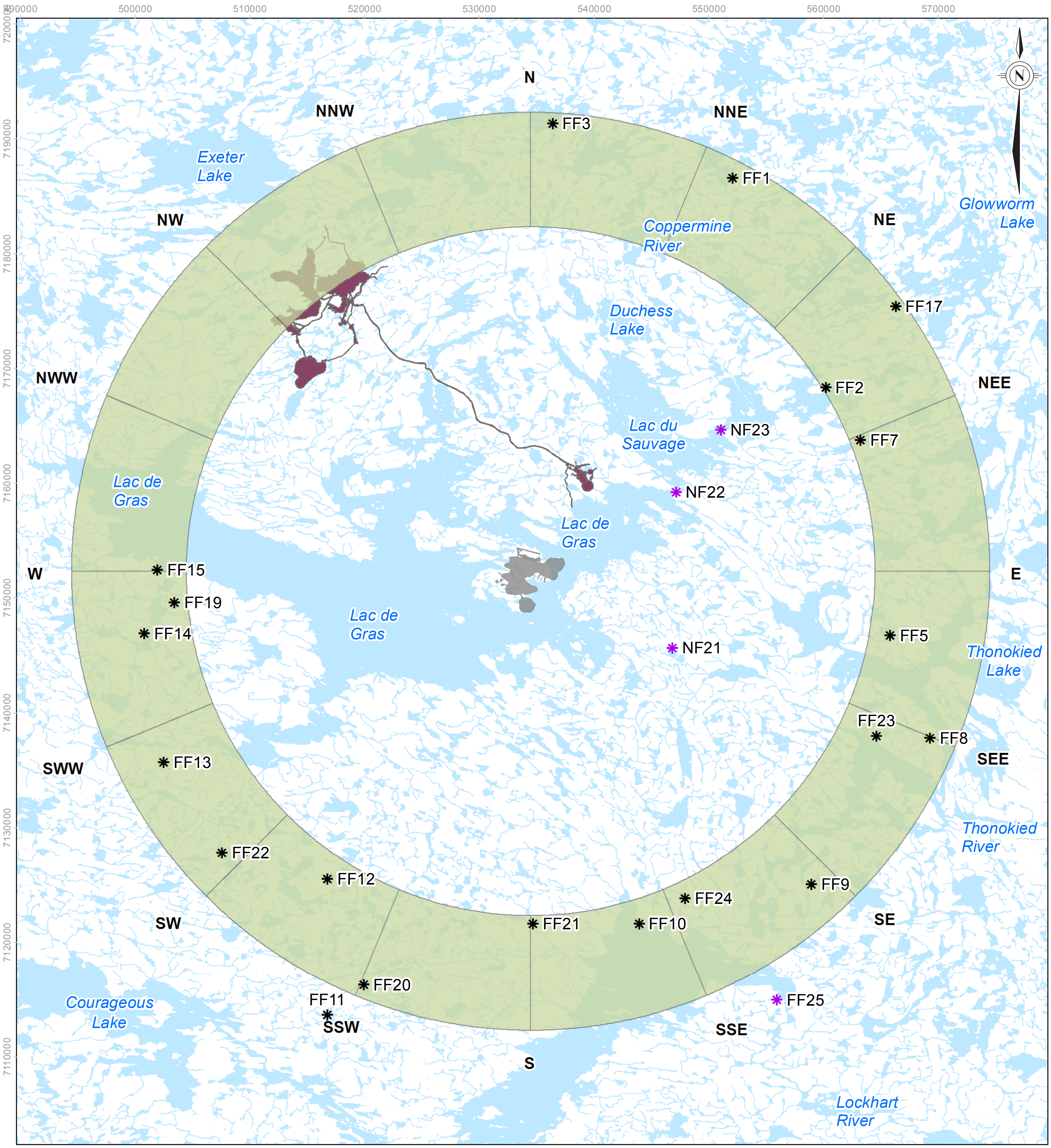

LEGEND

—	WATERCOURSE	✱	HISTORIC LICHEN SAMPLING LOCATION
▬	WATERBODY	✱	NEW 2013 LICHEN SAMPLING LOCATION
		■	EKATI FOOTPRINT
		■	DIAVIK FOOTPRINT
		■	30-40 Km ORDINAL BUFFER

10 0 10

SCALE 1:500,000 KILOMETRES

DRAFT

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
NAD 83 UTM ZONE

PROJECT

DIAVIK™
DIAMOND MINES INC.

TITLE

FAR-FIELD AREA LICHEN AND SOIL SAMPLING LOCATIONS, 2016

Golder Associates

PROJECT		1648005.2000	FILE No.	
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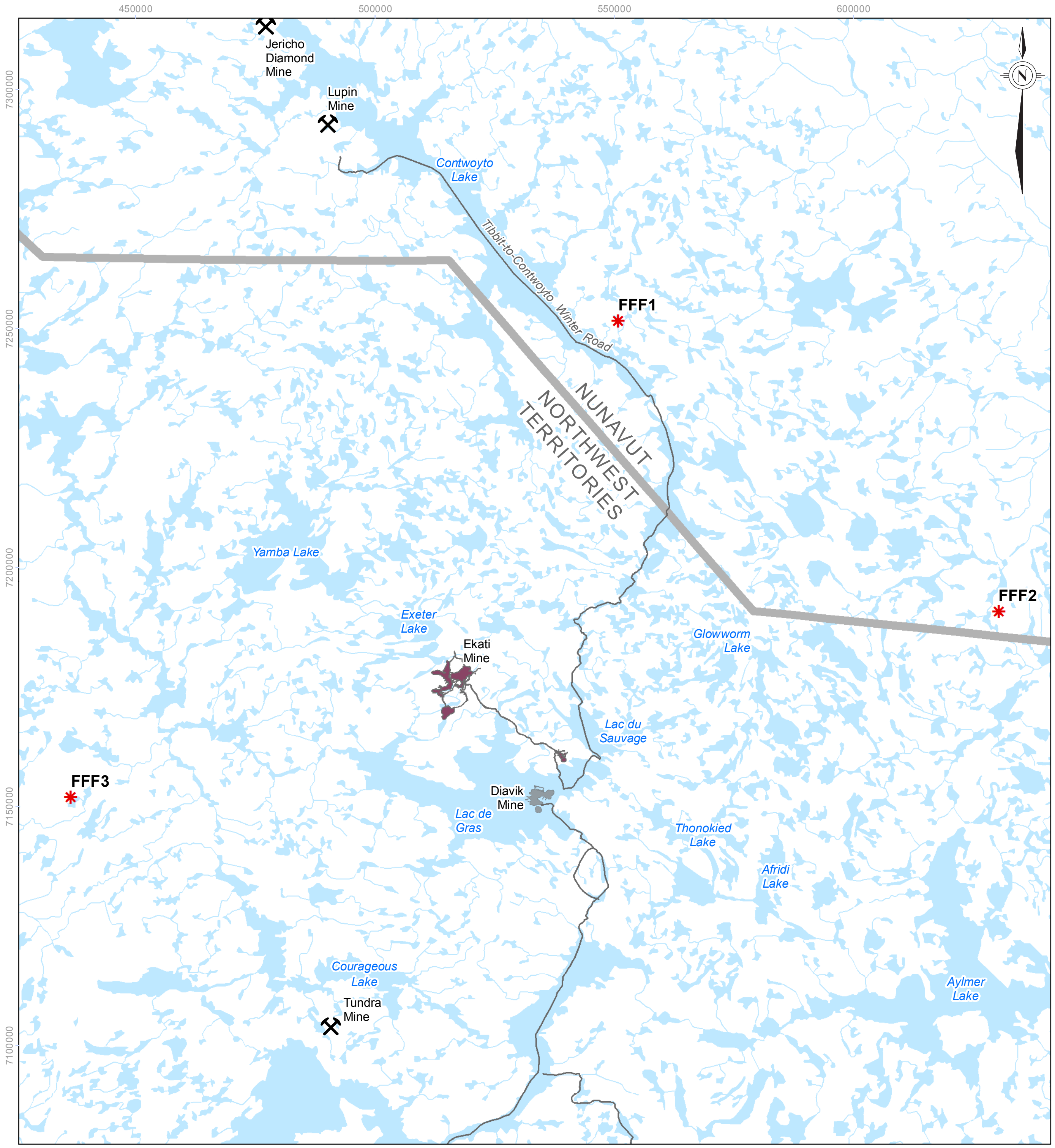
GIS	ANK	22/11/16		
CHECK			FIGURE: 3.1-2	
REVIEW				



LEGEND

✳ NEW 2016 LICHEN SAMPLING LOCATION

⚒ MINE LOCATION

— WATERCOURSE

— WINTER ROAD

■ WATERBODY

■ EKATI FOOTPRINT

■ DIAVIK FOOTPRINT

▭ TERRITORIAL BOUNDARY

25 0 25

SCALE 1:1,200,000 KILOMETRES

DRAFT

REFERENCE

CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
NAD 83 UTM ZONE

PROJECT

DIAVIK™
DIAMOND MINES INC.

TITLE

FAR-FAR-FIELD AREA LICHEN AND SOIL SAMPLING LOCATIONS, 2016

Golder Associates

PROJECT	1648005.2000		FILE No.
DESIGN			SCALE AS SHOWN REV. A
GIS	ANK	22/11/16	FIGURE: 3.1-3
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3.3 Methods

3.3.1 Sample Site Selection at Sampling Stations

Although there was a random element to the station selection in the original study design (Golder 2011b), the actual site of sampling in 2013 and 2016 was subjective and based on the previous guidance of the Elders (Tłı̨chǫ Government 2013) as to where caribou would eat (i.e., appropriate caribou habitat) and preferred caribou habitat. Upon arrival at the station coordinates, the general area was surveyed by the Golder biologist from the helicopter and on the ground to determine a location where caribou would be likely to feed. The final sampling sites were chosen within 1 km of the 2013 coordinates.

3.3.2 Data Collection

The field investigation was completed from 21 to 27 July 2016. The investigations were carried out by a biologist from Golder accompanied by a DDMI technical assistant. The weather during this sampling period was mainly cool, overcast and windy, with air temperatures ranging between 3 and 25 degrees Celsius during the day, with light rain/precipitation on four days, and a major rain event on 26 July 2016.

Once on the ground, signs of caribou use and which lichen species known to be consumed by caribou were documented. For each sample location, species of lichen collected, soil characteristics, and observations of caribou activity were recorded (Appendix E, Appendix F). Lichens previously identified by Elders as those that would potentially be consumed by caribou were observed and collected at every sample location; this includes the following species[2]:

- *Bryocaulon divergens* (northern foxhair lichen)
- *Cetraria* species
- *Cladonia* species
- *Cladonia mitis* (green reindeer lichen)
- *Cladonia rangiferina* (grey reindeer lichen)
- *Cladonia stellaris* (star-tipped reindeer lichen)
- *Cladonia stygia* (reindeer lichen)
- *Flavocetraria cucullata* (curled snow lichen)
- *Flavocetraria nivalis* (crinkled snow lichen)
- *Masonhalea richardsonii* (arctic tumbleweed lichen)
- *Stereocaulon tomentosumi* (woolly foam lichen)
- *Usnea* species (beard lichen)

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[2] In general, scientific nomenclature and common names followed naming conventions consistent with the NatureServe on-line database (NatureServe 2013).

Clean sampling protocols were implemented so that samples were not contaminated by external sources. Powderless nitrile gloves were used for all contact with lichens and soil. Titanium scissors were used to snip the upper leafy portion from several plants within the same location at each sample site to create a composite sample. Samples were collected in Ziploc bags and kept cool until they could be frozen and transported to the laboratory for analysis. All tools used in sampling were cleaned between sites by washing with detergent and rinsing with distilled water. New nitrile gloves were used at each sample plot. The samples collected at each plot were recorded, and each plot was photographed.

Lichen samples were not washed or otherwise cleaned of dust and soil prior to analysis. A cleaning step was not considered to be appropriate given that the purpose of the lichen monitoring program was to assess dust deposition on lichen and associated effects on caribou health. Caribou are also known to inadvertently ingest dust and soil while foraging. In addition, no statistical differences in metals concentrations were observed in comparisons of washed and unwashed lichen samples in 2010 (Golder 2011b).

Soil samples were collected from the top 15 cm of the soil layer at the same locations as lichen samples using a plastic (nylon) trowel. As with lichen samples, soil was collected in Ziploc bags and kept cool until it could be transported to the laboratory for analysis. The purpose of the soil sampling was to incorporate exposure from inadvertent ingestion of soil by caribou while grazing on lichens into a risk assessment, if deemed necessary.

Field duplicates of lichen and soil were collected to assess the variability in results within a sampling location. Seven lichen and soil duplicate samples were collected: four in the near-field area, two in the far-field area, and one in the far-far-field area. 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.

Lichen and soil samples were analyzed by Maxxam Analytics, Burnaby, British Columbia. Lichen samples were analyzed for percent moisture, total mercury by cold vapour atomic fluorescence spectroscopy (CVAFS), and total metals by inductively coupled plasma mass spectrometry (ICPMS). The metals analyzed by ICPMS were aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, cesium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, phosphorus, potassium, selenium, silver, sodium, strontium, tellurium, thallium, thorium, tin, titanium, uranium, vanadium, zinc, and zirconium. A sub-sample of each soil sample was analyzed for mercury because mercury in soil has a short holding time (14 days). The remaining soil sample was archived for possible future metals analysis if the results of the lichen analysis indicated higher concentrations than previously observed (i.e., an increasing trend in metals concentrations).

3.3.3 Data Analysis

3.3.3.1 Comparison of Near- and Far-Field Lichen Samples

Metals concentrations in lichen collected in 2016 were tabulated and summary statistics calculated for each area (e.g., mean, standard deviation, standard error, minimum and maximum concentrations). Mean concentrations of parameters measured in lichen from near-field and far-field areas were statistically and graphically compared to determine if metals concentrations were different between areas. Statistical analyses were completed using Systat 13.1 (Systat 2009). One half the detection limit (DL) was substituted for non-detect values in the dataset prior to data analyses. Data were examined for normality and samples were compared using two sample t-tests (normally-distributed data) or Mann-Whitney U tests (non-parametric test for data that were not normally distributed). Metals concentrations in lichen from the far-far-field were graphically compared to near-field and far-field values.

3.3.3.2 Comparison of 2016 Lichen Samples to Previous Years

The mean concentrations of parameters measured in lichen from the near-field area were statistically and graphically compared to determine if metals concentrations in the same area were different across 2010, 2013, and 2016. The metals concentration data collected in 2010 and 2013 are presented in Golder (2011b, 2014). The three near-field stations selected by the Elders in 2013 were excluded in the statistical and graphical analyses of current report as these near-field stations were noticeably different from other near-field stations using non-metric multi-dimensional scaling analysis (Golder 2014). One-way analysis of variance (ANOVA) using Systat 13.1 was used to compare metals concentrations in lichen samples collected in the near-field areas across years. Data were examined for normality and homoscedasticity. For those parameters that did not meet the statistical assumptions, Kruskal-Wallis tests (equivalent non-parametric test of one-way ANOVA) were used.

3.3.3.3 Comparison of Duplicate Samples

Duplicate lichen and soil samples were analyzed to assess sample homogeneity. The results obtained from the duplicate samples were used to calculate the relative percent difference (RPD) for each parameter. A lower RPD indicates higher sample homogeneity. An RPD was considered notable when it was 30% or greater and when the mean of the duplicates was greater than five times the DL. This second criterion takes into account the potential for data accuracy error when parameter concentrations approach detection limits. Relative percent difference (RPD) was calculated from the following formula:

$$RPD = \left(\frac{|sample - duplicate|}{mean}\right) \times 100$$

3.4 Results

3.4.1 Field Observations

In general, the field crew observed that the lichen in the near-field stations in close proximity to roads and the airstrip appeared in poorer health, which may be due to dust deposition. In comparison, the lichen and other vegetation in the far-field stations appeared healthier, and had no apparent signs of dust deposition. Based on field observations, both lichen cover and diversity also appeared higher at far-field sites with the exception of station NF15. This station had the highest density and diversity of lichen coverage, which may be due to its location on a small island in Lac de Gras, and associated higher moisture levels.

The Elders previously documented that caribou no longer used the near-field stations adjacent to the Mine or did not use them to the same extent prior to development of the Mine (Tłı̨chǫ Government 2013). In the 2016 field surveys, signs of caribou activity (e.g., tracks, fecal pellets, grazed lichens, or animal presence) were observed by the biologists at 11 near-field stations, although the age of these signs could not be confirmed (Table 3.3-1). A bull caribou was seen grazing in close proximity to the airstrip and sampling stations NF1 and NF10.

Table 3.3-1: Summary of Caribou Activity Observed at 2016 Sampling Stations

Sampling Area	Number of Stations with Observed Caribou Activity	Total Number of Stations	Percent of Total
Near-field	11	23	48%
Far-field	12	21	57%
Far-far-field	2	3	67%
Total	**25**	**57**	**44%**

In 2013, the far-field stations FF5, FF13, FF14, FF15, FF19, and FF21 were identified by Elders as no longer being of high use by caribou. Such areas were described as “sites not located on migration routes or on valuable forage areas” (Tłı̨chǫ Government 2013). Recent signs of caribou activity were observed at three of these stations (FF5, FF14 and FF15) in 2016. Recent caribou activity (e.g. animal sightings, fecal pellets and trails) was also observed at 12 of the far-field (57%) and 2 of the far-far field stations (Table 3.3-1).

3.4.2 Lichen Chemistry

Appendix G Table G-1 (near-field stations), Table G-2 (far-field stations), and Table G-3 (far-far-field stations) provides chemistry results by station and measured parameters for lichen samples.

Parameters with reported concentrations below DL in more than 60% of samples were not included in the analyses (Appendix H, Table H-1). Beryllium and tellurium were not detected in any lichen sample. Boron, silver, and tin were detected in less than 39% of the samples. Bismuth, lithium, and zirconium were detected infrequently in the far-field samples (0 to 33%) but frequently in the near-field samples (74 to 91%). However, detected concentrations of bismuth, boron, lithium, tin, and zirconium were within five times the detection limit, which is considered within the range of analytical uncertainty[3]. Thus, these parameters were not retained for further analysis.

Although several parameters were measured in lichen, the list of metals carried forward into the statistical analysis was limited to parameters that had the potential to be toxic to caribou or be present at high enough concentrations to cause toxicity. Parameters not retained for analysis were calcium, cesium, gallium, iron, lithium, magnesium, phosphorus, potassium, rhenium, rubidium, selenium, sodium, tellurium, thorium, yttrium, and zirconium. The 19 retained lichen chemistry parameters included:

- Aluminum
- Antimony
- Arsenic
- Barium
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Manganese
- Mercury
- Molybdenum
- Nickel
- Strontium
- Thallium
- Titanium
- Uranium
- Vanadium
- Zinc

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[3] Measured concentrations that are close to the analytical detection limit have a higher level of uncertainty. Acceptability criteria in water quality monitoring programs typically take into consideration this uncertainty, and relax the data quality objectives when reported values are close to the detection limit. For example, BC MWLAP (2003) assesses the acceptability of field duplicate results if at least one of the duplicate values is greater than five times the detection limit.

3.4.2.1 Comparison of Near-Field Area and Far-Field Area Lichen Samples from 2016

Mean (plus or minus [±] 1 standard error [SE]) metals concentrations in lichens collected from the near-field area were graphically compared to mean concentrations measured in the far-field area (Figures 3.3-1 to 3.3-4). For most parameters, mean metals concentrations were higher in the near-field area than in the far-field area. Metals concentrations of all assessed parameters in 2016 were confirmed to be statistically higher in the near-field area compared with the far-field area ($P \leq 0.05$) with the exception of arsenic, barium, cadmium, manganese, mercury, and zinc (Appendix H, Table H-1). In addition, mean (± 1SE) metals concentrations in lichens collected from the far-far-field area were graphically compared to mean concentrations measured in the far-field area (Figures 3.3-1 to 3.3-4). For all assessed parameters, mean metals concentrations in the far-far-field area were similar or higher compared to far-field area with the exception of antimony, lead, molybdenum, thallium, titanium, and vanadium.

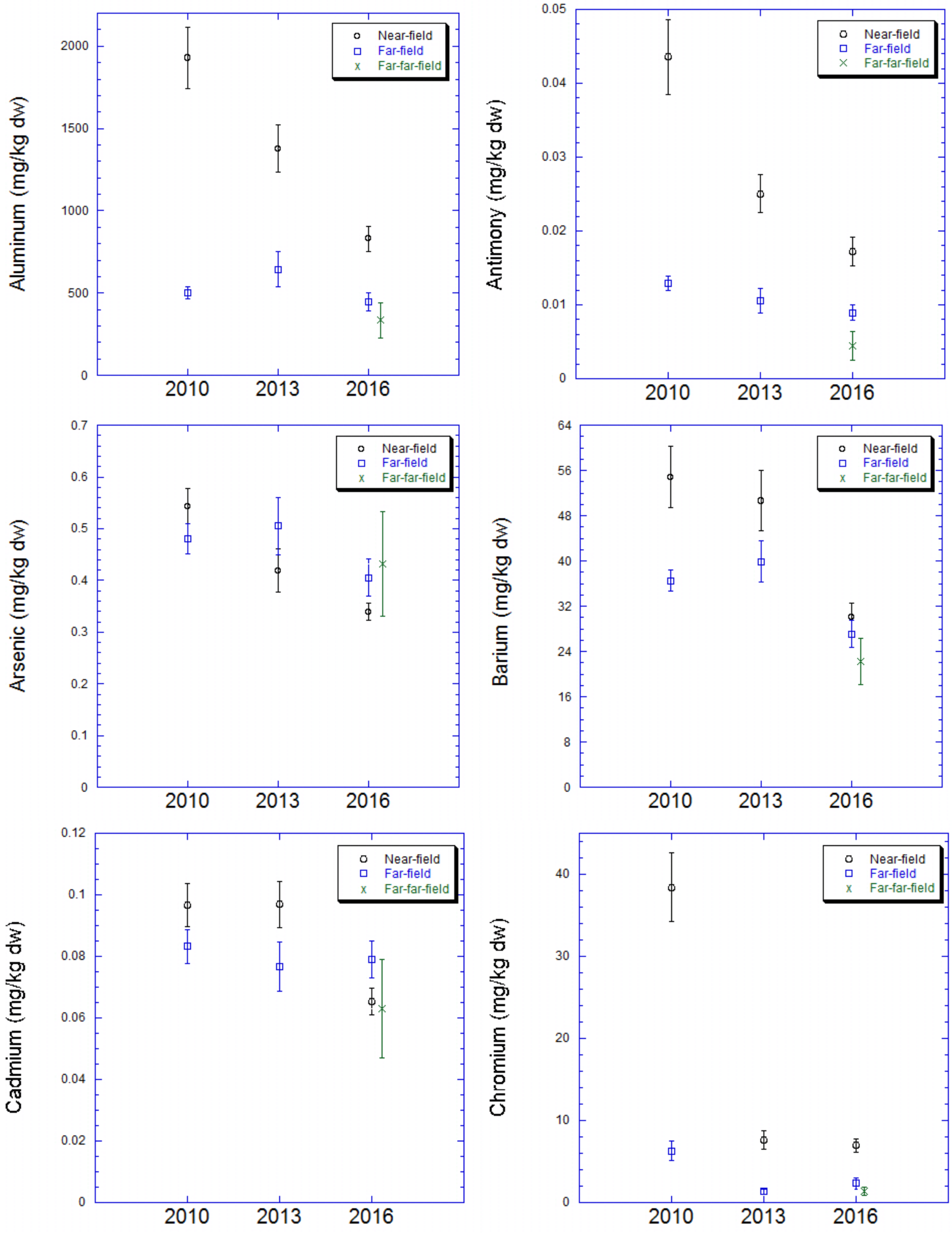

Figure 3.3-1: Mean (± 1SE) of Aluminum, Antimony, Arsenic, Barium, Cadmium, and Chromium in Lichen, 2010, 2013, and 2016

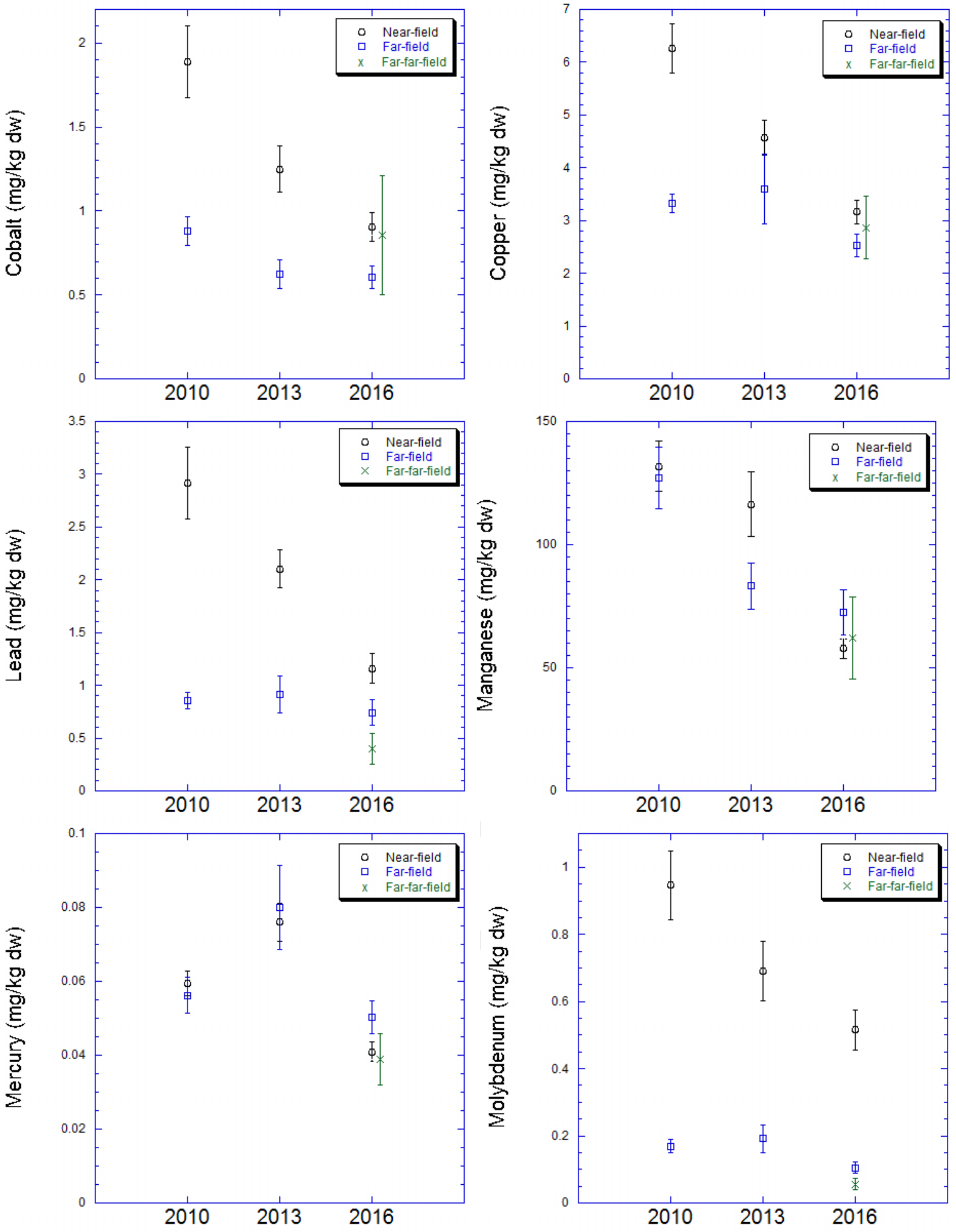

Figure 3.3-2: Mean (± 1SE) of Cobalt, Copper, Lead, Manganese, Mercury, and Molybdenum in Lichen, 2010, 2013, and 2016

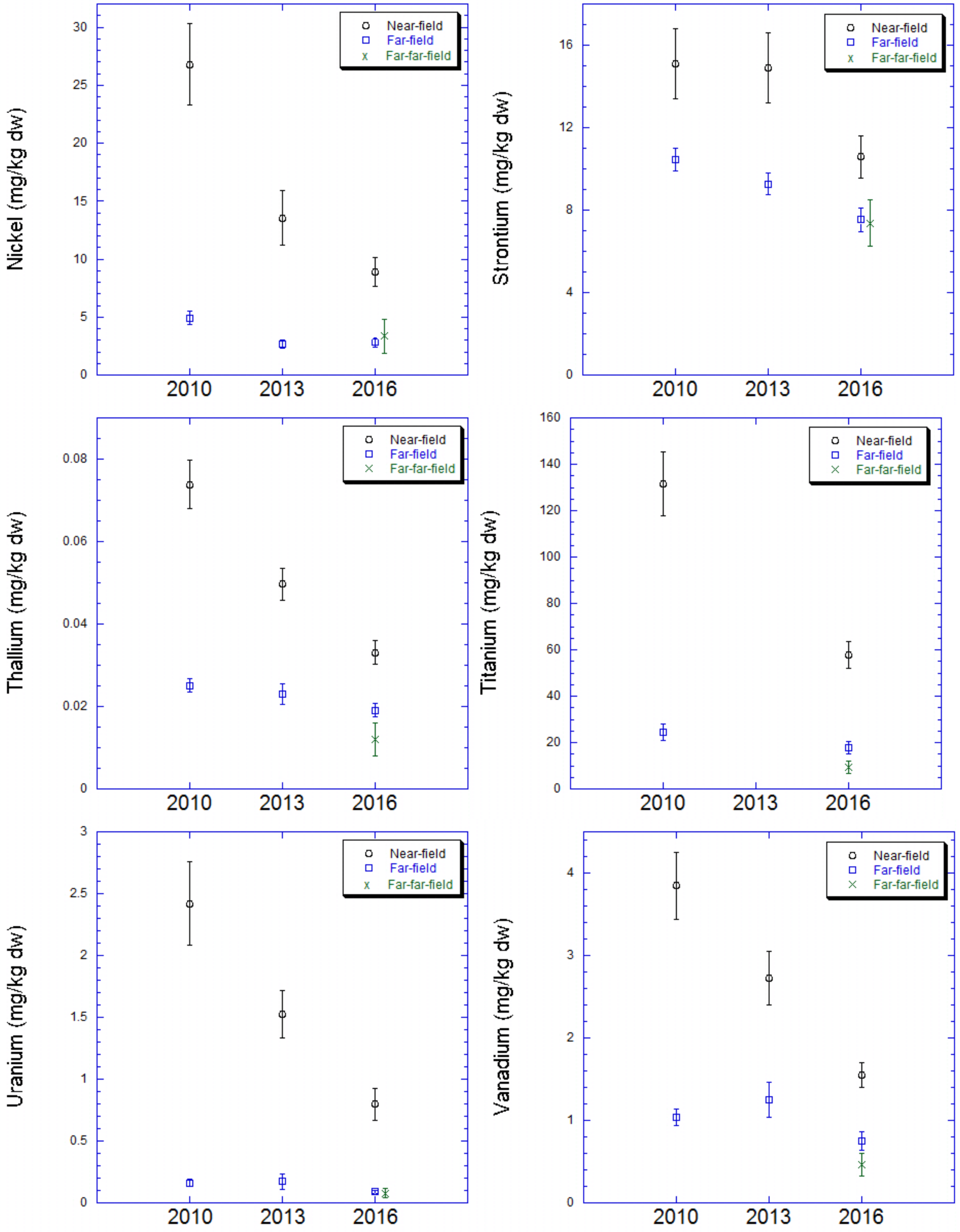

Figure 3.3-3: Mean (± 1SE) of Nickel, Strontium, Thallium, Titanium, Uranium, and Vanadium in Lichen, 2010, 2013, and 2016

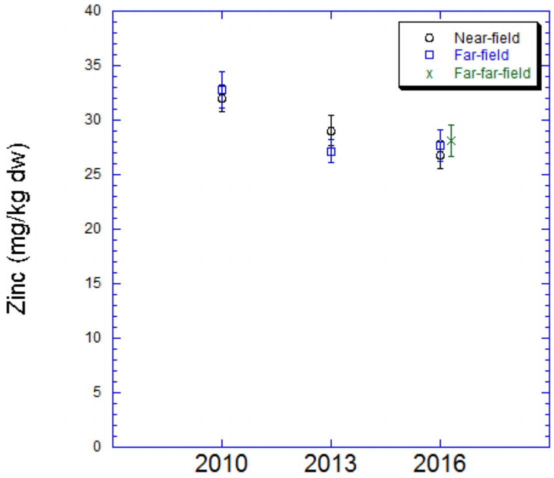

Figure 3.3-4: Mean (± 1SE) of Zinc in Lichen, 2010, 2013, and 2016

3.4.2.2 Comparison of Lichen Chemistry over Time

Mean metals concentrations in lichens in the near-field area were compared among years both graphically (Figures 3.3-1 to 3.3-4) and statistically (Appendix H, Table H-1). In lichen samples from the near-field area, most parameters (18 of 19) were measured at significantly (P≤0.05) lower concentrations in 2016 than in 2010 and/or 2013 (Table H-1).

3.4.2.3 Comparison of Duplicate Samples

The incidence of RPDs greater than 30% was generally high in the lichen duplicates, regardless of sampling areas. High variability among some duplicates was also observed in 2013 (Golder 2014).

3.4.3 Soil Chemistry

Appendix G, Table G-5 provides the mercury concentrations in soil samples collected with the lichen samples. These results are provided for future reference, but are not analyzed or discussed further in this report. As stated in Section 3.1, the purpose of the soil collection and analysis was to assess uptake of metals by caribou through incidental soil ingestion, which would be necessary if a new risk assessment was required.

3.5 Discussion

Lichen species are an important and preferred food source for caribou, along with willows, birch, sedges, grasses and mushrooms (Thomas 1998). Lichens are also good indicators of air quality as they absorb metals from fossil fuel and dust emissions. The input from the Elders during the 2013 field program remained valuable in 2016 for identifying specific sampling sites near the pre-selected near-field, far-field and far-far-field station locations (Tłı̨chǫ Government 2013). The Elders pointed out the lichen species that caribou prefer to eat and also commented on the lichen and vegetation conditions at the sampling sites, and how the dust from the Mine influences caribou use at the sites. Comments from the Elders on lichen and vegetation conditions near the Mine site reflect that they noticed dust on the lichen near the Mine, and they stated that this dust reduced the quality of the forage for caribou (Tłı̨chǫ Government 2013). The Elders also stated that the caribou will avoid using the area close to the Mine as their migration route because the caribou recognize the difference in lichen quality (by smell and taste). Science has also observed a potential link between total suspended particulates (which includes dust) near the Ekati and Diavik mines and local changes in abundance and distribution of caribou (Boulanger et al. 2012).

The lichen monitoring program provides data for testing the predictions associated with Key Questions in Table 1.2-1 (Section 1.2). During the 2016 sampling program, the field crew observed that the lichen in the near-field area in close proximity to roads and the airstrip appeared in poorer health, which may be due to dust deposition. In comparison, the lichen and other vegetation in the far-field stations were healthier and had no apparent signs of dust deposition. The statistical analysis of metals concentrations in lichen from the near-field area confirmed the observations of the Elders that dust deposition is higher near the Mine. Most of the assessed metals (13 of 19) were higher in lichens from the near-field area compared to the far-field area, which supports the predictions related to Key Questions 1 and 2 (Table 1.2-1).

Since 2012, all kimberlite extraction at the Mine has been completed using underground mining methods. This change in operations likely explains the decrease in dust deposition rates (Section 2.3.1) and the decreasing trend in metals concentrations observed in lichen from 2010 to 2016. Moreover, most assessed parameters (18 of 19) in the near-field area were significantly lower in 2016 compared to 2013 and/or 2010. This result does not support the prediction from Key Question 3 that metals concentrations in lichen would be similar over time (Table 1.2-1). Although, the analysis of all vegetation communities indicated that total lichen cover was higher on reference plots than mine plots, the difference was not statistically significant (Section 2.4). Lichen cover did not vary significantly over time on mine and reference plots. Lichen species richness was similar on mine and reference plots, but decreased significantly from 2013 to 2016 for all vegetation communities. Part of this decrease in species richness was likely associated with the exclusion of trace species from the 2016 observations (Section 2.4).

Analysis of split duplicates indicates that lichen samples collected at the same site can vary markedly in metals concentrations. Variability in metals concentrations among lichen samples at this small scale may be due to the composition of lichen species present in the sample (Naeth and Wilkinson 2006). However, the key objective of the monitoring program was to collect lichen that caribou eat to assess health risks, and not necessarily to obtain the same ratio of species in each sample. Importantly, given that statistically significant differences were observed for most metals between sampling areas and among years, the study design and sampling methods are sufficient for meeting the objectives of the monitoring program.

3.6 Recommendations

The lichen monitoring program was primarily designed to assess whether the predicted increased metals uptake by lichen near the Mine would pose a risk to the health of caribou. The 2010 risk assessment used conservative assumptions to estimate exposure and effects to caribou, such as assuming that the caribou would obtain all their food and water from the near-field area throughout the year (Golder 2011b). Despite these conservative assumptions, the risk estimates predicted no adverse effects to caribou health.

Analysis of lichen chemistry during 2013 showed that metals concentrations in the near-field (Mine site) area were higher than the far-field area; however, there was an apparent decreasing trend in metals concentrations near the Mine (Golder 2014). The analysis provided during the third cycle of this program provides further support for this decreasing trend as most of the metals examined were statistically lower in 2016 than in 2013 and/or 2010. Also, most metals concentrations in the far-far-field sampling area were similar to concentrations in the far-field sampling area, indicating that the far-field area provided a sufficient reference for testing conditions near the Mine site.

Given that the majority of metals concentrations have decreased below concentrations reported in the 2010 risk assessment, a follow up risk assessment based on 2016 data is not required. Metals concentrations are predicted to be within safe levels for caribou (as predicted from Key Question 4; Table 1.2-1), and should remain within safe levels into the future. Based on the principles of adaptive management, it is recommended that the sampling frequency for this study be reduced to once every 5 years to coincide with the suggested change in the vegetation monitoring program. Sampling frequency may resume on a 3-year cycle if dust deposition values exceed the upper 95% confidence interval for dustfall values on mine plots during the period of underground mining (approximately 400 mg/dm^2/y; Figure 2.3-1).

4.0 CLOSURE

We trust that the factual information provided in this report is sufficient for your present needs. Should you have any questions regarding the above information or require additional information please contact the undersigned.

GOLDER ASSOCIATES LTD.

Jaewoo Kim, MSc, PhD Aquatic Biostatistician	Kerrie Serben, MSc Environmental Scientist
Chris Shapka, BSs Ecologist	John Virgl, PhD Principal, Senior Ecologist

KS/JK/MP/JV/kpl/jc/cmm

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APPENDIX A

List of Permanent Vegetation Plots Sampled from 2001 to 2016

APPENDIX A
List of Permanent Vegetation Plots Sampled from 2001 to 2016

Table A 1: Summary of Plot Number, Location, and Years Sampled

PVP Number	Plot Type	Vegetation Type	UTM Zone	Easting	Northing	Year Established	Year Sampled						
							2001	2004	2006	2008	2010	2013	2016
PVP01	Mine	Heath Tundra	12W	533933	7154277	2001	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PVP02	Mine	Heath Tundra	12W	533955	7154320	2001	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PVP03	Mine	Tussock-Hummock	12W	534019	7154476	2001	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PVP04a[(a)]	Mine	Heath Tundra	12W	n/a	n/a	2001	Yes	Yes	No	No	No	No	No
PVP05a[(a)]	Mine	Heath Tundra	12W	n/a	n/a	2001	Yes	Yes	No	No	No	No	No
PVP06a[(a)]	Mine	Heath Tundra	12W	n/a	n/a	2001	Yes	Yes	No	No	No	No	No
PVP04[(b)]	Mine	Tussock-Hummock	12W	531572	7152032	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP05[(b)]	Mine	Shrub	12W	531450	7152017	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP06[(b)]	Mine	Heath Tundra	12W	531454	7151954	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP07	Mine	Tussock-Hummock	12W	535039	7151919	2001	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PVP08[(c)]	Mine	Esker	12W	n/a	n/a	2001	Yes	Yes	Yes	Yes	No	No	No
PVP09a[(a)]	Mine	Tussock-Hummock	12W	n/a	n/a	2001	Yes	Yes	No	No	No	No	No
PVP09[(b)]	Mine	Shrub	12W	531543	7151831	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP10[(b)]	Mine	Shrub	12W	532982	7150215	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP11 (PVP10a)	Reference	Heath Tundra	12W	534937	7145517	2001	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PVP12	Reference	Tussock-Hummock	12W	535033	7145453	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP13	Reference	Shrub	12W	535076	7145613	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP14	Reference	Heath Tundra	12W	526342	7154475	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP15	Reference	Tussock-Hummock	12W	526477	7154564	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP16	Reference	Shrub	12W	526578	7154638	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP17	Reference	Heath Tundra	12W	541029	7152048	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP18	Reference	Tussock-Hummock	12W	541123	7152116	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP19	Reference	Shrub	12W	541182	7152084	2006	No	No	Yes	Yes	Yes	Yes	Yes
PVP20	Mine	Tussock-Hummock	12W	532096	7151695	2008	No	No	No	Yes	Yes	Yes	Yes
PVP21	Mine	Heath Tundra	12W	531972	7151655	2008	No	No	No	Yes	Yes	Yes	Yes
PVP22	Mine	Shrub	12W	531843	7151611	2008	No	No	No	Yes	Yes	Yes	Yes
PVP23	Mine	Shrub	12W	531664	7151649	2008	No	No	No	Yes	Yes	Yes	Yes
PVP24	Mine	Tussock-Hummock	12W	532528	7153617	2008	No	No	No	Yes	Yes	Yes	Yes
PVP25	Reference	Tussock-Hummock	12W	526526	7154653	2008	No	No	No	Yes	Yes	Yes	Yes
PVP26	Reference	Heath Tundra	12W	535118	7145272	2008	No	No	No	Yes	Yes	Yes	Yes
PVP27	Reference	Shrub	12W	535067	7145232	2008	No	No	No	Yes	Yes	Yes	Yes
PVP28	Reference	Tussock-Hummock	12W	535113	7145348	2008	No	No	No	Yes	Yes	Yes	Yes
PVP29	Reference	Shrub	12W	540977	7152066	2008	No	No	No	Yes	Yes	Yes	Yes
PVP30	Reference	Heath Tundra	12W	541027	7152077	2008	No	No	No	Yes	Yes	Yes	Yes
PVP31	Mine	Heath Tundra	12W	532743	7153642	2008	No	No	No	Yes	Yes	Yes	Yes

a) Plot lost due to site expansion between 2004 and 2006; no UTM coordinates are available for these sites.

b) New plots established in 2006 to replace plots lost due to site expansion.

c) Plot not surveyed in 2013 onwards due to site location being an Esker.

PVP = permanent vegetation plots; UTM = Universal Transverse Mercator; n/a = not applicable.

APPENDIX B

Summary of 2016 Plot Data

Table B-1: Mean Percent Cover by Species in Mine Permanent Vegetation Plots, 2016

Scientific Name	Common Name	Shrub					Heath Tundra					Tussock-Hummock				
		PVP05	PVP09	PVP10	PVP22	PVP23	PVP01	PVP02	PVP06	PVP21	PVP31	PVP03	PVP04	PVP07	PVP20	PVP24
Shrub																
Andromeda polifolia	bog rosemary	0	0	0	0	0	0	0	0	0	0	0	4	11	<1	<1
Arctostaphylos rubra	alpine bearberry	0	6	11	6	0	13	4	0	2	19	3	0	0	8	0
Betula glandulosa	bog birch	23	31	59	35	65	13	13	1	16	6	7	12	9	21	20
Empetrum nigrum	crowberry	<1	7	9	17	7	8	8	<1	11	12	3	<1	<1	2	0
Ledum palustre ssp. *decumbens*	northern Labrador tea	44	16	10	4	5	5	7	48	4	12	21	4	3	23	20
Loiseleuria procumbens	alpine azalea	0	0	0	0	<1	16	5	0	6	0	0	0	0	0	0
Salix glauca	smooth willow	0	0	0	0	0	5	0	0	0	0	0	<1	0	0	0
Salix planifolia	flat-leaved willow	0	0	0	16	0	0	0	0	5	0	0	0	0	0	0
Salix sp.	willow species	0	0	0	0	10	1	6	0	0	0	0	<1	<1	0	0
Salix sp. 2	willow species	0	0	0	0	5	0	4	0	0	0	0	1	0	0	0
Vaccinium oxycoccus	small bog cranberry	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Vaccinium uliginosum	bog bilberry	11	14	8	6	18	2	<1	5	5	1	0	3	3	9	1
Vaccinium vitis-idaea	bog cranberry	29	40	5	42	4	11	6	25	15	7	10	11	0	15	15
Forb																
Astragalus agrestis	purple mlikvetch	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0
Astragalus alpinus	alpine milk vetch	0	0	0	0	0	9	4	0	0	0	0	0	0	0	0
Oxytropis maydelliana	Maydell's locoweed	0	0	0	0	0	3	11	0	0	0	0	0	0	0	0
Pedicularis labradorica	Labrador lousewort	0	0	0	0	0	<1	0	0	0	0	0	0	<1	0	0
Pedicularis lapponica	lappland lousewort	0	0	0	0	0	<1	0	0	0	0	1	0	<1	<1	<1
Rubus chamaemorus	cloudberry	3	3	0	0	1	0	0	3	1	0	0	4	0	<1	2
Tofieldia pusilla	dwarf false asphodel	0	0	0	0	0	1	1	0	0	0	0	0	<1	0	0
Graminoid																
Anthoxanthum monticola	alpine sweet grass	0	0	<1	<1	0	0	0	0	0	<1	0	0	0	0	0
Calamagrostis stricata spp. inexpansa	northern reed grass	2	1	0	1	2	0	<1	0	0	0	0	0	0	<1	0
Carex aquatilis	water sedge	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0
Carex aquatilis var. *aquatilis*	water sedge	3	0	2	<1	<1	0	0	0	0	0	<1	0	<1	0	0
Carex aquatilis var. *stans*	water sedge	<1	0	0	2	0	1	1	<1	2	<1	0	0	1	0	0
Carex sartwellii	Sartwell's sedge	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0
Carex saxatilis	rocky-ground sedge	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Carex sp.	sedge species	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0
Carex sp. 1	sedge species	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0
Eleocharis palustris	creeping spike-rush	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0
Eleocharis quinqueflora	few-flowered spike-rush	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Eriophorum sp.	cottongrass species	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0
Eriophorum vaginatum	sheathed cotton grass	0	0	0	0	0	0	0	1	0	0	7	5	0	5	7
Scirpus microcarpus	small-fruited bulrush	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0

Table B-1: Mean Percent Cover by Species in Mine Permanent Vegetation Plots, 2016

Scientific Name	Common Name	Shrub					Heath Tundra					Tussock-Hummock				
		PVP05	PVP09	PVP10	PVP22	PVP23	PVP01	PVP02	PVP06	PVP21	PVP31	PVP03	PVP04	PVP07	PVP20	PVP24
Bryophyte																
Anastrophyllum michauxii	liverwort	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0
Anastrophyllum minutum	liverwort	0	0	0	<1	0	<1	<1	<1	0	0	0	0	0	0	0
Aulacomnium palustre	tufted moss	0	2	0	0	0	0	7	0	5	<1	7	3	1	13	3
Aulacomnium turgidum	turgid moss	4	0	0	0	0	3	0	1	0	0	0	1	0	0	0
Bryum pseudotriquetrum	moss	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0
Calliergon stramineum	calliergon moss	0	<1	0	0	0	0	0	0	0	0	0	<1	0	0	0
Calypogeia sphagnicola	liverwort	0	<1	0	0	0	0	0	0	0	0	0	0	0	0	0
Cephalozia sp.	liverwort species	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0
Cephaloziella rubella	liverwort	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Cladopodiella fluitans	liverwort	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicranum acutifolium	cushion moss	0	0	0	0	0	0	0	0	5	0	0	0	0	0	<1
Dicranum elongatum	long forked moss	0	2	0	1	0	6	4	1	0	0	0	0	0	0	<1
Dicranum fuscescens	fuscous moss	0	0	<1	0	0	0	0	0	0	0	1	0	4	0	0
Dicranum scoparium	broom moss	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0
Dicranum sp.	dicranum moss species	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0
Dicranum spadiceum	cushion moss	0	9	0	0	0	0	0	0	0	0	0	3	0	0	0
Dicranum undulatum	wavy dicranum moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptobryum pyriforme	moss	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Loeskypnum badium	moss	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0
Lophozia binsteadii	liverwort	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Lophozia kunzeana	liverwort	<1	0	0	0	0	0	0	0	0	0	<1	0	0	0	0
Lophozia ventricosa	liverwort	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	<1
n/a	moss species 1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Odontoschisma sp.	flapwort species	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleurozium schreberi	Schreber's moss	0	0	0	0	0	0	0	0	0	0	<1	0	0	1	0
Pohlia nutans	copper wire moss	0	<1	0	0	0	0	0	0	0	0	0	<1	0	0	<1
Polytrichum commune	common hair-cap moss	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0
Polytrichum jensenii	Jensen's haircap moss	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Polytrichum juniperinum	juniper hair-cap moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Polytrichum strictum	slender hair-cap moss	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Ptilidium ciliare	liverwort	0	1	1	0	0	0	0	0	0	0	0	<1	0	1	0
Sanionia uncinata	brown moss	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0
Sphagnum balticum	peat moss	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphagnum capillifolium	acute-leaved peat moss	<1	0	0	0	0	0	0	0	0	0	0	31	0	0	10
Sphagnum compactum	neat bog moss	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Sphagnum fuscum	rusty peat moss	2	5	0	0	0	0	0	8	0	0	39	0	6	4	0
Sphagnum magellanicum	midway peat moss	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0

Table B-1: Mean Percent Cover by Species in Mine Permanent Vegetation Plots, 2016

Scientific Name	Common Name	Shrub					Heath Tundra					Tussock-Hummock				
		PVP05	PVP09	PVP10	PVP22	PVP23	PVP01	PVP02	PVP06	PVP21	PVP31	PVP03	PVP04	PVP07	PVP20	PVP24
Sphagnum sp.	peat moss	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0
Sphagnum sp. 1	peat moss	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Warnstorfia exannulata	brown moss	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Lichen																
Alectoria ochroleuca	green witch's hair lichen	0	0	0	0	0	0	<1	0	<1	<1	0	0	0	0	0
Arctoparmelia centrifuga	concentric ring lichen	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0
Bryocaulon divergens	northern foxhair lichen	0	0	0	1	0	0	<1	<1	<1	8	0	0	0	0	0
Bryoria nitidula	tundra horsehair lichen	0	0	0	<1	0	<1	0	0	10	0	0	0	0	0	0
Cetraria delisei	snowbed Iceland lichen	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0
Cetraria ericetorum	Iceland lichen	0	0	0	0	0	0	<1	0	<1	0	0	0	0	0	0
Cetraria fastigata	greater ruffed Iceland lichen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Cetraria islandica ssp. *crispiformis*	curly Iceland lichen	0	0	0	0	0	0	0	1	0	0	0	<1	0	0	<1
Cetraria laevigata	striped Iceland lichen	0	<1	0	0	0	0	0	<1	<1	0	0	0	0	0	0
Cetrariella commixta	intermingled camouflage lichen	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0
Cladonia amaurocraea	quill pixie lichen	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	<1
Cladonia botrytes	wooden soldiers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Cladonia carneola	crowned pixie-cup	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0
Cladonia chlorophaea	mealy pixie-cup lichen	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0
Cladonia deformis	lesser sulphur-cap lichen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Cladonia furcata	many-forked cladonia lichen	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0
Cladonia gracilis ssp. *elongata*	black-footed pixie lichen	<1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cladonia mitis	reindeer lichen	0	0	0	<1	0	<1	<1	1	<1	0	0	<1	0	0	<1
Cladonia pleurota	red-fruited pixie-cup lichen	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0
Cladonia rangiferina	reindeer lichen	<1	<1	<1	0	0	0	<1	6	<1	2	0	0	0	<1	<1
Cladonia sp.	cup lichen species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Cladonia stygia	reindeer lichen	<1	0	<1	0	0	0	0	0	0	3	0	<1	0	0	4
Cladonia uncialis	thorn cladonia lichen	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0
Cladonia wainioi	lichen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Dactylina arctica	arctic finger lichen	0	0	0	0	0	<1	<1	0	<1	<1	0	0	0	0	0
Flavocetraria cucullata	curled snow lichen	<1	0	0	0	0	0	<1	0	<1	0	0	<1	0	0	<1
Flavocetraria nivalis	crinkled snow lichen	<1	<1	<1	<1	0	4	6	1	10	14	0	<1	0	0	0
Gowardia nigricans	witch's hair lichen	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0
Masonhalea richardsonii	arctic tumbleweed lichen	0	0	0	0	0	<1	<1	0	0	<1	0	0	0	0	0
n/a	rock lichen	0	<1	0	11	0	<1	<1	0	1	0	0	10	0	0	0
Nephroma arcticum	arctic kidney lichen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Parmelia imbricaria	lichen	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Parmelia omphalodes	unsalted shield lichen	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Peltigera aphthosa	studded leather lichen	0	0	0	0	0	<1	0	0	<1	0	0	0	0	0	0

Table B-1: Mean Percent Cover by Species in Mine Permanent Vegetation Plots, 2016

Scientific Name	Common Name	Shrub					Heath Tundra					Tussock-Hummock				
		PVP05	PVP09	PVP10	PVP22	PVP23	PVP01	PVP02	PVP06	PVP21	PVP31	PVP03	PVP04	PVP07	PVP20	PVP24
Peltigera malacea	veinless pelt lichen	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Peltigera rufescens	field dog lichen	0	0	0	0	0	<1	0	0	0	0	0	0	0	0	0
Peltigera scabrosa	scabby pelt lichen	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Peltigera sp.	felt lichen species	<1	0	0	<1	0	<1	0	0	<1	0	0	0	0	0	0
Sphaerophorus globosus	coral lichen	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0
Stereocaulon paschale	common foam lichen	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0
Stereocaulon tomentosum	woolly foam lichen	0	0	<1	0	0	5	0	<1	<1	0	0	0	0	0	0
Thamnolia vermicularis	whiteworm lichen	0	0	0	0	0	<1	<1	0	<1	0	0	0	0	0	0
Ground Cover																
Bare Ground		0	0	<1	0	0	<1	<1	0	0	0	0	0	0	0	0
Fungi		0	<1	<1	0	0	0	0	0	0	0	0	0	<1	0	0
Terricolous (soil) Lichen		<1	1	<1	<1	0	7	13	11	23	29	<1	1	6	<1	5
Litter		9	11	10	11	6	6	5	6	12	9	12	12	28	12	25
Moss		8	11	1	<1	<1	10	12	5	9	<1	45	48	17	19	21
Animal Pellets		0	0	0	0	0	<1	<1	<1	0	<1	0	<1	<1	0	0
Rock		0	2	0	3	<1	<1	<1	0	<1	0	0	9	0	0	0
Saxicolous (rock) Lichen		0	1	0	6	<1	<1	<1	0	1	0	0	3	0	0	0
Total Vegetation		82	75	91	80	94	77	72	80	57	62	44	28	48	69	49
Water		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Means are rounded to the nearest whole number for presentation purposes; <1 indicates species present but with low cover.

Table B-2: Mean Percent Cover by Species in Reference Permanent Vegetation Plots, 2016

Scientific Name	Common Name	Shrub					Heath Tundra					Tussock-Hummock				
		PVP13	PVP16	PVP19	PVP27	PVP29	PVP11	PVP14	PVP17	PVP26	PVP30	PVP12	PVP15	PVP18	PVP25	PVP28
Shrub																
Andromeda polifolia	bog rosemary	<1	0	0	0	0	0	0	0	0	0	9	1	<1	0	2
Arctostaphylos rubra	alpine bearberry	0	2	17	0	9	17	0	4	3	15	12	0	0	13	0
Betula glandulosa	bog birch	17	72	46	60	60	16	12	9	14	5	9	<1	2	2	9
Empetrum nigrum	crowberry	3	12	2	<1	6	9	12	10	12	10	2	<1	2	17	2
Ledum palustre ssp. *decumbens*	northern Labrador tea	29	6	3	3	4	10	15	8	2	9	9	1	3	9	6
Loiseleuria procumbens	alpine azalea	0	0	0	0	0	0	2	9	4	5	0	0	0	0	0
Salix fuscescens	Alaska bog willow	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Salix glauca	smooth willow	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
Salix planifolia	flat-leaved willow	0	0	<1	0	0	0	0	0	1	0	0	0	0	0	0
Salix sp.	willow species	0	0	0	0	0	0	0	0	2	0	<1	0	0	0	0
Vaccinium oxycoccus	small bog cranberry	<1	0	0	0	0	0	0	0	0	0	0	2	<1	0	0
Vaccinium uliginosum	bog bilberry	4	4	2	2	4	0	11	<1	1	<1	8	6	<1	15	4
Vaccinium vitis-idaea	bog cranberry	20	30	11	2	23	21	19	1	5	5	13	<1	2	8	5
Forb																
Astragalus agrestis	purple mlikvetch	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
Equisetum arvense	common horsetail	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0
Oxytropis maydelliana	Maydell's locoweed	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
Pedicularis labradorica	Labrador lousewort	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pedicularis lapponica	lappland lousewort	0	0	0	0	0	0	0	0	0	0	<1	0	<1	0	<1
Pinguicula villosa	small butterwort	0	0	0	0	0	0	0	0	0	0	0	0	<1	<1	0
Rubus chamaemorus	cloudberry	<1	0	0	0	0	0	<1	0	0	0	16	<1	1	1	2
Stellaria sp.	chickweed species	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
Tofieldia pusilla	dwarf false asphodel	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0
Graminoid																
Anthoxanthum monticola	alpine sweet grass	0	0	<1	0	<1	0	0	0	0	0	0	0	0	0	0
Carex aquatilis	water sedge	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Carex aquatilis var. *aquatilis*	water sedge	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0
Carex aquatilis var. *stans*	water sedge	0	0	0	0	0	0	<1	0	<1	0	0	0	0	0	0
Carex sartwellii	Sartwell's sedge	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Carex saxatilis	rocky-ground sedge	0	0	0	0	0	0	0	0	0	0	0	12	0	0	<1
Carex sp.	sedge species	<1	0	0	<1	0	0	0	0	0	0	0	0	1	0	0
Carex sp. 2	sedge species	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Eriophorum vaginatum	sheathed cotton grass	0	0	0	0	0	0	0	0	0	0	<1	5	6	9	22
n/a	grass species	1	<1	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryophyte																
Anastrophyllum minutum	liverwort	0	0	<1	0	1	0	0	0	<1	<1	0	0	0	0	0
Aulacomnium palustre	tufted moss	0	<1	0	0	0	0	0	0	0	0	0	<1	<1	<1	<1

Table B-2: Mean Percent Cover by Species in Reference Permanent Vegetation Plots, 2016

Scientific Name	Common Name	Shrub					Heath Tundra					Tussock-Hummock				
		PVP13	PVP16	PVP19	PVP27	PVP29	PVP11	PVP14	PVP17	PVP26	PVP30	PVP12	PVP15	PVP18	PVP25	PVP28
Aulacomnium turgidum	turgid moss	<1	0	13	0	3	0	0	0	0	0	2	0	2	0	2
Bryum pseudotriquetrum	moss	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Calliergon stramineum	calliergon moss	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	0
Cephalozia lacinulata	liverwort	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Cephalozia pleniceps	liverwort	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Cephaloziella rubella	liverwort	0	0	0	0	0	0	0	0	0	0	<1	0	0	0	0
Cladopodiella fluitans	liverwort	3	0	0	0	0	0	0	0	0	0	<1	1	0	0	<1
Dicranum acutifolium	cushion moss	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0
Dicranum elongatum	long forked moss	0	0	1	0	0	0	0	0	0	0	2	0	2	0	4
Dicranum fuscescens	fuscous moss	0	0	2	9	6	0	<1	0	0	0	0	0	0	0	0
Dicranum scoparium	broom moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Dicranum sp.	dicranum moss species	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0
Dicranum spadiceum	cushion moss	0	0	0	0	0	0	0	0	2	0	1	0	1	0	0
Dicranum undulatum	wavy dicranum moss	0	0	0	0	0	2	0	0	0	0	0	0	4	0	0
Hylocomium splendens	stair-step moss	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Lophozia binsteadii	liverwort	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Lophozia cavifolia	liverwort	0	0	0	0	0	0	0	0	0	0	0	0	<1	0	0
Lophozia ventricosa	liverwort	0	0	0	<1	<1	0	0	0	0	0	0	0	0	0	<1
n/a	moss species 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Pohlia nutans	copper wire moss	0	0	0	<1	0	0	0	0	0	0	0	0	0	<1	0
Polytrichum commune	common hair-cap moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Polytrichum strictum	slender hair-cap moss	0	0	0	1	1	0	0	<1	0	0	<1	0	2	<1	0
Ptilidium ciliare	liverwort	0	0	0	3	0	2	0	0	1	0	0	0	0	1	3
Rhytidium rugosum	pipecleaner moss	0	0	7	0	3	0	0	0	0	0	0	0	0	0	0
Scapania irrigua	liverwort	0	0	0	0	0	0	0	0	0	0	0	<1	0	0	<1
Sphagnum angustifolium	peat moss	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sphagnum balticum	peat moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Sphagnum capillifolium	acute-leaved peat moss	0	<1	0	0	0	0	0	0	0	0	0	<1	0	0	<1
Sphagnum compactum	neat bog moss	0	0	0	0	0	0	0	0	0	0	1	0	10	0	1
Sphagnum fuscum	rusty peat moss	11	0	0	0	0	0	0	0	0	0	48	6	37	24	10
Sphagnum lindbergii	Lindberg's bog moss	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0
Sphagnum magellanicum	midway peat moss	2	0	0	0	0	0	0	0	0	0	0	24	0	0	0
Sphagnum platyphyllum	peat moss	0	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Sphagnum russowii	wide-tongued peat moss	0	0	0	0	0	0	0	0	0	0	0	<1	0	9	0
Sphagnum sp. 2	peat moss	0	0	0	0	0	0	0	0	0	0	0	34	0	0	0
Sphagnum teres	thin-leafed peat moss	0	0	0	0	0	0	0	0	0	0	4	<1	0	0	0
Warnstorfia exannulata	brown moss	0	0	0	0	0	0	0	0	0	0	<1	2	0	0	2

Table B-2: Mean Percent Cover by Species in Reference Permanent Vegetation Plots, 2016

Scientific Name	Common Name	Shrub					Heath Tundra					Tussock-Hummock				
		PVP13	PVP16	PVP19	PVP27	PVP29	PVP11	PVP14	PVP17	PVP26	PVP30	PVP12	PVP15	PVP18	PVP25	PVP28
Lichen																
Alectoria ochroleuca	green witch's hair lichen	0	0	0	0	0	0	<1	<1	<1	<1	0	0	0	0	0
Arctoparmelia separata	ring lichen	0	0	0	0	0	0	<1	1	0	3	0	0	0	0	0
Bryocaulon divergens	northern foxhair lichen	0	0	6	0	0	6	5	<1	18	<1	0	0	0	0	0
Bryoria nitidula	tundra horsehair lichen	0	0	<1	0	0	0	0	<1	0	<1	0	0	0	0	0
Cetraria andrejevii	Andrejev's Iceland lichen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Cetraria delisei	snowbed Iceland lichen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Cetraria ericetorum	Iceland lichen	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0
Cetraria islandica ssp. *crispiformis*	curly Iceland lichen	0	0	0	0	0	0	0	0	<1	<1	0	0	0	0	0
Cetraria laevigata	striped Iceland lichen	1	0	0	3	<1	0	0	0	0	0	0	0	0	0	0
Cetraria nigricans	blackened Iceland lichen	0	0	0	0	0	0	<1	0	0	<1	0	0	0	0	0
Cladonia amaurocraea	quill pixie lichen	0	0	<1	<1	0	0	<1	<1	0	0	0	0	0	0	0
Cladonia borealis	boreal pixie-cup	0	0	<1	<1	0	0	<1	<1	<1	0	0	0	0	0	0
Cladonia carneola	crowned pixie-cup	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0
Cladonia cenotea	powdered funnel lichen	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Cladonia cervicornis	ladder lichen	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0
Cladonia chlorophaea	mealy pixie-cup lichen	0	0	<1	0	0	0	0	<1	0	0	0	0	0	0	0
Cladonia crispata	organ-pipe lichen	0	0	0	<1	0	0	<1	0	0	0	0	0	0	0	0
Cladonia deformis	lesser sulphur-cap lichen	0	0	0	0	0	0	<1	0	0	0	0	0	0	0	0
Cladonia gracilis ssp. *elongata*	black-footed pixie lichen	0	<1	0	<1	0	0	0	0	<1	0	0	0	0	0	0
Cladonia macrophylla	cladonia lichen	0	0	0	<1	0	0	<1	0	0	0	0	0	0	0	0
Cladonia metacorallifera	cladonia lichen	0	0	0	0	0	0	0	0	0	<1	0	0	0	0	0
Cladonia mitis	reindeer lichen	2	0	0	4	0	0	2	0	<1	<1	0	0	0	<1	<1
Cladonia phyllophora	felt cladonia lichen	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
Cladonia pleurota	red-fruited pixie-cup lichen	0	0	0	<1	0	0	<1	<1	0	<1	0	0	0	0	0
Cladonia pyxidata	pebbled pixie-cup lichen	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0
Cladonia rangiferina	reindeer lichen	1	0	0	5	<1	2	6	<1	2	3	1	0	2	<1	7
Cladonia sp.	cup lichen species	0	0	0	0	<1	0	0	<1	0	0	0	0	1	0	0
Cladonia squamosa	dragon cladonia lichen	0	0	0	<1	0	0	<1	0	<1	0	0	0	0	0	0
Cladonia stricta	cladonia lichen	0	0	0	<1	0	0	0	0	0	<1	0	0	0	0	0
Cladonia stygia	reindeer lichen	<1	0	0	8	0	2	2	<1	2	1	1	0	4	0	8
Cladonia subfurcata	cladonia lichen	0	0	0	0	0	0	0	0	<1	0	0	0	0	0	0
Cladonia uncialis	thorn cladonia lichen	0	0	0	<1	0	0	0	0	0	0	0	0	0	0	0
Cladonia wainioi	lichen	0	0	0	<1	0	0	<1	0	<1	<1	0	0	0	0	0
Dactylina arctica	arctic finger lichen	<1	0	0	0	<1	0	0	0	0	0	<1	0	0	<1	0
Flavocetraria cucullata	curled snow lichen	3	0	5	2	1	10	8	2	15	17	2	0	0	<1	3
Flavocetraria nivalis	crinkled snow lichen	<1	0	2	7	<1	2	6	12	6	19	<1	0	10	6	0
Gowardia nigricans	witch's hair lichen	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Table B-2: Mean Percent Cover by Species in Reference Permanent Vegetation Plots, 2016

Scientific Name	Common Name	Shrub					Heath Tundra					Tussock-Hummock				
		PVP13	PVP16	PVP19	PVP27	PVP29	PVP11	PVP14	PVP17	PVP26	PVP30	PVP12	PVP15	PVP18	PVP25	PVP28
Masonhalea richardsonii	arctic tumbleweed lichen	0	0	<1	<1	0	<1	2	<1	0	<1	0	0	1	0	0
n/a	rock lichen	0	0	0	3	0	0	6	1	0	0	0	0	0	0	0
Parmelia fraudans	pea-green shield lichen	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
Parmelia omphalodes	unsalted shield lichen	0	0	<1	0	0	0	<1	0	0	0	0	0	0	0	0
Parmelia saxatilis	salted shield lichen	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
Peltigera aphthosa	studded leather lichen	0	0	<1	0	0	0	0	0	0	0	0	0	0	0	0
Peltigera conspersa	felt lichen	0	0	0	0	0	0	0	<1	0	0	0	0	0	0	0
Peltigera occidentalis	felt lichen	0	0	0	0	0	0	0	0	0	0	0	0	0	<1	0
Peltigera sp.	felt lichen species	0	0	1	0	<1	0	0	<1	0	0	0	0	0	0	0
Sphaerophorus globosus	coral lichen	0	0	0	0	0	0	0	0	2	<1	0	0	0	0	0
Stereocaulon tomentosum	woolly foam lichen	0	0	0	0	<1	0	0	0	9	0	0	0	0	0	0
Thamnolia vermicularis	whiteworm lichen	0	0	<1	0	0	0	<1	<1	<1	0	0	0	0	0	0
Ground Cover																
Bare Ground		0	0	<1	0	0	<1	<1	<1	0	<1	0	0	1	0	<1
Fungi		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Terricolous (soil) Lichen		6	<1	11	30	2	23	34	19	59	42	4	0	16	4	21
Litter		11	9	15	32	16	19	5	4	4	8	7	17	16	13	14
Moss		30	1	17	13	8	4	1	<1	2	0	54	64	48	17	26
Animal Pellets		0	<1	<1	0	0	0	<1	<1	<1	<1	<1	<1	<1	<1	0
Rock		0	0	<1	2	0	2	2	<1	<1	0	0	0	0	0	0
Saxicolous (rock) Lichen		0	0	0	3	<1	11	6	2	<1	0	0	0	0	0	0
Total Vegetation		53	91	58	21	74	45	55	75	35	49	40	19	20	67	39
Water		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0

Note: Means are rounded to the nearest whole number for presentation purposes; <1 indicates species present but with low cover.

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APPENDIX C

Mean Species Cover from 2006 to 2016

APPENDIX C

Mean Species Cover Changes over the 2006 to 2016 Period

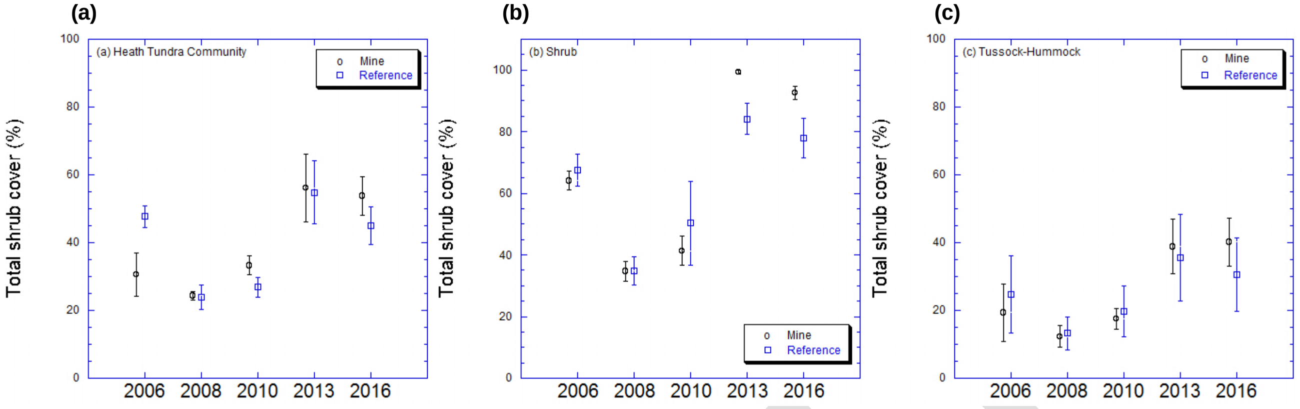

Figure C-1 (a-c): Mean (± 1 SE) total shrub cover (%), for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2006-2016).

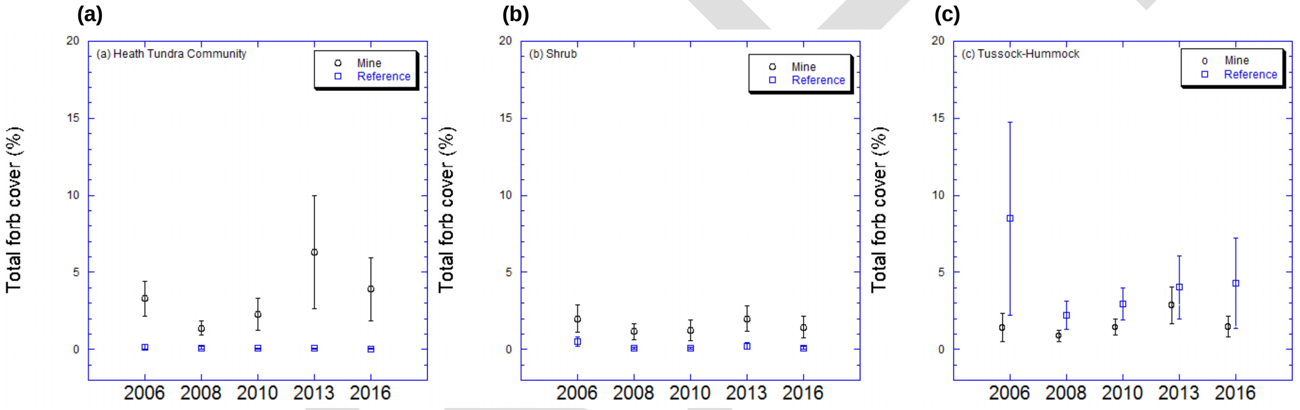

Figure C-2 (a-c): Mean (± 1 SE) total forb cover (%), for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2006-2016).

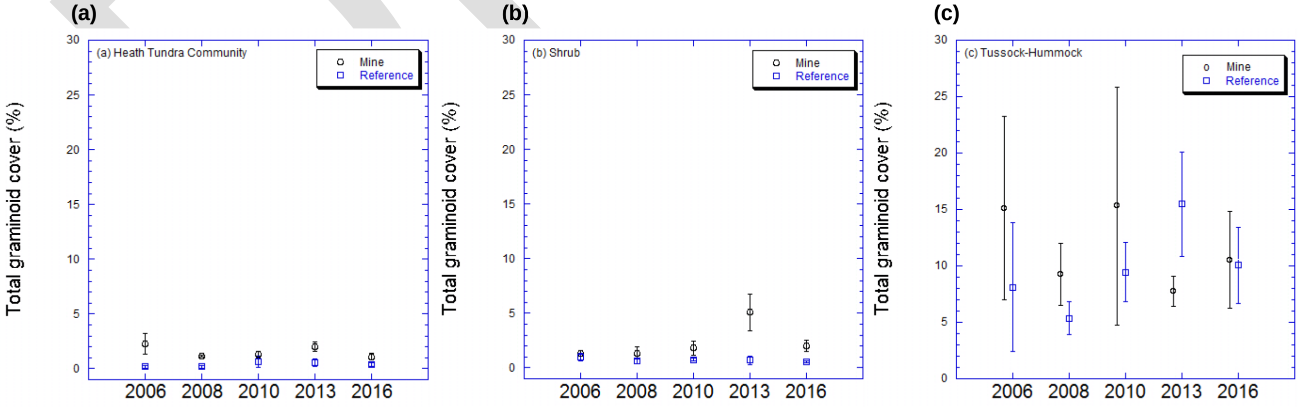

Figure C-3 (a-c): Mean (± 1 SE) total graminoid cover (%), for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2006-2016).

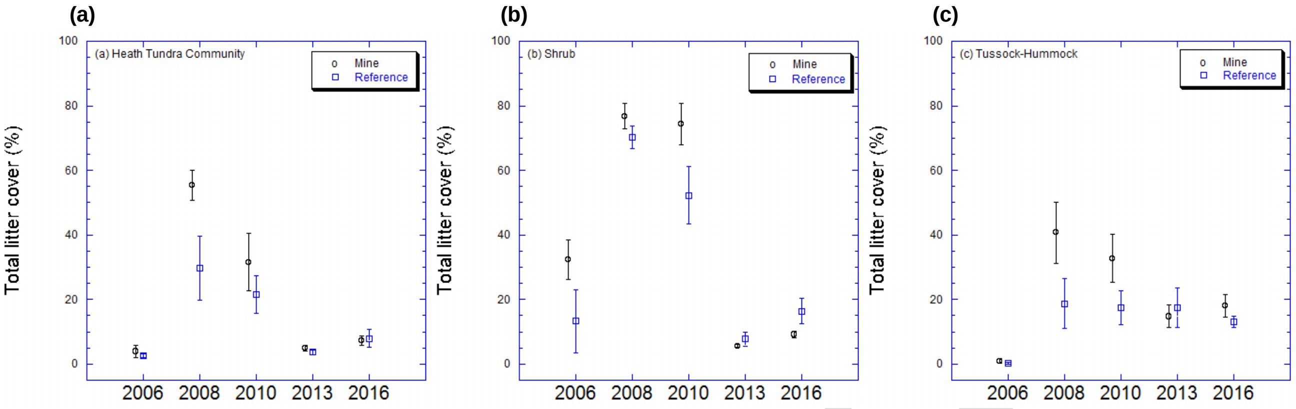

Figure C-4 (a-c): Mean (± 1 SE) total litter cover (%), for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2006-2016).

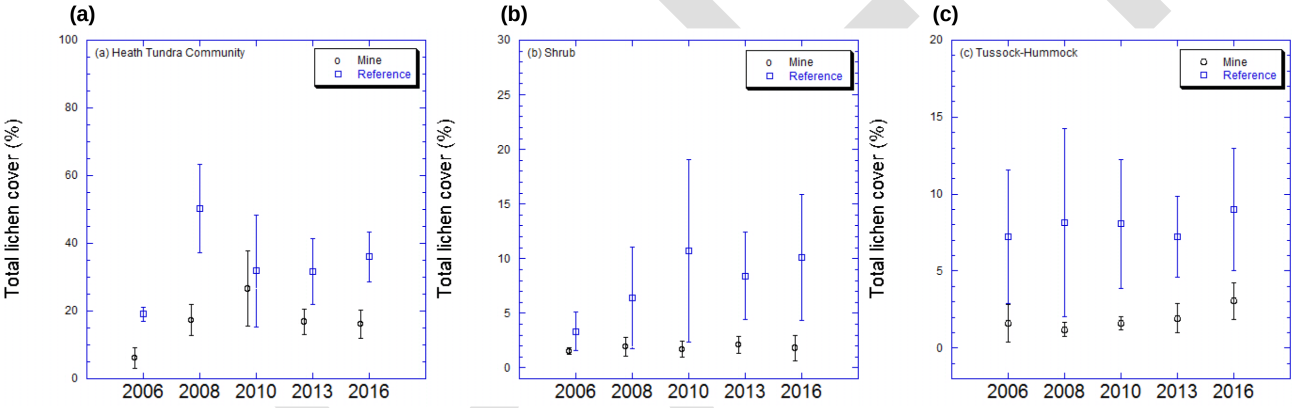

Figure C-5 (a-c): Mean (± 1 SE) total lichen cover (%), for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2006-2016).

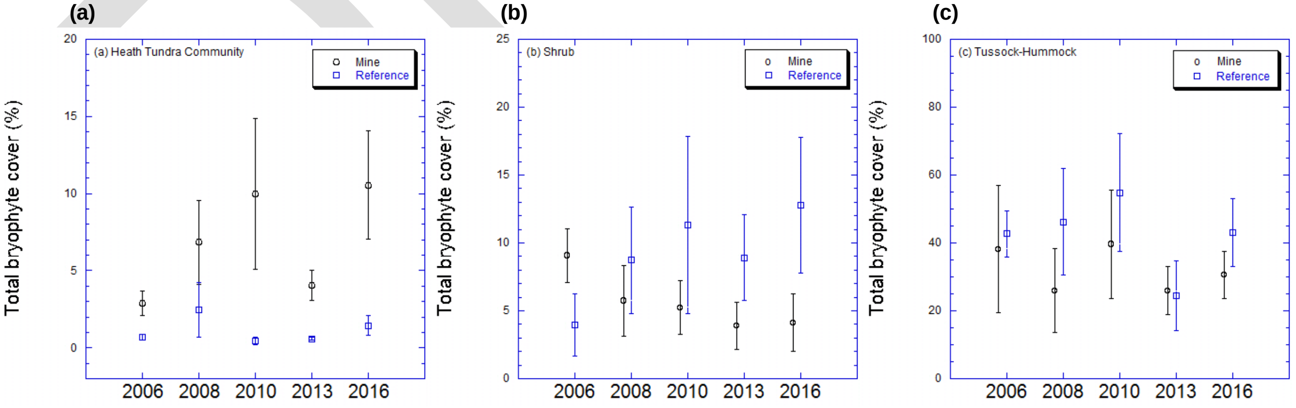

Figure C-6 (a-c): Mean (± 1 SE) total bryophyte cover (%), for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2006-2016).

APPENDIX D

Mean Species Richness from 2006 to 2016

APPENDIX D

Mean Species Richness Changes over the 2006 to 2016 Period

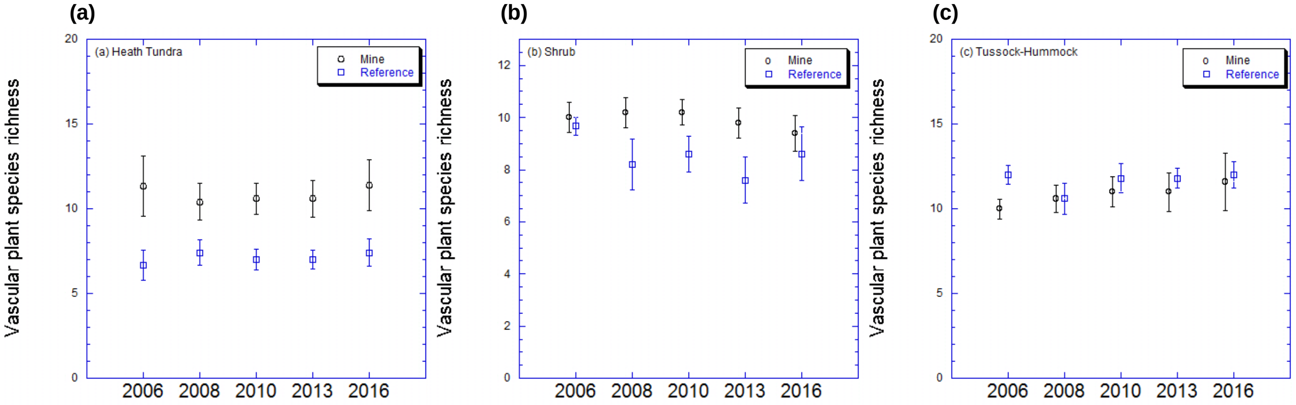

Figure D-1 (a-c): Mean (± 1 SE) species richness of total vascular plant (shrub, forb, and graminoid), for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2006-2016).

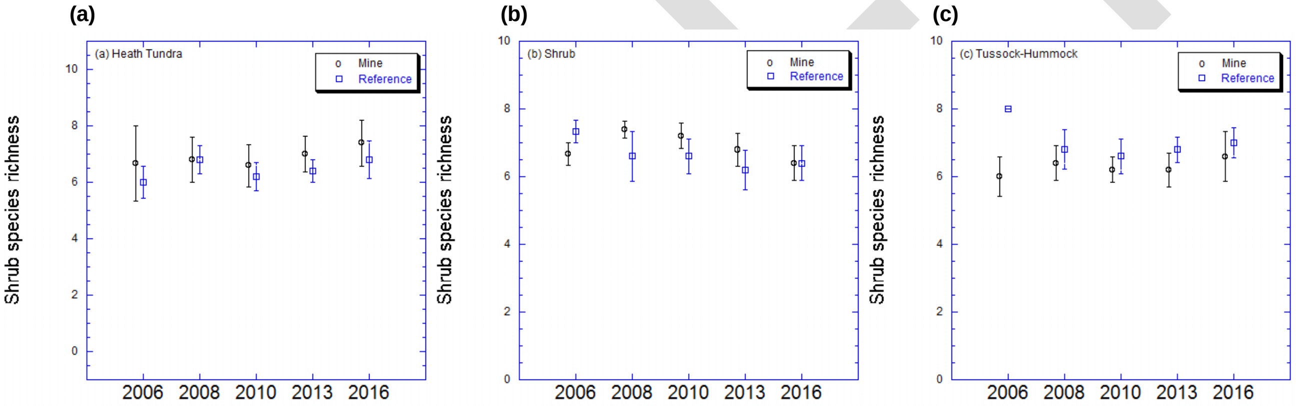

Figure D-2 (a-c): Mean (± 1 SE) shrub species richness for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2006-2016).

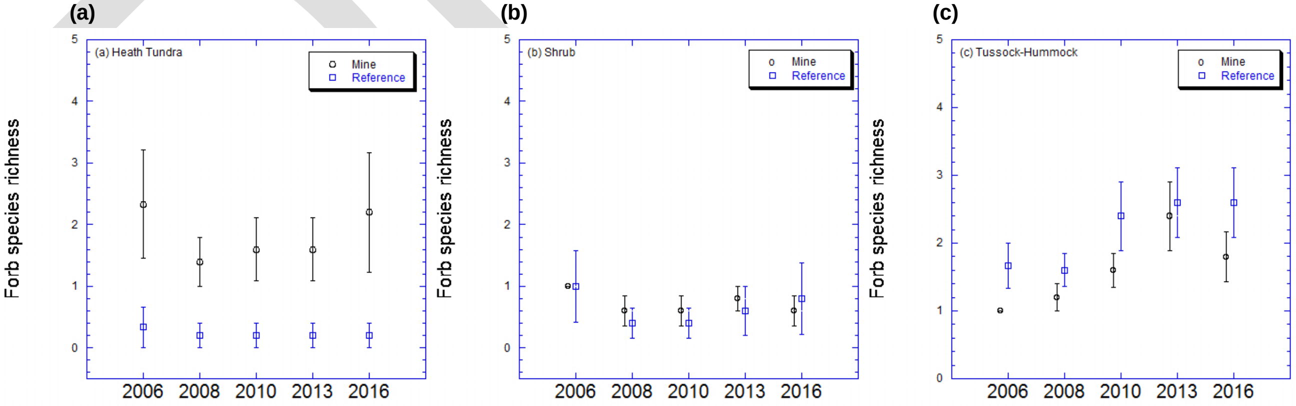

Figure D-3 (a-c): Mean (± 1 SE) forb species richness of forb for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2006-2016).

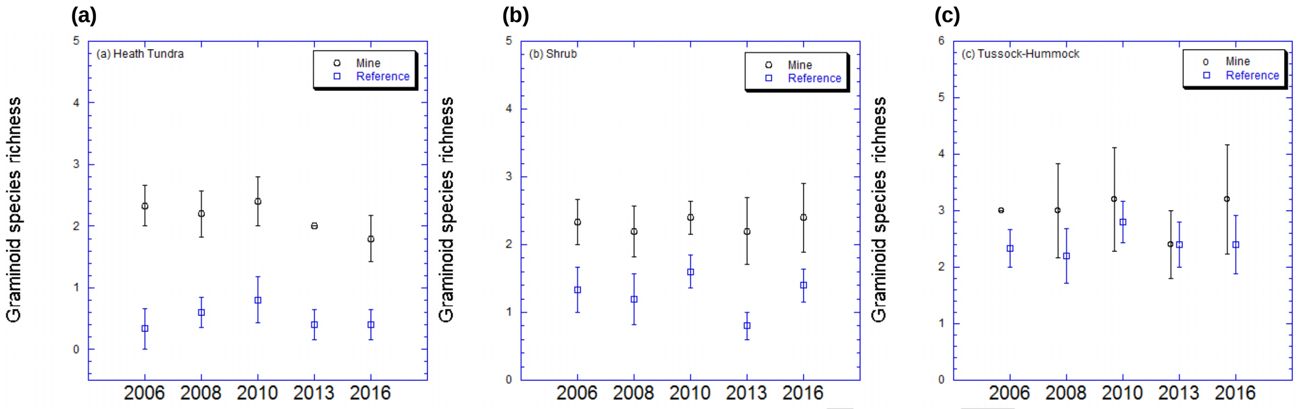

Figure D-4 (a-c): Mean (± 1 SE) graminoid (grass) species richness for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2006-2016).

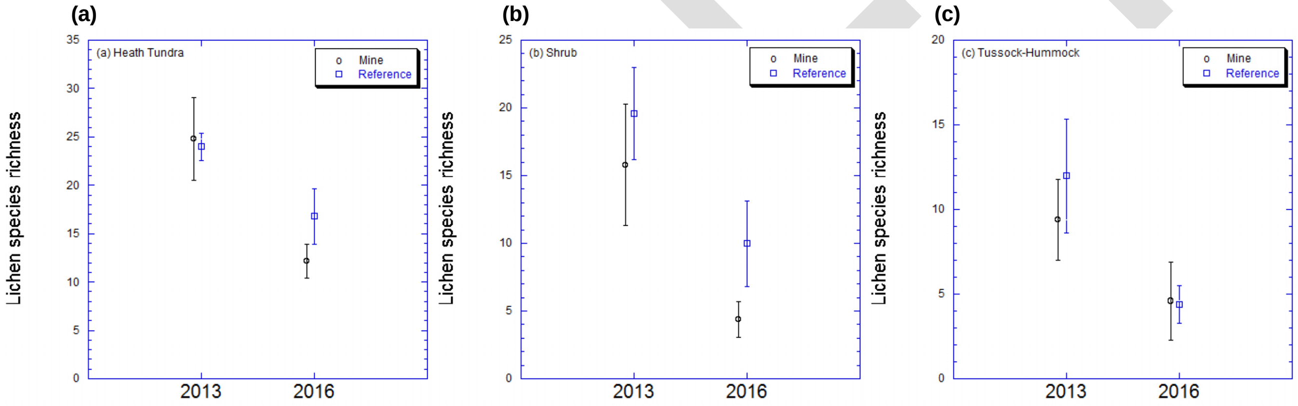

Figure D-5 (a-c): Mean (± 1 SE) lichen species richness for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2013 and 2016).

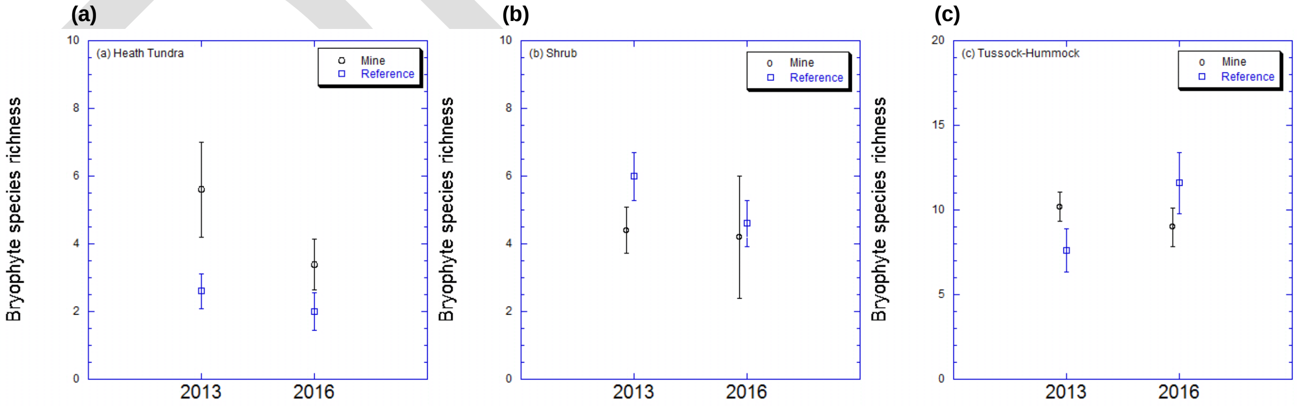

Figure D-6 (a-c): Mean (± 1 SE) bryophyte species richness for mine and reference plots between (a) Heath Tundra, (b) Shrub, and (c) Tussock-Hummock communities among sampling years (2013 and 2016).

APPENDIX E

2016 Lichen Monitoring Field Observations

Table E-1: Field Observations, 2016

Sample Location	Lichen Species Composition	Vegetation Class	Soil Type	Caribou Activity Observed
NF01	*Flavocetraria nivalis – 50%* *Flavocetraria cucullata – 35%* *Cladonia rangiferina – 6%* *Cladonia stygia – 6%* *Masonhalea richardsonii – 2%* *Cladonia mitis – 1%*	Heath tundra/tussock hummock	Sand	Fresh scat, tracks, and signs of recent caribou grazing.
NF02	*Flavocetraria nivalis – 62%* *Flavocetraria cucullata – 17%* *Bryocaulon divergens* – 9% *Stereocaulon tomentosumi – 6%* *Masonhalea richardsonii – 3%* *Cladonia rangiferina – 2%* *Cladonia stygia – 1%*	Heath tundra	Sand	None.
NF03	*Flavocetraria nivalis – 37%* *Flavocetraria cucullata – 30%* *Bryocaulon* species – 15% *Cladonia rangiferina – 3%* *Cladonia stygia – 3%* *Masonhalea richardsonii – 2%*	Heath tundra	Sand	Caribou trails.
NF04	*Flavocetraria cucullata – 75%* *Flavocetraria nivalis – 20%* *Usnea* species – 3% *Bryocaulon* species – 2%	Heath tundra	Sand	Caribou trails (old).
NF05	*Flavocetraria nivalis – 50%* *Flavocetraria cucullata – 35%* *Stereocaulon tomentosumi – 25%* *Cladonia rangiferina – 5%* *Cladonia stygia – 5%*	Heath tundra/tussock hummock	Sand	None.
NF06	*Flavocetraria nivalis – 50%* *Flavocetraria cucullata – 19%* *Cetraria* species – 15% *Cladonia rangiferina – 10%* *Cladonia stygia – 6%*	Heath tundra	Sand	Caribou trails (old).
NF07	*Flavocetraria nivalis – 40%* *Flavocetraria cucullata – 300%* *Cladonia rangiferina – 10%* *Cladonia stygia – 10%* *Masonhalea richardsonii – 5%* *Bryocaulon* species – 3% *Usnea* species – 2%	Tussock/hummock	Clay	None.

Table E-1: Field Observations, 2016

Sample Location	Lichen Species Composition	Vegetation Class	Soil Type	Caribou Activity Observed
NF08	*Flavocetraria nivalis – 47%* *Flavocetraria cucullata – 40%* *Bryocaulon* species – 5% *Usnea* species *– 4%* *Cladonia rangiferina – 2%* *Cladonia stygia – 2%*	Heath tundra	Sand	Caribou trails (old).
NF09	*Flavocetraria nivalis – 50%* *Flavocetraria cucullata – 27%* *Cladonia rangiferina – 10%* *Cladonia stygia – 10%* *Masonhalea richardsonii – 3%*	Heath tundra	Peat/organic material	Caribou scat and well used trail.
NF10	*Flavocetraria nivalis – 48%* *Flavocetraria cucullata – 30%* *Cladonia rangiferina – 5%* *Cladonia stygia – 5%* *Masonhalea richardsonii – 5%* *Bryocaulon* species – 5% *Stereocaulon tomentosumi – 2%*	Heath tundra/shrub	Sand	Caribou observed grazing in this area.
NF11	*Flavocetraria nivalis – 60%* *Flavocetraria cucullata – 15%* *Bryocaulon divergens* – 10% *Cladonia rangiferina – 5%* *Cladonia stygia – 5%* *Cetraria* species *– 3%* *Masonhalea richardsonii – 2%*	Heath tundra	Sand	None.
NF12	*Flavocetraria nivalis – 30%* *Flavocetraria cucullata – 25%* *Bryocaulon divergens* – 15% *Stereocaulon tomentosumi – 12%* *Cetraria* species *– 10%* *Cladonia rangiferina – 3%* *Cladonia stygia – 3%* *Masonhalea richardsonii – 2%*	Tussock/hummock	Sand	None.
NF13	*Flavocetraria nivalis – 57%* *Flavocetraria cucullata – 20%* *Stereocaulon tomentosumi – 9%* *Cladonia rangiferina – 7%* *Cladonia stygia – 5%* *Bryocaulon divergens* – 1% *Cetraria* species *– 1%*	Heath tundra	Sand	Old caribou bone and old trails.
NF14	*Flavocetraria nivalis – 50%* *Flavocetraria cucullata – 40%* *Masonhalea richardsonii – 5%* *Cladonia* species *– 3%* *Bryocaulon divergens* – 2%	Heath tundra	Sand	Fresh caribou tracks and well used trail in vicinity.

Table E-1: Field Observations, 2016

Sample Location	Lichen Species Composition	Vegetation Class	Soil Type	Caribou Activity Observed
NF15	*Flavocetraria nivalis – 33%* *Flavocetraria cucullata – 20%* *Cladonia rangiferina – 20%* *Cladonia stygia – 20%* *Bryocaulon divergens* – 5% *Masonhalea richardsonii – 2%*	Heath tundra	Peat/organic material	None.
NF16	*Stereocaulon tomentosumi – 60%* *Flavocetraria nivalis – 20%* *Flavocetraria cucullata – 15%* *Cladonia rangiferina – 2%* *Cladonia stygia – 2%* *Masonhalea richardsonii – 1%*	Heath tundra	Clay	Caribou trails.
NF17	*Flavocetraria nivalis – 50%* *Flavocetraria cucullata – 25%* *Cladonia stygia – 10%* *Bryocaulon divergens* – 8% *Cladonia rangiferina – 6%* *Masonhalea richardsonii – 1%*	Heath tundra	Peat/organic material	None.
NF18	*Flavocetraria nivalis – 43%* *Flavocetraria cucullata – 40%* *Stereocaulon tomentosumi – 10%* *Cladonia rangiferina – 4%* *Bryocaulon divergens* – 2% *Cladonia stygia – 1%*	Heath tundra	Sand	None.
NF19	*Flavocetraria nivalis – 46%* *Flavocetraria cucullata – 36%* *Bryocaulon* species – 8% *Masonhalea richardsonii – 3%* *Cladonia rangiferina – 2%* *Cladonia stygia – 2%* *Stereocaulon tomentosumi – 2%* *Usnea* species – *1%*	Heath tundra	Sand	None.
NF20	*Flavocetraria nivalis – 50%* *Stereocaulon tomentosumi – 30%* *Flavocetraria cucullata – 15%* *Cladonia rangiferina – 2%* *Cladonia stygia – 2%* *Bryocaulon* species – 1%	Shrub/Tussock hummock	Sand	None.
NF21	*Stereocaulon tomentosumi – 85%* *Cladonia rangiferina – 5%* *Cladonia stygia – 5%* *Flavocetraria cucullata – 2%* *Flavocetraria nivalis – 2%* *Cladonia* species *– 1%*	Shrub/Tussock hummock	Sand	None.

Table E-1: Field Observations, 2016

Sample Location	Lichen Species Composition	Vegetation Class	Soil Type	Caribou Activity Observed
NF22	*Flavocetraria nivalis – 50%* *Flavocetraria cucullata – 20%* *Cladonia rangiferina – 10%* *Stereocaulon tomentosumi – 10%* *Cladonia stygia – 9%* *Masonhalea richardsonii – 1%*	Heath Tundra	Sand	Old caribou scat and some well used trails.
NF23	*Flavocetraria nivalis – 45%* *Flavocetraria cucullata – 35%* *Cladonia rangiferina – 10%* *Cladonia stygia – 8%* *Masonhalea richardsonii – 2%*	Heath Tundra	Gravel/Sand	Caribou scat and trails adjacent to sampling site.
Far-Field				
FF01	*Flavocetraria nivalis – 26%* *Flavocetraria cucullata – 40%* *Cladonia rangiferina – 15%* *Cladonia stygia – 15%* *Cladonia mitis – 3%* *Dactylina* species – 1%	Tussock/Hummock	Peat/Organic Material	Caribou trails and scat.
FF02	*Flavocetraria cucullata – 50%* *Flavocetraria nivalis – 40%* *Cladonia rangiferina* – 4% *Bryocaulon divergens* – 2% *Masonhalea richardsonii – 2%* *Cladonia species – 1%* *Dactylina* species – 1%	Heath Tundra	Sand	Caribou scat, and old antler observed on site.
FF03	*Bryocaulon divergens* – 61% *Cladina* species – 25% *Bryoria* species – 5% *Flavocetraria cucullata – 4%* *Flavocetraria nivalis – 2%* *Usnea* species – 2%	Heath Tundra	Gravel/Sand	Lots of caribou scat.
FF05	*Cladonia species – 40%* *Flavocetraria cucullata – 40%* *Flavocetraria nivalis – 40%* *Cladonia rangiferina – 10%* *Cladonia stygia – 5%* *Stereocaulon tomentosumi – 3%* *Masonhalea richardsonii – 2%*	Heath Tundra	Sand/Clay	Caribou trails in the area and scat in close proximity to sampling site.
FF07	*Flavocetraria cucullata – 65%* *Flavocetraria nivalis – 17%* *Bryocaulon divergens* – 10% *Stereocaulon tomentosumi – 5%* *Cladonia stygia – 2%* *Masonhalea richardsonii* – 1%	Heath Tundra	Sand	None.

Table E-1: Field Observations, 2016

Sample Location	Lichen Species Composition	Vegetation Class	Soil Type	Caribou Activity Observed
FF08	*Flavocetraria cucullata* – 40% *Flavocetraria nivalis* – 28% *Bryocaulon divergens* – 10% *Stereocaulon tomentosumi* –85% *Cladonia stygia* – 7% *Cladonia rangiferina* – 5% *Cladonia* species – 2%	Heath Tundra	Sand	Caribou trails observed.
FF09	*Flavocetraria cucullata* – 25% *Flavocetraria nivalis* – 25% *Stereocaulon tomentosumi* – 25% *Bryocaulon divergens* – 15% *Cladonia rangiferina* – 5% *Cladonia mitis* – 2% *Bryocaulon* species – 1% *Cladonia* species – 1% *Usnea* species – 1%	Heath Tundra	Sand	None.
FF10	*Flavocetraria cucullata* – 40% *Cladonia stygia* – 35% *Flavocetraria nivalis* – 13% *Cladonia rangiferina* – 10% *Cladonia mitis* – 2%	Tussock/Hummock	Sand	Caribou trails, scat, and caribou hair.
FF11	*Flavocetraria cucullata* – 30% *Flavocetraria nivalis* – 25% *Cladonia stygia* – 20% *Cladonia rangiferina* – 5% *Cladonia mitis* – 5% *Cladonia* species – 3% *Masonhalea richardsonii* – 2%	Shrub	Sand	Recent caribou tracks and scat. Well used trails in area.
FF12	*Flavocetraria cucullata* – 30% *Stereocaulon tomentosumi* – 30% *Flavocetraria nivalis* – 27% *Bryocaulon divergens* – 10% *Cladonia rangiferina* – 2% *Masonhalea richardsonii* – 1%	Heath Tundra	Sand	Caribou trails.
FF13	*Stereocaulon tomentosumi* – 80% *Cetraria* species – 7% *Cladonia rangiferina* – 5% *Cladonia stygia* – 4% *Masonhalea richardsonii* – 2% *Peltigera* species – 2%	Shrub	Sand	None.
FF14	*Flavocetraria nivalis* – 45% *Flavocetraria cucullata* – 25% *Cladonia rangiferina* – 15% *Cladonia stygia* – 10% *Cladonia mitis* – 5%	Heath Tundra	Sand	Caribou scat.

Table E-1: Field Observations, 2016

Sample Location	Lichen Species Composition	Vegetation Class	Soil Type	Caribou Activity Observed
FF15	*Flavocetraria nivalis* – 40% *Flavocetraria cucullata* – 35% *Cladonia rangiferina* – 10% *Bryocaulon divergens* – 5% *Masonhalea richardsonii* – 5% *Cladonia* species – 5%	Heath Tundra	Peat/Organic Material	Caribou trail.
FF17	*Flavocetraria nivalis* – 80% *Flavocetraria cucullata* – 10% *Cladonia stygia* – 6% *Cladonia rangiferina* – 3% *Masonhalea richardsonii* – 1%	Heath Tundra	Sand	None.
FF19	*Stereocaulon tomentosumi* – 75% *Flavocetraria nivalis* – 10% *Cladonia rangiferina* – 7% *Flavocetraria cucullata* – 5% *Cladonia stygia* – 3%	Heath Tundra	Sand	None.
FF20	*Flavocetraria nivalis* – 40% *Stereocaulon tomentosumi* – 25% *Flavocetraria cucullata* – 20% *Bryocaulon divergens* – 10% *Cladonia stygia* – 3% *Cladonia rangiferina* – 2%	Heath Tundra	Sand	None.
FF21	*Stereocaulon tomentosumi* – 30% *Flavocetraria nivalis* – 25% *Flavocetraria cucullata* – 20% *Cladonia stygia* – 10% *Bryocaulon divergens* – 5% *Cladonia rangiferina* – 5% *Peltigera* species – 3% *Cetraria* species – 2%	Shrub	Sand	None.
FF22	*Flavocetraria nivalis* – 35% *Stereocaulon tomentosumi* – 25% *Flavocetraria cucullata* – 20% *Cladonia stygia* – 10% *Cladonia rangiferina* – 5% *Cetraria* species – 3% *Masonhalea richardsonii* – 1% *Cladonia* species – 1%	Shrub	Sand	None.
FF23	*Flavocetraria nivalis* – 35% *Flavocetraria cucullata* – 35% *Cladonia rangiferina* – 12% *Cladonia stygia* – 9% *Cladonia mitis* – 5% *Bryocaulon* species – 2% *Cladonia* species – 2%	Esker Complex	Sand	None.

Table E-1: Field Observations, 2016

Sample Location	Lichen Species Composition	Vegetation Class	Soil Type	Caribou Activity Observed
FF24	*Stereocaulon tomentosumi – 45%* *Flavocetraria cucullata – 20%* *Flavocetraria nivalis – 20%* *Bryocaulon divergens* – 10% *Cladonia rangiferina – 2%* *Cladonia stygia – 2%*	Esker Complex	Sand	Caribou trails in area.
FF25	*Flavocetraria cucullata – 30%* *Flavocetraria nivalis – 30%* *Cladonia mitis – 12%* *Cladonia stygia – 12%* *Cladonia rangiferina – 11%* *Masonhalea richardsonii* – 5%	Heath Tundra	Sand	Caribou trails through plot.
Far-Far-Field				
FFF01	*Flavocetraria nivalis – 64%* *Flavocetraria cucullata – 20%* *Stereocaulon tomentosumi – 10%* *Cetraria* species – 5% *Masonhalea richardsonii – 1%*	Heath Tundra	Gravel/Sand	Extensive caribou scat, and caribou observed in immediate vicinity.
FF02	*Flavocetraria nivalis – 45%* *Flavocetraria cucullata – 38%* *Cladonia rangiferina* – 10% *Cladonia stygia – 5%* *Masonhalea richardsonii – 2%*	Heath Tundra	Clay	Caribou scat, and trails in vicinity.
FF03	*Flavocetraria nivalis – 45%* *Flavocetraria cucullata – 29%* *Stereocaulon tomentosumi – 20%* *Cladonia rangiferina – 4%* *Cladonia stygia – 2%*	Heath Tundra	Sand	None.

Field observations were compiled from field data forms that were filled out by a Golder staff member during the field portion of the Diavik Soil and Lichen Sampling Program, August 2016.

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APPENDIX F

Select Photos from the Lichen Monitoring Program

Photo 1: Near-field Location 5 – Looking East

Photo 2: Near-field Location 5 – Looking at the Ground

Photo 3: Far-field Location 8 – Looking East

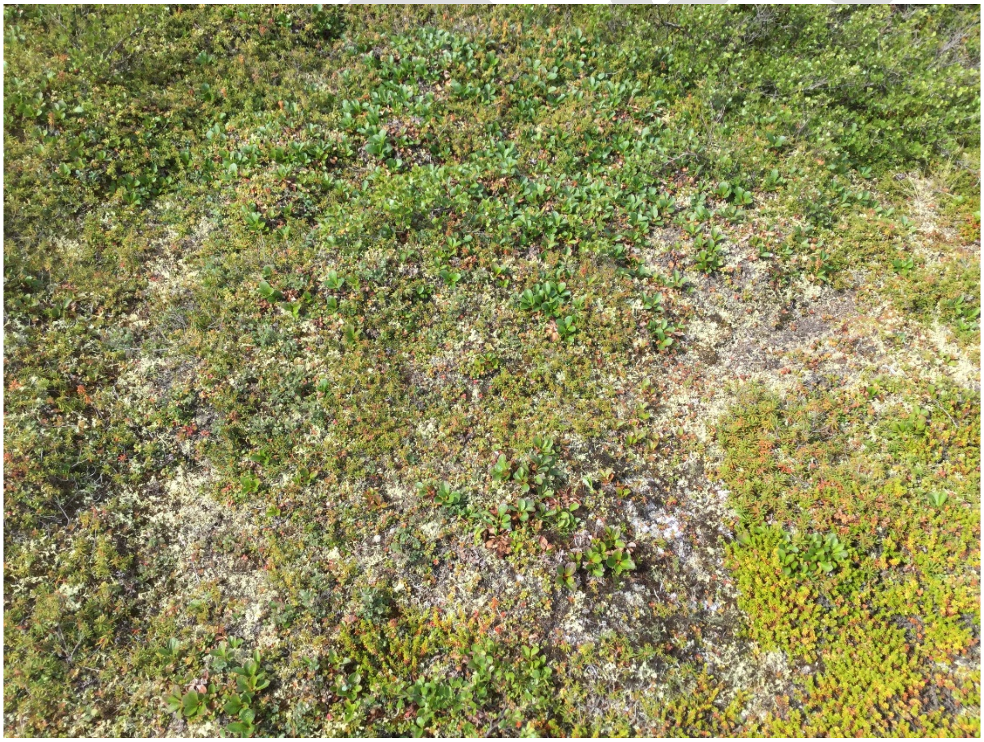

Photo 4:   Far-field Location 8 - Looking at the Ground

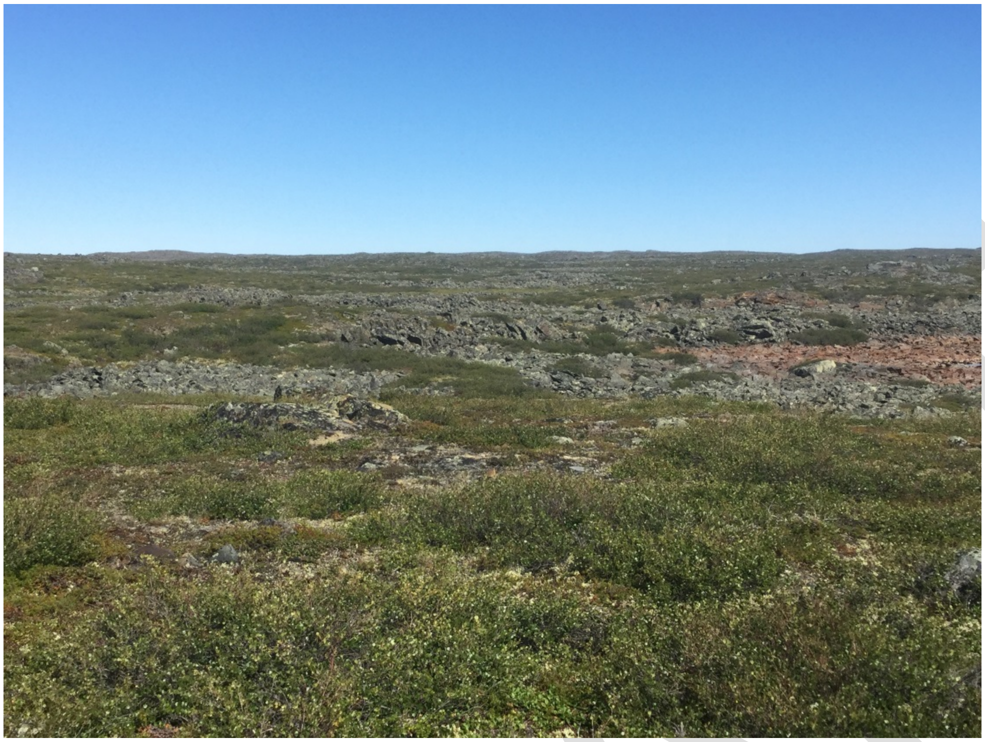

Photo 5: Far-far-field Location 2 – Looking North

Photo 6: far-far-field Location 2 - Looking at the Ground

APPENDIX G

Lichen and Soil Chemistry Results

Table G-1: Chemistry for Lichen Originals Collected from Near-field Locations, 2016

Parameter	Unit	DL	NF1	NF2	NF2	NF3	NF4	NF5	NF6	NF7	NF8	NF9	NF10	NF11	NF12	NF13	NF13	NF14	NF15	NF16	NF17	NF18	NF19	NF20	NF21	NF22	NF23
			25-Jul-16	25-Jul-16	25-Jul-16	25-Jul-16	25-Jul-16	24-Jul-16	26-Jul-16	26-Jul-16	26-Jul-16	23-Jul-16	25-Jul-16	26-Jul-16	26-Jul-16	25-Jul-16	25-Jul-16	23-Jul-16	24-Jul-16	23-Jul-16	23-Jul-16	24-Jul-16	26-Jul-16	23-Jul-16	23-Jul-16	23-Jul-16	23-Jul-16
			Original	Original	Duplicate	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Duplicate	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original
Physical Properties																											
Moisture	%	0.3	9.7	12	4.4	6.1	13	15	35	43	34	14	7.7	64	69	11	7.5	10	18	22	14	12	20	21	40	32	29
Mercury by CVAFS																											
Total Mercury (Hg)	mg/kg dw	0.005	0.0426	0.031	0.0361	0.0324	0.0494	0.0367	0.0287	0.0364	0.0273	0.0353	0.07	0.0279	0.0265	0.0686	0.0453	0.0564	0.0346	0.0368	0.0531	0.041	0.0476	0.0336	0.0276	0.0385	0.0599
Total Metals by ICPMS																											
Total Aluminum (Al)	mg/kg dw	1	1470	939	937	1040	570	659	835	941	1430	472	618	974	1530	1070	706	974	874	1000	597	729	1110	428	259	413	190
Total Antimony (Sb)	mg/kg dw	0.005	0.0141	0.0122	0.0128	0.0144	0.0141	0.0162	0.0178	0.0232	0.0287	0.0099	0.0067	0.0308	0.0267	0.0203	0.0188	0.0182	0.0187	0.0136	0.0156	0.0173	0.0457	0.0133	0.0058	0.007	0.0061
Total Arsenic (As)	mg/kg dw	0.05	0.341	0.353	0.306	0.573	0.272	0.316	0.22	0.329	0.396	0.317	0.192	0.255	0.458	0.351	0.283	0.393	0.362	0.297	0.331	0.322	0.431	0.316	0.243	0.398	0.338
Total Barium (Ba)	mg/kg dw	0.1	27.2	30.4	26.2	25.9	27.8	22.9	31.1	49.3	52.1	13	18.2	25.8	37.1	50	37.3	47.5	15.7	41.2	20.4	36	42.7	22.3	22.6	22.2	10.4
Total Beryllium (Be)	mg/kg dw	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Bismuth (Bi)	mg/kg dw	0.1	0.48	0.22	0.25	0.19	<0.1	0.12	0.14	0.15	0.18	<0.1	0.24	0.38	0.34	0.14	0.11	0.18	0.23	0.13	0.1	0.11	0.27	<0.1	<0.1	<0.1	<0.1
Total Boron (B)	mg/kg dw	2	2.3	<2	<2	<2	<2	<2	<2	<2	2	<2	<2	<2	2.5	<2	<2	2.4	<2	2.2	2.2	<2	<2	<2	<2	<2	<2
Total Cadmium (Cd)	mg/kg dw	0.01	0.108	0.102	0.081	0.046	0.068	0.057	0.088	0.061	0.062	0.044	0.066	0.062	0.047	0.067	0.073	0.106	0.028	0.085	0.068	0.066	0.076	0.056	0.047	0.038	0.055
Total Calcium (Ca)	mg/kg dw	10	2750	2540	1660	1570	2800	1450	2470	3310	2380	924	2210	2950	2990	1890	2110	2730	1040	648	1050	1920	3670	1030	642	604	670
Total Cesium (Cs)	mg/kg dw	0.1	1.3	0.91	0.84	0.6	0.38	0.58	0.87	0.56	0.58	0.59	0.7	0.76	1.05	0.61	0.48	0.59	0.5	0.82	0.57	0.56	0.67	0.35	0.26	0.25	0.29
Total Chromium (Cr)	mg/kg dw	0.2	9.09	8.59	7.26	8.96	6.83	5.83	7.89	10.9	14.1	3.82	5.04	8.61	13.4	9.07	5.62	7.51	7.5	5.34	3.99	5.4	12	2.61	0.97	1.81	0.72
Total Cobalt (Co)	mg/kg dw	0.02	1.6	0.834	0.754	1.2	0.837	0.704	0.974	1.51	1.8	0.358	1	0.969	1.2	0.981	0.677	0.745	0.567	0.832	0.83	0.72	1.33	0.531	0.435	0.708	0.149
Total Copper (Cu)	mg/kg dw	0.05	6.71	3.46	2.94	3.8	2.42	2.86	2.68	3.12	3.42	1.74	3.12	3.17	4.23	3.58	2.56	3.81	2.23	3.95	3.18	3.05	3.03	2.91	2.44	2.93	0.968
Total Iron (Fe)	mg/kg dw	10	2130	1380	1380	1480	911	1070	1460	1640	2110	570	906	1360	2670	1560	951	1260	1330	1170	774	1080	1880	519	316	451	221
Total Lead (Pb)	mg/kg dw	0.01	3.06	1.56	1.66	1.1	0.767	0.775	1.24	1.34	1.43	0.483	1.92	2.13	1.71	0.955	0.891	1.45	1.01	0.692	0.737	0.902	1.75	0.347	0.2	0.361	0.74
Total Lithium (Li)	mg/kg dw	0.5	5.77	2.44	2.48	2.83	1.22	1.44	2.54	2.33	3.01	1.04	1.63	2.75	4.46	2.24	1.13	2.09	1.67	2.44	1.21	1.43	2.79	0.89	<0.5	0.52	<0.5
Total Magnesium (Mg)	mg/kg dw	10	1250	1250	1060	2070	1650	1400	1960	3860	4240	614	817	1820	2550	2040	1390	964	1240	949	850	1460	3090	630	425	479	306
Total Manganese (Mn)	mg/kg dw	0.1	80.7	49.5	40.8	46	68.9	51.6	61.3	96.2	63.9	40.8	67.5	64.6	55.1	62.3	62.9	79	43.9	29.6	63.7	97.5	54.9	50.1	22.5	53.5	26
Total Molybdenum (Mo)	mg/kg dw	0.05	0.57	0.636	0.633	0.651	0.351	0.779	0.729	0.847	0.944	0.275	0.315	0.683	1.16	0.514	0.341	0.453	0.529	0.417	0.274	0.369	0.804	0.2	0.22	0.09	0.053
Total Nickel (Ni)	mg/kg dw	0.05	8.01	7.25	6.47	11	9.89	7.04	11.9	21.8	23.7	2.61	5.5	10.7	13.1	10.9	7.83	6.02	6.75	5.23	5.85	8.17	19.3	2.67	1.81	4.22	0.948
Total Phosphorus (P)	mg/kg dw	10	902	1150	875	999	1150	809	945	883	639	630	982	743	902	1250	1060	797	718	967	722	1070	746	769	709	1060	433
Total Potassium (K)	mg/kg dw	10	2260	2970	2160	2400	2680	2070	2200	2160	1720	1450	2520	1900	2440	2850	2500	1780	1560	2280	1500	2030	2020	1510	1890	2180	1180
Total Selenium (Se)	mg/kg dw	0.05	0.06	<0.05	0.058	0.053	0.051	0.061	<0.05	0.063	0.051	<0.05	<0.05	0.059	0.067	<0.05	0.054	0.054	<0.05	0.058	0.055	0.056	0.06	<0.05	<0.05	<0.05	0.052
Total Silver (Ag)	mg/kg dw	0.02	0.038	0.022	<0.02	<0.02	<0.02	<0.02	<0.02	0.027	0.024	0.02	<0.02	0.027	0.032	<0.02	<0.02	<0.02	<0.02	0.027	0.045	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Sodium (Na)	mg/kg dw	10	122	207	112	99	246	69	200	169	79	66	120	154	107	75	137	109	82	37	60	66	131	51	46	43	64
Total Strontium (Sr)	mg/kg dw	0.1	10.4	12.1	9.09	10.5	10.3	9.5	13.8	20.3	17	3.49	6.37	11.1	15.9	15.4	12.7	12.6	2.96	12.1	4.84	11.8	19.2	6.54	7.44	5.66	4.49
Total Tellurium (Te)	mg/kg dw	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Thallium (Tl)	mg/kg dw	0.002	0.0663	0.0376	0.0349	0.0346	0.0272	0.0303	0.0321	0.0349	0.0415	0.0252	0.029	0.0392	0.0536	0.043	0.0237	0.0379	0.0284	0.0397	0.0318	0.0407	0.0443	0.0154	0.0093	0.011	0.0081
Total Thorium (Th)	mg/kg dw	0.05	1.16	0.579	0.597	0.719	0.378	0.413	0.586	0.583	0.798	0.268	0.473	0.823	1.15	0.562	0.345	0.499	0.539	0.564	0.325	0.375	0.668	0.23	0.167	0.111	0.057
Total Tin (Sn)	mg/kg dw	0.1	0.11	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	0.11	<0.1	0.1	0.14	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	<0.1	<0.1	<0.1	<0.1
Total Titanium (Ti)	mg/kg dw	1	112	63.8	64	73.2	42.4	46.2	68	73.6	85.5	32.7	51.6	77.3	104	70.2	46.1	65.2	60.1	61.8	43.5	47.3	85.3	25.1	10.1	21.2	10.3
Total Uranium (U)	mg/kg dw	0.002	2.81	1.19	1.28	0.879	0.51	0.563	0.909	0.678	0.851	0.323	1.51	1.38	1.6	0.658	0.468	0.823	0.776	0.542	0.405	0.553	0.933	0.193	0.124	0.0811	0.0528
Total Vanadium (V)	mg/kg dw	0.2	2.23	1.6	1.56	2.19	1.06	1.28	1.64	2.06	2.74	0.78	0.92	1.86	3.09	2.03	1.25	1.9	1.4	1.64	1.13	1.45	2.28	0.74	0.45	0.75	0.35
Total Zinc (Zn)	mg/kg dw	0.2	31	33.8	25.7	22.9	27.6	30.4	29.4	23.1	22.4	20.8	25.3	19.6	29.7	32.7	27.5	42.7	18	31.1	21.5	27.7	23	32.3	26.4	28	17.5
Total Zirconium (Zr)	mg/kg dw	0.5	2.38	1.37	1.28	1.4	0.74	0.86	1.18	1.56	1.81	0.65	1.02	1.61	2.47	1.12	0.66	0.86	1.33	0.66	0.65	0.72	1.64	<0.5	<0.5	<0.5	<0.5

Table G-2: Chemistry for Lichen Originals Collected from Far-field Locations, 2016

Parameter	Unit	DL	FF1	FF2	FF3	FF5	FF7	FF8	FF9	FF9	FF10	FF11	FF12	FF13	FF13	FF14	FF15	FF17	FF19	FF20	FF21	FF22	FF23	FF24	FF25
			23-Jul-16	22-Jul-16	23-Jul-16	22-Jul-16	22-Jul-16	22-Jul-16	22-Jul-16	22-Jul-16	21-Jul-16	21-Jul-16	21-Jul-16	21-Jul-16	21-Jul-16	21-Jul-16	21-Jul-16	22-Jul-16	21-Jul-16	21-Jul-16	21-Jul-16	21-Jul-16	22-Jul-16	22-Jul-16	22-Jul-16
			Original	Original	Original	Original	Original	Original	Original	Duplicate	Original	Original	Original	Original	Duplicate	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original
Physical Properties																									
Moisture	%	0.3	32	38	59	36	38	20	21	23	25	30	49	60	61	61	42	27	66	34	46	32	53	46	25
Mercury by CVAFS																									
Total Mercury (Hg)	mg/kg dw	0.005	0.0287	0.0541	0.122	0.0635	0.0397	0.0606	0.0615	0.0657	0.0458	0.0652	0.0366	0.0338	0.022	0.0461	0.0439	0.0527	0.0312	0.0577	0.0379	0.0357	0.0308	0.0486	0.0598
Total Metals by ICPMS																									
Total Aluminum (Al)	mg/kg dw	1	87	275	108	641	356	373	1020	542	156	555	424	448	195	371	298	460	316	796	373	182	537	723	841
Total Antimony (Sb)	mg/kg dw	0.005	<0.005	0.0073	<0.005	0.0122	<0.005	0.0126	0.0104	0.0125	0.0059	0.0241	0.0094	0.0083	<0.005	0.0113	0.0088	0.0075	0.0073	0.0145	0.0074	0.0084	<0.005	0.0119	0.0095
Total Arsenic (As)	mg/kg dw	0.05	0.242	0.358	0.183	0.595	0.538	0.374	0.611	0.33	0.214	0.399	0.442	0.595	0.389	0.326	0.315	0.492	0.17	0.442	0.428	0.301	0.262	0.407	0.817
Total Barium (Ba)	mg/kg dw	0.1	27.8	22	9.83	42	30.1	34.2	34	27.1	14.2	51.3	27.8	26.6	23.4	50.2	23.5	15.6	21.1	21.1	27.3	17.9	17.2	31.4	24
Total Beryllium (Be)	mg/kg dw	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Bismuth (Bi)	mg/kg dw	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Boron (B)	mg/kg dw	2	<2	<2	<2	2.9	2.3	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	2.4	2.1	<2
Total Cadmium (Cd)	mg/kg dw	0.01	0.077	0.106	0.071	0.114	0.041	0.08	0.096	0.072	0.049	0.14	0.063	0.048	0.037	0.106	0.072	0.073	0.037	0.11	0.064	0.051	0.112	0.07	0.077
Total Calcium (Ca)	mg/kg dw	10	1540	1250	564	1890	441	2240	2170	1140	1020	1560	1040	1020	539	1850	1230	1260	822	1150	1730	1160	990	1790	1090
Total Cesium (Cs)	mg/kg dw	0.1	1.3	0.36	0.12	0.22	0.4	0.23	0.22	0.22	0.13	0.47	0.27	0.41	0.37	0.31	0.68	0.22	0.99	0.56	0.26	0.18	0.54	0.22	0.3
Total Chromium (Cr)	mg/kg dw	0.2	0.41	0.93	0.82	2.76	0.64	2.41	16	2.64	0.4	1.5	0.92	0.83	0.3	1.32	1.1	1.74	0.71	2	2	0.45	4.29	4.49	3.06
Total Cobalt (Co)	mg/kg dw	0.02	0.386	0.434	0.118	1.42	0.482	0.688	0.725	0.291	0.257	0.266	0.457	0.627	0.326	0.715	0.406	0.747	0.556	0.484	0.772	0.345	0.893	0.925	0.995
Total Copper (Cu)	mg/kg dw	0.05	1.25	2.54	1.03	4.92	3.03	2.97	2.41	2.01	1.69	2.42	2.32	4.32	2.82	3.07	2.05	1.58	2.37	2.08	3.11	1.67	1.77	2.95	3.71
Total Iron (Fe)	mg/kg dw	10	105	306	146	698	391	463	1030	531	241	435	375	575	235	341	343	491	221	778	467	214	658	867	999
Total Lead (Pb)	mg/kg dw	0.01	0.208	0.421	0.977	0.977	0.172	0.83	1.07	0.922	0.404	2.4	0.433	0.27	0.1	0.865	0.473	0.486	0.33	1.64	0.661	0.409	0.266	0.88	1.39
Total Lithium (Li)	mg/kg dw	0.5	<0.5	<0.5	<0.5	0.77	<0.5	0.51	2.03	0.55	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.61	<0.5	<0.5	<0.5	<0.5	3.48	0.9	0.86
Total Magnesium (Mg)	mg/kg dw	10	488	600	199	657	328	588	596	392	353	442	375	351	279	589	461	583	355	506	486	405	516	743	571
Total Manganese (Mn)	mg/kg dw	0.1	79.4	75.2	31.2	123	21.4	145	63.1	43	190	54.2	44.3	20.9	28.8	88.3	52	65.7	44.7	38	65.8	59.8	121	75.4	64.6
Total Molybdenum (Mo)	mg/kg dw	0.05	<0.05	0.097	<0.05	0.115	0.093	0.062	0.087	0.155	0.127	0.083	0.1	0.191	0.193	0.072	0.063	0.057	0.072	0.376	0.181	0.077	0.091	0.149	0.067
Total Nickel (Ni)	mg/kg dw	0.05	1.23	1.37	0.679	6.91	2.14	3.31	7.37	2.07	1.16	1.63	1.92	3.27	1.8	3.98	1.75	1.71	3.39	1.87	2.58	1.01	4.03	3.58	4.05
Total Phosphorus (P)	mg/kg dw	10	564	1260	419	807	1270	663	561	726	418	607	717	634	824	714	676	493	699	778	734	617	375	651	553
Total Potassium (K)	mg/kg dw	10	1300	2190	1280	1740	2440	1560	1440	1470	1100	1140	1630	1650	2180	1300	1410	1360	1700	1790	1870	1350	1230	1550	1460
Total Selenium (Se)	mg/kg dw	0.05	<0.05	<0.05	0.089	0.061	0.054	0.053	0.08	0.064	<0.05	0.08	0.055	0.056	<0.05	0.062	0.051	0.057	<0.05	0.082	0.063	<0.05	<0.05	0.072	0.053
Total Silver (Ag)	mg/kg dw	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.022	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total Sodium (Na)	mg/kg dw	10	89	169	31	60	45	82	68	44	59	42	55	46	34	34	50	54	59	57	41	38	35	92	33
Total Strontium (Sr)	mg/kg dw	0.1	8.66	6.55	2.29	10.7	7.92	7.06	9.2	6.78	3.14	10.1	6.54	9.79	8.56	12.1	8.07	6.62	7.28	6.66	10.7	5.68	4.78	10.1	4.47
Total Tellurium (Te)	mg/kg dw	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Thallium (Tl)	mg/kg dw	0.002	0.0433	0.013	0.01	0.0238	0.0112	0.0176	0.0184	0.0177	0.0113	0.022	0.0234	0.0127	0.0086	0.0249	0.0205	0.0137	0.0156	0.0243	0.0152	0.017	0.0245	0.0176	0.0203
Total Thorium (Th)	mg/kg dw	0.05	<0.05	0.089	0.066	0.171	0.076	0.119	0.412	0.193	<0.05	0.107	0.077	0.126	0.076	0.1	0.075	0.111	0.062	0.364	0.155	0.055	0.161	0.251	0.179
Total Tin (Sn)	mg/kg dw	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.22	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Titanium (Ti)	mg/kg dw	1	4.1	10.5	6.1	27	8.8	17.3	41.3	25	5.2	16.5	10.1	8.7	4.5	13.8	13.7	26.7	8.5	34	13.2	6.5	34.5	31.1	40.7
Total Uranium (U)	mg/kg dw	0.002	0.0459	0.0682	0.0399	0.0959	0.0665	0.101	0.148	0.0874	0.0413	0.0513	0.0492	0.138	0.0651	0.0755	0.055	0.0787	0.0549	0.203	0.123	0.0423	0.118	0.171	0.0951
Total Vanadium (V)	mg/kg dw	0.2	<0.2	0.46	<0.2	1.19	0.57	0.74	1.84	0.9	0.28	0.73	0.45	0.66	0.43	0.56	0.49	0.89	0.29	1.07	0.68	0.31	1.25	1.34	1.81
Total Zinc (Zn)	mg/kg dw	0.2	21	40.9	18.2	37.7	31.4	25.3	21.1	23.2	21.6	37.9	26.6	23.8	28.2	40	24.8	21.6	27.7	27.7	26.9	23.2	26.9	30.8	25.7
Total Zirconium (Zr)	mg/kg dw	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Table G-3: Chemistry for Lichen Originals Collected from Far-far-field Locations, 2016

Parameter	Unit	DL	FFF1	FFF2	FFF2	FFF3
			24-Jul-16	24-Jul-16	24-Jul-16	24-Jul-16
			Original	Original	Duplicate	Original
Physical Properties						
Moisture	%	0.3	15	13	6.9	13
Mercury by CVAFS						
Total Mercury (Hg)	mg/kg dw	0.005	0.041	0.0494	0.0303	0.0255
Total Metals by ICPMS						
Total Aluminum (Al)	mg/kg dw	1	281	535	281	186
Total Antimony (Sb)	mg/kg dw	0.005	<0.005	0.0083	0.009	<0.005
Total Arsenic (As)	mg/kg dw	0.05	0.493	0.568	0.992	0.235
Total Barium (Ba)	mg/kg dw	0.1	21.1	29.7	15.4	15.8
Total Beryllium (Be)	mg/kg dw	0.1	<0.1	<0.1	<0.1	<0.1
Total Bismuth (Bi)	mg/kg dw	0.1	<0.1	<0.1	<0.1	<0.1
Total Boron (B)	mg/kg dw	2	<2	<2	<2	<2
Total Cadmium (Cd)	mg/kg dw	0.01	0.076	0.082	0.049	0.03
Total Calcium (Ca)	mg/kg dw	10	1620	2010	1060	887
Total Cesium (Cs)	mg/kg dw	0.1	0.34	0.19	0.3	0.21
Total Chromium (Cr)	mg/kg dw	0.2	1.46	2.14	1.16	0.41
Total Cobalt (Co)	mg/kg dw	0.02	0.854	1.47	0.805	0.243
Total Copper (Cu)	mg/kg dw	0.05	2.73	3.96	2.01	1.91
Total Iron (Fe)	mg/kg dw	10	467	684	362	185
Total Lead (Pb)	mg/kg dw	0.01	0.369	0.669	0.453	0.159
Total Lithium (Li)	mg/kg dw	0.5	<0.5	0.53	<0.5	<0.5
Total Magnesium (Mg)	mg/kg dw	10	523	589	409	342
Total Manganese (Mn)	mg/kg dw	0.1	80.7	76.9	42	28.6
Total Molybdenum (Mo)	mg/kg dw	0.05	0.079	<0.05	<0.05	0.064
Total Nickel (Ni)	mg/kg dw	0.05	3.19	6.01	3.19	0.868
Total Phosphorus (P)	mg/kg dw	10	871	692	562	725
Total Potassium (K)	mg/kg dw	10	2200	1510	1540	1920
Total Selenium (Se)	mg/kg dw	0.05	0.054	0.059	<0.05	<0.05
Total Silver (Ag)	mg/kg dw	0.02	<0.02	<0.02	<0.02	<0.02
Total Sodium (Na)	mg/kg dw	10	135	79	77	48
Total Strontium (Sr)	mg/kg dw	0.1	7.99	8.93	5.7	5.19
Total Tellurium (Te)	mg/kg dw	0.1	<0.1	<0.1	<0.1	<0.1
Total Thallium (Tl)	mg/kg dw	0.002	0.0103	0.0195	0.0094	0.0074
Total Thorium (Th)	mg/kg dw	0.05	0.082	0.111	0.092	0.158
Total Tin (Sn)	mg/kg dw	0.1	<0.1	<0.1	<0.1	<0.1
Total Titanium (Ti)	mg/kg dw	1	9	14.1	7.4	5.2
Total Uranium (U)	mg/kg dw	0.002	0.0395	0.0377	0.0282	0.154
Total Vanadium (V)	mg/kg dw	0.2	0.38	0.73	0.46	0.27
Total Zinc (Zn)	mg/kg dw	0.2	30.9	26.3	26.1	27.2
Total Zirconium (Zr)	mg/kg dw	0.5	<0.5	<0.5	<0.5	<0.5

DL = detection limit; FFF = far-far-field; % = percent; CVAFS = Cold vapour atomic fluorescence spectroscopy; mg/kg dw = milligrams per kilogram dry weight; ICPMS = inductively coupled plasma mass spectrometry; < = less than.

DL = method detection limit; NFF = far-field; % = percent; CVAFS = Cold vapour atomic fluorescence spectroscopy; mg/kg dw = milligrams per kilogram dry weight; ICPMS = inductively coupled plasma mass spectrometry; < = less than.

Table G-4: Relative Percent Difference of Duplicate Lichen Originals, 2016

				FF13			FF9			FFF2			NF13			NF2			NF13			NF2		
Parameter	**Unit**	**DL**	**5*DL**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**	**Original**	**Duplicate**	**RPD**
				21-Jul-16	**21-Jul-16**		**22-Jul-16**	**22-Jul-16**		**24-Jul-16**	**24-Jul-16**		**25-Jul-16**	**25-Jul-16**		**25-Jul-16**	**25-Jul-16**		**25-Jul-16**	**25-Jul-16**		**25-Jul-16**	**25-Jul-16**	
Physical Properties																								
Moisture	%	0.3	1.5	60	61	1.7%	21	23	9.1%	13	6.9	**61.3%**	11	7.5	**37.8%**	12	4.4	**92.7%**	11	7.5	**37.8%**	12	4.4	**92.7%**
Mercury by CVAFS																								
Total Mercury (Hg)	mg/kg dw	0.005	0.025	0.0338	0.022	**42.3%**	0.0615	0.0657	6.6%	0.0494	0.0303	**47.9%**	0.0686	0.0453	**40.9%**	0.031	0.0361	15.2%	0.0686	0.0453	**40.9%**	0.031	0.0361	15.2%
Total Metals by ICPMS																								
Total Aluminum (Al)	mg/kg dw	1	5	448	195	**78.7%**	1020	542	**61.2%**	535	281	**62.3%**	1070	706	**41.0%**	939	937	0.2%	1070	706	**41.0%**	939	937	0.2%
Total Antimony (Sb)	mg/kg dw	0.005	0.025	0.0083	<0.005	-	0.0104	0.0125	-	0.0083	0.009	-	0.0203	0.0188	-	0.0122	0.0128	-	0.0203	0.0188	-	0.0122	0.0128	-
Total Arsenic (As)	mg/kg dw	0.05	0.25	0.595	0.389	**41.9%**	0.611	0.33	**59.7%**	0.568	0.992	**54.4%**	0.351	0.283	21.5%	0.353	0.306	14.3%	0.351	0.283	21.5%	0.353	0.306	14.3%
Total Barium (Ba)	mg/kg dw	0.1	0.5	26.6	23.4	12.8%	34	27.1	22.6%	29.7	15.4	**63.4%**	50	37.3	29.1%	30.4	26.2	14.8%	50	37.3	29.1%	30.4	26.2	14.8%
Total Beryllium (Be)	mg/kg dw	0.1	0.5	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-
Total Bismuth (Bi)	mg/kg dw	0.1	0.5	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	0.14	0.11	-	0.22	0.25	-	0.14	0.11	-	0.22	0.25	-
Total Boron (B)	mg/kg dw	2	10	<2	<2	-	<2	<2	-	<2	<2	-	<2	<2	-	<2	<2	-	<2	<2	-	<2	<2	-
Total Cadmium (Cd)	mg/kg dw	0.01	0.05	0.048	0.037	-	0.096	0.072	28.6%	0.082	0.049	**50.4%**	0.067	0.073	8.6%	0.102	0.081	23.0%	0.067	0.073	8.6%	0.102	0.081	23.0%
Total Calcium (Ca)	mg/kg dw	10	50	1020	539	**61.7%**	2170	1140	**62.2%**	2010	1060	**61.9%**	1890	2110	11.0%	2540	1660	**41.9%**	1890	2110	11.0%	2540	1660	**41.9%**
Total Cesium (Cs)	mg/kg dw	0.1	0.5	0.41	0.37	-	0.22	0.22	-	0.19	0.3	-	0.61	0.48	23.9%	0.91	0.84	8.0%	0.61	0.48	23.9%	0.91	0.84	8.0%
Total Chromium (Cr)	mg/kg dw	0.2	1	0.83	0.3	-	16	2.64	**143.3%**	2.14	1.16	**59.4%**	9.07	5.62	**47.0%**	8.59	7.26	16.8%	9.07	5.62	**47.0%**	8.59	7.26	16.8%
Total Cobalt (Co)	mg/kg dw	0.02	0.1	0.627	0.326	**63.2%**	0.725	0.291	**85.4%**	1.47	0.805	**58.5%**	0.981	0.677	**36.7%**	0.834	0.754	10.1%	0.981	0.677	**36.7%**	0.834	0.754	10.1%
Total Copper (Cu)	mg/kg dw	0.05	0.25	4.32	2.82	**42.0%**	2.41	2.01	18.1%	3.96	2.01	**65.3%**	3.58	2.56	**33.2%**	3.46	2.94	16.3%	3.58	2.56	**33.2%**	3.46	2.94	16.3%
Total Iron (Fe)	mg/kg dw	10	50	575	235	**84.0%**	1030	531	**63.9%**	684	362	**61.6%**	1560	951	**48.5%**	1380	1380	0.0%	1560	951	**48.5%**	1380	1380	0.0%
Total Lead (Pb)	mg/kg dw	0.01	0.05	0.27	0.1	**91.9%**	1.07	0.922	14.9%	0.669	0.453	**38.5%**	0.955	0.891	6.9%	1.56	1.66	6.2%	0.955	0.891	6.9%	1.56	1.66	6.2%
Total Lithium (Li)	mg/kg dw	0.5	2.5	<0.5	<0.5	-	2.03	0.55	-	0.53	<0.5	-	2.24	1.13	-	2.44	2.48	-	2.24	1.13	-	2.44	2.48	-
Total Magnesium (Mg)	mg/kg dw	10	50	351	279	22.9%	596	392	**41.3%**	589	409	**36.1%**	2040	1390	**37.9%**	1250	1060	16.5%	2040	1390	**37.9%**	1250	1060	16.5%
Total Manganese (Mn)	mg/kg dw	0.1	0.5	20.9	28.8	**31.8%**	63.1	43	**37.9%**	76.9	42	**58.7%**	62.3	62.9	1.0%	49.5	40.8	19.3%	62.3	62.9	1.0%	49.5	40.8	19.3%
Total Molybdenum (Mo)	mg/kg dw	0.05	0.25	0.191	0.193	-	0.087	0.155	-	<0.05	<0.05	-	0.514	0.341	**40.5%**	0.636	0.633	0.5%	0.514	0.341	**40.5%**	0.636	0.633	0.5%
Total Nickel (Ni)	mg/kg dw	0.05	0.25	3.27	1.8	**58.0%**	7.37	2.07	**112.3%**	6.01	3.19	**61.3%**	10.9	7.83	**32.8%**	7.25	6.47	11.4%	10.9	7.83	**32.8%**	7.25	6.47	11.4%
Total Phosphorus (P)	mg/kg dw	10	50	634	824	26.1%	561	726	25.6%	692	562	20.7%	1250	1060	16.5%	1150	875	27.2%	1250	1060	16.5%	1150	875	27.2%
Total Potassium (K)	mg/kg dw	10	50	1650	2180	27.7%	1440	1470	2.1%	1510	1540	2.0%	2850	2500	13.1%	2970	2160	**31.6%**	2850	2500	13.1%	2970	2160	**31.6%**
Total Selenium (Se)	mg/kg dw	0.05	0.25	0.056	<0.05	-	0.08	0.064	-	0.059	<0.05	-	<0.05	0.054	-	<0.05	0.058	-	<0.05	0.054	-	<0.05	0.058	-
Total Silver (Ag)	mg/kg dw	0.02	0.1	0.022	<0.02	-	<0.02	<0.02	-	<0.02	<0.02	-	<0.02	<0.02	-	0.022	<0.02	-	<0.02	<0.02	-	0.022	<0.02	-
Total Sodium (Na)	mg/kg dw	10	50	46	34	-	68	44	**42.9%**	79	77	2.6%	75	137	**58.5%**	207	112	**59.6%**	75	137	**58.5%**	207	112	**59.6%**
Total Strontium (Sr)	mg/kg dw	0.1	0.5	9.79	8.56	13.4%	9.2	6.78	**30.3%**	8.93	5.7	**44.2%**	15.4	12.7	19.2%	12.1	9.09	28.4%	15.4	12.7	19.2%	12.1	9.09	28.4%
Total Tellurium (Te)	mg/kg dw	0.1	0.5	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-
Total Thallium (Tl)	mg/kg dw	0.002	0.01	0.0127	0.0086	**38.5%**	0.0184	0.0177	3.9%	0.0195	0.0094	**69.9%**	0.043	0.0237	**57.9%**	0.0376	0.0349	7.4%	0.043	0.0237	**57.9%**	0.0376	0.0349	7.4%
Total Thorium (Th)	mg/kg dw	0.05	0.25	0.126	0.076	-	0.412	0.193	**72.4%**	0.111	0.092	-	0.562	0.345	**47.9%**	0.579	0.597	3.1%	0.562	0.345	**47.9%**	0.579	0.597	3.1%
Total Tin (Sn)	mg/kg dw	0.1	0.5	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-
Total Titanium (Ti)	mg/kg dw	1	5	8.7	4.5	**63.6%**	41.3	25	**49.2%**	14.1	7.4	**62.3%**	70.2	46.1	**41.4%**	63.8	64	0.3%	70.2	46.1	**41.4%**	63.8	64	0.3%
Total Uranium (U)	mg/kg dw	0.002	0.01	0.138	0.0651	**71.8%**	0.148	0.0874	**51.5%**	0.0377	0.0282	28.8%	0.658	0.468	**33.7%**	1.19	1.28	7.3%	0.658	0.468	**33.7%**	1.19	1.28	7.3%
Total Vanadium (V)	mg/kg dw	0.2	1	0.66	0.43	-	1.84	0.9	**68.6%**	0.73	0.46	-	2.03	1.25	**47.6%**	1.6	1.56	2.5%	2.03	1.25	**47.6%**	1.6	1.56	2.5%
Total Zinc (Zn)	mg/kg dw	0.2	1	23.8	28.2	16.9%	21.1	23.2	9.5%	26.3	26.1	0.8%	32.7	27.5	17.3%	33.8	25.7	**27.2%**	32.7	27.5	17.3%	33.8	25.7	**27.2%**
Total Zirconium (Zr)	mg/kg dw	0.5	2.5	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	-	1.12	0.66	-	1.37	1.28	-	1.12	0.66	-	1.37	1.28	-

Notes

- = no data or not applicable.

Bolded RPD values are greater than 30% and the mean is greater than 5*DL.

DL = method detection limit; FF = far-field; FFF = far-far-field; NF = near-field; RPD = relative percent difference; % = percent; CVAFS = Cold vapour atomic fluorescence spectroscopy; mg/kg dw = milligrams per kilogram dry weight; ICPMS = inductively coupled plasma mass spectrometry; < = less than.

Table G-5: Total Mercury in Soil Collected with the Lichen Samples, 2016

Near-field Stations

NF1-16S	NF2-16S	NF2-16SB	NF3-16S	NF4-16S	NF5-16S	NF6-16S	NF7-16S	NF8-16S	NF9-16S	NF10-16S	NF11-16S	NF12-16S	NF13-16S	NF13-16SB	NF14-16S	NF15-16S	NF16-16S	NF17-16S	NF18-16S	NF19-16S	NF20-16S	NF21-16S	NF22-16S	NF23-16S
25/07/2016	25/07/2016	25/07/2016	25/07/2016	25/07/2016	24/07/2016	26/07/2016	26/07/2016	26/07/2016	23/07/2016	25/07/2016	26/07/2016	26/07/2016	25/07/2016	Duplicate	23/07/2016	24/07/2016	23/07/2016	23/07/2016	24/07/2016	26/07/2016	23/07/2016	23/07/2016	23/07/2016	23/07/2016
Original	Original	Duplicate	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original
<0.0050	0.0094	0.0076	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0059	0.0315	<0.0050	<0.0050	<0.0050	0.0051	0.0065	<0.0050	0.107	0.0072	0.0735	0.0163	<0.0050	<0.0050	<0.0050	<0.0050	0.0146

Far-field Stations

FF1-16S	FF2-16S	FF3-16S	FF5-16S	FF7-16S	FF8-16S	FF9-16S	FF9-16SB	FF10-16S	FF11-16S	FF12-16S	FF13-16S	FF13-16SB	FF14-16S	FF15-16S	FF17-16S	FF19-16S	FF20-16S	FF21-16S	FF22-16S	FF23-16S	FF24-16S	FF25-16S
23/07/2016	22/07/2016	23/07/2016	22/07/2016	22/07/2016	22/07/2016	22/07/2016	22/07/2016	21/07/2016	21/07/2016	21/07/2016	21/07/2016	21/07/2016	21/07/2016	21/07/2016	22/07/2016	21/07/2016	21/07/2016	21/07/2016	21/07/2016	22/07/2016	22/07/2016	22/07/2016
Original	Original	Original	Original	Original	Original	Original	Duplicate	Original	Original	Original	Original	Duplicate	Original	Original	Original	Original	Original	Original	Original	Original	Original	Original
0.062	0.0106	<0.0050	0.0051	<0.0050	<0.0050	0.017	0.0078	<0.0050	0.0101	<0.0050	<0.0050	<0.0050	<0.0050	0.164	<0.0050	0.0212	0.0071	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Far-far-field Stations

FFF1-16S	FFF2-16S	FFF2-16SB	FFF3-16S
24/07/2016	24/07/2016	Duplicate	24/07/2016
Original	Original	Original	Original
<0.0050	0.0122	<0.0050	<0.0050

Notes:

Units are mg/kg dw (milligram per kilogram dry weight). Detection limit is 0.005 mg/kg dw.

NF = near-field; 16S = 2016 Sample; 16SB = 2016 duplicate sample; FF = far-field; FFF = far-far-field.

Your Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Your C.O.C. #: 08425880, 08425879

Attention:Kerrie Serben
GOLDER ASSOCIATES LTD
1721 8TH Street East
Saskatoon, SK
Canada

Report Date: 2016/08/24
Report #: R2246071
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B663374
Received: 2016/07/29, 12:10

Sample Matrix: Soil
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Soil by CVAF	6	2016/08/12	2016/08/12	BBY7SOP-00012	EPA 245.7 R2 m

Sample Matrix: Tissue (Plant)
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Tissue by CVAF - Dry Wt	5	N/A	2016/08/19	BBY7SOP-00012	EPA 245.7 R2 m
Mercury in Tissue by CVAF - Dry Wt	1	N/A	2016/08/24	BBY7SOP-00012	EPA 245.7 R2 m
Elements in Tissue by CRC ICPMS - Dry Wt	6	2016/08/11	2016/08/17	BBY7SOP-00002	EPA 6020A R1 m
Moisture in Tissue	6	N/A	2016/08/10	BBY8SOP-00017	OMOE E3139 3.1 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Tabitha Rudkin
Burnaby Project Manager
24 Aug 2016 18:43:25 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Tabitha Rudkin, AScT, Burnaby Project Manager
Email: TRudkin@maxxam.ca
Phone# (604)638-2639

cosign

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total Cover Pages : 1

MERCURY BY COLD VAPOR (SOIL)

Maxxam ID		PD6207	PD6208	PD6209	PD6210	PD6211	PD6212		
Sampling Date		2016/07/26 08:09	2016/07/26 09:36	2016/07/26 11:10	2016/07/26 12:40	2016/07/26 14:00	2016/07/26 17:00		
COC Number		08425880	08425880	08425880	08425880	08425880	08425880		
	UNITS	**NF19-16S**	**NF8-16S**	**NF6-16S**	**NF7-16S**	**NF12-16S**	**NF11-16S**	**RDL**	**QC Batch**
Elements									
Total Mercury (Hg)	mg/kg	<0.0050	0.0059	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	8360329
RDL = Reportable Detection Limit									

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE (PLANT))

Maxxam ID		PD6213	PD6214	PD6215	PD6216	PD6217	PD6218		
Sampling Date		2016/07/26 08:09	2016/07/26 09:36	2016/07/26 11:10	2016/07/26 12:40	2016/07/26 14:00	2016/07/26 17:00		
COC Number		08425879	08425879	08425879	08425879	08425879	08425879		
	UNITS	**NF19-16L**	**NF8-16L**	**NF6-16L**	**NF7-16L**	**NF12-16L**	**NF11-16L**	**RDL**	**QC Batch**
Mercury by CVAA									
Total Mercury (Hg)	mg/kg	0.0476	0.0273	0.0287	0.0364	0.0265	0.0279	0.0050	8359943
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	1110	1430	835	941	1530	974	1.0	8359825
Total Antimony (Sb)	mg/kg	0.0457	0.0287	0.0178	0.0232	0.0267	0.0308	0.0050	8359825
Total Arsenic (As)	mg/kg	0.431	0.396	0.220	0.329	0.458	0.255	0.050	8359825
Total Barium (Ba)	mg/kg	42.7	52.1	31.1	49.3	37.1	25.8	0.10	8359825
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8359825
Total Bismuth (Bi)	mg/kg	0.27	0.18	0.14	0.15	0.34	0.38	0.10	8359825
Total Boron (B)	mg/kg	<2.0	2.0	<2.0	<2.0	2.5	<2.0	2.0	8359825
Total Cadmium (Cd)	mg/kg	0.076	0.062	0.088	0.061	0.047	0.062	0.010	8359825
Total Calcium (Ca)	mg/kg	3670	2380	2470	3310	2990	2950	10	8359825
Total Cesium (Cs)	mg/kg	0.67	0.58	0.87	0.56	1.05	0.76	0.10	8359825
Total Chromium (Cr)	mg/kg	12.0	14.1	7.89	10.9	13.4	8.61	0.20	8359825
Total Cobalt (Co)	mg/kg	1.33	1.80	0.974	1.51	1.20	0.969	0.020	8359825
Total Copper (Cu)	mg/kg	3.03	3.42	2.68	3.12	4.23	3.17	0.050	8359825
Total Iron (Fe)	mg/kg	1880	2110	1460	1640	2670	1360	10	8359825
Total Lead (Pb)	mg/kg	1.75	1.43	1.24	1.34	1.71	2.13	0.010	8359825
Total Lithium (Li)	mg/kg	2.79	3.01	2.54	2.33	4.46	2.75	0.50	8359825
Total Magnesium (Mg)	mg/kg	3090	4240	1960	3860	2550	1820	10	8359825
Total Manganese (Mn)	mg/kg	54.9	63.9	61.3	96.2	55.1	64.6	0.10	8359825
Total Molybdenum (Mo)	mg/kg	0.804	0.944	0.729	0.847	1.16	0.683	0.050	8359825
Total Nickel (Ni)	mg/kg	19.3	23.7	11.9	21.8	13.1	10.7	0.050	8359825
Total Phosphorus (P)	mg/kg	746	639	945	883	902	743	10	8359825
Total Potassium (K)	mg/kg	2020	1720	2200	2160	2440	1900	10	8359825
Total Selenium (Se)	mg/kg	0.060	0.051	<0.050	0.063	0.067	0.059	0.050	8359825
Total Silver (Ag)	mg/kg	<0.020	0.024	<0.020	0.027	0.032	0.027	0.020	8359825
Total Sodium (Na)	mg/kg	131	79	200	169	107	154	10	8359825
Total Strontium (Sr)	mg/kg	19.2	17.0	13.8	20.3	15.9	11.1	0.10	8359825
Total Tellurium (Te)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8359825
Total Thallium (Tl)	mg/kg	0.0443	0.0415	0.0321	0.0349	0.0536	0.0392	0.0020	8359825
Total Thorium (Th)	mg/kg	0.668	0.798	0.586	0.583	1.15	0.823	0.050	8359825
RDL = Reportable Detection Limit									

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE (PLANT))

Maxxam ID		PD6213	PD6214	PD6215	PD6216	PD6217	PD6218		
Sampling Date		2016/07/26 08:09	2016/07/26 09:36	2016/07/26 11:10	2016/07/26 12:40	2016/07/26 14:00	2016/07/26 17:00		
COC Number		08425879	08425879	08425879	08425879	08425879	08425879		
	UNITS	**NF19-16L**	**NF8-16L**	**NF6-16L**	**NF7-16L**	**NF12-16L**	**NF11-16L**	**RDL**	**QC Batch**
Total Tin (Sn)	mg/kg	0.12	0.12	<0.10	<0.10	0.14	0.10	0.10	8359825
Total Titanium (Ti)	mg/kg	85.3	85.5	68.0	73.6	104	77.3	1.0	8359825
Total Uranium (U)	mg/kg	0.933	0.851	0.909	0.678	1.60	1.38	0.0020	8359825
Total Vanadium (V)	mg/kg	2.28	2.74	1.64	2.06	3.09	1.86	0.20	8359825
Total Zinc (Zn)	mg/kg	23.0	22.4	29.4	23.1	29.7	19.6	0.20	8359825
Total Zirconium (Zr)	mg/kg	1.64	1.81	1.18	1.56	2.47	1.61	0.50	8359825
RDL = Reportable Detection Limit									

PHYSICAL TESTING (TISSUE (PLANT))

Maxxam ID		PD6213	PD6214	PD6215	PD6216	PD6217	PD6218		
Sampling Date		2016/07/26 08:09	2016/07/26 09:36	2016/07/26 11:10	2016/07/26 12:40	2016/07/26 14:00	2016/07/26 17:00		
COC Number		08425879	08425879	08425879	08425879	08425879	08425879		
	UNITS	**NF19-16L**	**NF8-16L**	**NF6-16L**	**NF7-16L**	**NF12-16L**	**NF11-16L**	**RDL**	**QC Batch**
Physical Properties									
Moisture	%	20	34	35	43	69	64	0.30	8355958
RDL = Reportable Detection Limit									

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.3°C

Results relate only to the items tested.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8355958	Moisture	2016/08/10					<0.30	%	1.4	20		
8359825	Total Aluminum (Al)	2016/08/17					<1.0	mg/kg	9.0	35	37	17 - 93
8359825	Total Antimony (Sb)	2016/08/17	103	75 - 125	105	75 - 125	<0.0050	mg/kg	NC	35		
8359825	Total Arsenic (As)	2016/08/17	109	75 - 125	111	75 - 125	<0.050	mg/kg	5.5	35	84	42 - 199
8359825	Total Barium (Ba)	2016/08/17	NC	75 - 125	112	75 - 125	<0.10	mg/kg	1.5	35		
8359825	Total Beryllium (Be)	2016/08/17	115	75 - 125	103	75 - 125	<0.10	mg/kg	NC	35		
8359825	Total Bismuth (Bi)	2016/08/17					<0.10	mg/kg	NC	35		
8359825	Total Boron (B)	2016/08/17					<2.0	mg/kg	NC	35	92	75 - 125
8359825	Total Cadmium (Cd)	2016/08/17	109	75 - 125	104	75 - 125	<0.010	mg/kg	NC	35	95	75 - 125
8359825	Total Calcium (Ca)	2016/08/17					<10	mg/kg	9.0	35	99	75 - 125
8359825	Total Cesium (Cs)	2016/08/17					<0.10	mg/kg				
8359825	Total Chromium (Cr)	2016/08/17	NC	75 - 125	103	75 - 125	<0.20	mg/kg	3.5	35		
8359825	Total Cobalt (Co)	2016/08/17	94	75 - 125	104	75 - 125	<0.020	mg/kg	5.4	35	85	75 - 125
8359825	Total Copper (Cu)	2016/08/17	94	75 - 125	104	75 - 125	<0.050	mg/kg	0.31	35	91	75 - 125
8359825	Total Iron (Fe)	2016/08/17					<10	mg/kg	2.0	35		
8359825	Total Lead (Pb)	2016/08/17	104	75 - 125	105	75 - 125	<0.010	mg/kg	4.0	35		
8359825	Total Lithium (Li)	2016/08/17	110	75 - 125	111	75 - 125	<0.50	mg/kg				
8359825	Total Magnesium (Mg)	2016/08/17					<10	mg/kg	5.6	35		
8359825	Total Manganese (Mn)	2016/08/17	NC	75 - 125	106	75 - 125	<0.10	mg/kg	0.27	35	96	75 - 125
8359825	Total Molybdenum (Mo)	2016/08/17	105	75 - 125	101	75 - 125	<0.050	mg/kg	3.6	35		
8359825	Total Nickel (Ni)	2016/08/17	NC	75 - 125	106	75 - 125	<0.050	mg/kg	3.3	35	79	75 - 125
8359825	Total Phosphorus (P)	2016/08/17					<10	mg/kg	0.17	35	120	75 - 125
8359825	Total Potassium (K)	2016/08/17					<10	mg/kg	0.41	35	108	75 - 125
8359825	Total Selenium (Se)	2016/08/17	109	75 - 125	109	75 - 125	<0.050	mg/kg	NC	35	94	75 - 125
8359825	Total Silver (Ag)	2016/08/17	95	75 - 125	95	75 - 125	<0.020	mg/kg	NC	35		
8359825	Total Sodium (Na)	2016/08/17					<10	mg/kg	15	35	104	75 - 125
8359825	Total Strontium (Sr)	2016/08/17	NC	75 - 125	103	75 - 125	<0.10	mg/kg	0.79	35	97	75 - 125
8359825	Total Tellurium (Te)	2016/08/17					<0.10	mg/kg				
8359825	Total Thallium (Tl)	2016/08/17	110	75 - 125	108	75 - 125	<0.0020	mg/kg	0.25	35		
8359825	Total Thorium (Th)	2016/08/17					<0.050	mg/kg				
8359825	Total Tin (Sn)	2016/08/17	93	75 - 125	89	75 - 125	<0.10	mg/kg	NC	35		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8359825	Total Titanium (Ti)	2016/08/17	NC	75 - 125	112	75 - 125	<1.0	mg/kg	1.8	35		
8359825	Total Uranium (U)	2016/08/17	104	75 - 125	103	75 - 125	<0.0020	mg/kg	3.7	35		
8359825	Total Vanadium (V)	2016/08/17	95	75 - 125	104	75 - 125	<0.20	mg/kg	6.1	35		
8359825	Total Zinc (Zn)	2016/08/17	NC	75 - 125	111	75 - 125	<0.20	mg/kg	0.88	35	95	75 - 125
8359825	Total Zirconium (Zr)	2016/08/17					<0.50	mg/kg				
8359943	Total Mercury (Hg)	2016/08/24	97	75 - 125	105	75 - 125	<0.010	mg/kg	1.2	20	101	75 - 125
8360329	Total Mercury (Hg)	2016/08/12	98	75 - 125	108	75 - 125	<0.010	mg/kg	NC	35	103	70 - 130

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Rob Reinert, B.Sc., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

08425879

Maxxam
A Bureau Veritas Group Company

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

BBY FCD-00077/06
Page 2 of 2

Invoice Information

Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5536
Email: david.wells@riotinto.com

Report Information (if differs from invoice)

Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 206 202 7817 (cell if urgent)
Email: kserben@golder.com

Project Information (where applicable)

Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required

☑ Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)
☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days

Date Required:
Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

Analysis Requested

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TIC ☐ TC ☐ TOC	Cation Exchange Capacity	Available Nitrate	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	NF19-16L	2016/07/26	0809	tissue	X	X	X							
2	NF8-16L	2016/07/26	0936	tissue	X	X	X							
3	NF6-16L	2016/07/26	1110	tissue	X	X	X							
4	NF7-16L	2016/07/26	12^{40}	tissue	X	X	X							
5	NF12-16L	2016/07/26	14^{00}	tissue	X	X	X							
6	NF11-16L	2016/07/26	17^{00}	tissue	X	X	X							
7				tissue	X	X	X							
8				tissue	X	X	X							
9				tissue	X	X	X							
10				tissue	X	X	X							

LABORATORY USE ONLY

CUSTODY SEAL Y / [✓ N]		COOLER TEMPERATURES
Present	Intact	
N	N	6,3,8
Y	Y	9,4,9

BBY

COOLING MEDIA PRESENT [✓ Y] / N

COMMENTS

Do NOT wash the lichen samples before analysis.

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C.SHAPKA	2016/07/28	0630	David Tidmar	2016/07/29	12:10
ALYSSA HLEBL	2016/07/29	1709	Nahed Amer	2016/07/30	12:30

B663374_COC

1326

08425880

Maxxam
A Bureau Veritas Group Company

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

BBY FCD-00077/06
Page 1 of 2

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)	
Company Name:	Diavik Diamond Mines (DDMI)	Company Name:	Golder Associates Ltd.	Quotation #:	B61006
Contact Name:	David Wells	Contact Name:	Kerrie Serben	P.O. #/ AFE#:	
Address:	P.O. Box 2498 5007-50th Ave Yellowknife	Address:	1721 8th Street East	Project #:	Golder Project #1648005 Phase 2000
	NWT PC:		Saskatoon, SK PC:	Site Location:	Diavik Mine
Phone:	867 669 6500 ext 5536	Phone:	306 667 1531 (office) 206 202 7817 (cell if urgent)	Site #:	
Email:	david.wells@riotinto.com	Email:	kserben@golder.com	Sampled By:	Chris Shapka

Turnaround Time (TAT) Required

☑ Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days

Date Required:

Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TOC ☐ TC ☐ TIC	Cation Exchange Capacity	Available Nitrate	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	NF19-16S	2016/07/26	0809	soil		X								
2	NF8-16S	2016/07/26	0936	soil		X								
3	NF6-16S	2016/07/26	1110	soil		X								
4	NF7-16S	2016/07/26	1240	soil		X								
5	NF12-16S	2016/07/26	1400	soil		X								
6	NF11-16S	2016/07/26	1700	soil		X								
7				soil		X								
8				soil		X								
9				soil		X								
10				soil		X								

LABORATORY USE ONLY

CUSTODY SEAL Y [✓ N]		COOLER TEMPERATURES
Present	Intact	
		6, 3, 8
4	4	9, 4, 9

BBY

COOLING MEDIA PRESENT [✓ Y] / N

COMMENTS

Maxxam - Take a sub-sample and analyze it for mercury; archive remaining sample for possible future metals analysis.

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C.S HAPKA	2016/07/28	0630	David Tidman	2016/07/29	12:10
ANIKA FIUPL	20160729	1739	Nahed Amer	2016/07/30	12:30

B663374_COC

Your Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Your C.O.C. #: 08425881, 08425882

Attention:Kerrie Serben
GOLDER ASSOCIATES LTD
1721 8TH Street East
Saskatoon, SK
Canada

Report Date: 2016/08/19
Report #: R2241801
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B663413
Received: 2016/07/29, 12:10

Sample Matrix: Soil
Samples Received: 10

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Soil by CVAF	10	2016/08/04	2016/08/05	BBY7SOP-00012	EPA 245.7 R2 m

Sample Matrix: TISSUE
Samples Received: 10

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Tissue by CVAF - Dry Wt	10	N/A	2016/08/19	BBY7SOP-00012	EPA 245.7 R2 m
Elements in Tissue by CRC ICPMS - Dry Wt	10	2016/08/15	2016/08/18	BBY7SOP-00002	EPA 6020A R1 m
Moisture in Tissue	10	N/A	2016/08/18	BBY8SOP-00017	OMOE E3139 3.1 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Tabitha Rudkin
Burnaby Project Manager
19 Aug 2016 18:23:13 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Tabitha Rudkin, AScT, Burnaby Project Manager
Email: TRudkin@maxxam.ca
Phone# (604)638-2639
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total Cover Pages : 1

MERCURY BY COLD VAPOR (SOIL)

Maxxam ID		PD6467	PD6468	PD6469	PD6470	PD6471	PD6472		
Sampling Date		2016/07/22 08:41	2016/07/22 09:47	2016/07/22 10:02	2016/07/22 11:20	2016/07/22 12:32	2016/07/22 14:00		
COC Number		08425881	08425881	08425881	08425881	08425881	08425881		
	UNITS	**FF24-16S**	**FF9-16S**	**FF9-16SB**	**FF23-16S**	**FF8-16S**	**FF5-16S**	**RDL**	**QC Batch**
Elements									
Total Mercury (Hg)	mg/kg	<0.0050	0.0170	0.0078	<0.0050	<0.0050	0.0051	0.0050	8350895
RDL = Reportable Detection Limit									

Maxxam ID		PD6473	PD6474	PD6475	PD6476		
Sampling Date		2016/07/22 15:21	2016/07/22 16:12	2016/07/22 17:02	2016/07/22 17:54		
COC Number		08425881	08425881	08425881	08425881		
	UNITS	**FF25-16S**	**FF7-16S**	**FF2-16S**	**FF17-16S**	**RDL**	**QC Batch**
Elements							
Total Mercury (Hg)	mg/kg	<0.0050	<0.0050	0.0106	<0.0050	0.0050	8350895
RDL = Reportable Detection Limit							

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PD6477	PD6478	PD6479	PD6480	PD6481	PD6482	PD6483		
Sampling Date		2016/07/22 08:41	2016/07/22 09:47	2016/07/22 10:20	2016/07/22 11:20	2016/07/22 12:32	2016/07/22 14:00	2016/07/22 15:07		
COC Number		08425882	08425882	08425882	08425882	08425882	08425882	08425882		
	UNITS	**FF24-16L**	**FF9-16L**	**FF9-16LB**	**FF23-16L**	**FF8-16L**	**FF5-16L**	**FF25-16L**	**RDL**	**QC Batch**
Mercury by CVAA										
Total Mercury (Hg)	mg/kg	0.0486 (1)	0.0615	0.0657	0.0308	0.0606	0.0635	0.0598	0.0050	8363157
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	723	1020	542	537	373	641	841	1.0	8363112
Total Antimony (Sb)	mg/kg	0.0119	0.0104	0.0125	<0.0050	0.0126	0.0122	0.0095	0.0050	8363112
Total Arsenic (As)	mg/kg	0.407	0.611	0.330	0.262	0.374	0.595	0.817	0.050	8363112
Total Barium (Ba)	mg/kg	31.4	34.0	27.1	17.2	34.2	42.0	24.0	0.10	8363112
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363112
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363112
Total Boron (B)	mg/kg	2.1	<2.0	<2.0	2.4	<2.0	2.9	<2.0	2.0	8363112
Total Cadmium (Cd)	mg/kg	0.070	0.096	0.072	0.112	0.080	0.114	0.077	0.010	8363112
Total Calcium (Ca)	mg/kg	1790	2170	1140	990	2240	1890	1090	10	8363112
Total Cesium (Cs)	mg/kg	0.22	0.22	0.22	0.54	0.23	0.22	0.30	0.10	8363112
Total Chromium (Cr)	mg/kg	4.49	16.0	2.64	4.29	2.41	2.76	3.06	0.20	8363112
Total Cobalt (Co)	mg/kg	0.925	0.725	0.291	0.893	0.688	1.42	0.995	0.020	8363112
Total Copper (Cu)	mg/kg	2.95	2.41	2.01	1.77	2.97	4.92	3.71	0.050	8363112
Total Iron (Fe)	mg/kg	867	1030	531	658	463	698	999	10	8363112
Total Lead (Pb)	mg/kg	0.880	1.07	0.922	0.266	0.830	0.977	1.39	0.010	8363112
Total Lithium (Li)	mg/kg	0.90	2.03	0.55	3.48	0.51	0.77	0.86	0.50	8363112
Total Magnesium (Mg)	mg/kg	743	596	392	516	588	657	571	10	8363112
Total Manganese (Mn)	mg/kg	75.4	63.1	43.0	121	145	123	64.6	0.10	8363112
Total Molybdenum (Mo)	mg/kg	0.149	0.087	0.155	0.091	0.062	0.115	0.067	0.050	8363112
Total Nickel (Ni)	mg/kg	3.58	7.37	2.07	4.03	3.31	6.91	4.05	0.050	8363112
Total Phosphorus (P)	mg/kg	651	561	726	375	663	807	553	10	8363112
Total Potassium (K)	mg/kg	1550	1440	1470	1230	1560	1740	1460	10	8363112
Total Selenium (Se)	mg/kg	0.072	0.080	0.064	<0.050	0.053	0.061	0.053	0.050	8363112
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8363112
Total Sodium (Na)	mg/kg	92	68	44	35	82	60	33	10	8363112
Total Strontium (Sr)	mg/kg	10.1	9.20	6.78	4.78	7.06	10.7	4.47	0.10	8363112
Total Tellurium (Te)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363112
Total Thallium (Tl)	mg/kg	0.0176	0.0184	0.0177	0.0245	0.0176	0.0238	0.0203	0.0020	8363112

RDL = Reportable Detection Limit

(1) Matrix Spike (Mercury) outside acceptance criteria due to sample matrix interference re-analysis yields similar results

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PD6477	PD6478	PD6479	PD6480	PD6481	PD6482	PD6483		
Sampling Date		2016/07/22 08:41	2016/07/22 09:47	2016/07/22 10:20	2016/07/22 11:20	2016/07/22 12:32	2016/07/22 14:00	2016/07/22 15:07		
COC Number		08425882	08425882	08425882	08425882	08425882	08425882	08425882		
	UNITS	**FF24-16L**	**FF9-16L**	**FF9-16LB**	**FF23-16L**	**FF8-16L**	**FF5-16L**	**FF25-16L**	**RDL**	**QC Batch**
Total Thorium (Th)	mg/kg	0.251	0.412	0.193	0.161	0.119	0.171	0.179	0.050	8363112
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363112
Total Titanium (Ti)	mg/kg	31.1	41.3	25.0	34.5	17.3	27.0	40.7	1.0	8363112
Total Uranium (U)	mg/kg	0.171	0.148	0.0874	0.118	0.101	0.0959	0.0951	0.0020	8363112
Total Vanadium (V)	mg/kg	1.34	1.84	0.90	1.25	0.74	1.19	1.81	0.20	8363112
Total Zinc (Zn)	mg/kg	30.8	21.1	23.2	26.9	25.3	37.7	25.7	0.20	8363112
Total Zirconium (Zr)	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8363112

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PD6484	PD6485	PD6486		
Sampling Date		2016/07/22 16:10	2016/07/22 17:02	2016/07/22 17:54		
COC Number		08425882	08425882	08425882		
	UNITS	**FF7-16L**	**FF2-16L**	**FF17-16L**	**RDL**	**QC Batch**
Mercury by CVAA						
Total Mercury (Hg)	mg/kg	0.0397	0.0541	0.0527	0.0050	8363157
Total Metals by ICPMS						
Total Aluminum (Al)	mg/kg	356	275	460	1.0	8363112
Total Antimony (Sb)	mg/kg	<0.0050	0.0073	0.0075	0.0050	8363112
Total Arsenic (As)	mg/kg	0.538	0.358	0.492	0.050	8363112
Total Barium (Ba)	mg/kg	30.1	22.0	15.6	0.10	8363112
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	0.10	8363112
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	0.10	8363112
Total Boron (B)	mg/kg	2.3	<2.0	<2.0	2.0	8363112
Total Cadmium (Cd)	mg/kg	0.041	0.106	0.073	0.010	8363112
Total Calcium (Ca)	mg/kg	441	1250	1260	10	8363112
Total Cesium (Cs)	mg/kg	0.40	0.36	0.22	0.10	8363112
Total Chromium (Cr)	mg/kg	0.64	0.93	1.74	0.20	8363112
Total Cobalt (Co)	mg/kg	0.482	0.434	0.747	0.020	8363112
Total Copper (Cu)	mg/kg	3.03	2.54	1.58	0.050	8363112
Total Iron (Fe)	mg/kg	391	306	491	10	8363112
Total Lead (Pb)	mg/kg	0.172	0.421	0.486	0.010	8363112
Total Lithium (Li)	mg/kg	<0.50	<0.50	0.61	0.50	8363112
Total Magnesium (Mg)	mg/kg	328	600	583	10	8363112
Total Manganese (Mn)	mg/kg	21.4	75.2	65.7	0.10	8363112
Total Molybdenum (Mo)	mg/kg	0.093	0.097	0.057	0.050	8363112
Total Nickel (Ni)	mg/kg	2.14	1.37	1.71	0.050	8363112
Total Phosphorus (P)	mg/kg	1270	1260	493	10	8363112
Total Potassium (K)	mg/kg	2440	2190	1360	10	8363112
Total Selenium (Se)	mg/kg	0.054	<0.050	0.057	0.050	8363112
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	0.020	8363112
Total Sodium (Na)	mg/kg	45	169	54	10	8363112
Total Strontium (Sr)	mg/kg	7.92	6.55	6.62	0.10	8363112
Total Tellurium (Te)	mg/kg	<0.10	<0.10	<0.10	0.10	8363112
Total Thallium (Tl)	mg/kg	0.0112	0.0130	0.0137	0.0020	8363112
Total Thorium (Th)	mg/kg	0.076	0.089	0.111	0.050	8363112

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PD6484	PD6485	PD6486		
Sampling Date		2016/07/22 16:10	2016/07/22 17:02	2016/07/22 17:54		
COC Number		08425882	08425882	08425882		
	UNITS	**FF7-16L**	**FF2-16L**	**FF17-16L**	**RDL**	**QC Batch**
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	0.10	8363112
Total Titanium (Ti)	mg/kg	8.8	10.5	26.7	1.0	8363112
Total Uranium (U)	mg/kg	0.0665	0.0682	0.0787	0.0020	8363112
Total Vanadium (V)	mg/kg	0.57	0.46	0.89	0.20	8363112
Total Zinc (Zn)	mg/kg	31.4	40.9	21.6	0.20	8363112
Total Zirconium (Zr)	mg/kg	<0.50	<0.50	<0.50	0.50	8363112
RDL = Reportable Detection Limit						

PHYSICAL TESTING (TISSUE)

Maxxam ID		PD6477	PD6478	PD6479	PD6480	PD6481	PD6482	PD6483		
Sampling Date		2016/07/22 08:41	2016/07/22 09:47	2016/07/22 10:20	2016/07/22 11:20	2016/07/22 12:32	2016/07/22 14:00	2016/07/22 15:07		
COC Number		08425882	08425882	08425882	08425882	08425882	08425882	08425882		
	UNITS	**FF24-16L**	**FF9-16L**	**FF9-16LB**	**FF23-16L**	**FF8-16L**	**FF5-16L**	**FF25-16L**	**RDL**	**QC Batch**
Physical Properties										
Moisture	%	46	21	23	53	20	36	25	0.30	8366315

RDL = Reportable Detection Limit

Maxxam ID		PD6484	PD6485	PD6486		
Sampling Date		2016/07/22 16:10	2016/07/22 17:02	2016/07/22 17:54		
COC Number		08425882	08425882	08425882		
	UNITS	**FF7-16L**	**FF2-16L**	**FF17-16L**	**RDL**	**QC Batch**
Physical Properties						
Moisture	%	38	38	27	0.30	8366315

RDL = Reportable Detection Limit

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.0°C

Results relate only to the items tested.

Maxxam Job #: B663413
Report Date: 2016/08/19

QUALITY ASSURANCE REPORT

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8350895	Total Mercury (Hg)	2016/08/05	88	75 - 125	87	75 - 125	<0.0050	mg/kg	NC	35	88	N/A
8363112	Total Aluminum (Al)	2016/08/18					<1.0	mg/kg	7.9	35	39	17 - 93
8363112	Total Antimony (Sb)	2016/08/18	105	75 - 125	105	75 - 125	<0.0050	mg/kg	NC	35		
8363112	Total Arsenic (As)	2016/08/18	100	75 - 125	102	75 - 125	<0.050	mg/kg	2.7	35	84	42 - 199
8363112	Total Barium (Ba)	2016/08/18	NC	75 - 125	112	75 - 125	<0.10	mg/kg	3.0	35		
8363112	Total Beryllium (Be)	2016/08/18	119	75 - 125	112	75 - 125	<0.10	mg/kg	NC	35		
8363112	Total Bismuth (Bi)	2016/08/18					<0.10	mg/kg	NC	35		
8363112	Total Boron (B)	2016/08/18					<2.0	mg/kg	NC	35	115	75 - 125
8363112	Total Cadmium (Cd)	2016/08/18	105	75 - 125	103	75 - 125	<0.010	mg/kg	0.34	35	98	75 - 125
8363112	Total Calcium (Ca)	2016/08/18					<10	mg/kg	1.2	35	93	75 - 125
8363112	Total Cesium (Cs)	2016/08/18					<0.10	mg/kg	NC	N/A		
8363112	Total Chromium (Cr)	2016/08/18	NC	75 - 125	97	75 - 125	<0.20	mg/kg	5.8	35		
8363112	Total Cobalt (Co)	2016/08/18	93	75 - 125	98	75 - 125	<0.020	mg/kg	2.5	35	86	75 - 125
8363112	Total Copper (Cu)	2016/08/18	NC	75 - 125	100	75 - 125	<0.050	mg/kg	5.1	35	95	75 - 125
8363112	Total Iron (Fe)	2016/08/18					<10	mg/kg	8.0	35		
8363112	Total Lead (Pb)	2016/08/18	99	75 - 125	101	75 - 125	<0.010	mg/kg	1.6	35		
8363112	Total Lithium (Li)	2016/08/18	113	75 - 125	112	75 - 125	<0.50	mg/kg	NC	35		
8363112	Total Magnesium (Mg)	2016/08/18					<10	mg/kg	4.6	35		
8363112	Total Manganese (Mn)	2016/08/18	NC	75 - 125	102	75 - 125	<0.10	mg/kg	3.6	35	97	75 - 125
8363112	Total Molybdenum (Mo)	2016/08/18	100	75 - 125	103	75 - 125	<0.050	mg/kg	NC	35		
8363112	Total Nickel (Ni)	2016/08/18	NC	75 - 125	99	75 - 125	<0.050	mg/kg	2.3	35	81	75 - 125
8363112	Total Phosphorus (P)	2016/08/18					<10	mg/kg	2.5	35	111	75 - 125
8363112	Total Potassium (K)	2016/08/18					<10	mg/kg	1.8	35	98	75 - 125
8363112	Total Selenium (Se)	2016/08/18	107	75 - 125	102	75 - 125	<0.050	mg/kg	NC	35	100	75 - 125
8363112	Total Silver (Ag)	2016/08/18	94	75 - 125	91	75 - 125	<0.020	mg/kg	NC	35		
8363112	Total Sodium (Na)	2016/08/18					<10	mg/kg	8.9	35	98	75 - 125
8363112	Total Strontium (Sr)	2016/08/18	NC	75 - 125	99	75 - 125	<0.10	mg/kg	0.54	35	96	75 - 125
8363112	Total Tellurium (Te)	2016/08/18					<0.10	mg/kg	NC	35		
8363112	Total Thallium (Tl)	2016/08/18	104	75 - 125	107	75 - 125	<0.0020	mg/kg	2.1	35		
8363112	Total Thorium (Th)	2016/08/18					<0.050	mg/kg	8.5	35		
8363112	Total Tin (Sn)	2016/08/18	94	75 - 125	90	75 - 125	<0.10	mg/kg	NC	35		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
8363112	Total Titanium (Ti)	2016/08/18	NC	75 - 125	101	75 - 125	<1.0	mg/kg	11	35		
8363112	Total Uranium (U)	2016/08/18	100	75 - 125	101	75 - 125	<0.0020	mg/kg	2.4	35		
8363112	Total Vanadium (V)	2016/08/18	90	75 - 125	94	75 - 125	<0.20	mg/kg	26	35		
8363112	Total Zinc (Zn)	2016/08/18	NC	75 - 125	97	75 - 125	<0.20	mg/kg	1.2	35	96	75 - 125
8363112	Total Zirconium (Zr)	2016/08/18					<0.50	mg/kg	NC	35		
8363157	Total Mercury (Hg)	2016/08/19	72 (1)	75 - 125	98	75 - 125	<0.010	mg/kg	0.47	20	84	75 - 125
8366315	Moisture	2016/08/18					<0.30	%	8.8	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Andy Lu, Ph.D., P.Chem., Scientific Specialist

Rob Reinert, B.Sc., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

1322

08425881

Maxxam
A Bureau Veritas Group Company

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

BBY FCD-00077/06
Page 1 of 2

Invoice Information

Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5538
Email: david.wells@riotinto.com

Report Information (if differs from invoice)

Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 306 202 7817 (cell if urgent)
Email: kserben@golder.com

Project Information (where applicable)

Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required

☑ Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days

Date Required:
Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TOC ☐ TIC ☐ TC	Cation Exchange Capacity	Available Nitrate	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	FF24-165	2016/07/22	0841	soil		X								
2	FF9-165	2016/07/22	0947	soil		X								
3	FF9-165b	2016/07/22	1002	soil		X								
4	FF23-165	2016/07/22	1120	soil		X								
5	FF8-165	2016/07/22	1232	soil		X								
6	FF5-165	2016/07/22	1400	soil		X								
7	FF25-165	2016/07/22	1521	soil		X								
8	FF7-165	2016/07/22	1612	soil		X								
9	FF2-165	2016/07/22	1702	soil		X								
10	FF17-165	2016/07/22	1754	soil		X								

LABORATORY USE ONLY

CUSTODY SEAL Y N No Seal D-T 2016/07/29

Present	Intact	COOLER TEMPERATURES
N	N	12,8,3
D-T	2016/07/27	
Y	Y	4,9,8

BBY

COOLING MEDIA PRESENT [✓ Y] / N

COMMENTS

Maxxam - Take a sub-sample and analyze it for mercury; archive remaining sample for possible future metals analysis.

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C. SHAPKA	2016/07/2	0630	David Tidman	2016/07/29	12:10
[illegible]	20160729	1721	Nahed Omer	2016/07/30	12:30

B663413_COC

08425882

Maxxam
A Bureau Veritas Group Company

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

BBY FCD-00077/06
Page 2 of 2

Invoice Information

Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5536
Email: david.wells@riotinto.com

Report Information (if differs from invoice)

Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 206 202 7817 (call if urgent)
Email: kserben@golder.com

Project Information (where applicable)

Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required

☑ Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days

Date Required:
Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TOC ☐ TIC ☐ TC	Cation Exchange Capacity	Available Nitrate									# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	FP24-16L	206/07/22	0841	tissue	X	X	X															
2	FF9-16L	2016/07/22	0947	tissue	X	X	X															
3	FF9-16Lb	2016/07/22	1020	tissue	X	X	X															
4	FF23-16L	2016/07/22	1120	tissue	X	X	X															
5	FF8-16L	2016/07/22	1232	tissue	X	X	X															
6	FF5-16L	2016/07/22	1400	tissue	X	X	X															
7	FF25-16L	2016/07/22	1504	tissue	X	X	X															
8	FF7-16L	2016/07/22	1610	tissue	X	X	X															
9	FF2-16L	2016/07/22	1702	tissue	X	X	X															
10	FF17-16L	2016/07/22	1754	tissue	X	X	X															

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C. SHAPKA	2016/07/28	0630	Davi T. Iman	2016/07/29	12:10
Acuga Pilezl	20160729	1721	Nahed Omer	2016/07/30	12:30

LABORATORY USE ONLY

CUSTODY SEAL Y / [✓ N]

Present	Intact	COOLER TEMPERATURES
N	N	12,8,3
Y	Y	4,9,8

BBY

COOLING MEDIA PRESENT [✓ Y] / N

COMMENTS

Do NOT wash the lichen samples before analysis

B663413_COC

Your Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Your C.O.C. #: 08425871, 08425872

Attention:Kerrie Serben
GOLDER ASSOCIATES LTD
1721 8TH Street East
Saskatoon, SK
Canada

Report Date: 2016/08/24
Report #: R2246070
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B663450
Received: 2016/07/29, 12:10

Sample Matrix: Soil
Samples Received: 8

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Soil by CVAF	8	2016/08/04	2016/08/05	BBY7SOP-00012	EPA 245.7 R2 m

Sample Matrix: TISSUE
Samples Received: 8

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Tissue by CVAF - Dry Wt	6	N/A	2016/08/19	BBY7SOP-00012	EPA 245.7 R2 m
Mercury in Tissue by CVAF - Dry Wt	2	N/A	2016/08/24	BBY7SOP-00012	EPA 245.7 R2 m
Elements in Tissue by CRC ICPMS - Dry Wt	7	2016/08/11	2016/08/17	BBY7SOP-00002	EPA 6020A R1 m
Elements in Tissue by CRC ICPMS - Dry Wt	1	2016/08/15	2016/08/18	BBY7SOP-00002	EPA 6020A R1 m
Moisture in Tissue	8	N/A	2016/08/19	BBY8SOP-00017	OMOE E3139 3.1 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Tabitha Rudkin
Burnaby Project Manager
24 Aug 2016 18:42:16 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Tabitha Rudkin, AScT, Burnaby Project Manager
Email: TRudkin@maxxam.ca
Phone# (604)638-2639

cosign

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total Cover Pages : 1

MERCURY BY COLD VAPOR (SOIL)

Maxxam ID		PD6697	PD6698	PD6699	PD6700	PD6701	PD6702	PD6703		
Sampling Date		2016/07/25 08:45	2016/07/25 10:25	2016/07/25 10:25	2016/07/25 13:35	2016/07/25 14:20	2016/07/25 15:41	2016/07/25 17:04		
COC Number		08425871	08425871	08425871	08425871	08425871	08425871	08425871		
	UNITS	**NF4-16S**	**NF18-16S**	**NF18-16SB**	**NF2-16S**	**NF2-16SB**	**NF3-16S**	**NF10-16S**	**RDL**	**QC Batch**
Elements										
Total Mercury (Hg)	mg/kg	<0.0050	0.0051	0.0065	0.0094	0.0076	<0.0050	<0.0050	0.0050	8350895
RDL = Reportable Detection Limit										

Maxxam ID		PD6704		
Sampling Date		2016/07/25 17:55		
COC Number		08425871		
	UNITS	**NF1-16S**	**RDL**	**QC Batch**
Elements				
Total Mercury (Hg)	mg/kg	<0.0050	0.0050	8350895
RDL = Reportable Detection Limit				

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PD6706	PD6707	PD6708	PD6709	PD6710	PD6711	PD6712		
Sampling Date		2016/07/25 08:45	2016/07/25 10:25	2016/07/25 10:25	2016/07/25 13:35	2016/07/25 14:20	2016/07/25 15:41	2016/07/25 07:04		
COC Number		08425872	08425872	08425872	08425872	08425872	08425872	08425872		
	UNITS	**NF4-16L**	**NF18-16L**	**NF18-16LB**	**NF2-16L**	**NF2-16LB**	**NF3-16L**	**NF10-16L**	**RDL**	**QC Batch**
Mercury by CVAA										
Total Mercury (Hg)	mg/kg	0.0494	0.0686	0.0453	0.0310	0.0361	0.0324	0.0700	0.0050	8359943
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	570	1070	706	939	937	1040	618	1.0	8359825
Total Antimony (Sb)	mg/kg	0.0141	0.0203	0.0188	0.0122	0.0128	0.0144	0.0067	0.0050	8359825
Total Arsenic (As)	mg/kg	0.272	0.351	0.283	0.353	0.306	0.573	0.192	0.050	8359825
Total Barium (Ba)	mg/kg	27.8	50.0	37.3	30.4	26.2	25.9	18.2	0.10	8359825
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8359825
Total Bismuth (Bi)	mg/kg	<0.10	0.14	0.11	0.22	0.25	0.19	0.24	0.10	8359825
Total Boron (B)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	8359825
Total Cadmium (Cd)	mg/kg	0.068	0.067	0.073	0.102	0.081	0.046	0.066	0.010	8359825
Total Calcium (Ca)	mg/kg	2800	1890	2110	2540	1660	1570	2210	10	8359825
Total Cesium (Cs)	mg/kg	0.38	0.61	0.48	0.91	0.84	0.60	0.70	0.10	8359825
Total Chromium (Cr)	mg/kg	6.83	9.07	5.62	8.59	7.26	8.96	5.04	0.20	8359825
Total Cobalt (Co)	mg/kg	0.837	0.981	0.677	0.834	0.754	1.20	1.00	0.020	8359825
Total Copper (Cu)	mg/kg	2.42	3.58	2.56	3.46	2.94	3.80	3.12	0.050	8359825
Total Iron (Fe)	mg/kg	911	1560	951	1380	1380	1480	906	10	8359825
Total Lead (Pb)	mg/kg	0.767	0.955	0.891	1.56	1.66	1.10	1.92	0.010	8359825
Total Lithium (Li)	mg/kg	1.22	2.24	1.13	2.44	2.48	2.83	1.63	0.50	8359825
Total Magnesium (Mg)	mg/kg	1650	2040	1390	1250	1060	2070	817	10	8359825
Total Manganese (Mn)	mg/kg	68.9	62.3	62.9	49.5	40.8	46.0	67.5	0.10	8359825
Total Molybdenum (Mo)	mg/kg	0.351	0.514	0.341	0.636	0.633	0.651	0.315	0.050	8359825
Total Nickel (Ni)	mg/kg	9.89	10.9	7.83	7.25	6.47	11.0	5.50	0.050	8359825
Total Phosphorus (P)	mg/kg	1150	1250	1060	1150	875	999	982	10	8359825
Total Potassium (K)	mg/kg	2680	2850	2500	2970	2160	2400	2520	10	8359825
Total Selenium (Se)	mg/kg	0.051	<0.050	0.054	<0.050	0.058	0.053	<0.050	0.050	8359825
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	0.022	<0.020	<0.020	<0.020	0.020	8359825
Total Sodium (Na)	mg/kg	246	75	137	207	112	99	120	10	8359825
Total Strontium (Sr)	mg/kg	10.3	15.4	12.7	12.1	9.09	10.5	6.37	0.10	8359825
Total Tellurium (Te)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8359825
Total Thallium (Tl)	mg/kg	0.0272	0.0430	0.0237	0.0376	0.0349	0.0346	0.0290	0.0020	8359825
Total Thorium (Th)	mg/kg	0.378	0.562	0.345	0.579	0.597	0.719	0.473	0.050	8359825

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PD6706	PD6707	PD6708	PD6709	PD6710	PD6711	PD6712		
Sampling Date		2016/07/25 08:45	2016/07/25 10:25	2016/07/25 10:25	2016/07/25 13:35	2016/07/25 14:20	2016/07/25 15:41	2016/07/25 07:04		
COC Number		08425872	08425872	08425872	08425872	08425872	08425872	08425872		
	UNITS	**NF4-16L**	**NF18-16L**	**NF18-16LB**	**NF2-16L**	**NF2-16LB**	**NF3-16L**	**NF10-16L**	**RDL**	**QC Batch**
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8359825
Total Titanium (Ti)	mg/kg	42.4	70.2	46.1	63.8	64.0	73.2	51.6	1.0	8359825
Total Uranium (U)	mg/kg	0.510	0.658	0.468	1.19	1.28	0.879	1.51	0.0020	8359825
Total Vanadium (V)	mg/kg	1.06	2.03	1.25	1.60	1.56	2.19	0.92	0.20	8359825
Total Zinc (Zn)	mg/kg	27.6	32.7	27.5	33.8	25.7	22.9	25.3	0.20	8359825
Total Zirconium (Zr)	mg/kg	0.74	1.12	0.66	1.37	1.28	1.40	1.02	0.50	8359825

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PD6713		
Sampling Date		2016/07/25 17:55		
COC Number		08425872		
	UNITS	**NF1-16L**	**RDL**	**QC Batch**
Mercury by CVAA				
Total Mercury (Hg)	mg/kg	0.0426	0.0050	8363157
Total Metals by ICPMS				
Total Aluminum (Al)	mg/kg	1470	1.0	8363112
Total Antimony (Sb)	mg/kg	0.0141	0.0050	8363112
Total Arsenic (As)	mg/kg	0.341	0.050	8363112
Total Barium (Ba)	mg/kg	27.2	0.10	8363112
Total Beryllium (Be)	mg/kg	<0.10	0.10	8363112
Total Bismuth (Bi)	mg/kg	0.48	0.10	8363112
Total Boron (B)	mg/kg	2.3	2.0	8363112
Total Cadmium (Cd)	mg/kg	0.108	0.010	8363112
Total Calcium (Ca)	mg/kg	2750	10	8363112
Total Cesium (Cs)	mg/kg	1.30	0.10	8363112
Total Chromium (Cr)	mg/kg	9.09	0.20	8363112
Total Cobalt (Co)	mg/kg	1.60	0.020	8363112
Total Copper (Cu)	mg/kg	6.71	0.050	8363112
Total Iron (Fe)	mg/kg	2130	10	8363112
Total Lead (Pb)	mg/kg	3.06	0.010	8363112
Total Lithium (Li)	mg/kg	5.77	0.50	8363112
Total Magnesium (Mg)	mg/kg	1250	10	8363112
Total Manganese (Mn)	mg/kg	80.7	0.10	8363112
Total Molybdenum (Mo)	mg/kg	0.570	0.050	8363112
Total Nickel (Ni)	mg/kg	8.01	0.050	8363112
Total Phosphorus (P)	mg/kg	902	10	8363112
Total Potassium (K)	mg/kg	2260	10	8363112
Total Selenium (Se)	mg/kg	0.060	0.050	8363112
Total Silver (Ag)	mg/kg	0.038	0.020	8363112
Total Sodium (Na)	mg/kg	122	10	8363112
Total Strontium (Sr)	mg/kg	10.4	0.10	8363112
Total Tellurium (Te)	mg/kg	<0.10	0.10	8363112
Total Thallium (Tl)	mg/kg	0.0663	0.0020	8363112
Total Thorium (Th)	mg/kg	1.16	0.050	8363112
RDL = Reportable Detection Limit				

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PD6713		
Sampling Date		2016/07/25 17:55		
COC Number		08425872		
	UNITS	**NF1-16L**	**RDL**	**QC Batch**
Total Tin (Sn)	mg/kg	0.11	0.10	8363112
Total Titanium (Ti)	mg/kg	112	1.0	8363112
Total Uranium (U)	mg/kg	2.81	0.0020	8363112
Total Vanadium (V)	mg/kg	2.23	0.20	8363112
Total Zinc (Zn)	mg/kg	31.0	0.20	8363112
Total Zirconium (Zr)	mg/kg	2.38	0.50	8363112

RDL = Reportable Detection Limit

PHYSICAL TESTING (TISSUE)

Maxxam ID		PD6706	PD6707	PD6708	PD6709	PD6710	PD6711	PD6712		
Sampling Date		2016/07/25 08:45	2016/07/25 10:25	2016/07/25 10:25	2016/07/25 13:35	2016/07/25 14:20	2016/07/25 15:41	2016/07/25 07:04		
COC Number		08425872	08425872	08425872	08425872	08425872	08425872	08425872		
	UNITS	**NF4-16L**	**NF18-16L**	**NF18-16LB**	**NF2-16L**	**NF2-16LB**	**NF3-16L**	**NF10-16L**	**RDL**	**QC Batch**
Physical Properties										
Moisture	%	13	11	7.5	12	4.4	6.1	7.7	0.30	8368277

RDL = Reportable Detection Limit

Maxxam ID		PD6713		
Sampling Date		2016/07/25 17:55		
COC Number		08425872		
	UNITS	**NF1-16L**	**RDL**	**QC Batch**
Physical Properties				
Moisture	%	9.7	0.30	8368277

RDL = Reportable Detection Limit

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	10.0°C

Results relate only to the items tested.

Maxxam Job #: B663450
Report Date: 2016/08/24

QUALITY ASSURANCE REPORT

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8350895	Total Mercury (Hg)	2016/08/05	88	75 - 125	87	75 - 125	<0.0050	mg/kg	NC	35	88	N/A
8359825	Total Aluminum (Al)	2016/08/17					<1.0	mg/kg	9.0	35	37	17 - 93
8359825	Total Antimony (Sb)	2016/08/17	103	75 - 125	105	75 - 125	<0.0050	mg/kg	NC	35		
8359825	Total Arsenic (As)	2016/08/17	109	75 - 125	111	75 - 125	<0.050	mg/kg	5.5	35	84	42 - 199
8359825	Total Barium (Ba)	2016/08/17	NC	75 - 125	112	75 - 125	<0.10	mg/kg	1.5	35		
8359825	Total Beryllium (Be)	2016/08/17	115	75 - 125	103	75 - 125	<0.10	mg/kg	NC	35		
8359825	Total Bismuth (Bi)	2016/08/17					<0.10	mg/kg	NC	35		
8359825	Total Boron (B)	2016/08/17					<2.0	mg/kg	NC	35	92	75 - 125
8359825	Total Cadmium (Cd)	2016/08/17	109	75 - 125	104	75 - 125	<0.010	mg/kg	NC	35	95	75 - 125
8359825	Total Calcium (Ca)	2016/08/17					<10	mg/kg	9.0	35	99	75 - 125
8359825	Total Cesium (Cs)	2016/08/17					<0.10	mg/kg				
8359825	Total Chromium (Cr)	2016/08/17	NC	75 - 125	103	75 - 125	<0.20	mg/kg	3.5	35		
8359825	Total Cobalt (Co)	2016/08/17	94	75 - 125	104	75 - 125	<0.020	mg/kg	5.4	35	85	75 - 125
8359825	Total Copper (Cu)	2016/08/17	94	75 - 125	104	75 - 125	<0.050	mg/kg	0.31	35	91	75 - 125
8359825	Total Iron (Fe)	2016/08/17					<10	mg/kg	2.0	35		
8359825	Total Lead (Pb)	2016/08/17	104	75 - 125	105	75 - 125	<0.010	mg/kg	4.0	35		
8359825	Total Lithium (Li)	2016/08/17	110	75 - 125	111	75 - 125	<0.50	mg/kg				
8359825	Total Magnesium (Mg)	2016/08/17					<10	mg/kg	5.6	35		
8359825	Total Manganese (Mn)	2016/08/17	NC	75 - 125	106	75 - 125	<0.10	mg/kg	0.27	35	96	75 - 125
8359825	Total Molybdenum (Mo)	2016/08/17	105	75 - 125	101	75 - 125	<0.050	mg/kg	3.6	35		
8359825	Total Nickel (Ni)	2016/08/17	NC	75 - 125	106	75 - 125	<0.050	mg/kg	3.3	35	79	75 - 125
8359825	Total Phosphorus (P)	2016/08/17					<10	mg/kg	0.17	35	120	75 - 125
8359825	Total Potassium (K)	2016/08/17					<10	mg/kg	0.41	35	108	75 - 125
8359825	Total Selenium (Se)	2016/08/17	109	75 - 125	109	75 - 125	<0.050	mg/kg	NC	35	94	75 - 125
8359825	Total Silver (Ag)	2016/08/17	95	75 - 125	95	75 - 125	<0.020	mg/kg	NC	35		
8359825	Total Sodium (Na)	2016/08/17					<10	mg/kg	15	35	104	75 - 125
8359825	Total Strontium (Sr)	2016/08/17	NC	75 - 125	103	75 - 125	<0.10	mg/kg	0.79	35	97	75 - 125
8359825	Total Tellurium (Te)	2016/08/17					<0.10	mg/kg				
8359825	Total Thallium (Tl)	2016/08/17	110	75 - 125	108	75 - 125	<0.0020	mg/kg	0.25	35		
8359825	Total Thorium (Th)	2016/08/17					<0.050	mg/kg				
8359825	Total Tin (Sn)	2016/08/17	93	75 - 125	89	75 - 125	<0.10	mg/kg	NC	35		

QUALITY ASSURANCE REPORT(CONT'D)

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8359825	Total Titanium (Ti)	2016/08/17	NC	75 - 125	112	75 - 125	<1.0	mg/kg	1.8	35		
8359825	Total Uranium (U)	2016/08/17	104	75 - 125	103	75 - 125	<0.0020	mg/kg	3.7	35		
8359825	Total Vanadium (V)	2016/08/17	95	75 - 125	104	75 - 125	<0.20	mg/kg	6.1	35		
8359825	Total Zinc (Zn)	2016/08/17	NC	75 - 125	111	75 - 125	<0.20	mg/kg	0.88	35	95	75 - 125
8359825	Total Zirconium (Zr)	2016/08/17					<0.50	mg/kg				
8359943	Total Mercury (Hg)	2016/08/24	97	75 - 125	105	75 - 125	<0.010	mg/kg	1.2	20	101	75 - 125
8363112	Total Aluminum (Al)	2016/08/18					<1.0	mg/kg	7.9	35	39	17 - 93
8363112	Total Antimony (Sb)	2016/08/18	105	75 - 125	105	75 - 125	<0.0050	mg/kg	NC	35		
8363112	Total Arsenic (As)	2016/08/18	100	75 - 125	102	75 - 125	<0.050	mg/kg	2.7	35	84	42 - 199
8363112	Total Barium (Ba)	2016/08/18	NC	75 - 125	112	75 - 125	<0.10	mg/kg	3.0	35		
8363112	Total Beryllium (Be)	2016/08/18	119	75 - 125	112	75 - 125	<0.10	mg/kg	NC	35		
8363112	Total Bismuth (Bi)	2016/08/18					<0.10	mg/kg	NC	35		
8363112	Total Boron (B)	2016/08/18					<2.0	mg/kg	NC	35	115	75 - 125
8363112	Total Cadmium (Cd)	2016/08/18	105	75 - 125	103	75 - 125	<0.010	mg/kg	0.34	35	98	75 - 125
8363112	Total Calcium (Ca)	2016/08/18					<10	mg/kg	1.2	35	93	75 - 125
8363112	Total Cesium (Cs)	2016/08/18					<0.10	mg/kg	NC	N/A		
8363112	Total Chromium (Cr)	2016/08/18	NC	75 - 125	97	75 - 125	<0.20	mg/kg	5.8	35		
8363112	Total Cobalt (Co)	2016/08/18	93	75 - 125	98	75 - 125	<0.020	mg/kg	2.5	35	86	75 - 125
8363112	Total Copper (Cu)	2016/08/18	NC	75 - 125	100	75 - 125	<0.050	mg/kg	5.1	35	95	75 - 125
8363112	Total Iron (Fe)	2016/08/18					<10	mg/kg	8.0	35		
8363112	Total Lead (Pb)	2016/08/18	99	75 - 125	101	75 - 125	<0.010	mg/kg	1.6	35		
8363112	Total Lithium (Li)	2016/08/18	113	75 - 125	112	75 - 125	<0.50	mg/kg	NC	35		
8363112	Total Magnesium (Mg)	2016/08/18					<10	mg/kg	4.6	35		
8363112	Total Manganese (Mn)	2016/08/18	NC	75 - 125	102	75 - 125	<0.10	mg/kg	3.6	35	97	75 - 125
8363112	Total Molybdenum (Mo)	2016/08/18	100	75 - 125	103	75 - 125	<0.050	mg/kg	NC	35		
8363112	Total Nickel (Ni)	2016/08/18	NC	75 - 125	99	75 - 125	<0.050	mg/kg	2.3	35	81	75 - 125
8363112	Total Phosphorus (P)	2016/08/18					<10	mg/kg	2.5	35	111	75 - 125
8363112	Total Potassium (K)	2016/08/18					<10	mg/kg	1.8	35	98	75 - 125
8363112	Total Selenium (Se)	2016/08/18	107	75 - 125	102	75 - 125	<0.050	mg/kg	NC	35	100	75 - 125
8363112	Total Silver (Ag)	2016/08/18	94	75 - 125	91	75 - 125	<0.020	mg/kg	NC	35		
8363112	Total Sodium (Na)	2016/08/18					<10	mg/kg	8.9	35	98	75 - 125

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8363112	Total Strontium (Sr)	2016/08/18	NC	75 - 125	99	75 - 125	<0.10	mg/kg	0.54	35	96	75 - 125
8363112	Total Tellurium (Te)	2016/08/18					<0.10	mg/kg	NC	35		
8363112	Total Thallium (Tl)	2016/08/18	104	75 - 125	107	75 - 125	<0.0020	mg/kg	2.1	35		
8363112	Total Thorium (Th)	2016/08/18					<0.050	mg/kg	8.5	35		
8363112	Total Tin (Sn)	2016/08/18	94	75 - 125	90	75 - 125	<0.10	mg/kg	NC	35		
8363112	Total Titanium (Ti)	2016/08/18	NC	75 - 125	101	75 - 125	<1.0	mg/kg	11	35		
8363112	Total Uranium (U)	2016/08/18	100	75 - 125	101	75 - 125	<0.0020	mg/kg	2.4	35		
8363112	Total Vanadium (V)	2016/08/18	90	75 - 125	94	75 - 125	<0.20	mg/kg	26	35		
8363112	Total Zinc (Zn)	2016/08/18	NC	75 - 125	97	75 - 125	<0.20	mg/kg	1.2	35	96	75 - 125
8363112	Total Zirconium (Zr)	2016/08/18					<0.50	mg/kg	NC	35		
8363157	Total Mercury (Hg)	2016/08/19	72 (1)	75 - 125	98	75 - 125	<0.010	mg/kg	0.47	20	84	75 - 125
8368277	Moisture	2016/08/19					<0.30	%	14	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

Maxxam Job #: B663450
Report Date: 2016/08/24

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Rob Reinert, B.Sc., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

1325

08425871

Maxxam
A Bureau Veritas Group Company

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

BBY FCD-00077/06
Page 1 of 2

Invoice Information

Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5536
Email: david.wells@riotinto.com

Report Information (if differs from Invoice)

Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 206 202 7817 (cell if urgent)
Email: kserben@golder.com

Project Information (where applicable)

Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required

☑ Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)
☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days

Date Required:

Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

LABORATORY USE ONLY

CUSTODY SEAL Y / [✓ N]		COOLER TEMPERATURES
Present	Intact	
N	N	13, 7, 10
Y	Y	16, 14, 10

BBY

COOLING MEDIA PRESENT [✓ Y] / N

COMMENTS

Maxxam - Take a sub-sample and analyze it for mercury; archive remaining sample for possible future metals analysis.

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TIC ☐ TC ☐ TOC	Cation Exchange Capacity	Available Nitrate									# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	NF4-16S	2016/07/25	0845	soil		X																
2	NF18-16S	2016/07/25	1025	soil		X																
3	NF18-16Sb	2016/07/25	1025	soil		X																
4	NF2-16S	2016/07/25	1335	soil		X																
5	NF2-16Sb	2016/07/25	1420	soil		X																
6	NF3-16S	2016/07/25	1541	soil		X																
7	NF10-16S	2016/07/25	1704	soil		X																
8	NF1-16S	2016/07/25	1755	soil		X																
9				soil		X																
10				soil		X																

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C.S HAPKA	2016/07/28	0630	David Tidman	2016/07/29	12:1
ALYSSA FUERL	20160729	1743	Nahed Amer	2016/07/30	12:30

B663450_COC

08425872

Maxxam
A Bureau Veritas Group Company

CHAIN OF CUSTODY RECORD

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

BBY FCD-00077/06
Page 2 of 2

Invoice Information

Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5536
Email: david.wells@riotinto.com

Report Information (if differs from invoice)

Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 206 202 7817 (cell if urgent)
Email: kserben@golder.com

Project Information (where applicable)

Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required

☑ Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)
☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days

Date Required:

Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

Analysis Requested

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TOC ☐ TC ☐ TIC	Cation Exchange Capacity	Available Nitrate	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	NF4-16L	2016/07/25	0845	tissue	X	X	X							
2	NF18-16L	2016/07/25	1025	tissue	X	X	X							
3	NF18-16Lb	2016/07/25	1025	tissue	X	X	X							
4	NF2-16L	2016/07/25	1335	tissue	X	X	X							
5	NF2-16Lb	2016/07/25	1420	tissue	X	X	X							
6	NF3-16L	2016/07/25	1541	tissue	X	X	X							
7	NF10-16L	2016/07/25	1704	tissue	X	X	X							
8	NF1-16L	2016/07/25	1755	tissue	X	X	X							
9				tissue	X	X	X							
10				tissue	X	X	X							

LABORATORY USE ONLY

CUSTODY SEAL Y / [✓ N]		COOLER TEMPERATURES
Present	Intact	
N	N	13, 7, 10
Y	Y	16, 14, 10

BBY

COOLING MEDIA PRESENT [✓ Y] / N

COMMENTS

Do NOT wash the lichen samples before analysis

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C SHAPKA	2016/07/28	0630	David Tilman	2016/07/29	12:10
Alyssa [illegible]	20160729	1743	Nahed Amer	2016/07/30	12:30

B663450_COC

Your Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Your C.O.C. #: 08425873, 08425874

Attention:Kerrie Serben

GOLDER ASSOCIATES LTD
1721 8TH Street East
Saskatoon, SK
Canada

Report Date: 2016/08/20
Report #: R2242466
Version: 3 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B664098
Received: 2016/07/29, 12:10

Sample Matrix: Soil
Samples Received: 10

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Soil by CVAF	10	2016/08/05	2016/08/05	BBY7SOP-00012	EPA 245.7 R2 m

Sample Matrix: TISSUE
Samples Received: 10

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Tissue by CVAF - Dry Wt	10	N/A	2016/08/19	BBY7SOP-00012	EPA 245.7 R2 m
Elements in Tissue by CRC ICPMS - Dry Wt	9	2016/08/15	2016/08/18	BBY7SOP-00002	EPA 6020A R1 m
Elements in Tissue by CRC ICPMS - Dry Wt	1	2016/08/15	2016/08/19	BBY7SOP-00002	EPA 6020A R1 m
Moisture in Tissue	10	N/A	2016/08/20	BBY8SOP-00017	OMOE E3139 3.1 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Tabitha Rudkin
Burnaby Project Manager
22 Aug 2016 11:34:13 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Tabitha Rudkin, AScT, Burnaby Project Manager
Email: TRudkin@maxxam.ca
Phone# (604)638-2639

cosign

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

MERCURY BY COLD VAPOR (SOIL)

Maxxam ID		PE0471	PE0472	PE0473	PE0474	PE0475	PE0476	PE0477		
Sampling Date		2016/07/23 08:25	2016/07/23 09:07	2016/07/23 10:33	2016/07/23 11:40	2016/07/23 12:53	2016/07/23 13:49	2016/07/23 15:02		
COC Number		08425874	08425874	08425874	08425874	08425874	08425874	08425874		
	UNITS	**FF3-16S**	**FF1-16S**	**NF23-16S**	**NF22-16S**	**NF21-16S**	**NF17-16S**	**NF16-16S**	**RDL**	**QC Batch**
Elements										
Total Mercury (Hg)	mg/kg	<0.0050	0.0620	0.0146	<0.0050	<0.0050	0.0735	0.0072	0.0050	8352109
RDL = Reportable Detection Limit										

Maxxam ID		PE0478	PE0479	PE0480		
Sampling Date		2016/07/23 16:19	2016/07/23 17:13	2016/07/23 18:00		
COC Number		08425874	08425874	08425874		
	UNITS	**NF14-16S**	**NF20-16S**	**NF9-16S**	**RDL**	**QC Batch**
Elements						
Total Mercury (Hg)	mg/kg	<0.0050	<0.0050	0.0315	0.0050	8352109
RDL = Reportable Detection Limit						

Maxxam Job #: B664098
Report Date: 2016/08/20

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PE0453	PE0454	PE0455	PE0456	PE0457	PE0458	PE0459		
Sampling Date		2016/07/23 08:25	2016/07/23 09:07	2016/07/23 10:33	2016/07/23 11:40	2016/07/23 12:53	2016/07/23 13:44	2016/07/23 15:02		
COC Number		08425873	08425873	08425873	08425873	08425873	08425873	08425873		
	UNITS	**FF3-16L**	**FF1-16L**	**NF23-16L**	**NF22-16L**	**NF21-16L**	**NF17-16L**	**NF16-16L**	**RDL**	**QC Batch**
Mercury by CVAA										
Total Mercury (Hg)	mg/kg	0.122	0.0287	0.0599	0.0385	0.0276	0.0531	0.0368	0.0050	8363157
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	108	87.0	190	413	259	597	1000	1.0	8363112
Total Antimony (Sb)	mg/kg	<0.0050	<0.0050	0.0061	0.0070	0.0058	0.0156	0.0136	0.0050	8363112
Total Arsenic (As)	mg/kg	0.183	0.242	0.338	0.398	0.243	0.331	0.297	0.050	8363112
Total Barium (Ba)	mg/kg	9.83	27.8	10.4	22.2	22.6	20.4	41.2	0.10	8363112
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363112
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	0.13	0.10	8363112
Total Boron (B)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	2.2	2.2	2.0	8363112
Total Cadmium (Cd)	mg/kg	0.071	0.077	0.055	0.038	0.047	0.068	0.085	0.010	8363112
Total Calcium (Ca)	mg/kg	564	1540	670	604	642	1050	648	10	8363112
Total Cesium (Cs)	mg/kg	0.12	1.30	0.29	0.25	0.26	0.57	0.82	0.10	8363112
Total Chromium (Cr)	mg/kg	0.82	0.41	0.72	1.81	0.97	3.99	5.34	0.20	8363112
Total Cobalt (Co)	mg/kg	0.118	0.386	0.149	0.708	0.435	0.830	0.832	0.020	8363112
Total Copper (Cu)	mg/kg	1.03	1.25	0.968	2.93	2.44	3.18	3.95	0.050	8363112
Total Iron (Fe)	mg/kg	146	105	221	451	316	774	1170	10	8363112
Total Lead (Pb)	mg/kg	0.977	0.208	0.740	0.361	0.200	0.737	0.692	0.010	8363112
Total Lithium (Li)	mg/kg	<0.50	<0.50	<0.50	0.52	<0.50	1.21	2.44	0.50	8363112
Total Magnesium (Mg)	mg/kg	199	488	306	479	425	850	949	10	8363112
Total Manganese (Mn)	mg/kg	31.2	79.4	26.0	53.5	22.5	63.7	29.6	0.10	8363112
Total Molybdenum (Mo)	mg/kg	<0.050	<0.050	0.053	0.090	0.220	0.274	0.417	0.050	8363112
Total Nickel (Ni)	mg/kg	0.679	1.23	0.948	4.22	1.81	5.85	5.23	0.050	8363112
Total Phosphorus (P)	mg/kg	419	564	433	1060	709	722	967	10	8363112
Total Potassium (K)	mg/kg	1280	1300	1180	2180	1890	1500	2280	10	8363112
Total Selenium (Se)	mg/kg	0.089	<0.050	0.052	<0.050	<0.050	0.055	0.058	0.050	8363112
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.045	0.027	0.020	8363112
Total Sodium (Na)	mg/kg	31	89	64	43	46	60	37	10	8363112
Total Strontium (Sr)	mg/kg	2.29	8.66	4.49	5.66	7.44	4.84	12.1	0.10	8363112
Total Tellurium (Te)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363112
Total Thallium (Tl)	mg/kg	0.0100	0.0433	0.0081	0.0110	0.0093	0.0318	0.0397	0.0020	8363112
Total Thorium (Th)	mg/kg	0.066	<0.050	0.057	0.111	0.167	0.325	0.564	0.050	8363112
RDL = Reportable Detection Limit										

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PE0453	PE0454	PE0455	PE0456	PE0457	PE0458	PE0459		
Sampling Date		2016/07/23 08:25	2016/07/23 09:07	2016/07/23 10:33	2016/07/23 11:40	2016/07/23 12:53	2016/07/23 13:44	2016/07/23 15:02		
COC Number		08425873	08425873	08425873	08425873	08425873	08425873	08425873		
	UNITS	**FF3-16L**	**FF1-16L**	**NF23-16L**	**NF22-16L**	**NF21-16L**	**NF17-16L**	**NF16-16L**	**RDL**	**QC Batch**
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363112
Total Titanium (Ti)	mg/kg	6.1	4.1	10.3	21.2	10.1	43.5	61.8	1.0	8363112
Total Uranium (U)	mg/kg	0.0399	0.0459	0.0528	0.0811	0.124	0.405	0.542	0.0020	8363112
Total Vanadium (V)	mg/kg	<0.20	<0.20	0.35	0.75	0.45	1.13	1.64	0.20	8363112
Total Zinc (Zn)	mg/kg	18.2	21.0	17.5	28.0	26.4	21.5	31.1	0.20	8363112
Total Zirconium (Zr)	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	0.65	0.66	0.50	8363112

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PE0460	PE0461		PE0462		
Sampling Date		2016/07/23 16:19	2016/07/23 17:13		2016/07/23 18:00		
COC Number		08425873	08425873		08425873		
	UNITS	**NF14-16L**	**NF20-16L**	**QC Batch**	**NF9-16L**	**RDL**	**QC Batch**
Mercury by CVAA							
Total Mercury (Hg)	mg/kg	0.0564	0.0336	8363157	0.0353	0.0050	8363162
Total Metals by ICPMS							
Total Aluminum (Al)	mg/kg	974	428	8363112	472	1.0	8363141
Total Antimony (Sb)	mg/kg	0.0182	0.0133	8363112	0.0099	0.0050	8363141
Total Arsenic (As)	mg/kg	0.393	0.316	8363112	0.317	0.050	8363141
Total Barium (Ba)	mg/kg	47.5	22.3	8363112	13.0	0.10	8363141
Total Beryllium (Be)	mg/kg	<0.10	<0.10	8363112	<0.10	0.10	8363141
Total Bismuth (Bi)	mg/kg	0.18	<0.10	8363112	<0.10	0.10	8363141
Total Boron (B)	mg/kg	2.4	<2.0	8363112	<2.0	2.0	8363141
Total Cadmium (Cd)	mg/kg	0.106	0.056	8363112	0.044	0.010	8363141
Total Calcium (Ca)	mg/kg	2730	1030	8363112	924	10	8363141
Total Cesium (Cs)	mg/kg	0.59	0.35	8363112	0.59	0.10	8363141
Total Chromium (Cr)	mg/kg	7.51	2.61	8363112	3.82	0.20	8363141
Total Cobalt (Co)	mg/kg	0.745	0.531	8363112	0.358	0.020	8363141
Total Copper (Cu)	mg/kg	3.81	2.91	8363112	1.74	0.050	8363141
Total Iron (Fe)	mg/kg	1260	519	8363112	570	10	8363141
Total Lead (Pb)	mg/kg	1.45	0.347	8363112	0.483	0.010	8363141
Total Lithium (Li)	mg/kg	2.09	0.89	8363112	1.04	0.50	8363141
Total Magnesium (Mg)	mg/kg	964	630	8363112	614	10	8363141
Total Manganese (Mn)	mg/kg	79.0	50.1	8363112	40.8	0.10	8363141
Total Molybdenum (Mo)	mg/kg	0.453	0.200	8363112	0.275	0.050	8363141
Total Nickel (Ni)	mg/kg	6.02	2.67	8363112	2.61	0.050	8363141
Total Phosphorus (P)	mg/kg	797	769	8363112	630	10	8363141
Total Potassium (K)	mg/kg	1780	1510	8363112	1450	10	8363141
Total Selenium (Se)	mg/kg	0.054	<0.050	8363112	<0.050	0.050	8363141
Total Silver (Ag)	mg/kg	<0.020	<0.020	8363112	0.020	0.020	8363141
Total Sodium (Na)	mg/kg	109	51	8363112	66	10	8363141
Total Strontium (Sr)	mg/kg	12.6	6.54	8363112	3.49	0.10	8363141
Total Tellurium (Te)	mg/kg	<0.10	<0.10	8363112	<0.10	0.10	8363141
Total Thallium (Tl)	mg/kg	0.0379	0.0154	8363112	0.0252	0.0020	8363141
Total Thorium (Th)	mg/kg	0.499	0.230	8363112	0.268	0.050	8363141

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PE0460	PE0461		PE0462		
Sampling Date		2016/07/23 16:19	2016/07/23 17:13		2016/07/23 18:00		
COC Number		08425873	08425873		08425873		
	UNITS	**NF14-16L**	**NF20-16L**	**QC Batch**	**NF9-16L**	**RDL**	**QC Batch**
Total Tin (Sn)	mg/kg	<0.10	<0.10	8363112	0.11	0.10	8363141
Total Titanium (Ti)	mg/kg	65.2	25.1	8363112	32.7	1.0	8363141
Total Uranium (U)	mg/kg	0.823	0.193	8363112	0.323	0.0020	8363141
Total Vanadium (V)	mg/kg	1.90	0.74	8363112	0.78	0.20	8363141
Total Zinc (Zn)	mg/kg	42.7	32.3	8363112	20.8	0.20	8363141
Total Zirconium (Zr)	mg/kg	0.86	<0.50	8363112	0.65	0.50	8363141

RDL = Reportable Detection Limit

PHYSICAL TESTING (TISSUE)

Maxxam ID		PE0453	PE0454	PE0455	PE0456	PE0457	PE0458	PE0459		
Sampling Date		2016/07/23 08:25	2016/07/23 09:07	2016/07/23 10:33	2016/07/23 11:40	2016/07/23 12:53	2016/07/23 13:44	2016/07/23 15:02		
COC Number		08425873	08425873	08425873	08425873	08425873	08425873	08425873		
	UNITS	**FF3-16L**	**FF1-16L**	**NF23-16L**	**NF22-16L**	**NF21-16L**	**NF17-16L**	**NF16-16L**	**RDL**	**QC Batch**
Physical Properties										
Moisture	%	59	32	29	32	40	14	22	0.30	8370076
RDL = Reportable Detection Limit										

Maxxam ID		PE0460	PE0461	PE0462		
Sampling Date		2016/07/23 16:19	2016/07/23 17:13	2016/07/23 18:00		
COC Number		08425873	08425873	08425873		
	UNITS	**NF14-16L**	**NF20-16L**	**NF9-16L**	**RDL**	**QC Batch**
Physical Properties						
Moisture	%	10	21	14	0.30	8370076
RDL = Reportable Detection Limit						

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	8.7°C

Results relate only to the items tested.

Maxxam Job #: B664098
Report Date: 2016/08/20

QUALITY ASSURANCE REPORT

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8352109	Total Mercury (Hg)	2016/08/05	100	75 - 125	93	75 - 125	<0.0050	mg/kg	NC	35	95	70 - 130
8363112	Total Aluminum (Al)	2016/08/18					<1.0	mg/kg	7.9	35	39	17 - 93
8363112	Total Antimony (Sb)	2016/08/18	105	75 - 125	105	75 - 125	<0.0050	mg/kg	NC	35		
8363112	Total Arsenic (As)	2016/08/18	100	75 - 125	102	75 - 125	<0.050	mg/kg	2.7	35	84	42 - 199
8363112	Total Barium (Ba)	2016/08/18	NC	75 - 125	112	75 - 125	<0.10	mg/kg	3.0	35		
8363112	Total Beryllium (Be)	2016/08/18	119	75 - 125	112	75 - 125	<0.10	mg/kg	NC	35		
8363112	Total Bismuth (Bi)	2016/08/18					<0.10	mg/kg	NC	35		
8363112	Total Boron (B)	2016/08/18					<2.0	mg/kg	NC	35	115	75 - 125
8363112	Total Cadmium (Cd)	2016/08/18	105	75 - 125	103	75 - 125	<0.010	mg/kg	0.34	35	98	75 - 125
8363112	Total Calcium (Ca)	2016/08/18					<10	mg/kg	1.2	35	93	75 - 125
8363112	Total Cesium (Cs)	2016/08/18					<0.10	mg/kg	NC	N/A		
8363112	Total Chromium (Cr)	2016/08/18	NC	75 - 125	97	75 - 125	<0.20	mg/kg	5.8	35		
8363112	Total Cobalt (Co)	2016/08/18	93	75 - 125	98	75 - 125	<0.020	mg/kg	2.5	35	86	75 - 125
8363112	Total Copper (Cu)	2016/08/18	NC	75 - 125	100	75 - 125	<0.050	mg/kg	5.1	35	95	75 - 125
8363112	Total Iron (Fe)	2016/08/18					<10	mg/kg	8.0	35		
8363112	Total Lead (Pb)	2016/08/18	99	75 - 125	101	75 - 125	<0.010	mg/kg	1.6	35		
8363112	Total Lithium (Li)	2016/08/18	113	75 - 125	112	75 - 125	<0.50	mg/kg	NC	35		
8363112	Total Magnesium (Mg)	2016/08/18					<10	mg/kg	4.6	35		
8363112	Total Manganese (Mn)	2016/08/18	NC	75 - 125	102	75 - 125	<0.10	mg/kg	3.6	35	97	75 - 125
8363112	Total Molybdenum (Mo)	2016/08/18	100	75 - 125	103	75 - 125	<0.050	mg/kg	NC	35		
8363112	Total Nickel (Ni)	2016/08/18	NC	75 - 125	99	75 - 125	<0.050	mg/kg	2.3	35	81	75 - 125
8363112	Total Phosphorus (P)	2016/08/18					<10	mg/kg	2.5	35	111	75 - 125
8363112	Total Potassium (K)	2016/08/18					<10	mg/kg	1.8	35	98	75 - 125
8363112	Total Selenium (Se)	2016/08/18	107	75 - 125	102	75 - 125	<0.050	mg/kg	NC	35	100	75 - 125
8363112	Total Silver (Ag)	2016/08/18	94	75 - 125	91	75 - 125	<0.020	mg/kg	NC	35		
8363112	Total Sodium (Na)	2016/08/18					<10	mg/kg	8.9	35	98	75 - 125
8363112	Total Strontium (Sr)	2016/08/18	NC	75 - 125	99	75 - 125	<0.10	mg/kg	0.54	35	96	75 - 125
8363112	Total Tellurium (Te)	2016/08/18					<0.10	mg/kg	NC	35		
8363112	Total Thallium (Tl)	2016/08/18	104	75 - 125	107	75 - 125	<0.0020	mg/kg	2.1	35		
8363112	Total Thorium (Th)	2016/08/18					<0.050	mg/kg	8.5	35		
8363112	Total Tin (Sn)	2016/08/18	94	75 - 125	90	75 - 125	<0.10	mg/kg	NC	35		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8363112	Total Titanium (Ti)	2016/08/18	NC	75 - 125	101	75 - 125	<1.0	mg/kg	11	35		
8363112	Total Uranium (U)	2016/08/18	100	75 - 125	101	75 - 125	<0.0020	mg/kg	2.4	35		
8363112	Total Vanadium (V)	2016/08/18	90	75 - 125	94	75 - 125	<0.20	mg/kg	26	35		
8363112	Total Zinc (Zn)	2016/08/18	NC	75 - 125	97	75 - 125	<0.20	mg/kg	1.2	35	96	75 - 125
8363112	Total Zirconium (Zr)	2016/08/18					<0.50	mg/kg	NC	35		
8363141	Total Aluminum (Al)	2016/08/19					<1.0	mg/kg	4.2	35	39	17 - 93
8363141	Total Antimony (Sb)	2016/08/19	102	75 - 125	100	75 - 125	<0.0050	mg/kg	NC	35		
8363141	Total Arsenic (As)	2016/08/19	105	75 - 125	101	75 - 125	<0.050	mg/kg	3.1	35	84	42 - 199
8363141	Total Barium (Ba)	2016/08/19	NC	75 - 125	110	75 - 125	<0.10	mg/kg	4.2	35		
8363141	Total Beryllium (Be)	2016/08/19	108	75 - 125	105	75 - 125	<0.10	mg/kg	NC	35		
8363141	Total Bismuth (Bi)	2016/08/19					<0.10	mg/kg	NC	35		
8363141	Total Boron (B)	2016/08/19					<2.0	mg/kg	NC	35	103	75 - 125
8363141	Total Cadmium (Cd)	2016/08/19	104	75 - 125	101	75 - 125	<0.010	mg/kg	NC	35	96	75 - 125
8363141	Total Calcium (Ca)	2016/08/19					<10	mg/kg	5.9	35	93	75 - 125
8363141	Total Cesium (Cs)	2016/08/19					<0.10	mg/kg	2.8	N/A		
8363141	Total Chromium (Cr)	2016/08/19	NC	75 - 125	95	75 - 125	<0.20	mg/kg	5.3	35		
8363141	Total Cobalt (Co)	2016/08/19	98	75 - 125	98	75 - 125	<0.020	mg/kg	1.4	35	83	75 - 125
8363141	Total Copper (Cu)	2016/08/19	102	75 - 125	98	75 - 125	<0.050	mg/kg	3.1	35	92	75 - 125
8363141	Total Iron (Fe)	2016/08/19					<10	mg/kg	8.7	35		
8363141	Total Lead (Pb)	2016/08/19	94	75 - 125	99	75 - 125	<0.010	mg/kg	10	35		
8363141	Total Lithium (Li)	2016/08/19	98	75 - 125	104	75 - 125	<0.50	mg/kg	NC	35		
8363141	Total Magnesium (Mg)	2016/08/19					<10	mg/kg	3.3	35		
8363141	Total Manganese (Mn)	2016/08/19	NC	75 - 125	97	75 - 125	<0.10	mg/kg	2.4	35	94	75 - 125
8363141	Total Molybdenum (Mo)	2016/08/19	98	75 - 125	93	75 - 125	<0.050	mg/kg	2.4	35		
8363141	Total Nickel (Ni)	2016/08/19	NC	75 - 125	99	75 - 125	<0.050	mg/kg	5.1	35	81	75 - 125
8363141	Total Phosphorus (P)	2016/08/19					<10	mg/kg	2.4	35	108	75 - 125
8363141	Total Potassium (K)	2016/08/19					<10	mg/kg	2.3	35	95	75 - 125
8363141	Total Selenium (Se)	2016/08/19	108	75 - 125	107	75 - 125	<0.050	mg/kg	NC	35	94	75 - 125
8363141	Total Silver (Ag)	2016/08/19	88	75 - 125	90	75 - 125	<0.020	mg/kg	NC	35		
8363141	Total Sodium (Na)	2016/08/19					<10	mg/kg	8.5	35	92	75 - 125
8363141	Total Strontium (Sr)	2016/08/19	NC	75 - 125	97	75 - 125	<0.10	mg/kg	3.4	35	95	75 - 125

QUALITY ASSURANCE REPORT(CONT'D)

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005

Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
8363141	Total Tellurium (Te)	2016/08/19					<0.10	mg/kg	NC	35		
8363141	Total Thallium (Tl)	2016/08/19	102	75 - 125	98	75 - 125	<0.0020	mg/kg	2.7	35		
8363141	Total Thorium (Th)	2016/08/19					<0.050	mg/kg	6.5	35		
8363141	Total Tin (Sn)	2016/08/19	93	75 - 125	87	75 - 125	<0.10	mg/kg	NC	35		
8363141	Total Titanium (Ti)	2016/08/19	NC	75 - 125	97	75 - 125	<1.0	mg/kg	0.19	35		
8363141	Total Uranium (U)	2016/08/19	96	75 - 125	98	75 - 125	<0.0020	mg/kg	12	35		
8363141	Total Vanadium (V)	2016/08/19	99	75 - 125	98	75 - 125	<0.20	mg/kg	NC	35		
8363141	Total Zinc (Zn)	2016/08/19	NC	75 - 125	106	75 - 125	<0.20	mg/kg	2.9	35	96	75 - 125
8363141	Total Zirconium (Zr)	2016/08/19					<0.50	mg/kg	NC	35		
8363157	Total Mercury (Hg)	2016/08/19	72 (1)	75 - 125	98	75 - 125	<0.010	mg/kg	0.47	20	84	75 - 125
8363162	Total Mercury (Hg)	2016/08/19	77	75 - 125	95	75 - 125	<0.010	mg/kg	3.6	20	82	75 - 125
8370076	Moisture	2016/08/20					<0.30	%	9.1	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Andy Lu, Ph.D., P.Chem., Scientific Specialist

Rob Reinert, B.Sc., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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08425873

Maxxam
A Bureau Veritas Group Company

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

BBY FCD-00077/06
Page 1 of 2

Invoice Information
Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5536
Email: david.wells@riotinto.com

Report Information (if differs from invoice)
Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 306 202 7817 (cell if urgent)
Email: kserben@golder.com

Project Information (where applicable)
Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required
☑ Regular TAT 5 days (Most analyses)
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Rush TAT (Surcharges will be applied)
☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days
Date Required:
Rush Confirmation #:

Regulatory Criteria
☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions
☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

Analysis Requested

LABORATORY USE ONLY

CUSTODY SEAL Y / [✓ N]		COOLER TEMPERATURES
Present	Intact	
N	N	17,5,4
Y	Y	18,18,14

BBY

COOLING MEDIA PRESENT [✓ Y] / N

COMMENTS

Do NOT wash the lichen samples before analysis.

SAMPLES MUST BE KEPT COOL (≤ 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TIC ☐ TC ☐ TOC	Cation Exchange Capacity	Available Nitrate	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	FF3-16L	2016/07/23	0825	tissue	X	X	X							
2	FF1-16L	2016/07/23	0907	tissue	X	X	X							
3	NF23-16L	2016/07/23	1033	tissue	X	X	X							
4	NF22-16L	2016/07/23	1140	tissue	X	X	X							
5	NF21-16L	2016/07/23	1253	tissue	X	X	X							
6	NF17-16L	2016/07/23	1344	tissue	X	X	X							
7	NF16-16L	2016/07/23	1502	tissue	X	X	X							
8	NF14-16L	2016/07/23	1619	tissue	X	X	X							
9	NF20-16L	2016/07/23	1713	tissue	X	X	X							
10	NF9-16L	2016/07/23	1800	tissue	X	X	X							

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Pr	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C.SHAPKA	2016/07/28	0630	David [illegible]	2016/07/29	12:10
			Nahed Amer	2016/07/30	12:30

B664098_COC

08425874

Maxxam
A Bureau Veritas Group Company

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5, Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

BBY FCD-00077/06
Page 2 of 2

Invoice Information

Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5536
Email: david.wells@riotinto.com

Report Information (if differs from invoice)

Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 206 202 7817 (cell if urgent)
Email: kserben@golder.com

Project Information (where applicable)

Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required

☑ Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)
☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days
Date Required:
Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

Analysis Requested

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TIC ☐ TOC ☐	Cation Exchange Capacity	Available Nitrate	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	FF3-16S	2016/07/23	0825	soil		X								
2	FF1-16S	2016/07/23	0907	soil		X								
3	NF23-16S	2016/07/23	1033	soil		X								
4	NF22-16S	2016/07/23	1140	soil		X								
5	NF21-16S	2016/07/23	1253	soil		X								
6	NF17-16S	2016/07/23	1349	soil		X								
7	NF16-16S	2016/07/23	1502	soil		X								
8	NF14-16S	2016/07/23	1619	soil		X								
9	NF20-16S	2016/07/23	1713	soil		X								
10	NF9-16S	2016/07/23	1800	soil		X								

LABORATORY USE ONLY

CUSTODY SEAL Y / [✓ N] Present	Intact	COOLER TEMPERATURES
N	N	17, 5, 4
Y	Y	18, 18, 14

BBY

COOLING MEDIA PRESENT [✓ Y] / N

COMMENTS

Maxxam - Take a sub-sample and analyze it for mercury; archive remaining sample for possible future metals analysis.

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C. SHAPKA	2016/07/28	0630	/ David Tilman	2016/07/29	12:10
			Nahed Amer	2016/07/30	12:30

B664098_COC

Your Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE

Attention:Kerrie Serben
GOLDER ASSOCIATES LTD
1721 8TH Street East
Saskatoon, SK
Canada

Your C.O.C. #: 08425875, 08425878, 08425877, 08425876

Report Date: 2016/08/19
Report #: R2241818
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B664103
Received: 2016/07/29, 12:10

Sample Matrix: Soil
Samples Received: 11

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Soil by CVAF	11	2016/08/05	2016/08/05	BBY7SOP-00012	EPA 245.7 R2 m

Sample Matrix: TISSUE
Samples Received: 11

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Mercury in Tissue by CVAF - Dry Wt	11	N/A	2016/08/19	BBY7SOP-00012	EPA 245.7 R2 m
Elements in Tissue by CRC ICPMS - Dry Wt	11	2016/08/15	2016/08/19	BBY7SOP-00002	EPA 6020A R1 m
Moisture in Tissue	11	N/A	2016/08/16	BBY8SOP-00017	OMOE E3139 3.1 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Tabitha Rudkin
Burnaby Project Manager
19 Aug 2016 17:49:46 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Tabitha Rudkin, AScT, Burnaby Project Manager
Email: TRudkin@maxxam.ca
Phone# (604)638-2639
==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

MERCURY BY COLD VAPOR (SOIL)

Maxxam ID		PE0537	PE0538	PE0539	PE0540	PE0541	PE0542		
Sampling Date		2016/07/21 09:00	2016/07/21 10:00	2016/07/21 10:25	2016/07/21 11:20	2016/07/21 11:36	2016/07/21 12:26		
COC Number		08425878	08425878	08425878	08425878	08425878	08425878		
	UNITS	**FF15-16S**	**FF19-16S**	**FF14-16S**	**FF13-16S**	**FF13-16SB**	**FF22-16S**	**RDL**	**QC Batch**
Elements									
Total Mercury (Hg)	mg/kg	0.164	0.0212	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	8352109

RDL = Reportable Detection Limit

Maxxam ID		PE0543	PE0544	PE0545	PE0546	PE0548		
Sampling Date		2016/07/21 13:20	2016/07/21 14:08	2016/07/21 14:49	2016/07/21 15:31	2016/07/21 16:18		
COC Number		08425878	08425878	08425878	08425878	08425876		
	UNITS	**FF12-16S**	**FF20-16S**	**FF11-16S**	**FF21-16S**	**FF10-16S**	**RDL**	**QC Batch**
Elements								
Total Mercury (Hg)	mg/kg	<0.0050	0.0071	0.0101	<0.0050	<0.0050	0.0050	8352109

RDL = Reportable Detection Limit

Maxxam Job #: B664103
Report Date: 2016/08/19

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PE0527	PE0528	PE0529	PE0530	PE0531	PE0532	PE0533		
Sampling Date		2016/07/21 08:41	2016/07/21 09:37	2016/07/21 10:50	2016/07/21 11:28	2016/07/21 11:31	2016/07/21 12:26	2016/07/21 13:20		
COC Number		08425875	08425875	08425875	08425875	08425875	08425875	08425875		
	UNITS	**FF15-16L**	**FF19-16L**	**FF14-16L**	**FF13-16L**	**FF13-16LB**	**FF22-16L**	**FF12-16L**	**RDL**	**QC Batch**
Mercury by CVAA										
Total Mercury (Hg)	mg/kg	0.0439	0.0312	0.0461	0.0338	0.0220	0.0357	0.0366	0.0050	8363162
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	298	316	371	448	195	182	424	1.0	8363141
Total Antimony (Sb)	mg/kg	0.0088	0.0073	0.0113	0.0083	<0.0050	0.0084	0.0094	0.0050	8363141
Total Arsenic (As)	mg/kg	0.315	0.170	0.326	0.595	0.389	0.301	0.442	0.050	8363141
Total Barium (Ba)	mg/kg	23.5	21.1	50.2	26.6	23.4	17.9	27.8	0.10	8363141
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363141
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363141
Total Boron (B)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	8363141
Total Cadmium (Cd)	mg/kg	0.072	0.037	0.106	0.048	0.037	0.051	0.063	0.010	8363141
Total Calcium (Ca)	mg/kg	1230	822	1850	1020	539	1160	1040	10	8363141
Total Cesium (Cs)	mg/kg	0.68	0.99	0.31	0.41	0.37	0.18	0.27	0.10	8363141
Total Chromium (Cr)	mg/kg	1.10	0.71	1.32	0.83	0.30	0.45	0.92	0.20	8363141
Total Cobalt (Co)	mg/kg	0.406	0.556	0.715	0.627	0.326	0.345	0.457	0.020	8363141
Total Copper (Cu)	mg/kg	2.05	2.37	3.07	4.32	2.82	1.67	2.32	0.050	8363141
Total Iron (Fe)	mg/kg	343	221	341	575	235	214	375	10	8363141
Total Lead (Pb)	mg/kg	0.473	0.330	0.865	0.270	0.100	0.409	0.433	0.010	8363141
Total Lithium (Li)	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8363141
Total Magnesium (Mg)	mg/kg	461	355	589	351	279	405	375	10	8363141
Total Manganese (Mn)	mg/kg	52.0	44.7	88.3	20.9	28.8	59.8	44.3	0.10	8363141
Total Molybdenum (Mo)	mg/kg	0.063	0.072	0.072	0.191	0.193	0.077	0.100	0.050	8363141
Total Nickel (Ni)	mg/kg	1.75	3.39	3.98	3.27	1.80	1.01	1.92	0.050	8363141
Total Phosphorus (P)	mg/kg	676	699	714	634	824	617	717	10	8363141
Total Potassium (K)	mg/kg	1410	1700	1300	1650	2180	1350	1630	10	8363141
Total Selenium (Se)	mg/kg	0.051	<0.050	0.062	0.056	<0.050	<0.050	0.055	0.050	8363141
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	0.022	<0.020	<0.020	<0.020	0.020	8363141
Total Sodium (Na)	mg/kg	50	59	34	46	34	38	55	10	8363141
Total Strontium (Sr)	mg/kg	8.07	7.28	12.1	9.79	8.56	5.68	6.54	0.10	8363141
Total Tellurium (Te)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363141
Total Thallium (Tl)	mg/kg	0.0205	0.0156	0.0249	0.0127	0.0086	0.0170	0.0234	0.0020	8363141
Total Thorium (Th)	mg/kg	0.075	0.062	0.100	0.126	0.076	0.055	0.077	0.050	8363141

RDL = Reportable Detection Limit

Maxxam Job #: B664103
Report Date: 2016/08/19

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PE0527	PE0528	PE0529	PE0530	PE0531	PE0532	PE0533		
Sampling Date		2016/07/21 08:41	2016/07/21 09:37	2016/07/21 10:50	2016/07/21 11:28	2016/07/21 11:31	2016/07/21 12:26	2016/07/21 13:20		
COC Number		08425875	08425875	08425875	08425875	08425875	08425875	08425875		
	UNITS	**FF15-16L**	**FF19-16L**	**FF14-16L**	**FF13-16L**	**FF13-16LB**	**FF22-16L**	**FF12-16L**	**RDL**	**QC Batch**
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8363141
Total Titanium (Ti)	mg/kg	13.7	8.5	13.8	8.7	4.5	6.5	10.1	1.0	8363141
Total Uranium (U)	mg/kg	0.0550	0.0549	0.0755	0.138	0.0651	0.0423	0.0492	0.0020	8363141
Total Vanadium (V)	mg/kg	0.49	0.29	0.56	0.66	0.43	0.31	0.45	0.20	8363141
Total Zinc (Zn)	mg/kg	24.8	27.7	40.0	23.8	28.2	23.2	26.6	0.20	8363141
Total Zirconium (Zr)	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8363141
RDL = Reportable Detection Limit										

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PE0534	PE0535	PE0536	PE0547		
Sampling Date		2016/07/21 14:08	2016/07/21 14:49	2016/07/21 15:31	2016/07/21 16:18		
COC Number		08425875	08425875	08425875	08425877		
	UNITS	**FF20-16L**	**FF11-16L**	**FF21-16L**	**FF10-16L**	**RDL**	**QC Batch**
Mercury by CVAA							
Total Mercury (Hg)	mg/kg	0.0577	0.0652	0.0379	0.0458	0.0050	8363162
Total Metals by ICPMS							
Total Aluminum (Al)	mg/kg	796	555	373	156	1.0	8363141
Total Antimony (Sb)	mg/kg	0.0145	0.0241	0.0074	0.0059	0.0050	8363141
Total Arsenic (As)	mg/kg	0.442	0.399	0.428	0.214	0.050	8363141
Total Barium (Ba)	mg/kg	21.1	51.3	27.3	14.2	0.10	8363141
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	0.10	8363141
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	0.10	8363141
Total Boron (B)	mg/kg	<2.0	<2.0	<2.0	<2.0	2.0	8363141
Total Cadmium (Cd)	mg/kg	0.110	0.140	0.064	0.049	0.010	8363141
Total Calcium (Ca)	mg/kg	1150	1560	1730	1020	10	8363141
Total Cesium (Cs)	mg/kg	0.56	0.47	0.26	0.13	0.10	8363141
Total Chromium (Cr)	mg/kg	2.00	1.50	2.00	0.40	0.20	8363141
Total Cobalt (Co)	mg/kg	0.484	0.266	0.772	0.257	0.020	8363141
Total Copper (Cu)	mg/kg	2.08	2.42	3.11	1.69	0.050	8363141
Total Iron (Fe)	mg/kg	778	435	467	241	10	8363141
Total Lead (Pb)	mg/kg	1.64	2.40	0.661	0.404	0.010	8363141
Total Lithium (Li)	mg/kg	<0.50	<0.50	<0.50	<0.50	0.50	8363141
Total Magnesium (Mg)	mg/kg	506	442	486	353	10	8363141
Total Manganese (Mn)	mg/kg	38.0	54.2	65.8	190	0.10	8363141
Total Molybdenum (Mo)	mg/kg	0.376	0.083	0.181	0.127	0.050	8363141
Total Nickel (Ni)	mg/kg	1.87	1.63	2.58	1.16	0.050	8363141
Total Phosphorus (P)	mg/kg	778	607	734	418	10	8363141
Total Potassium (K)	mg/kg	1790	1140	1870	1100	10	8363141
Total Selenium (Se)	mg/kg	0.082	0.080	0.063	<0.050	0.050	8363141
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	8363141
Total Sodium (Na)	mg/kg	57	42	41	59	10	8363141
Total Strontium (Sr)	mg/kg	6.66	10.1	10.7	3.14	0.10	8363141
Total Tellurium (Te)	mg/kg	<0.10	<0.10	<0.10	<0.10	0.10	8363141
Total Thallium (Tl)	mg/kg	0.0243	0.0220	0.0152	0.0113	0.0020	8363141
Total Thorium (Th)	mg/kg	0.364	0.107	0.155	<0.050	0.050	8363141

RDL = Reportable Detection Limit

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PE0534	PE0535	PE0536	PE0547		
Sampling Date		2016/07/21 14:08	2016/07/21 14:49	2016/07/21 15:31	2016/07/21 16:18		
COC Number		08425875	08425875	08425875	08425877		
	UNITS	**FF20-16L**	**FF11-16L**	**FF21-16L**	**FF10-16L**	**RDL**	**QC Batch**
Total Tin (Sn)	mg/kg	<0.10	0.22	<0.10	<0.10	0.10	8363141
Total Titanium (Ti)	mg/kg	34.0	16.5	13.2	5.2	1.0	8363141
Total Uranium (U)	mg/kg	0.203	0.0513	0.123	0.0413	0.0020	8363141
Total Vanadium (V)	mg/kg	1.07	0.73	0.68	0.28	0.20	8363141
Total Zinc (Zn)	mg/kg	27.7	37.9	26.9	21.6	0.20	8363141
Total Zirconium (Zr)	mg/kg	<0.50	<0.50	<0.50	<0.50	0.50	8363141

RDL = Reportable Detection Limit

PHYSICAL TESTING (TISSUE)

Maxxam ID		PE0527	PE0528	PE0529	PE0530	PE0531	PE0532	PE0533		
Sampling Date		2016/07/21 08:41	2016/07/21 09:37	2016/07/21 10:50	2016/07/21 11:28	2016/07/21 11:31	2016/07/21 12:26	2016/07/21 13:20		
COC Number		08425875	08425875	08425875	08425875	08425875	08425875	08425875		
	UNITS	**FF15-16L**	**FF19-16L**	**FF14-16L**	**FF13-16L**	**FF13-16LB**	**FF22-16L**	**FF12-16L**	**RDL**	**QC Batch**
Physical Properties										
Moisture	%	42	66	61	60	61	32	49	0.30	8363933

RDL = Reportable Detection Limit

Maxxam ID		PE0534	PE0535	PE0536	PE0547		
Sampling Date		2016/07/21 14:08	2016/07/21 14:49	2016/07/21 15:31	2016/07/21 16:18		
COC Number		08425875	08425875	08425875	08425877		
	UNITS	**FF20-16L**	**FF11-16L**	**FF21-16L**	**FF10-16L**	**RDL**	**QC Batch**
Physical Properties							
Moisture	%	34	30	46	25	0.30	8363933

RDL = Reportable Detection Limit

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.3°C

Results relate only to the items tested.

Maxxam Job #: B664103
Report Date: 2016/08/19

QUALITY ASSURANCE REPORT

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8352109	Total Mercury (Hg)	2016/08/05	100	75 - 125	93	75 - 125	<0.0050	mg/kg	NC	35	95	70 - 130
8363141	Total Aluminum (Al)	2016/08/19					<1.0	mg/kg	4.2	35	39	17 - 93
8363141	Total Antimony (Sb)	2016/08/19	102	75 - 125	100	75 - 125	<0.0050	mg/kg	NC	35		
8363141	Total Arsenic (As)	2016/08/19	105	75 - 125	101	75 - 125	<0.050	mg/kg	3.1	35	84	42 - 199
8363141	Total Barium (Ba)	2016/08/19	NC	75 - 125	110	75 - 125	<0.10	mg/kg	4.2	35		
8363141	Total Beryllium (Be)	2016/08/19	108	75 - 125	105	75 - 125	<0.10	mg/kg	NC	35		
8363141	Total Bismuth (Bi)	2016/08/19					<0.10	mg/kg	NC	35		
8363141	Total Boron (B)	2016/08/19					<2.0	mg/kg	NC	35	103	75 - 125
8363141	Total Cadmium (Cd)	2016/08/19	104	75 - 125	101	75 - 125	<0.010	mg/kg	NC	35	96	75 - 125
8363141	Total Calcium (Ca)	2016/08/19					<10	mg/kg	5.9	35	93	75 - 125
8363141	Total Cesium (Cs)	2016/08/19					<0.10	mg/kg	2.8	N/A		
8363141	Total Chromium (Cr)	2016/08/19	NC	75 - 125	95	75 - 125	<0.20	mg/kg	5.3	35		
8363141	Total Cobalt (Co)	2016/08/19	98	75 - 125	98	75 - 125	<0.020	mg/kg	1.4	35	83	75 - 125
8363141	Total Copper (Cu)	2016/08/19	102	75 - 125	98	75 - 125	<0.050	mg/kg	3.1	35	92	75 - 125
8363141	Total Iron (Fe)	2016/08/19					<10	mg/kg	8.7	35		
8363141	Total Lead (Pb)	2016/08/19	94	75 - 125	99	75 - 125	<0.010	mg/kg	10	35		
8363141	Total Lithium (Li)	2016/08/19	98	75 - 125	104	75 - 125	<0.50	mg/kg	NC	35		
8363141	Total Magnesium (Mg)	2016/08/19					<10	mg/kg	3.3	35		
8363141	Total Manganese (Mn)	2016/08/19	NC	75 - 125	97	75 - 125	<0.10	mg/kg	2.4	35	94	75 - 125
8363141	Total Molybdenum (Mo)	2016/08/19	98	75 - 125	93	75 - 125	<0.050	mg/kg	2.4	35		
8363141	Total Nickel (Ni)	2016/08/19	NC	75 - 125	99	75 - 125	<0.050	mg/kg	5.1	35	81	75 - 125
8363141	Total Phosphorus (P)	2016/08/19					<10	mg/kg	2.4	35	108	75 - 125
8363141	Total Potassium (K)	2016/08/19					<10	mg/kg	2.3	35	95	75 - 125
8363141	Total Selenium (Se)	2016/08/19	108	75 - 125	107	75 - 125	<0.050	mg/kg	NC	35	94	75 - 125
8363141	Total Silver (Ag)	2016/08/19	88	75 - 125	90	75 - 125	<0.020	mg/kg	NC	35		
8363141	Total Sodium (Na)	2016/08/19					<10	mg/kg	8.5	35	92	75 - 125
8363141	Total Strontium (Sr)	2016/08/19	NC	75 - 125	97	75 - 125	<0.10	mg/kg	3.4	35	95	75 - 125
8363141	Total Tellurium (Te)	2016/08/19					<0.10	mg/kg	NC	35		
8363141	Total Thallium (Tl)	2016/08/19	102	75 - 125	98	75 - 125	<0.0020	mg/kg	2.7	35		
8363141	Total Thorium (Th)	2016/08/19					<0.050	mg/kg	6.5	35		
8363141	Total Tin (Sn)	2016/08/19	93	75 - 125	87	75 - 125	<0.10	mg/kg	NC	35		

Maxxam Job #: B664103
Report Date: 2016/08/19

QUALITY ASSURANCE REPORT(CONT'D)

GOLDER ASSOCIATES LTD
Client Project #: GOLDER PROJECT #1648005
Site Location: PHASE 2000 DIVAIK MINE
Sampler Initials: CS

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8363141	Total Titanium (Ti)	2016/08/19	NC	75 - 125	97	75 - 125	<1.0	mg/kg	0.19	35		
8363141	Total Uranium (U)	2016/08/19	96	75 - 125	98	75 - 125	<0.0020	mg/kg	12	35		
8363141	Total Vanadium (V)	2016/08/19	99	75 - 125	98	75 - 125	<0.20	mg/kg	NC	35		
8363141	Total Zinc (Zn)	2016/08/19	NC	75 - 125	106	75 - 125	<0.20	mg/kg	2.9	35	96	75 - 125
8363141	Total Zirconium (Zr)	2016/08/19					<0.50	mg/kg	NC	35		
8363162	Total Mercury (Hg)	2016/08/19	77	75 - 125	95	75 - 125	<0.010	mg/kg	3.6	20	82	75 - 125
8363933	Moisture	2016/08/16					<0.30	%	13	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Andy Lu, Ph.D., P.Chem., Scientific Specialist

1321

08425875

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CHAIN OF CUSTODY RECORD

BBY FCD-00077/06
Page 1 of 4

Invoice Information

Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5536
Email: david.wells@riotinto.com

Report Information (if differs from invoice)

Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 206 202 7817 (cell if urgent)
Email: kserben@golder.com

Project Information (where applicable)

Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required

☑ Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)
☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days

Date Required:
Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

LABORATORY USE ONLY

D-T 2016/07/29

CUSTODY SEAL ~~Y~~ N No Seal

Present	Intact	COOLER TEMPERATURES
		5 D-T 2016/07/29
No	N	~~18~~,6,5
D-T	2016/07/27	
4	4	14,9,6

COOLING MEDIA PRESENT [✓ Y] / N

BB4

COMMENTS

Do NOT wash the lichen samples before analysis

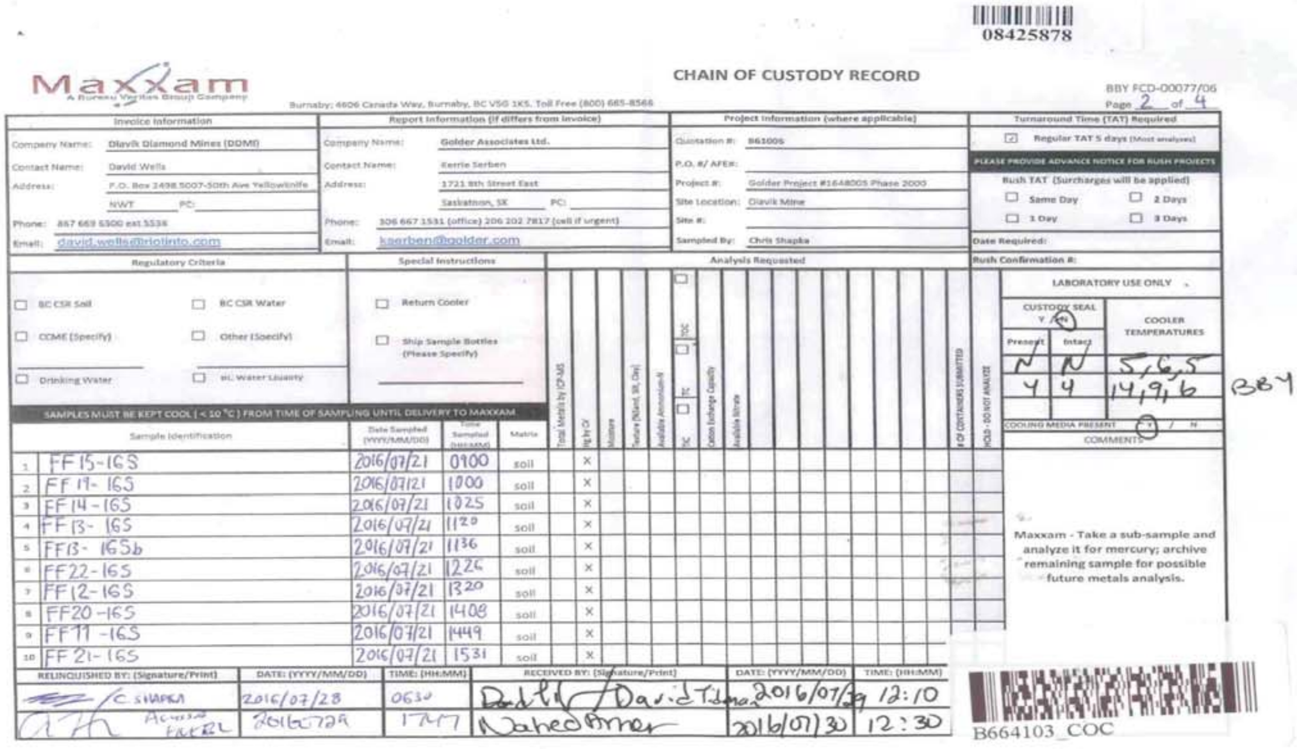
SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TOC ☐ TC ☐ TIC	Cation Exchange Capacity	Available Nitrate									# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	FF15-16L	2016/07/21	0841	tissue	X	X	X															
2	FF19-16L	2016/07/21	0937	tissue	X	X	X															
3	FF14-16L	2016/07/21	1050	tissue	X	X	X															
4	FF13-16L	2016/07/21	1120	tissue	X	X	X															
5	FF13-16Lb	2016/07/21	1131	tissue	X	X	X															
6	FF22-16L	2016/07/21	1226	tissue	X	X	X															
7	FF12-16L	2016/07/21	1320	tissue	X	X	X															
8	FF20-16L	2016/07/21	1408	tissue	X	X	X															
9	FF11-16L	2016/07/21	1449	tissue	X	X	X															
10	FF21-16L	2016/07/21	1531	tissue	X	X	X															

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C. SHAPKA	206/07/28	0630	David T.T / David Tidan	2016/07/29	12:10
[illegible]	20160729	1747	Nahed Amer	2016/07/30	12:30

B664103_COC



08425878

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CHAIN OF CUSTODY RECORD

BBY FCD-00077/06
Page 2 of 4

Invoice Information

Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5534
Email: david.wells@riotinto.com

Report Information (if differs from invoice)

Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 206 202 7817 (cell if urgent)
Email: kserben@golder.com

Project Information (where applicable)

Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required

☑ Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)
☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days

Date Required:
Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

Analysis Requested

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TOC ☐ TC ☐ IC	Cation Exchange Capacity	Available Nitrate									# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	FF15-16S	2016/07/21	0900	soil		×																
2	FF19-16S	2016/07/21	1000	soil		×																
3	FF14-16S	2016/07/21	1025	soil		×																
4	FF13-16S	2016/07/21	1120	soil		×																
5	FF13-16Sb	2016/07/21	1136	soil		×																
6	FF22-16S	2016/07/21	1226	soil		×																
7	FF12-16S	2016/07/21	1320	soil		×																
8	FF20-16S	2016/07/21	1408	soil		×																
9	FF11-16S	2016/07/21	1449	soil		×																
10	FF21-16S	2016/07/21	1531	soil		×																

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
/ C. SHAPKA	2016/07/28	0630	/ David Tidmar	2016/07/29	12:10
Acuna FAERL	20160729	1747	Nahed Amer	2016/07/30	12:30

LABORATORY USE ONLY

CUSTODY SEAL Y / [✓ N]		COOLER TEMPERATURES
Present	Intact	
N	N	5,6,5
Y	Y	14,9,6

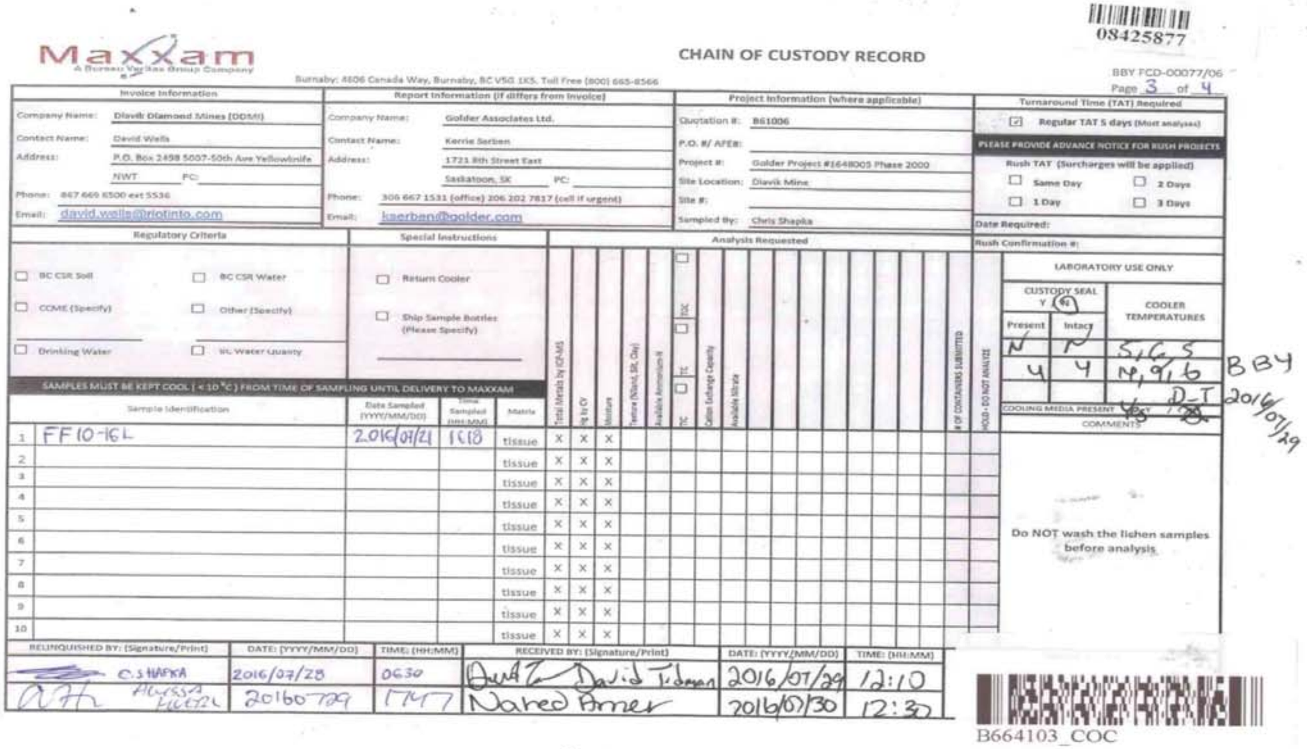
BBY

COOLING MEDIA PRESENT [✓ Y] / N

COMMENTS

Maxxam - Take a sub-sample and analyze it for mercury; archive remaining sample for possible future metals analysis.

B664103_COC



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08425877

CHAIN OF CUSTODY RECORD

BBY FCD-00077/06
Page 3 of 4

Invoice Information
Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5536
Email: david.wells@riotinto.com

Report Information (if differs from invoice)
Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 306 202 7817 (cell if urgent)
Email: kserben@golder.com

Project Information (where applicable)
Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required
☑ Regular TAT 5 days (Most analyses)
PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Rush TAT (Surcharges will be applied)
☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days
Date Required:
Rush Confirmation #:

Regulatory Criteria
☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions
☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TOC ☐ TIC ☐ TC	Cation Exchange Capacity	Available Nitrate	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	FF10-16L	2016/07/21	1618	tissue	X	X	X							
2				tissue	X	X	X							
3				tissue	X	X	X							
4				tissue	X	X	X							
5				tissue	X	X	X							
6				tissue	X	X	X							
7				tissue	X	X	X							
8				tissue	X	X	X							
9				tissue	X	X	X							
10				tissue	X	X	X							

LABORATORY USE ONLY

CUSTODY SEAL Y [✓ N]

Present	Intact	COOLER TEMPERATURES
N	N	5,6,5
4	4	4,9,6

COOLING MEDIA PRESENT Yes ~~Y~~ / ~~N~~ D-T

BBY 2016/07/29

COMMENTS
Do NOT wash the lichen samples before analysis.

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C.SHAPKA	2016/07/28	0630	David Tidman	2016/07/29	12:10
ALYSSA HUETZL	20160729	1747	Nared Amer	2016/07/30	12:30

B664103_COC

08425876

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CHAIN OF CUSTODY RECORD

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BBY FCD-00077/06
Page 4 of 4

Invoice Information

Company Name: Diavik Diamond Mines (DDMI)
Contact Name: David Wells
Address: P.O. Box 2498 5007-50th Ave Yellowknife
NWT PC:
Phone: 867 669 6500 ext 5536
Email: david.wells@riotinto.com

Report Information (if differs from invoice)

Company Name: Golder Associates Ltd.
Contact Name: Kerrie Serben
Address: 1721 8th Street East
Saskatoon, SK PC:
Phone: 306 667 1531 (office) 206 202 7817 (cell if urgent)
Email: kserben@golder.com

Project Information (where applicable)

Quotation #: B61006
P.O. #/ AFE#:
Project #: Golder Project #1648005 Phase 2000
Site Location: Diavik Mine
Site #:
Sampled By: Chris Shapka

Turnaround Time (TAT) Required

☑ Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days

Date Required:
Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Total Metals by ICP-MS	Hg by CV	Moisture	Texture (%Sand, Silt, Clay)	Available Ammonium-N	☐ TIC ☐ TC ☐ TOC	Cation Exchange Capacity	Available Nitrate	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	FF10-16S	2016/07/21	1618	soil		X								
2				soil		X								
3				soil		X								
4				soil		X								
5				soil		X								
6				soil		X								
7				soil		X								
8				soil		X								
9				soil		X								
10				soil		X								

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
C.SHAPKA	2016/07/28	0630	/ David Tidman	2016/07/29	12:10
ALYSSA FILLOBL	20160729	FM7	Nahed Omer	2016/07/30	12:30

LABORATORY USE ONLY

CUSTODY SEAL Y / [✓ N]

Present	Intact	COOLER TEMPERATURES
N	N	5,6,5
Y	Y	14,9,6

BBY

COOLING MEDIA PRESENT [✓ Y] / N

COMMENTS

Maxxam - Take a sub-sample and analyze it for mercury; archive remaining sample for possible future metals analysis.

B664103_COC

#: 8355958

Page #: 1/1

Report Name : Worksheet - (Solids)

Assignment Date :

Assigned to : cgs

Test Code : MOISTV-TI

Instrument Id:

Test Description : Moisture in Tissue

BLANK = 1.69g = 1.69g.

Job Number	Sample Number	D	Sample ID	PAN ~~Wet Weight~~	WET ~~Final Dilution~~	DRY ~~Dry Weight Determination~~		% Moisture	Dry Weight	Balance ID	Test DeadLine	Criteria
						~~Initial~~	Final					
B663360	PD6159-01R		NF15-16L	1.85	6.16	5.40		17.6			2016/08/12 23:00	
B663360	PD6160-01R		NF5-16L	1.84	6.87	6.14		14.5			2016/08/12 23:00	
B663360	PD6161-01R		NF18-16L	1.84	5.41	4.97		12.3			2016/08/12 23:00	
B663360	PD6162-01R		FFF1-16L	1.86	7.94	7.03		15			2016/08/12 23:00	
B663360	PD6163-01R		FFF2-16L	1.84	6.93	6.29		12.6			2016/08/12 23:00	
B663360	PD6164-01R		FFF2-16LB	1.85	4.47	4.29		6.9			2016/08/12 23:00	
B663360	PD6165-01R		FFF3-16L	1.84	4.78	4.40		12.9			2016/08/12 23:00	
B663374	PD6213-01R		NF19-16L	1.91	6.09	5.25		20.1			2016/08/12 23:00	
B663374	PD6214-01R		NF8-16L	1.85 CW 2016/08	~~8.43~~	8.33	6.12	34.1			2016/08/12 23:00	
B663374	PD6215-01R		NF6-16L	1.86	7.72	5.69		34.6			2016/08/12 23:00	
B663374	PD6216-01R		NF7-16L	1.90	11.16	7.15		43.3			2016/08/12 23:00	
B663374	PD6217-01R		NF12-16L	1.86	10.75	4.62		69				
B663374	PD6218-01R		NF11-16L	1.86	8.57	4.29		63.8				

<---------- DUPLICATE

PAN =	1.67 g.
WET =	14.07 g.
DRY =	5.39 g.
%M =	70

GC Vial Code: ____________________

Remarks: ____________________

Samples extracted by: ____________________ Date: ____________

Instrumentation performed by: ____________________ Date: ____________

Calculations performed by: ____________________ Date: ____________

Validated by: ____________________ Date: ____________

WS#: 8366315

Page #: 1/1

Report Name : Worksheet - (Solids)
Assignment Date : Wednesday, August 17, 2016
Assigned to : Kelly Restiaux
Test Code : MOISTV-TI
Instrument Id:
Test Description : Moisture in Tissue

| PAN | WET | DRY |

Job Number	Sample Number	D	Sample ID	Wet Weight	~~Final Dilution~~	Dry Weight Determination Initial	Dry Weight Determination Final	% Moisture	Dry Weight	Balance ID	Test DeadLine	Criteria
	BLANK					1.69	1.69	0				
B663413	PD6477-01R		FF24-16L		1.89	7.73	5.07	45.5			2016/08/12 23:00	
B663413	PD6478-01R		FF9-16L		1.91	7.13	6.03	21.1			2016/08/12 23:00	
B663413	PD6479-01R		FF9-16LB		1.90	6.66	5.56	23.1			2016/08/12 23:00	
B663413	PD6480-01R		FF23-16L		1.89	7.70	4.60	53.4			2016/08/12 23:00	
B663413	PD6481-01R		FF8-16L		1.89	5.08	4.44	20.1			2016/08/12 23:00	
B663413	PD6482-01R		FF5-16L		1.90	9.08	6.52	35.7			2016/08/12 23:00	
B663413	PD6483-01R		FF25-16L		1.90	5.22	4.39	25.0			2016/08/12 23:00	
B663413	PD6484-01R		FF7-16L		1.91	8.31	5.89	37.8			2016/08/12 23:00	
B663413	PD6485-01R		FF2-16L		1.88	7.66	5.45	38.2			2016/08/12 23:00	
B663413	PD6486-01R	0	FF17-16L		1.89	6.48	5.23	27.2			2016/08/12 23:00	
B663413	PD6486-01R	1	FF17-16L ←		1.69	6.37 ~~6.48~~	4.98 ~~5.23~~	29.7 ~~27.2~~			2016/08/12 23:00	
			DUPLICATE					LO 20160818				

GC Vial Code:

Remarks:

Samples extracted by:	Kelly Restiaux	Date:	
Instrumentation performed by:	Lolita Obusan	Date:	
Calculations performed by:	Lolita Obusan	Date:	2016/08/18
Validated by:	Lolita Obusan	Date:	2016/08/18

WS#: 8368277

Page #: 1/1

Report Name : Worksheet - (Solids)
Assignment Date : Thursday, August 18, 2016
Assigned to : Kelly Restiaux
Test Code : MOISTV-TI
Instrument Id:
Test Description : Moisture in Tissue

| PAN | WET | DRY |

Job Number	Sample Number	D	Sample ID	Wet Weight	Final Dilution	Dry Weight Determination		% Moisture	Dry Weight	Balance ID	Test DeadLine	Criteria
						Initial	Final					
	BLANK					1.67	1.67	0				
B663450	PD6706-01R		NF4-16L		1.89	4.77	4.39	13.2			2016/08/12 23:00	
B663450	PD6707-01R		NF18-16L		1.88	5.30	4.92	11.1			2016/08/12 23:00	
B663450	PD6708-01R		NF18-16LB		1.89	3.90	3.75	7.5			2016/08/12 23:00	
B663450	PD6709-01R		NF2-16L		1.87	4.67	4.34	11.8			2016/08/12 23:00	
B663450	PD6710-01R		NF2-16LB		1.87	5.06	4.92	4.4			2016/08/12 23:00	
~~B663450~~	~~PD6711-01R~~		~~NF3-16L~~		~~1.87~~	~~3.99~~	~~3.86~~	~~6.1~~			~~2016/08/12 23:00~~	
B663450	PD6712-01R		NF10-16L		1.87	4.59	4.38	7.7			2016/08/12 23:00	
B663450	PD6713-01R	0	NF1-16L		1.88	3.95	3.75	9.7			2016/08/12 23:00	
B663450	PD6713-01R	1	NF1-16L ←		1.68	3.71 ~~3.95~~	3.54 ~~3.75~~	8.4 ~~9.7~~	LMO 20160819		2016/08/12 23:00	
			DUPLICATE									

GC Vial Code: ______________________

Remarks: ______________________

Samples extracted by:	Kelly Restiaux	Date:	
Instrumentation performed by:	Lolita Obusan	Date:	
Calculations performed by:	Lolita Obusan	Date:	2016/08/19
Validated by:	Lolita Obusan	Date:	2016/08/19

APPENDIX H

Statistical Analyses for Lichen Chemistry

Table H 1: Statistical Comparison of Metal Concentration in Lichen

Parameter	Units	2016 Near-field								2016 Far-field							
		n	# of ND	Detection Frequency (%)	Mean	SD	SE	Min	Max	n	# of ND	Detection Frequency (%)	Mean	SD	SE	Min	Max
Aluminum (Al)-Total	mg/kg	23	0	100	831.391	365.673	76.248	190.000	1530.000	21	0	100	444.762	248.286	54.180	87.000	1020.000
Antimony (Sb)-Total	mg/kg	23	0	100	0.017	0.009	0.002	0.006	0.046	21	4	81	0.009	0.005	0.001	0.003	0.024
Arsenic (As)-Total	mg/kg	23	0	100	0.339	0.082	0.017	0.192	0.573	21	0	100	0.405	0.163	0.035	0.170	0.817
Barium (Ba)-Total	mg/kg	23	0	100	30.078	12.290	2.563	10.400	52.100	21	0	100	27.101	10.882	2.375	9.830	51.300
Cadmium (Cd)-Total	mg/kg	23	0	100	0.065	0.021	0.004	0.028	0.108	21	0	100	0.079	0.028	0.006	0.037	0.140
Chromium (Cr)-Total	mg/kg	23	0	100	6.956	3.706	0.773	0.720	14.100	21	0	100	2.323	3.353	0.732	0.400	16.000
Cobalt (Co)-Total	mg/kg	23	0	100	0.905	0.401	0.084	0.149	1.800	21	0	100	0.605	0.300	0.065	0.118	1.420
Copper (Cu)-Total	mg/kg	23	0	100	3.166	1.061	0.221	0.968	6.710	21	0	100	2.536	0.972	0.212	1.030	4.920
Lead (Pb)-Total	mg/kg	23	0	100	1.159	0.668	0.139	0.200	3.060	21	0	100	0.741	0.549	0.120	0.172	2.400
Manganese (Mn)-Total	mg/kg	23	0	100	57.787	19.385	4.042	22.500	97.500	21	0	100	72.524	41.937	9.151	20.900	190.000
Mercury (Hg)-Total	mg/kg	23	0	100	0.041	0.013	0.003	0.027	0.070	21	0	100	0.050	0.020	0.004	0.029	0.122
Molybdenum (Mo)-Total	mg/kg	23	0	100	0.516	0.284	0.059	0.053	1.160	21	2	90	0.105	0.075	0.016	0.025	0.376
Nickel (Ni)-Total	mg/kg	23	0	100	8.886	6.036	1.258	0.948	23.700	21	0	100	2.807	1.794	0.391	0.679	7.370
Strontium (Sr)-Total	mg/kg	23	0	100	10.600	4.909	1.024	2.960	20.300	21	0	100	7.543	2.595	0.566	2.290	12.100
Thallium (Tl)-Total	mg/kg	23	0	100	0.033	0.014	0.003	0.008	0.066	21	0	100	0.019	0.007	0.002	0.010	0.043
Titanium (Ti)- Total	mg/kg	23	0	100	57.843	27.075	5.646	10.100	112.000	21	0	100	18.014	12.222	2.667	4.100	41.300
Uranium (U)-Total	mg/kg	23	0	100	0.798	0.614	0.128	0.053	2.810	21	0	100	0.089	0.046	0.010	0.040	0.203
Vanadium (V)-Total	mg/kg	23	0	100	1.547	0.719	0.150	0.350	3.090	21	2	90	0.753	0.501	0.109	0.100	1.840
Zinc (Zn)-Total	mg/kg	23	0	100	26.822	5.950	1.241	17.500	42.700	21	0	100	27.657	6.565	1.433	18.200	40.900

Table H 1: Statistical Comparison of Metal Concentration in Lichen

Parameter	Units	2016 Far-far-Field								2016 Near vs. Far-field Comparison		Near-field Comparison of 2010, 2013, 2016	
		n	# of ND	Detection Frequency (%)	Mean	SD	SE	Min	Max	p-value	T-test vs. Mann-Whitney U Test	p-value	ANOVA vs. Kruskal-Wallis
Aluminum (Al)-Total	mg/kg	3	0	100	334.000	180.436	104.175	186.000	535.000	**<0.001**	T-test	**<0.001**	K-W
Antimony (Sb)-Total	mg/kg	3	2	33	0.004	0.003	0.002	0.003	0.008	**0.001**	M-W	**<0.001**	K-W
Arsenic (As)-Total	mg/kg	3	0	100	0.432	0.175	0.101	0.235	0.568	0.105	T-test	**<0.001**	K-W
Barium (Ba)-Total	mg/kg	3	0	100	22.200	7.015	4.050	15.800	29.700	0.399	T-test	**<0.001**	K-W
Cadmium (Cd)-Total	mg/kg	3	0	100	0.063	0.028	0.016	0.030	0.082	0.078	T-test	**<0.001**	Anova
Chromium (Cr)-Total	mg/kg	3	0	100	1.337	0.872	0.503	0.410	2.140	**<0.001**	M-W	**<0.001**	K-W
Cobalt (Co)-Total	mg/kg	3	0	100	0.856	0.614	0.354	0.243	1.470	**0.007**	T-test	**<0.001**	K-W
Copper (Cu)-Total	mg/kg	3	0	100	2.867	1.032	0.596	1.910	3.960	**0.017**	M-W	**<0.001**	K-W
Lead (Pb)-Total	mg/kg	3	0	100	0.399	0.256	0.148	0.159	0.669	**0.021**	M-W	**<0.001**	K-W
Manganese (Mn)-Total	mg/kg	3	0	100	62.067	29.045	16.769	28.600	80.700	0.335	M-W	**<0.001**	K-W
Mercury (Hg)-Total	mg/kg	3	0	100	0.039	0.012	0.007	0.026	0.049	0.063	M-W	**<0.001**	K-W
Molybdenum (Mo)-Total	mg/kg	3	1	67	0.056	0.028	0.016	0.025	0.079	**<0.001**	M-W	**0.006**	K-W
Nickel (Ni)-Total	mg/kg	3	0	100	3.356	2.575	1.487	0.868	6.010	**<0.001**	M-W	**<0.001**	K-W
Strontium (Sr)-Total	mg/kg	3	0	100	7.370	1.946	1.123	5.190	8.930	**0.013**	T-test	0.092	K-W
Thallium (Tl)-Total	mg/kg	3	0	100	0.012	0.006	0.004	0.007	0.020	**<0.001**	M-W	**<0.001**	K-W
Titanium (Ti)- Total	mg/kg	3	0	100	9.433	4.466	2.578	5.200	14.100	**<0.001**	M-W	**<0.001**	K-W
Uranium (U)-Total	mg/kg	3	0	100	0.077	0.067	0.038	0.038	0.154	**<0.001**	M-W	**<0.001**	K-W
Vanadium (V)-Total	mg/kg	3	0	100	0.460	0.240	0.139	0.270	0.730	**<0.001**	M-W	**<0.001**	K-W
Zinc (Zn)-Total	mg/kg	3	0	100	28.133	2.438	1.408	26.300	30.900	0.869	M-W	**0.021**	Anova

Notes: **Bolded** p-values indicate a significant difference (i.e., p<0.05). n = number of samples; # of ND = number of non-detects (i.e., values below the detection limit); detection frequency = percentage of real values in a given samples.

Mean = average value; SD = standard deviation; SE = standard error; Min = minimum value; Max = maximum value; p-value = probability value; mg/kg = milligrams per kilogram; < = less than; - = not applicable.

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
Suite 200 - 2920 Virtual Way
Vancouver, BC, V5M 0C4
Canada
T: +1 (604) 296 4200

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Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
Suite 200 - 2920 Virtual Way
Vancouver, BC, V5M 0C4
Canada
T: +1 (604) 296 42006319