2017 Mary River Project Terrestrial Environment Annual Monitoring Report

Prepared For

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Down to Earth Biology

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SUMMARY

The Mary River Project (the Project) is an iron ore mine located in the Qikiqtaaluk Region on North Baffin Island, Nunavut. The Project involves the construction, operation, closure, and reclamation of a 22.2 million tonne per annum (mtpa) open pit mine that will operate for 21 years. The high-grade iron ore is suitable for international shipment after crushing and screening with no chemical processing facilities. Construction on the project and associated facilities started in 2013, and mining began in September 2014. Currently, up to 4.2 mtpa of the crushed and screened iron ore is trucked to Milne Inlet year-round, stockpiled, and shipped during the open water season. Also approved is a railway system that will transport 18 mtpa of the ore from the mine area to a proposed all season deep water port at Steensby Inlet where the ore will be loaded into ore carriers for overseas shipment through Foxe Basin. The Project was issued Amendment # 1 to Project Certificate No. 005 by the Nunavut Impact Review Board (NIRB) on May 28, 2014. At this time the Project only trucks iron ore to Milne Port for open water shipping.

As a condition of Project approval, the Nunavut Impact Review Board (NIRB) Project Certificate #005 includes numerous conditions that require Baffinland to conduct effects monitoring for the terrestrial environment. Work conducted for the terrestrial environmental monitoring program is guided by Inuit Qaujimajatuqangit and by the Terrestrial Environment Mitigation and Monitoring Plan (TEMMP; (Baffinland Iron Mines Corporation 2017) and is overseen by the Terrestrial Environment Working Group (TEWG) which includes members from Baffinland, the Qikiqtani Inuit Association (QIA), the Government of Nunavut (GN), and Environment Canada and Climate Change (ECCC) and the Mittimatalik Hunters and Trappers Organization (MHTO). The terrestrial environment monitoring program began in 2012 and has continued through 2017 with adaptations to the programs over the years.

Baffinland anticipates that programs will continue in the future. However, all carnivore monitoring programs completed in the past were put on hold in 2015 as the Terrestrial Environment Working Group (TEWG) consider these surveys to no longer be required due to low abundance. These studies will be initiated in the future should changes occur in carnivore abundance and after further discussion with the GN and the TEWG.

This report summarizes the data collection and monitoring activities conducted in 2017 for the Project, including the following survey programs (summaries provided in Table 1):

- Dust fall monitoring program;
- Vegetation abundance monitoring;
- Vegetation and soil base metals monitoring;
- Rare plant observations (incidental findings);
- Helicopter flight height analysis;
- Snow track surveys;
- Snow bank height monitoring;

- Height of land caribou surveys;
- Pre-clearing nest surveys; and
- Cliff nesting raptor occupancy and productivity surveys.

Results of 2017 monitoring programs are as follows:

Climate, Dust and Traffic:

- Climate conditions were similar with regard to air temperature, but considerably drier in 2017 when compared to baseline data.
- The average number of vehicle passes on the Tote Road in all months regularly exceeded the projected maximum traffic volume; this vehicle activity is a contributor to dust fall as measured at both the south and north Tote Road crossing sample locations.
- Dust fall at the Mine Site was within predicted levels and 2017 annual dust was generally less than was observed in 2016, but some crusher activities in late November/early December 2017 resulted in higher than anticipated dust fall in those months compared to previous years.
- Dust fall at Milne Port exceeded predictions. The highest dust fall was noted near the ore stock piles and near the camp where dust is generated by both traffic and the nearby ore piles.
- Dust fall associated with the Tote Road at both the north and south crossing indicated a similar trend: Within 30 m and one kilometre on either side of the road, dust fall showed an increase over predictions. However, outside the one kilometre range the dust fall deposition rates decreased to just at or below laboratory detection limits, which is within predicted levels.
- At most year-round sampling locations throughout the Project area, dust fall in 2017 was less than in 2016. This overall decrease may be due to increased effectiveness of dust suppression activities, particularly along the Tote Road.

Climate, Dust and Traffic Monitoring will continue in 2018.

Vegetation:

- The vegetation monitoring program design was finalized in 2016 and provided a statistically robust program that will be able to detect Project-related changes in abundance and metals uptake should that effect occur.
- All vegetation abundance plots have been measured consistently for two years, and some for three years.
- To date, while annual changes in vegetation abundance in the Project area have been observed, there is no suggestion of changes in vegetation abundance as a result of a Project-related effect.
- Metal concentrations across all 2012 to 2016 vegetation and soil base metals monitoring sites are below Project thresholds. There is no suggestion of any Project-related effect of metals uptake in plants.
- Some previously reported rare plants have been found in the study area, and it is likely that more will be found as vegetation surveys continue in the Project area. Known populations will

continue to be monitored in the Project area and newly discovered populations will be documented as they are found on an opportunistic basis. There is no evidence to suggest that the Mary River Project is affecting the occurrence of rare plants.

Vegetation monitoring will continue, but the frequency of the detailed studies (e.g., abundance and metals sampling) is still being considered by the TEWG and Baffinland.

Mammals:

- Ground-based surveys continue to be used to monitor potential wildlife interactions with the Project. These include Height of Land surveys, Snow Track surveys, and incidental sighting reports from on-site personnel.
- In June 2013, a group of five caribou were observed in the PDA during Height of Land (HOL) surveys; however, caribou have not been observed during surveys conducted between 2014 and 2017. Lack of caribou observations on site follow the trends of low numbers recorded in regional observations and have been confirmed through collaboration with the GN who conducts caribou aerial surveys and through Inuit Qaujimajatuqangit received at workshops held in November 2015 and April 2016. Spring and fall caribou surveys were conducted in the North Baffin Region by the GN in 2017.
- Low numbers of incidental observations of caribou between the mine site and Milne Inlet between 2013 and 2017 also coincide with the lack of caribou observations during the HOL surveys.
- No caribou, wolf or other large mammal tracks were observed during snow tracking surveys conducted between 2014 and 2017; however, similar numbers of Arctic fox and Arctic hare tracks were observed throughout all survey years.
- The majority of snow bank height measurements were in compliance between 2014 and 2017. The number of snow bank height exceedances were similar from 2014–2016, with between 13–18 exceedances observed during these years. However, in 2017, 31 exceedances were recorded during the survey.

Height of Land, Snow Track, Snow bank height, and incidental observations will continue in 2018.

Birds:

- Active migratory bird nest searches (AMBNS) have been conducted since 2013 prior to any proposed land disturbance and/or clearing during the breeding bird window (May 31 – August 31), and raptor surveys (baseline and monitoring) have been conducted annually since 2011.
- In 2014 three nests were found during AMBNS surveys, one at the Mine Site and two at Milne Port; in each of these locations, construction activities were delayed until post fledging. No nests were located during any other year, so no buffers were required.

- In 2017, site occupancy, brood size, and nest success were monitored for all known nest sites located within 10 km of the PDA (the Raptor Monitoring Area). Areas with high nest-site suitability for cliff-nesting raptors located between known nest sites were also surveyed.
- A total of 166 unique nesting sites have been detected in the RMA, five of which were detected in 2017. Of these, 63 sites were occupied by raptors in 2017; 50 by peregrine falcon, five by rough-legged hawk, two by gyrfalcon, and four by common raven.
- Although annual variation in productivity for peregrine falcons and rough-legged hawks is apparent, it is most likely representative of natural variability associated with variation in prey availability and weather rather than due to any influence of disturbance.
- For rough-legged hawks, occupancy appears to be cyclical (approximately four-year oscillation), and strongly suggests that occupancy is associated with the natural lemming cycle, which is also known to cycle approximately every four years.
- Occupancy of potential nesting sites by gyrfalcon in the RMA have been too low to monitor annual trends.
- It appears that factors such as distance to disturbance and distance to nearest neighbour (individually and as an interaction) have no negative effect on occupancy or reproductive success for both peregrine falcon and rough-legged hawk.

AMBNS surveys will continue in future years prior to any proposed land disturbance and/or clearing during the breeding bird window, and raptor monitoring will continue to focus on multiple nesting territory visits in 2018.

Helicopter Flight Height:

- Helicopter flight heights continue to be used to monitor potential disturbance to birds and other wildlife inside and outside the snow goose area.
- Helicopter flight height compliance inside the goose area during moulting period was considerably higher in 2017 (95%) than in 2015 (55%) and 2016 (10%). This increase was largely due to an additional analysis performed in 2017, which considered justifications provided by pilots for many of the transits flown below the elevation requirements. For analytical purposes, non-compliant data points were converted to represent compliance with Project Conditions in cases where reasonable rationale were provided on daily timesheets. If a data point was originally non-compliant and no explanation was given, then the point remained non-compliant.
- Helicopter flight height compliance within and outside the goose area in all months was higher in 2017 (76%) than in 2015 (40%) and 2016 (33%), which was also largely due to the additional analysis performed in 2017, as stated above.

Helicopter flight height analysis including rationale from pilot timesheets will continue in 2018.

Table 1 Terrestrial baseline, monitoring and research activities conducted in 2017 for the Mary River Project.

Survey	Reason for survey[1]	Work completed, effects observed, required mitigation and recommendations for future work
Dust fall monitoring program	Addresses Project Conditions 36, 50, 54d, 58c, and Project Commitment 60	33 dust fall collectors are distributed around the Project area, some of which are further away from the Potential Development Area (PDA) and are controls. More than three years of monitoring from August 2013 to December 2016 are now complete. Future monitoring will continue to investigate dust fall at the 33 sites through the summer season and a subset of 16 year-round sites. Improvements were made to the traffic logs to better quantify road traffic.
Vegetation abundance monitoring	Addresses Project Conditions 36 & 50, and Project Commitment 67	A trends analysis was conducted to assess potential changes in percent plant cover and plant group composition with the relationship of distance to Project infrastructure and treatment effect between open and closed plots. Inter–annual differences in total percent ground cover, total percent canopy cover, and plant group composition were small in magnitude and consistent across all distance classes and treatments; therefore, differences are attributed to natural variation among years rather than a Project related effect in the first three years of monitoring.
Vegetation and soil base metals monitoring	Addresses Project Conditions 34, 36 & Project Commitment 50	All soil and lichen samples from 2016 were below thresholds with the exception of two sites which were suspected sampling errors. These sites, L – 71 and L– 91, were resampled in 2017. The results of the vegetation and soil base metals monitoring analysis determined that metal concentrations in soil and lichen samples at sites L–71 and L–91 were below CCME and relevant thresholds provided in the literature. 2017 sampling confirms that baseline metal concentrations in soil and lichen are below Project thresholds for all vegetation and soil base metals monitoring sites. Future monitoring will consider changes in metal concentrations for soil and vegetation (i.e., lichen) and compare these concentrations to Project specific thresholds.
Helicopter flight height analysis	Addresses Project Conditions 59, 71 and 72	Prior to flying for Baffinland, all personnel are made aware of flight height requirements to reduce stress to the wildlife of Baffin Island, particularly during sensitive times (e.g. staging, calving etc.). Ensuring that aircraft maintain, whenever possible (except for specified operational purposes such as drill moves, take offs and landings), and subject to pilot discretion regarding aircraft and human safety, a cruising altitude of at least 650 metres during point to point travel when in areas likely to have migratory birds, and 1,100 metres vertical and 1,500 metres horizontal distance from observed concentrations of migratory birds. Flight corridors are also used to avoid areas of significant wildlife importance. In 2017, compliance within the snow goose area during the moulting season was 95%, and compliance within and outside the snow goose area in all months was 76%. 2017 was the first year that flight height data were cross-referenced with pilot logs from daily timesheets to help justify non-compliant transits. For analytical purposes, non-compliant flight height data were converted to represent compliance with Project Conditions in cases where reasonable explanations were provided by pilots. This additional analysis resulted in an increase in helicopter flight height compliance when compared to previous years. Examples given to explain low-level flights included: weather, slinging, staking, surveys, drop off/pick up, demobilization and evacuations.

[1] Project Conditions and Project Commitments as per: Project Certificate No. 005.

Table 1 Terrestrial baseline, monitoring and research activities conducted in 2017 for the Mary River Project.

Survey	Reason for survey[1]	Work completed, effects observed, required mitigation and recommendations for future work
Snow track surveys	Addresses Project Condition 54dii, 58f Addresses QIA concerns about snow bank heights and the effects on wildlife crossings	Snow track surveys were completed along the Tote Road to investigate the movement of caribou in April – Arctic fox and Arctic hare were the only species detected; no evidence of caribou was observed during the survey. As part of the survey, at all locations where tracks crossed the Tote Road, snow bank depths were recorded, and tracks were followed to see if the individual was deterred by road crossing conditions. Future monitoring will continue to look for caribou and other wildlife tracks and indications of their interaction with the Tote Road.
Snow bank height monitoring	Addresses Project Conditions 53ai and 53c Addresses QIA concerns about snow bank heights and the effects on wildlife	Snow bank height monitoring was conducted in April to ensure compliance with recommended snow bank heights no greater than 1 m. The management of snow bank height allows for wildlife, specifically caribou, to cross the transportation corridor without being blocked by steep snow banks, as well as allowing drivers greater visibility to help reduce wildlife–vehicle collisions. In 2017, snow bank heights were found to exceed the maximum snow depth of 100 centimetres at 31 sites, with a maximum recorded depth twice the suggested maximum height. In some areas where snow bank heights exceeded the guideline, the snow was being piled according to landscape limitations. The survey crew observed a dozer on multiple days pushing back off the snow banks in various locations.
Height–of–land caribou surveys	Addresses Project Condition 53a, 53b, 54b, 58b	All 24 HOL stations were visited at least once in 2017. Just over 19.5 hours of surveys were conducted at these stations in April (late winter), and early June (caribou calving) with an EDI biologist and a Mittimatalik Hunter and Trappers Organization representative. No caribou were observed during any of these surveys. In 2016, viewshed mapping was completed to demonstrate the extent of area surveyors could observe while conducting HOL surveys. Monitoring is expected to be conducted annually. The 2017 observations will add to a larger database as monitoring efforts continue through the life of the Project.
Pre–clearing nest surveys	Addresses Project Conditions 66, 70	In 2017 approximately 162,915 m² of land was disturbed for Project infrastructure. Of the approximate areas cleared, 36% of the work was done outside the breeding bird window. During the breeding bird window, approximately 103,473 m² of land was cleared. Thirteen pre–clearing surveys were conducted, a total of 8.71 person hours and 141,917 m² (14.1 ha) of area were searched for active nests in the Mine Site, Tote Road and Milne Port development areas. No nests were detected and therefore no buffers were required. Surveys will continue to be required whenever clearing vegetation within the migratory bird nesting season.
Cliff–nesting raptor occupancy and productivity surveys	Addresses Project Conditions 50, 73, 74, and Project Commitment 75	This program is a continuation of baseline and effects monitoring work conducted since 2011. Approximately 37% of the 166 known nesting sites within the raptor monitoring area surveyed in 2017 were occupied by cliff–nesting raptors. Of these, 50 were occupied by peregrine falcons, five by rough–legged hawks, two by gyrfalcons, and four by common raven. Productivity for peregrine falcons and rough–legged hawks was 1.2±0.2 and 1.5±0.5 nestlings, respectively. 2017 surveys focused on confirming raptor occupancy and productivity of known nesting sites.

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ACRONYMS AND ABBREVIATIONS

ARInc. .... Arctic Raptors Inc.

Baffinland .... Baffinland Iron Mines Corporation

CCME .... Canadian Council of Ministers of the Environment

CoPC .... Metals/Metalloids of Potential Concern

COSEWIC .... Committee on the Status of Endangered Wildlife in Canada

CWS .... Canadian Wildlife Service

EC .... Environment Canada

EDI .... Environmental Dynamics Inc.

ERP .... Early Revenue Program

FEIS .... Final Environmental Impact Statement

GIS .... Geographic Information System

GN .... Government of Nunavut

GPS .... Global Positioning System

HOL .... Height of Land

Mt/a .... Million Tonnes per Year

NIRB .... Nunavut Impact Review Board

NLC .... Northern Land Cover

PDA .... Potential Development Area

PRISM .... Program for Regional and International Shorebird Monitoring

Project .... Mary River Project

QIA .... Qikiqtani Inuit Association

RSA .... Regional Study Area

SARA .... Species at Risk Act

TEMMP .... Terrestrial Environment Management and Monitoring Plan

TEWG .... Terrestrial Environment Working Group

TSP .... Total Suspended Particles

US EPA .... US Environmental Protection Agency

VEC .... Valued Ecosystem Component

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1 OVERVIEW OF TERRESTRIAL ENVIRONMENT MONITORING

As a condition of Project approval, the Nunavut Impact Review Board (NIRB) Project Certificate #005 includes numerous conditions that require Baffinland to conduct effects monitoring for the terrestrial environment. Work conducted for the terrestrial environmental monitoring program is guided by Inuit Qaujimajatuqangit and by the Terrestrial Environment Mitigation and Monitoring Plan (TEMMP) (Baffinland Iron Mines Corporation 2017) and is overseen by the Terrestrial Environment Working Group (TEWG) which includes members from Baffinland, the Qikiqtani Inuit Association (QIA), the Government of Nunavut (GN), and Environment Canada and Climate Change (ECCC) and the Mittimatalik Hunters and Trappers Organization (MHTO). Several data collection and monitoring programs are conducted as part of the terrestrial environmental monitoring program and include the following inventories:

- Dust fall monitoring (2013–2017);
- Height of land caribou surveys (2013–2017);
- Cliff nesting raptor occupancy and productivity surveys (2011–2017);
- Vegetation abundance monitoring (2014, 2016, 2017);
- Vegetation and soil base metals monitoring (2012–2017);
- Exotic invasive vegetation monitoring and natural revegetation (2014);
- Caribou fecal pellet collection (2011, 2012, 2013, 2014);
- Caribou water crossing surveys (2014);
- Height of land caribou surveys (2013–2017);
- Helicopter flight height analysis (2015–2017);
- Snow track surveys and snow bank height monitoring (2014–2017);
- Carnivore den survey (2014);
- Communication tower surveys (2014, 2015);
- Roadside waterfowl surveys (2012–2014);
- Red knot surveys (2014);
- Staging water fowl surveys (2015);
- Active migratory bird nest surveys (2013–2017);
- Raptor occupancy and productivity surveys (2011–2017);
- Tundra breeding bird PRISM (Program for Regional and International Shorebird Monitoring) plots (2012, 2013);
- Bird encounter transects (2013); and
- Coastline nesting and foraging habitat surveys along Steensby Inlet (2012) and Milne Inlet (2013).

The results of the 2012 to 2016 surveys are described in the completed and reviewed Annual Terrestrial Monitoring Reports (EDI 2013, 2014, 2015, 2016). The 2017 terrestrial environment monitoring program summarized in this report includes details and updates about the following programs:

- Dust fall monitoring program;
- Vegetation abundance monitoring;
- Vegetation and soil base metals monitoring;
- Exotic invasive vegetation monitoring and natural revegetation (incidental findings);
- Helicopter flight height analysis;
- Snow track surveys;
- Snow bank height monitoring;
- Height of land caribou surveys;
- Pre-clearing nest surveys; and
- Raptor occupancy and productivity surveys.

2 DUST FALL MONITORING PROGRAM

Dust deposition on soil and vegetation can have adverse effects on vegetation health and ultimately on wildlife and humans that consume vegetation. Baffinland is therefore committed to establishing a monitoring program investigating the extent of dust fall generated from Project activities. Several of the Project Conditions (e.g. Project Conditions 36, 50, 54d and 58c) address dust fall concerns or relate to reporting requirements for the dust fall monitoring program.

To meet these requirements, the Mary River dust fall monitoring program was initiated in the summer of 2013. The three main objectives of the dust fall monitoring program are to:

1. Quantify the extent and magnitude of dust fall generated by Project activities;
2. Determine seasonal variations in dust fall; and
3. Determine if annual changes in dust fall exceed identified thresholds associated with the dust fall dispersion models (Volume 6, Section 3; Baffinland Iron Mines Corporation 2013).

To address Project Condition 57g, which refers to assessment and presentation of annual environmental conditions including timing of snowmelt, green-up, as well as standard weather summaries, weather summaries including an overview of the 2017 weather conditions, timing of snow melt, and green–up are provided under Section 2.2.1.1.

2.1 METHODS

In addition to the collection of dust fall data, the monitoring program also reviewed supporting data that may affect the magnitude and extent of dust fall over the 2017 time period. These supporting data includes weather conditions and traffic on the Tote Road.

2.1.1 REVIEW OF SUPPORTING DATA

2.1.1.1 Overview of Weather Conditions

Climate data for 2017 collected from on-site meteorological stations at Mary River and Milne Inlet were compared with baseline data for the area (2005–2010; EDI Environmental Dynamics Inc. 2012). Air temperature, precipitation as rainfall, wind speed, and wind direction were considered in relation to dust fall.

2.1.1.2 Traffic on the Tote Road

Ore hauling began in September 2014 and the number of trucks hauling ore on the Tote Road each day is tracked by Mine Operations Dispatch. All non-haul vehicle traffic on the Tote Road from the Mine Site to Milne Port is recorded by Baffinland security. Data from both sources were collected, reviewed and compiled, and are presented on a 'vehicle transits per day' basis; further, these data are compared with the projected ore haul and non-haul vehicle transits (Volume 3, Appendix 3B, Baffinland Iron Mines Corporation 2013).

While the ore haul truck traffic data provides a clear picture of the number of ore haul trucks travelling the full length of the Tote Road, there are limitations associated with 'other traffic' vehicle transits. These data are collected from the Mary River and Milne Port security staff for purposes of ensuing employee safety while travelling the Tote Road. The data includes date and time of travel, the number of vehicles, road closures, etc. (but not ore haul), and does not include complete data regarding the length of travel of each vehicle along the Tote Road. The non–haul ('other') vehicle transits are generally over-estimated (and thus inflate vehicle transits where this may not be the case) because it is assumed that all vehicles complete the full travel distance from Mary River to Milne Port. Much of the non-ore haul traffic on the Tote Road travels less than 50 km along the road, and then return to camp without completing the full Tote Road distance. This type of vehicle traffic includes road maintenance mobile equipment, mechanical maintenance/fueling trucks, pick-up trucks, etc.

2.1.1.3 Dust Suppression

Dust suppression activities are carried out by Baffinland Mine Operations staff each year throughout the Project footprint at the Mine Site, Milne Port, along the Tote Road, and along the Mine Haul Road using water and calcium chloride. After the 2017 dust suppression program, an excel sheet detailing the completed program, including dates and times of water and calcium chloride application, was provided to EDI staff for analysis.

2.1.2 DUST FALL SAMPLING

The dust fall monitoring program began in July 2013 with 26 dust fall monitoring sites. In August 2014 one site at Milne Port (DF-P-2) was discontinued as it needed to be re-located to allow for port infrastructure, and an additional eight sites were added at the mine and port areas (Map 1; Table 2). Dust fall sampling locations were chosen to represent areas of various expected dust fall deposition rates based on isopleth dispersion models and the direction of prevailing winds within the RSA, excluding areas of future infrastructure development. Since August 2014, there have been no changes in the number of dust fall sampling location; the 33 dust fall sampling locations for 2017 include:

- Nine (9) dust fall samplers located at the Mine Site (three within the Mine Site, four outside the mine footprint within low to moderate isopleth areas and two references sites; one to the northeast, and one to the south) located at least 14 km from any Project infrastructure, outside of the extent of expected dust fall;
- Six (6) dust fall samplers located at Milne Port (five active sites on the port site footprint; DF-P-5 replaced DF-P-2) and one (1) reference site located northeast of the port site outside of the extent of expected dust fall; and
- Sixteen (16) dust fall samplers divided between two sites along the Tote Road (North sites and South sites). These two sites are organized into transects, each composed of eight (8) dust fall samplers distributed perpendicular to the Tote Road centreline at 30 m, 100 m, 1,000 m, and 5,000 m on either side of the road. The prevailing wind direction is variable, often parallel to the Tote Road as opposed to perpendicular; therefore 'upwind' and 'downwind' directions from the

road are not identified. The two (2) reference dust fall samplers are located 14 km southwest of the Tote Road (one at the north site, one at the south site).

Each dust fall sampler comprises one sampling apparatus including a hollow post, approximately two metres in height, and a terminal bowl-shaped holder for the dust collection vessel. The terminal bowl is topped with "bird spikes" to prevent birds perching and contaminating samples with feces. Each sampling apparatus was installed by inserting rebar posts into the ground, placing the post over the rebar, and then stabilizing the apparatus with guy wires. Dust collection canisters were placed in the holder; these containers were pre-charged with 250 mL of algaecide in summer and 250 mL of isopropyl alcohol in winter. Collection vessels were changed out every month and shipped to ALS Environmental Laboratory (ALS) in Waterloo, Ontario, for analysis of total suspended particulates (TSP; units of $mg/dm^2 \cdot day$). In addition to the analysis of TSP, the dust fall samples were analyzed for total metal concentrations to help inform potential trends in soil and vegetation tissues, collected as part of vegetation health monitoring.

Table 2 Dust fall monitoring sites.

Site ID	Location	Sample period	Distance to PDA[1] (m)	Dust isopleth zone	Latitude	Longitude
DF-M-01	Mine Site	year round	Within PDA	High	71.3243	-79.3747
DF-M-02	Mine Site	year round	Within PDA	High	71.3085	-79.2906
DF-M-03	Mine Site	year round	Within PDA	High	71.3072	-79.2433
DF-M-04	Mine Site	variable	9,000	Nil	71.2197	-79.3277
DF-M-05	Mine Site	variable	9,000	Nil	71.3731	-78.9230
DF-M-06	Mine Site	variable	1,000	Moderate	71.3196	-79.1560
DF-M-07	Mine Site	variable	1,000	Moderate	71.3000	-79.1953
DF-M-08	Mine Site	variable	4,000	Moderate	71.2945	-79.1002
DF-M-09	Mine Site	variable	2,500	Low	71.2936	-79.4127
DF-RS-01	Tote Road – south	variable	5,000	Nil	71.3275	-79.8001
DF-RS-02	Tote Road – south	variable	1,000	Low	71.3893	-79.8324
DF-RS-03	Tote Road – south	year round	100	Moderate	71.3967	-79.8228
DF-RS-04	Tote Road – south	year round	30	Moderate	71.3975	-79.8222
DF-RS-05	Tote Road – south	year round	30	Moderate	71.3980	-79.8228
DF-RS-06	Tote Road – south	year round	100	Moderate	71.3986	-79.8234
DF-RS-07	Tote Road – south	variable	1,000	Nil	71.4077	-79.8182
DF-RS-08	Tote Road – south	variable	5,000	Nil	71.4489	-79.7106
DF-RN-01	Tote Road – north	variable	5,000	Nil	71.6883	-80.5363
DF-RN-02	Tote Road – north	variable	1,000	Low	71.7145	-80.4704
DF-RN-03	Tote Road – north	year round	100	Moderate	71.7186	-80.4473
DF-RN-04	Tote Road – north	year round	30	Moderate	71.7189	-80.4456
DF-RN-05	Tote Road – north	year round	30	Moderate	71.7185	-80.4414
DF-RN-06	Tote Road – north	year round	100	Moderate	71.7189	-80.4397
DF-RN-07	Tote Road – north	variable	1,000	Nil	71.7226	-80.4165
DF-RN-08	Tote Road – north	variable	5,000	Nil	71.7435	-80.2898
DF-P-01	Milne Port	year round	Within PDA	Moderate	71.8802	-80.9072
DF-P-02	Milne Port	decommissioned	Within PDA	Moderate	71.8850	-80.8912
DF-P-03	Milne Port	variable	3,000	Nil	71.8996	-80.7884
DF-P-04	Milne Port	year round	Within PDA	Low	71.8710	-80.8828
DF-P-05	Milne Port	year round	Within PDA	Moderate	71.8843	-80.8945
DF-P-06	Milne Port	year round	Within PDA	Low	71.8858	-80.8790
DF-P-07	Milne Port	year round	Within PDA	High	71.8838	-80.9160
DF-RR-01	Reference– Road	summer only	14,000	Nil	71.2805	-80.2450
DF-RR-02	Reference– Road	summer only	14,000	Nil	71.5189	-80.6923

1. PDA = Potential Development Area

Dust fall sampling was conducted year-round; however, the winter sampling program was limited to a subset of the sample sites (16 out of 33 in the 2017 season) because access to remote sites is restricted and unsafe during the winter months (17 by helicopter access when helicopter available on site in summer, and just the 16 truck access locations during winter). Those sites exposed to the highest dust fall, i.e., those samplers located within one kilometre of the Potential Development Area (PDA) were sampled throughout 2017 (Table 3). The sites not visited over the winter months are generally those located at a distance one kilometre or greater from the PDA, and therefore exposed to the least amount of Project-related dust fall.

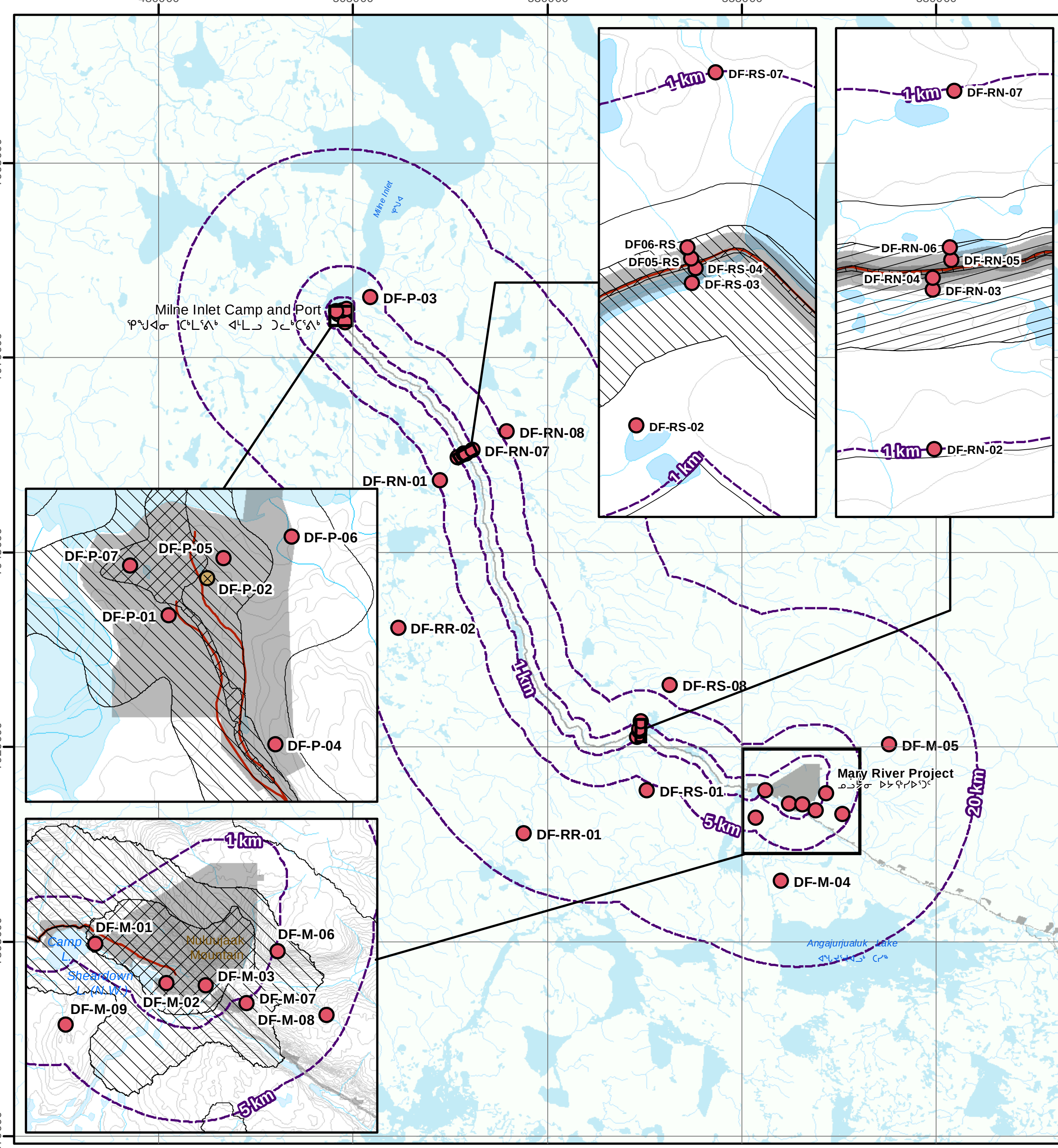
For data analysis and reporting purposes, summer includes sampling data from June, July and August, and winter includes data collected September through May. This seasonal delineation was determined after reviewing site weather data, indicating that in September through May the average daily temperature is below 0°C, and more than 50% of the monthly precipitation falls as snow. It is anticipated that less dust is mobilized under frozen, snow-covered conditions. The 2017 dust fall monitoring program data includes data collected for a full calendar year from mid December 2016 through mid-December 2017.

Table 3 Record of sampling associated with the 2017 dust fall monitoring program.

Sampling session	Start date[1]	End date[1]	Number of days[1]	Number of canisters deployed	Number of canisters analyzed	Sampling solution
1	18,19 Dec-2016	15, 16, 19 Jan-2017	28–31	16	16	Alcohol
2	15, 16, 19 Jan-2017	16, 17, 18 Feb-2017	31–35	16	16	Alcohol
3	16, 17, 18 Feb-2017	19, 20, 22 Mar-2017	28–33	16	16	Alcohol
4	19, 20, 22 Mar-2017	22, 23 Apr-2017	32–34	15	15	Alcohol
5	22, 23 Apr-2017	21, 22, 23 May-2017	28–30, 64[2]	16	16	Alcohol
6	21, 22, 23 May-2017	19, 20 Jun-2017	28,29	16	16	Alcohol
7	19, 20 Jun-2017	21, 22, 23 Jul-2017	31–33	33	33	Algaecide
8	21, 22, 23 Jul-2017	19, 21Aug-2017	27–30	33	33	Algaecide
9	19, 21 Aug-2017	19, 20, 21 Sep-2017	31–34	33	33	Algaecide
10	19, 20, 21 Sep-2017	15 Oct-2017	24-26	16	16	Alcohol
11	15 Oct-2017	13,14 Nov-2017	29-30	16	16	Alcohol
12	13,14 Nov-2017	10, 11 Dec-2018	26-28	16	16	Alcohol

[1] Sample collection and jar change out takes approximately three days when all 33 sites are collected.

[2] DF-RN-04 was buried in snow during April sample collection, collection vessel therefore remained deployed for 64 days until 23-May-17.



LEGEND

- Active Dust Fall Monitoring Site
- Decommissioned Dust Fall Monitoring Site
- Milne Tote Road
- Potential Development Area

TSP Annual Deposition

- High
- Moderate
- Low

Dust Fall Sample Locations for the Project Area

NOTES

TSP isopleths provided by RWDI Air Inc (2010/2014). These data were modified by EDI for the purpose of map display.

Updated PDA provided by Hatch (25 April 2013).

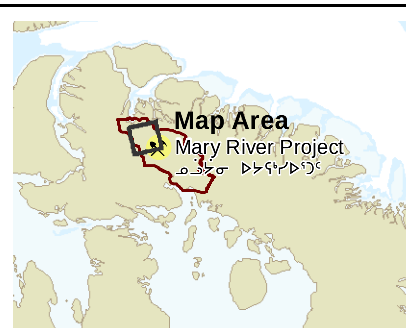
Scale

0 5 10 20 30

Km

Map Scale: 1:750,000 (printed on 8.5 x 11)
Map Projection: NAD 1983 UTM Zone 17N

Drawn:	Checked:	Date:	
MP	MAS/DH	10/20/2017	MAP 1



Baffinland EDI

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2.1.3 ANALYTICAL METHODS

The RSA was divided into four areas for the purposes of reviewing dust fall data:

1. The Mine Site;
2. Milne Port;
3. The Tote Road South crossing; and
4. The Tote Road North crossing.

Extent and Magnitude of Dust Fall at Various Sites — Dust fall deposition rates (as Total Suspended Particles — TSP) for each site were compiled for the 2017 season and reviewed to determine which sites in each sampling area are most affected by dust fall, and if any reference sites were recording high deposition rates of dust fall.

Daily dust fall from summer sampling periods (June, July, and August) were used to look at the relationship between dust fall and distance from source for the Mine Site, Tote Road north and Tote Road south crossing sites; dust fall has historically been highest in June/July, and only a subset of the sites are sampled though the winter which renders the data less useful for review of this relationship. Mixed effects models were used to test for a relationship between distance from the road and daily dust fall. Distance from the Mine Site was treated as a categorical variable with three classes — Near (within footprint), Far (1,000 m – 5,000 m), and Reference (>5,000 m). Distance from the Tote Road was treated as a categorical variable with four classes – 30 m, 100 m, 1,000 m, and 5,000 m. Sample site was included as a random effect in all models. Daily dust fall values were log transformed prior to analysis.

Residual plots were examined to confirm assumptions of normality and equality of variance in the residuals. Significance of model terms was tested using F-tests; terms were considered significant at $\alpha < 0.05$. If there was an effect of distance class on dust fall, we used pairwise comparisons of means with a Tukey correction to determine which distance classes were different. Linear combinations of means and t-tests were used to report differences in group means. All estimates were back transformed to the original scale and reported as medians ±95% confidence intervals. Statistical analysis was conducted using R version 3.3.1 (R Core Team 2016).

Seasonal Variation in Dust Fall — We used generalized least squares regression to test for effects of season (summer and winter) and sample site on daily dust fall accumulation for each project area (mine site, Milne Inlet port, north road and south road), for sites that were sampled throughout the year. Each model included main effects of season and sample site, with an interaction term between sample site and season. All dust fall data were log transformed prior to analysis and results were back-transformed to the original scale. Models included a first order autocorrelation structure, based on sampling period within a sample site, to account for the possibility that dust fall in one sampling period was more similar to samples from the preceding period than other samples from the same site (Zuur et al. 2009). Fixed model weights based on the number of days in each sampling period were used to give more weight to dust samples collected over a longer time (Zuur et al. 2009).

Residual plots were examined to confirm assumptions of normality and equality of variance in the residuals. Significance of model terms was tested using marginal F-tests; terms were considered significant at α <0.05. If there was no evidence that daily dust fall was related to season or site, then median dust fall ± 95% confidence intervals was reported across all sites and seasons. If there was evidence of an effect of season on daily dust fall we used least squared means to estimate the median effect of season after accounting for the effect of sample site (Lenth 2014). Statistical analysis was conducted using R version 3.3.1 (R Core Team 2016).

Annual Dust Fall — Annual total suspended particulates (TSP) thresholds were developed for the Project, see Appendix B. 4-3 of the TEMMP (Baffinland Iron Mines Corporation 2017). These thresholds were developed with input from the results of the dust dispersion models, existing literature related to air quality guidelines and dust deposition, and similar dust monitoring programs in place at other northern mines:

Low: 1–4.5 $g/m^2/year$;

Moderate: 4.6–50 $g/m^2/year$; and

High: ≥50 $g/m^2/year$.

The results of the dust fall 2017 sampling program were converted from units of $mg/dm^2 \cdot day$ to $g/m^2/year$ and were compared with the modelled dust deposition isopleths for the Project to determine if deposition rates exceed the applicable indicator threshold. Each month's data are converted to ($g/m^2/day$), and then summed to add up to one year

Sites in the nil and low isopleth zones were not sampled during winter months, so annual accumulation was not calculated for those sites. Very low dust fall accumulation, often below laboratory detection, was observed at these sites during the summer months.

2.2 RESULTS AND DISCUSSION

2.2.1 SUPPORTING DATA

2.2.1.1 Overview of Weather Conditions

North Baffin Island has a semi-arid climate with relatively little precipitation and few frost-free days (Baffinland Iron Mines Corporation 2012). Generally, snow melt occurs in late June and frost-free conditions last until late August. In 2017, the onset of snow melt was around mid to late June where temperatures were consistently above 0ºC. Following the onset of snow melt, air temperatures rise and the amount of daily sunlight increases, triggering plant growth and green-up. On-site staff reported an abundance of flowering purple saxifrage (*Saxifraga oppositifolia*) across the landscape in late June and early July 2017.

Environment Canada operated a climate station at Mary River from 1963–1965 during the summer months (Baffinland Iron Mines Corporation 2012). This data is included for comparison where relevant. Climate data for 2017 was collected from on-site meteorological stations at Mary River and Milne Inlet and compared to available baseline data (2005–2010; Baffinland Iron Mines Corporation 2012). Baffinland established an on-site meteorological station at Mary River Camp on June 13, 2005 and at Milne Inlet in June 2006. Parameters measured include monthly air temperature, precipitation as rainfall, wind speed, and wind direction. Data included in the following analysis was from January 1, 2017 to December 31, 2018.

Air Temperature — Air temperatures in 2017 were somewhat cooler during the summer and warmer during the winter relative to baseline conditions, 2005–2010. Air temperatures recorded by Environment Canada at the Mary River meteorological station from 1963–1965 were cooler during the summer months than 2017 air temperatures. In general, air temperatures for North Baffin Island tend to be warmest in July and coldest in February.

At Milne Inlet, the lowest air temperature recorded during baseline conditions was -46.9°C in February 2008 compared to -40.2°C in February/March 2017. The highest air temperature recorded during baseline was 22.3°C in July 2009 compared to 16.3°C in July 2017.

At the Mine Site, the lowest air temperature recorded during baseline was -70.0°C in April 2010 compared to -40.2°C in February/March 2017. The highest air temperature recorded during baseline was 22.8°C in July 2009 and 11.0°C in September 1964. In 2017, the highest temperature recorded was 17.9°C in July.

Precipitation (Rainfall) — There were fewer days of rainfall and a lower total amount of rain in 2017 at Milne Inlet relative to baseline conditions, 2005–2010, while the number of rainfall days at Mary River in 2017 was somewhat average. The highest recorded rainfall in 2017 at Milne Inlet was also lower than baseline conditions, while maximum recorded rainfall at Mary River was comparable. Total rainfall recorded annually from 1963–1965 by Environment Canada at the Mary River meteorological station was lower than the 2017 amount at the Mine Site. In general, July and August tend to be the wettest months for North Baffin Island.

At Milne Inlet, the total number of days when rainfall was recorded during baseline conditions was 40 days in 2006, 25 days in 2007, and 26 days in 2008. Baseline rainfall data was not available for Milne Inlet in August 2009 and after March 4, 2010 to provide an accurate estimate for these years. In 2017, there were 21 days when rainfall was recorded. The highest recorded rainfall at Milne Inlet during baseline conditions was 7.4 mm in July 2008. This is somewhat higher than in 2017 where 4.8 mm of rain fell in July 2017. The total amount of rainfall recorded at the Milne Inlet weather station in 2017 was 54 mm.

At Mary River, the total number of days when rainfall was recorded during baseline conditions was 46 days in 2005, 53 days in 2006, 34 days in 2007, 27 days in 2008, and 51 days in 2009. Baseline rainfall data for Mary River was not available after July 7, 2010 to provide an accurate estimate for 2010. In 2017, there were 41 days when rainfall was recorded. The highest recorded rainfall at Mary River during baseline conditions, 2005–2010, was 5.3 mm in July 2007. This is similar to 2017 with 5.7 mm of rain falling in August 2017. The total amount of rainfall recorded at the Mary River weather station in 2017 was 159.5 mm. From 1963–1965 the highest amount of rainfall recorded in a single year at the Mary River meteorological station was 94.4 mm in 1964.

Wind Direction and Speed — Wind direction recorded in 2017 at Milne Inlet and Mary River was mostly consistent with baseline wind direction data, 2005–2010. In both 2017 and baseline conditions, the range in minimum and maximum wind speeds was variable from calm to gusting winds on the upper end of the Beaufort scale. Wind data was not recorded at the Environment Canada Mary River meteorological station, 1963–1965.

At Milne Inlet, wind direction data during baseline conditions is consistent with current wind direction data from the Baffinland weather station where prevailing north/northwest and south/southeast winds occur most frequently. The range in baseline minimum and maximum wind speeds was similar during baseline conditions and in 2017 with 0–29.5 m/s or 90 km/hr, which is considered "calm" to "storm" on the Beaufort scale. In 2017, a maximum wind speed of 24.9 m/s was recorded at Milne Inlet in September, October, and November. This is categorized as "storm" winds on the Beaufort scale, indicating strong, violent winds at Milne Inlet. Wind speed is recorded every hour at Baffinland weather stations and high winds indicating storm conditions are likely a result of gusting winds.

At the Mine Site, baseline wind direction data is mostly consistent with previously reported wind direction data from the Mary River weather station where prevailing south/southeast winds occur most frequently, followed by strong north winds. The range in baseline minimum and maximum wind speed was similar during baseline conditions to 2017.

2.2.1.2 Vehicle Transits on the Tote Road

The numbers of ore haul trucks per day remained relatively steady in 2017, with an average number of 195.9 ore haul transits per day (Figure 1). The only month where the number of ore transits was decreased was May, when the average number of ore haul transits decreased to 116 transits/day (58 ore loads); ore transits began to decrease mid-May and remained depressed until the first week of June. This decrease is noted each year and coincides with spring melt conditions which result in road closures for haul trucks, traffic is restricted to only light vehicles during the warmest hours of the day or closed to all traffic for hours/days based on melt conditions.

The average annual number of ore haul truck transits slightly exceeded the projected maximum haul truck transits (152 ore haul transits per day, as per Volume 3, Appendix 3B, Baffinland Iron Mines Corporation 2013). Other non-haul truck traffic had an annual average of 32.3 vehicle transits per day, with the highest number of transits occurring in September.

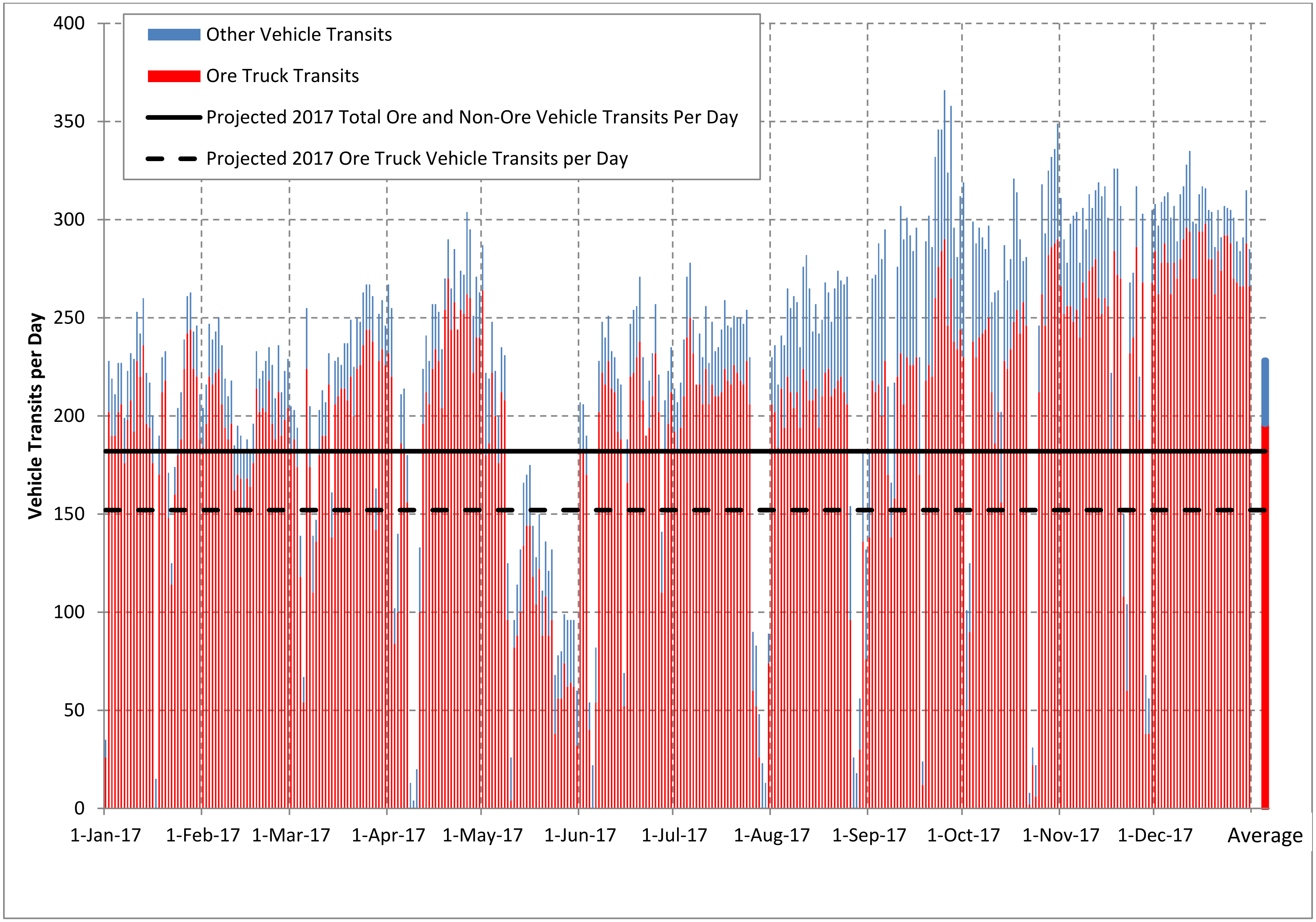


Figure 1 **Vehicle transits per day on the Tote Road, including both full ore trucks (red), and all other traffic (blue) through 2017.** *Also included is the projected maximum number of vehicle passes per day on the Tote Road, and the projected maximum number of Ore Haul Trucks per day on the Tote Road.*

2.2.1.3 Dust Fall Suppression in 2017

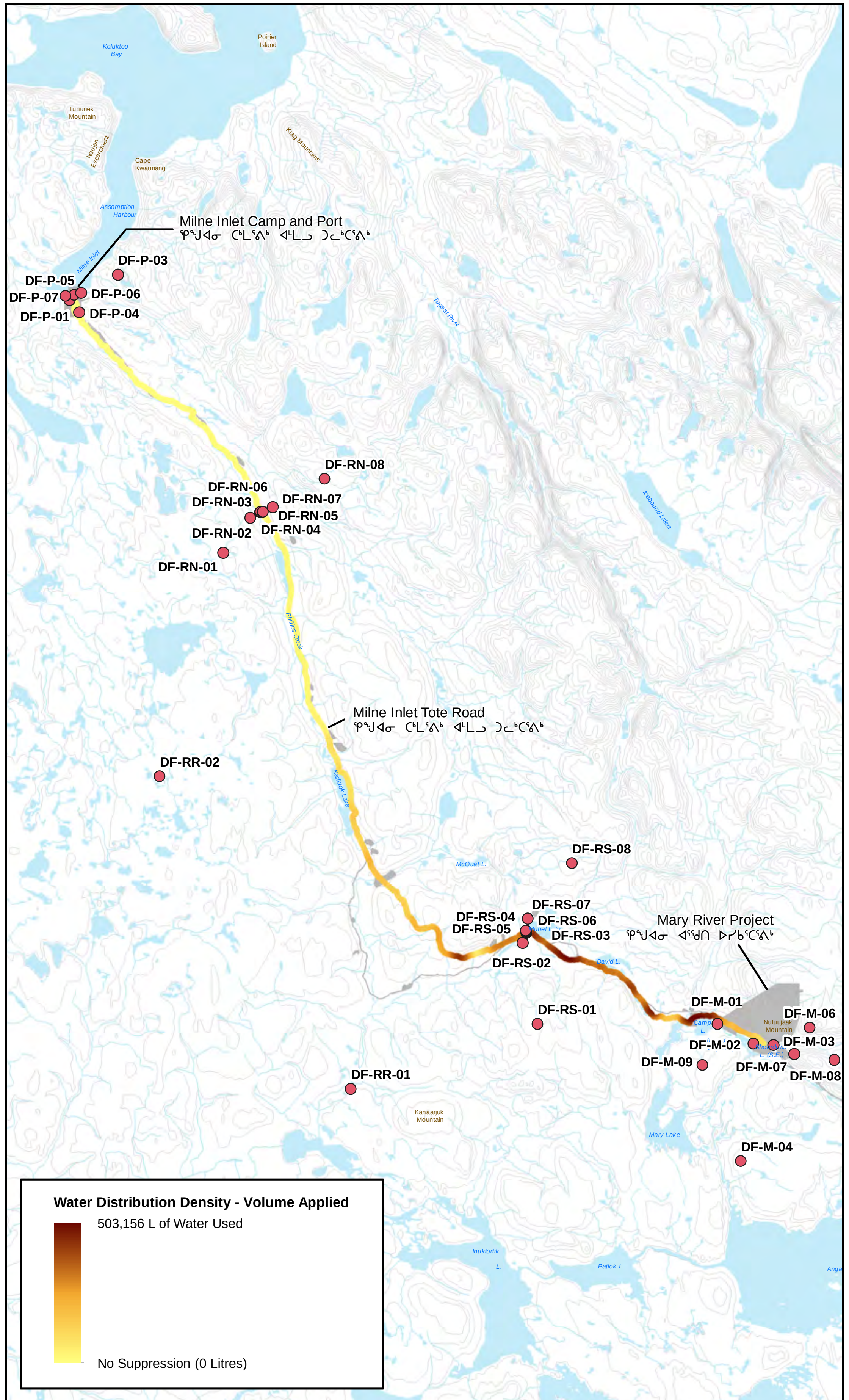
Water and calcium chloride were used for dust suppression throughout the Project area from July 6 through August 25, except for Milne Port, where there was no dust suppression. Water was used to suppress dust fall on Project areas including the Tote Road, the Mine Site and the Mine Haul Road. It was used on 13 events in the Mine Site area, 58 events along the Mine Haul Road, 467 events along the northern half of the Tote Road, and 25 events along the southern half of the Tote Road (Table 4; Map 2). The total amount of water used in each area was 393.7 m^3 in the Mine Site area, 4898.3 m^3 along the Mine Haul Road, 13,728.6 m^3 along the North Tote Road, and 567.8 m^3 along the South Tote Road.

Calcium chloride was used only along the Tote Road. Along the North Tote Road there were 11 events where calcium chloride was spread, with an average of 2,630.9 kg per event, for a total of 28,940 kg used. Along the South Tote Road there were 17 events where calcium chloride was spread with an average of 3,188.2 kg per event, for a total of 54,200 kg used (Table 4; Map 3).

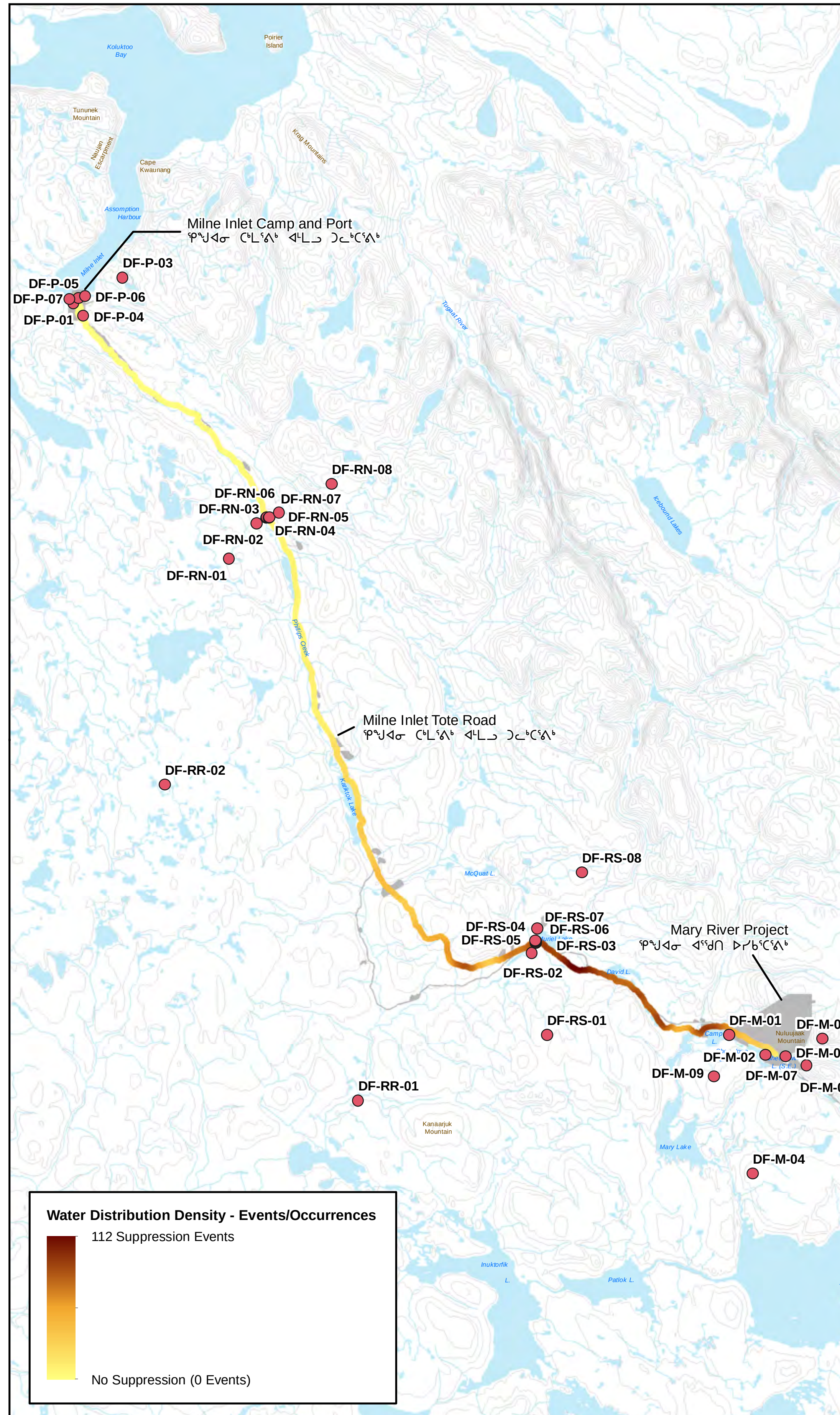
Table 4 Summary of dust fall suppression activities, summer 2017.

Area	Type of Dust Suppression	Number of Application Events[1]	Average Quantity of Suppressant per Event	Total Quantity of Suppressant Used
Mine Site	Calcium Chloride	0	–	–
	Water	13	30.3 m^3	393.7 m^3
Mine Haul Road	Calcium Chloride	0	–	–
	Water	58	84.5 m^3	4898.3 m^3
Milne Port	Calcium Chloride	0	–	–
	Water	0	–	–
North Tote Road	Calcium Chloride	11	2630.9 kg	28,940 kg
	Water	467	29.4 m^3	13,728.6 m^3
South Tote Road	Calcium Chloride	17	3188.2 kg	54,200 kg
	Water	25	22.7 m^3	567.8 m^3

[1] 'Events' refers to each truck carrying either calcium chloride or water for dust suppression activities; there may be more than one event per day.



Density of Water Distribution by Volume



Density of Water Distribution by Occurrence

LEGEND

- Dust Fall Monitoring Site
- Potential Development Area
- Regional Study Area

NOTES

Map Projection: North American Datum UTM Zone 17N.

PDA provided by KP, July 11, 2017.

Suppression data provided by Baffinland Iron Mines (October 2017). Data includes suppression events from June to August, 2017.

This document is not an official land survey and the spatial data presented is subject to change without notice.

Scale 0 2.75 5.5 11 16.5 22 27.5 Km

Baffinland

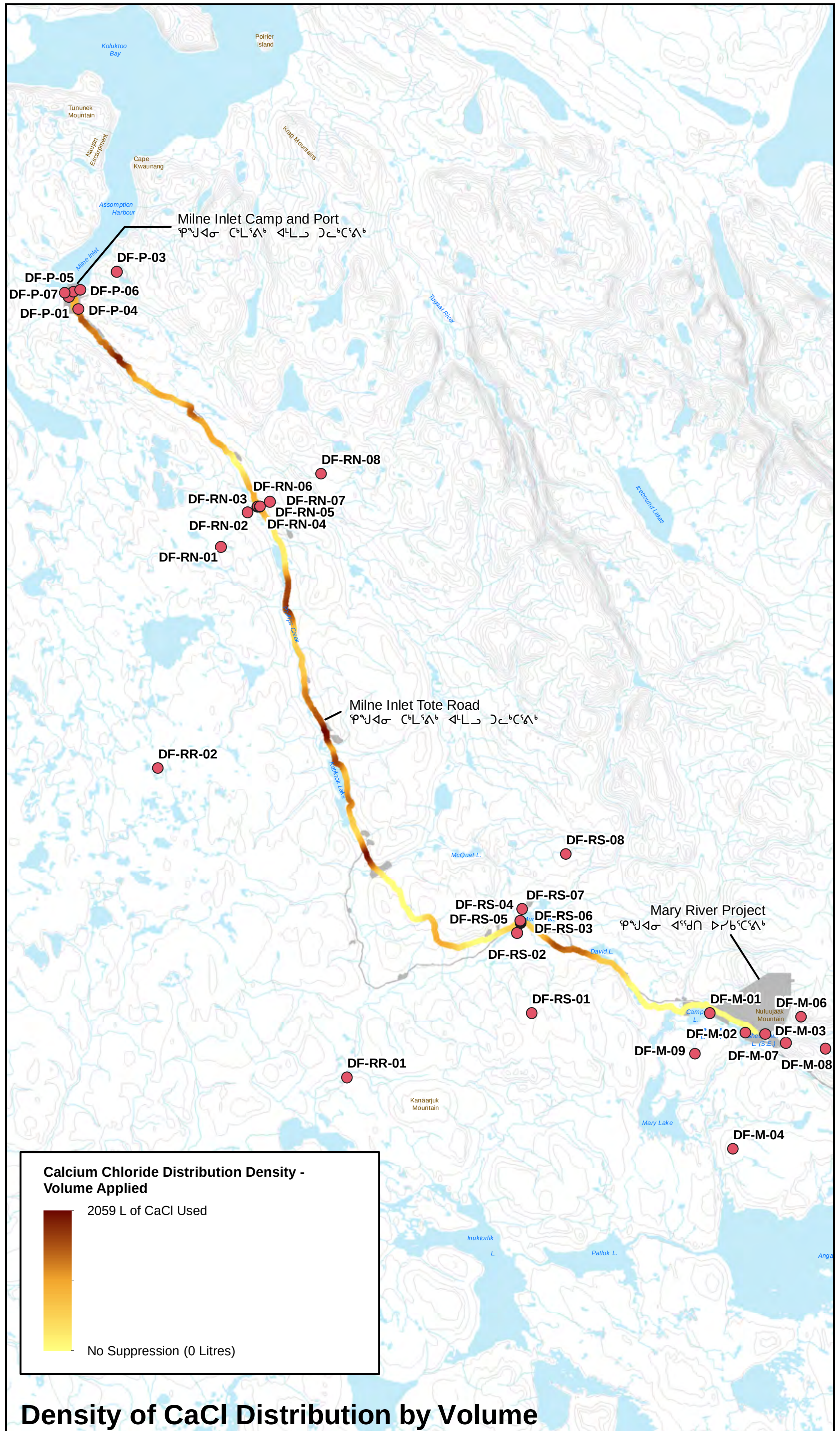
Dust Fall Suppression Using Water Along the Tote Road

EDI

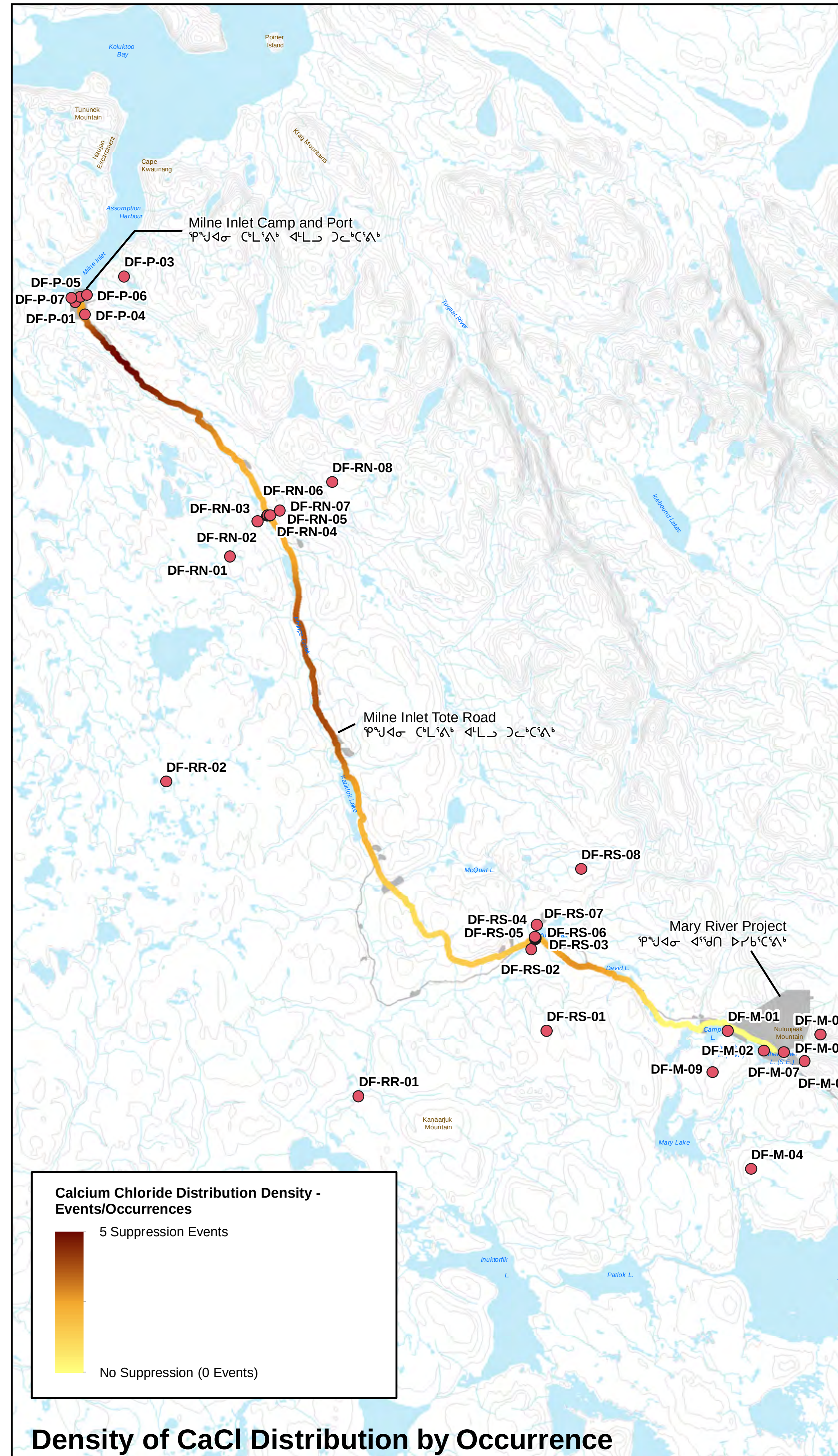
Date: 1/17/2018

Map 2

Path: O:\2017\17Y0152_BIM_Monitoring\GIS\Final\Map2_Water_Supp.mxd



Density of CaCl Distribution by Volume



Density of CaCl Distribution by Occurrence

LEGEND

- Dust Fall Monitoring Site
- Potential Development Area
- Regional Study Area

NOTES

Map Projection: North American Datum UTM Zone 17N.

PDA provided by KP, July 11, 2017.

Suppression data provided by Baffinland Iron Mines (October 2017). Data includes suppression events from June to August, 2017.

This document is not an official land survey and the spatial data presented is subject to change without notice.

Scale 0 2.75 5.5 11 16.5 22 27.5 Km

Baffinland Iron Mines Corporation

Dust Fall Suppression Using Calcium Chloride Along the Tote Road

EDI

Date: 1/17/2018

MAP 3

2.2.2 MAGNITUDE AND EXTENT OF 2017 DUST FALL

Mine Site — The 2017 monitoring included nine dust fall samplers associated with the Mine Site – three within the mine footprint (Near sites), four outside the mine footprint but within the five kilometre buffer (Far sites), and two reference sites located more than 5 km from the Mine Site (Table 2). The highest recorded dust fall at the Mine Site was at sample site DF-M-01, located near the weather station (Map 1); deposition rates ranged from below detection (<0.10 mg/dm²·day) in February 2017 to a high of 41.50 mg/dm²·day in December 2017 (Table 5). At DF-M-02, located between the airstrip and the land fill site, the dust deposition rates ranged from 0.22 mg/dm²·day to 10.50 mg/dm²·day. At site DF-M-03, located just south of the mine haul road, the dust fall deposition rates ranged from 0.19 mg/dm²·day to a high of 5.04 mg/dm²·day. Elevated dust fall in late November/early December 2017 is believed to be associated with a crusher that was operated in the QMR2 quarry from November 24, 2017 through December 7, 2017; it was observed to create a dust cloud when operating.

Sites DF-M-06, -07, -08, and -09, all located outside the mine footprint but within 5 km radius, are sampled only during the summer months (June, July and August). Dust fall recorded at these stations was generally below detection (Table 5); the only exceptions were in the samples collected at DF-M-07 and DF-M-09, both in July 2017 with dust fall levels of 0.13 and 0.19 mg/dm²·day, respectively. Dust fall deposition rates at both Mine Site reference locations (DF-M-04 and DF-M-05) were below detection in all samples collected (sampled only during summer months).

There was strong evidence of differences in distance class for mine sites, i.e., Near compared with Far sites ($p < 0.001$; Figure 2). Median daily dust fall was highest in the Near distance class at 0.9 (CI = 0.6 – 1.5) mg/dm²·day, this was 8.9 (CI = 4.9 – 16.0) times higher than the other two distances classes ($p < 0.001$). There was no difference in dust fall between the Far and Reference distance classes ($p = 0.97$), where daily dust fall was less than 0.1 (CI = 0.1 – 0.2) and 0.1 (CI = 0.1 – 0.2) mg/dm²·day, respectively.

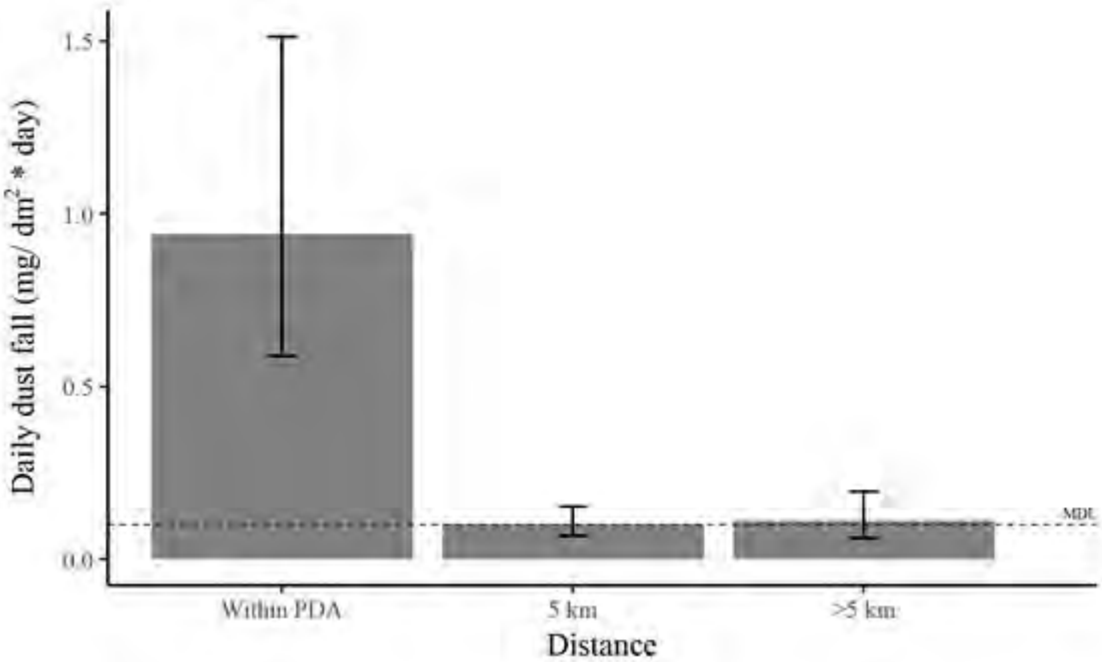


Figure 2 **Median daily dust fall (mg/dm²·day) for mine sites by distance class. Bar heights show median daily dust fall with 95% confidence intervals.** *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

Milne Port — Six dust fall samplers were associated with Milne Port in 2017 (Table 2, Map 1); five active sites on the port footprint; DF-P-5 replaced DF-P-2 and one reference site located northeast of the port site. Dust fall deposition rates at Milne Port were highest at DF-P-01, where dust fall ranged from 0.22 mg/dm²·day to 19.60 mg/dm²·day in December. Dust fall at DF-P-05 ranged from 0.36 mg/dm²·day to 4.84 mg/dm²·day (Table 5). Dust fall data collected at sites DF-P-04, -06 and -07 were all low, exceeding 1.0 mg/dm²·day only during the November sampling period when dust fall at DF-P-04 and -06 was 1.64 and 1.82 mg/dm²·day, respectively. Dust fall deposition rates at the Milne Port reference site, DF-03-P, which is sampled only in summer months were below detection in all samples. Elevated dust fall in November and December 2017 at DF-P-01 and -05 is believed to be associated with ore stackers on the Milne Port ore pad, which were producing dust clouds that were depositing on snow over a distance of one kilometre coupled with wind speed gusts between 10 and 25 m/s.

Photo 1 Dust cloud blowing off the ore stacker at Milne Inlet Port, November 21, 2017 (photo courtesy of BIM).

Tote Road Crossings — Eighteen dust fall samplers were associated with the Tote Road; eight at each of two sample sites consisting of transects perpendicular to the road (the North crossing site and South crossing site), and two reference samplers are located approximately 14 km from the road.

North Crossing — As at the North Crossing, dust fall was highest at the sample station nearest the centerline on the south side of the Tote Road (DF-RN-04) with dust fall that ranged from 1.24 $mg/dm^2 \cdot day$ to 51.10 $mg/dm^2 \cdot day$. On the north side of the road (DF-RN-05) the dust fall ranged from 0.28 $mg/dm^2 \cdot day$ to 8.79 $mg/dm^2 \cdot day$. Dust fall decreased with distance from the centerline, and dust fall at DF-RN-03 and DF-RN-06 ranged from below detection (<0.10 $mg/dm^2 \cdot day$) to 5.05 $mg/dm^2 \cdot day$, and from below detection to 2.96 $mg/dm^2 \cdot day$, respectively. Dust fall in samples collect during the summer season at the farthest sites (DF-RN-01, -02, -07 and -08) were all low, below 0.20 $mg/dm^2 \cdot day$ (Table 5).

There was strong evidence of an effect of distance from the north road on daily dust fall ($p < 0.005$; Figure 3). Median daily dust fall was highest in the 30 m distance class at 4.5 (CI = 2.2 – 9.5) $mg/dm^2 \cdot day$, this was 42.4 times higher than the 1,000 m and 5,000 m distance classes ($p < 0.001$). There was suggestive evidence ($p = 0.07$) that dust fall in the 30 m distance class was 3.6 (CI = 1.3 – 10.1) times higher than the 100 m distance class. Daily dust fall in the 100 m distance class was 1.3 (CI = 0.6 – 2.6) $mg/dm^2 \cdot day$, which was also higher than the two farther distance classes ($p < 0.001$). There was no difference in dust fall between the 1,000 m and 5,000 m distance classes ($p = 0.99$), where daily dust fall was than 0.1 (CI = 0.1 – 0.2) and 0.1 (CI = 0.1 – 0.2) $mg/dm^2 \cdot day$, respectively.

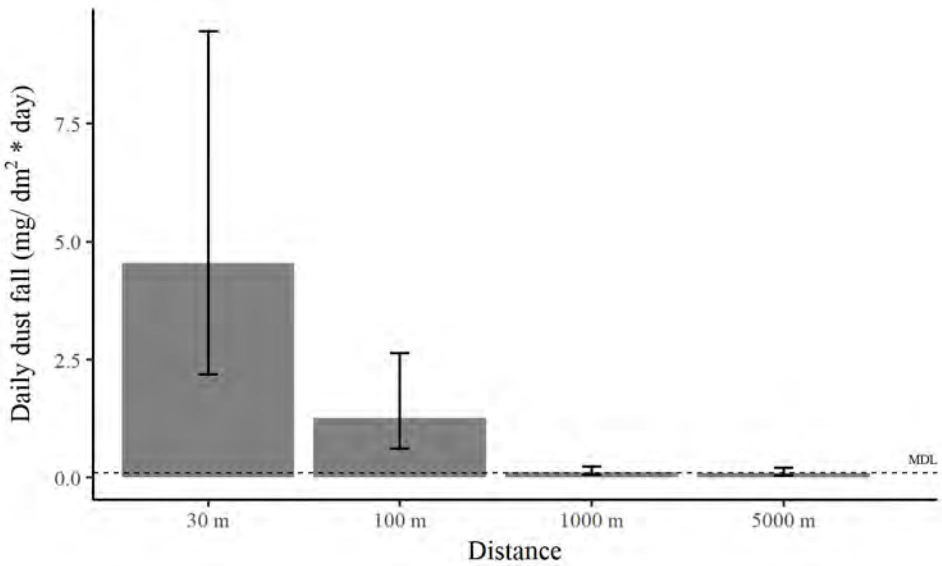


Figure 3. **Median daily dust fall (mg/dm²·day) for north road sites as a function of distance from the tote road. Bar heights show median daily dust fall with 95% confidence intervals.** *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

South Crossing — Dust fall was highest at the sample station nearest the centerline on the south side of the Tote Road (DF-RS-04) with dust fall that ranged from 0.12 mg/dm²·day to 41.50 mg/dm²·day. On the north side of the road (DF-RS-05) the dust fall ranged from below detection (<0.10 mg/dm²·day) to 33.00 mg/dm²·day Dust fall decreased with distance from the centerline, and dust fall at DF-RS-03 and DF-RS-06 ranged from below detection to 6.91 mg/dm²·day and from below detection to 3.46 mg/dm²·day, respectively. Dust fall in samples collected during the summer season at the farthest sites (DF-RS-01, -02, -07 and -08) were all low, below 1.0 mg/dm²·day (Table 5).

There was strong evidence of an effect of distance from the south road on daily dust fall ($p = 0.001$; Figure 4). Median daily dust fall was highest in the 30 m distance class at 10.1 (CI = 5.5 – 18.7) mg/dm²·day, this was significantly higher than all other distances classes ($p < 0.001$). Dust fall in the 30 m distance class was 5.5 (CI = 2.3 – 13.0) times higher than the 100 m distance class. Daily dust fall in the 100 m distance class was 1.8 (CI = 1.0 – 3.4) mg/dm²·day, which was 13.6 (CI = 6.5 – 28.6) times higher than the two farther distance classes ($p < 0.001$). There was no difference in dust fall between the 1000 m and 5000 m distance classes ($p = 0.49$), where daily dust fall was less than 0.2 (CI = 0.1 – 0.4) and 0.1 (CI = 0.1 – 0.2) mg/dm²·day, respectively.

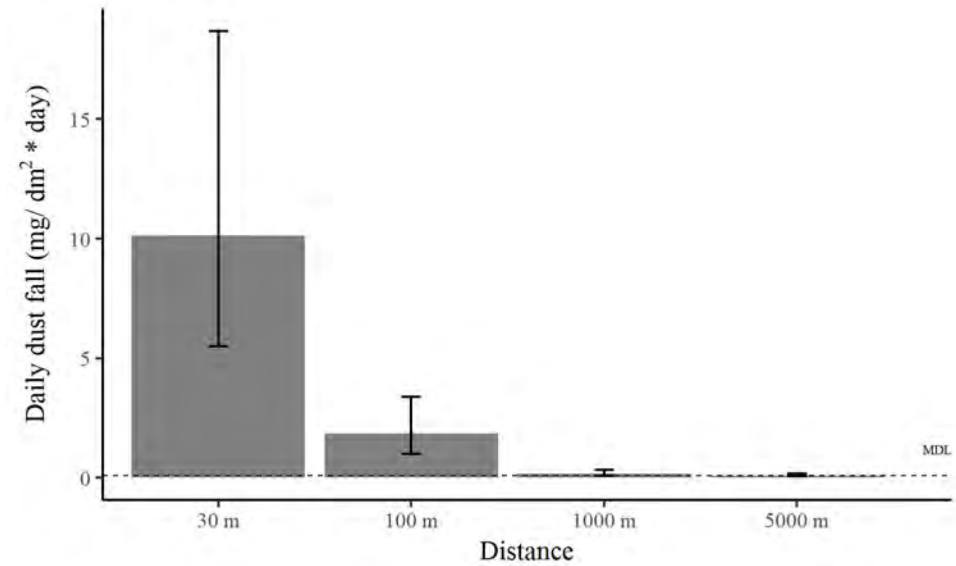


Figure 4. Median daily dust fall (mg/dm²·day) for south road sites as a function of distance from the tote road. Bar heights show median daily dust fall with 95% confidence intervals. *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

Reference sites — Dust fall deposition rates at the two Tote Road reference sites (DF-RR-01 and DF-RR-02), which are sampled only in summer months were below lab detection in all samples (Table 5) and are not included in graphs such as Figure 4.

Table 5 Dust fall, as total suspended particulate matter (mg/dm²·day), collected at all sample sites during the 2017 monitoring year.

Site Name	Sample Collection Timing											
	January	February	March	April	May	June	July	August	September	October	November	December
DF-M-01	6.01	<0.10	0.89	1.53	9.89	2.46	5.48	0.40	0.20	2.84	0.87	41.50
DF-M-02	3.28	0.26	2.33	1.09	4.18	0.88	2.50	0.22	0.56	1.70	1.58	10.50
DF-M-03	0.89	0.19	1.51	1.02	3.86	1.74	5.04	0.95	1.21	2.65	0.81	2.87
DF-M-04	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-M-05	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-M-06	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-M-07	–	–	–	–	–	–	0.13	<0.10	<0.10	–	–	–
DF-M-08	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-M-09	–	–	–	–	–	–	0.19	<0.10	<0.10	–	–	–
DF-P-01	4.80	0.22	1.97	3.80	7.15	2.09	7.46	2.96	1.11	3.91	9.37	19.60
DF-P-03	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-P-04	<0.10	<0.10	<0.10	0.24	0.63	0.24	0.26	0.22	0.13	0.46	1.64	0.31
DF-P-05	1.70	0.36	1.95	1.15	3.25	1.77	1.70	1.31	0.94	3.37	2.59	4.84
DF-P-06	0.16	<0.10	0.19	0.26	0.39	0.21	0.11	<0.10	0.13	0.76	1.82	0.46
DF-P-07	0.48	<0.10	0.50	0.40	0.46	<0.10	0.84	0.24	0.16	0.81	0.68	7.40
DF-RN-01	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-RN-02	–	–	–	–	–	–	0.17	<0.10	<0.10	–	–	–
DF-RN-03	0.65	<0.10	0.34	0.80	2.82	1.24	5.05	2.03	0.23	1.39	0.46	1.01
DF-RN-04	10.40	1.33	14.30	–	5.88	13.8	51.10	6.85	1.24	8.48	3.58	8.53
DF-RN-05	2.70	0.28	1.09	2.87	6.47	7.60	8.79	2.70	1.05	4.24	1.80	1.00
DF-RN-06	1.12	<0.10	0.50	1.10	2.89	1.98	2.96	1.40	0.45	1.83	0.95	0.47
DF-RN-07	–	–	–	–	–	–	0.14	<0.10	<0.10	–	–	–
DF-RN-08	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-RS-01	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-RS-02	–	–	–	–	–	–	0.67	0.22	0.18	–	–	–
DF-RS-03	0.25	<0.10	0.11	0.38	2.75	3.85	6.91	1.08	1.37	2.88	0.22	0.31
DF–RS-04	1.05	0.12	0.34	1.37	11.90	41.50	40.60	9.06	9.15	22.10	1.02	0.57
DF-RS-05	1.04	<0.10	0.30	1.33	12.00	33.00	17.40	7.42	2.39	5.27	0.73	0.81
DF-RS-06	0.27	<0.10	0.13	0.51	4.14	5.36	3.46	1.73	0.67	1.37	0.25	0.40
DF-RS-07	–	–	–	–	–	–	0.13	0.12	<0.10	–	–	–
DF-RS-08	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-RR-01	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–
DF-RR-02	–	–	–	–	–	–	<0.10	<0.10	<0.10	–	–	–

2.2.3 SEASONAL COMPARISONS OF 2017 DUST FALL

Seasonal variations in dust fall in all Project areas were investigated as per the dust fall monitoring objectives.

Mine Site — The effect of season on dust fall differed among Mine site sample stations during the 2017 summer season, but not the winter. There was significant evidence of an interaction between season and sample site for the mine sites during the summer season ($p = 0.006$) (Figure 5). Dust fall at DF-M-03 in summer was 3.4 (CI = 1.4 – 8.3) times higher than DF-M-02 in summer. There were no significant differences among sites in winter.

Milne Inlet Port — There was no support for a seasonal effect ($p = 0.95$) or an interaction between season and sample site in the Milne Port area ($p = 0.24$). There was, however strong evidence of a difference in dust fall among sample sites for the Milne Port ($p < 0.001$; Figure 6). DF-P-01 and DF-P0-5 had significantly higher median daily dust fall than the other three sites ($p < 0.001$), a trend that was present in both summer and winter sampling periods.

North Crossing — There was no evidence of an interaction between sample site and season for the north road sampling area ($p = 0.45$). There was evidence of seasonal differences in dust fall for the north road sites ($p = 0.50$; Figure 7). There was a significant difference among sample sites ($p < 0.001$). After accounting for seasonal effects, median daily dust fall at DF-RN-04 was 3.4 (CI = 2.6 – 4.5) times higher than DF-RN-05 ($p < 0.001$), and DF-RN-05 was 2.3 (CI = 1.9 – 2.9) higher than the other two north road sites ($p < 0.001$).

South Crossing —There was suggestive evidence of an interaction between sample site and season for the south road sampling area ($p = 0.08$; Figure 8); dust fall in summer was significantly greater than dust fall in winter ($p < 0.001$). Dust fall at site DF-RS-04 was 7.4 (CI = 1.1 – 47.9) times higher in summer than in winter ($p = 0.04$). After accounting for season, DF-RS-04 was 1.7 (CI = 1.1 – 2.6) times higher than DF-RS-05 ($p = 0.07$), and DF-RS-05 was 3.2 (CI = 2.2 – 4.7) times higher than the other two sites ($p < 0.001$).

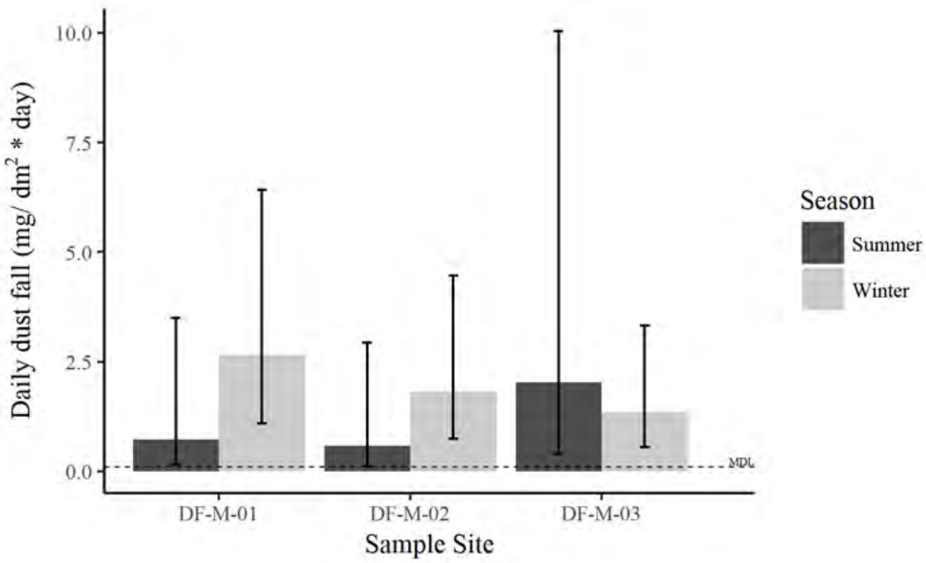


Figure 5 **Median daily dust fall by site and season for the mine site sampling sites. Bar heights show median daily dust fall with 95% confidence intervals.** *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

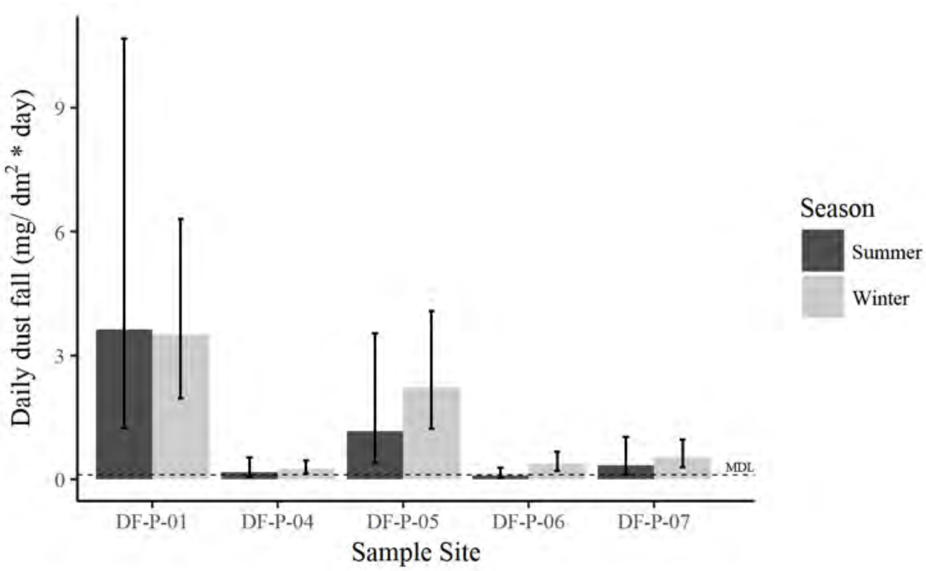


Figure 6 **Median daily dust fall by site and season for the Milne Inlet Port sampling sites. Bar heights show median daily dust fall with 95% confidence intervals.** *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

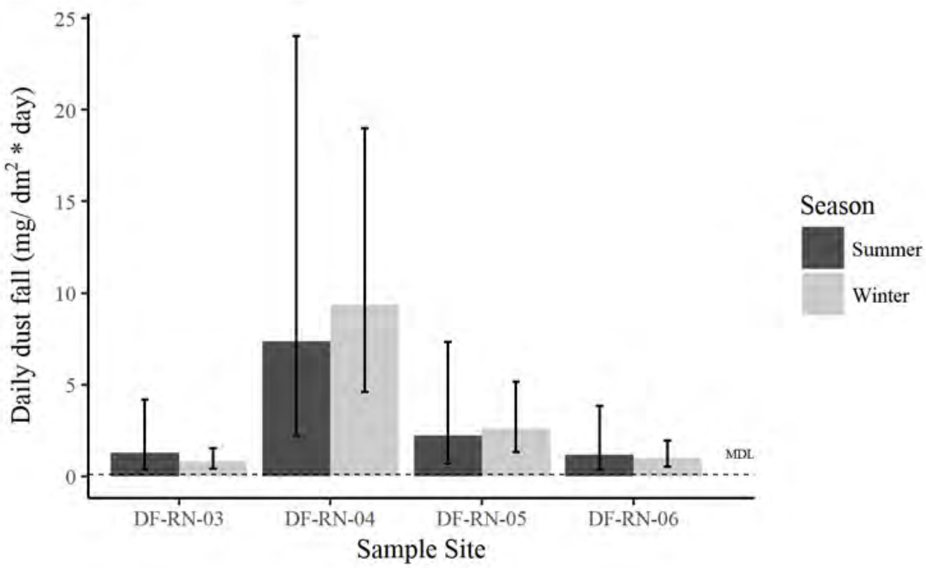


Figure 7 Median daily dust fall by site and season for the Road North sampling sites. Bar heights show median daily dust fall with 95% confidence intervals. *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

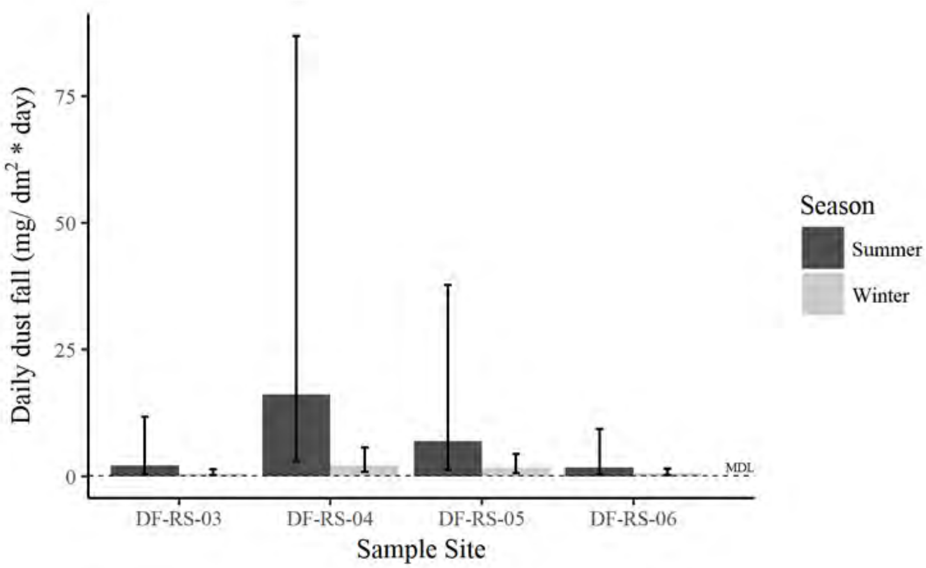


Figure 8 Median daily dust fall by site and season for the Road South sampling sites. Bar heights show median daily dust fall with 95% confidence intervals. *The dashed horizontal line indicates the minimum detection limit (MDL) for dust samples.*

2.2.4 ANNUAL DUST FALL

Total annual dust fall was reviewed at all sites that were sampled year-round for the 2017 calendar year; data presented here is from December 20, 2016 through December 10, 2017. Sites in the nil and low isopleth zones were not sampled during winter months when helicopter access was unavailable; therefore, annual accumulation was not estimated for these sites. However, very low dust fall accumulation, generally below laboratory detection, was observed at these sites during the summer months.

Annual dust fall in samplers at the Mine Site were all predicted to be in the 'high' isopleth (≥ 50 g/m²/year). Dust fall from sample locations DF-M-01, -02, and -03 all indicated annual dust fall that was greater than 50 g/m²/year, with the highest dust fall at site DF-M-01 (198.37 g/m²/year). Dust fall was less than 100 g/m²/year at sites DF-M-02 and -03 (Figure 9).

Year-round dust fall samplers at Milne Inlet Port sites DF-P-01 and -05 had annual dust fall deposition rates that were greater than 50 g/m²/year, though it is modelled to be in the moderate threshold. The total annual deposition rate at DF-P-01 and -05 were 186.68 g/m²/year and 71.70 g/m²/year, respectively (Table 6). Milne Port sites DF-P-04, -06 and -07 all fell into the moderate isopleth threshold with annual dust fall rates of 13.02, 13.58 and 34.03 g/m²/year, respectively; however, DF-P-04 and -06 were modelled to be in the low threshold (Figure 10).

Annual dust fall at the north and south Tote Road crossing locations within 100 m of the road centreline fell within the high isopleth, though they were modelled to fall into the moderate isopleth (Table 6). Dust fall at the sites located closest to the Tote Road centreline at both the north and south crossing transects was higher than observed at any sampling locations at Mine Site and Milne Inlet Port (Figure 11 and Figure 12).

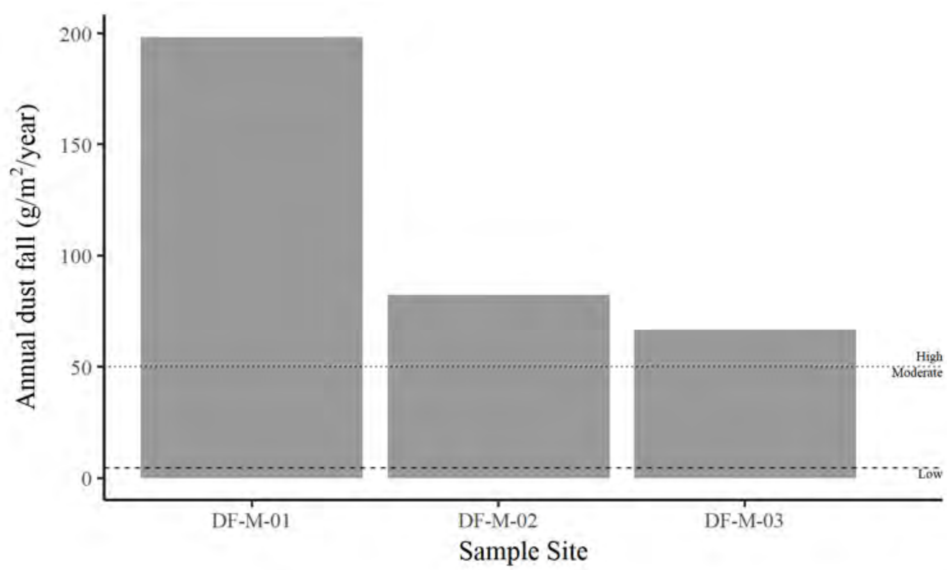


Figure 9 Mine Site annual dust fall for high isopleth sampling stations that were sampled year-round. *Dashed horizontal lines show low, moderate, and high dust isopleth threshold upper limits.*

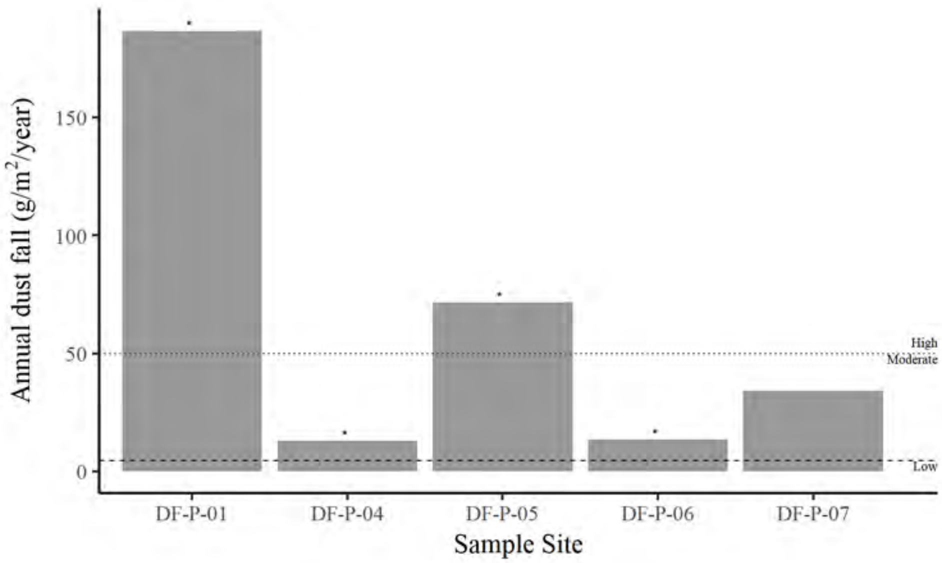


Figure 10 Milne Port annual dust fall for sampling stations that were sampled year-round. *Dashed horizontal lines show low, moderate, and high dust isopleth threshold upper limits. The asterisk (*) denotes that the annual dust fall was greater than projected by the predicted isopleth.*

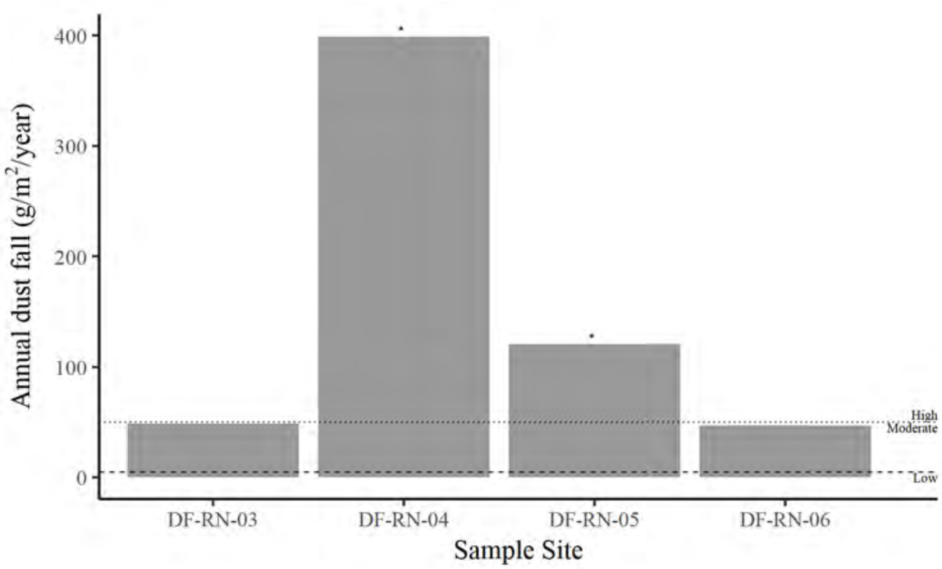


Figure 11 Tote Road north crossing annual dust fall for sampling stations that were sampled year-round. *Dashed horizontal lines show low, moderate, and high dust isopleth threshold upper limits. The asterisk (*) denotes that the annual dust fall was greater than projected by the predicted isopleth.*

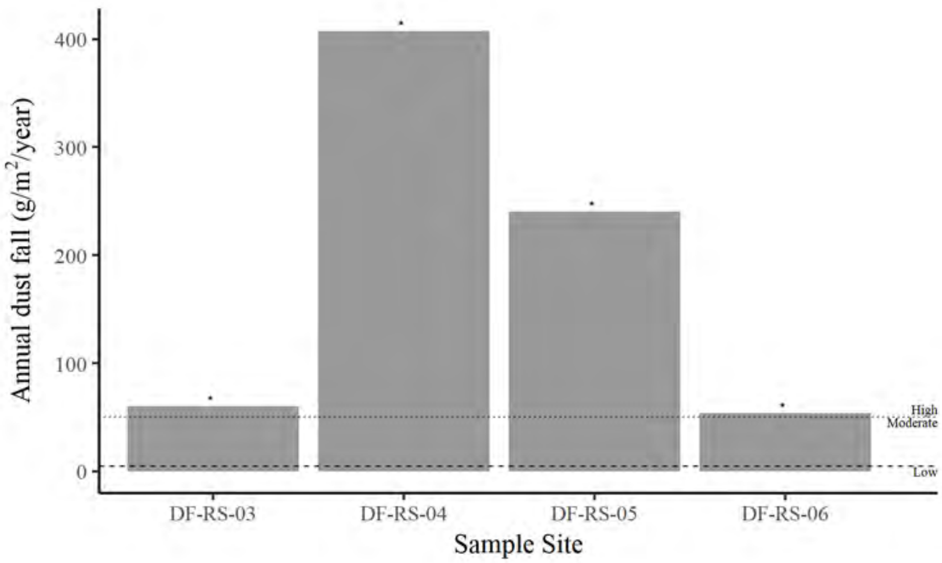


Figure 12 **Tote Road south crossing annual dust fall for sampling stations that were sampled year-round.** *Dashed horizontal lines show low, moderate, and high dust isopleth threshold upper limits. The asterisk (*) denotes that the annual dust fall was greater than projected by the predicted isopleth.*

Table 6 **Annual dust fall accumulation for sites sampled throughout the year. Annual accumulations are reported for the period 20 Dec 2016 to 10 Dec 2017. Sample sites that exceeded the predicted annual dust fall are shaded.**

Site	Area	Distance	Threshold	Threshold Upper Limit	Annual Dust Fall [1] ($g/m^2/year$)
DF-M-01	Mine Site	0	High	N/A[2]	198.37
DF-M-02	Mine Site	0	High	N/A	82.32
DF-M-03	Mine Site	0	High	N/A	66.83
DF-P-01	Milne Inlet Port	0	Moderate	50	186.68
DF-P-04	Milne Inlet Port	0	Low	4.5	13.02
DF-P-05	Milne Inlet Port	0	Moderate	50	71.70
DF-P-06	Milne Inlet Port	0	Low	4.5	13.58
DF-P-07	Milne Inlet Port	0	High	N/A	34.03
DF-RS-03	Road South	100	Moderate	50	60.29
DF-RS-04	Road South	30	Moderate	50	407.64
DF-RS-05	Road South	30	Moderate	50	240.38
DF-RS-06	Road South	100	Moderate	50	53.80
DF-RN-03	Road North	100	Moderate	50	48.43
DF-RN-04 [3]	Road North	30	Moderate	50	399.24
DF-RN-05	Road North	30	Moderate	50	120.73
DF-RN-06	Road North	100	Moderate	50	46.67

Notes:
[1] Total to date; figures will be updated for final report once all 2017 data has been collected.
[2] The 'high' threshold does not have an upper limit; sites modelled in the high threshold are predicted to have >50 $g/m^2/year$ of total suspended particulate matter (dust fall).
[3] one sample not collected for one month because collector was buried in snow.

Annual Dust Fall Trends

Year over year trends can be reviewed for all year-round monitoring stations. In general, dust fall across the Project area increased from 2014 through 2016 as mine production increased, however, 2016 and 2017 showed a levelling off in most sites, except DF-M-01, which was affected by crusher activities in late November/early December 2017 resulting in higher than expected dust fall.

Mine Site dust fall monitoring sites DF-M-02 and DF-M-03 saw a decrease in dust fall in 2017 compared with 2016, however, dust fall at site DF-M-01 indicated an steep increase over 2016 (Figure 13).

Milne Port dust fall monitoring sites DF-P-01 and DF-P-05 indicated a decrease in dust fall in 2017 when compared with 2016. Very slight increases or no change was noted at DF-P-04, -06 and -07 (Figure 13).

The Tote Road North dust fall monitoring station DF-RS-04 indicated an increase in dust fall in 2017 compared with 2016. All other sites at the Tote Road North crossing transect indicated a negligible change in dust fall in 2017 compared with 2016 (Figure 13). Dust fall suppression, particularly with water, was less in the area around the north crossing sampling locations when compared to the south (Map 2), which may be associated with the increase over 2016.

Tote Road South dust fall monitoring sites all indicated a decrease in dust fall in 2017 compared with 2016, particularly at sites DF-RS-04 and -05, which are closest to the road centreline (Figure 13). This decrease may be associated with effective dust suppression activities along this section of the Tote Road.

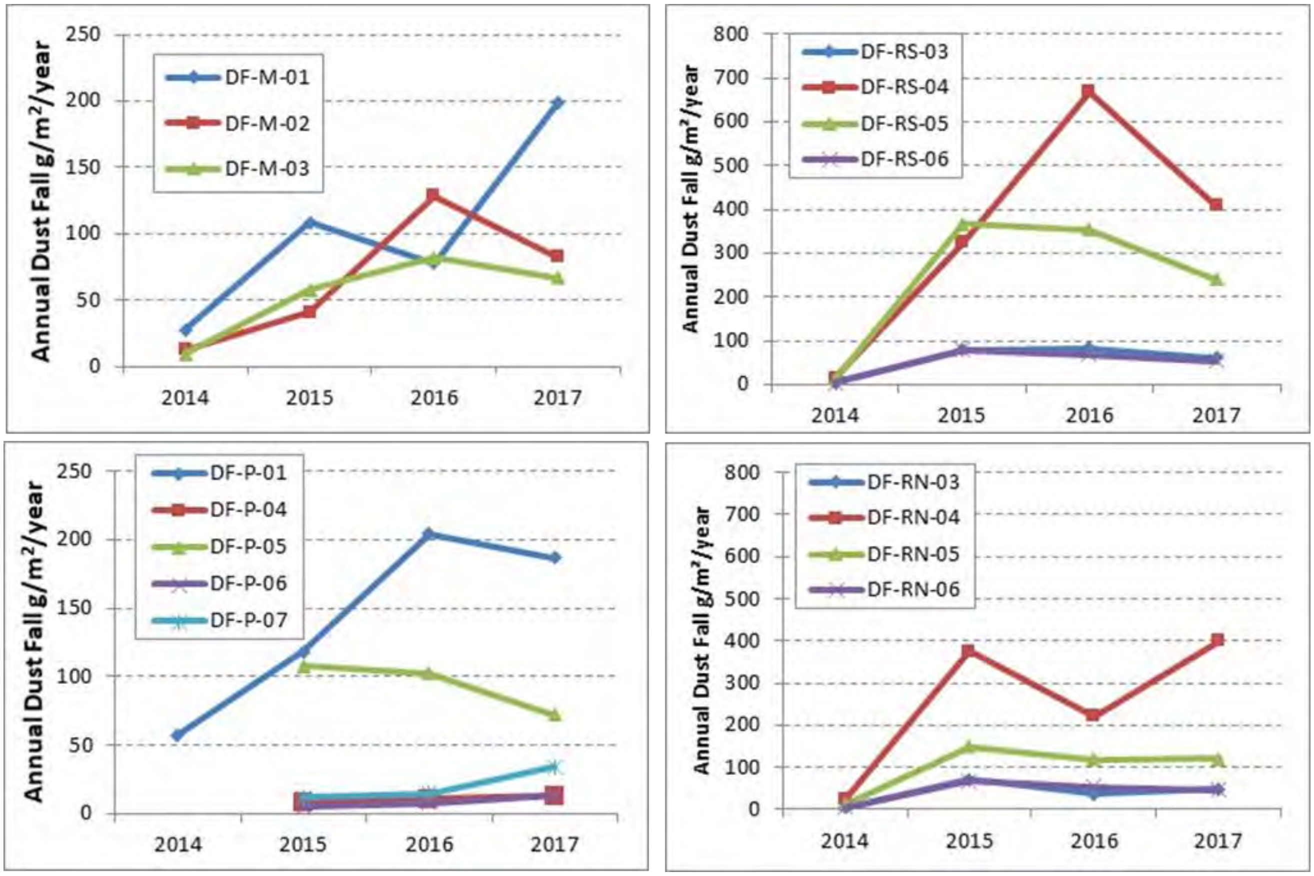


Figure 13 Annual dust fall trends throughout the Project area.

2.3 SUMMARY AND TRENDS

- Dust fall monitoring data is compared to predictions that were made in the FEIS and is valuable in the context of effects to other indicators including potential changes to vegetation and soil.
- Climate data collected in 2017 was compared with climate data collected as part of the project baseline data collection (2005–2010). Conditions were similar with regard to air temperature, but considerably drier in 2017 when compared to baseline data.
- The average number of vehicle passes on the Tote Road in all months regularly exceeded the projected maximum traffic volume; this vehicle activity is a contributor to dust fall as measured at both the south and north Tote Road crossing sample locations.
- Annual dust fall at the Mine Site sample locations currently falls within predicted levels and 2017 annual dust is less than was observed in 2016, except DF-M-01, which was affected by crusher activities in late November/early December 2017 resulting in higher than anticipated dust fall in those months given the dust fall in early winter in previous monitoring years.

- Dust fall at Milne Port exceeded predicted threshold levels at all sites except DF-P-07. The highest dust fall was noted at DF-P-01, which is located in close proximity to ore stock piles and DF-P-05, which is near the camp and affected by both camp traffic and nearby ore piles.
- Dust fall associated with the Tote Road at both the north and south crossing indicated a similar trend: Within 30 m and one kilometre on either side of the road centreline dust fall showed an increase over the predicted threshold amount, however outside the one kilometre range the dust fall deposition rates decreased to just at or below laboratory detection limits, which is analogous to background conditions and within predicted levels.
- At most year-round sampling locations throughout the Project area, dust fall in 2017 was less than in 2016; DF-M-01 and DF-RN-04 are the exceptions where it has increased. This decrease may be due to increased effectiveness of dust suppression activities, particularly along the Tote Road.

3 VEGETATION

The Project's Final Environment Impact Statement (FEIS) identified potential effects on vegetation abundance, diversity and health (Baffinland Iron Mines Corporation 2012) as a potentially Project-related. Overall effects to vegetation abundance and diversity were predicted to be "not significant" with a high level of confidence, while effects on vegetation health were predicted to be limited, with moderate confidence due to uncertainties on the effects of dust, metals and emissions on local vegetation. To address these limitations, data collection for long-term vegetation monitoring was completed for the following programs:

- Dust fall monitoring (Section 2);
- Vegetation abundance monitoring; and
- Vegetation and soil base metal monitoring.

3.1 VEGETATION ABUNDANCE MONITORING

To meet the terms and conditions required by the NIRB Project Certificate, Baffinland committed to establishing a long-term monitoring program to study potential changes to vegetation abundance used as caribou forage within the RSA. This commitment directly relates to the following conditions:

- Project Condition #36 – *The Proponent shall establish an on–going monitoring program for vegetation species used as caribou forage (such as lichens) near Project development areas, prior to commencing operations.*
- Project Condition #50 *and Project Commitment #67 also address these limitations or relate to the reporting requirements for the vegetation abundance monitoring program.*

To meet these monitoring commitments, a long-term vegetation monitoring program was initiated in 2014. The objective of the vegetation abundance monitoring program is to:

- Measure percent plant cover and plant group composition of available caribou forage within the RSA to track potential changes at varying distances from the edge of the PDA through long-term monitoring.

Vegetation monitoring data was collected under the initial study design for three years. Vegetation data was collected for a total of 15 balanced transects and six reference sites according to the following schedule:

- 2014 — Transects one to eight and reference sites one to three
- 2015 — No vegetation monitoring occurred
- 2016 — Transects one to fifteen (transects four, five and eight were only sampled at the 1,200 m distance class) and reference sites one to six (excluding reference site five)
- 2017 — Transects one to fifteen and reference sites one to six

In 2017, a trends analysis was conducted to assess potential changes in percent plant cover and plant group composition with the relationship of distance to Project infrastructure and treatment effect between open and closed plots (to control for the effect of herbivory).

Inter-annual differences in total percent ground cover, total percent canopy cover, and plant group composition were small in magnitude and consistent across all distance classes and treatments; therefore, differences are attributed to natural variation among years rather than a Project related effect in the first three years of monitoring.

3.1.1 METHODS

The study design and sample site selection were based on a review of relevant literature, and input from the Government of Nunavut Department of Environment staff in their role on the TEWG. Information considered when developing the vegetation monitoring program included dust fall modeling (Baffinland Iron Mines Corporation 2013), northern Canadian vegetation habitat types (Olthof et al. 2009), preferred caribou forage (summarized in Baffinland Iron Mines Corporation 2012) and other literature (Spatt and Miller 1981, Walker and Everett 1987, Walker 1996, Auerbach et al. 1997). Where feasible, recommendations from the Government of Nunavut (2014) and Parks Canada (Hudson and Ouimet 2011) were included in the study design.

A distance gradient approach was used based on the assumption that vegetation close to Project disturbance would likely be more affected than vegetation further from disturbance areas. To assess potential changes in vegetation associated with Project disturbance (e.g. dust and emissions), vegetation sampling occurred at specific distances (30, 100, 750 and 1,200 m) from the edge of the PDA. The four distance classes were chosen based on a review of relevant available literature and dust isopleth modeling (Baffinland Iron Mines Corporation 2013).

The monitoring program follows a Before-After-Control-Impact-design (BACI) (Bernstein and Zalinski 1983, Stewart-Oaten et al. 1992) with a stratified random paired/block design. The BACI design is common for impact assessments where the goal is to determine whether there is a statistically significant and biologically meaningful difference between baseline and disturbance conditions (e.g., changes to abundance of a species). This design involves pairing control and impacted sites where samples are taken simultaneously at both sites before and after a disturbance occurs.

To reduce natural variability in vegetation cover associated with differing habitat types and to allow for meaningful statistical comparisons, all sites were located within one habitat type. The habitat type chosen was based on the following factors:

- Relative abundance of habitat type (as summarized in the Project's wildlife baseline report – Appendix 6F, Baffinland Iron Mines Corporation 2012);
- Relative habitat use by caribou (a mixture of the Resource Selection Probability Function model results in the Project's wildlife baseline report and the energetics model presented in Russell (2014); and
- Likelihood of habitat type containing high quality caribou forage (Appendix 6F, Baffinland Iron Mines Corporation 2012).

The habitat type selected for vegetation abundance monitoring was the Moist to Dry Non-Tussock Graminoid/Dwarf Shrub type (Northern Land Cover, Olthof et al. 2009), one of the more common habitats in the RSA (Photo 2). The North Baffin Island Caribou herd does not appear to select one habitat type over another, but do exclude areas where vegetation cover is relatively low (Russell 2014). The Moist to Dry Non-Tussock Graminoid/Dwarf Shrub vegetation habitat type is considered high quality caribou forage, given that it contains lichen, grasses, sedges, forbs and deciduous shrubs. These plant groups are considered important food items for caribou in summer when plant nutritional value and digestibility is high, as well as in winter when food availability is mainly limited to lichen.

The vegetation abundance monitoring program involved the establishment of long-term vegetation plots. Plots were situated along 15 transects radiating out from the Mine Site (six transects), Tote Road (five transects) and Milne Inlet (four transects). In addition, six control (reference) sites were established within the RSA, approximately 20 km from the Project footprint. In total, 66 sample sites were located within the RSA (Map 4). Some pre-selected site locations had to be moved to locate the site within the selected habitat type. To prevent pseudo-replication and ensure independence between sites, all transects were spaced a minimum of 200 m apart with the majority of transects spaced 500 m apart. Each transect extended perpendicular from the Project disturbance footprint. Along each transect, four sample sites were located at 30 m, 100 m, 750 m and 1,200 m from the edge of the Project footprint.

To exclude potentially confounding effects of grazing (e.g., from caribou and small mammals) exclosure (i.e., closed plots consisting of a cage) and open plots were used to account for herbivory effects. In response to recommendations made by the Government of Nunavut, all 1 x 1 m cages from 2014 were replaced with 2m x 2 m cages in 2016 to reduce the influence of edge effects associated with the cages. Each sample site consisted of one closed plot and one open plot. To account for within-site variability in vegetation cover, some sites included a second open plot, for a total of three plots at one site. Of the 66 sample sites, 47 sample sites had one closed plot associated with an open plot and 19 sites had one closed plot associated with two open plots (all three control sites had three plots each). In total, 151 1m x 1 m plots were sampled. To reduce bias, individual plots at each site were located close to the center of the polygon. Plots within a site were spaced 3 m apart to provide replication and reduce within site variability. At sites where 1 x 1 m cages were replaced with 2 x 2 m cages, plots were spaced 2.5 m apart. Figure 14 provides a schematic illustration of sample site and plot locations along a transect. At the time of plot establishment none of the sites selected for this study showed signs of herbivory. A table of all plots, transects, distances, treatments and coordinates is provided in APPENDIX A – Vegetation Abundance Monitoring Site Locations.

Closed-plot cages were constructed from sturdy, weather resistant materials for long–term durability and to prevent caribou grazing from above and small mammal grazing at ground level. Galvanized rebar was used to mark the measuring plot and corner posts for the cage, half-inch galvanized hex wire along all four sides and one-inch galvanized poultry netting for the roof. Galvanized wire was used to secure the roof and galvanized nails with weather resistant rope were used to secure and stake the cage to the ground. Completely enclosed, the cage stands approximately 1 m in height and covers an area of 2m x 2 m. The hex wire was flanged at the base and piled with rocks to exclude small mammals from entering below the cage from the edges. The roofs of the cages were designed to be removable along three sides to allow for vegetation monitoring at plots inside the cages during future sampling events. The roof can be re-secured using galvanized wire. A typical site in terms of plot layout, topography, vegetation characteristics and closed plot cage construction is illustrated in Photo 3.

Each monitoring plot was given a unique identifier code. The plot labelling scheme was based on the transect number, distance class, and type and number of plots at a given site. Closed plots were denoted with an "X". The first open-plot at a site was represented by an "A"; the second, if present, was labelled with a "B". For example, plot T1D30X represents Transect 1, distance class 30 m and it is a closed plot.

Vegetation abundance monitoring plots (both open and closed) were 1m x 1 m square and were sampled using the point quadrat method. Plot dimensions and design were based on standards used by the International Tundra Experiment (ITEX; Walker 1996). The point quadrat method is considered one of the most objective and repeatable methods for monitoring vegetation (Levy and Madden 1933, Goodall 1952, Bonham 2013) and is the recommended method for assessing vegetation changes in tundra plant communities (Molau and Mølgaard 1996). It is a quantitative method that has been widely recommended for measuring vegetation abundance and is suitable for long-term monitoring (Stampfli 1991, Elzinga et al. 1998, Hudson and Henry 2009).

The point quadrat method involves a square 1 m x 1 m metal plot frame with 100 fixed measurement locations spaced 10 cm apart across the frame (Figure 15). In traditional studies, a long pin is dropped through the frame at each of the 100 locations; however, the quadrat frame in this study uses a laser instead of pins. The laser was moved and shot vertically downwards at each of the 100 marked locations along the frame. The first plant species that was touched or "hit" by the laser in the canopy layer and in the ground layer were tallied. Figure 16 provides a schematic illustration of the laser "hitting" the first plant in the canopy layer and then the first plant in the ground layer within a sampling plot. Percent plant cover was determined by summing the total number of "hits" for each species in each of the canopy and ground layers. Plant species were also categorized into respective plant groups to determine percent plant group cover.

The quadrat (i.e., plot) frame was set above the ground on four legs, two of which were permanent rebar posts marking the plot location (Photo 4). The rebar corner posts allow the frame to be set up in the same location year after year for repeatable measurements. All measurements began at the corner of the frame with the thicker of the two rebar pieces, moving from one side of the frame to the other and ended on the side of the plot with the skinny rebar post. The frame was leveled and positioned above the ground from 15–45 cm depending on the slope. The height of the frame had no effect on the diameter of the laser projecting onto the vegetation (~2 mm) (Photo 5).

Percent plant cover by plant group was used as the measure of vegetation abundance. Percent plant cover was measured using the point quadrat method with a total of 100 sampling points each for canopy cover and ground cover per plot. This method is widely used by ITEX for measuring various vegetation abundance measures (Walker 1996). Plant composition was assessed by tallying all species encountered and then grouped into broad vegetation groups (Molles and Cahill 2008). The plant groups selected for this study coincide with those used in the caribou energetics model (Russell 2014) and include deciduous shrubs, evergreen shrubs, forbs, graminoids, moss and lichen. Standing dead litter was also included as important winter forage that provides nutritional balance to caribou winter diet (Heggberget et al. 2002). Dead ground litter, un-vegetated substrates including bare ground, rock or gravel and cryptobiotic soil crusts were recorded but excluded from the percent cover values because these do not represent useable forage for caribou.

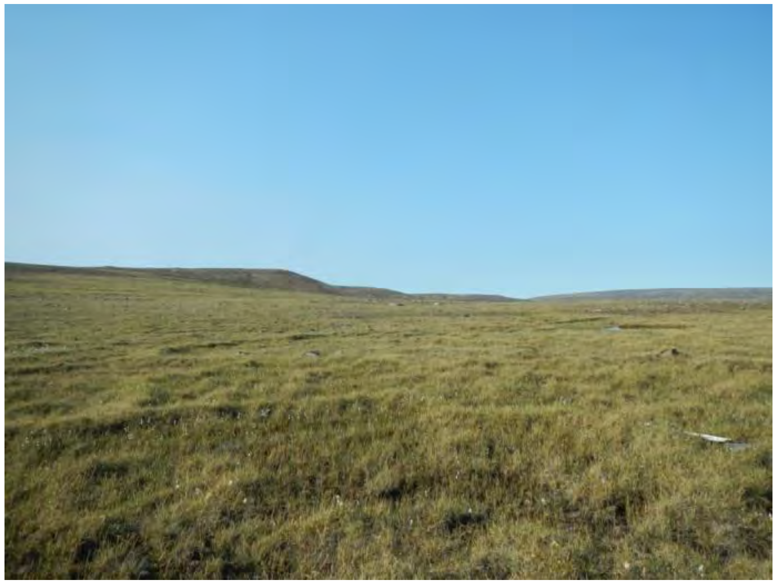
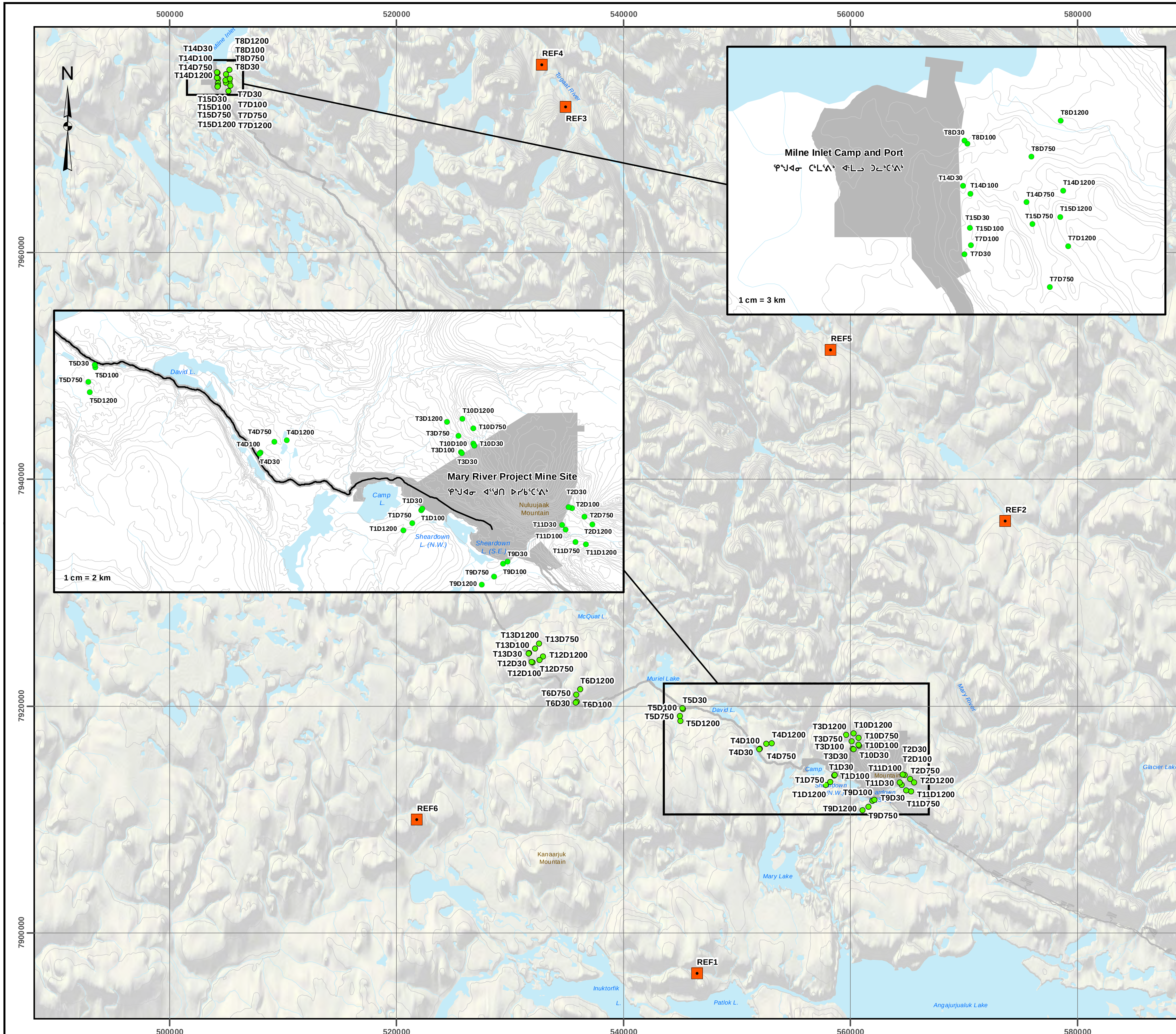


Photo 2 Example of the Moist to Dry Non–Tussock Graminoid/Dwarf shrub vegetation habitat type in the Mary River RSA selected for the vegetation abundance monitoring program.



LEGEND

Vegetation Abundance Monitoring Samping Site [1]

- REF 1 — Reference site
- T7D1200 — Transect site
- Topographic contour (20m interval)
- Potential Development Area
- Regional Study Area

[1] Vegetation Abundance: Transect Site Nomenclature

Transect #
T1D30
Distance Class (m)

NOTES

Map Projection: North American Datum UTM Zone 17N.

Updated PDA provided by Hatch (25 April 2013).

This document is not an official land survey and the spatial data presented is subject to change without notice.

Scale 0 2 4 8 12 16 20 Km

Baffinland

Vegetation Abundance Monitoring Sites within the RSA, 2014-2017

EDI

Date: 10/6/2017

MAP 4

Path: O:\2017\17Y0152_BIM_Monitoring\GIS\Vegetation\Map4_VegAbundance_20171006.mxd

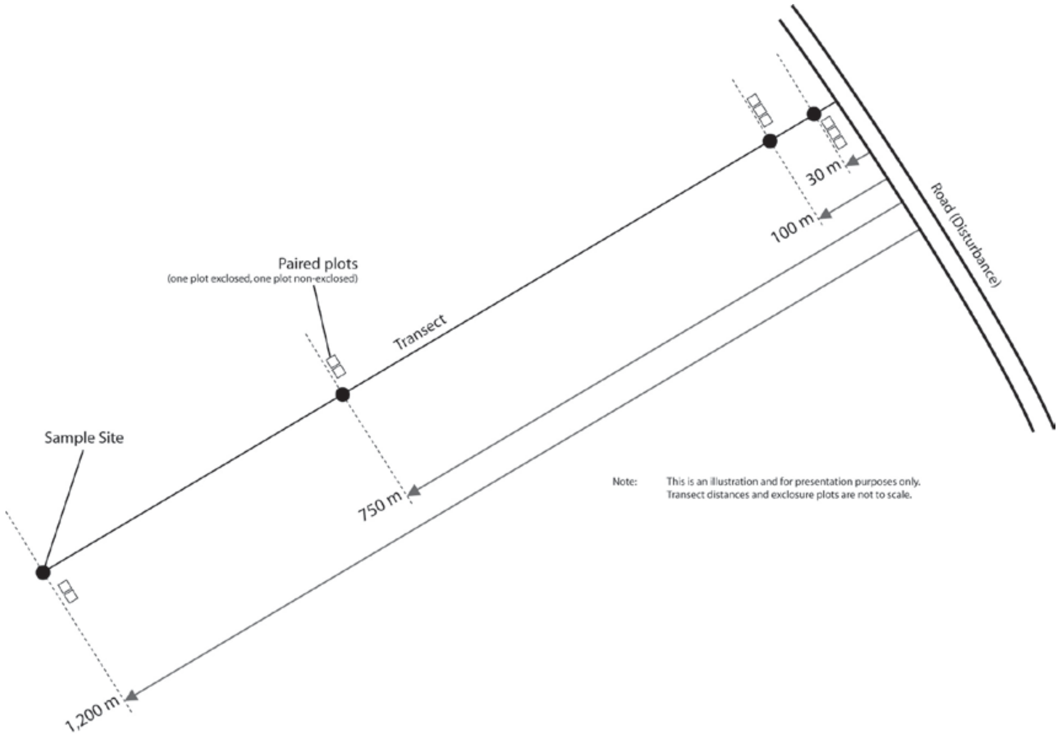


Figure 14 Schematic diagram showing the location of sample sites and plots along a transect.

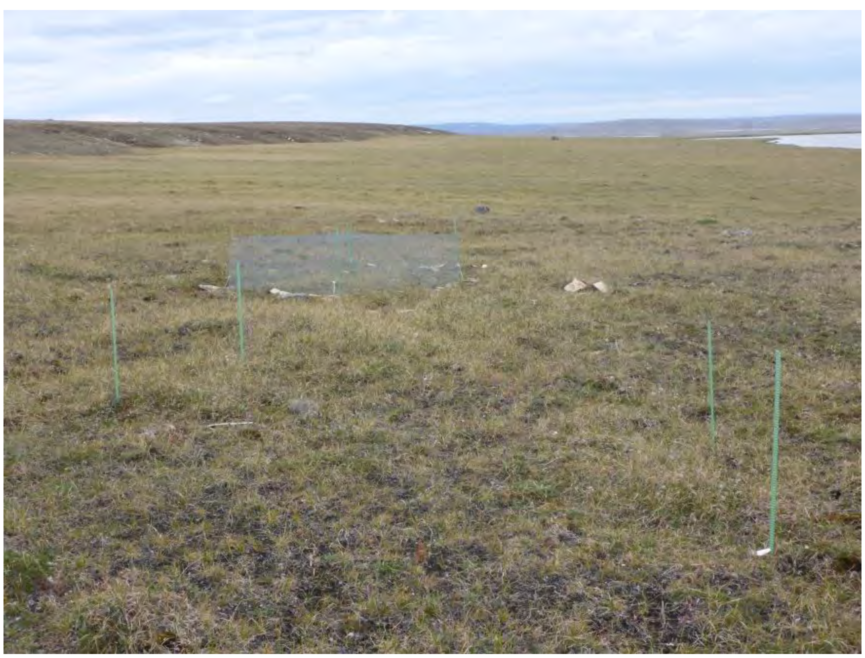


Photo 3 Representative site photo of general plot layout and site conditions.
This is site T12D1200 with one closed plot and two open plots located along the Tote Road, 6 August 2017.

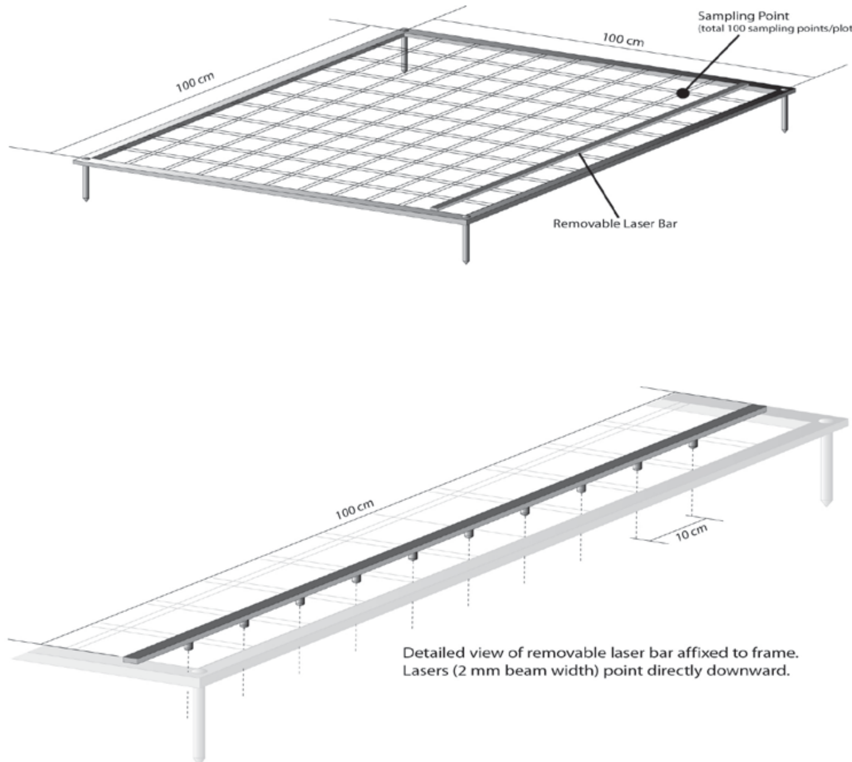


Figure 15 **Illustration of the point quadrat frame used to measure percent plant cover.**

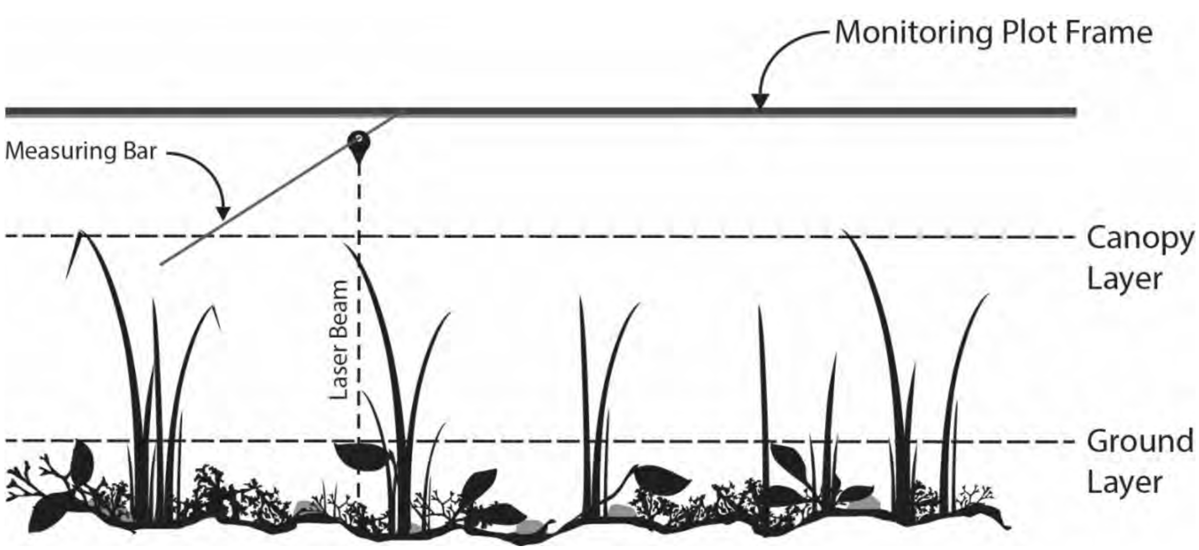


Figure 16 **Schematic diagram of canopy and ground cover.**
Showing the laser beam of the monitoring plot frame "hitting" the first plant in the canopy layer and then the first plant in the ground layer.

Photo 4 Measuring plot frame erected above the vegetation during sampling, 5 August 2017.

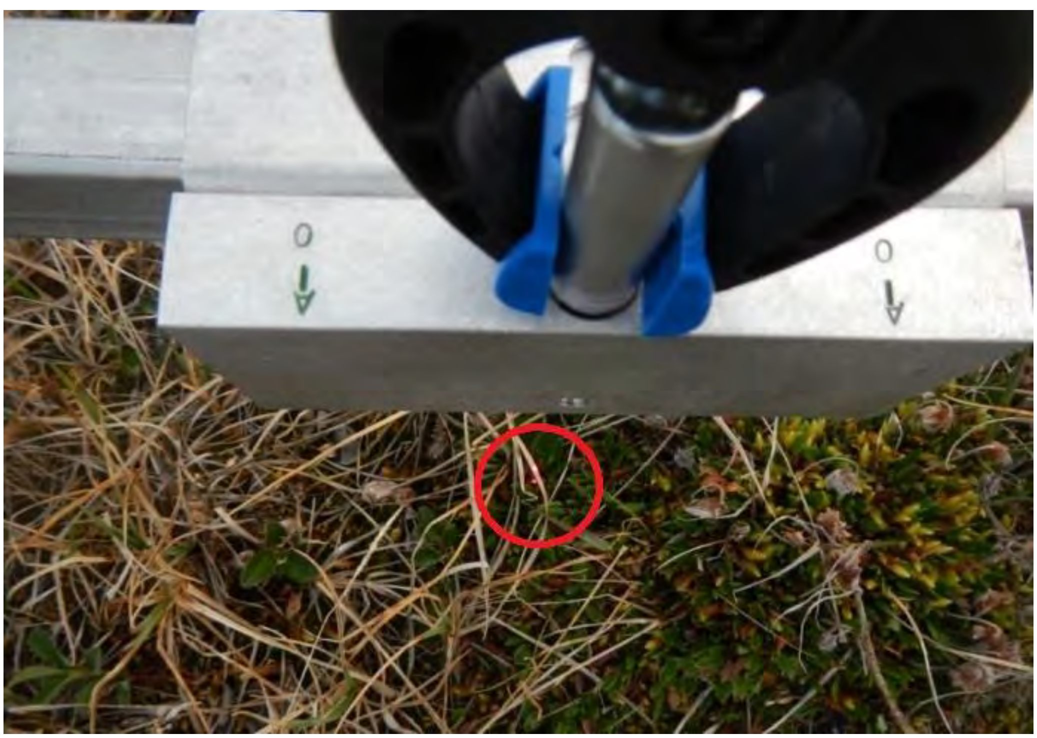


Photo 5 A view showing the diameter of the laser projecting onto the vegetation (2 mm), 27 July 2014.

3.1.1.1 Analytical Methods

Data were analyzed to investigate the relationship among years in vegetation cover and composition to distance class, while accounting for the potential effect of herbivory (closed- vs. open-plots). An emphasis was placed on caribou forage, such as lichen. Data analyzed included 1) total ground cover, 2) total percent canopy cover and 3) percent cover by plant group.

Since the variability in the individual species data was high, percent plant cover for ground and canopy layers was divided by general plant groups (i.e., deciduous shrubs, evergreen shrubs, forbs, graminoids, moss, and lichen). The percent cover of each plant group was first quantified by adding up all the "hits" from the laser for a plant group within a plot. This was done separately for the ground cover and canopy cover layers. The total number of "hits" within a plot represented overall percent plant cover.

Linear mixed effects models were used to test for differences in total ground cover, total canopy cover and plant group cover. Models included three main effects for year, distance class and plot treatment (i.e. closed- vs. open-plots), and all interactions between these effects. Plots nested within sample sites were included as random effects to account for repeated measurements of the sample plots over multiple years and the possibility that plots from the same sample site were more similar to one another than plots from different sampling sites. Percent cover values were logit transformed to create a continuous variable with an approximately normal distribution (Warton and Hui 2011). Not all plant groups were present in all plots; therefore, a value of 0.005 was added to plant group values prior to transformation (Warton and Hui 2011).

All estimates were back transformed to the original scales and are reported as average plant cover with 95% confidence intervals. F-tests were used to determine the statistical significance of model parameters. Residual plots were visually examined to confirm that models met the assumptions of normality and equality of variance. All analyses were performed using R, version 3.3.1 (R Core Team 2016). Mixed effects models were run using the 'nlme' package (Pinheiro et al. 2016). Pairwise comparisons within groups and confidence intervals were calculated using the 'lsmeans' package (Lenth 2014).

3.1.2 RESULTS AND DISCUSSION

This report (2017) is the first year that vegetation abundance data were analyzed among years including data from 2014, 2016, and 2017. A trends analysis of only three years of data should be interpreted with caution, due to the lack of a full sample size in all three years. Refer to Section 3.1 – Vegetation Abundance Monitoring for details on the vegetation abundance monitoring program schedule.

There were small significant declines in total percent ground cover between 2014 and 2016/2017 across all plots (i.e., a regional change not related to distance from the PDA). Although statistically significant, these small differences in ground cover are not biologically important. These differences were small; the range in confidence intervals is also small with little variation between years.

Similarly, there was no real interaction between treatment and year for total percent ground cover data; therefore, differences in ground cover between open and closed plots were the result of underlying variation in the data and are not considered biologically important. In the ground cover layer, moss and lichen cover declined between 2014 and 2016/2017, while ground litter increased during the same period. Although these results were statistically significant, inter-annual differences were small and consistent across all distance classes and treatments; therefore, differences are attributed to natural variation among years rather than a Project related effect.

There was a significant increase in total percent canopy cover between 2014 and 2016/2017. Changes in total percent canopy cover were driven by an increase in the amount of standing dead litter in the canopy cover layer and a simultaneous decrease in graminoids cover over the same period. There was some evidence that graminoids and deciduous shrubs had different responses related to distance class and year; however, these differences were small in magnitude and showed no consistent pattern in relation to distance from Project infrastructure. There was no support for a treatment effect on canopy cover for any analysis. We conclude that differences in total percent canopy cover were driven by annual variation in plant cover and there is no evidence to support a Project related effect in the first three years of monitoring.

In summary, there is annual variation in vegetation abundance in the Project area, but there is no evidence of changes in vegetation abundance as a result of a Project-related effect.

3.1.2.1 Total Percent Ground Cover

There was a significant effect of year on total ground cover ($p < 0.001$). Averaging across distance classes and treatment, total ground cover was 94.5% (CI = 92.5– 96.1) in 2014, 91.5% (CI = 88.8– 93.6) in 2016, and 90.2% (CI = 87.3– 92.6) in 2017. Total ground cover in 2014 was higher than in 2016 ($p < 0.001$) and 2017 ($p < 0.001$); there was no difference between 2016 and 2017 ($p = 0.17$, Figure 17). There was a significant effect of treatment on total ground cover ($p = 0.006$, Figure 18), but no interaction between treatment and year ($p = 0.21$). After accounting for year, average ground cover in closed plots was 91.4% (CI = 88.6– 93.6) and open plots was 93.1% (CI = 90.9– 94.8).

There was no evidence of an interaction between year and distance class ($p = 0.32$) or a main effect of year ($p = 0.75$). There was no three-way interaction between year, distance, and treatment ($p = 0.93$).

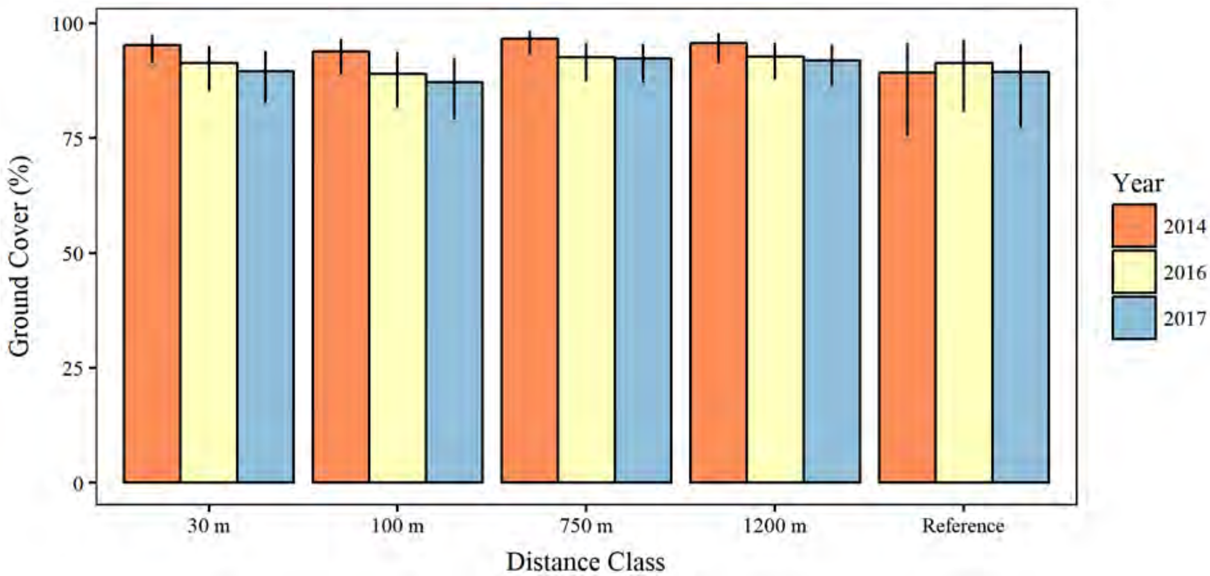


Figure 17 **Total ground cover by distance class and year.**
Bar heights show average ground cover and error bars show 95% confidence intervals.

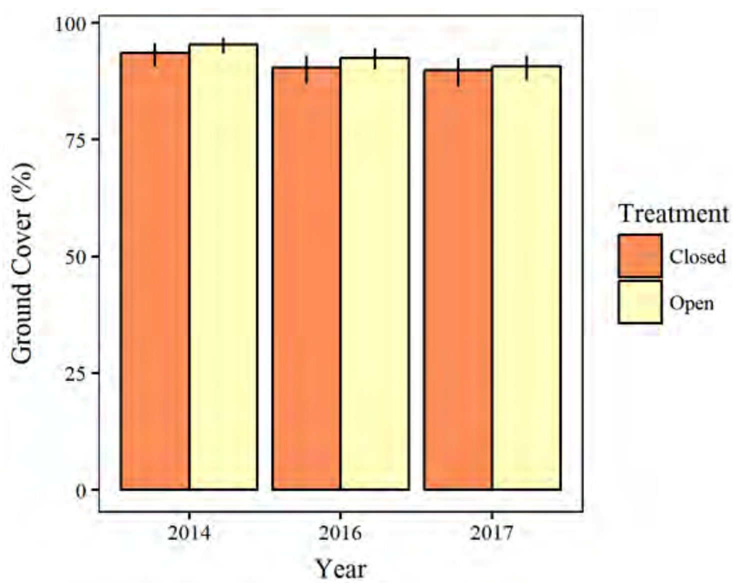


Figure 18 **Total ground cover by treatment and year.**
Bar heights show average ground cover and error bars show 95% confidence intervals

3.1.2.2 Ground Cover Plant Groups

Differences in plant group cover were examined by year to look at overall changes in plant cover and to determine which plant groups within the ground layer warranted detailed examination. The average cover of plant groups changed among years ($p < 0.001$, Figure 19). Based on this analysis, the following plant groups were considered for detailed analysis including ground litter, moss, evergreen shrubs, and lichen. Deciduous shrubs, forbs, and graminoids each had less than 1% cover in all three years; therefore, these plant groups were not investigated further.

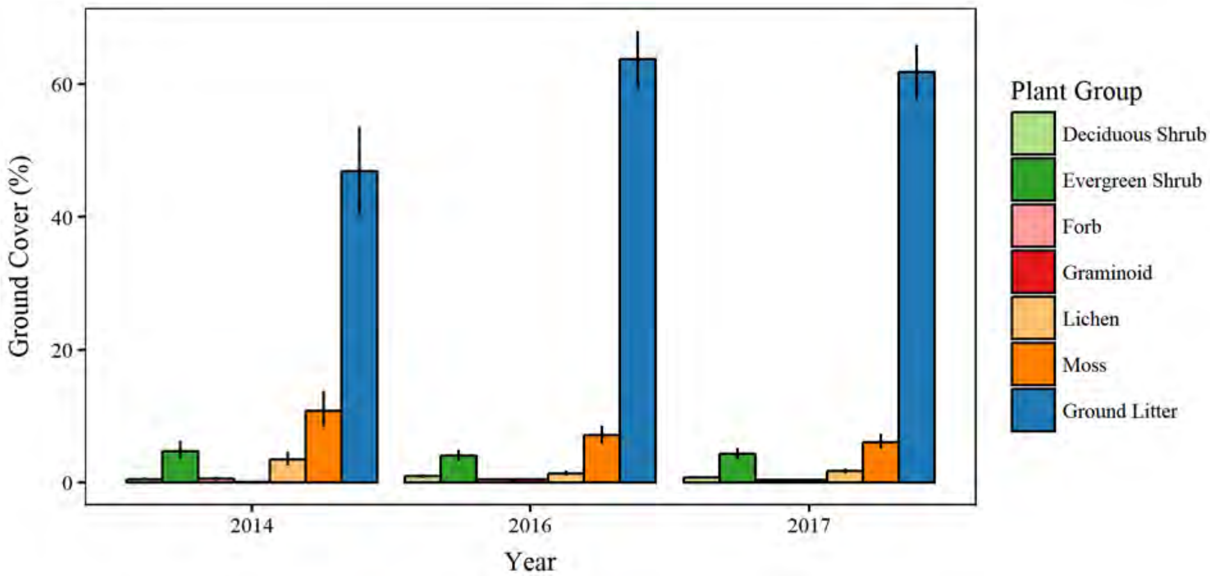


Figure 19 Ground cover by plant group and year.
Bar heights show average ground cover and error bars show 95% confidence intervals.

Ground Litter

Ground litter (dead, unattached material) made up the majority of ground cover in all years (Figure 19). Although ground litter is not considered caribou forage, it was included in the analysis because it is related to and may help explain potential changes in the standing dead litter group for the canopy layer. Factors such as wind or the amount of standing dead litter in a plot can influence ground litter cover from year to year.

There was evidence of a year effect on ground litter ($p < 0.001$). Ground litter was lowest in 2014 at 46.9% (CI = 40.2– 53.6) and increased significantly in 2016 to 63.8% (CI = 59.2– 68.0; $p < 0.001$) and 61.8% (CI = 57.6– 65.9; $p < 0.001$) in 2017. There was no evidence of an interaction between year and distance class ($p = 0.47$, Figure 20) or a main effect of distance class ($p = 0.49$). There was no evidence of an interaction between year and treatment ($p = 0.18$) or a main effect of treatment ($p = 0.21$). There was also no three-way interaction between year, treatment, and distance class ($p = 0.76$).

Moss

Moss had the second highest cover in the ground layer for all years. There was evidence of a year effect on moss in the ground cover layer ($p < 0.001$, Figure 19); moss cover was highest in 2014, at 10.7% (CI = 8.4– 13.8), in 2016, 7.1% (CI = 5.9– 8.6; $p = 0.02$), and in 2017, 6.1% (CI = 5.1– 7.4; $p < 0.001$).

There was no evidence of an interaction between year and distance class ($p = 0.41$, Figure 21) or a main effect of distance class ($p = 0.14$). There was no evidence of an interaction between year and treatment ($p = 0.55$) or a main effect of treatment ($p = 0.41$). There was also no three-way interaction between year, treatment, and distance class ($p = 0.42$).

Evergreen Shrubs

There was no evidence for inter–annual differences in evergreen shrub cover in the ground layer which was 4.7% (CI = 3.6– 6.3) in 2014, 4.0% (CI = 3.2– 5.0) in 2016, and 4.3% (CI = 3.6– 5.2) in 2017 (all $p > 0.69$). There was no evidence of an interaction between year and distance class ($p = 0.77$, Figure 22) or a main effect of distance class ($p = 0.24$) or year ($p = 0.79$).

There was no evidence of an interaction between year and treatment ($p = 0.86$) or a main effect of treatment ($p = 0.60$). There was also no three way interaction between year, treatment, and distance class ($p = 0.59$).

Lichen

There was evidence of a year effect on lichen in the ground layer ($p < 0.001$, Figure 19). Lichen cover followed the same pattern as moss, with the highest cover in 2014, at 3.4% (CI = 2.6– 4.6) and lower cover in 2016, 1.4% (CI = 1.1– 1.8; $p < 0.001$) and 2017, 1.7% (CI = 1.4– 2.1; $p = 0.002$).

There was no evidence of an interaction between year and distance class ($p = 0.48$) or a main effect of distance class ($p = 0.63$). There was no evidence of an interaction between year and treatment ($p = 0.95$, Figure 23) or a main effect of treatment ($p = 0.38$). There was also no three way interaction between year, treatment, and distance class ($p = 0.94$).

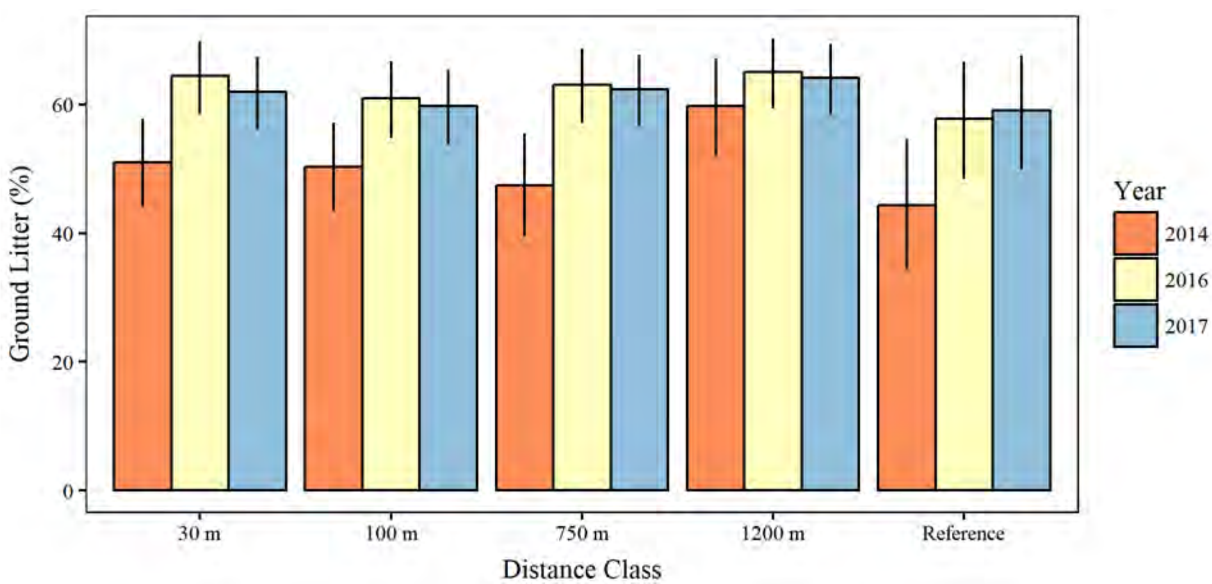


Figure 20 **Ground litter cover in the ground layer by distance class and year.**
Bar heights show average ground cover and error bars show 95% confidence intervals.

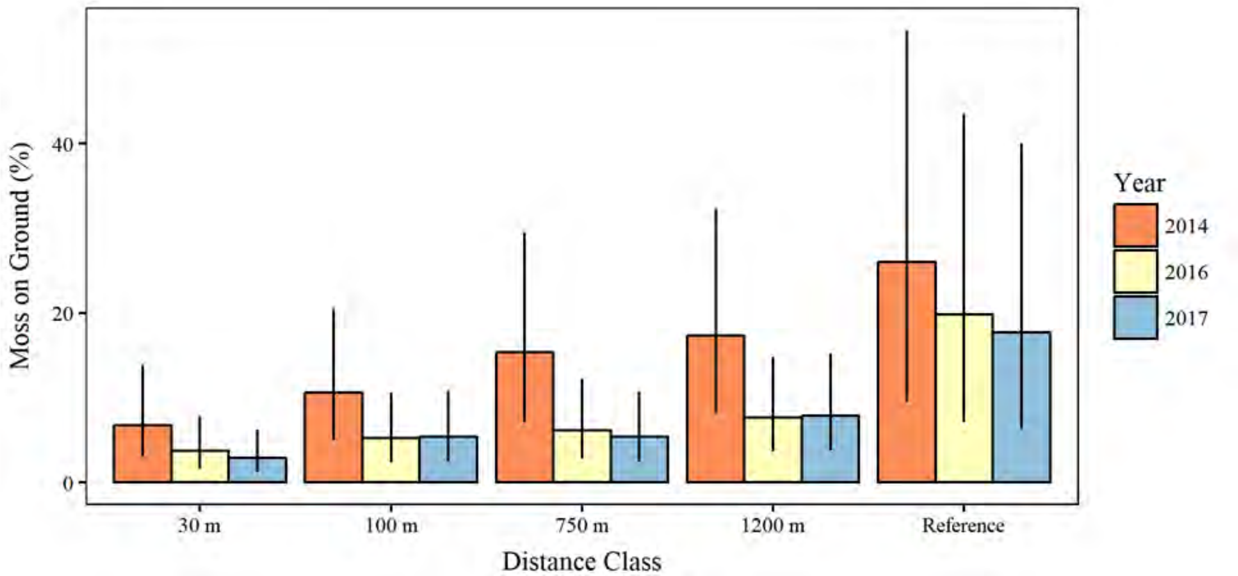


Figure 21 **Moss cover in the ground layer by distance class and year.**
Bar heights show average ground cover and error bars show 95% confidence intervals.

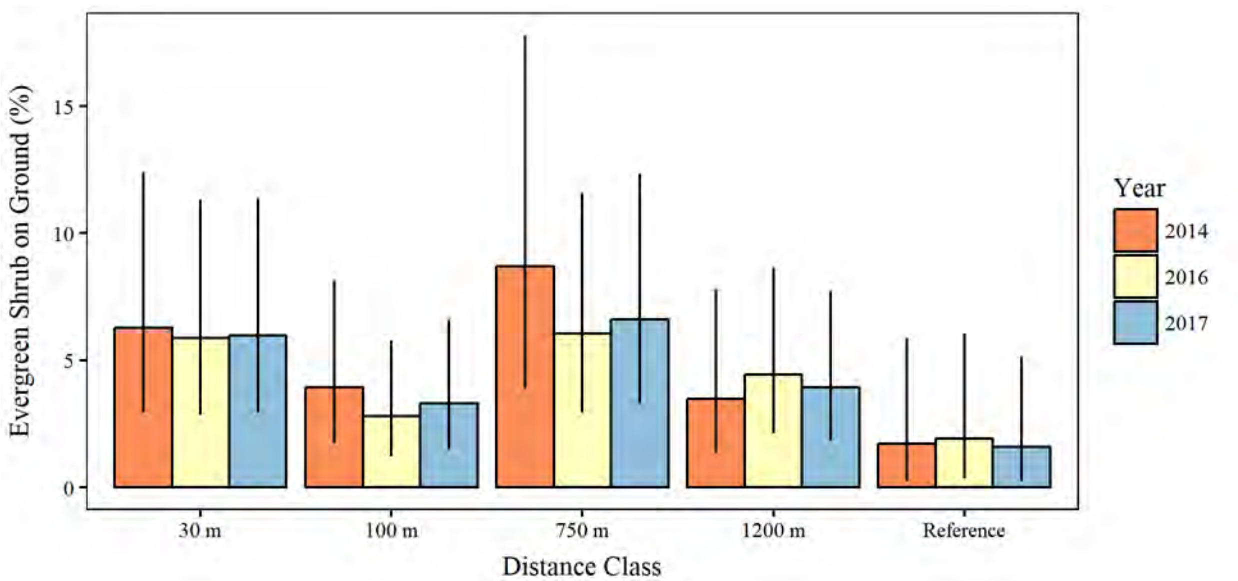


Figure 22 **Evergreen shrub cover in the ground layer by distance class and year.**
Bar heights show average ground cover and error bars show 95% confidence intervals.

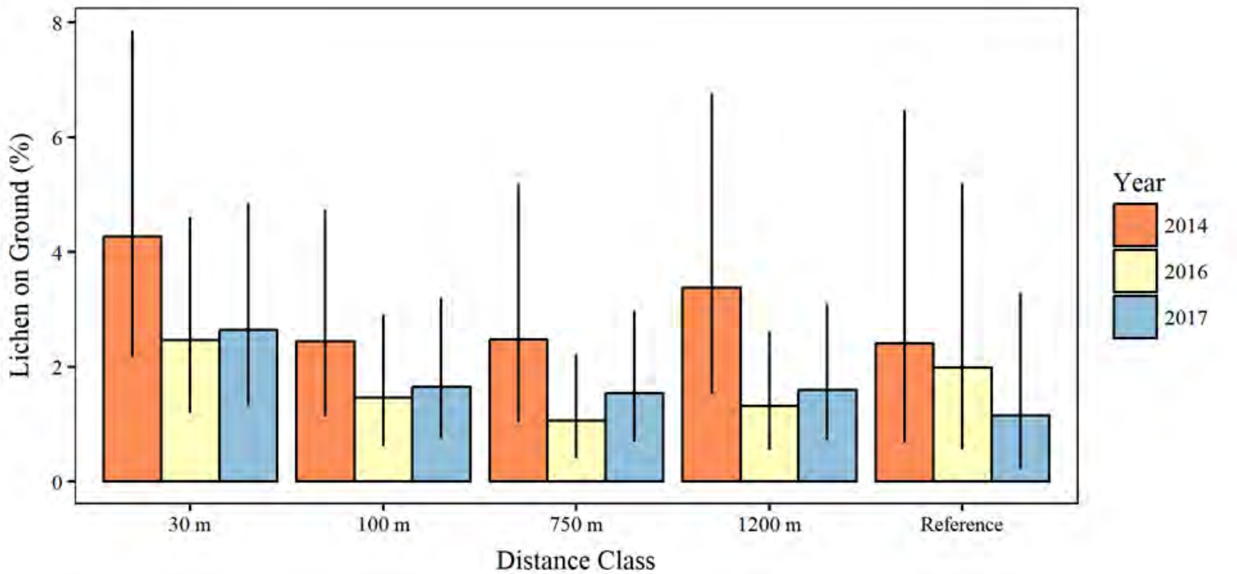


Figure 23 Lichen cover in the ground layer by distance class and year.
Bar heights show average ground cover and error bars show 95% confidence intervals.

3.1.2.3 Total Percent Canopy Cover

There was a significant effect of year on total canopy cover ($p < 0.001$). Averaging across distance classes, total canopy cover was 43.3% (CI = 39.5– 47.1) in 2014, 51.7% (CI = 48.3– 55.0) in 2016, and 50.6% (CI = 47.4– 53.9) in 2017. Total canopy cover in 2014 was significantly lower than in 2016 ($p < 0.001$) and 2017 ($p < 0.001$); there was no difference between 2016 and 2017 ($p = 0.61$).

There was some evidence of an interaction between year and distance class ($p = 0.02$, Figure 24). Most distance classes followed the overall annual trend described above, except for the 750 m distance class between 2014 and 2017 ($p = 0.03$). There was no support for a main effect of distance class on total canopy cover ($p = 0.43$). There was no evidence for a main effect of treatment on total canopy cover ($p = 0.33$) or for interactions between treatment and distance or year (all $p > 0.17$, Figure 25).

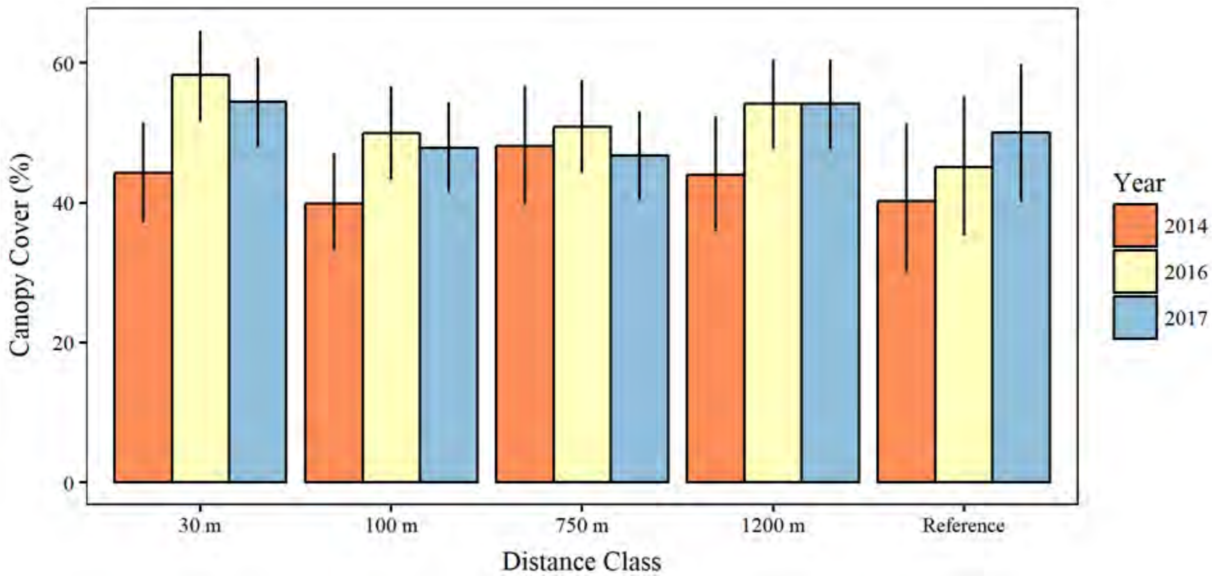


Figure 24 Total canopy cover by distance class and year.
Bar heights show average ground cover and error bars show 95% confidence intervals.

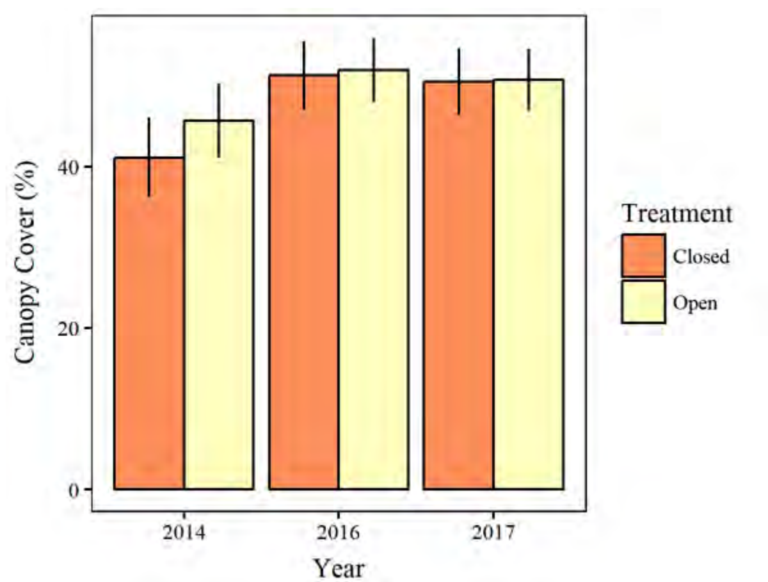


Figure 25 Total canopy cover by treatment and year.
Bar heights show average ground cover and error bars show 95% confidence intervals.

3.1.2.4 Canopy Cover Plant Groups

Differences in plant group cover were examined by year to look at overall changes in plant cover and to determine which plant groups within the canopy layer warranted detailed examination. The average cover of plant groups changed among years ($p < 0.001$, Figure 26). Based on this analysis, the following plant groups were considered for detailed analysis including standing dead litter, graminoids, and deciduous shrub cover. Average cover of evergreen shrubs and forbs was less than 2% in all years; therefore, these plant groups were not investigated further.

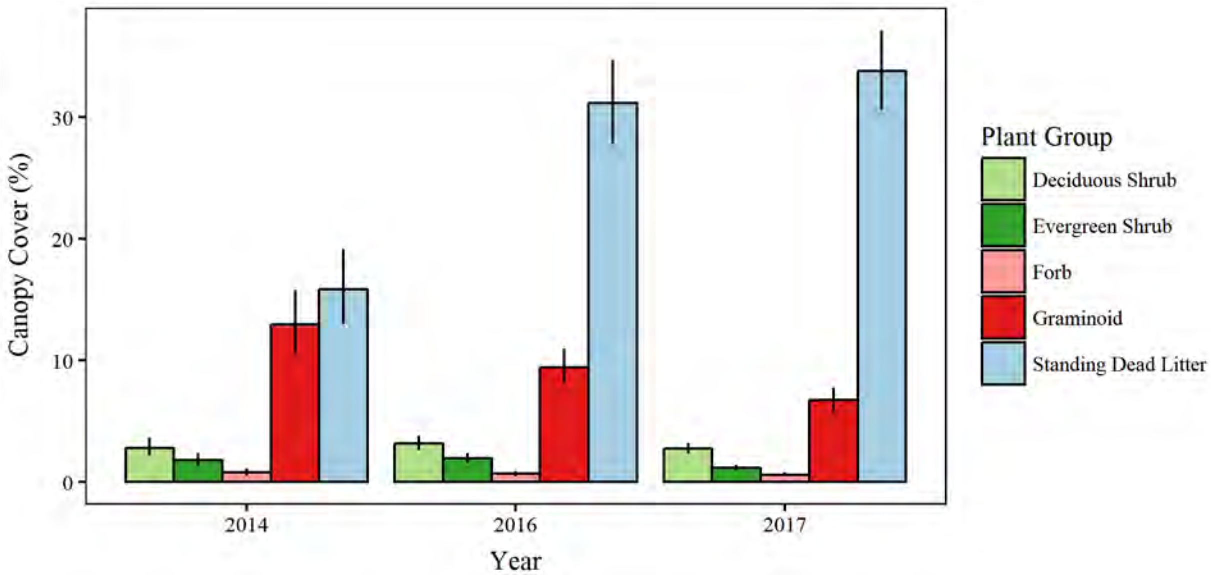


Figure 26 Canopy cover by plant group and year.
Bar heights show average ground cover and error bars show 95% confidence intervals.

Standing Dead Litter

There was strong evidence of a year effect on standing dead litter cover in the canopy layer ($p < 0.001$). Standing dead litter more than doubled from 2014, when it was 15.9% (CI = 31.1– 33.9), to 2016 and 2017, when cover was 31.2% (CI = 27.8– 34.7; $p < 0.001$) and 33.8% (CI = 30.6– 37.2; $p < 0.001$), respectively. There was no difference in standing dead litter between 2016 and 2017 ($p = 0.51$).

There was no evidence of an interaction between year and distance class ($p = 0.16$, Figure 27) or a main effect of distance class ($p = 0.69$). There was no evidence of an interaction between year and treatment ($p = 0.49$) or a main effect of treatment ($p = 0.63$). There was also no three-way interaction between year, treatment, and distance class ($p = 0.47$).

Graminoids

There was suggestive evidence of an interaction between year and distance class for graminoid cover in the canopy layer ($p = 0.06$, Figure 28) and strong evidence of a year effect on graminoid cover ($p < 0.001$). Graminoid cover declined significantly in each year from 13.0% in 2014 (CI = 10.6– 15.8) to 9.4% in 2016 (CI = 8.1– 10.9; $p = 0.03$) and 6.7% in 2017 (CI = 5.8– 7.8; $p = 0.004$). This pattern was generally consistent across distance classes, except there was no difference in graminoid cover between 2014 and 2016 in the 100 m distance class ($p = 0.59$) or between 2016 and 2017 for the reference class ($p = 0.36$).
There was no evidence of an interaction between year and treatment ($p = 0.96$) or a main effect of treatment ($p = 0.18$). There was also no three way interaction between year, treatment, and distance class ($p = 0.78$).

Deciduous Shrub

There was no evidence for inter-annual differences in deciduous shrub cover which was 2.8% (CI = 2.2– 3.6) in 2014, 3.2% (CI = 2.7– 3.8) in 2016, and 2.7% (CI = 2.3– 3.2) in 2017 (all $p > 0.39$). There was evidence of an interaction between year and distance class ($p = 0.03$; Figure 29) for deciduous shrubs in the canopy layer. In the 100 m distance class, deciduous shrub cover was lower in 2017 (2.5%, CI = 1.4– 4.2) than in 2014 (4.0%, CI = 2.2– 6.7; $p = 0.02$). Deciduous shrub cover in the 750 m distance class was lower in 2016 (1.5%, CI = 0.7– 2.6) than in 2014 (2.9%, CI = 1.5– 5.5; $p = 0.03$) or in 2017 (2.1%, CI = 1.2– 3.9; $p = 0.05$). There were no other significant year differences within distance classes (all $p > 0.21$).

There was no evidence of an interaction between year and treatment ($p = 0.56$) or a main effect of treatment ($p = 0.83$). There was also no three-way interaction between year, treatment, and distance class ($p = 0.39$).

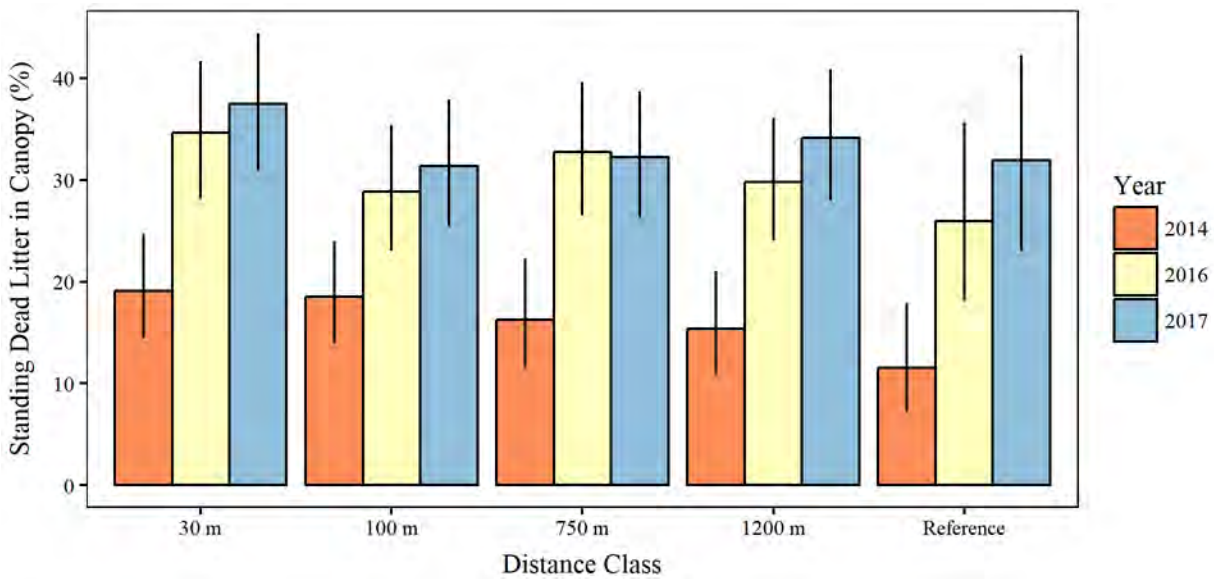


Figure 27 **Standing dead litter in the canopy layer by distance class and year.**
Bar heights show average ground cover and error bars show 95% confidence intervals.

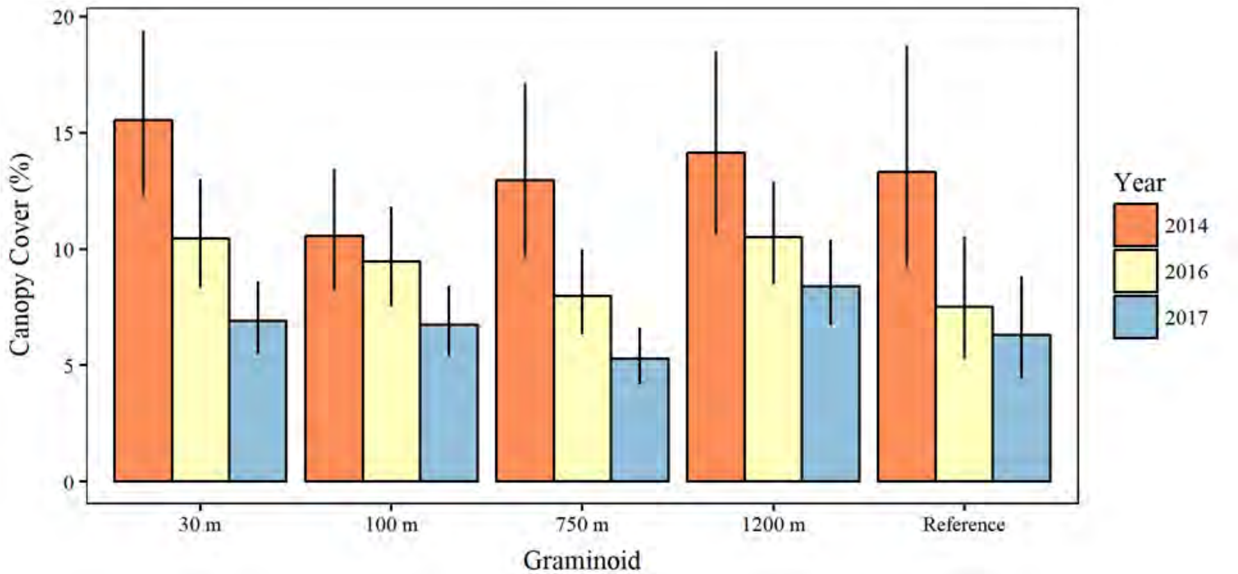


Figure 28 Graminoid cover in the canopy layer by distance class and year.
Bar heights show average ground cover and error bars show 95% confidence intervals.

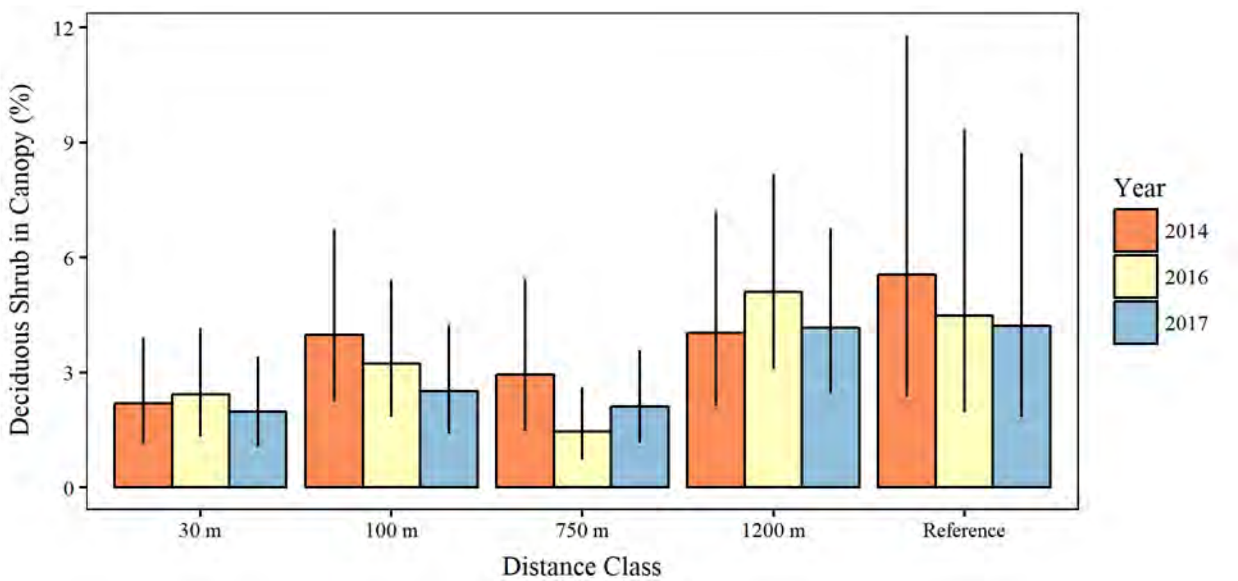


Figure 29 Deciduous shrub cover in the canopy layer by distance class and year.
Bar heights show average ground cover and error bars show 95% confidence intervals.

3.2 VEGETATION AND SOIL BASE METALS MONITORING

Potential metals or emissions uptake by vegetation was identified as a concern to the health of vegetation, as well as to wildlife and humans that may consume affected plant material. Conditions in the NIRB Project Certificate were developed to address limitations related to potential increases in vegetation and soil metal concentrations:

- Project Condition #34 – *The Proponent shall conduct soil sampling to determine metal levels of soils in areas with berry–producing plants near any of the potential development areas, prior to commencing operations.*
- Project Condition #36 – *The Proponent shall establish an on–going monitoring program for vegetation species used as caribou forage (such as lichens) near Project development areas, prior to commencing operations.*
- Project Commitment #50 also addresses these limitations or relates to the reporting requirements for the vegetation and soil base metal monitoring program.

To meet these monitoring commitments a long–term vegetation and soil base metals monitoring program was established. The main objectives of the vegetation and soil base metals monitoring program are to:

- Monitor metal concentrations in vegetation and soil, particularly caribou forage (i.e., lichen), near Project infrastructure; and
- Determine if metal concentrations in vegetation and soil exceed available CCME and relevant threshold levels provided in the literature.

Baseline sampling was conducted in the southern sections of the RSA in 2012 and in the northern portions of the RSA in 2013. Vegetation included in the monitoring program consisted of three focal species/species groups: lichen (*Cladina* and *Flavocetraria* spp.), willow (*Salix* spp.), and blueberry (*Vaccinium uliginosum*). In 2013, the relationship of metal concentrations in vegetation and soils to distance from the PDA was explored for seven metals/metalloids of interest: aluminum, arsenic, cadmium, copper, lead, selenium, and zinc (EDI Environmental Dynamics Inc. 2014). Results were compared to identified Project thresholds and indicated that baseline metal concentrations in soil were well below thresholds, and metal concentrations in vegetation tissues (excluding blueberry due to insufficient sample size) were mostly below thresholds with few baseline metal levels naturally exceeding thresholds. For detailed monitoring results refer to the 2013 Annual Terrestrial Monitoring Report (EDI Environmental Dynamics Inc. 2014).

In 2014, additional sample sites were selected at distances of 5–15 km from the PDA to increase the sample size of blueberry and improve overall sampling coverage. Based on the results of the 2014 vegetation and soil base metals monitoring program, as outlined in the 2014 Annual Terrestrial Monitoring Report (EDI Environmental Dynamics Inc. 2015), blueberry was removed from the monitoring program due to limited availability on the landscape and willow was removed due to issues regarding metal tolerance. Aluminum was also removed as a metal of interest due to its ubiquitous nature, its lack of Canadian Council of Ministers of the Environment (CCME) and/or US Environment Protection Agency (US EPA) soil quality guidelines for the protection of environmental and human health, and because there is no pathway for introduction of aluminium from Project activities.

In 2015, the NIRB 2014–2015 Annual Monitoring Report for the Mary River Project (Nunavut Impact Review Board 2015) included recommendations from the NIRB and GN to improve the vegetation and soil based metals monitoring program. Specifically, the recommended changes were to increase the sample size and extent of sampling to improve coverage of the PDA to adequately detect changes in metal concentrations in lichen and soil over time. To address these recommendations, a power analysis was conducted to determine the number of soil and lichen samples required to detect a change in metal concentrations between the 'before' period (i.e., baseline sampling) and the 'after' period (i.e., post-construction sampling) for all metals before threshold levels are exceeded. The study design was improved to align with the dust fall monitoring program where reasonable to include new sample sites at varying distances from the PDA to compare metal concentrations in soil and lichen between near, far, and control sites. Based on the results of the power analysis, as outlined in the 2015 Annual Terrestrial Monitoring Report (EDI Environmental Dynamics Inc. 2016), the revised study design was implemented in 2016 and considers sample size and appropriate spatial distribution of future samples.

All data were combined from 2012–2016 to characterize metal concentrations in soil and lichen with distance to PDA and to assess the potential relationship between metal concentrations in soil and lichen (EDI Environmental Dynamics Inc. 2017). The 2016 analysis determined that all soil and lichen samples were below thresholds with the exception of two sites, L-71 and L-91. At site L-71 differences were found in lichen metal concentrations between sampling areas which indicated higher concentrations of lead within 100 m of Tote Road. At site L-91 differences were also found in soil metal concentrations between sampling areas which indicated higher concentrations of copper within 100 m of Milne Port. Although these differences were non–biological, sites L-71 and L-91 were resampled in 2017 to investigate if a field sampling error had occurred. At both sites, collections were made for soil and lichen including a duplicate sample of each. A duplicate sample consists of two samples taken from the same location using the same sampling procedures. Duplicate samples are analyzed separately and are used to evaluate the precision of field sampling procedures. The results of the 2017 analysis determined that metal concentrations in soil and lichen samples at sites L-71 and L-91 were below CCME and other relevant thresholds in the literature. The results of the re-sampling suggested that the original exceedance was due to either a field sampling or lab analysis error.

3.2.1 METHODS

The improved study design for the vegetation and soil base metals monitoring program considers three Project areas (Milne Port, Tote Road, Mine Site) at varying distances from the PDA (0–100 m; 101–1,000 m; >1,000 m). Control site locations are those that are greater than 1,000 m from the PDA. Distance classes were selected based on data from the dust fall monitoring program that indicate differences in dust fall within 100 m from the PDA and between 100–1,000 m from the PDA (EDI Environmental Dynamics Inc. 2015). Beyond 1,000 m, dust fall levels were generally below laboratory detection limits. Soil and lichen samples were collected late-July to early-August following the same procedures as previous vegetation and soil base metals monitoring:

- A new pair of nitrile gloves were worn at each sample site.
- Stainless steel tablespoons used for soil sampling were cleaned with alcohol wipes before and after each sample.
- A minimum of 10 grams of each vegetation sample was collected at each site.
- A minimum of 100 grams of soil from the top A horizon was collected at each site to a depth of ~10 cm and above permafrost. This reflects the top layer of the rooting zone where the potential for metal uptake in plants is expected to be the greatest.
- Samples were placed in new, clean zip-loc bags, frozen and sent to an accredited laboratory for metals analyses.

A subset of total metals were chosen for the Project based on the following considerations:

- Baseline metal concentrations in soils and vegetation (i.e., several metals were not detectable in soil and vegetation samples; therefore, they were not selected as metals of interest);
- Metals present in the Mary River ore — relevant metals include iron (64%), phosphorus, manganese, aluminum (as aluminum oxide), and trace metals (Appendix 3D, Baffinland Iron Mines Corporation 2012);
- Potential metals in road cover/road-generated dust; and
- The level of risk associated with each element.

Several sources were consulted including:

- o Canadian Environmental Quality Guidelines (provided by the Canadian Council of Ministers of the Environment [CCME]) including soil quality guidelines for both agricultural and industrial settings;
- o Relevant studies on the presence, effects, and other aspects of metals in arctic and northern terrestrial biota (e.g. Canadian Arctic Contaminants Assessment Report 2003, Gamberg 2008); and
- o Literature on vegetation and lichen–specific toxicity.

Based on this review, six metals were selected including arsenic, cadmium, copper, lead, selenium, and zinc. For each of the metals, toxicity thresholds were identified for soil and lichen (Table 7). For more information on the selection of metals and the determination of Project thresholds, see Appendix B. 4-2 of the TEMMP (Baffinland Iron Mines Corporation 2017).

Table 7 Project thresholds identified for pH and metals in soil and vegetation — vegetation and soil base metals monitoring program.

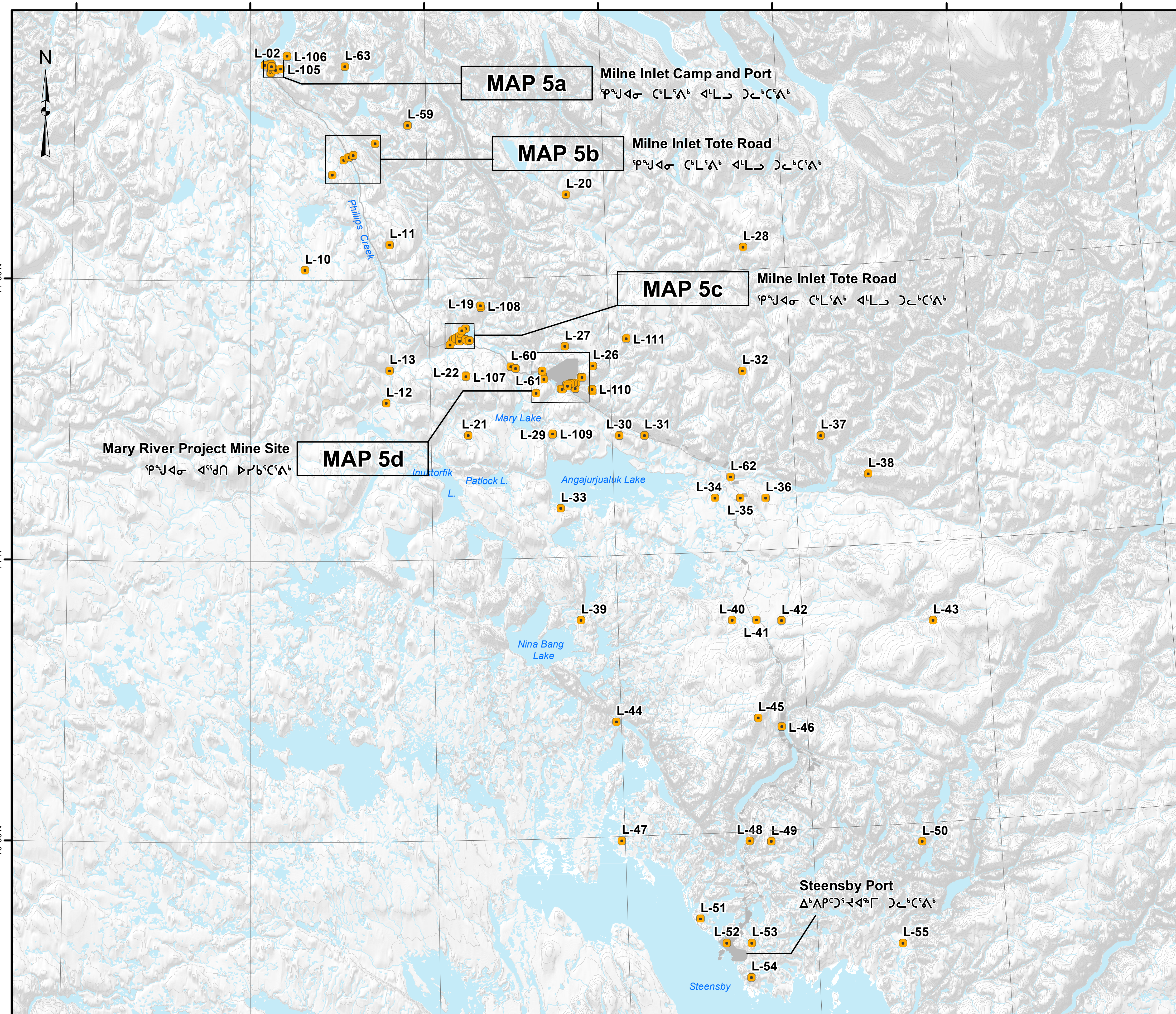
pH and Metal	Thresholds	
	Soils[1] (mg/kg)	Lichens[2] (mg/kg dry weight)
pH	6–8	–
Arsenic	12	–
Cadmium	1.4	30
Copper	63	15
Lead	70	5
Selenium	1	–
Zinc	200	178

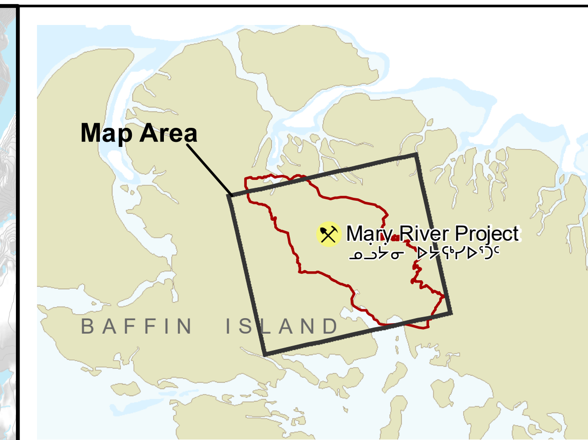
1 Thresholds based on CCME Agricultural Soil Quality Guidelines for the Protection of Environmental and Human Health

2 Thresholds based on various sources including: (Nash 1975, Tomassini et al. 1976, Nieboer et al. 1978, Folkeson and Andersson-Bringmark 1988)

From 2012 to 2016, 117 sites were visited (Map 5 and Map 6). A table of all sites, locations, distance from PDA, vegetation species collected, and associated dust fall collector is provided in APPENDIX B – Vegetation and Soil Base Metals Monitoring Locations.

Although no new sites were added to the vegetation and soil base metals monitoring program in 2017, two sites were resampled where metal concentrations in soil and lichen were reported above the threshold during 2016 sampling. Site L-71 was resampled for lead in lichen within 100 m of Tote Road and Site L-91 was resampled for copper in soil within 100 m of Milne Port.





LEGEND

- Vegetation and Soil Base Metal Sampling Site
- Topographic Contour
- Potential Development Area

NOTES

Map Projection: North American Datum UTM Zone 17N.

Updated PDA provided by Hatch (25 April 2013).

This document is not an official land survey and the spatial data presented is subject to change without notice.

Scale 0 4 8 16 24 32 40 Km

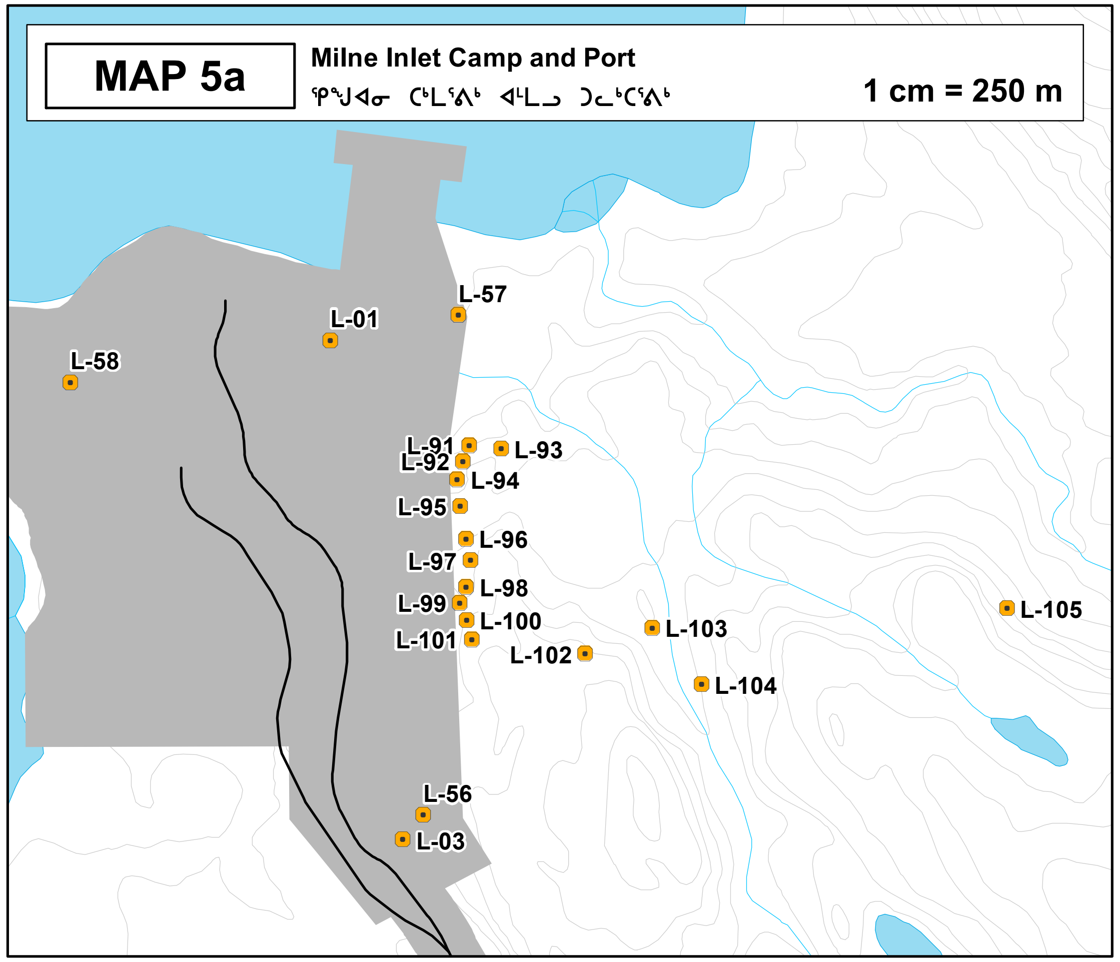
Baffinland Iron Mines Corporation

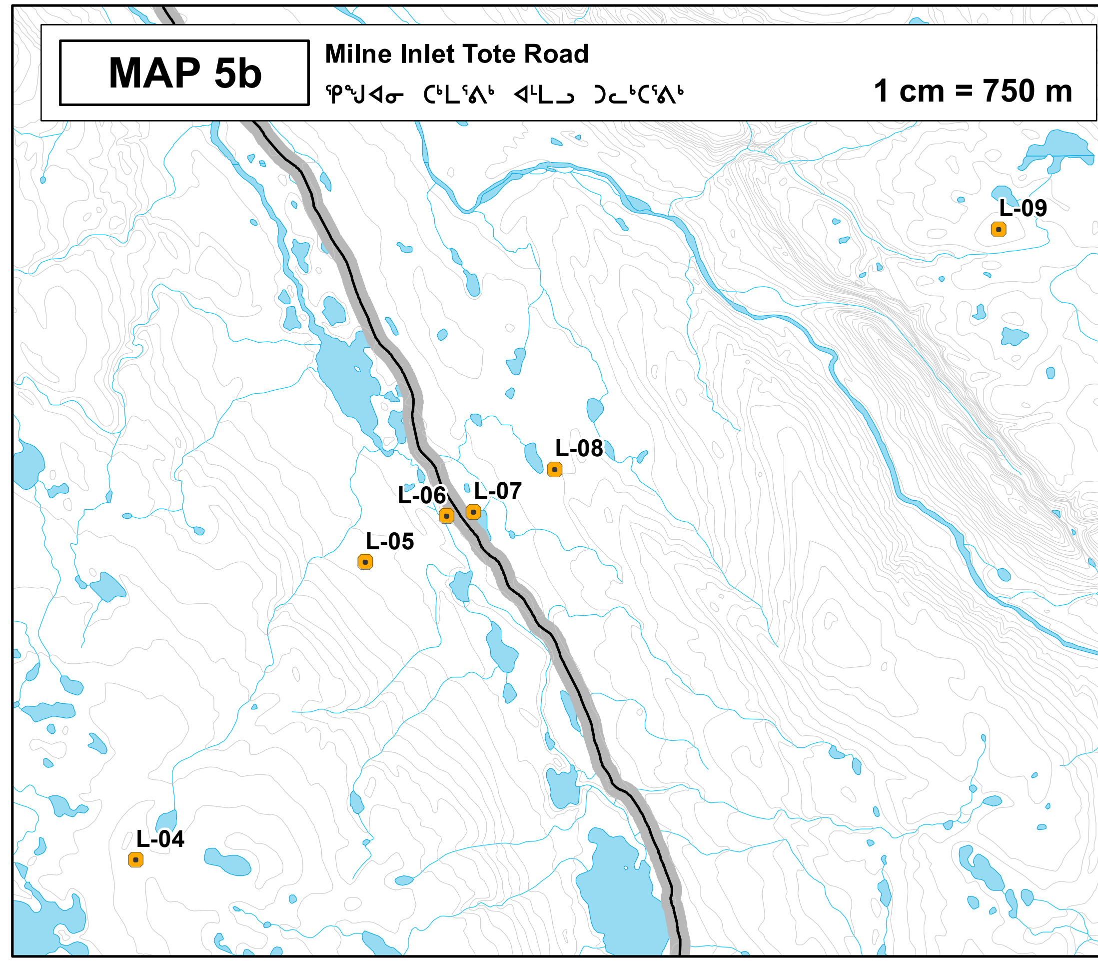
Overview Map of Vegetation and Soil Base Metals Monitoring Sites within the RSA, 2012 – 2017

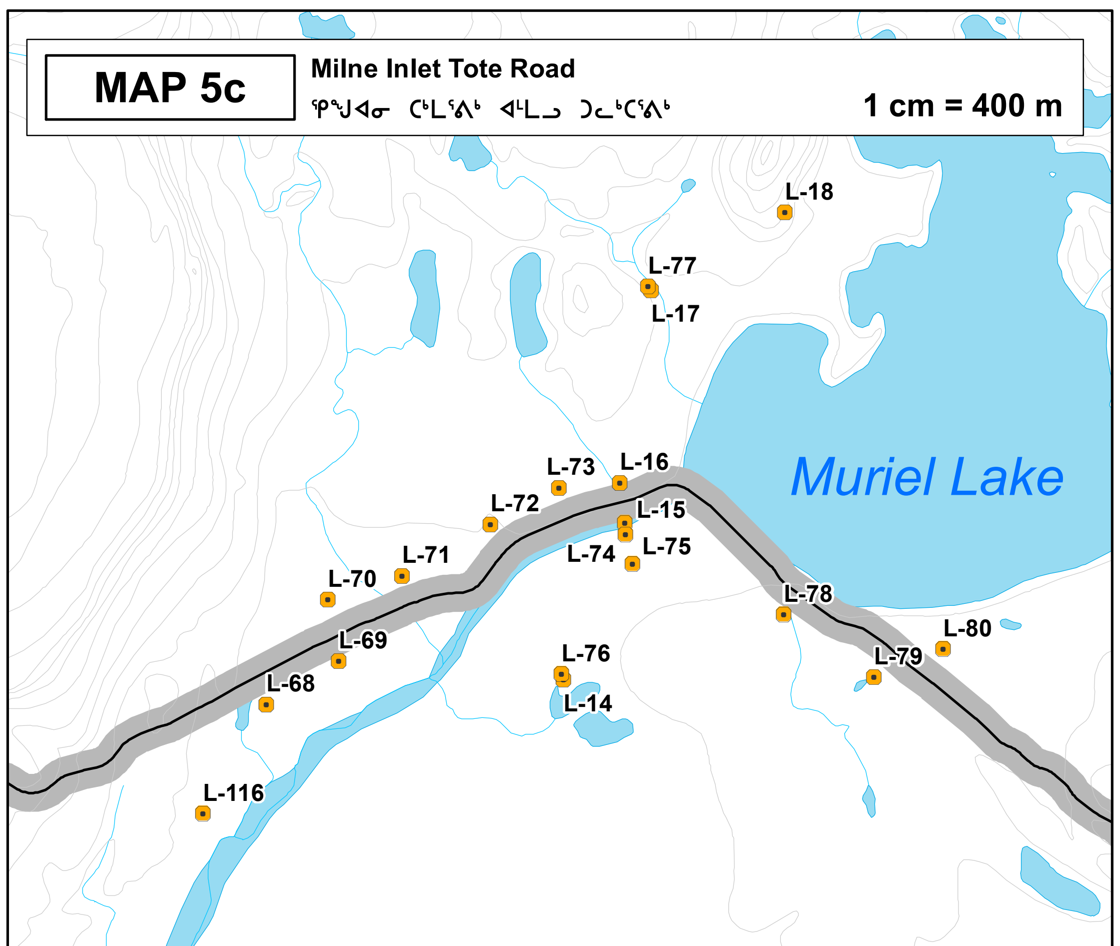
EDI

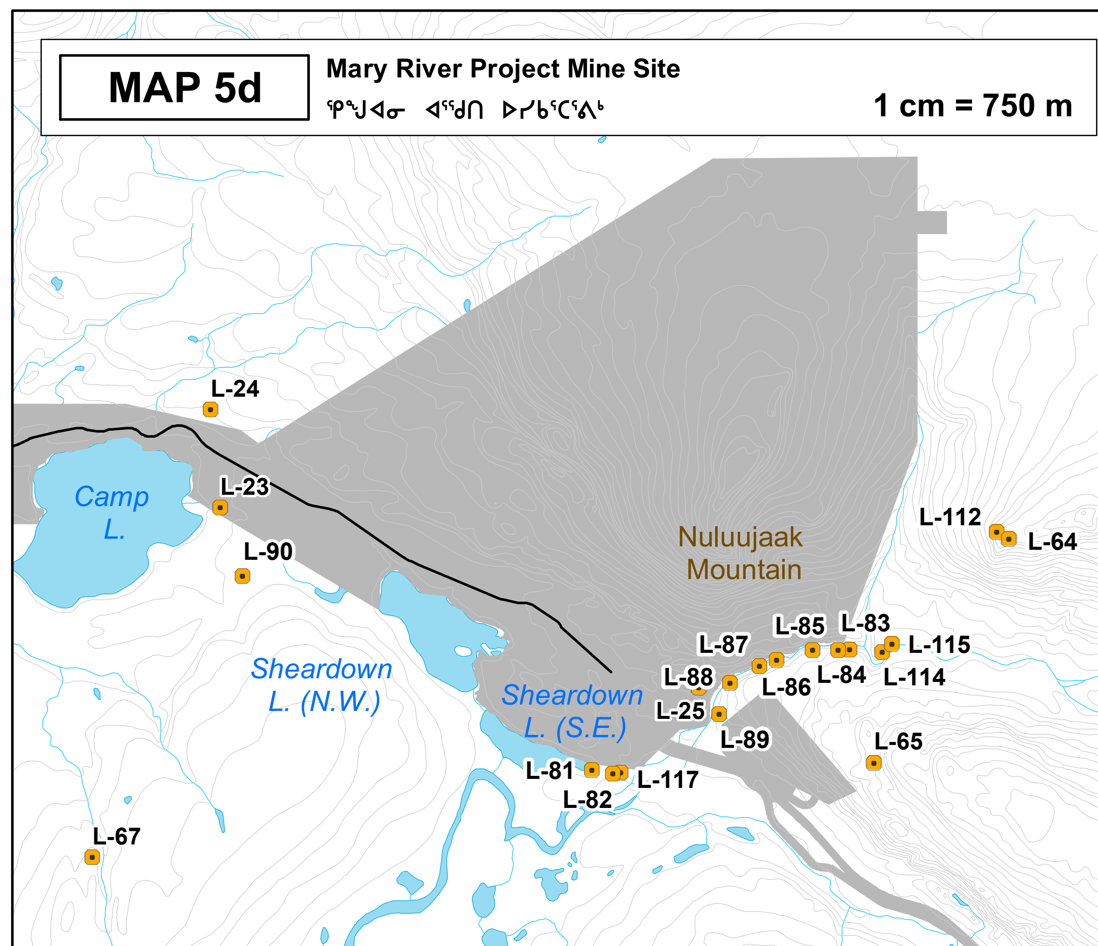
Date: 3/9/2018

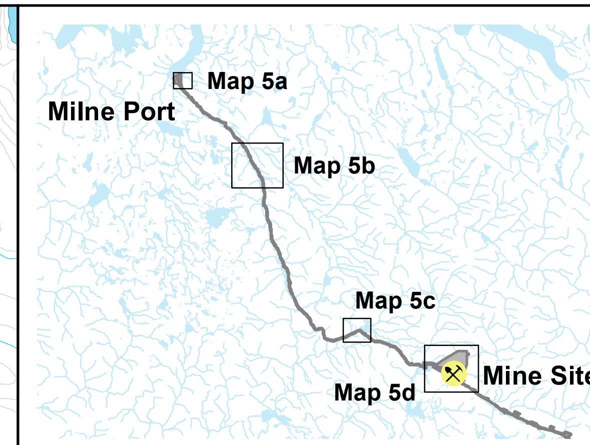
MAP 5











LEGEND

- Vegetation and Soil Base Metal Sampling Site
- Milne Tote Road
- Topographic Contour
- Potential Development Area

NOTES

Map Projection: North American Datum UTM Zone 17N.

Updated PDA provided by Hatch (25 April 2013).

This document is not an official land survey and the spatial data presented is subject to change without notice.

Baffinland Iron Mines Corporation

Detailed Map of Vegetation and Soil Base Metals Monitoring Sites within the RSA, 2012 – 2017

EDI

Date: 3/9/2018

MAP 6

3.2.2 RESULTS AND DISCUSSION

The laboratory results from 2017 sampling determined that metal concentrations in soil and lichen samples at sites L-71 and L-91 were below CCME and relevant thresholds provided in the literature (Table 8). This confirms that baseline metal concentrations across all 2012 to 2016 vegetation and soil base metals monitoring sites are below Project thresholds. For a complete list of laboratory results for the vegetation and soil base metals monitoring program refer to APPENDIX C – Vegetation and Soil Base Metals Monitoring Laboratory Results.

Table 8 2016 sample sites re–sampled in 2017 due to suspect metal concentrations – vegetation and soil base metals monitoring program.

Year	L-91 (Soil mg/kg)	L-71 (Lichen mg/kg dry weight)
	Cu	**Pb**
2016	116	6.04
2017	27.2	3.23
Threshold	**63**	**5**

3.3 RARE PLANT OBSERVATIONS

Although surveys for rare plants are not required as part of the NIRB Project Certificate No. 005, incidental observations of a territorial "May Be At Risk" plant species for Nunavut were recorded 2014–2017 during other vegetation surveys. This finding represents a large range extension for North Baffin Island and significant contribution to the overall knowledge of the species (Brouillet, pers. comm., 2014).

Horned Dandelion (*Taraxacum ceratophorum*) is a native dandelion species and is listed as "May Be At Risk" for Nunavut (Photo 6; CESCC 2011). It was first found in 2014 at two locations close to the Mine Site consisting of two populations and 31 individuals. In 2016, additional Horned Dandelion populations were observed along Tote Road from KM 84.6 to 85.2. Five sub-populations were found growing along and up to 50 m from the road totalling approximately 750–800 plants. The habitat was open and dominated by sand. All plants were in flower and appeared healthy. In 2017, field crews observed road construction work along the Tote Road where a large proportion of Horned Dandelion was found growing in 2016. Approved construction activities from equipment between KM 84.6 and 85.2 have removed approximately 620 Horned Dandelions. Habitats on the east side of the Tote Road appear unaffected by road construction work. In total, there are approximately 205 known Horned Dandelion plants that remain in the Project area.

Table 9 provides location details and population update for Horned Dandelion occurrences in the Project area.

Photo 6 Horned Dandelion.
A "May Be At Risk" plant species in Nunavut was found during other vegetation surveys, 2014–2017.

Table 9 Locations and population update of Horned Dandelion, a "May Be At Risk" species found incidentally during vegetation surveys in the Project area.

Year	Name	Location Description	Habitat	Latitude	Longitude	Abundance and Distribution	Present in 2017?
2014	TARACER1_2014	Edge of PDA near KM 93.5, along Tote Road, sea can storage area	Sandy, exposed slope and small drainage leading down to delta	71.32708	-79.45897	25 scattered flowering plants in close vicinity	Yes
2014	TARACER2_2014	Near KM 98, along Tote Road	Sandy, exposed soil bank	71.33159	-82.59750	6 scattered flowering plants in close vicinity	Yes
2016	TARACER1_2016	South edge of PDA near KM 84.6, along Tote Road	Sandy, exposed soil near stream	71.37605	-79.70719	13 flowering plants in close vicinity	Yes
2016	TARACER2_2016	North edge of PDA near KM 84.6, along Tote road	Sandy, exposed soil near stream	71.37662	-79.70661	65 flowering and vegetative plants scattered along slope of tributary	Yes
2016	TARACER3_2016	North edge of PDA and on plateau above slope near KM 84.7, along Tote Road	Sandy, exposed plateau	71.37643	-79.70499	96 flowering and vegetative plants scattered on sandy plateau	Yes
2016	TARACER4_2016	South edge of PDA near KM 84.7, along Tote Road	Sandy, exposed slope	71.3761	-79.70442	150 flowering and vegetative plants scattered along edge of Tote Road	No
2016	TARACER5_2016	South edge of PDA from approximately KM 85.1 to 85.2, along Tote Road	Sandy, exposed slope above lake	71.37571	-79.69231	420 flowering and vegetative plants scattered along edge of Tote Road	No
						205 plants in Project area 2017	

3.4 SUMMARY AND TRENDS

- The vegetation monitoring program design was finalized in 2016 and provided a statistically robust program that will be able to detect Project-related changes in abundance and metals uptake should that effect occur.
- All vegetation abundance plots have been measured consistently for two years, and some for three years.
- To date, while annual changes in vegetation abundance in the Project area have been observed, there is no suggestion of changes in vegetation abundance as a result of a Project-related effect.
- Metal concentrations across all 2012 to 2016 vegetation and soil base metals monitoring sites are below Project thresholds. There is no suggestion of any Project-related effect of metals uptake in plants.
- Some previously reported rare plants have been found in the study area, and it is likely that more will be found as vegetation surveys continue in the Project area. Known populations will continue to be monitored in the Project area and newly discovered populations will be documented as they are found on an opportunistic basis. There is no evidence to suggest that the Mary River Project is affecting the occurrence of rare plants.

4 MAMMALS

The 2017 monitoring for mammals included a number of surveys designed to enhance baseline data and monitor the effects of construction activities on caribou. Specific surveys included:

- Snow track surveys;
- Snow bank height monitoring;
- Height of land caribou surveys; and
- Incidental observations and wildlife log.

The 2017 surveys were conducted in partnership with the Mittimatalik Hunters and Trappers Organization (MHTO) to incorporate Inuit Qaujimajatuqangit (IQ) into the surveys. MHTO member Elijah Panipakoocho participated in all survey programs and provided valuable input on survey methods, primarily for the height of land caribou survey program.

4.1 SNOW TRACK SURVEY

During the review of both the original Project application and the Early Revenue Phase proposal, the QIA and other reviewers expressed concerns that the Project activities would have a negative effect on caribou movement patterns. Specific concerns included human infrastructure as well as human presence deterring, constraining, or altering the natural movement of wildlife with particular concern for caribou. As a result of concerns that caribou would potentially avoid crossing due to train or vehicle presence and the potential for constraining wildlife movement across roadways, Project conditions were issued to address this concern including:

- Project condition #54dii) *"The Proponent shall provide an updated Terrestrial Environmental Management and Monitoring Plan which shall include…Snow track surveys during construction and the use of video–surveillance to improve the predictability of caribou exposure to the railway and Tote Road. Using the result of this information, an early warning system for caribou on the railway and Tote Road shall be developed for operation."*
- Project condition #58f) *"Within its annual report to the NIRB, the Proponent shall incorporate a review section which includes….Any updates to information regarding caribou migration trails. Maps of caribou migration trails, primarily obtained through any new collar and snow tracking data, shall be updated (at least annually) in consultation with the Qikiqtani Inuit Association and affected communities, and shall be circulated as new information becomes available."*

Snow track surveys were conducted in April 2017 to study the movement of caribou and other wildlife in relation to the road and document behavioural reactions to human activities near the Project footprint. Snow bank height monitoring was also conducted within the same week to assess the effectiveness of mitigation for movement by keeping snow bank height less than 1 m high.

4.1.1 METHODS

The snow track survey took place over the course of three days, from April 22 – 24, 2017. The purpose of the snow track survey was to collect data on caribou response to Project activities based on patterns of movement observed by their tracks. The 2017 survey was conducted differently than in previous years due to large numbers of high snow banks (>1 m) observed in the snow bank monitoring survey conducted on April 21, which made it difficult or impossible to see potential tracks beyond the banks from the truck. Instead of driving slowly along the Tote Road and looking for tracks from the vehicle, the survey team stopped at every kilometre marker and got out of the truck to look for tracks behind the snowbanks. In areas where snow bank heights were <1 m, surveyors still got out of the truck to look for tracks to maintain consistent methods at all survey points. Some additional stops were made between kilometre markers if tracks were observed, or if snow banks appeared to be >2 m in height. When wildlife tracks were observed, surveyors would confirm the species and then follow the tracks towards and away from the road to observe behaviour, habitat use and possible divergence of travel paths. When tracks were near or crossed the Tote Road, surveyors would record the following information:

- Latitude and longitude at the point where the tracks crossed the road;
- Species the tracks were from;
- Number of sets of tracks counted (i.e. group size);
- A designation describing travel in relation to the road (e.g., deflected, travelled along, or crossing the Tote Road); and
- Height of the snow bank measured at either the crossing point, or likely point of deflection.
- Often photos as well as any additional relevant information were recorded.

Surveyors began snow track surveys from Milne Inlet, and surveyed from KM 1–43 on April 22, KM 44–90 on April 23, and KM 91–100 on April 24. The surveys were completed two weeks after a blizzard which closed the Tote Road for three days. There is currently no reliable system for measuring winter precipitation at Mary River, so the information gathered on snow conditions prior to the survey is highly reliant on observations from on-site staff.

4.1.2 RESULTS AND DISCUSSION

Survey conditions were not ideal for snow tracking, as the last snow fall before the survey occurred approximately two weeks prior. Additionally, wind speeds recorded at Mary River and Milne Inlet during April were considered typical for the area and ranged between 0 to 21.89 m/s and 0 to 15.49 m/s, respectively, which likely re-distributed the snow shortly after the snow fall event. Snow cover observed during the survey was fairly consistent throughout the Tote Road, and many sections exhibited windswept hard pack snow, which made it difficult to determine whether tracks were old or fresh. Throughout the Tote Road, boulders and exposed ridges were visible, which were typical conditions experienced in the area. Weather was sunny and visibility was excellent (>1 km) on all three days of the survey, with air temperatures between -16°C and -19°C. Winds were light from the NE for most of the survey, except between km 14–26 of the Tote Road, where the survey crew experienced high winds, snow drifts and limited visibility.

Surveyors observed over 100 sets of Arctic fox tracks adjacent to the Tote Road, 23 of which were observed to be crossing. Of the 23 observed crossings, at least 6 sets of tracks were considered to be fresh. Surveyors observed one Arctic hare near the burn pit around km 98; however, the hare did not cross. Thirty-two additional sets of Arctic hare tracks were seen along the road, nine of which were observed to be crossing. Of the nine observed crossings, at least seven sets of tracks were considered to be fresh. In addition, three sets of fresh ptarmigan tracks were also observed. No signs of caribou or other mammal tracks were observed.

Some of the areas observed contained multiple track sets which likely represent one or a few individuals moving back and forth on the same trail; however, the majority of the tracks observed were considered to be from individual animals. The windswept snow conditions and lack of fresh snow prior to the survey limited the surveyor's ability to determine whether tracks were old or fresh, and also to determine the path/intention of older tracks. Many of the old tracks observed were parallel to the road and did not appear to cross; however, it is possible that some of these animals did in fact cross the road. Tracks often followed either side of the road before and after crossing; however, there were also many instances where tracks appeared to cross directly. No caribou tracks or sign were observed. Typical site conditions and examples of observed tracks are displayed in Photo 7 – Photo 10.

Snow track surveys will continue on an annual basis and will occur more often by on-site staff once caribou are observed near site on a consistent and regular basis (e.g. based on trends observed from the Height of Land monitoring data, or incidental monitoring data), or on observations of local harvesters and as reported to Baffinland or the Terrestrial Environment Working Group (TEWG).

Photo 7 Fresh Arctic hare tracks observed crossing the Tote Road with no deflection at km 2, April 22, 2017.

Photo 8 Old and new Arctic fox tracks observed running parallel to the Tote Rd near km 46, April 23, 2017.

Photo 9 Example of snow bank heights >1 m at km 79, April 23, 2017.

Photo 10 Arctic hare observed near the burn pit at km 98.5, April 24, 2017.

4.2 SNOW BANK HEIGHT MONITORING

During review of the project, QIA and NIRB expressed concerns that Project activities could have a negative effect on caribou movement patterns. Specific concerns included caribou avoiding crossing due to vehicle presence and snow bank heights and the potential for constraining wildlife movement across roadways. In conjunction with the snow track survey (Section 4.1), and the concerns expressed by the QIA and other reviewers during the assessment of the original Project application to NIRB and the Early Revenue Phase proposal, the following Project conditions were issued to address these concerns including:

- Project condition #53ai) *"Specific measures intended to address the reduced effectiveness of visual protocols for the Milne Inlet Tote Road and access roads/trails during times of darkness and low visibility must be included."*
- Project condition #53c) *"The Proponent shall demonstrate consideration for…Evaluation of the effectiveness of proposed caribou crossing over the railway, Milne Inlet Tote Road and access roads as well as the appropriate number."*

To address these concerns, Baffinland committed to various mitigation measures allowing for effective caribou crossings of the Tote Road. Mitigation measures were developed to reduce the likelihood of a barrier effect on caribou movement which involves snow bank management and maintaining the snow bank heights at less than 1 m along the railway and roadways as well as smoothing the snow banks on the edges of roadways to reduce the probability of drifting snow. These mitigations allow for wildlife, specifically caribou, to cross the transportation corridor without being blocked by steep snow banks, as well as allowing greater visibility for drivers to help reduce wildlife-vehicle collisions.

4.2.1 METHODS

Snow bank height monitoring was developed to be completed in conjunction with snow track surveys, in compliance with the QIA request to increase monitoring requirements. In 2017, snow bank height monitoring was conducted on April 21, 2017, and was completed systematically by surveyors driving the Tote Road and stopping at the same kilometre markers as previous survey years. At the set locations, surveyors would measure the height of the east and west snow banks. Snow bank measurements were collected from the solid road surface to the top of the snow bank using folding plastic rulers and were measured in centimetres. Surveyors would record the kilometre post marker number, photo number, bank height measurement (centimeters) for the east and west banks as well as any relevant comments. Snow depth measurements were collected at 45 kilometre post markers along the Tote Road, resulting in 90 measurements (Photo 11 and Photo 12).

4.2.2 RESULTS AND DISCUSSION

Snow bank measurements were as low as 5 cm in height and were found to exceed the maximum snow depth of 100 cm on 31 separate occasions (33% of observations), with a maximum height of 200 cm (Figure 30). Four of the measurements were slightly over the 100 cm threshold, seven locations had exceedances on both the east and west sides of the road, and five locations were double the 100 cm threshold. The majority of the sites measured complied with the snow bank height recommendations (Photo 13); however, several were double the maximum height (Photo 14). According to on-site staff, the last snow fall before the survey was a blizzard which closed the Tote Road for three days; which occurred approximately two weeks prior to the survey. During surveys, it was apparent that snow bank height management was in progress, as the survey crew observed a dozer on multiple days pushing back the snow banks in various locations.

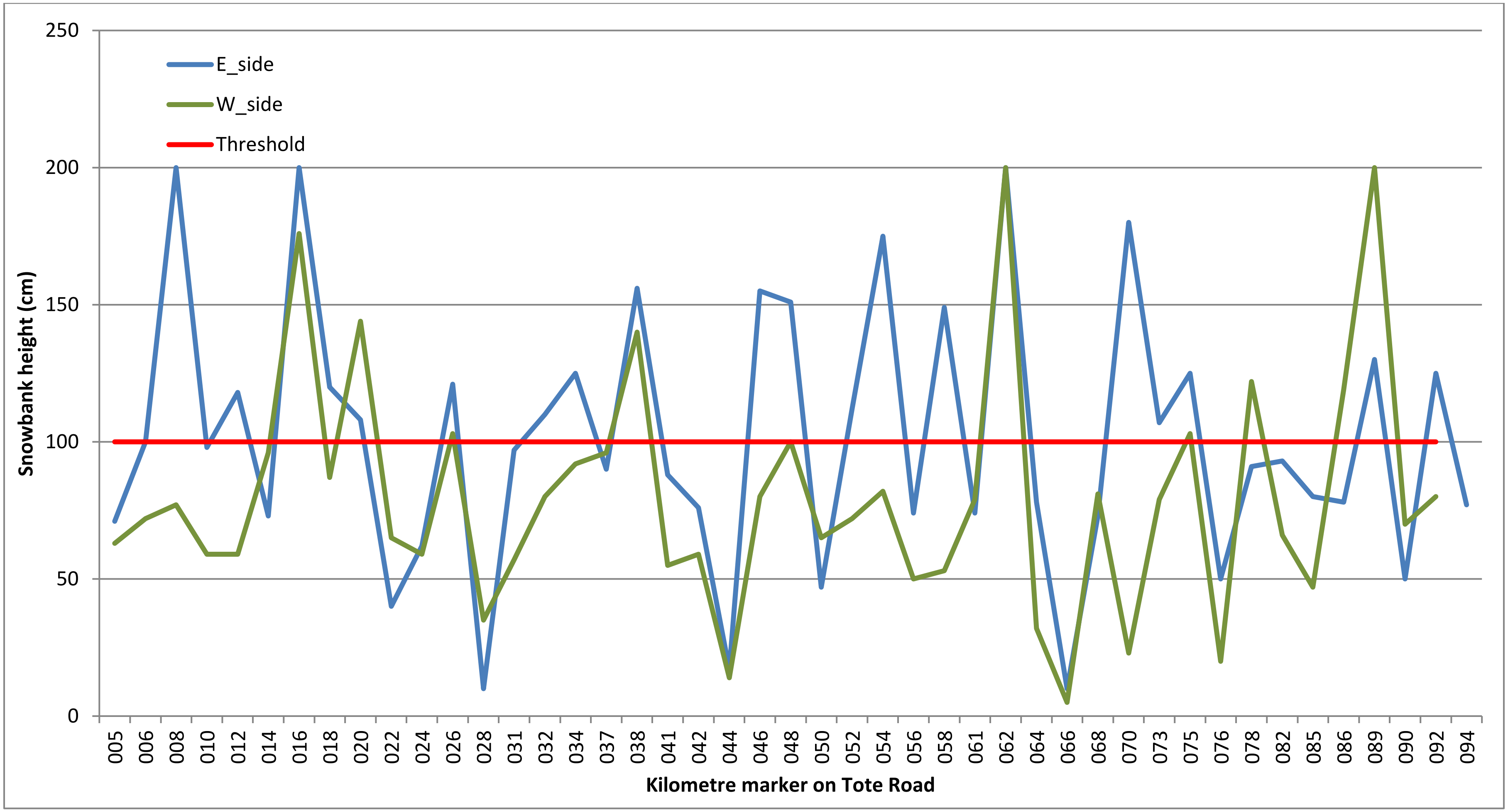


Figure 30 Snow bank heights measured from road surface to top of snow bank at kilometre posts along the Tote Road, April 21, 2017.

Photo 11 Snow bank heights measured from the road surface up to the top of the bank on both the east and west banks at set locations (km 61), April 21, 2017.

Photo 12 Snow bank heights measured from the road surface up to the top of the bank on both the east and west banks at set locations (km 73), April 21, 2017.

Photo 13 Example of snow bank management on east and west sides of Tote Rd to ensure they do not exceed the maximum snow depth at km 28, April 21, 2017.

Photo 14 Example of snow bank conditions >2 m at km 16 on the Tote Road, April 21, 2017.

4.3 HEIGHT–OF–LAND SURVEYS

Project conditions 54b requires "*Monitoring for caribou presence and behavior during railway and Tote Road construction" while Project condition 58b requires "A detailed analysis of wildlife responses to operations with emphasis on calving and post–calving caribou behaviour and displacements (if any), and caribou responses to and crossing of the railway, the Milne Inlet Tote Road and associated access roads/trails*." Similarly, #53b requires "*monitoring and mitigation measures at points where the railway, roads, trails, and flight paths pass through caribou calving areas, particularly during caribou calving times*."

To address the Project conditions, height-of-land (HOL) surveys were initiated in 2013 to study caribou use and their behavioural reactions to human activities near the Project footprint, especially during the calving season. The focus of the HOL surveys is to examine how or if caribou, especially cows with calves, respond to Project activities and infrastructure. HOL surveys allow for long-term monitoring and observation of caribou behaviour throughout the life of the Project, providing information to verify and monitor predicted Project effects on caribou movement and habitat use. Among other things, behaviour sampling can provide insight into responses to environmental stimuli (Martin and Bateson 1993).

4.3.1 METHODS

The HOL surveys use a basic survey technique that involves observing an area from a high point of land (to increase the amount of observable area) for a prescribed amount of time, using binoculars and/or a spotting scope to detect and record caribou and their proximity to Project infrastructure. The 2017 HOL surveys were conducted in April and June in an effort to observe caribou during the late winter and calving periods. Two to four observers were present during all HOL surveys in 2017. The surveys followed the 2013 HOL survey design as closely as possible; however, due to resource constraints on site, sometimes a helicopter was used to access sites normally accessed by foot. Additionally, due to early melt in 2017, some of the sites were not accessible via hiking due to open water preventing access to the stations. Stations visited in April were accessed via snow machine and hiking from the Tote Road. Surveys included two to four observers traveling within the Project footprint, stopping at predetermined HOL stations along the way and scanning the landscape for approximately 20 minutes.

Twenty three of twenty-four HOL stations were visited at least once in 2017. The HOL stations were established at the highest point possible, although a 360 degree view was rarely achievable. Project components (e.g. the road, camp, or deposit) were visible from each station. Stations were chosen based on their location along the road, gain in height (e.g. improved view), and accessibility in spring conditions. A few of the sites would be inaccessible if not for helicopter support due to waterbodies and long travel time by foot.

At each station, the following information was recorded:

- Station number;
- Location description (direction from road, aspect, terrain, other identifying features);
- General habitat description (vegetation, soil);
- Photograph numbers (taken in multiple directions);
- Observation start and end time;
- Snow cover on landscape.

Observations were made with one spotting scope and 1 to 3 sets of binoculars (Photo 15 to Photo 18). Generally, observations were made continuously for 20–52 minutes by scanning the viewable landscape. If caribou were observed, the crew would begin monitoring behaviour following protocols established and described in the 2013 Annual Terrestrial Monitoring Report (EDI Environmental Dynamics Inc. 2014). Observations would be made as either a focal or scan sample (depending on the number of caribou; (Martin and Bateson 1993) and observations would be recorded on field data sheets. For scan sampling, activity categories (i.e., walking, foraging, running, lying, etc.) would be assigned and tallied every two minutes. For the focal sample, activity observations would be recorded every two minutes; however, certain events (e.g. a truck passing by) would also be recorded to document any unique response. The individual's or group's distance to Project infrastructure and directional movement would also be recorded when possible. Distance from the observers would either be estimated by sight or by using a GPS.

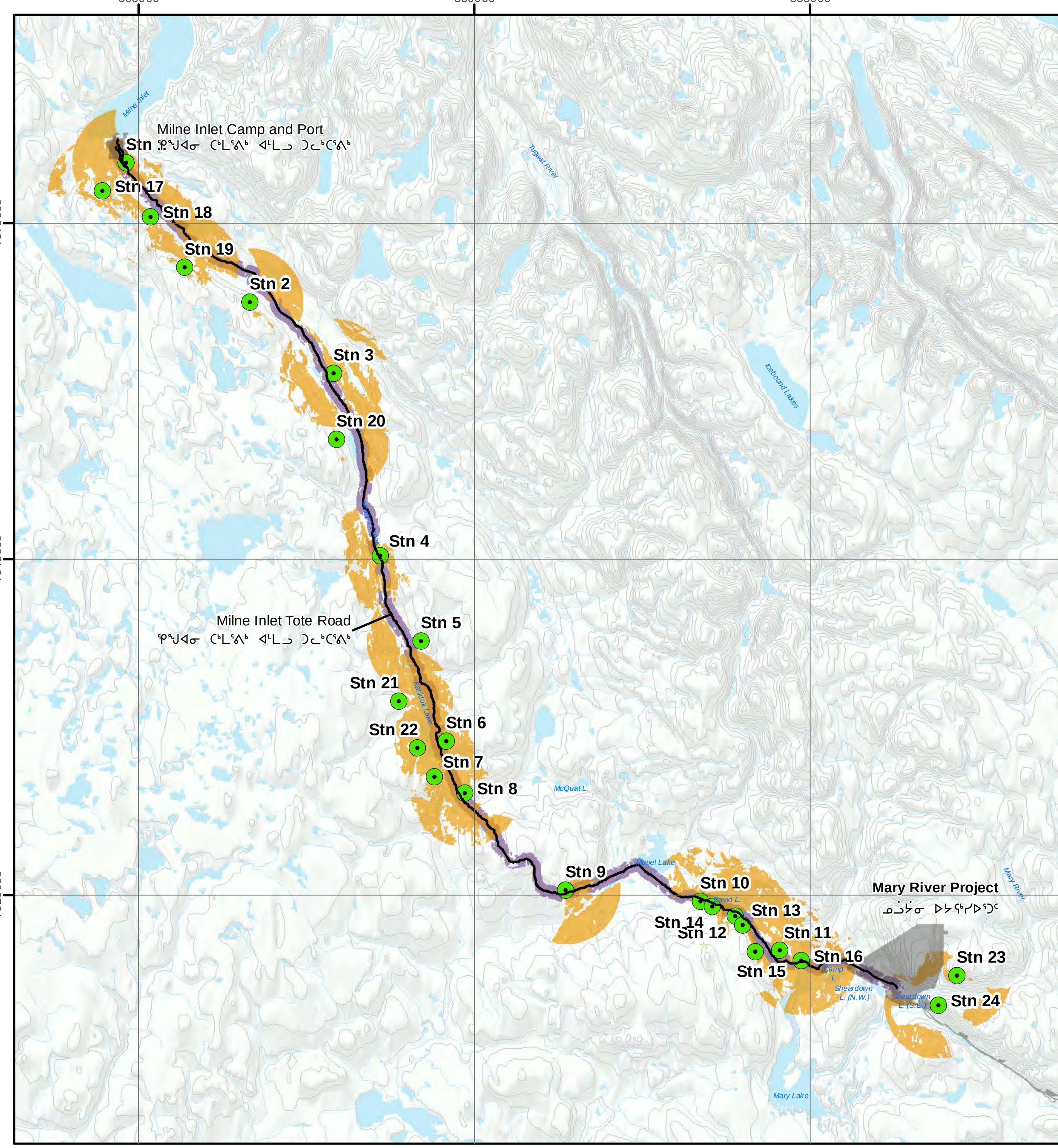
In 2016, viewshed mapping was completed to demonstrate how far and to what extent surveyors could actively observe while conducting HOL surveys (EDI Environmental Dynamics Inc. 2017). The viewshed was modeled to determine the amount of viewable area while conducting HOL surveys. A total of 227 km^2 were surveyed within the viewshed area, survey coverage ranging from 5 km^2 to 22 km^2 from each HOL station (Map 7). For more details on the viewshed mapping methodology, see section 4.3.1 in the 2016 Terrestrial Environment Annual Monitoring Report (EDI Environmental Dynamics Inc. 2017).

Photo 15 Height of land surveys conducted in April were accessed by snowmobile or hiking from the Tote Road, surveys were completed using binoculars and a spotting scope, April 20, 2017.

Photo 16 Height of land surveys conducted in April were accessed by snowmobile or hiking from the Tote Road, surveys were completed using binoculars and a spotting scope, April 24, 2017.

Photo 17 Height of land surveys conducted in June during peak calving were accessed by helicopter or hiking from the Tote Road, June 11, 2017.

Photo 18 Height of land surveys conducted in June during peak calving were accessed by helicopter or hiking from the Tote Road, June 14, 2017.



LEGEND ᑐᑭᓕᐅᕐᑦ

Milne Tote Road

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Caribou Height of Land Station

Viewshed from Tote Road (500 m distance)

Viewshed from Height of Land Sites (4 km radius)

Caribou Height of Land Viewshed Mapping

NOTES ᖃᐅᔨᒪᔭᒃᓴᐃᑦ

Viewsheds created by EDI Environmental Dynamics Inc. (2016).

Updated PDA provided by Hatch (25 April 2013).

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Map Projection: NAD 1983 UTM Zone 17N

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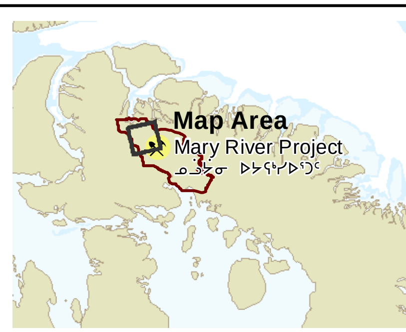
MP	MAS/DH	10/20/2017	**MAP 7**



Baffinland EDI

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4.3.2 RESULTS AND DISCUSSION

There were no caribou observed during HOL surveys completed in April and June, 2017. A total of 19 hours and 28 minutes of HOL surveys were conducted, with the majority of the surveys completed in June during peak calving (13 hours and 9 minutes) while 6 hours and 19 minutes were conducted in April (Table 10). Twenty-three out of the twenty-four HOL stations were visited at least once and 13 stations were visited twice between the April and June site visits. Station 23 was not surveyed in 2017 due to wind loaded snow conditions near the station, which was deemed unsafe for landing and exiting the helicopter.

Weather conditions during the HOL surveys were variable, ranging from excellent, clear viewing conditions to overcast with poor visibility (snow/rain and fog) and windy. Temperatures during the April surveys ranged from -10˚C to -23˚C while June temperatures ranged from -3˚C to +3˚C. During both April and June surveys, snow was still present with 85–95% cover in April, and 10–60% cover in June. Two sites in June had higher percent cover at 80% (station 5) and 90% (station 22). Snow cover was sufficient to allow for observation of tracks in the snow for most areas, however no caribou tracks or fresh signs of caribou were observed during surveys or on route to survey stations. Survey times ranged from 20–90 minutes in duration, and observation times exceeded 20 minutes if observers were attempting to distinguish an unidentifiable object on the landscape (e.g. a suspected animal).

Table 10 Summary details of height–of–land surveys conducted in the Mary River Project study area in 2017.

Method of transportation to HOL station	Dates of observation	Number of observers per survey	Survey Effort (hh:mm)
Snowmobile; Truck and hiking from Tote Road	April 20, 22, 24, 25	4	6:19
Helicopter; Truck and hiking from Tote Road	June 09, 10, 11, 12, 13, 14	2–3	13:09
Total	**10 Days**		**19:28**

4.3.2.1 Inuit Qaujimajatuqangit

Elijah Panipakoocho[2], of the MHTO provided valuable IQ on recent and historical caribou use of the Mary River area, as well as information on caribou behaviour and how to look for caribou on the North Baffin landscape during the 2017 HOL surveys conducted in April and June. He also provided some feedback on the design of the HOL surveys as well as the viewshed mapping methods. His comments and observations, organized by subject are as follows:

[2] Personal reference used with permission.

Recent and historical caribou use in the area

- Caribou have historically crossed through the valley where the Tote Road is located and are often found in adjacent valleys in the Milne area (historic crossings at km 26, 60, 63 and 83).
- Popular summer and winter areas for caribou exist in adjacent valleys on the east side of the Tote Road. Also, caribou have been seen calving on the slopes in June and tend to hide in other nearby valleys during windy periods.
- According to some elders on site, a hunting party saw approximately 20 caribou in March, 2017 in a nearby valley (before seasonal winds picked up), travelling NE from the km 60 pull-out.
- In early June, a group of caribou were seen by some fishermen between Mary River and Pond Inlet, and caribou tracks were seen around Bylot Island (near Pond Inlet).
- Caribou were seen approximately three years ago on and behind the hills south of station 9; however, other areas around station 9 are very rocky, so caribou will only pass through these areas as there are limited food resources.
- Caribou have been seen approximately 4 to 5 years ago at the bottom of the hill at station 15 near the lakes in this area, and on the east side of the Tote Road near station 17, approximately 20 years ago.
- There is a big lake in an adjacent valley to the north of station 17 (west of Bruce Head), which is used for culture camps. Caribou have been known to hang out in this area to hide from wolves as recently as 2005. This is also a known historical hunting site for people from Arctic Bay, with lots of Inuksuk, old sod houses and caribou bones.
- Caribou have historically been seen (50 years ago) in spring around a lake adjacent to the Tote Road near km 51–52 and there are some places with open water all year around km 51 of the Tote Road, where caribou have historically been known to frequent.
- We observed a very old caribou trail running parallel to the Tote Road while walking between station 13 & 12, and Elijah says there are more old trails at the bottom of the slope also. Elijah believes that greater numbers of caribou will move back into north Baffin over the next 10 years or so.

Caribou behaviour

- When windy, male caribou sometimes go down into valleys to hide from wind, but pregnant females usually stay on top of hills because they don’t want to walk up and down as much.
- In the morning caribou are more active and can be seen walking around and feeding, whereas around noon time they are often seen sitting and resting.
- Caribou are more active around 2:30/3:00 AM, because there are less bugs and it’s easier to see when they are walking around.
- When asked if caribou would avoid the vicinity of the mine, Elijah said that caribou tend to dislike loud sudden sounds such as blasting; however, quieter, more constant sounds such as trucks driving on the road don’t seem to bother them as much.

- In 2010 Elijah was hunting SW of Mary River (a long distance away) and he observed caribou reacting to blasting sounds from the mine, even at such great distance. He only saw the smoke from the blast, but did not hear the blast himself. The caribou reacted by becoming alert and running a short distance away.

How to look for caribou on the North Baffin landscape

- From a distance, caribou look white like snow geese at this time of year with a bit of brown on top. When seen against the snow, they look light brown, and when seen against the land they tend to look whiter.
- Calves are born brown and can be seen running around. In spring, caribou split apart into individuals or small groups, and in fall/winter they tend to group together in groups of 30–40.
- Elijah looks for caribou on gentler rolling slopes as opposed to steeper rockier slopes. He also looks on top of slopes, and on slopes with more vegetation and less rocks, as they contain more food resources.

Elijah agreed that 20 minutes (or more) at each HOL survey site was sufficient, and he did not express any concerns on how the viewshed mapping was developed (Panipakoocho, pers. comm., 2017). Elijah often preferred to survey longer than 20 minutes at stations with viewsheds containing prime caribou habitat, such as gentler rolling slopes where caribou were known to historically frequent, as opposed to steeper rockier slopes where caribou would more likely just be passing through. When conducting surveys with Elijah, the amount of survey effort expended at each HOL station was largely determined by whether the surveyors were satisfied with their coverage of the area, rather than the length of time spent surveying. However, it was agreed that 20 minutes was a reasonable minimum amount of time to spend at each HOL station.

4.4 INCIDENTAL OBSERVATIONS

Site personnel are asked to record wildlife sightings in the camp's wildlife logs – at both Mary River camp and at Milne Port camp. These logs provide an indication of the wildlife species that occur in proximity to Project infrastructure or areas where exploration may be occurring. Wildlife species recorded in the camp wildlife logs for 2017 are summarized in Table 11 In addition to those species listed, a number of birds were also recorded on the wildlife logs including ducks, yellow-billed loon, tundra swans, American golden plover, common raven, snow buntings, northern wheatear, sandhill cranes, snow geese, gulls, ptarmigan, gyrfalcon, peregrine falcon, and rough legged hawk. Polar bear tracks were also documented near kilometre 63 of the Tote Road in late April; however the animal was not seen.

Baffinland personnel also recorded wildlife sightings at various locations where exploration activities were being conducted in 2017, such as Steensby Inlet, Eqe Bay, Grant Suttie Bay, the Rowley River area, and other remote locations in the region (Table 12).

Table 11 Wildlife species observations recorded in the 2017 Mary River and Milne Port camps wildlife logs.

Species	Number of observations		
	Mary River Camp	Tote Road	Milne Inlet
Arctic hare	18	5	3
Arctic fox	57	10	21
Caribou	3[1]	–	–
Polar Bear		1	

[1] No additional information available on location of caribou sightings.

Table 12 Wildlife species observations recorded in during 2017 exploration activities.

Species	Number of observations				
	Steensby	Eqe Bay	Grant Suttie Bay	Rowley River	Other
Polar bear	–	3	–	2	12
Narwhal	16	–	–	28	–
Seal	[1]	–	–	–	–
Walrus	–	–	–	16	7
Beluga Whale	–	–	1	–	14
Caribou	–	3	–	–	13

4.5 HUMAN USE LOG

Baffinland monitors human use by maintaining a log of visitors to site, with particular notation for those traveling through and hunting within the RSA. However, there is no certainty of a complete data set, as it is not compulsory for individuals to check in with Baffinland security unless they are stopping in and using the Baffinland facilities. A total of 154 individuals stopped and checked in at either Mary River or Milne Port camps, the majority of which stopped at Milne port (128 individuals in 31 groups) while only nine groups were recorded at Mary River (2–6 individuals per visit). Individuals frequenting the area were often passing through, fishing, Canadian Rangers or were hunting, while the activities of the majority of visitors were not recorded. One hunting party that checked in at Mary River on December 16, 2017 reported seeing 10 caribou and harvesting two of the 10 seen. No further information on the location of the caribou sightings and/or harvest was recorded.

4.6 SUMMARY AND TRENDS

- In June 2013, a group of five caribou were observed in the PDA during HOL surveys; however, caribou have not been observed during surveys conducted between 2014 and 2017. Lack of caribou observations on site follow the trends of low numbers recorded in regional observations and have been confirmed through collaboration with the Government of Nunavut who conducts caribou aerial surveys and through Inuit Qaujimajatuqangit received at workshops held in November 2015 and April 2016. Spring and fall caribou surveys were conducted in the North

Baffin Region by the GN in 2017, but the findings were not yet available at the time of reporting.

- Low numbers of incidental observations of caribou between the mine site and Milne Inlet between 2013 and 2017 also coincide with the lack of caribou observations during the HOL surveys.
- No caribou, wolf or other large mammal tracks were observed during snow tracking surveys conducted between 2014 and 2017; however, similar numbers of Arctic fox and Arctic hare tracks were observed throughout all survey years.
- The majority of snow bank height measurements were in compliance between 2014 and 2017. The number of snow bank height exceedances were similar from 2014–2016, with between 13 – 18 exceedances observed during these years. However, in 2017, 31 exceedances were recorded during the survey.

5 BIRDS

The 2017 Project surveys for birds included pre-clearing nest surveys for birds when necessary, and continued monitoring and baseline data collection for cliff-nesting raptors. Specific surveys included:

- Pre-clearing nest surveys for breeding birds; and
- Cliff-nesting raptor occupancy and productivity surveys.

Project Condition #74 requires that *"The Proponent shall continue to develop and update relevant monitoring and management plans for migratory birds…key indicators for follow up monitoring…will include: peregrine falcon, gyrfalcon, common and king eider, red knot, seabird migration and wintering, and songbird and shorebird diversity."* During previous years, bird surveys included several surveys for songbirds and shorebirds to meet that portion of Project Condition #74. However, analysis of the survey results from the 2012 and 2013 PRISM plots and the 2013 bird encounter transects indicated that monitoring of Project effects on songbirds and shorebirds was unlikely to detect an effect of disturbance due to the low number of birds present. Subsequent discussions with the Terrestrial Environment Working Group (TEWG) and Canadian Wildlife Service (CWS) concluded that effects monitoring for tundra breeding birds could be discontinued but that Baffinland would:

- Contribute to regional monitoring efforts by conducting 20 PRISM plots every five years (next scheduled for 2018);
- Complete coastline nesting surveys of the identified islet near the proposed Steensby Port site prior to construction of the port;
- Conduct pre-clearing nest surveys prior to any clearing of vegetation or surface disturbance during the nesting season; and
- Continue with monitoring programs for cliff–nesting raptors (annual occupancy and productivity) and inland waterfowl survey when qualified biologists are available and onsite (roadside waterfowl survey).

Although red knot specific surveys were not conducted in 2017, when qualified biologists were on site they were aware of the potential for red knot to occupy the area and were vigilant during all other surveys. Additionally all BIM environmental staff were trained in conducting active migratory birds nest surveys (AMBNS) which included recognition of red knot as well as other listed species. A list of all bird species observed within the Project area from 2006–2017 can be found in APPENDIX D.

5.1 PRE–CLEARING NEST SURVEYS

Project condition #66 states that *"If Species at Risk or their nests and eggs are encountered during Project activities or monitoring programs, the primary mitigation measure must be avoidance. The Proponent shall establish clear zones of avoidance on the basis of the species–specific nest setback distances outlined in the Terrestrial Environment Management and Monitoring Plan."* Project condition #70 states *"The Proponent shall protect any nests found (or indicated nests) with a buffer zone determined by the setback distances outlined in its Terrestrial Environment Mitigation and Monitoring Plan, until the young* *have fledged. If it is determined that observance of these setbacks is not feasible, the Proponent will develop nest–specific guidelines and procedures to ensure bird's nests and their young are protected."*

In accordance with those Project conditions, pre–clearing nest surveys were done prior to any disturbance to ensure no bird nests were located in areas where any clearing or new area disturbance was scheduled. In 2017, prior to the nesting season, Baffinland anticipated which areas would be developed in the spring and summer, and cleared these areas of all vegetation, therefore reducing the nesting potential and reducing the likeliness of interaction with nesting birds. Protection of all migratory bird nests is legally required and it is a federal offence to damage, destroy or disturb an active nest. Within any proposed disturbance, pre-clearing nest surveys are necessary between May 31st and August 15th while birds are actively nesting (TEMMP Section 3.2, Baffinland Iron Mines Corporation 2017).

5.1.1 METHODS

Pre-clearing nest surveys were conducted by Baffinland environmental staff over the 2017 nesting season in areas that had to be disturbed for approved construction activities during the nesting season. In early June at the beginning of pre-clearing surveys, EDI biologists provided a refresher-presentation to staff that have previously completed the training, and a more detailed training event with new staff that were on site. Training included refreshing Baffinland environmental staff on methods to conduct nest searching surveys as well as common species found in the areas. EDI provided Baffinland environmental staff with a template for datasheets as well as a database for data entry when nests are located. The CWS provided advice to increase detection of nests during surveys at the TEWG meeting in 2015, and as a result, EDI staff supplied two rope-drags (For Mary River and Milne environmental offices) to increase the likelihood of nest/nesting adult detection during future surveys. Rope drags were constructed following the template provided by CWS (Rausch 2015).

Pre-clearing surveys were conducted with a minimum of one individual and up to four observers. Observers would conduct this survey by walking slowly through the area, stopping regularly to make note of incidental observations. Areas were surveyed for active nests a maximum of five days prior to clearing. If the area was not developed within the five-day window, surveys were conducted again to ensure no birds had started nesting. Nest searching also involved observers looking for signs of nesting bird behavior including broken wing displays, alarm calling, or carrying food indicating a nest is within the area. Surveyors recorded all incidental bird observations during nest surveys, but identification was limited to the skills of the individual observers.

5.1.2 RESULTS AND DISCUSSION

To ensure that birds were not nesting in the area during the 2017 nesting season, Baffinland Environmental monitors conducted pre-clearing active migratory bird nest searches (AMBNS). Thirteen pre-clearing surveys were conducted that included a total of 8.71 person hours and 141,917 m² (14.2 ha) of area in the Mine Site, Tote Road and Milne Port development areas (Table 13). No bird nests were located during any of the AMBNS, and therefore no buffers were required. During AMBNS, environmental monitors did note songbirds including snow buntings, and common ravens, however there was no indication of nesting behaviours observed (e.g., carrying food, carrying nesting material).

In 2017, approximately 162,915 m² of land was disturbed for project infrastructure. Of the approximate areas cleared, 36% of the work was done outside of the breeding bird window. During the breeding bird window, approximately 103,473 m² of land was cleared while 141,917 m² was surveyed through AMBNS (Table 13).

Table 13 Summary of AMBNS surveys conducted in 2017 during bird nesting season.

Location	Date (dd/mm/yy)	Site Description	Nest located	Birds observed	Surveys effort	Area surveyed (m²)
Mary River	02/06/17	Crusher– Welding ship expansion, north end of crusher pond	–	1 raven, 1 snow bunting	4 surveyors, 0.83 hours	9200
Milne Port	08/07/17	Area between laydown and stream, east of Port Site Complex	–	–	5 surveyors, 0.82 hours	290
Tote Road	11/07/17	RHS of Tote Road, just past 100 km dip	–	–	5 surveyors, 0.13 hours	652
Tote Road	13/07/17	Borrow pit at km 97	–	–	4 surveyors, 0.17 hours	6309
Milne Port	16/077/17	Area south of the PSC, site pad to south of the manmade ditch.	–	1 snow bunting, goose prints	3 surveyors, 1.3 hours	12,177
Mary River	26/07/17	Between maintenance and crusher pad. Grassy rock area near mine site.	–	–	3 surveyors, 0.83 hours	9200
Mary River	04/08/17	W13 as proposed as Hatch laydown sketch. North batch plant south ore pad.	–	–	3 surveyors, 0.5 hours	5500
	06/08/17	2007–08 laydown expansion (small expansion of existing)	–	–	3 surveyors, 1 hour	15000
	07/08/17	South of warehouse, between the road and sea can, bisected diagonally by a pond.	–	–	3 surveyors, 0.42 hours	12404
	07/08/17	W14 and W3	*	*	3 surveyors*	20176
	09/08/17	2A	–	52 snow bunting calls heard	3 surveyors, 0.5 hours	30464
	09/08/17	MS camp pad (MSCP)	–	1 snow bunting, 1 fledgling	3 surveyors, 1.08 hours	31426
	11/08/17	2B (ore handling laydown)	–	–	3 surveyors, 0.8 hours	2592
	13/08/17	2B (ore handling laydown)	–	1 snow bunting	4 surveyors, 0.33 hours	6702
	Total Survey Effort (Person Hours) and Total Area surveyed (m²)				**8.71**	**141,917**

*survey data lost

5.2 RAPTOR EFFECTS MONITORING

The Baffinland Final Environmental Impact Statement (FEIS) states that a monitoring program for raptors will be used to assess the accuracy of predictions by comparing measurable parameters from within the footprint to those documented at appropriate control sites (Baffinland Iron Mines Corporation 2012). NIRB Project Condition #74 identifies peregrine falcon and gyrfalcon as key indicators for follow up monitoring of birds (Nunavut Impact Review Board 2014). Further, during the final hearing, Baffinland committed to monitoring relevant sections of the project area for peregrine falcon nesting activities (Commitment #75).

5.2.1 BACKGROUND 2011–2017

Arctic Raptors Inc. (ARInc.) personnel have conducted raptor monitoring as part of the Baffinland Iron Mine terrestrial baseline surveys and terrestrial effects monitoring efforts from 2011 through 2017. In general, surveys on known nesting sites were conducted by helicopter, boat, and on foot in the Steensby Inlet area, and by truck and helicopter along the Tote Road from the mine site to Milne Inlet. Over this period of time, monitoring objectives have been aligned with each phase of the Project (e.g., pre-FEIS, Early Revenue Phase).

The main goal of the survey in 2011 was to revisit locations provided by Baffinland in an effort to substantiate and undertake quality control of monitoring data that had been collected from 2006–2008 in the Regional Study Area (RSA; extending from Milne Inlet in the north to Steensby Inlet in the south). A second goal was to gauge the potential for establishing a dedicated study area to be based at Steensby Inlet that could serve as a replicate for the long-term monitoring program located near Rankin Inlet, Nunavut. ARInc. initiated a banding program of breeding adults and nestlings, collected blood samples, searched for nesting locations that had not been previously identified, and conducted small mammal trapping following protocols already in place at Rankin Inlet. Surveys were conducted in 2012 of all known nesting sites with the same goals that had been identified in 2011. Prior to conducting surveys in 2013, Baffinland Iron Mine supported a successful application to the Natural Sciences and Engineering Research Council (NSERC) Industry Grants Program to fund the stipend of a graduate student to investigate nesting habitat selection of peregrine falcons (PEFA) and rough-legged hawks (RLHA). Field work in 2014 involved ongoing extensive surveys (occupancy and productivity) of known nesting sites in the RSA and additional coverage of areas not previously surveyed to validate habitat selection models.

Prior to the 2015 breeding season, Arctic Raptors Inc. was tasked with providing a monitoring program to estimate potential effects of the Project Development Area (PDA). This marked a departure from extensive monitoring of known nesting sites throughout the RSA to monitoring nests within a 10 km buffer of the PDA, hereafter referred to as the Raptor Monitoring Area (RMA). Prior to the start of the 2015 field season, a total of 131 nesting sites (65 PEFA and 66 RLHA) were known to exist within the RMA. The density of nesting sites was distributed disproportionately with higher densities located within 3 km of anthropogenic disturbance and much lower density beyond 3 km of disturbance. Thus, starting in 2015, survey effort shifted from extensive monitoring of known nesting sites throughout the RSA to monitoring of nesting sites only within the RMA as well as searching for previously unknown nesting sites. In 2015, efforts to locate previously unknown nest sites focused on those areas further from disturbance to address the limitation associated with small sample size further from disturbance. Survey effort in 2016 similarly focused on monitoring of known nesting sites within the RMA, as well as searching for previously unknown nesting sites, but also placed greater effort on multiple visits to address detection error. Fieldwork in 2017 followed the same methodology as 2016 and additional effort was placed on addressing issues raised in previous reports (terminology, and methodology to address the effect of alternative nesting sites on estimates of occupancy and productivity). The 2017 report summarizes data collected only within the RMA and focuses on effects monitoring.

5.2.2 TERMINOLOGY

Terminology used throughout this report follows Franke et al. (2017). The following terms are highlighted given their frequent use in this report:

ALTERNATIVE NESTING SITE — One of potentially several nests within a nesting territory that is not a used nest in the current year (Millsap et al. 2015).

MINIMUM ACCEPTABLE AGE FOR ASSESSING SUCCESS — A standard nestling age at which a nest can be considered successful. An age when young are well grown but not old enough to fly and after which mortality is minimal until actual fledging. Typically 80% of the age that young of a species normally leave the nest of their own volition for many species, but lower (65–75%) for species in which age at fledging varies considerably or for species that are more likely to leave the nest prematurely when checked (Steenhoff and Newton 2007).

NESTING SITE — The substrate which supports the nest or the specific location of the nest on the landscape (Ritchie and Curatolo 1982, Millsap et al. 2015, Steenhof et al. 2017).

NESTING TERRITORY— An area that contains, or historically contained, one or more nests within the home range of a mated pair: a confined locality where nests are found, usually in successive years, and where no more than one pair is known to have bred at one time (Newton and Marquiss 1984, Steenhoff and Newton 2007). Note that a nesting territory may or may not be defended (Postupalsky 1974), and probably does not include all of a pair’s foraging habitat (Newton and Marquiss 1984, Steenhoff and Newton 2007).

OCCUPANCY — The quotient of the count of occupied nesting territories and the count of known nesting territories that were fully surveyed in a given breeding season (Franke et al. 2017).

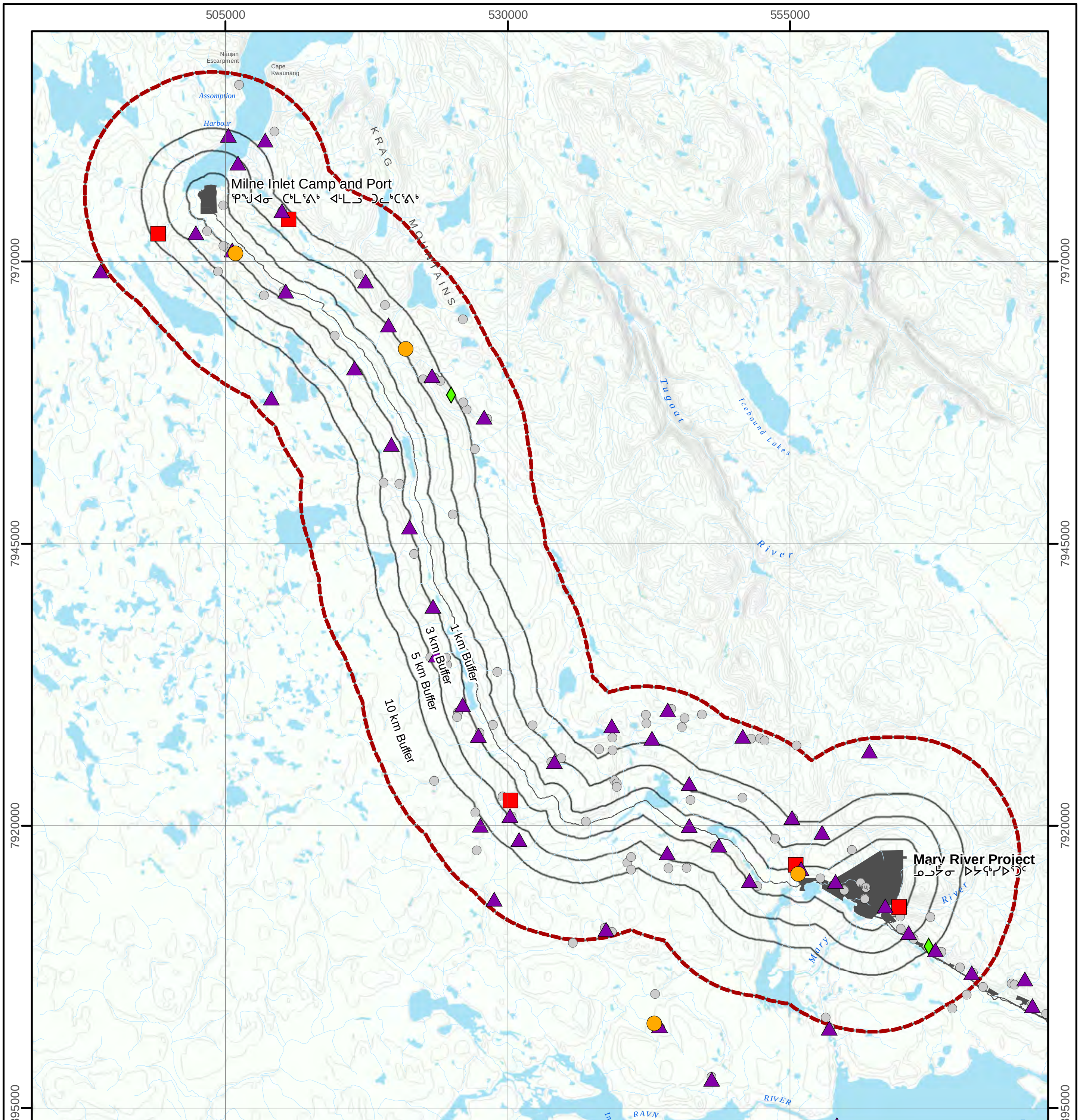
PRODUCTIVITY— The number of young that reach the minimum acceptable age for assessing success; usually reported as the number of young produced per territorial pair or per occupied territory in a particular year (Steenhoff and Newton 2007, Steenhof et al. 2017).

5.2.3 BREEDING PHENOLOGY

Breeding phenology is an important determinant of timing of occupancy and productivity surveys. In Nunavut, the earliest documented arrival for peregrine falcons is May 10 at a known breeding site near Rankin Inlet. Although arrival timing varies with spring conditions, most sites are occupied during the third week of May. Median laying date in Rankin Inlet (June 9 ± 4.0 days) was earlier than Igloolik (June 15 ± 3.6 days; $Chi^2 = 31.56$, $p < 0.001$) and north Baffin Island (June 16 ± 3.5 days; $Chi^2 = 35.56$, $p < 0.001$) with no difference observed between Igloolik and Baffin ($Chi^2 = 0.77$, $p = 0.38$) (Jaffré et al. 2015). The incubation period of the fourth laid egg (33 days) is similar to what has been reported elsewhere (Burnham 1983). Rough-legged hawk breeding phenology is very similar to peregrine falcons but is typically advanced by a week to 10 days (Poole and Bromley 1988). Additionally, presence of breeding pairs in locations where ground squirrels are absent (as is the case on Baffin Island) is typically cyclic in association with lemming abundance. Timing of surveys on Baffin Island was conducted to match the phenology of local breeding birds.

5.2.4 RAPTOR MONITORING DATA

The landscape is generally rugged and elevation varies ranging from sea-level to 685 metres. The area includes a wide valley associated with Philip's Creek surrounded by high plateaus and mountains. The valley extends southward into poorly drained plains and rolling tundra. Vegetation is patchy, and dominated by mountain aven and arctic willow, along with alpine foxtail, wood rush, and saxifrage. Dry or high elevation sites are very sparsely vegetated, whereas wet areas have a continuous cover of sedge, cottongrass, saxifrage, and moss. Peregrine falcon (*Falco peregrinus tundrius*) and rough-legged hawk (*Buteo lagopus*) are the most common raptor species. Gyrfalcon (GYRF; *Falco rusticolus*), snowy owl (SNOW; *Bubo scandiacus*) and common raven (CORA; *Corvus corax*) are also encountered. The spatial extent of the 2017 surveys was limited to nesting site within RMA and to searching for additional nesting sites near Milne Inlet (Map 8).



Distribution of nesting sites during occupancy and productivity surveys in 2017

LEGEND ᑐᑭᓯᒋᐊᕐᕕᑦ

- Common Raven Nesting Site (4)
- Peregrine Falcon Nesting Site (50)
- Rough-legged Hawk Nesting Site (5)
- Gyrfalcon Nesting Site (2)
- Unoccupied Nesting Site (105)
- 2017 Raptor Monitoring Area
- Potential Development Area ᓄᓇ ᐊᒃᑐᕐᑕᐅᑐᐃᓇᓇᐊᓕᒃ ᓴᕿᒃᓴᕐᓯᐅᕐᑐᓂᑦ

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PDA provided by KP, July 11, 2017.

This document is not an official land survey and the spatial data presented is subject to change without notice.

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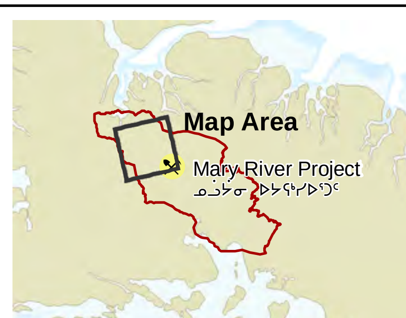
Map Scale ᐊᖏᓂᖓ: 1:500,000 (printed on 8.5 x 11)
Map Projection: NAD 1983 UTM Zone 17N

Drawn:	Checked:	Date:	
HG/MP	DH/MAS	2/26/2018	MAP 8



Baffinland EDI

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5.2.5 METHODS

Raptor surveys from 2011 through 2014 were conducted through the region extending from Milne Inlet to Steensby Inlet, and results of those surveys were reported in previous annual monitoring reports (EDI Environmental Dynamics Inc. 2013, 2014, 2015, 2016). Survey efforts from 2015 to 2017 focused on monitoring of occupancy and reproductive success only within the RMA, and opportunistically documented previously unknown nesting sites.

5.2.5.1 Helicopter Survey

Two surveys were conducted June 16–20 (20.6 hours) and August 5-8 (26.7 hours). The focus of these surveys was to search known nesting sites for the presence of cliff-nesting birds. In addition to the structured surveys, favourable habitat was searched opportunistically when ferrying between known sites, camps or other mine infrastructure and when raptors or signs of site use (e.g., whitewash, orange-colored lichen, and unused nests) were observed. Sites were considered occupied if one or more adults displayed territorial or reproductive behavior (e.g. vocalization and/or flight behavior associated with defense of breeding territory or presence of nest building, nest, or eggs). Locations with partially built or unused nests without detection of breeding aged adults were noted as such (i.e., no birds detected, NBD).

5.2.5.2 Distance to Disturbance

Within the spatial extent of the 2015 study area, ESRI ArcGIS for Desktop v.10.3 (ESRI 2010) was used to calculate the distance from all raptor nest sites to the nearest mapped disturbance features (e.g., project infrastructure). Shapefiles were derived from CAD drawings provided by HATCH, the onsite procurement and engineering contractors. From the CAD files, the mine site, Milne Port and tote road footprints were used to represent current and proposed disturbance as of September 2014. The ArcGIS Near Tool was used to calculate the Euclidean distance for each nest site (i.e., point location) to the nearest point of the Project footprint. Sites that were located within the spatial extent of the PDA received a distance value of 0 meters. Distance to disturbance (DD) values for only those sites with the RMA were retained for effects analysis on occupancy and reproductive success.

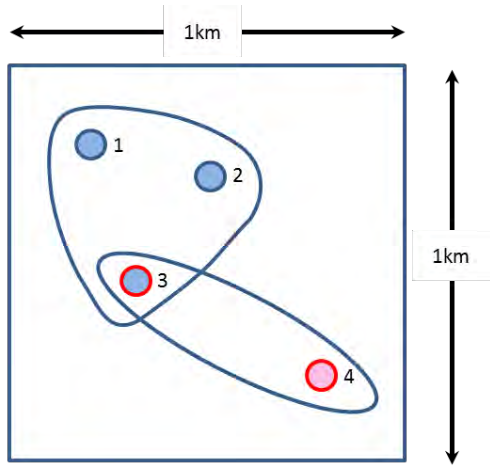
5.2.5.3 Distance to Nearest Neighbour

Nearest neighbour distances (NND) were calculated in R (R Development Core Team 2017) using the sp, rgeos, and geosphere packages to transform the geographic coordinates describing nesting site locations into spatial objects, calculate pairwise distances and identify the shortest distance between each point and it nearest neighbouring point. Nearest neighbour distances were then used to assign nesting sites to nesting territories.

5.2.5.4 Assigning Nesting Sites to Nesting Territories

In the absence of marked individuals, it can be challenging to definitively identify alternative nesting sites. Failure to account for alternative nesting sites can lead to underestimating demographic parameters such as annual productivity. In order to address this problem, a rule-based approach was used to estimate the number of alternative nesting sites within the RMA. Mean Nearest Neighbor Distance within the RMA equaled 1.2 km, and this information was used in conjunction with the following rule set to identify clusters of nesting sites that were potential alternative nesting sites (Figure 31):

1. If two species-specific nesting sites were separated by a distance of ≤ 1 km they were considered alternative nesting sites in a single nesting territory.
2. If two nesting sites within 1 km of each other were occupied by the same species in a given year, they were considered separate territories.
3. In the event that multiple species-specific nesting sites were within 1 km of one another, discrete geographic landforms or discontinuities in cliff structure were used to separate or combine sites into territories.
4. Temporal patterns of multi-species occupancy were used to assess the plausibility of decisions based on application of the three rules listed above. For example, if two nesting sites were located within 1 km of each other, and were occupied by two different species in alternating years, these nesting sites were identified as distinct alternative nesting sites for each species.
5. Assigning Identification Numbers (ID) to Nesting Territories was conducted according to the following rule set:
    a. Nesting Territory IDs were assigned within species only (e.g., Nesting Territory IDs for PEFA and RLHA were never shared).
    b. Nesting Territory IDs were assigned using the Identification Number of one of the Nesting Sites in the cluster according to the following rule set, in order of priority:
        i. Length of tenure (i.e., nesting sites with longest tenure)
        ii. First tenure (i.e., nesting sites with first tenure in the event length of tenure was equal).



NS ID	PEFA NT ID	RLHA NT ID	2011	2012	2103	2014	2015	2016	2017
1	**1**	**-**	PEFA	PEFA	NBD	NBD	NBD	PEFA	PEFA
2	1	-	NBD	NBD	PEFA	NBD	PEFA	NBD	NBD
3	1	4	NBD	NBD	NBD	PEFA	RLHA	RLHA	NBD
4	-	4	RLHA	RLHA	NBD	RLHA	NBD	NBD	RLHA

Figure 31 Rule based approach used to assigning nesting sites to nesting territories. Occupancy Modelling
A cluster of four nesting sites within 1 km of one another that exhibit a site occupancy history among seven years for two species (PEFA and RLHA). Nesting Sites 1 and 2 (blue circles with blue borders) have been occupied solely by PEFA. Nesting Site 4 (red circle with red border) has been occupied solely by RLHA. Nesting Site 3 (blue circle with red border) has been occupied by both PEFA and RLHA. In this example, Nesting Sites 1, 2 and 3 are grouped into a single PEFA Nesting Territory and assigned Nesting Territory ID 1 based on PEFA–specific tenure length (Nesting Site 1 has the longest tenure) and first tenure. Nesting Sites 3 and 4 are grouped into a single RLHA Territory and assigned Nesting Territory ID 4 based on RLHA–specific tenure length (Nesting Site 4 has the longest tenure) and first tenure. Unique nesting locations are ultimately defined by a Nesting Territory ID and a Nesting Site ID (E.g., NT ID 1, NS ID 2). NBD = no birds detected.

5.2.5.5 Occupancy Modelling

Although estimation of nesting site occupancy can serve as a metric of population status (MacKenzie et al. 2002, 2003), detection of nesting pairs is invariably imperfect, and estimating the proportion of occupied sites without accounting for detection error can lead to underestimation of true occupancy (Kéry and Schmidt 2008). Hierarchical occupancy modeling can estimate parameters that influence occupancy and simultaneously account for detection probability <1 (Marsh and Trenham 2008).

Occupancy at a nesting sites is limited to one of only two outcomes (occupied or not occupied), and is therefore a Bernoulli trial, and estimates of colonization (i.e., an unoccupied site becomes occupied), extinction (i.e., an occupied site becomes unoccupied), and survival (i.e., an occupied site remains occupied) can be generated for the time series, and covariates can be added to the model in order to test whether they influence the parameters by linking specific covariates to each of the three parameters using a logit link function.

Mutli-year occupancy was calculated in R (R Development Core Team 2017) using the *unmarked* package. Where appropriate, data were standardized (e.g., DNN was standardized by subtracting the mean from each distance value and dividing by the standard deviation) and then formatted specifically for *unmarked* using the unmarkedMultFrame function. Model fitting of candidate models was performed using the colext function. Akaike Information Criterion (AIC) was used for model selection. Fifteen candidate models were selected *apriori* to address anthropogenic (i.e., distance to disturbance) and ecological factors (i.e., distance to nearest neighbour), and interactions among factors with potential to influence model parameters (initial colonization, annual colonization, annual extinction, and detection probabilities). For example, the effect of distance to disturbance may vary with distance to nearest neighbour (i.e., the effect of distance to disturbance may depend on proximity of neighbouring nesting sites). The aim of this analysis was twofold: 1) to estimate the proportion of occupied nesting sites and identify factors that may influence whether sites are occupied or not, and 2) to estimate the overall trend in occupancy from 2012 – 2017 (2011 was dropped from the analysis as only four nesting sites were fully surveyed in 2011). Trend was estimated using annual occupancy probabilities to calculate average rate of change at the population level (MacKenzie et al. 2003) where a mean value <1 indicates population decline and >1 indicates an increase.

5.2.5.6 Reproductive Success

Productivity is defined as the number of young that reach the minimum acceptable age (MAA) for assessing success, and is usually reported as the number of young produced per territorial pair or per occupied territory in a particular year (Steenhoff and Newton 2007, Franke et al. 2017, Steenhof et al. 2017). The MAA for peregrine falcons based on recommendations in Steenhof et al. (2017) is 26 days, but 25 days of age is typically used (Anctil et al. 2014, Franke et al. 2016, 2017, Lamarre et al. 2017), to ensure nestlings do not fledge prematurely. Based on an average at 40 days of age (range 31 - 45; Parmelee et al. 1967), the MAA for rough-legged hawks is 32 days.

Given that nestling age during the survey period varied annually among years and sites, measures of annual productivity *per se* are biased high (i.e., counts of nestlings are often done when nestlings are <MAA), but should still allow for comparison among years within the RMA. Estimates of productivity reported here should not be compared to estimates of productivity in other regions. For this report, any nesting site that was surveyed once in either the pre-laying period or early during the incubation period, and once during the brood rearing period, was considered "fully surveyed", and estimates of productivity were calculated as:

$$\text{Productivity} = N_{\text{Chicks}}/N_{\text{NestingTerritoriesOccupied}}$$

where N_{Chicks} is equal to the total count of chicks observed in the summer survey and $N_{\text{NestingTerritoriesOccupied}}$ is equal to the count of nesting territories occupied (Parmelee et al. 1967). Surveys were conducted in the first week of August when nestlings are expected to range between 15 and 25 days of age and are conspicuous.

Distance to disturbance and distance to nearest neighbour individually, and as an interaction term were used as covariates to model the effect on count of nestlings at fully surveyed peregrine falcon (N=306) and rough-legged hawk (N=336) nesting territories from 2012 – 2017 in R (R Development Core Team 2017) using the *glm* command with Poisson link in Package MASS.

5.2.6 RESULTS

5.2.6.1 Nesting Site Detections

A total of 166 unique nesting sites have been detected in the RMA including five new nesting sites detected in 2017. Three were within 1 km of previously known nesting sites and were considered likely alternative nesting sites, one unoccupied nesting site had evidence of recent use (likely a failed/fledged GYRF or CORA nesting site), and one was considered to be a unique nesting territory. Among years, the greatest number of previously unknown nesting sites was detected in 2014 (N=19) and 2015 (N=32) due to efforts associated with the model validation aspect of the nesting habitat selection study and efforts to increase sample sizes in regions further from disturbance in 2014 and 2015, respectively. Although the number of known nesting sites has increased considerably in the RMA since 2011 (from N=96 to N=166), the percentage of known sites checked annually has remained high (range of 83% to 100%). In 2017, all 166 nesting sites (100%) were surveyed at least twice. Annually, cliff-nesting birds are detected at over half of known nesting sites that are checked. However, in years when detections of RLHA are very low (i.e., 2013 and 2017), cliff-nesting birds are detected at approximately one third of known nesting sites. Of the 166 nesting sites visited in 2017, cliff-nesting birds were detected at 61 sites; 50 held peregrine falcons, five held rough-legged hawks, two held gyrfalcons, and four held common ravens. Raptors were not detected at one hundred five known nesting sites (Table 14).

Table 14 Summary statistics for survey effort and detections at known raptor nesting sites within the RMA from 2011 to 2017.

Variable		Year						
		2011	2012	2013	2014	2015	2016	2017
Effort	Total nesting sites known annually	96	106	107	126	158	161	166
	New sites found annually	0	10	1	19	32	3	5
	Count of sites checked	87	106	89	124	148	141	166
	% known sites checked	91%	100%	83%	98%	94%	88%	100%
	Count of checked sites occupied	56	72	30	77	99	70	61
	% checked sites occupied	64%	68%	34%	62%	67%	50%	37%
	Count of sites checked twice annually	4	71	59	97	127	106	166
Detections	Count of sites no raptors detected	31	34	59	47	49	71	105
	Count of sites PEFA detected	27	26	29	43	50	48	50
	Count of sites RLHA detected	26	44	1	31	47	18	5
	Count of sites GYRF detected	3	0	0	1	1	2	2
	Count of sites CORA detected	0	1	0	1	0	1	4
	Count of sites GLGU detected	0	1	0	0	1	1	0
	Count of sites SNOW detected	0	0	0	1	0	0	0

5.2.6.2 Assigning Nesting Sites to Nesting Territories

Of the 166 nesting sites detected within the RMA, 96 sites were within 1 km of one or more neighbouring nesting sites and were assigned to 34 clusters. Of the 91 nesting sites at which peregrine falcons were detected, 53 were within 1 km of one or more neighbour nesting sites and assigned to 35 nesting territories. Of the 92 nesting sites at which rough-legged hawks were detected, 57 were within 1 km of one or more neighbour nesting sites and assigned to 39 nesting territories. Of the five nesting sites at which gyrfalcons were detected, two were within 1 km of one or more neighbour nesting sites but none were considered alternative nesting sites based on the rule sets outlined previously, and thus all five were by default considered nesting territories per se. Thus, across all years, the estimated number of nesting territories within the RMA was 75, 79 and 5 for peregrine falcons, rough-legged hawks and gyrfalcons, respectively.

5.2.6.3 Occupancy

From 2012 – 2017 the best model for the raptor guild (peregrine falcons, rough-legged hawks and gyrfalcons) indicated that colonization and extinction were best explained by time alone (i.e., year of survey, see Table 15). The best ranked model did not include a covariate for distance to disturbance or distance to nearest neighbour individually or as an interaction term. The time-series (Figure 32) is long enough to identify a single peak in occupancy in 2015 but it is likely that a similar peak occurred in 2011. The null model was ranked first for peregrine falcons (Table 16). Multi-year occupancy for peregrine falcons (Figure 33) indicated $\lambda = 0.94 \pm 0.09$. The best model for rough-legged hawks indicated that occupancy was best explained by a year effect for colonization and extinction (Table 17). Multi-year occupancy for rough-legged hawks (Figure 34) indicated $\lambda = 1.28 \pm 1.26$ from 2012 – 2017. Considerable annual variation exists with lows in 2013 and 2017. Although the time-series is long enough to identify a single peak in occupancy in 2015, it is likely that a similar, yet higher, peak occurred in 2011.

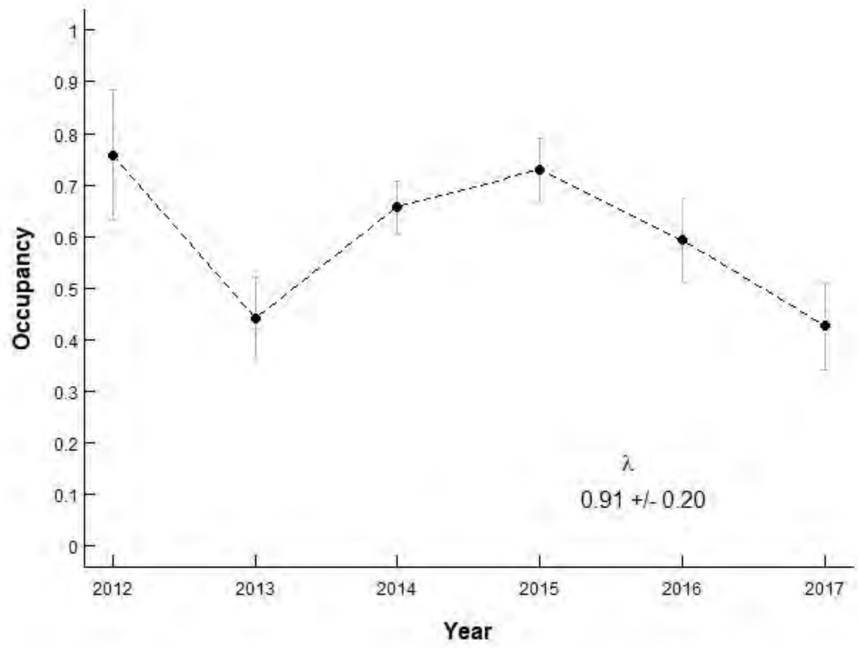


Figure 32 Annual estimates (± standard errors) of nesting territory occupancy at the guild level within the RMA from 2012 –2017.

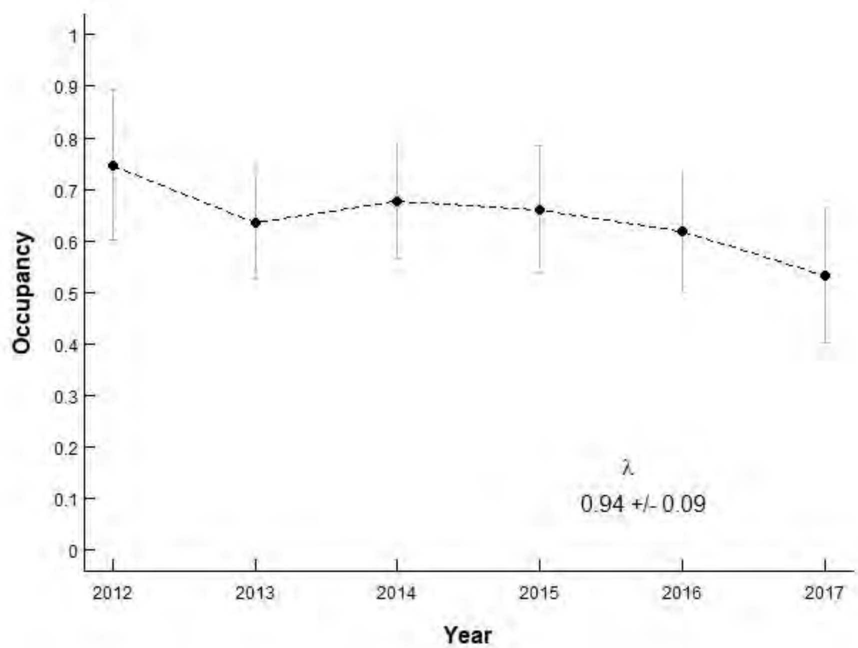


Figure 33 Annual estimates (± standard errors) of nesting territory occupancy peregrine falcons within the RMA from 2012 – 2017.

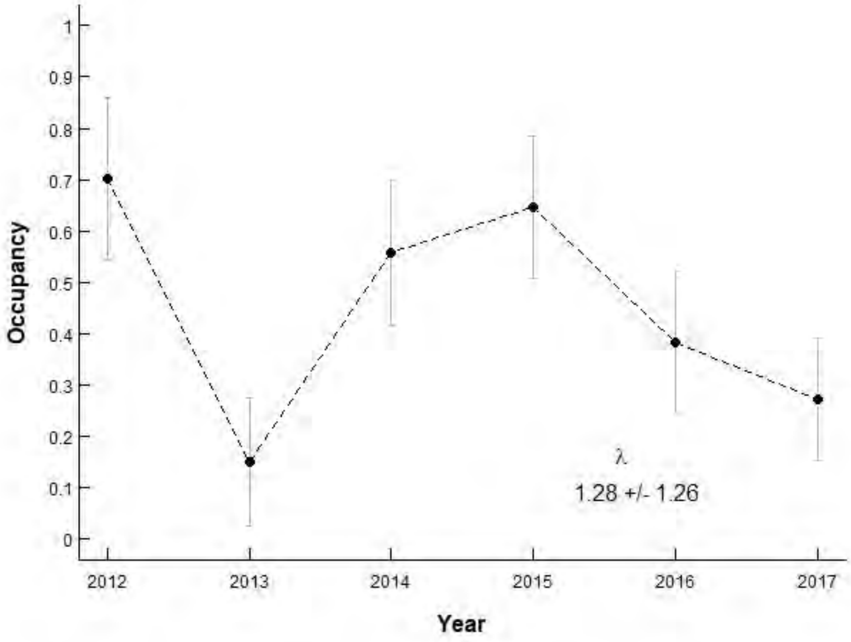


Figure 34 **Annual estimates (± standard errors) of nesting territory occupancy for rough-legged hawks within the RMA from 2012 – 2017.**

Table 15 Site occupancy modeling at the guild level incorporates the main parameters inherent to metapopulation dynamics (i.e., colonization (γ), and extinction (ε)). Model selection was conducted using Akaike Information Criterion (AiCc). Model parameters reflect first-year occupancy, colonization, extinction and detection.

Model	Model number	K	AICc	Delta_AICc	ModelLik	AICcWt	LL	Cum.Wt
-.yr.yr.sp	7	13	1416.42	0.00	1.00	0.74	-693.85	0.74
md.yr.yr.sp	4	14	1418.48	2.06	0.36	0.26	-693.66	1.00
-.yr.yr.-	3	12	1436.25	19.83	0.00	0.00	-704.97	1.00
-.dtn.dtn.sp	9	7	1446.88	30.46	0.00	0.00	-716.04	1.00
-.md.md.sp	8	7	1447.39	30.97	0.00	0.00	-716.30	1.00
md.md.md.sp	2	8	1449.19	32.77	0.00	0.00	-716.08	1.00
-.dtn.-.-	14	5	1465.83	49.40	0.00	0.00	-727.70	1.00
-.-.-.-	1	4	1466.01	49.59	0.00	0.00	-728.86	1.00
-.-.md.-	13	5	1466.66	50.24	0.00	0.00	-728.12	1.00
-.md.-.-	12	5	1468.15	51.73	0.00	0.00	-728.86	1.00
dtn.yr.yr.sp	5	14	1476.80	60.38	0.00	0.00	-722.82	1.00
-.md*dtn.-.-	10	7	1502.40	85.98	0.00	0.00	-743.80	1.00
-.-.dtn.-	15	5	1782.12	365.70	0.00	0.00	-885.85	1.00
-.-.md*dtn.-	11	7	1786.49	370.07	0.00	0.00	-885.85	1.00
-.md*dtn.md*dtn.sp	6	11	1795.28	378.86	0.00	0.00	-885.67	1.00

Table 16 **Site occupancy modeling for peregrine falcons incorporate the main parameters inherent to metapopulation dynamics (i.e., colonization (γ), and extinction (ε)). Model selection was conducted using Akaike Information Criterion (AiCc). Model parameters reflect first-year occupancy, colonization, extinction and detection.**

Model	Model number	K	AICc	Delta_AICc	ModelLik	AICcWt	LL	Cum.Wt
-.-.-.-	1	4	570.29	0.00	1.00	0.37	-281.01	0.37
-.md.-.-	12	5	571.20	0.91	0.63	0.23	-280.39	0.60
-.md.md.sp	8	8	571.66	1.37	0.50	0.19	-277.31	0.79
-.-.md.-	13	5	572.43	2.14	0.34	0.13	-281.00	0.92
md.md.md.sp	2	9	573.91	3.62	0.16	0.06	-277.30	0.98
-.yr.yr.sp	7	14	577.43	7.14	0.03	0.01	-273.14	0.99
-.yr.yr.-	3	12	579.00	8.71	0.01	0.00	-276.35	0.99
-.md*dtn.-.-	10	7	579.42	9.13	0.01	0.00	-282.31	1.00
md.yr.yr.sp	4	15	579.90	9.61	0.01	0.00	-273.13	1.00
dtn.yr.yr.sp	5	15	607.07	36.78	0.00	0.00	-286.72	1.00
-.dtn.-.-	14	5	657.00	86.71	0.00	0.00	-323.29	1.00
-.-.dtn.-	15	5	681.71	111.42	0.00	0.00	-335.64	1.00
-.-.md*dtn.-	11	7	686.09	115.79	0.00	0.00	-335.64	1.00
-.md*dtn.md*dtn.sp	6	12	692.00	121.71	0.00	0.00	-332.85	1.00
-.dtn.dtn.sp	9	8	705.57	135.28	0.00	0.00	-344.27	1.00

Table 17 Site occupancy modeling for rough-legged hawks incorporate the main parameters inherent to metapopulation dynamics (i.e., colonization (γ), and extinction (ε)). Model selection was conducted using Akaike Information Criterion (AiCc). Model parameters reflect first-year occupancy, colonization, extinction and detection.

Model	Model number	K	AICc	Delta_AICc	ModelLik	AICcWt	LL	Cum.Wt
-.yr.yr.-	3	12	529.81	0.00	1.00	0.51	-249.36	0.51
-.yr.yr.sp	7	13	530.28	0.47	0.79	0.40	-247.91	0.91
md.yr.yr.sp	4	14	533.40	3.59	0.17	0.08	-247.70	1.00
-.-.md.-	13	5	540.32	10.51	0.01	0.00	-264.57	1.00
-.md.md.sp	8	7	542.70	12.90	0.00	0.00	-263.21	1.00
-.-.-.-	1	4	544.34	14.53	0.00	0.00	-267.78	1.00
md.md.md.sp	2	8	545.00	15.19	0.00	0.00	-263.00	1.00
-.-.dtn.-	15	5	546.37	16.56	0.00	0.00	-267.60	1.00
-.dtn.-.-	14	5	546.54	16.73	0.00	0.00	-267.68	1.00
-.md.-.-	12	5	546.55	16.74	0.00	0.00	-267.69	1.00
-.dtn.dtn.sp	9	7	548.72	18.91	0.00	0.00	-266.22	1.00
dtn.yr.yr.sp	5	14	562.30	32.50	0.00	0.00	-262.15	1.00
-.-.md*dtn.-	11	7	641.30	111.49	0.00	0.00	-312.51	1.00
-.md*dtn.-.-	10	7	641.54	111.73	0.00	0.00	-312.63	1.00
-.md*dtn.md*dtn.sp	6	11	653.04	123.23	0.00	0.00	-312.59	1.00

5.2.6.4 Reproductive Success

Productivity for peregrine falcons and rough-legged hawks within the RMA in 2017 was 1.2±0.2 and 1.5±0.5 nestlings per fully-surveyed occupied site, respectively (Table 18). These values are within the range calculated for all survey years combined (0.6±0.3 to 2.4±0.2 for peregrine falcons, and 0.0 to 2.2±0.2 for rough-legged hawks). It should be noted that, although productivity was within the range of values calculated annually from 2011–2017, the count of nestlings (Total Production) should be acknowledged in conjunction with productivity. The count of nestlings for peregrine falcons and rough-legged hawks at fully surveyed nesting territories in 2017 was 58 and 5, respectively.

There was no evidence (all p values > 0.05) that distance to disturbance and distance to nearest neighbour individually, and as an interaction term influenced the count of nestlings at fully surveyed peregrine falcon (Table 19) and rough-legged hawk (

Table 20) nesting territories from 2012 – 2017.

Table 18 Productivity (number of young per occupied nesting territory per year) for peregrine falcons and rough-legged hawks within the RMA from 2011 – 2017 for fully surveyed sites only.

	PEFA							RLHA						
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Territories known	27	37	44	57	72	73	75	26	52	52	61	78	79	79
Territories visited	27	33	39	48	61	60	75	26	46	46	55	67	66	79
Occupied (fully surveyed)	3	10	25	42	49	53	50	1	18	8	26	46	17	5
Count of nestlings	7	16	33	65	95	114	58	0	26	0	58	106	29	5
Productivity±SE	2.3±1.2	0.6±0.3	1.3±0.3	1.5±0.2	1.9±0.2	2.4±0.2	1.2±0.2	-	1.4±0.3	-	2.2±0.2	2.3±0.2	1.7±0.3	1.5±0.5

Table 19 Effects of distance to disturbance and distance to nearest neighbour individually, and as an interaction term on count of nestlings at fully surveyed peregrine falcon (N=306) nesting territories from 2012 – 2017.

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	3.2360E-01	1.1250E-01	2.88	0.00
DD	2.2770E-05	1.3180E-05	1.73	0.08
DN	8.7120E-05	6.0910E-05	1.43	0.15
DD:DN	-8.6290E-09	8.4590E-09	-1.02	0.31

Table 20 Effects of distance to disturbance and distance to nearest neighbour individually, and as an interaction term on count of nestlings at fully surveyed rough-legged hawk (N=336) nesting territories from 2012 – 2017.

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	6.4210E-01	1.4250E-01	4.51	0.00
DD	1.3300E-05	1.9130E-05	0.70	0.49
DN	-3.0330E-05	9.3300E-05	-0.33	0.75
DD:DN	1.7850E-09	1.5070E-08	0.12	0.91

5.2.7 DISCUSSION

This report addresses two issues raised previously by reviewers, a need for clear definitions and accounting for alternative nesting sites. Although annual variation in productivity for peregrine falcons and rough-legged hawks is apparent, it is most likely representative of natural variability associated with variation in prey availability and weather rather than due to any influence of disturbance. For rough-legged hawks, occupancy appears to be cyclical (approximately 4-year oscillation), and strongly suggests that occupancy (and therefore count of nestlings) is associated with the natural lemming cycle which is also known to cycle approximately every four years (Gilg et al. 2003). On the basis of the analysis to account for distance to disturbance and distance to nearest neighbour individually, and as an interaction, it appears that there is no negative effect of these factors on occupancy (i.e., estimates ± standard errors of λ overlap with 1.0) or reproductive success (i.e., p values > 0.05) for both species. Future monitoring will continue to focus on multiple nesting territory visits annually. Accounting for detection error is an important component of periodic within-season monitoring (to account for the assumption of closure) and, should be conducted a minimum of twice (early incubation and during brood rearing).

5.3 SUMMARY AND TRENDS

- Active migratory bird nest searches (AMBNS) have been conducted since 2013 prior to any proposed land disturbance and/or clearing during the breeding bird window (May 31 – August 31). In 2014, three nests were located during the AMBNS, one at the Mine Site and two at Milne Port; in each of these locations, construction activities were delayed until post fledging. No nests were located during any other year, so no buffers were required.
- Raptor surveys were conducted in 2011 and 2012 as part of the Project's terrestrial baseline surveys, and annual raptor monitoring surveys have been conducted since 2013.
- In 2017, site occupancy, brood size, and nest success were monitored for all known nest sites located within 10 km of the PDA (the Raptor Monitoring Area). Areas with high nest-site suitability for cliff-nesting raptors located between known nest sites were also surveyed.
- A total of 166 unique nesting sites have been detected in the RMA, five of which were detected in 2017. Of these, 63 sites were occupied by raptors in 2017; 50 by peregrine falcon, five by rough–legged hawk, two by gyrfalcon, and four by common raven.

- Although annual variation in productivity for peregrine falcons and rough-legged hawks is apparent, it is most likely representative of natural variability associated with variation in prey availability and weather rather than due to any influence of disturbance.
- For rough-legged hawks, occupancy appears to be cyclical (approximately four-year oscillation), and strongly suggests that occupancy is associated with the natural lemming cycle, which is also known to cycle approximately every four years.
- Occupancy of potential nesting sites by gyrfalcon in the RMA have been too low to monitor annual trends.
- It appears that factors such as distance to disturbance and distance to nearest neighbour (individually and as an interaction) have no negative effect on occupancy or reproductive success for both peregrine falcon and rough-legged hawk.

6 HELICOPTER FLIGHT HEIGHT

Helicopter flight-height management and monitoring are critical for wildlife (particularly calving and post-calving caribou) and staging waterfowl. All wildlife and bird species can be sensitive to disturbance, and low flying helicopters can be stressful for wildlife resulting in increased activity or reduction in forage time. The following Project conditions were issued to address these concerns including:

- Project Condition 59) *"The Proponent shall ensure that aircraft maintain, whenever possible (except for specified operational purposes such as drill moves, take offs and landings), and subject to pilot discretion regarding aircraft and human safety, a cruising altitude of at least 610 metres during point to point travel when in areas likely to have migratory birds, and 1,000 metres vertical and 1,500 metres horizontal distance from observed concentrations of migratory birds (or as otherwise prescribed by the Terrestrial Environment Working Group) and use flight corridors to avoid areas of significant wildlife importance…"*
- Project Condition 71) *"Subject to safety requirements, the Proponent shall require all project related aircraft to maintain a cruising altitude of at least:*
    - *650 m during point to point travel when in areas likely to have migratory birds*
    - *1,100 m vertical and 1500 m horizontal distance from observed concentrations of migratory birds*
    - *1,100 m over the area identified as a key site for moulting snow geese during the moulting period (July–August), and if maintaining this altitude is not possible, maintain a lateral distance of at least 1,500 m from the boundary of this site."*
- Project Condition 72) *"The Proponent shall ensure that pilots are informed of minimum cruising altitude guidelines and that a daily log or record of flight paths and cruising altitudes of aircraft within all Project Areas is maintained and made available for regulatory authorities such as Transport Canada to monitor adherence and to follow up on complaints."*

Baffinland in collaboration with the TEWG committed to *"specific measures to ensure that employees and subcontractors providing aircraft services to the Project are respectful of wildlife and Inuit harvesting that may occur in and around Project areas"* (Qikiqtani Inuit Association and Baffinland Iron Mines Corporation 2014).

To monitor compliance with these Project Conditions, and Baffinland's commitment, data from helicopter flight logs were analyzed to determine if there was compliance with the Project Conditions.

6.1.1 METHODS

As per Project Condition 71, the analysis includes the following aircraft cruising altitudes in consideration of migratory birds during specific time periods:

- 1,100 metres above ground level (magl) and 1,500 m horizontal distance while travelling through the key moulting area for snow geese during July and August;
- 650 magl during point to point travel in areas outside of the goose area, and in all other months in all areas; and

- 1,100 magl vertical and 1,500 m horizontal distance from observed concentrations of migratory birds at all times.

Canadian Helicopters provided monthly flight tracklog data, as well as daily pilot timesheets (with flight details) to provide context and explain the need for non-compliant transits. Point data was provided in feet above sea level and was converted to metres above sea level (masl). A Digital Elevation Model (DEM) was used to estimate ground level elevation value above sea level, which provides point elevation data that is used to calculate the helicopter tracklog's altitude above ground level. To find the elevation above ground level in metres, the masl from the DEM was subtracted from the masl from the helicopter track log, resulting in an analysis that provided a helicopter's approximate metres above ground level (magl) at each tracklog point.

To assure the calculated values were correct; a Quality Assurance/Quality Control procedure was done on the data by querying the status field of the flight tracklog data. It was assumed that when the helicopter status was "wheels off" or "wheels on", the elevation would be at or close to 0.0 magl. The average values from the query show that accuracy is ~ ±12 m.

Data were initially split into two categories: 1) data within the snow goose area in July and August in relation to 1,100 magl elevation requirement and 2) data within and outside the snow goose area in all months in relation to 650 magl. The data sets were then analyzed separately to assess specific flight height allowances using the different areas and elevation values. The flight height data was also cross-referenced with pilot logs from daily timesheets, and any flight data with justifications for flying at lower elevations than required was considered to be compliant. Based on this analysis, flight data was organized into the following six categories:

1. Those data within the snow goose area in July and August, where the 1,100 magl elevation requirement was achieved (compliant);

2. Those data within the snow goose area in July and August where the 1,100 magl elevation requirement was not achieved, but lower elevation flying was justified by pilots (compliant);

3. Those data within the snow goose area in July and August where the 1,100 magl elevation requirement was not achieved and no justification for low level flying was given (non-compliant);

4. Those data within and outside the snow goose area in all months where the 650 magl elevation requirement was achieved (compliant);

5. Those data within and outside the snow goose area in all months where the 650 magl elevation requirement was not achieved, but lower elevation flying was justified by pilots (compliant);

6. Those data within and outside the snow goose area in all months where the 650 magl elevation requirement was not achieved and no justification for low level flying was given (non-compliant).

6.1.2 RESULTS/DISCUSSION

There is a discrepancy between Project Condition 59, suggesting that minimum flight height should be 610 magl in all areas, and Project Condition 71 prescribes a minimum flight height of 650 magl. Considering that most, if not all, areas where Baffinland operated in June through September were likely to have migratory birds, the default minimum altitude for the analysis was 650 magl (during point to point travel).

There were no identified "observed concentrations of migratory birds", nor areas specifically prescribed by the TEWG to avoid for migratory birds in 2017. With exception of the snow goose area, there was no analysis necessary to determine compliance of 1,100 m vertical and 1,500 m horizontal distance of any other location. There were also no known public complaints about helicopter overflights for follow-up as per Project Condition 72. In 2017, Canadian Helicopters operated three helicopters during the summer season; two helicopters have been used in recent years (2015 and 2016).

There were 1,349 total transits flown within the analysis time frame (June – September), of which 358 (27%) intersected the snow goose area and 991 (73%) were outside of the area (Table 21). In 2017, flight height compliance within the snow goose area during the moulting season was 95% (Table 22; Map 10 & Map 11), and compliance within and outside the snow goose area in all months was 76% (Table 23; Map 9 – Map 12).

2017 was the first year that flight height data were cross-referenced with pilot logs from daily timesheets. For analytical purposes, non-compliant flight height data points were converted to represent compliance with Project Conditions in cases where the pilot's discretionary rationale for deviating from flight heights was provided by daily timesheets. If a data point was originally non-compliant and no explanation was given, then the point remained non-compliant. This additional analysis resulted in an increase in helicopter flight height compliance when compared to previous years, as it provided explanations for transits flown lower than the elevation requirements. Some examples given to explain low-level flights included the following:

- Weather
- Slinging
- Staking
- Surveys
- Drop off/pick up
- Demobilization
- Sampling, and
- Evacuations.

This additional analysis showed that when considering rationale provided by pilots for low-level flying, the majority of originally non-compliant helicopter flights were ultimately considered compliant. For example, of all the compliant transits within the snow goose area during the moulting season, only 1% were ≥ 1,100 magl, and the other 99% were < 1,100 magl with reasons given by pilots. Similarly, when looking at all compliant transits within and outside the snow goose area in all months, only 6% were ≥ 650 magl, and the other 94% were < 650 magl with reasons given by pilots. Drop offs and pick ups were stated as the most common reason for flying below the elevation requirements both inside and outside the snow goose area, followed by slinging, surveying and weather.

Overall, 2017 flight height compliance was higher inside the snow goose area compared to outside; however, there were almost triple the amount of transits outside the snow goose area in 2017. Pilots frequently indicated on flight tickets that they made efforts to avoid the snow goose area during the moulting season when possible, and most transits over the snow goose area appeared to be direct flights between Mary River and Steensby, which only skirted the eastern edge of the boundary. The majority of flights near the goose area boundary are within a well-defined track, away from habitat areas that have been identified as having higher concentrations of geese within the goose area. Non-compliant transits were those that did not achieve elevation requirements, and where no rationale for low level flights was provided from pilots. Baffinland will continue to work with Canadian Helicopters to improve flight height compliance by communicating elevation requirements and improving documentation of reasons for not meeting the requirements. Although the majority of transits were below the recommended elevations, the potential disturbance to birds cannot be described.

Table 21 Number of transits flown per month with a breakdown of transits (№ and %) flown over and outside of the snow goose area, June 1– September 30, 2017.

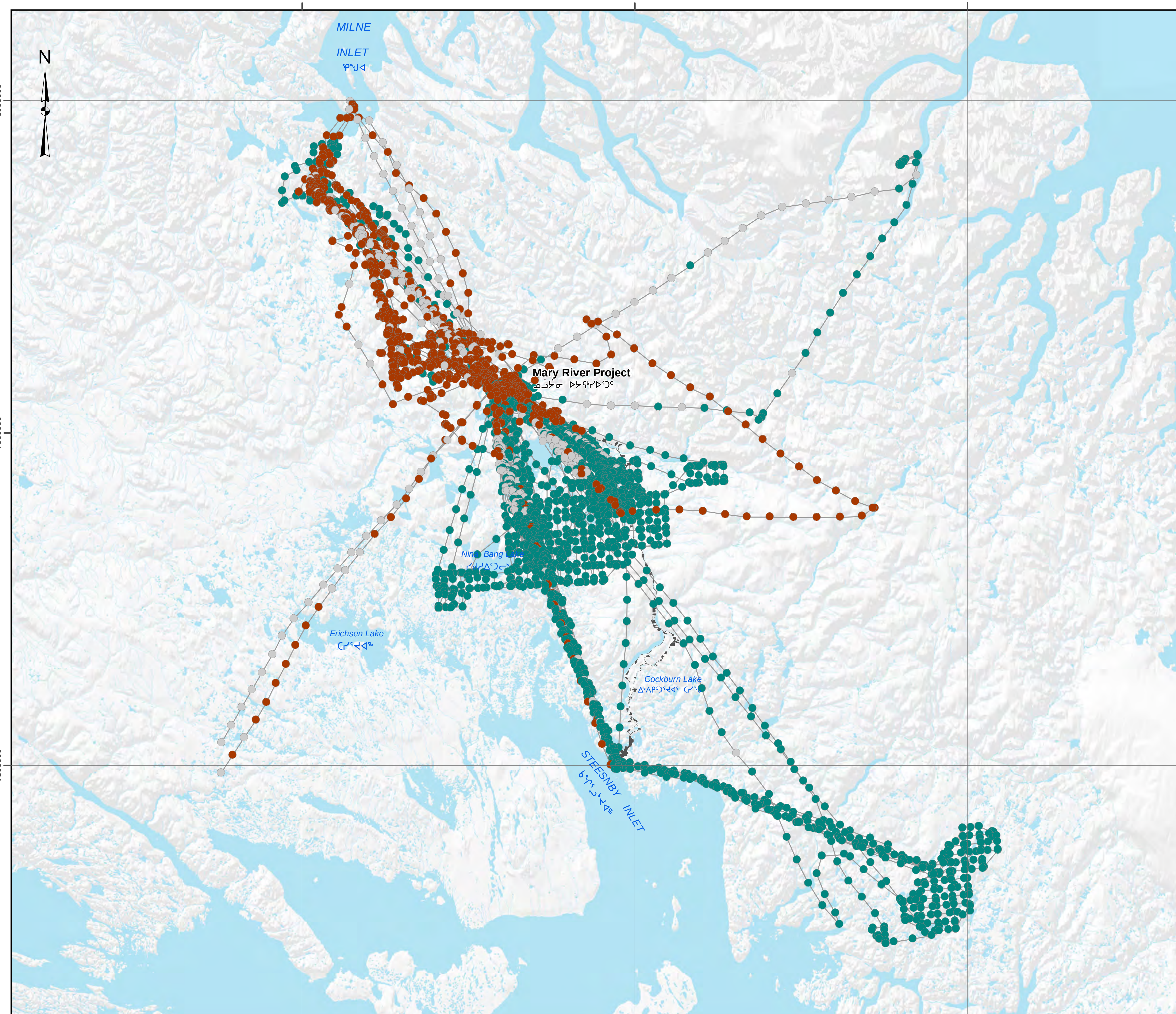
Month	Total № transits	№ transits over snow goose area	% transits over snow goose area	№ transits outside snow goose area	% transits outside snow goose area
June	212	98	46	114	54
July	336	88	26	248	74
August	556	117	21	439	79
September	245	55	22	190	78
Total	**1,349**	**358**	**27**	**991**	**73**

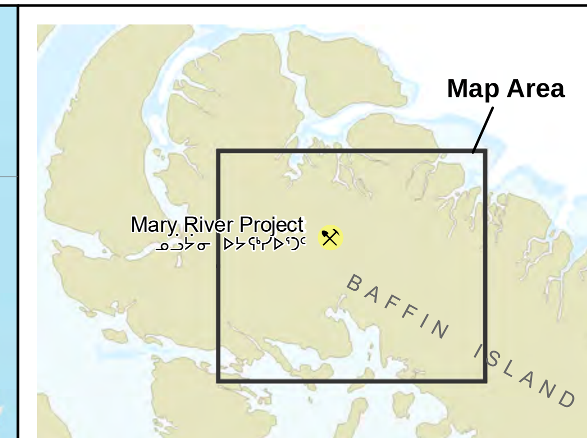
Table 22 Elevation points calculated to obtain flight height compliance over the snow goose area, June 1– September 30, 2017.

Month	Area	Total points	Total № compliant points	% compliance	Total № non–compliant points	% non–compliance
June	Not applicable (n/a)			n/a		
July	Within SNGO Area	410	381	93	29	7
August	Within SNGO Area	827	792	96	35	4
September	Not applicable (n/a)			n/a		
Total		**1,237**	**1,173**	**95**	**64**	**5**

Table 23 Elevation points calculated to obtain flight height compliance outside the snow goose area, June 1–September 30, 2017.

Month	Area	Total points	Total № compliant points	% compliance	Total № non–compliant points	% non–compliance
June	All Areas	3,368	2368	70	1000	30
July	Outside SNGO Area	3,831	2355	61	1476	39
August	Outside SNGO Area	7,384	6576	89	808	11
September	All Areas	3646	2644	73	1002	27
Total		**18,229**	**13,943**	**76**	**4,286**	**24**





LEGEND ᑐᑭᒋᔭᕐᒋᑦ

- Non-Compliant June Flights (GPS points) Below 650 m (agl)
- Compliant – Low Level Flight Required – June Flights (GPS points) Below 650 m (agl)
- Compliant June Flights (GPS points) Above 650 m (agl)
- Helicopter Flight Path
- Potential Development Area ᓄᓇ ᐊᒃᑐᕐᑕᐅᑐᐃᓇᑎᐊᓚᒃ ᓴᕕᒃᓴᕐᓯᐅᕐᑐᓐᓂᑦ

NOTES ᖃᐅᔨᒪᔭᒃᓴᐃᑦ

Map Projection: North American Datum UTM Zone 17N.

Helicopter flight data and tickets collected and provided by Canadian Helicopters (2017).

Potential Disturbance Area provided by Knight Piesold (July, 2017).

This document is not an official land survey and the spatial data presented is subject to change without notice.

Scale ᐊᖏᓂᖓ 0 10 20 30 40 50 60 Km ᑭᓚᒥᑦ

Baffinland

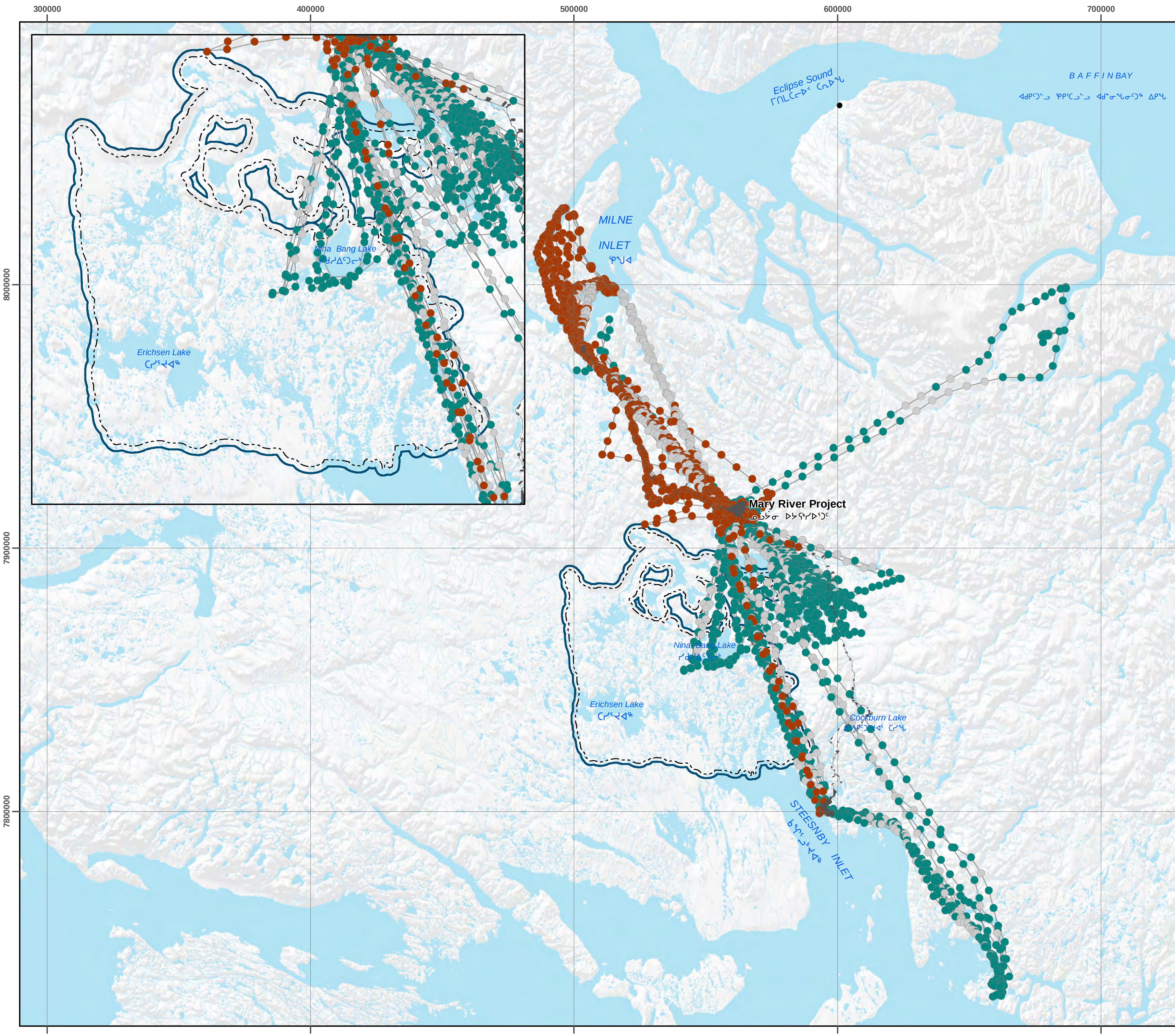
Overview Map of Helicopter Flight Paths for June, 2017

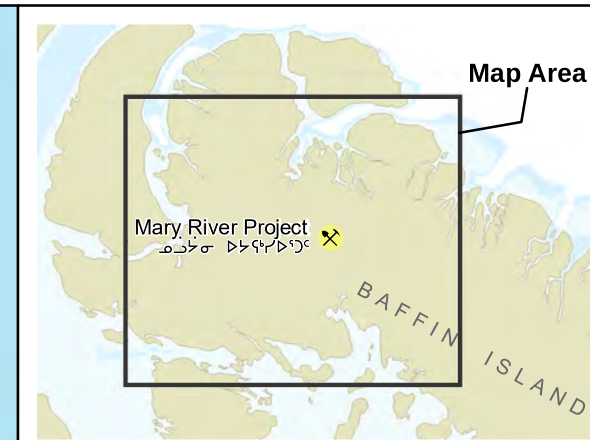
EDI

Date: 1/30/2018

MAP 9

Path: O:\2017\17Y0152_BIM_Monitoring\GIS\Final\FlightCompliance_Revision_20180124\Map9_June_Overview_20180124.mxd





LEGEND

- Non-Compliant July Flights (GPS points) Inside the SGMA and Below 1,100 m (agl); Outside the SGMA and Below 650 m (agl)
- Compliant – Low Level Flight Required – July Flights (GPS points) Inside the SGMA and Below 1,100 m (agl); Outside the SGMA and Below 650 m (agl)
- Compliant July Flights (GPS points) Inside the SGMA and Above 1,100 m (agl); Outside the SGMA and Above 650 m (agl)
- Helicopter Flight Path
- Environment Canada Area of Interest (Geese)
- Environment Canada Area of Interest (Geese) 1500 m Buffer
- Potential Development Area

NOTES

Map Projection: North American Datum UTM Zone 17N.

Helicopter flight data and tickets collected and provided by Canadian Helicopters (2017).

Potential Disturbance Area provided by Knight Piesold (July, 2017).

This document is not an official land survey and the spatial data presented is subject to change without notice.

Scale 0 10 20 30 40 50 Km

Baffinland

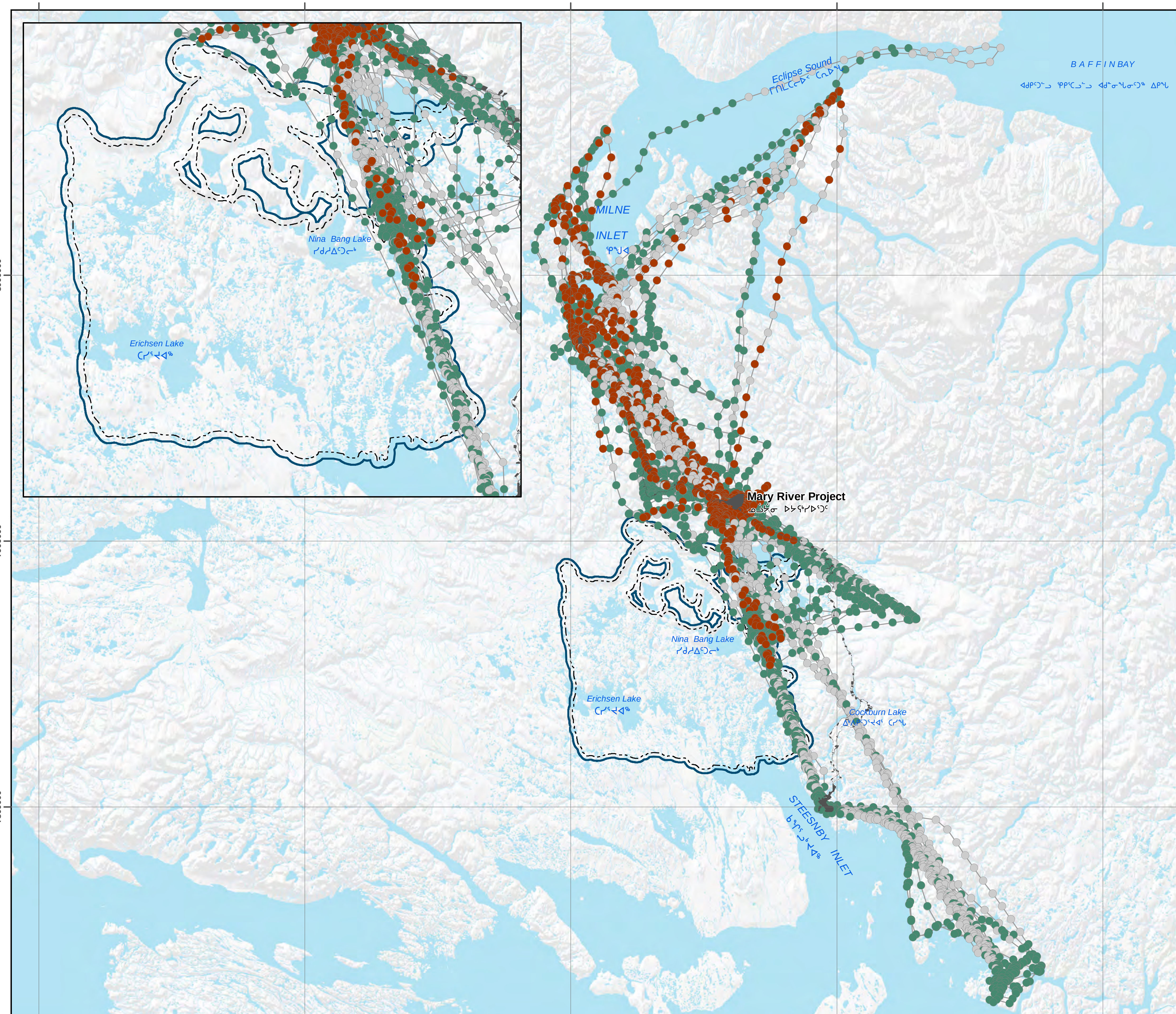
Overview Map of Helicopter Flight Paths for July, 2017

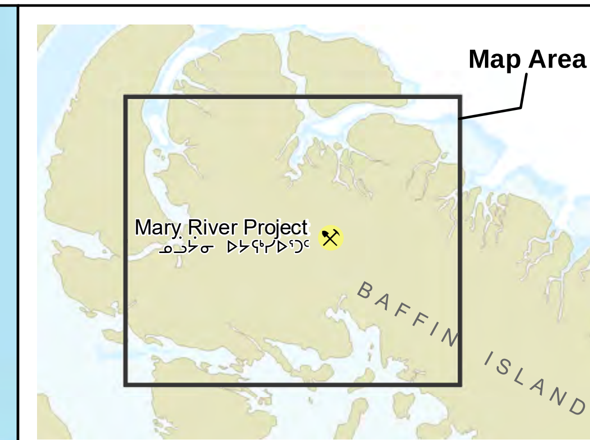
EDI

Date: 1/30/2018

MAP 10

Path: O:\2017\17Y0152_BIM_Monitoring\GIS\Final\FlightCompliance_Revision_20180124\Map10_July_Overview_20180124.mxd





LEGEND

- Non-Compliant August Flights (GPS points) Inside the SGMA and Below 1,100 m (agl); Outside the SGMA and Below 650 m (agl)
- Compliant – Low Level Flight Required – August Flights (GPS points) Inside the SGMA and Below 1,100 m (agl); Outside the SGMA and Below 650 m (agl)
- Compliant August Flights (GPS points) Inside the SGMA and Above 1,100 m (agl); Outside the SGMA and Above 650 m (agl)
- Helicopter Flight Path
- Environment Canada Area of Interest (Geese)
- Environment Canada Area of Interest (Geese) 1500 m Buffer
- Potential Development Area

NOTES

Map Projection: North American Datum UTM Zone 17N.

Helicopter flight data and tickets collected and provided by Canadian Helicopters (2017).

Potential Disturbance Area provided by Knight Piesold (July, 2017).

This document is not an official land survey and the spatial data presented is subject to change without notice.

Scale 0 10 20 30 40 50 Km

Baffinland

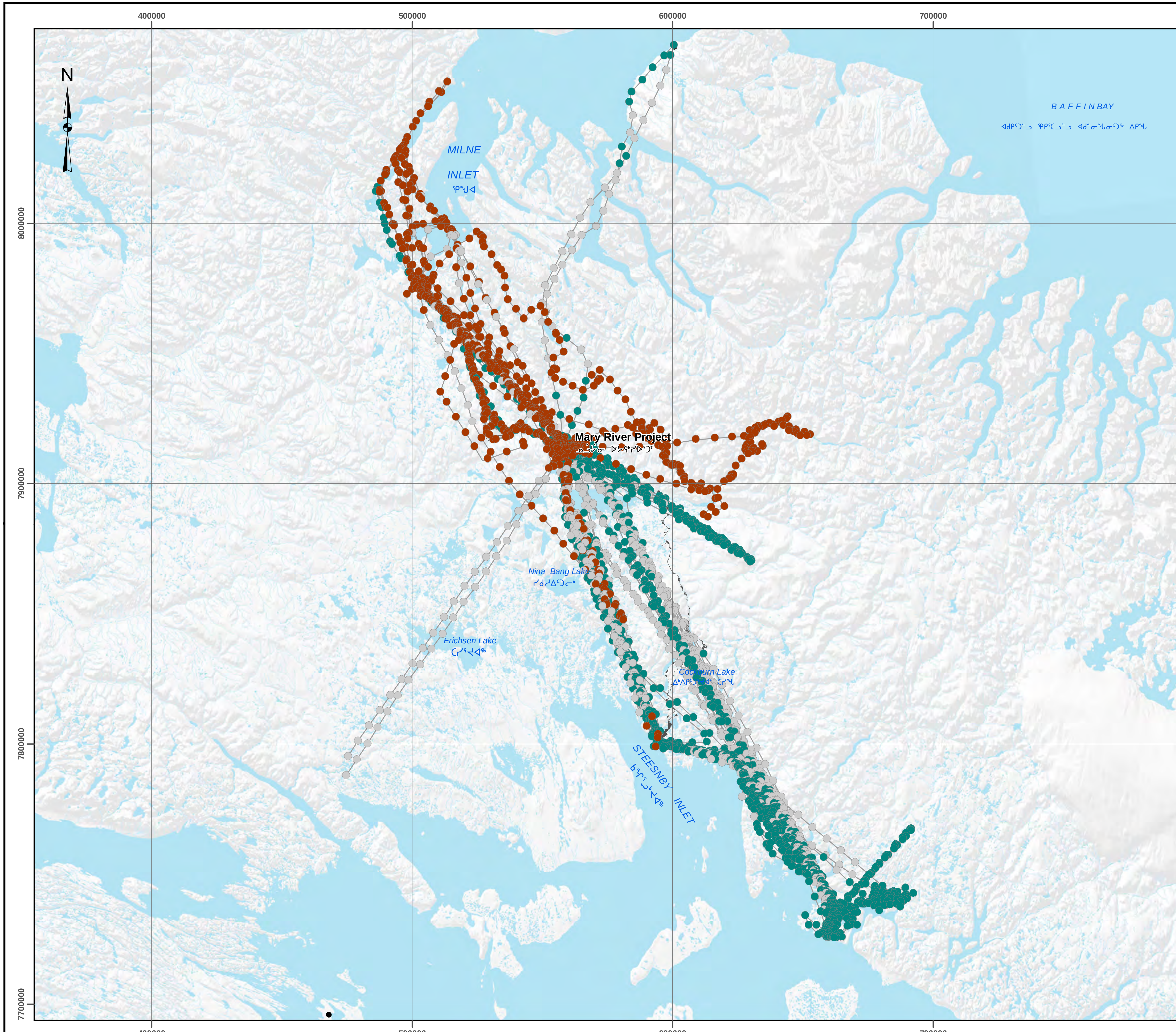
Overview Map of Helicopter Flight Paths for August, 2017

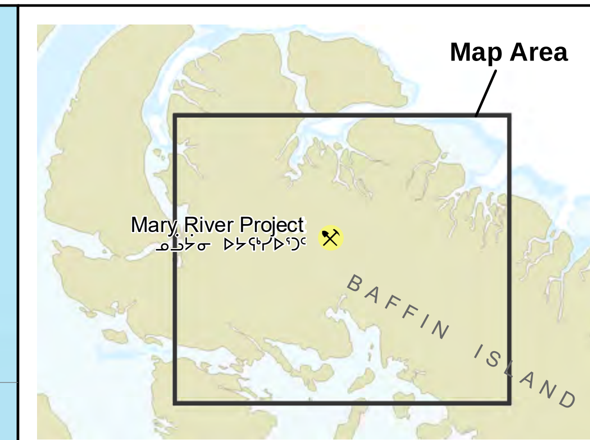
EDI

Date: 1/30/2018

MAP 11

Path: O:\2017\17Y0152_BIM_Monitoring\GIS\Final\FlightCompliance_Revision_20180124\Map11_August_Overview_20180124.mxd





LEGEND

- Non-Compliant September Flights (GPS points) Below 650 m (agl)
- Compliant – Low Level Flight Required – September Flights (GPS points) Below 650 m (agl)
- Compliant September Flights (GPS points) Above 650 m (agl)
- Helicopter Flight Path
- Potential Development Area

NOTES

Map Projection: North American Datum UTM Zone 17N.

Helicopter flight data and tickets collected and provided by Canadian Helicopters (2017).

Potential Disturbance Area provided by Knight Piesold (July, 2017).

This document is not an official land survey and the spatial data presented is subject to change without notice.

Scale 0 10 20 30 40 50 60 Km

Baffinland

Overview Map of Helicopter Flight Paths for September, 2017

EDI

Date: 1/30/2018

MAP 12

Path: O:\2017\17Y0152_BIM_Monitoring\GIS\Final\FlightCompliance_Revision_20180124\Map12_Sept_Overview_20180124.mxd

6.1.3 SUMMARY AND TRENDS

- Helicopter flight height compliance inside the goose area during moulting period was considerably higher in 2017 (95%) than in 2015 (55%) and 2016 (10%) (Figure 35). This increase was largely due to an additional analysis performed in 2017, which considered justifications provided by pilots for many of the transits flown below the elevation requirements. For analytical purposes, non-compliant data points were converted to represent compliance with Project Conditions in cases where reasonable rationale were provided on daily timesheets. If a data point was originally non-compliant and no explanation was given, then the point remained non-compliant.
- Helicopter flight height compliance within and outside the goose area in all months was higher in 2017 (76%) than in 2015 (40%) and 2016 (33%), which was also largely due to the additional analysis performed in 2017, as stated above (Figure 35).

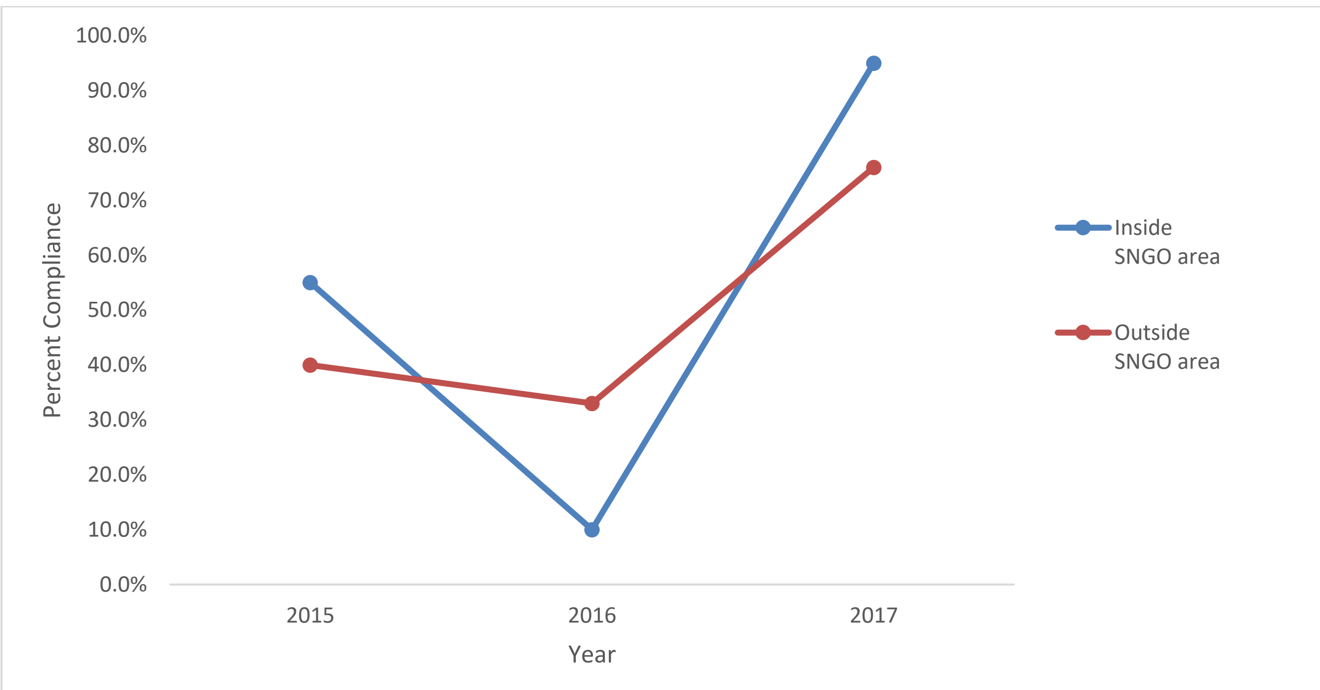


Figure 35 Percent compliance for flights inside the goose area during the moulting season and within and outside the goose area in all months from 2015–2017.

7 WILDLIFE INTERACTIONS AND MORTALITIES

Although wildlife interactions and mortalities related to human presence within the Project area are uncommon and measures are taken to avoid them, incidents did occur in 2017. When a wildlife interaction or mortality occurs, an incident report is drafted and an investigation is undertaken to better understand the circumstances. As a result of the investigation, mitigation methods are implemented to address the areas of concern to help prevent further interactions and mortalities.

7.1 WILDLIFE INTERACTIONS AND MORTALITIES IN 2017

In 2017, seven non-fatal wildlife interactions and 15 wildlife mortality incidents were reported, all of which were individual losses. Almost all of the non-fatal wildlife interactions reported involved Arctic fox in areas with attractants, such as the incinerator or garbage bins at either the Mine Site or Port Site. Most of the mortalities that occurred in 2017 involved Arctic fox (a total of 12 individuals), and three Arctic hares were also killed. Ten of the fatalities were a result of vehicle-wildlife collisions, and two Arctic fox were put down; one due to a fatal leg injury from an interaction with the kitchen garbage bin, and the other for aggressively pursuing an employee. The aggressive fox tested positive for rabies. Nine of the wildlife mortalities in 2017 occurred on the Tote Road, two occurred at the Port Site, and four at or around the Mine Site.

7.2 WILDLIFE INTERACTION AND MORTALITY PREVENTION MEASURES

Baffinland continues to mitigate Wildlife Interactions on the Project area by training, enforcing, and monitoring waste management practices and guidelines. All management and supervisors attend mandatory Environment Protection Plan (EPP) training, which is then passed on to all employees. Included in the EPP are wolf, polar bear, Arctic fox and caribou Protection measures and Waste Management guidelines that are continually updated and implemented. Incineration and proper waste sorting are the most prominent deterrents used. Wildlife attractants such as food scraps and human waste are sorted and sealed in animal proof containers and incinerated on site. Posted around each site are waste sorting guidelines that clearly define where food and other attractants should be placed. Other deterrents used include metal skirting to minimalize wildlife entry under buildings. Wire skirting is used under the main camps at both sites to ensure no wildlife such as foxes or hares den underneath. For equipment, honking your horn before starting the vehicle helps to scare off wildlife that might be hiding in the equipment. Wildlife has the right of way on all roadways, unless unsafe to do so. Snow banks along Tote Road are reduced where feasible by feathering back snow with equipment to ensure personnel along Tote Road have visual view of wildlife crossing the road. Feeding of wildlife is strictly prohibited and noncompliance is dealt with accordingly.

7.3 SUMMARY AND TRENDS

- In 2017, twelve Arctic fox and three Arctic hare mortalities were reported, which is consistent with reports from previous years, except for 2015, where only three Arctic fox mortalities were reported. A total of twelve waterfowl mortalities have been reported since 2014, two in 2014 and 10 in 2016. No caribou mortalities have occurred thus far as a result of the Project (Figure 36).

- The majority of mortalities that have occurred on site have been attributed to wildlife-vehicle collisions. Other reported causes of mortality include: fatal injuries incurred from heavy machinery or Project infrastructure, and euthanasia by on-site staff due to aggressive behaviour towards employees.

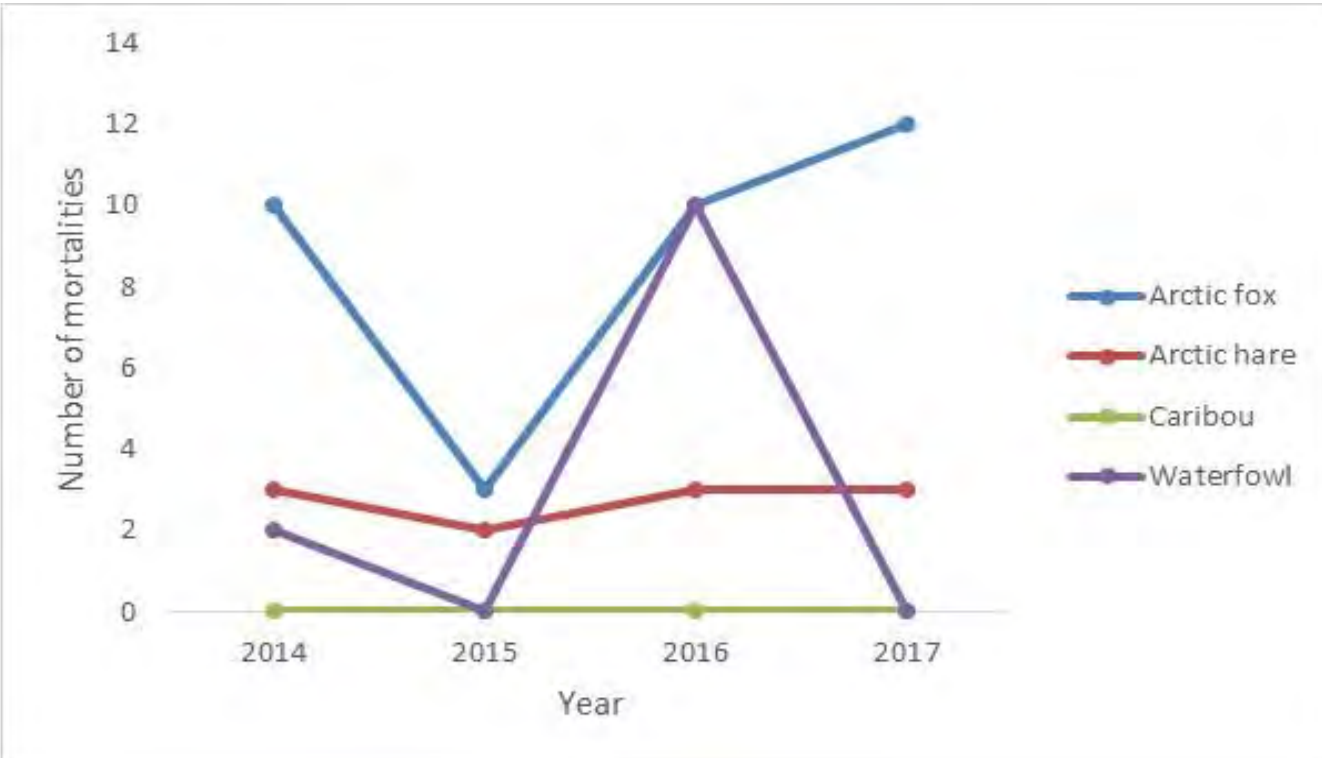


Figure 36 Wildlife mortality trends from 2014 –2017.

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APPENDIX A. VEGETATION ABUNDANCE MONITORING SITES FOR EXCLOSURE (I.E., CLOSED) AND OPEN PLOTS IN THE RSA, 2014 & 2016

Table A-1 Vegetation Abundance Monitoring Sites for Exclosure (i.e., Closed) and Open Plots in the RSA, 2014 and 2016.

Site Location	Transect/ Control No.	Plot ID[1]	Actual distance to PDA (m)	Treatment type	Latitude	Longitude
Mine Site	1	T1D30A	29	Open	71.32020	-79.35944
Mine Site	1	T1D30X	29	Closed	71.32016	-79.35923
Mine Site	1	T1D100A	102	Open	71.31966	-79.36069
Mine Site	1	T1D100X	102	Closed	71.31964	-79.36049
Mine Site	1	T1D750A	751	Open	71.31495	-79.37126
Mine Site	1	T1D750X	751	Closed	71.31495	-79.37126
Mine Site	1	T1D1200A	1,191	Open	71.31239	-79.38171
Mine Site	1	T1D1200X	1,186	Closed	71.31243	-79.38161
Mine Site	2	T2D30A	19	Open	71.31922	-79.19151
Mine Site	2	T2D30X	16	Closed	71.31921	-79.19163
Mine Site	2	T2D100A	175	Open	71.31862	-79.18756
Mine Site	2	T2D100X	174	Closed	71.31871	-79.18748
Mine Site	2	T2D750A	765	Open	71.31549	-79.17373
Mine Site	2	T2D750X	765	Closed	71.31549	-79.17373
Mine Site	2	T2D1200A	1,178	Open	71.31269	-79.16479
Mine Site	2	T2D1200B	1,177	Open	71.31271	-79.16478
Mine Site	2	T2D1200X	1,179	Closed	71.31264	-79.16482
Mine Site	3	T3D30A	30	Open	71.34010	-79.31164
Mine Site	3	T3D30X	34	Closed	71.34013	-79.31172
Mine Site	3	T3D100A	87	Open	71.34042	-79.31307
Mine Site	3	T3D100B	98	Open	71.34051	-79.31317
Mine Site	3	T3D100X	103	Closed	71.34054	-79.31329
Mine Site	3	T3D750A	734	Open	71.34668	-79.31554
Mine Site	3	T3D750X	730	Closed	71.34664	-79.31550
Mine Site	3	T3D71200A	1,445	Open	71.35172	-79.32806
Mine Site	3	T3D1200X	1,445	Closed	71.35172	-79.32806
Tote Road	4	T4D30A	35	Open	71.34193	-79.54399

Site Location	Transect/ Control No.	Plot ID[1]	Actual distance to PDA (m)	Treatment type	Latitude	Longitude
Tote Road	4	T4D30X	36	Closed	71.34193	-79.54398
Tote Road	4	T4D100A	95	Open	71.31234	-79.54282
Tote Road	4	T4D100X	98	Closed	71.34231	-79.54267
Tote Road	4	T4D750A	830	Open	71.34631	-79.52631
Tote Road	4	T4D750B	831	Open	71.34626	-79.52620
Tote Road	4	T4D750X	832	Closed	71.34362	-79.52609
Tote Road	4	T4D1200A	1,268	Open	71.34653	-79.51250
Tote Road	4	T4D1200X	1,268	Closed	71.34653	-79.51250
Tote Road	5	T5D30A	21	Open	71.37588	-79.73111
Tote Road	5	T5D30X	22	Closed	71.37586	-79.73100
Tote Road	5	T5D100A	86	Open	71.37511	-79.73049
Tote Road	5	T5D100X	89	Closed	71.37508	-79.73042
Tote Road	5	T5D750A	730	Open	71.36990	-79.73830
Tote Road	5	T5D750B	738	Open	71.36984	-79.73837
Tote Road	5	T5D750X	740	Closed	71.36983	-79.73842
Tote Road	5	T5D1200A	1,106	Open	71.36624	-79.73808
Tote Road	5	T5D1200X	1,139	Closed	71.36585	-79.73741
Tote Road	6	T6D30A	42	Open	71.38194	-79.99419
Tote Road	6	T6D30B	44	Open	71.38197	-79.99432
Tote Road	6	T6D30X	41	Closed	71.38196	-79.99448
Tote Road	6	T6D100A	91	Open	71.38248	-79.99201
Tote Road	6	T6D100X	91	Closed	71.38248	-79.99219
Tote Road	6	T6D750A	694	Open	71.38803	-79.99321
Tote Road	6	T6D750X	694	Closed	71.38803	-79.99321
Tote Road	6	T6D1200A	1,225	Open	71.39247	-79.98299
Tote Road	6	T6D1200X	1,226	Closed	71.39249	-79.98305
Milne Inlet	7	T7D30A	26	Open	71.87114	-80.87792

Site Location	Transect/ Control No.	Plot ID[1]	Actual distance to PDA (m)	Treatment type	Latitude	Longitude
Milne Inlet	7	T7D30X	26	Closed	71.87122	-80.87794
Milne Inlet	7	T7D100A	105	Open	71.87211	-80.87576
Milne Inlet	7	T7D100X	99	Closed	71.87212	-80.87593
Milne Inlet	7	T7D750A	884	Open	71.86808	-80.85032
Milne Inlet	7	T7D750B	874	Open	71.86797	-80.85041
Milne Inlet	7	T7D750X	871	Open	71.86788	-80.85025
Milne Inlet	7	T7D1200A	1,136	Open	71.87198	-80.84419
Milne Inlet	7	T7D1200B	1,135	Open	71.87201	-80.84426
Milne Inlet	7	T7D1200X	1,133	Closed	71.87203	-80.84431
Milne Inlet	8	T8D30A	51	Open	71.88273	-80.87804
Milne Inlet	8	T8D30X	54	Closed	71.88277	-80.87793
Milne Inlet	8	T8D100A	90	Open	71.88243	-80.87705
Milne Inlet	8	T8D100X	94	Closed	71.88245	-80.87691
Milne Inlet	8	T8D750A	818	Open	71.88108	-80.85626
Milne Inlet	8	T8D750B	822	Open	71.88110	-80.85614
Milne Inlet	8	T8D750X	826	Closed	71.88111	-80.85604
Milne Inlet	8	T8D1200A	1,098	Open	71.88471	-80.84666
Milne Inlet	8	T8D1200X	1,104	Closed	71.88476	-80.84648
Mine Site	9	T9D30A	32	Open	71.29982	-79.26338
Mine Site	9	T9D30X	32	Closed	71.29981	-79.26321
Mine Site	9	T9D100A	135	Open	71.29912	-79.26827
Mine Site	9	T9D100X	134	Closed	71.29915	-79.26846
Mine Site	9	T9D750A	713	Open	71.29443	-79.27907
Mine Site	9	T9D750B	708	Open	71.29448	-79.27903
Mine Site	9	T9D750X	701	Closed	71.29453	-79.27890
Mine Site	9	T9D1200A	1,186	Open	71.29173	-79.29365

Site Location	Transect/ Control No.	Plot ID[1]	Actual distance to PDA (m)	Treatment type	Latitude	Longitude
Mine Site	9	T9D1200X	1,182	Closed	71.29176	-79.29358
Mine Site	10	T10D30A	28	Open	71.34274	-79.29750
Mine Site	10	T10D30X	34	Closed	71.34280	-79.29755
Mine Site	10	T10D100A	127	Open	71.34355	-79.29861
Mine Site	10	T10D100B	127	Open	71.34355	-79.29861
Mine Site	10	T10D100X	127	Closed	71.34355	-79.29861
Mine Site	10	T10D750A	650	Open	71.34911	-79.29802
Mine Site	10	T10D750X	650	Closed	71.34911	-79.29802
Mine Site	10	T10D1200A	1,219	Open	71.35276	-79.31007
Mine Site	10	T10D1200X	1,219	Closed	71.35276	-79.31007
Mine Site	11	T11D30A	29	Open	71.31259	-79.19954
Mine Site	11	T11D30X	17	Closed	71.31273	-79.19974
Mine Site	11	T11D100A	233	Open	71.31095	-79.19546
Mine Site	11	T11D100X	233	Closed	71.31095	-79.19546
Mine Site	11	T11D750A	804	Open	71.30648	-79.18466
Mine Site	11	T11D750B	805	Open	71.30640	-79.18483
Mine Site	11	T11D750X	802	Closed	71.30642	-79.18486
Mine Site	11	T11D1200A	1,219	Open	71.30536	-79.17309
Mine Site	11	T11D1200X	1,225	Closed	71.30538	-79.17287
Tote Road	12	T12D30A	55	Open	71.41457	-80.1019
Tote Road	12	T12D30X	50	Closed	71.41467	-80.1021
Tote Road	12	T12D100A	113	Open	71.41430	-80.10019
Tote Road	12	T12D100X	113	Closed	71.4143	-80.10019
Tote Road	12	T12D750A	757	Open	71.41617	-80.08279
Tote Road	12	T12D750B	757	Open	71.41617	-80.08279
Tote Road	12	T12D750X	757	Closed	71.41617	-80.08279

Site Location	Transect/ Control No.	Plot ID[1]	Actual distance to PDA (m)	Treatment type	Latitude	Longitude
Tote Road	12	T12D1200A	1,141	Open	71.41851	-80.07372
Tote Road	12	T12D1200X	1,140	Closed	71.41859	-80.07383
Tote Road	13	T13D30A	35	Open	71.42143	-80.10964
Tote Road	13	T13D30B	35	Open	71.42143	-80.10964
Tote Road	13	T13D30X	35	Closed	71.42143	-80.10964
Tote Road	13	T13D100A	87	Open	71.42149	-80.10794
Tote Road	13	T13D100X	87	Closed	71.42149	-80.10794
Tote Road	13	T13D750A	669	Open	71.42509	-80.09329
Tote Road	13	T13D750X	674	Closed	71.42512	-80.09317
Tote Road	13	T13D1200A	1,166	Open	71.42884	-80.08349
Tote Road	13	T13D1200X	1,165	Closed	71.42895	-80.08375
Milne Inlet	14	T14D30A	43	Open	71.87797	-80.87826
Milne Inlet	14	T14D30X	37	Closed	71.87815	-80.87845
Milne Inlet	14	T14D100A	129	Open	71.87736	-80.87571
Milne Inlet	14	T14D100X	118	Closed	71.87738	-80.87601
Milne Inlet	14	T14D750A	756	Open	71.87649	-80.85755
Milne Inlet	14	T14D750X	749	Closed	71.87649	-80.85775
Milne Inlet	14	T14D1200A	1,178	Open	71.87772	-80.84550
Milne Inlet	14	T14D1200B	1,173	Open	71.87770	-80.84564
Milne Inlet	14	T14D1200X	1,170	Closed	71.87766	-80.84573
Milne Inlet	15	T15D30A	48	Open	71.87430	-80.87769
Milne Inlet	15	T15D30X	50	Closed	71.87434	-80.87763
Milne Inlet	15	T15D100A	104	Open	71.87393	-80.87603
Milne Inlet	15	T15D100X	100	Closed	71.87391	-80.87615
Milne Inlet	15	T15D750A	812	Open	71.87411	-80.85563
Milne Inlet	15	T15D750X	806	Closed	71.87427	-80.85583

Site Location	Transect/ Control No.	Plot ID[1]	Actual distance to PDA (m)	Treatment type	Latitude	Longitude
Milne Inlet	15	T15D1200A	1,130	Open	71.87504	-80.84659
Milne Inlet	15	T15D1200X	1,126	Closed	71.87500	-80.84671
Total	**--**	**133 plots**	--	--	--	--
Control	1	REF1A	19,450	Open	71.16658	-79.71055
Control	1	REF1B	19,448	Open	71.16658	-79.71037
Control	1	REF1X	19,450	Closed	71.16655	-79.71028
Control	2	REF2A	20,409	Open	71.51695	-78.91855
Control	2	REF2B	20,410	Open	71.51694	-78.91845
Control	2	REF2X	20,407	Closed	71.51690	-78.91839
Control	3	REF3A	20,595	Open	71.85313	-79.99586
Control	3	REF3B	20,593	Open	71.85307	-79.99581
Control	3	REF3X	20,594	Closed	71.85302	-79.99567
Control	4	REF4A	21,178	Open	71.88674	-80.05467
Control	4	REF4B	21,185	Open	71.88678	-80.05450
Control	4	REF4X	21,190	Closed	71.88680	-80.05435
Control	5	REF5A	33,185	Open	71.65634	-79.34103
Control	5	REF5B	33,184	Open	71.65635	-79.34108
Control	5	REF5X	33,184	Closed	71.65638	-79.34125
Control	6	REF6A	16,435	Open	71.29160	-80.39122
Control	6	REF6B	16,429	Open	71.29161	-80.39097
Control	6	REF6X	16,432	Closed	71.29155	-80.39089
Total	**--**	**18 plots**	--	--	--	--
Total (66 sites)	**--**	**151 plots**	--	--	--	--

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APPENDIX B. VEGETATION AND SOIL BASE METALS MONITORING LOCATIONS

Table B-1. Vegetation and soil base metal sample sites, including control sites (*) within the RSA, 2012–2016.

Location	Site ID[1]	Soil	Lichen	Willow	Blueberry	Distance to PDA (m)[2]	Distance Category	Distance Class (m)	Associated Dust Fall Site[3]	Latitude	Longitude
2016 Sampling											
Milne Port	L-91	1	1			67	Near	0-100	n/a	71.8819	-80.8780
Milne Port	L-92	1	1			46	Near	0-100	n/a	71.8814	-80.8786
Milne Port	L-93	1	1			173	Far	101-1000	n/a	71.8818	-80.8750
Milne Port	L-94	1	1			24	Near	0-100	n/a	71.8809	-80.8791
Milne Port	L-95	1	1			30	Near	0-100	n/a	71.8801	-80.8789
Milne Port	L-96	1	1			45	Near	0-100	n/a	71.8791	-80.8783
Milne Port	L-97	1	1			57	Near	0-100	n/a	71.8785	-80.8779
Milne Port	L-98	1	1			40	Near	0-100	n/a	71.8777	-80.8783
Milne Port	L-99	1	1			17	Near	0-100	n/a	71.8772	-80.8789
Milne Port	L-100	1	1			37	Near	0-100	n/a	71.8767	-80.8783
Milne Port	L-101	1	1			51	Near	0-100	n/a	71.8761	-80.8778
Milne Port	L-102	1	1			424	Far	101-1000	n/a	71.8757	-80.8670
Milne Port	L-103	1	1			650	Far	101-1000	n/a	71.8765	-80.8606
Milne Port	L-104	1	1			805	Far	101-1000	n/a	71.8748	-80.8559
Milne Port	L-105	1	1			1823*	Control	>1000	n/a	71.8770	-80.8268
Milne Port	L-106	1	1			3218*	Control	>1000	DF-P-03	71.8999	-80.7902
Tote Road	L-68	1	1			55	Near	0-100	n/a	71.3884	-79.8766
Tote Road	L-69	1	1			24	Near	0-100	n/a	71.3904	-79.8657
Tote Road	L-70	1	1			91	Near	0-100	n/a	71.3933	-79.8671
Tote Road	L-71	1	1			52	Near	0-100	n/a	71.3944	-79.8560
Tote Road	L-72	1	1			56	Near	0-100	n/a	71.3967	-79.8428
Tote Road	L-73	1	1			63	Near	0-100	n/a	71.3984	-79.8325
Tote Road	L-74	1	1			71	Near	0-100	DF-RS-03	71.3962	-79.8227
Tote Road	L-75	1	1			231	Far	101-1000	n/a	71.3948	-79.8217
Tote Road	L-76	1	1			546	Far	101-1000	DF-RS-02	71.3896	-79.8326

Location	Site ID[1]	Soil	Lichen	Willow	Blueberry	Distance to PDA (m)[2]	Distance Category	Distance Class (m)	Associated Dust Fall Site[3]	Latitude	Longitude
Tote Road	L-77	1	1			953	Far	101-1000	DF-RS-07	71.4079	-79.8187
Tote Road	L-78	1	1			36	Near	0-100	n/a	71.3922	-79.7995
Tote Road	L-79	1	1			72	Near	0-100	n/a	71.3891	-79.7862
Tote Road	L-80	1	1			77	Near	0-100	n/a	71.3904	-79.7759
Tote Road	L-107	1	1			6121*	Control	>1000	n/a	71.3259	-79.8008
Tote Road	L-108	1	1			6855*	Control	>1000	n/a	71.4515	-79.7117
Tote Road	L-116	1	1			411	Far	101-1000	n/a	71.3833	-79.8862
Mine Site	L-81	1	1			58	Near	0-100	n/a	71.3001	-79.2737
Mine Site	L-82	1	1			72	Near	0-100	n/a	71.2997	-79.2679
Mine Site	L-83	1	1			90	Near	0-100	n/a	71.3101	-79.2012
Mine Site	L-84	1	1			86	Near	0-100	n/a	71.3101	-79.2043
Mine Site	L-85	1	1			68	Near	0-100	n/a	71.3102	-79.2114
Mine Site	L-86	1	1			50	Near	0-100	n/a	71.3094	-79.2215
Mine Site	L-87	1	1			64	Near	0-100	n/a	71.3089	-79.2263
Mine Site	L-88	1	1			59	Near	0-100	n/a	71.3075	-79.2346
Mine Site	L-89	1	1			92	Near	0-100	n/a	71.3047	-79.2379
Mine Site	L-90	1	1			401	Far	101-1000	n/a	71.3182	-79.3691
Mine Site	L-109	1	1			8808*	Control	>1000	DF-M-04	71.2208	-79.3274
Mine Site	L-110	1	1			2449*	Control	>1000	n/a	71.2981	-79.1020
Mine Site	L-111	1	1			10386*	Control	>1000	n/a	71.3860	-78.9034
Mine Site	L-112	1	1			1046*	Control	>1000	DF-M-06	71.3202	-79.1594
Mine Site	L-113	1	1			1185*	Control	>1000	DF-M-06	71.3196	-79.1560
Mine Site	L-114	1	1			390	Far	101-1000	n/a	71.3098	-79.1921
Mine Site	L-115	1	1			451	Far	101-1000	n/a	71.3105	-79.1894
Mine Site	L-117	1	1			50	Near	0-100	n/a	71.2998	-79.2657
2016 Total	50	50	50								
2014 Sampling											

Location	Site ID[1]	Soil	Lichen	Willow	Blueberry	Distance to PDA (m)[2]	Distance Category	Distance Class (m)	Associated Dust Fall Site[3]	Latitude	Longitude
Milne Port	L-56	1	1	1		0	Near	0-100	DF04-P	71.87094399	-80.8824
Milne Port	L-57	1		1		0	Near	0-100	DF06-P	71.88576596	-80.8790
Milne Port	L-58	1	1			0	Near	0-100	DF07-P	71.8837833	-80.9159
Tote Road	L-59	1	1	1		13,177*	Control	>1000	n/a	71.77518301	-80.1047
Tote Road	L-60	1	1	1	1	0	Near	0-100	n/a	71.34229903	-79.5512
Tote Road	L-61	1	1	1	1	417	Far	101-1000	n/a	71.33833104	-79.5246
Tote Road	L-63	1	1	1		10,630*	Control	>1000	n/a	71.88054102	-80.4592
Mine Site	L-64	1	1			1,184*	Control	>1000	DF06-M	71.31956303	-79.1559
Mine Site	L-67	1	1	1	1	3,347*	Control	>1000	DF09-M	71.29357201	-79.4128
Rail	L-62	1	1	1	1	0	Near	0-100	n/a	71.13236102	-78.3563
Rail	L-65	1	1	1		316	Far	101-1000	DF07-M	71.30001199	-79.1953
Rail	L-66	1	1	1		2,141*	Control	>1000	DF08-M	71.29453802	-79.1001
2014 Total	12	12	11	10	4						
2013 Sampling											
Milne Port	L-01	1	1			0	Near	0-100	n/a	71.8850	-80.8911
Milne Port	L-02	1	1	1		3,269*	Control	>1000	DF03-P	71.8996	-80.7884
Milne Port	L-03	1	1		1	0	Near	0-100	n/a	71.8702	-80.8843
Tote Road	L-04	1	1	1		4,491*	Control	>1000	DF01-RN	71.6882	-80.5362
Tote Road	L-05	1	1	1		941	Far	101-1000	DF02-RN	71.6883	-80.5363
Tote Road	L-06	1	1	1		15	Near	0-100	DF03-RN	71.7186	-80.4473
Tote Road	L-07	1	1			25	Near	0-100	DF06-RN	71.7189	-80.4397
Tote Road	L-08	1	1	1		920	Far	101-1000	DF07-RN	71.7226	-80.4165
Tote Road	L-09	1	1	1		5,864*	Control	>1000	DF08-RN	71.7435	-80.2898
Tote Road	L-10	1		1		13,938*	Control	>1000	DF01-RR	71.2805	-80.245
Tote Road	L-12	1	1	1	1	941	Control	>1000	DF02-RN	71.7145	-80.4704
Tote Road	L-14	1	1			571	Far	101-1000	DF02-RS	71.3894	-79.8324
Tote Road	L-15	1	1		1	9	Near	0-100	DF03-RS	71.3967	-79.8228

Location	Site ID[1]	Soil	Lichen	Willow	Blueberry	Distance to PDA (m)[2]	Distance Category	Distance Class (m)	Associated Dust Fall Site[3]	Latitude	Longitude
Tote Road	L-16	1	1	1		1	Near	0-100	DF06-RS	71.3986	-79.8234
Tote Road	L-17	1	1	1		936	Far	101-1000	DF07-RS	71.4077	-79.8182
Tote Road	L-19	1		1		6,628*	Control	>1000	DF08-RS	71.4489	-79.7107
Tote Road	L-22	1		1		5,948*	Control	>1000	DF01-RS	71.3275	-79.8001
Mine Site	L-23	1	1		1	0	Near	0-100	DF01-M	71.3243	-79.3747
Mine Site	L-25	1	1	1		0	Near	0-100	DF03-M	71.3071	-79.2432
Rail	L-29	1	1	1		8,916*	Control	>1000	DF04-M	71.2196	-79.3276
2013 Total	20	20	17	14	4						
2012 Sampling											
Tote Road	L-11	1	1			2,961*	Control	>1000	n/a	71.5627	-80.2147
Tote Road	L-13	1	1			8,595*	Control	>1000	n/a	71.3386	-80.2238
Tote Road	L-18	1	1			1,451*	Control	>1000	n/a	71.4112	-79.7980
Mine Site	L-21	1	1			15,485*	Control	>1000	n/a	71.2215	-79.7947
Mine Site	L-20	1	1			32,532*	Control	>1000	n/a	71.6457	-79.2153
Mine Site	L-24	1	1			129	Far	101-1000	n/a	71.3331	-79.3766
Mine Site	L-26	1	1			2,881*	Control	>1000	n/a	71.3391	-79.0935
Mine Site	L-27	1				2,448*	Control	>1000	n/a	71.3758	-79.2471
Mine Site	L-28	1	1			39,601*	Control	>1000	n/a	71.5403	-78.2296
Rail	L-30	1	1			2,015*	Control	>1000	n/a	71.2143	-78.9602
Rail	L-31	1	1			0	Near	0-100	n/a	71.2128	-78.8212
Rail	L-32	1	1			18,179*	Control	>1000	n/a	71.3204	-78.2655
Rail	L-33	1	1			20,033*	Control	>1000	n/a	71.0874	-79.2945
Rail	L-34	1	1			3,711*	Control	>1000	n/a	71.0966	-78.4454
Rail	L-35	1	1			0	Near	0-100	n/a	71.0946	-78.3073
Rail	L-36	1	1			3,409*	Control	>1000	n/a	71.0926	-78.1692

Location	Site ID[1]	Soil	Lichen	Willow	Blueberry	Distance to PDA (m)[2]	Distance Category	Distance Class (m)	Associated Dust Fall Site[3]	Latitude	Longitude
Rail	L-37	1	1			18,231*	Control	>1000	n/a	71.1990	-77.8488
Rail	L-38	1	1			24,241*	Control	>1000	n/a	71.1262	-77.5989
Rail	L-39	1	1			31,678*	Control	>1000	n/a	70.8877	-79.2012
Rail	L-40	1	1			3,742*	Control	>1000	n/a	70.8777	-78.3815
Rail	L-41	1	1			0	Near	0-100	n/a	70.8763	-78.2491
Rail	L-42	1	1			3,511*	Control	>1000	n/a	70.8733	-78.1138
Rail	L-43	1	1			31,295*	Control	>1000	n/a	70.8590	-77.2928
Rail	L-44	1	1			30,423*	Control	>1000	n/a	70.7046	-79.0277
Rail	L-45	1	1			4,460*	Control	>1000	n/a	70.7023	-78.2643
Rail	L-46	1	1			318	Far	101-1000	n/a	70.6844	-78.1392
Rail	L-47	2	1			23,710*	Control	>1000	n/a	70.4932	-79.0189
Rail	L-48	1	1			198	Control	>1000	n/a	70.4844	-78.3384
Rail	L-49	1	1			3,021*	Far	101-1000	n/a	70.4813	-78.2232
Rail	L-50	1	1			25,141*	Control	>1000	n/a	70.4672	-77.4202
Rail	L-55	1	1			29,266*	Control	>1000	n/a	70.2890	-77.5545
Steensby Port	L-51	1	1			4,727*	Control	>1000	n/a	70.3491	-78.6164
Steensby Port	L-52	1	1			0	Near	0-100	n/a	70.3043	-78.4834
Steensby Port	L-53	1	1			1,944*	Control	>1000	n/a	70.3024	-78.3506
Steensby Port	L-54	1	1			3,588*	Control	>1000	n/a	70.2412	-78.3607
2012 Total	35	36	34	0	0	13					
Total (2012-2016)	**117**	**117**	**112**	**24**	**8**	**49 Control(*)**					

[1] Collection sites for 2012 and 2013 were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; all results reported here are by the new Site ID with the exception of the lab results presented in Appendix B and C (refer to the 2013 Terrestrial Environment Annual Monitoring Report) where samples were sent to the lab under the original label - samples were labelled by the Original site label followed by a label for the sample type: "S" for soil, "L" for lichen, "W" for willow, and "B" for blueberry. For example: the sample label L-13.05-S01 would indicate Original site L-13.05 soil sample 01; the sample label L-13.11-W01 would indicate Original site L-13.11 willow sample 01.

Location	Site ID[1]	Soil	Lichen	Willow	Blueberry	Distance to PDA (m)[2]	Distance Category	Distance Class (m)	Associated Dust Fall Site[3]	Latitude	Longitude

[2] Control sites are labelled with an asterisk (*). Control sites are ≥1000 m to coincide with the dust fall monitoring program.
[3] Sites were considered 'associated' if they were within 60 m or less of each other; most sites were 0-12 m of each other; sites within 150 m of each another may be considered somewhat associated.

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APPENDIX C. VEGETATION AND SOIL BASE METALS MONITORING LABORATORY RESULTS

Table C-1. 2017 Soil metal analysis (n=2), sample sites L-71and L-91.

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-71	L-71-R[3]	L-91	L-91-R[3]	RDL[4]
pH	6-8	6-8	4.33	4.31	6.20	6.13	0.10
Aluminum	100	100	842	1420	10900	11000	50
Antimony	0.10	0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic	0.50	0.50	0.22	0.23	2.78	2.57	0.10
Barium	0.10	0.10	3.49	4.87	30.8	27.4	0.50
Beryllium	0.40	0.40	<0.10	<0.10	0.63	0.59	0.10
Bismuth	0.10	0.10	<0.20	<0.20	<0.20	<0.20	0.20
Cadmium	0.050	0.050	<0.020	<0.020	0.075	0.070	0.020
Calcium	100	100	273	210	13500	13100	50
Chromium	1.0	1.0	18.5	12.2	28.8	28.3	0.50
Cobalt	0.30	0.30	1.40	1.17	7.33	6.93	0.10
Copper	0.50	0.50	1.02	1.50	27.2	26.7	0.50
Iron	100	100	15200	9230	18200	17800	50
Lead	0.10	0.10	1.61	1.49	22.5	22.2	0.50
Lithium	5.0	5.0	<2.0	2.2	23.6	21.7	2.0
Magnesium	100	100	527	735	6190	6170	20
Manganese	0.20	0.20	32.5	26.0	402	355	1.0
Mercury	0.050	0.050	<0.0050	<0.0050	0.0445	0.0434	0.0050
Molybdenum	0.10	0.10	<0.10	<0.10	0.82	0.76	0.10
Nickel	0.80	0.80	3.47	3.19	16.6	16.1	0.50
Phosphorus	10	10	128	149	809	799	50
Potassium	100	100	110	140	1480	1450	100
Selenium	0.50	0.50	<0.20	<0.20	0.45	0.47	0.20
Silver	0.050	0.050	<0.10	<0.10	<0.10	<0.10	0.10
Sodium	100	100	<50	<50	84	78	50
Strontium	0.10	0.10	1.27	1.30	18.3	17.5	0.50
Thallium	0.050	0.050	<0.050	<0.050	0.250	0.241	0.050
Tin	0.10	0.10	<2.0	<2.0	<2.0	<2.0	2.0
Titanium	1.0	1.0	95.3	111	291	309	1.0

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-71	L-71-R[3]	L-91	L-91-R[3]	RDL[4]
Uranium	0.050	0.050	0.237	0.246	27.1	28.3	0.050
Vanadium	2.0	2.0	17.0	11.1	30.0	28.8	0.20
Zinc	1.0	1.0	2.6	3.4	35.3	34.5	2.0
Zirconium	0.50	0.50	<1.0	<1.0	2.6	2.4	1.0

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)
[3] Duplicate sample
[4] Reportable Detection Limit (RDL)

Table C-2. 2017 Lichen metal analysis (n=4), sample sites L-71and L-91.

Parameter[1]	L-71	L-71-R[2]	L-91	L-91-R[2]	RDL[3]
Aluminum	3290	2780	271	316	2.0
Antimony	0.017	0.019	<0.010	0.011	0.010
Arsenic	0.225	0.230	0.067	0.073	0.020
Barium	25.4	22.4	4.21	4.67	0.050
Beryllium	0.128	0.112	0.017	0.017	0.010
Bismuth	0.106	0.124	0.015	0.014	0.010
Boron	2.6	2.0	1.2	1.2	1.0
Cadmium	0.0518	0.0647	0.0477	0.0387	0.0050
Calcium	2300	2530	15900	24400	20
Chromium	7.22	6.39	0.558	0.709	0.050
Cobalt	1.87	1.65	0.170	0.187	0.020
Copper	6.06	5.92	1.09	1.14	0.10
Iron	6400	5340	603	840	3.0
Lead	3.23	3.15	1.01	1.04	0.020
Magnesium	3090	2820	1440	1390	2.0
Manganese	88.2	76.6	17.8	18.3	0.050
Mercury	0.0333	0.0387	0.0760	0.0671	0.0050
Molybdenum	0.801	0.702	0.102	0.103	0.020
Nickel	5.37	4.79	0.43	0.52	0.20
Phosphorus	370	426	416	324	10
Potassium	1790	1750	1490	1300	20
Selenium	0.081	0.080	0.072	0.071	0.050
Silver	0.0430	0.0455	0.0128	0.0123	0.0050
Sodium	34	32	467	345	20
Strontium	5.65	5.62	13.3	16.0	0.050
Thallium	0.0557	0.0510	0.0084	0.0082	0.0020
Tin	0.19	0.17	<0.10	0.15	0.10
Titanium	173	150	16.0	17.0	0.10
Uranium	0.449	0.391	0.185	0.270	0.0020

Parameter[1]	L-71	L-71-R[2]	L-91	L-91-R[2]	RDL[3]
Vanadium	5.44	4.73	0.54	0.66	0.10
Zinc	19.4	18.3	13.7	11.2	0.50

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Duplicate sample
[3] Reportable Detection Limit (RDL)

Table C-3. 2016 Soil metal analysis (n=50), sample sites L-68 to L-79.

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-68	L-69	L-70	L-71	L-72	L-73	L-74	L-75	L-76	L-77	L-78	L-79	RDL[3]
pH	6-8	6-8	5.47	5.92	5.44	5.54	5.42	5.53	5.48	5.51	5.46	5.78	5.59	5.25	N/A
Aluminum	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Antimony	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Arsenic	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Barium	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Beryllium	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Bismuth	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Cadmium	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Calcium	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Chromium	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
Cobalt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Copper	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Iron	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Lead	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Lithium	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
Magnesium	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Manganese	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Mercury	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Molybdenum	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Nickel	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Phosphorus	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Potassium	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Selenium	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Silver	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Sodium	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Strontium	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Thallium	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Tin	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Titanium	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

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-68	L-69	L-70	L-71	L-72	L-73	L-74	L-75	L-76	L-77	L-78	L-79	RDL[3]
Uranium	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Vanadium	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Zinc	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
Zirconium	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)
[3] Reportable Detection Limit (RDL)

Table C-4. 2016 Soil metal analysis (n=50), sample sites L-80 to L-91.

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-80	L-81	L-82	L-83	L-84	L-85	L-86	L-87	L-88	L-89	L-90	L-91	RDL[3]
pH	6-8	6-8	5.47	6.96	6.57	6.99	7.38	7.73	7.91	5.90	5.85	6.55	7.15	7.56	N/A
Aluminum	100	100	480	1640	2580	6330	6110	2900	5680	1840	2040	2340	1720	5410	100
Antimony	0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic	0.50	0.50	<0.50	<0.50	<0.50	1.53	0.84	0.77	1.06	<0.50	<0.50	<0.50	<0.50	0.82	0.50
Barium	0.10	0.10	2.83	4.67	10.2	34.5	17.3	12.7	20.4	5.38	4.69	8.03	5.36	7.93	0.10
Beryllium	0.40	0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.44	0.40
Bismuth	0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	0.16	0.10
Cadmium	0.050	0.050	<0.050	<0.050	0.064	0.152	0.070	0.050	0.093	<0.050	<0.050	0.061	<0.050	0.065	0.050
Calcium	100	100	228	726	1030	5700	2560	1760	5690	586	699	854	974	1830	100
Chromium	1.0	1.0	3.2	8.0	22.9	44.3	24.3	21.4	24.6	7.6	9.3	11.0	5.9	11.1	1.0
Cobalt	0.30	0.30	0.32	1.74	3.40	10.1	4.52	3.69	5.01	1.54	1.93	2.19	1.86	3.43	0.30
Copper	0.50	0.50	<0.50	2.76	2.67	19.1	6.94	6.56	11.7	1.54	2.31	2.40	2.09	116	0.50
Iron	100	100	951	7230	10900	14200	11900	6860	11900	3400	6110	6540	4150	10300	100
Lead	0.10	0.10	0.54	11.2	3.91	10.8	7.40	4.02	10.5	2.99	2.61	3.02	2.24	10.8	0.10
Lithium	5.0	5.0	<5.0	<5.0	6.1	13.6	11.1	5.7	13.1	<5.0	<5.0	5.2	<5.0	18.3	5.0
Magnesium	100	100	265	1570	2180	8390	4410	3090	6370	932	1440	1880	1400	5100	100
Manganese	0.20	0.20	3.98	66.4	123	304	126	142	190	52.5	62.6	71.2	40.1	169	0.20
Mercury	0.050	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Molybdenum	0.10	0.10	<0.10	<0.10	0.18	0.18	0.16	<0.10	0.24	<0.10	<0.10	0.11	<0.10	0.55	0.10
Nickel	0.80	0.80	1.96	5.96	11.3	91.5	30.3	23.8	17.1	4.37	6.66	8.48	7.02	6.34	0.80
Phosphorus	10	10	101	182	182	390	309	176	312	161	229	153	287	186	10
Potassium	100	100	<100	166	357	1230	986	521	1100	435	369	449	364	709	100
Selenium	0.50	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	0.050	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.062	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Sodium	100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100
Strontium	0.10	0.10	1.18	1.79	1.88	4.75	4.18	2.04	4.79	1.64	1.74	1.97	2.87	2.71	0.10
Thallium	0.050	0.050	<0.050	<0.050	0.095	0.192	0.105	0.056	0.136	<0.050	<0.050	<0.050	<0.050	0.084	0.050
Tin	0.10	0.10	<0.10	0.10	0.28	0.36	0.40	0.13	0.33	0.11	0.17	0.21	0.16	0.52	0.10
Titanium	1.0	1.0	37.6	148	318	352	416	233	389	122	184	238	173	353	1.0

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-80	L-81	L-82	L-83	L-84	L-85	L-86	L-87	L-88	L-89	L-90	L-91	RDL[3]
Uranium	0.050	0.050	0.101	0.421	0.661	2.04	1.62	0.479	0.896	0.223	0.301	0.357	0.559	2.27	0.050
Vanadium	2.0	2.0	2.3	11.0	16.4	20.1	17.8	11.6	17.4	6.4	8.8	10.5	6.8	15.8	2.0
Zinc	1.0	1.0	1.2	6.4	11.8	29.7	24.4	13.8	18.5	7.1	8.3	11.7	7.9	26.7	1.0
Zirconium	0.50	0.50	<0.50	0.51	0.59	2.52	1.25	0.86	1.90	<0.50	<0.50	<0.50	0.96	1.65	0.50

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)
[3] Reportable Detection Limit (RDL)

Table C-5. 2016 Soil metal analysis (n=50), sample sites L-92 to L-104.

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-92	L-93	L-94	L-95	L-96	L-97	L-98	L-99	L-100	L-101	L-102	L-103	L-104	RDL[3]
pH	6-8	6-8	7.10	7.57	8.00	8.35	7.17	8.35	8.14	7.03	7.91	8.62	8.74	8.66	8.39	N/A
Aluminum	100	100	2770	5810	3670	3810	5520	4250	3690	6520	5600	4070	3630	2740	1190	100
Antimony	0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic	0.50	0.50	<0.50	<0.50	0.69	0.74	1.10	0.73	0.59	1.19	0.81	1.00	0.75	<0.50	<0.50	0.50
Barium	0.10	0.10	3.72	9.65	6.91	11.1	14.1	14.4	9.23	16.8	11.3	11.2	10.6	7.02	2.63	0.10
Beryllium	0.40	0.40	<0.40	0.44	<0.40	<0.40	<0.40	<0.40	<0.40	0.50	0.42	<0.40	<0.40	<0.40	<0.40	0.40
Bismuth	0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.14	<0.10	<0.10	<0.10	<0.10	0.10
Cadmium	0.050	0.050	<0.050	0.074	<0.050	0.067	0.082	0.091	0.057	0.136	0.085	0.060	0.101	0.076	<0.050	0.050
Calcium	100	100	666	1480	5870	24700	2270	23600	15400	3930	3220	44000	97100	60400	9600	100
Chromium	1.0	1.0	6.4	15.2	8.5	7.3	13.9	8.4	6.7	18.3	9.4	8.1	8.2	6.6	2.0	1.0
Cobalt	0.30	0.30	1.83	3.62	2.42	2.52	3.46	2.61	2.08	4.15	3.08	2.51	2.36	1.91	0.95	0.30
Copper	0.50	0.50	2.02	3.69	5.72	4.13	5.27	11.1	4.13	8.49	5.85	5.25	4.56	3.17	1.55	0.50
Iron	100	100	6830	10000	7210	6940	10200	7430	6940	12100	10800	7700	7420	5670	2690	100
Lead	0.10	0.10	3.69	3.48	7.72	4.09	6.50	4.46	4.32	8.31	7.27	5.22	4.52	3.55	1.82	0.10
Lithium	5.0	5.0	9.3	23.0	14.4	10.8	19.4	12.9	10.9	18.3	19.9	12.0	13.2	9.4	<5.0	5.0
Magnesium	100	100	2490	5360	5910	15500	3760	14500	9450	4110	4930	19000	22000	21600	5600	100
Manganese	0.20	0.20	85.8	170	110	117	180	122	113	183	155	126	120	106	40.8	0.20
Mercury	0.050	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Molybdenum	0.10	0.10	<0.10	0.11	0.15	0.18	0.26	0.14	0.12	0.34	0.23	0.17	0.16	0.12	<0.10	0.10
Nickel	0.80	0.80	3.13	7.36	4.58	4.10	7.80	5.03	3.91	10.1	5.47	4.16	4.32	3.27	1.20	0.80
Phosphorus	10	10	94	203	132	162	221	187	183	244	174	157	150	217	80	10
Potassium	100	100	337	919	522	692	869	887	492	905	481	586	594	539	209	100
Selenium	0.50	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	0.050	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Sodium	100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100
Strontium	0.10	0.10	1.64	2.86	4.57	8.82	4.58	10.1	7.09	5.68	3.49	20.2	52.8	26.8	4.08	0.10
Thallium	0.050	0.050	<0.05	0.103	0.087	0.107	0.092	0.123	0.076	0.577	0.103	0.104	0.079	0.056	<0.05	0.050

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-92	L-93	L-94	L-95	L-96	L-97	L-98	L-99	L-100	L-101	L-102	L-103	L-104	RDL[3]
			0												0	
Tin	0.10	0.10	0.29	0.43	0.40	0.29	0.33	0.31	0.31	0.41	0.50	0.33	0.36	0.19	<0.10	0.10
Titanium	1.0	1.0	182	318	183	245	263	259	193	294	252	250	292	177	65.6	1.0
Uranium	0.050	0.050	1.02	1.52	1.87	0.806	5.15	0.820	1.02	20.6	1.76	0.993	0.928	0.566	0.379	0.050
Vanadium	2.0	2.0	11.5	17.4	11.4	11.9	16.9	11.8	9.5	17.6	15.2	11.7	12.5	8.9	5.0	2.0
Zinc	1.0	1.0	12.1	23.9	15.8	12.6	20.9	15.9	15.5	25.1	22.7	14.2	13.7	9.9	4.2	1.0
Zirconium	0.50	0.50	0.68	0.64	1.33	1.60	1.10	1.74	1.36	1.34	1.50	1.56	2.40	1.33	0.87	0.50

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)
[3] Reportable Detection Limit (RDL)

Table C-6. 2016 Soil metal analysis (n=50), sample sites L-105 to L-117.

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-105	L-106	L-107	L-108	L-109	L-110	L-111	L-112	L-113	L-114	L-115	L-116	L-117	RDL[3]
pH	6-8	6-8	7.58	8.68	5.66	6.69	6.56	7.10	7.33	6.70	7.10	8.06	6.99	5.72	6.49	N/A
Aluminum	100	100	5140	3300	2550	4300	2070	2730	2440	15400	4770	2530	2760	626	4160	100
Antimony	0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic	0.50	0.50	0.89	0.83	1.17	0.53	<0.50	0.75	<0.50	0.87	0.57	0.56	<0.50	<0.50	1.20	0.50
Barium	0.10	0.10	14.0	8.90	7.80	19.4	8.79	9.62	13.3	42.6	16.8	7.97	8.28	2.55	17.6	0.10
Beryllium	0.40	0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.45	<0.40	<0.40	<0.40	<0.40	<0.40	0.40
Bismuth	0.10	0.10	<0.10	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	0.14	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Cadmium	0.050	0.050	0.121	0.064	<0.050	0.057	<0.050	<0.050	0.084	0.152	0.126	<0.050	0.060	0.070	0.108	0.050
Calcium	100	100	1820	36100	484	1930	1090	1030	1880	2090	1330	10100	1970	216	1610	100
Chromium	1.0	1.0	6.9	16.8	9.9	20.2	8.1	10.4	10.6	18.6	19.6	10.8	11.0	3.1	33.7	1.0
Cobalt	0.30	0.30	3.64	2.73	2.00	3.81	1.92	2.75	2.75	7.54	4.05	2.54	2.20	0.38	5.56	0.30
Copper	0.50	0.50	9.60	3.55	2.96	5.53	2.65	3.42	2.99	16.9	5.96	3.97	3.01	0.52	8.05	0.50
Iron	100	100	9910	7120	22800	10800	6570	6510	8160	37900	10200	5960	7820	1870	13800	100
Lead	0.10	0.10	4.41	2.98	2.65	3.86	1.73	4.16	2.83	6.62	4.56	4.34	3.45	0.85	6.09	0.10
Lithium	5.0	5.0	14.2	11.6	5.4	8.6	<5.0	7.5	5.6	23.3	9.7	5.8	5.4	<5.0	6.5	5.0
Magnesium	100	100	4060	13700	1700	3260	1710	1780	2000	8790	2870	6940	1810	350	4680	100
Manganese	0.20	0.20	134	95.7	193	118	58.0	105	90.5	459	134	108	83.4	6.64	135	0.20
Mercury	0.050	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Molybdenum	0.10	0.10	0.15	0.14	<0.10	0.11	<0.10	<0.10	0.10	0.44	<0.10	<0.10	0.16	<0.10	0.15	0.10
Nickel	0.80	0.80	4.88	12.2	6.28	10.4	4.40	6.36	5.55	18.3	10.4	8.62	5.19	1.26	25.5	0.80
Phosphorus	10	10	133	140	206	298	309	235	472	389	273	230	452	62	261	10
Potassium	100	100	1050	892	297	829	448	581	760	2480	904	508	462	125	715	100
Selenium	0.50	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	0.050	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Sodium	100	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-105	L-106	L-107	L-108	L-109	L-110	L-111	L-112	L-113	L-114	L-115	L-116	L-117	RDL[3]
Strontium	0.10	0.10	3.36	20.0	1.45	4.51	2.12	2.10	4.48	4.27	2.70	4.85	3.70	0.85	2.59	0.10
Thallium	0.050	0.050	0.088	0.071	<0.050	0.065	<0.050	0.060	0.063	0.328	0.128	0.056	0.059	<0.050	0.062	0.050
Tin	0.10	0.10	0.34	0.21	0.19	0.27	0.12	0.16	0.33	0.45	0.31	0.18	0.27	<0.10	0.23	0.10
Titanium	1.0	1.0	401	209	253	306	241	235	496	714	521	202	348	46.3	490	1.0
Uranium	0.050	0.050	1.50	0.400	0.494	0.786	0.484	0.340	0.809	1.49	0.841	0.349	0.981	0.122	0.930	0.050
Vanadium	2.0	2.0	19.1	10.9	9.5	17.0	11.3	11.7	15.8	22.1	16.5	10.4	12.4	3.5	17.4	2.0
Zinc	1.0	1.0	19.6	9.5	10.0	14.5	8.1	13.7	12.4	39.6	15.7	10.1	10.1	2.0	16.2	1.0
Zirconium	0.50	0.50	4.14	1.93	0.53	1.22	0.55	0.68	2.43	3.64	5.22	1.22	2.16	1.84	1.50	0.50

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)
[3] Reportable Detection Limit (RDL)

Table C-7. 2016 Lichen metal analysis (n=50), sample sites L-68 to L-81.

Parameter[1]	L-68	L-69	L-70	L-71	L-72	L-73	L-74	L-75	L-76	L-77	L-78	L-79	L-80	L-81	RDL[2]
Aluminum	2660	4170	1980	4210	3030	3140	3530	1650	1380	548	3730	2890	2260	861	1.0
Antimony	0.0302	0.0255	0.0219	0.0287	0.0207	0.0200	0.0160	0.0079	0.0080	0.0051	0.0175	0.0157	0.0166	0.0092	0.0050
Arsenic	0.193	0.352	0.166	0.243	0.146	0.191	0.233	0.104	0.110	0.071	0.216	0.165	0.135	0.113	0.050
Barium	20.3	28.8	18.2	30.7	23.3	24.0	24.1	10.9	10.7	4.08	22.8	18.2	15.1	4.37	0.10
Beryllium	0.11	0.13	<0.10	0.13	<0.10	0.10	0.12	<0.10	<0.10	<0.10	0.12	0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	4.7	3.9	4.5	4.9	4.9	3.7	3.0	<2.0	2.1	4.5	4.7	3.6	3.1	3.7	2.0
Cadmium	0.054	0.038	0.048	0.080	0.041	0.029	0.035	0.025	0.026	0.026	0.028	0.028	0.042	0.045	0.010
Calcium	3490	3230	2640	3450	2320	2010	2690	1470	1430	1180	2940	2660	2230	1140	10
Chromium	5.58	10.1	4.09	10.0	5.63	7.24	7.14	4.56	3.68	6.00	18.8	11.4	6.93	2.48	0.20
Cobalt	1.53	2.18	1.16	2.36	1.56	1.65	1.78	0.904	0.894	0.394	2.42	1.73	1.34	0.664	0.020
Copper	4.06	5.34	2.96	5.22	3.38	3.87	4.09	2.11	1.87	1.14	4.29	3.80	3.33	2.15	0.050
Iron	4980	7330	3520	7710	4800	5380	5890	2880	2590	1020	8170	5680	4030	2900	10
Lead	2.24	2.58	1.43	6.04	2.56	2.81	2.98	1.26	0.932	0.571	1.70	1.76	1.60	1.25	0.010
Magnesium	3080	4060	2460	3940	3050	3590	3770	2220	1800	787	4270	3260	2910	1210	10
Manganese	75.2	102	65.9	112	89.4	102	100	74.5	77.2	28.4	108	97.2	83.3	44.4	0.10
Mercury	0.037	0.036	0.036	0.041	0.046	0.028	0.033	0.022	0.024	0.035	0.037	0.023	0.034	0.044	0.010
Molybdenum	0.353	0.534	0.298	0.473	0.246	0.433	0.581	0.186	0.207	0.052	0.369	0.401	0.388	0.285	0.050
Nickel	4.24	7.32	3.30	7.28	4.32	5.18	5.39	3.20	2.80	2.78	11.2	6.97	4.80	2.11	0.050
Phosphorus	353	371	342	428	453	390	457	271	371	343	462	350	348	446	10
Potassium	1850	2270	1590	2390	2060	2040	2070	1220	1180	887	1930	1620	1500	1180	10
Selenium	0.071	0.081	0.067	0.088	0.068	0.064	0.078	<0.050	0.061	<0.050	0.083	0.052	0.062	0.074	0.050
Silver	<0.020	0.027	<0.020	0.029	0.024	0.026	0.033	<0.020	<0.020	<0.020	0.025	<0.020	0.020	0.022	0.020
Sodium	45	52	48	55	46	40	50	24	34	37	40	39	48	41	10
Strontium	4.80	5.26	4.36	6.32	4.35	3.96	4.43	2.36	3.02	2.88	5.23	4.25	3.36	1.29	0.10
Thallium	0.0486	0.0651	0.0359	0.0617	0.0503	0.0564	0.0556	0.0256	0.0218	0.0103	0.0423	0.0396	0.0348	0.0185	0.0020
Tin	0.12	0.25	<0.10	0.20	0.12	0.14	0.14	<0.10	<0.10	<0.10	0.13	0.16	0.26	<0.10	0.10
Titanium	144	215	110	215	164	179	175	83.9	70.9	31.3	142	131	118	46.3	1.0
Uranium	0.453	0.538	0.275	0.508	0.347	0.418	0.493	0.214	0.192	0.0803	0.418	0.442	0.353	0.221	0.0020

Parameter[1]	L-68	L-69	L-70	L-71	L-72	L-73	L-74	L-75	L-76	L-77	L-78	L-79	L-80	L-81	RDL[2]
Vanadium	4.31	6.52	3.32	6.69	4.51	5.07	5.13	2.54	2.25	1.27	6.60	5.03	3.64	1.68	0.20
Zinc	16.0	18.0	15.0	22.2	18.0	16.5	17.9	13.5	16.0	9.35	19.7	15.9	18.1	14.8	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

Table C-8. 2016 Lichen metal analysis (n=50), sample sites L-82 to L-95.

Parameter[1]	L-82	L-83	L-84	L-85	L-86	L-87	L-88	L-89	L-90	L-91	L-92	L-93	L-94	L-95	RDL[2]
Aluminum	586	385	623	900	1070	1220	1590	1030	1420	230	160	234	165	143	1.0
Antimony	<0.0050	0.0070	0.0052	0.0067	<0.0050	<0.0050	<0.0050	0.0059	0.0127	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050
Arsenic	0.068	0.055	0.077	0.101	0.116	0.108	0.095	0.095	0.107	0.051	0.057	0.074	<0.050	<0.050	0.050
Barium	3.01	3.02	3.41	4.75	5.23	6.73	8.42	8.06	8.50	3.88	4.68	3.51	4.69	3.48	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	4.0	3.2	<2.0	<2.0	2.2	2.1	3.8	2.2	3.1	2.9	<2.0	<2.0	<2.0	2.6	2.0
Cadmium	0.032	0.040	0.040	0.034	0.051	0.055	0.063	0.049	0.031	0.039	0.034	0.037	0.037	0.033	0.010
Calcium	1130	1310	1760	2480	1610	1470	1240	1510	2180	24100	17500	21700	31400	21200	10
Chromium	1.76	1.23	2.61	3.17	3.84	4.37	4.68	2.74	3.75	1.74	0.68	1.57	1.32	1.06	0.20
Cobalt	0.427	0.282	0.439	0.574	0.701	0.847	0.966	0.692	0.966	0.145	0.100	0.177	0.108	0.103	0.020
Copper	1.56	1.29	1.59	1.90	3.02	2.50	2.98	2.36	4.49	0.964	0.897	1.06	0.835	0.809	0.050
Iron	2070	757	1940	2540	2300	2840	3270	3020	3470	453	277	696	332	273	10
Lead	0.593	0.576	0.713	0.954	1.31	1.34	1.56	1.20	1.67	1.02	0.730	1.19	1.20	0.881	0.010
Magnesium	1090	887	1290	1500	1510	1680	2030	1500	2360	1080	1160	1590	1230	938	10
Manganese	35.6	24.1	23.4	31.4	37.1	50.1	76.2	44.0	63.3	14.5	14.5	15.9	15.0	14.4	0.10
Mercury	0.033	0.060	0.032	0.039	0.068	0.053	0.048	0.044	0.030	0.053	0.054	0.053	0.046	0.044	0.010
Molybdenum	0.160	0.093	0.118	0.197	0.258	0.331	0.650	0.426	0.299	0.075	0.060	0.073	0.073	0.066	0.050
Nickel	1.42	1.39	2.04	2.46	2.72	3.23	3.51	2.26	3.34	0.854	0.413	0.824	0.628	0.517	0.050
Phosphorus	368	316	240	286	248	415	376	341	291	351	374	388	339	378	10
Potassium	1010	954	791	931	946	1230	1450	1150	1270	1380	1410	1300	1270	1500	10
Selenium	<0.050	0.056	0.071	0.079	0.054	0.068	0.056	0.054	<0.050	0.065	0.061	0.056	0.058	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	0.023	<0.020	0.036	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	36	36	51	55	47	37	34	37	55	409	412	591	369	425	10
Strontium	0.90	1.08	1.30	1.53	1.47	1.57	1.30	1.43	1.89	16.0	15.8	29.3	22.0	14.9	0.10
Thallium	0.0122	0.0077	0.0114	0.0149	0.0214	0.0230	0.0276	0.0172	0.0261	0.0066	0.0049	0.0064	0.0050	0.0043	0.0020

Parameter[1]	L-82	L-83	L-84	L-85	L-86	L-87	L-88	L-89	L-90	L-91	L-92	L-93	L-94	L-95	RDL[2]
Tin	<0.10	<0.10	<0.10	0.13	<0.10	<0.10	0.12	0.11	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	31.0	22.1	33.6	46.9	59.4	68.7	90.0	53.1	78.0	12.8	7.5	10.8	9.6	6.6	1.0
Uranium	0.146	0.0911	0.159	0.184	0.228	0.278	0.324	0.254	0.392	0.262	0.109	0.188	0.222	0.287	0.0020
Vanadium	1.06	0.65	1.21	1.65	2.06	2.41	2.87	1.79	2.73	0.43	0.34	0.41	0.29	0.23	0.20
Zinc	11.1	13.5	10.8	11.2	11.1	14.3	15.3	14.2	15.5	11.6	9.90	11.0	10.7	11.6	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated

[2] Reportable Detection Limit (RDL)

Table C-9. 2016 Lichen metal analysis (n=50), sample sites L-96 to L-109.

Parameter[1]	L-96	L-97	L-98	L-99	L-100	L-101	L-102	L-103	L-104	L-105	L-106	L-107	L-108	L-109	RDL[2]
Aluminum	225	120	258	284	158	120	138	122	108	143	134	223	413	133	1.0
Antimony	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0060	0.0052	0.0050
Arsenic	0.074	<0.050	0.072	0.076	0.068	0.055	<0.050	<0.050	<0.050	<0.050	0.060	<0.050	0.075	<0.050	0.050
Barium	5.13	4.24	4.97	6.12	5.17	4.98	4.43	3.93	4.10	2.38	3.04	4.04	4.02	5.94	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	<2.0	3.1	2.4	<2.0	<2.0	<2.0	2.7	<2.0	<2.0	<2.0	2.0	2.2	<2.0	2.0
Cadmium	0.038	0.024	0.050	0.043	0.035	0.036	0.045	0.021	0.031	0.031	0.034	0.044	0.037	0.086	0.010
Calcium	36100	27800	27800	34900	32300	40100	34000	31100	19100	16900	30500	1740	2460	5280	10
Chromium	1.03	0.53	1.27	1.42	0.76	0.48	0.67	0.44	0.64	0.53	0.83	1.36	3.27	0.44	0.20
Cobalt	0.134	0.076	0.168	0.172	0.103	0.083	0.088	0.082	0.075	0.094	0.099	0.171	0.283	0.121	0.020
Copper	0.821	0.680	0.874	0.843	0.785	0.739	0.877	0.797	0.764	0.932	0.772	0.875	0.753	0.806	0.050
Iron	417	196	428	471	246	198	248	232	181	234	211	473	679	281	10
Lead	1.23	0.532	1.19	1.46	0.902	0.931	0.785	0.510	0.414	0.401	0.446	0.286	0.836	0.411	0.010
Magnesium	1380	1340	1620	1190	1100	1030	1060	948	1180	1440	934	874	759	819	10
Manganese	16.9	9.63	16.2	19.2	13.3	11.5	11.4	11.5	12.6	9.68	8.97	24.4	14.6	34.5	0.10
Mercury	0.045	0.047	0.044	0.045	0.051	0.052	0.046	0.039	0.044	0.063	0.057	0.033	0.067	0.045	0.010
Molybdenum	0.085	<0.050	0.062	0.071	0.056	0.071	0.074	<0.050	0.051	0.059	0.051	<0.050	<0.050	<0.050	0.050
Nickel	0.590	0.307	0.751	0.736	0.445	0.329	0.387	0.296	0.331	0.331	0.527	0.768	1.55	0.365	0.050
Phosphorus	351	319	353	325	295	289	342	310	344	370	366	340	240	326	10
Potassium	1260	1280	1290	1240	1250	1180	1270	1220	1440	1400	1310	1030	705	1010	10
Selenium	0.074	0.058	0.058	0.072	0.056	0.077	0.070	0.069	<0.050	0.051	0.051	0.057	<0.050	0.065	0.050
Silver	<0.020	<0.020	<0.020	0.021	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	437	368	399	352	306	289	370	307	388	384	377	35	47	115	10
Strontium	23.0	16.4	19.0	20.8	19.1	22.8	21.2	19.8	12.6	6.73	14.5	2.50	2.00	4.60	0.10

Parameter[1]	L-96	L-97	L-98	L-99	L-100	L-101	L-102	L-103	L-104	L-105	L-106	L-107	L-108	L-109	RDL[2]
Thallium	0.0062	0.0037	0.0066	0.0106	0.0054	0.0042	0.0040	0.0035	0.0030	0.0036	0.0031	0.0047	0.0109	0.0038	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	14.3	7.2	15.5	16.1	10.7	7.6	8.5	6.4	6.2	7.6	7.8	12.5	26.0	8.3	1.0
Uranium	0.467	0.185	0.260	0.430	0.202	0.202	0.235	0.0943	0.0846	0.0680	0.0926	0.0372	0.112	0.0318	0.0020
Vanadium	0.45	<0.20	0.52	0.56	0.31	0.25	0.24	0.22	<0.20	0.25	0.27	0.42	0.93	<0.20	0.20
Zinc	9.16	8.26	11.4	9.00	7.85	7.16	10.3	7.70	11.0	12.7	12.1	15.3	6.47	15.2	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated

[2] Reportable Detection Limit (RDL)

Table C-10. 2016 Lichen metal analysis (n=50), sample sites L-110 to L-117.

Parameter[1]	L-110	L-111	L-112	L-113	L-114	L-115	L-116	L-117	RDL[2]
Aluminum	226	166	390	314	286	321	458	623	1.0
Antimony	<0.0050	<0.0050	0.0052	0.0068	0.0055	<0.0050	0.0085	0.0066	0.0050
Arsenic	<0.050	<0.050	0.076	0.112	0.067	<0.050	0.071	0.066	0.050
Barium	3.73	5.45	12.4	16.9	5.29	4.10	10.5	7.82	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	2.4	2.5	<2.0	<2.0	<2.0	2.6	3.3	3.3	2.0
Cadmium	0.095	0.072	0.114	0.166	0.039	0.036	0.057	0.088	0.010
Calcium	4860	3500	13000	10900	12400	5630	15100	9720	10
Chromium	1.43	1.18	1.29	1.02	2.12	1.34	1.72	2.70	0.20
Cobalt	0.190	0.162	0.276	0.236	0.344	0.259	0.345	0.471	0.020
Copper	0.900	0.888	1.30	1.03	1.11	1.03	1.22	1.83	0.050
Iron	479	245	857	864	1070	813	858	1810	10
Lead	0.566	0.279	1.41	1.73	1.03	0.563	1.12	1.10	0.010
Magnesium	742	773	1500	995	1150	948	1240	1460	10
Manganese	32.0	15.9	31.5	76.5	21.2	26.2	39.5	50.8	0.10
Mercury	0.058	0.055	0.076	0.092	0.063	0.065	0.046	0.067	0.010
Molybdenum	<0.050	<0.050	0.070	0.070	0.089	0.078	0.091	0.208	0.050
Nickel	0.793	0.660	0.987	1.02	1.39	0.953	1.26	2.06	0.050
Phosphorus	443	391	527	375	449	536	387	585	10
Potassium	1250	1120	2120	1650	1680	1550	1710	1880	10
Selenium	0.071	<0.050	0.115	0.100	0.066	<0.050	0.056	0.063	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	147	113	322	237	319	296	251	314	10
Strontium	2.60	4.46	7.64	16.8	5.27	2.75	6.70	3.26	0.10
Thallium	0.0063	0.0053	0.0113	0.0066	0.0086	0.0082	0.0115	0.0140	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	18.0	17.4	30.5	21.8	20.6	24.6	26.1	35.9	1.0
Uranium	0.0610	0.0530	0.0751	0.0650	0.122	0.0976	0.123	0.190	0.0020

Parameter[1]	L-110	L-111	L-112	L-113	L-114	L-115	L-116	L-117	RDL[2]
Vanadium	0.54	0.41	0.66	0.57	0.59	0.66	0.83	1.28	0.20
Zinc	18.0	18.5	22.4	19.5	9.08	12.2	13.9	19.6	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated

[2] Reportable Detection Limit (RDL)

Table C-11. 2014 Soil metal analysis (n=12), sample sites L-56 to L-67.

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-56	L-57	L-58	L-59	L-60	L-61	L-62	L-63	L-64	L-65	L-66	L-67	RDL[3]
pH	6-8	6-8	8.54	8.74	7.97	6.47	5.31	4.94	5.23	8.60	5.49	7.93	6.21	6.89	N/A
Aluminum	NA	NA	5320	3140	1450	4550	2020	2770	5600	4730	3030	3190	6390	1040	100
Antimony	20	40	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.13	<0.10	<0.10	<0.10	0.10
Arsenic	12	12	1.01	1.82	1.01	0.86	0.61	<0.50	0.59	0.90	1.86	0.81	0.83	<0.50	0.50
Barium	750	2000	13.3	8.34	4.45	9.47	7.70	13.7	32.3	12.0	5.41	9.62	36.1	2.81	0.10
Beryllium	4	8	0.45	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40
Bismuth	NA	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Cadmium	1.4	22	0.119	0.147	<0.050	<0.050	<0.050	<0.050	0.098	0.150	<0.050	<0.050	0.158	<0.050	0.050
Calcium	NA	NA	10900	66800	28900	1390	323	344	1980	19100	334	3150	5950	677	100
Chromium	64	87	4.9	11.9	6.6	12.0	26.0	14.2	16.5	13.4	9.0	21.6	12.3	4.8	1.0
Cobalt	40	300	2.46	2.36	1.12	2.85	2.11	1.62	4.17	2.96	2.49	3.38	3.15	0.77	0.30
Copper	63	91	4.55	4.44	1.92	3.43	2.42	2.34	5.31	5.82	5.66	4.85	8.79	0.86	0.50
Iron	NA	NA	9040	7300	4870	9700	14600	8010	11200	9350	90500	7360	7160	3050	100
Lead	70	600	4.73	4.43	1.97	4.91	2.12	1.76	5.58	5.16	2.77	4.84	4.89	1.40	0.10
Lithium	NA	NA	18.7	14.5	7.6	11.9	<5.0	<5.0	8.5	13.8	<5.0	6.3	6.8	<5.0	5.0
Magnesium	NA	NA	7380	37100	15900	3160	1160	1490	3200	11800	1050	5120	2640	817	100
Manganese	NA	NA	181	94.7	50.3	122	72.4	32.8	162	108	227	117	135	19.7	0.20
Mercury	6.6	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	<0.050	0.050
Molybdenum	5	40	0.17	0.32	0.12	0.12	0.10	<0.10	0.34	0.21	0.16	<0.10	0.18	<0.10	0.10
Nickel	50	50	4.33	7.09	3.04	6.66	8.49	6.41	9.52	8.23	9.12	34.7	7.21	2.92	0.80
Phosphorus	NA	NA	170	276	153	465	179	194	547	370	354	257	517	232	10
Potassium	NA	NA	803	1260	500	550	289	622	654	811	236	606	872	248	100
Selenium	1	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	20	40	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Sodium	NA	NA	<100	404	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100
Strontium	NA	NA	6.87	34.1	14.9	3.12	2.40	1.92	6.50	9.51	1.25	2.90	7.87	2.01	0.10
Thallium	1	1	0.127	0.074	<0.050	0.055	<0.050	<0.050	0.110	0.113	<0.050	0.061	0.099	<0.050	0.050
Tin	5	300	0.47	0.22	0.10	0.31	0.15	0.19	0.58	0.50	0.20	0.20	0.24	<0.10	0.10

Parameter[1]	CCME Agri[2]	CCME Ind[2]	L-56	L-57	L-58	L-59	L-60	L-61	L-62	L-63	L-64	L-65	L-66	L-67	RDL[3]
Titanium	NA	NA	171	200	67.0	238	151	159	609	316	197	208	178	114	1.0
Uranium	23	300	1.39	0.537	0.245	1.16	0.423	0.414	2.07	0.628	0.562	0.507	0.887	0.248	0.050
Vanadium	130	130	11.6	13.3	8.0	15.1	14.4	11.5	21.2	15.5	10.9	12.6	12.9	5.3	2.0
Zinc	200	360	22.7	10.2	5.6	19.4	8.4	9.8	23.9	16.9	12.5	12.3	16.3	4.1	1.0
Zirconium	NA	NA	3.50	4.81	0.61	0.99	<0.50	<0.50	1.56	6.87	<0.50	0.78	1.65	0.58	0.50

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)
[3] Reportable Detection Limit (RDL)

Table C-12. 2014 Vegetation metal analysis (n=25), sample sites L-56 to L-60.

Parameter[1]	L-56 (lichen)	L-56 (willow)	L-57 (willow)	L-58 (lichen)	L-59 (lichen)	L-59 (willow)	L-60 (lichen)	L-60 (willow)	L-60 (blueberry)	RDL[2]
Aluminum	508	32.6	24.9	380	63.8	9.6	713	332	277	1.0
Antimony	0.0183	<0.0050	0.0126	0.0214	<0.0050	0.0156	0.0058	<0.0050	<0.0050	0.0050
Arsenic	0.187	<0.050	<0.050	0.225	<0.050	<0.050	0.104	<0.050	<0.050	0.050
Barium	7.20	2.45	0.91	4.40	4.55	3.81	7.26	13.2	49.2	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	3.6	28.5	24.4	4.5	<2.0	23.5	2.7	30.3	22.2	2.0
Cadmium	0.094	0.757	0.515	0.042	0.054	0.533	0.099	0.574	0.265	0.010
Calcium	27200	15800	11300	37400	12300	17400	5170	9280	6440	10
Chromium	2.85	0.24	0.69	2.77	0.26	0.59	3.80	1.02	1.07	0.20
Cobalt	0.334	0.116	0.650	0.272	0.077	0.314	0.666	1.23	0.269	0.020
Copper	2.12	9.36	10.3	1.83	0.870	12.5	3.28	11.2	12.8	0.050
Iron	980	103	156	915	109	94	1510	619	489	10
Lead	2.60	0.090	0.089	1.81	0.399	0.088	0.970	0.279	0.336	0.010
Magnesium	1930	5060	5910	3570	2030	7240	2170	7320	2030	10
Manganese	32.2	39.4	75.6	28.2	11.0	76.2	97.8	226	1600	0.10
Mercury	0.236	0.025	0.012	0.083	0.062	0.011	0.043	0.011	0.016	0.010
Molybdenum	0.098	0.123	0.575	0.134	<0.050	0.177	0.364	<0.050	0.064	0.050
Nickel	1.65	0.414	1.48	1.57	0.242	1.72	3.37	6.96	3.00	0.050
Phosphorus	485	3610	3090	450	493	4330	393	3510	1380	10
Potassium	1870	14200	15900	1720	1860	17800	1640	17600	5260	10
Selenium	0.142	<0.050	<0.050	0.095	<0.050	<0.050	0.055	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	257	27	145	457	404	31	110	28	20	10
Strontium	19.6	13.8	15.9	39.0	6.13	6.72	4.20	12.9	3.09	0.10
Thallium	0.0159	0.0066	<0.0020	0.0110	0.0024	0.0042	0.0146	0.0106	0.0052	0.0020
Tin	<0.10	<0.10	0.12	<0.10	<0.10	0.50	0.17	0.11	<0.10	0.10
Titanium	31.3	2.2	1.3	22.2	4.0	<1.0	61.5	28.4	17.2	1.0
Uranium	0.502	0.0273	0.0172	0.463	0.0339	0.0033	0.158	0.158	0.111	0.0020

Vanadium	1.41	<0.20	<0.20	1.04	<0.20	<0.20	2.58	1.07	0.76	0.20
Zinc	16.2	74.8	90.2	14.2	12.6	188	28.8	352	118	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated

[2] Reportable Detection Limit (RDL)

Table C-13. 2014 Vegetation metal analysis (n=25), sample sites L-61 to L-63.

Parameter[1]	L-61 (lichen)	L-61 (willow)	L-61 (blueberry)	L-62 (lichen)	L-62 (willow)	L-62 (blueberry)	L-63 (lichen)	L-63 (willow)	RDL[2]
Aluminum	198	32.0	119	1240	20.7	124	121	3.7	1.0
Antimony	0.0055	0.0061	<0.0050	0.0077	<0.0050	<0.0050	<0.0050	<0.0050	0.0050
Arsenic	0.053	<0.050	<0.050	0.104	<0.050	<0.050	<0.050	<0.050	0.050
Barium	9.76	15.4	60.5	26.6	25.6	75.2	5.96	1.32	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	2.2	25.4	24.9	2.7	22.6	26.8	3.6	21.1	2.0
Cadmium	0.082	0.441	0.412	0.100	0.488	0.396	0.048	0.231	0.010
Calcium	7390	10200	5770	5050	8540	4640	26700	10500	10
Chromium	0.93	0.81	0.36	4.52	0.26	0.40	0.82	0.32	0.20
Cobalt	0.271	2.19	0.213	1.28	1.72	0.251	0.098	0.162	0.020
Copper	3.82	10.7	10.8	3.67	9.31	11.3	2.14	8.89	0.050
Iron	432	106	82	2320	71	100	218	59	10
Lead	0.675	0.084	0.056	2.19	0.034	0.083	0.681	0.036	0.010
Magnesium	1330	7840	1720	1550	5620	1290	1900	3900	10
Manganese	80.2	147	1070	77.8	201	667	12.2	26.5	0.10
Mercury	0.078	0.015	0.010	0.147	0.011	0.011	0.055	<0.010	0.010
Molybdenum	<0.050	0.066	<0.050	0.170	0.133	0.412	0.189	0.267	0.050
Nickel	1.02	4.47	2.38	3.45	3.01	2.71	0.500	0.719	0.050
Phosphorus	865	5530	2420	883	3300	1800	589	3200	10
Potassium	2060	17900	7110	2130	15900	5680	2070	11900	10
Selenium	0.071	<0.050	<0.050	0.096	<0.050	<0.050	0.069	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	351	22	<10	228	<10	13	367	<10	10
Strontium	4.26	15.7	3.76	11.6	22.9	5.39	14.0	5.25	0.10
Thallium	0.0048	0.0057	0.0026	0.0234	0.0068	0.0023	0.0055	0.0052	0.0020
Tin	<0.10	0.16	<0.10	0.11	<0.10	0.14	<0.10	<0.10	0.10
Titanium	16.4	1.6	2.2	125	<1.0	3.6	7.7	<1.0	1.0
Uranium	0.0514	0.0055	0.0101	0.713	0.0033	0.0201	0.135	<0.0020	0.0020

Parameter[1]	L-61 (lichen)	L-61 (willow)	L-61 (blueberry)	L-62 (lichen)	L-62 (willow)	L-62 (blueberry)	L-63 (lichen)	L-63 (willow)	RDL[2]
Vanadium	0.60	<0.20	<0.20	3.43	<0.20	<0.20	0.38	<0.20	0.20
Zinc	33.2	214	77.9	25.4	114	52.6	18.9	188	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

Table C-14. 2014 Vegetation metal analysis (n=25), sample sites L-64 to L-67.

Parameter[1]	L-64 (lichen)	L-65 (lichen)	L-65 (willow)	L-66 (lichen)	L-66 (willow)	L-67 (lichen)	L-67 (willow)	L-67 (blueberry)	RDL[2]
Aluminum	991	406	21.3	230	12.9	304	10.7	24.2	1.0
Antimony	0.0637	<0.0050	0.0076	0.0050	0.0053	<0.0050	<0.0050	<0.0050	0.0050
Arsenic	1.10	0.108	<0.050	0.053	<0.050	0.094	<0.050	<0.050	0.050
Barium	18.3	7.46	10.3	7.30	9.17	5.44	3.86	30.4	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	2.9	27.3	<2.0	12.4	<2.0	18.3	19.6	2.0
Cadmium	0.263	0.095	0.832	0.090	0.342	0.042	0.504	0.277	0.010
Calcium	16300	17100	14300	8770	7680	18300	13700	5180	10
Chromium	5.99	2.16	0.42	0.62	<0.20	1.39	0.86	0.24	0.20
Cobalt	0.558	0.554	0.256	0.168	0.602	0.286	0.180	0.034	0.020
Copper	3.18	2.24	13.4	1.27	7.63	1.40	6.99	11.3	0.050
Iron	8830	760	98	367	62	595	62	71	10
Lead	6.71	1.42	0.089	0.749	0.077	1.05	0.155	0.058	0.010
Magnesium	1280	2200	6450	1080	4190	1440	6540	2170	10
Manganese	87.6	41.0	35.0	32.9	75.4	20.2	58.3	181	0.10
Mercury	0.169	0.068	0.014	0.058	<0.010	0.087	<0.010	<0.010	0.010
Molybdenum	0.087	0.051	2.12	<0.050	<0.050	0.070	0.201	0.072	0.050
Nickel	3.83	3.45	4.87	0.539	1.81	1.18	2.56	0.633	0.050
Phosphorus	509	819	4770	466	3170	456	2720	1440	10
Potassium	1650	2090	21400	1430	10700	1520	10400	5910	10
Selenium	0.197	0.079	<0.050	0.063	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	170	366	19	213	<10	273	<10	<10	10
Strontium	14.0	6.80	5.74	5.94	8.56	4.24	5.60	2.41	0.10
Thallium	0.0191	0.0117	0.0079	0.0051	0.0025	0.0098	0.0035	<0.0020	0.0020
Tin	0.13	<0.10	0.14	<0.10	0.38	<0.10	<0.10	<0.10	0.10
Titanium	66.6	35.6	<1.0	17.4	<1.0	28.3	<1.0	1.5	1.0
Uranium	0.231	0.0661	0.0044	0.0516	0.0023	0.0871	0.0036	0.0074	0.0020

Vanadium	2.27	1.15	<0.20	0.65	<0.20	0.92	<0.20	<0.20	0.20
Zinc	23.8	15.9	83.6	19.4	103	9.82	118	83.3	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

Table C-15. 2013 Soil metal analysis (n=20), sample sites L-01 to L-10 (new site ID)[1].

Parameter[2]	CCME Agri[3]	CCME Ind[3]	L-01	L-02	L-03	L-04	L-05	L-06	L-07	L-08	L-09	L-10	RDL[4]
pH	6-8	6-8	8.27	8.52	6.35	8.53	8.59	8.60	8.32	7.65	6.05	8.64	0.010
Aluminum	NA	NA	1240	4360	6640	6380	3480	4200	5230	1650	2390	5770	100
Antimony	20	40	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic	12	12	<0.50	0.57	<0.50	0.90	0.78	1.19	1.25	0.60	<0.50	<0.50	0.50
Barium	750	2000	3.33	8.75	22.6	18.7	8.47	12.8	14.7	9.22	7.44	11.1	0.10
Beryllium	4	8	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.46	<0.40	<0.40	0.40	0.40
Bismuth	NA	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Cadmium	1.4	22	<0.050	0.080	0.081	0.134	0.066	0.075	0.061	<0.050	<0.050	0.250	0.050
Calcium	NA	NA	22200	9660	6060	44100	82200	83500	51000	2710	677	179000	100
Chromium	64	87	6.0	22.4	9.8	20.6	9.1	12.2	17.0	3.6	9.5	15.2	1.0
Cobalt	40	300	1.06	3.27	4.60	4.30	2.18	3.01	3.87	2.09	1.85	3.08	0.30
Copper	63	91	1.56	4.20	6.17	8.38	4.45	6.03	7.03	3.99	2.03	6.14	0.50
Iron	NA	NA	3540	7310	11000	10100	5850	8890	9980	2850	6670	11400	100
Lead	70	600	1.64	2.92	5.60	6.97	3.89	5.26	6.51	2.30	2.94	7.74	0.10
Lithium	NA	NA	6.3	15.0	13.9	24.7	23.8	23.4	27.9	<5.0	6.2	8.1	5.0
Magnesium	NA	NA	12000	7740	4240	21100	36600	41100	28200	880	1400	23100	100
Manganese	NA	NA	55.1	100	349	160	111	183	194	69.0	83.5	251	0.20
Mercury	6.6	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Molybdenum	5	40	0.11	0.10	0.26	0.22	0.32	0.55	0.30	0.11	0.13	0.19	0.10
Nickel	50	50	2.66	18.9	6.48	13.0	5.34	6.80	10.1	2.99	4.17	8.58	0.80
Phosphorus	NA	NA	112	172	473	278	173	233	325	132	223	104	10
Potassium	NA	NA	347	903	1020	1690	1230	1160	1260	327	323	317	100
Selenium	1	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	20	40	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.051	0.050
Sodium	NA	NA	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100
Strontium	NA	NA	11.6	7.42	13.3	25.4	46.3	45.8	25.5	2.75	2.49	83.3	0.10
Thallium	1	1	<0.050	0.084	0.140	0.133	0.062	0.082	0.102	<0.050	<0.050	0.191	0.050
Tin	5	300	<0.10	0.31	0.50	0.34	0.14	0.17	0.26	<0.10	0.20	0.16	0.10
Titanium	NA	NA	61.5	231	391	336	105	90.4	147	42.3	201	78.4	1.0

Uranium	23	300	0.250	0.431	2.62	0.507	0.314	0.401	0.461	0.502	0.473	0.491	0.050
Vanadium	130	130	6.2	11.8	18.6	18.8	10.3	13.5	15.9	5.2	13.0	9.7	2.0
Zinc	200	360	4.1	11.4	34.3	15.9	8.1	11.6	16.2	6.2	6.9	16.4	1.0
Zirconium	NA	NA	<0.50	2.30	1.58	4.36	0.53	0.57	1.51	0.68	<0.50	6.35	0.50

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[4] Reportable Detection Limit (RDL)

Table C-16. 2013 Soil metal analysis (n=20), sample sites L-12 to L-29 (new site ID)[1].

Parameter[2]	CCME Agri[3]	CCME Ind[3]	L-12	L-14	L-15	L-16	L-17	L-19	L-22	L-23	L-25	L-29	RDL[4]
pH	6-8	6-8	7.59	5.29	5.67	6.70	6.28	7.03	7.10	6.54	7.42	5.55	0.010
Aluminum	NA	NA	2270	2020	789	646	1120	2530	5110	2980	3450	3640	100
Antimony	20	40	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic	12	12	0.71	1.26	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.61	<0.50	0.50
Barium	750	2000	9.79	30.2	2.77	3.04	3.83	11.8	16.5	11.2	12.6	13.7	0.10
Beryllium	4	8	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40
Bismuth	NA	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Cadmium	1.4	22	0.063	0.080	<0.050	<0.050	<0.050	0.073	0.252	<0.050	0.102	<0.050	0.050
Calcium	NA	NA	1640	1400	195	240	302	636	2120	617	1600	1050	100
Chromium	64	87	7.8	13.8	3.3	3.5	6.5 (1)	9.8	20.2	38.8	14.9	11.8	1.0
Cobalt	40	300	1.88	2.39	0.64	0.70	1.22	2.38	4.22	5.40	3.19	3.14	0.30
Copper	63	91	5.04	3.97	0.96	1.17	1.77	4.51	5.82	2.41	7.27	2.73	0.50
Iron	NA	NA	4760	34500	2110	2020	4610	7180	10100	9620	13200	8790	100
Lead	70	600	3.16	2.11	0.82	0.89	1.29	1.96	4.95	3.31	4.55	3.22	0.10
Lithium	NA	NA	6.4	<5.0	<5.0	<5.0	<5.0	<5.0	10.2	5.7	7.4	10.6	5.0
Magnesium	NA	NA	1910	1120	631	669	794	2160	2760	3860	3150	2670	100
Manganese	NA	NA	65.7	38.1	17.5	18.4	32.3	65.8	145	113	191	96.7	0.20
Mercury	6.6	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Molybdenum	5	40	<0.10	0.23	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	0.22	<0.10	0.10
Nickel	50	50	6.45	20.2	2.01	3.11	2.80	7.36	11.1	39.4	19.7	6.76	0.80
Phosphorus	NA	NA	156	528	56	77	102	169	524	221	177	287	10
Potassium	NA	NA	495	177	156	150	195	452	917	375	601	747	100
Selenium	1	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	20	40	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Sodium	NA	NA	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100
Strontium	NA	NA	2.51	8.04	1.11	1.18	1.53	2.59	3.53	2.27	2.22	3.15	0.10
Thallium	1	1	0.052	<0.050	<0.050	<0.050	<0.050	<0.050	0.122	<0.050	0.062	0.052	0.050
Tin	5	300	0.16	0.11	<0.10	<0.10	<0.10	0.14	0.44	0.27	0.68	0.26	0.10
Titanium	NA	NA	181	82.3	52.7	48.5	97.4	187	539	220	458	424	1.0

Uranium	23	300	0.332	0.636	0.140	0.136	0.168	0.351	0.784	0.545	0.932	0.475	0.050
Vanadium	130	130	9.3	9.1	3.9	3.3	6.1	12.0	16.6	13.3	14.7	16.1	2.0
Zinc	200	360	8.9	17.0	3.2	2.3	4.4	7.5	15.9	11.4	17.1	16.5	1.0
Zirconium	NA	NA	1.23	0.98	<0.50	0.96	<0.50	1.79	9.86	<0.50	1.73	1.51	0.50

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[4] Reportable Detection Limit (RDL)

Table C-17. 2013 Vegetation metal analysis (n=35), sample sites L-01 to L-07 (new site ID)[1].

Parameter[2]	L-01 (lichen)	L-02 (lichen)	L-02 (willow)	L-03 (lichen)	L03 (blueberry)	L-04 (lichen)	L-04 (willow)	L-05 (lichen)	L-05 (willow)	L-06 (lichen)	L-06 (willow)	L-07 (willow)	RDL[3]
Aluminum	177	211	6.5	191	98.1	360	35.3	91.6	3.1	334	8.0	452	1.0
Antimony	0.0127	<0.0050	<0.0050	0.0071	<0.0050	0.0075	<0.0050	<0.0050	<0.0050	0.0070	0.0056	0.0086	0.0050
Arsenic	0.145	0.075	<0.050	0.081	<0.050	0.153	<0.050	0.055	<0.050	0.192	<0.050	0.215	0.050
Barium	1.89	3.08	1.47	5.41	0.87	3.98	2.79	2.52	0.71	3.19	0.59	4.26	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	2.4	<2.0	13.7	<2.0	18.0	<2.0	15.0	<2.0	15.7	<2.0	25.0	2.9	2.0
Cadmium	0.032	0.059	0.447	0.046	0.841	0.039	0.295	0.025	0.227	0.038	0.441	0.032	0.010
Calcium	27900	36300	13500	24400	18100	51100	16300	31700	13400	42500	20800	35800	10
Chromium	0.59	0.77	<0.20	0.48	0.23	1.27	<0.20	0.29	<0.20	0.99	<0.20	1.35	0.20
Cobalt	0.118	0.145	0.579	0.105	1.44	0.237	0.683	0.060	0.497	0.211	0.238	0.299	0.020
Copper	1.22	0.816	5.81	1.23	12.8	1.15	6.85	0.691	4.88	1.16	6.52	1.53	0.050
Iron	310	295	59	293	186	549	104	129	53	567	82	748	10
Lead	0.856	0.906	0.024	0.817	0.119	1.18	0.066	0.427	0.017	1.11	0.029	1.06	0.010
Magnesium	2260	882	3690	1960	5610	1400	4680	1280	4080	1700	6490	2990	10
Manganese	14.7	11.0	72.8	21.6	296	17.3	77.5	10.7	67.0	25.2	122	31.5	0.10
Mercury	0.066	0.031	<0.010	0.069	<0.010	0.046	<0.010	0.038	<0.010	0.071	0.011	0.071	0.010
Molybdenum	0.066	0.069	0.671	0.063	0.101	0.052	0.246	<0.050	0.223	0.054	0.177	0.069	0.050
Nickel	0.365	0.638	1.16	0.375	2.48	0.928	2.45	0.215	0.896	0.667	0.199	0.860	0.050
Phosphorus	708	298	3110	533	7870	380	4720	357	3390	327	4400	395	10
Potassium	2040	1170	11200	1830	17900	1380	14100	1430	11200	1380	19300	1650	10
Selenium	0.066	0.066	<0.050	0.065	<0.050	0.062	<0.050	<0.050	<0.050	0.082	<0.050	0.080	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	651	329	10	524	21	281	15	250	<10	141	24	225	10
Strontium	75.9	15.6	7.11	26.9	7.50	21.8	11.7	14.8	6.47	19.3	10.4	18.5	0.10
Thallium	0.0047	0.0062	0.0040	0.0072	0.0080	0.0090	0.0029	0.0030	0.0027	0.0113	<0.0020	0.0127	0.0020
Tin	<0.10	<0.10	1.76	<0.10	<0.10	<0.10	0.30	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	10.3	12.8	<1.0	10.0	2.3	20.6	2.1	3.6	<1.0	14.4	<1.0	19.1	1.0
Uranium	0.0779	0.145	0.0031	0.104	0.0079	0.0588	0.0057	0.0167	<0.0020	0.0438	<0.0020	0.0551	0.0020

Vanadium	0.44	0.49	<0.20	0.41	<0.20	0.87	<0.20	<0.20	<0.20	0.82	<0.20	1.11	0.20
Zinc	10.4	9.40	92.9	12.1	251	9.74	82.0	7.14	111	8.57	133	9.84	0.20

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Reportable Detection Limit (RDL)

Table C-18. 2013 Vegetation metal analysis (n=35), sample sites L-08 to L-16 (new site ID)[1].

Parameter[2]	L-08 (lichen)	L-08 (willow)	L-09 (lichen)	L-09 (willow)	L-10 (willow)	L-12 (lichen)	L-12 (willow)	L-12 (blueberry)	L-14 (lichen)	L-15 (blueberry)	L-15 (lichen)	L-16 (lichen)	RDL[3]
Aluminum	158	3.6	62.6	4.0	54.3	60.5	18.2	197	122	191	482	1140	1.0
Antimony	0.0069	0.0061	<0.0050	<0.0050	<0.0050	0.0142	<0.0050	0.0057	0.0063	0.0371	<0.0050	0.0221	0.0050
Arsenic	0.112	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.060	<0.050	0.121	0.175	0.050
Barium	3.65	0.69	5.34	6.14	36.6	2.55	2.84	63.1	3.08	4.76	3.20	15.0	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	16.4	<2.0	10.4	30.9	<2.0	11.5	19.0	<2.0	8.3	<2.0	2.4	2.0
Cadmium	0.045	0.162	0.174	0.464	0.631	0.067	0.380	0.447	0.025	0.764	0.047	0.084	0.010
Calcium	54900	8900	16600	8690	7550	16900	9320	6990	1150	7700	4680	8260	10
Chromium	0.58	<0.20	<0.20	<0.20	<0.20	0.23	<0.20	0.98	0.46	1.35	3.02	3.92	0.20
Cobalt	0.158	0.594	0.068	0.439	0.054	0.042	0.280	0.201	0.173	0.388	0.441	0.930	0.020
Copper	1.02	6.63	0.834	8.38	17.6	0.798	11.6	12.2	0.764	10.6	2.30	2.65	0.050
Iron	245	56	85	69	111	90	67	354	266	432	1080	2170	10
Lead	0.783	0.017	0.699	0.024	0.076	0.809	0.066	0.350	0.218	0.173	0.526	2.57	0.010
Magnesium	2210	4020	1010	4800	2830	1020	5280	1950	840	5100	1280	1880	10
Manganese	14.4	56.2	14.9	80.3	392	12.7	167	488	35.4	306	39.6	40.5	0.10
Mercury	0.048	<0.010	0.068	0.012	0.011	0.049	<0.010	0.011	0.020	0.016	0.046	0.050	0.010
Molybdenum	<0.050	0.159	<0.050	0.063	0.053	<0.050	0.091	<0.050	<0.050	0.088	0.077	0.072	0.050
Nickel	0.430	0.492	0.228	1.36	1.68	0.235	0.447	2.10	0.629	3.94	2.87	3.74	0.050
Phosphorus	323	4760	476	5160	3450	316	3490	1340	289	4880	722	544	10
Potassium	1440	18000	1880	12800	11200	1470	14300	4210	953	10500	2090	1410	10
Selenium	0.061	<0.050	0.055	<0.050	<0.050	0.056	<0.050	<0.050	<0.050	<0.050	0.064	0.065	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	382	31	371	11	30	220	14	13	36	34	164	321	10
Strontium	15.8	2.84	8.83	6.68	9.22	6.36	4.97	4.61	1.92	8.74	4.65	15.3	0.10
Thallium	0.0050	<0.0020	0.0036	0.0047	0.0043	0.0030	<0.0020	0.0091	0.0042	0.0036	0.0091	0.0203	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	0.10
Titanium	5.3	<1.0	4.6	<1.0	1.3	4.1	<1.0	13.3	7.9	8.0	33.7	63.4	1.0
Uranium	0.0773	0.0021	0.0174	<0.0020	0.0118	0.0083	<0.0020	0.0158	0.0192	0.0286	0.109	0.230	0.0020

Vanadium	0.39	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.53	0.30	0.55	1.48	3.11	0.20
Zinc	10.8	138	20.6	194	133	16.0	396	121	12.3	369	21.0	20.5	0.20

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Reportable Detection Limit (RDL)

Table C-19. 2013 Vegetation metal analysis (n=35), sample sites L-16 to L-29 (new site ID)[1]

Parameter[2]	L-16 (willow)	L-17 (lichen)	L-17 (willow)	L-19 (willow)	L-22 (willow)	L-23 (lichen)	L-23 (blueberry)	L-24 (blueberry)	L-25 (lichen)	L-25 (willow)	L-29 (willow)	L-29 (willow)	RDL[3]
Aluminum	91.1	419	93.3	93.2	31.2	898	117	898	268	13.4	36.3	16.7	1.0
Antimony	0.0548	0.0066	0.0052	<0.0050	0.0055	0.0552	0.0138	0.0552	0.0081	0.0052	0.0198	<0.0050	0.0050
Arsenic	<0.050	0.075	<0.050	<0.050	<0.050	0.244	<0.050	0.244	0.089	<0.050	<0.050	<0.050	0.050
Barium	8.76	6.67	4.18	4.94	4.17	13.3	39.1	13.3	9.98	4.99	5.52	5.83	0.10
Beryllium	<0.10	0.14	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	18.6	<2.0	17.7	15.5	10.5	<2.0	28.5	<2.0	<2.0	15.7	<2.0	13.2	2.0
Cadmium	0.312	0.048	0.374	0.772	0.657	0.136	0.940	0.136	0.166	3.65	0.189	1.08	0.010
Calcium	8000	10700	10900	14800	9810	10400	6750	10400	14900	13500	11200	7460	10
Chromium	0.90	2.02	0.98	0.35	<0.20	6.03	0.59	6.03	1.35	<0.20	<0.20	<0.20	0.20
Cobalt	0.870	0.347	0.519	0.385	0.415	1.39	0.267	1.39	0.254	0.385	0.059	1.34	0.020
Copper	12.0	1.28	7.57	8.28	10.0	3.44	15.7	3.44	1.71	9.32	0.975	10.3	0.050
Iron	235	860	340	194	116	2110	244	2110	551	80	53	106	10
Lead	0.151	1.04	0.125	0.093	0.076	3.47	0.274	3.47	1.94	0.041	0.620	0.046	0.010
Magnesium	5450	964	4710	6720	3690	2770	3790	2770	1500	6840	898	4330	10
Manganese	118	20.7	51.2	75.7	114	70.1	411	70.1	29.4	84.9	25.0	220	0.10
Mercury	0.012	0.037	<0.010	0.011	<0.010	0.085	0.023	0.085	0.086	<0.010	0.036	<0.010	0.010
Molybdenum	0.365	<0.050	0.098	0.130	0.130	0.260	0.110	0.260	0.352	1.11	<0.050	0.224	0.050
Nickel	5.00	1.34	2.78	2.06	2.88	12.2	18.9	12.2	1.96	10.7	0.247	1.86	0.050
Phosphorus	8290	327	5010	4510	6020	622	3250	622	473	3410	278	5240	10
Potassium	18700	1180	14600	17200	15700	1690	9770	1690	1910	15400	1570	15800	10
Selenium	<0.050	0.057	<0.050	<0.050	<0.050	0.090	<0.050	0.090	0.093	<0.050	0.058	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	41	199	17	14	21	276	<10	276	304	<10	282	20	10
Strontium	10.1	5.74	6.36	4.81	6.58	5.64	3.75	5.64	5.60	4.40	8.33	7.26	0.10
Thallium	0.0051	0.0101	0.0050	0.0040	0.0067	0.0249	0.0042	0.0249	0.0103	0.0051	0.0023	0.0040	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	0.23	0.16	<0.10	0.16	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	5.1	32.4	7.3	5.3	2.1	67.9	6.5	67.9	21.6	1.2	2.6	1.3	1.0
Uranium	0.0242	0.0600	0.0308	0.0092	0.0079	0.405	0.0474	0.405	0.147	0.0047	0.0152	0.0022	0.0020

Vanadium	<0.20	1.23	0.25	0.22	<0.20	2.52	0.22	2.52	0.71	<0.20	<0.20	<0.20	0.20
Zinc	131	11.7	70.0	73.5	208	20.4	65.8	20.4	19.2	242	29.1	221	0.20

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Reportable Detection Limit (RDL)

Table C-20. 2012 Soil metal analysis (n=36), sample sites L-11 to L-30 (new site ID)[1].

Parameter[2]	CCME Agri[3]	CCME Ind[3]	L-11	L-13	L-18	L-20	L-21	L-24	L-26	L-27	L-28	L-30	RDL[4]
pH	6–8	6–8	8.35	8.57	7.45	5.90	4.83	6.83	6.64	7.59	5.94	5.66	0.010
Aluminum	NA	NA	4390	543	2140	4030	4540	2960	2750	6120	11900	474	100
Antimony	20	40	<0.10	<0.10	0.85	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic	12	12	1.43	<0.50	4.14	<0.50	<0.50	<0.50	<0.50	0.91	<0.50	<0.50	0.50
Barium	750	2000	17.3	2.07	7.33	15.4	8.26	9.20	7.22	23.1	47.0	1.73	0.10
Beryllium	4	8	<0.40	<0.40	0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.54	<0.40	0.40
Bismuth	NA	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Cadmium	1.4	22	0.132	<0.050	<0.050	0.055	<0.050	0.066	0.072	0.275	0.103	<0.050	0.050
Calcium	NA	NA	20500	5580	1070	1760	398	1310	662	1870	1840	263	100
Chromium	64	87	16.9	3.8	24.3	21.8	13.1	13.1	7.8	36.0	26.8	2.1	1.0
Cobalt	40	300	3.74	0.57	2.48	3.45	2.44	2.71	2.27	5.94	7.11	0.42	0.30
Copper	63	91	8.77	0.67	4.53	4.29	2.21	2.78	3.58	10.2	10.1	0.81	0.50
Iron	NA	NA	8920	2370	49700	19900	8750	7530	4650	13900	18200	1550	100
Lead	70	600	7.85	1.18	1.93	4.13	4.03	2.02	3.02	6.83	4.75	0.65	0.10
Lithium	NA	NA	13.0	<5.0	7.0	9.9	9.2	6.7	<5.0	15.1	13.5	<5.0	5.0
Magnesium	NA	NA	13800	2910	2270	3030	1960	2430	1280	5360	7400	269	100
Manganese	NA	NA	147	18.3	99.3	105	80.3	88.7	78.7	190	213	13.6	0.20
Mercury	6.6	50	<0.050	<0.050	0.097	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Molybdenum	5	40	0.12	<0.10	0.77	<0.10	<0.10	<0.10	<0.10	0.15	0.24	<0.10	0.10
Nickel	50	50	10.2	1.64	14.8	8.88	5.32	7.49	4.97	22.2	15.9	1.07	0.80
Phosphorus	NA	NA	246	178	312	549	181	314	167	325	583	109	10
Potassium	NA	NA	1110	136	301	663	522	484	387	1240	2150	107	100
Selenium	1	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	20	40	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Sodium	500	NA	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100
Strontium	NA	NA	9.01	3.12	3.22	3.82	1.92	2.60	1.97	3.54	7.11	0.94	0.10
Thallium	1	1	0.129	<0.050	<0.050	0.061	0.068	0.066	<0.050	0.144	0.126	<0.050	0.050
Tin	5	300	0.29	<0.10	0.14	0.37	0.31	0.22	0.16	0.49	0.56	<0.10	0.10
Titanium	NA	NA	291	61.2	157	476	353	363	192	638	929	49.4	1.0

Uranium	23	300	0.476	0.149	0.976	1.19	0.321	0.423	0.291	1.42	1.61	0.151	0.050
Vanadium	130	130	15.1	3.9	8.6	33.8	14.8	13.0	7.6	22.4	31.2	2.2	2.0
Zinc	200	360	13.9	2.4	6.6	15.9	16.9	10.5	8.1	23.1	39.1	2.1	1.0
Zirconium	NA	NA	5.09	0.91	0.99	2.61	<0.50	2.04	1.55	8.69	3.87	<0.50	0.50

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[4] Reportable Detection Limit (RDL)

Table C-21. 2012 Soil metal analysis (n=36), sample sites L-31 to L-40 (new site ID)[1].

Parameter[2]	CCME Agri[3]	CCME Ind[3]	L-31	L-32	L-33	L-34	L-35	L-36	L-37	L-38	L-39	L-40	RDL[4]
pH	6–8	6–8	5.19	6.02	6.62	7.60	8.38	5.21	5.64	5.55	6.05	5.15	0.010
Aluminum	NA	NA	2380	4090	1920	3780	3360	5910	4740	7790	4490	4610	100
Antimony	20	40	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic	12	12	<0.50	<0.50	<0.50	1.03	1.23	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Barium	750	2000	17.1	16.2	8.20	19.7	15.3	29.9	16.0	22.0	15.1	10.9	0.10
Beryllium	4	8	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40
Bismuth	NA	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	<0.10	0.10
Cadmium	1.4	22	<0.050	0.241	<0.050	<0.050	0.164	0.073	0.180	0.061	0.097	<0.050	0.050
Calcium	NA	NA	397	1960	1080	4700	42300	1590	1790	1580	1720	760	100
Chromium	64	87	6.2	19.4	8.9	9.0	8.7	17.6	11.5	17.4	12.8	11.2	1.0
Cobalt	40	300	1.55	3.78	1.74	2.94	2.64	3.41	2.61	4.44	2.91	2.53	0.30
Copper	63	91	2.00	5.46	1.31	5.22	3.93	8.74	3.95	6.68	3.75	2.82	0.50
Iron	NA	NA	6530	11500	5050	10600	7680	12500	8900	13500	9290	7960	100
Lead	70	600	3.15	5.16	2.27	5.55	6.23	5.42	3.16	5.25	3.91	2.27	0.10
Lithium	NA	NA	5.0	11.2	<5.0	8.0	9.5	10.2	6.8	15.2	8.6	9.7	5.0
Magnesium	NA	NA	1500	3330	1420	3990	26100	3380	2430	3570	2780	3170	100
Manganese	NA	NA	57.1	145	56.7	155	134	105	71.7	125	103	69.6	0.20
Mercury	6.6	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Molybdenum	5	40	0.15	0.28	<0.10	0.34	0.16	0.32	0.14	0.21	0.16	<0.10	0.10
Nickel	50	50	4.40	9.67	4.11	5.11	4.55	9.24	6.04	11.5	6.36	6.26	0.80
Phosphorus	NA	NA	130	515	252	391	405	437	539	451	308	308	10
Potassium	NA	NA	418	990	591	1070	1010	598	587	928	863	575	100
Selenium	1	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	20	40	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Sodium	500	NA	<100	<100	<100	121	<100	<100	<100	<100	<100	<100	100
Strontium	NA	NA	2.04	4.76	2.15	5.69	16.8	5.37	3.82	5.21	4.13	2.18	0.10
Thallium	1	1	<0.050	0.120	<0.050	0.098	0.095	0.101	<0.050	0.079	0.095	0.056	0.050
Tin	5	300	0.44	0.46	0.22	0.59	0.43	0.62	0.33	0.57	0.39	0.39	0.10
Titanium	NA	NA	344	621	317	526	392	661	529	935	564	281	1.0

Uranium	23	300	0.940	2.48	0.329	0.920	0.592	2.24	1.07	1.67	0.604	0.605	0.050
Vanadium	130	130	12.0	19.7	9.3	17.3	14.7	21.4	15.2	23.1	17.1	14.0	2.0
Zinc	200	360	10.6	18.2	10.0	18.9	14.1	26.7	15.7	27.5	16.2	17.1	1.0
Zirconium	NA	NA	0.57	10.2	1.74	2.23	5.45	2.24	6.36	2.09	3.16	0.67	0.50

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[4] Reportable Detection Limit (RDL)

Table C-22. 2012 Soil metal analysis (n=36) sample sites L-41 to L-48 (new site ID)[1].

Parameter[2]	CCME Agri[3]	CCME Ind[3]	L-41	L-42	L-43	L-44	L-45	L-46	L-47[4]	L-47[4]	L-48	RDL[5]
pH	6–8	6–8	5.10	5.45	5.41	4.92	5.59	4.89	4.58	7.80	4.80	0.010
Aluminum	NA	NA	3330	7250	2990	2170	3280	39300	951	3450	15700	100
Antimony	20	40	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic	12	12	<0.50	<0.50	<0.50	<0.50	<0.50	2.93	<0.50	1.06	<0.50	0.50
Barium	750	2000	11.7	12.5	21.3	7.82	15.0	126	16.6	18.2	132	0.10
Beryllium	4	8	<0.40	<0.40	<0.40	<0.40	<0.40	1.78	<0.40	<0.40	0.76	0.40
Bismuth	NA	NA	<0.10	<0.10	<0.10	<0.10	<0.10	0.19	<0.10	<0.10	<0.10	0.10
Cadmium	1.4	22	<0.050	0.060	0.126	<0.050	0.255	<0.050	0.054	<0.050	0.275	0.050
Calcium	NA	NA	1080	1050	951	1040	1380	2750	18800	5320	3760	100
Chromium	64	87	14.0	12.3	7.9	12.5	3.7	55.7	1.6	9.7	29.4	1.0
Cobalt	40	300	1.87	3.03	2.11	2.12	2.14	17.5	0.37	3.03	11.5	0.30
Copper	63	91	1.15	3.96	3.11	1.51	4.16	43.0	10.3	6.65	48.4	0.50
Iron	NA	NA	7450	14300	10500	10900	9140	45900	1910	10200	31300	100
Lead	70	600	2.15	5.12	4.36	4.08	6.06	31.7	1.42	5.41	15.0	0.10
Lithium	NA	NA	6.9	10.9	7.7	<5.0	<5.0	54.3	<5.0	8.0	26.9	5.0
Magnesium	NA	NA	1690	2490	1760	1510	1320	17000	3890	3630	10600	100
Manganese	NA	NA	51.0	68.6	64.8	63.3	57.7	416	7.93	116	259	0.20
Mercury	6.6	50	<0.050	<0.050	<0.050	<0.050	<0.050	0.088	0.152	<0.050	<0.050	0.050
Molybdenum	5	40	<0.10	0.19	0.39	0.12	<0.10	2.53	0.36	0.21	1.39	0.10
Nickel	50	50	5.12	6.95	3.98	4.33	2.33	37.7	1.49	4.77	23.9	0.80
Phosphorus	NA	NA	492	390	367	324	521	847	778	266	876	10
Potassium	NA	NA	618	525	834	281	617	2600	290	535	2620	100
Selenium	1	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	0.51	<0.50	<0.50	<0.50	0.50
Silver	20	40	<0.050	<0.050	<0.050	<0.050	<0.050	0.198	<0.050	<0.050	0.094	0.050
Sodium	500	NA	<100	<100	<100	<100	<100	185	<100	<100	299	100
Strontium	NA	NA	2.58	2.75	2.04	3.17	3.08	20.9	21.9	6.61	15.8	0.10
Thallium	1	1	<0.050	0.059	0.078	<0.050	<0.050	0.431	0.064	0.066	0.435	0.050
Tin	5	300	0.35	0.51	0.31	0.45	0.37	2.66	0.12	0.44	1.80	0.10
Titanium	NA	NA	289	583	411	555	365	2060	86.1	547	1730	1.0

Uranium	23	300	0.525	0.985	1.19	0.665	1.06	5.37	6.13	1.28	5.26	0.050
Vanadium	130	130	11.7	26.2	17.0	19.6	14.3	83.9	2.3	18.7	52.4	2.0
Zinc	200	360	12.1	19.0	16.9	11.7	13.1	118	21.9	18.7	93.4	1.0
Zirconium	NA	NA	0.60	1.77	5.43	0.73	11.0	37.9	1.45	1.41	6.29	0.50

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[4] Two soil samples were taken from sample site L-47

[5] Reportable Detection Limit (RDL)

Table C-23. 2012 Soil metal analysis (n=36) sample sites L-49 to L-55 (new site ID)[1].

Parameter[2]	CCME Agri[3]	CCME Ind[3]	L-49	L-50	L-51	L-52	L-53	L-54	L-55	RDL[4]
pH	6–8	6–8	6.17	5.07	6.40	4.98	5.34	5.38	8.81	0.010
Aluminum	NA	NA	3890	3010	3270	3980	10600	3440	1980	100
Antimony	20	40	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Arsenic	12	12	<0.50	<0.50	<0.50	<0.50	0.51	<0.50	<0.50	0.50
Barium	750	2000	33.5	13.1	34.4	11.3	21.7	21.8	9.28	0.10
Beryllium	4	8	<0.40	<0.40	<0.40	<0.40	0.64	<0.40	<0.40	0.40
Bismuth	NA	NA	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Cadmium	1.4	22	0.150	<0.050	<0.050	<0.050	0.128	<0.050	<0.050	0.050
Calcium	NA	NA	3900	1170	2270	1120	1900	1420	1800	100
Chromium	64	87	21.1	14.7	27.6	13.6	28.2	19.9	8.3	1.0
Cobalt	40	300	4.84	2.55	3.70	3.19	6.22	3.85	1.83	0.30
Copper	63	91	13.0	6.73	8.60	3.04	21.3	9.19	3.10	0.50
Iron	NA	NA	23000	12700	14000	16100	21100	14400	8370	100
Lead	70	600	5.85	4.29	3.36	5.93	8.23	3.22	2.03	0.10
Lithium	NA	NA	8.4	5.2	6.3	6.5	23.5	8.9	5.3	5.0
Magnesium	NA	NA	3310	1890	3330	2770	7230	2460	2220	100
Manganese	NA	NA	100	64.1	80.1	94.8	225	81.3	51.2	0.20
Mercury	6.6	50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Molybdenum	5	40	0.42	0.19	0.19	0.20	0.28	0.15	<0.10	0.10
Nickel	50	50	7.53	5.90	8.49	5.76	11.5	8.24	3.42	0.80
Phosphorus	NA	NA	1500	303	515	402	610	495	237	10
Potassium	NA	NA	1270	438	633	549	1270	1040	527	100
Selenium	1	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	20	40	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Sodium	500	NA	116	107	134	<100	<100	<100	<100	100
Strontium	NA	NA	7.60	4.06	9.43	2.45	5.08	2.77	3.83	0.10
Thallium	1	1	0.079	<0.050	0.057	0.059	0.123	0.064	<0.050	0.050
Tin	5	300	0.70	0.38	0.43	0.51	0.84	0.36	0.24	0.10
Titanium	NA	NA	586	349	691	707	810	602	271	1.0

Uranium	23	300	1.52	1.32	1.14	0.977	1.72	0.602	0.441	0.050
Vanadium	130	130	47.9	26.5	28.6	28.3	34.7	28.9	15.8	2.0
Zinc	200	360	22.8	13.4	18.4	24.5	46.0	18.1	10.2	1.0
Zirconium	NA	NA	6.08	1.46	1.24	1.13	2.56	0.77	0.85	0.50

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Agriculture and Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[4] Reportable Detection Limit (RDL)

Table C-24. 2012 Vegetation metal analysis (n=34), sample sites L-11 to L-32 (new site ID)[1].

Parameter[2]	L-11 (lichen)	L-13 (lichen)	L-18 (lichen)	L-20 (lichen)	L-21 (lichen)	L-24 (lichen))	L-26 (lichen)	L-28 (lichen)	L-30 (lichen)	L-31 (lichen)	L-32 (lichen)	RDL[3]
Aluminum	70.5	312	49.9	216	149	106	909	239	58.6	110	562	1.0
Antimony	0.0143	0.0071	<0.0050	0.0085	0.0055	0.0073	0.0064	0.0085	0.0107	0.0057	0.0132	0.0050
Arsenic	<0.050	0.112	<0.050	0.123	<0.050	<0.050	0.234	0.122	<0.050	0.066	0.181	0.050
Barium	3.04	4.65	2.59	20.6	8.16	4.54	13.2	26.0	3.28	15.1	17.0	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Cadmium	0.068	0.064	0.044	0.241	0.116	0.040	0.192	0.178	0.045	0.117	0.182	0.010
Calcium	33300	18700	14100	25700	11200	15500	12700	7040	13100	4120	11300	10
Chromium	0.26	1.47	0.21	0.62	0.36	0.44	4.09	0.59	0.24	0.26	1.84	0.20
Cobalt	0.061	0.282	0.051	0.196	0.146	0.098	0.782	0.288	0.060	0.118	0.475	0.020
Copper	0.941	1.23	0.661	1.14	0.738	0.928	1.79	1.10	0.628	0.750	1.81	0.050
Iron	82	473	67	279	197	183	1310	273	74	122	791	10
Lead	0.539	1.76	0.391	2.93	0.784	0.751	4.29	2.57	0.609	1.38	1.85	0.010
Magnesium	3010	1590	931	1180	755	1400	690	443	911	459	1450	10
Manganese	12.0	26.1	11.6	25.6	46.8	11.1	49.3	25.1	16.2	31.6	46.2	0.10
Mercury	0.059	0.055	0.051	0.094	0.050	0.062	0.059	0.068	0.052	0.041	0.066	0.010
Molybdenum	<0.050	<0.050	<0.050	0.055	0.199	0.078	0.067	<0.050	<0.050	<0.050	0.101	0.050
Nickel	0.238	1.21	0.084	0.972	0.265	0.288	2.46	0.700	0.051	0.435	1.46	0.050
Phosphorus	336	500	394	353	318	389	388	318	422	296	576	10
Potassium	1410	1800	1630	1200	1420	1380	1140	1090	1420	1100	1980	10
Selenium	0.071	<0.050	<0.050	0.075	<0.050	0.050	0.105	0.077	<0.050	0.079	0.061	0.050
Silver	0.045	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	358	337	330	154	262	196	31	44	291	150	318	10
Strontium	10.8	8.46	4.08	34.3	5.84	5.64	13.6	27.1	4.46	9.80	23.3	0.10
Thallium	0.0033	0.0092	0.0021	0.0067	0.0042	0.0036	0.0194	0.0072	0.0037	0.0045	0.0155	0.0020
Tin	0.50	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.14	0.10
Titanium	3.2	21.5	3.3	16.6	15.3	8.3	73.2	17.1	3.9	9.7	61.6	1.0
Uranium	0.0170	0.0481	0.0085	0.0733	0.0193	0.0392	0.109	0.0549	0.0108	0.0453	0.847	0.0020

Vanadium	<0.20	0.76	<0.20	0.51	0.34	0.24	2.50	0.42	<0.20	<0.20	1.36	0.20
Zinc	15.3	12.2	12.4	14.1	19.8	9.10	11.8	13.6	10.4	13.1	28.3	0.20

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Reportable Detection Limit (RDL)

Table C-25. 2012 Vegetation metal analysis (n=34), sample sites L-33 to L-43 (new site ID)[1].

Parameter[2]	L-33 (lichen)	L-34 (lichen)	L-35 (lichen)	L-36 (lichen)	L-37 (lichen)	L-38 (lichen)	L-39 (lichen)	L-40 (lichen)	L-41 (lichen)	L-42 (lichen)	L-43 (lichen)	RDL[3]
Aluminum	54.4	37.6	44.2	92.0	311	106	107	102	112	94.0	154	1.0
Antimony	0.0053	<0.0050	0.0071	0.0071	0.0064	<0.0050	0.0100	0.0086	0.0056	0.0092	0.0052	0.0050
Arsenic	<0.050	<0.050	<0.050	<0.050	0.125	0.125	<0.050	<0.050	0.060	0.071	0.154	0.050
Barium	4.42	2.26	4.36	7.73	43.3	15.2	4.51	18.1	16.1	32.0	16.0	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Cadmium	0.054	0.039	0.045	0.046	0.297	0.203	0.046	0.150	0.123	0.240	0.144	0.010
Calcium	6430	13500	14100	5160	11000	4610	7910	7760	7900	11100	10000	10
Chromium	<0.20	<0.20	<0.20	<0.20	0.46	0.26	0.57	<0.20	<0.20	<0.20	0.23	0.20
Cobalt	0.036	0.031	0.036	0.134	0.497	0.167	0.096	0.282	0.188	0.342	0.147	0.020
Copper	0.747	0.589	0.774	0.760	0.951	0.574	0.894	0.740	0.837	0.899	0.935	0.050
Iron	66	47	64	107	252	91	131	121	124	83	130	10
Lead	0.226	0.277	0.302	0.411	4.44	3.19	0.390	1.11	0.882	1.30	2.21	0.010
Magnesium	753	1190	1730	625	527	252	953	815	869	1240	628	10
Manganese	34.3	7.55	9.73	60.4	34.1	16.7	46.2	74.0	60.9	82.9	28.4	0.10
Mercury	0.044	0.044	0.041	0.047	0.069	0.081 (1)	0.062	0.055	0.051	0.025	0.084	0.010
Molybdenum	<0.050	0.087	0.138	<0.050	<0.050	<0.050	0.050	<0.050	<0.050	<0.050	0.055	0.050
Nickel	0.470	0.075	0.166	0.107	0.994	0.393	0.475	0.499	0.292	0.547	0.216	0.050
Phosphorus	288	354	346	375	360	184	557	344	367	318	247	10
Potassium	1190	1410	1560	1410	1320	798	2130	1610	1590	1390	1030	10
Selenium	<0.050	<0.050	<0.050	<0.050	0.106	0.075	<0.050	0.066	0.056	<0.050	0.065	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	188	312	266	339	200	72	552	366	342	361	113	10
Strontium	2.76	4.96	6.16	6.68	38.2	19.7	5.73	18.6	18.8	33.8	44.0	0.10
Thallium	0.0020	<0.0020	0.0027	0.0032	0.0074	0.0040	0.0040	0.0029	0.0041	0.0031	0.0032	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	4.9	3.7	4.0	10.0	18.0	8.4	9.3	8.8	10.2	6.6	9.6	1.0
Uranium	0.0149	0.0148	0.0383	0.0349	0.0642	0.0230	0.0217	0.0185	0.0327	0.0278	0.102	0.0020

Vanadium	<0.20	<0.20	<0.20	<0.20	0.33	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	15.7	11.0	15.8	15.4	15.4	11.7	23.8	24.0	21.4	29.5	13.4	0.20

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Reportable Detection Limit (RDL)

Table C-26. 2012 Vegetation metal analysis (n=34), sample sites L-44 toL-55 (new site ID)[1].

Parameter[2]	L-44 (lichen)	L-45 (lichen)	L-46 (lichen)	L-47 (lichen)	L-48 (lichen)	L-49 (lichen)	L-50 (lichen)	L-51 (lichen)	L-52 (lichen)	L-53 (lichen)	L-54 (lichen)	L-55 (lichen)	RDL[3]
Aluminum	62.9	392	510	20.5	230	38.5	65.4	37.1	56.3	32.3	41.0	185	1.0
Antimony	0.0058	0.0104	0.0053	<0.0050	0.0078	<0.0050	<0.0050	<0.0050	0.0141	0.0054	<0.0050	0.0062	0.0050
Arsenic	0.066	0.092	0.508	0.067	0.109	0.096	0.061	<0.050	0.054	0.091	0.075	0.061	0.050
Barium	9.48	37.1	16.7	1.66	14.8	4.67	8.11	6.59	4.39	2.25	3.99	8.16	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Cadmium	0.127	0.185	0.234	0.079	0.050	0.107	0.136	0.070	0.079	0.115	0.114	0.050	0.010
Calcium	9620	5880	33500	3350	2360	2410	5410	6940	3620	3020	4280	11000	10
Chromium	0.32	0.38	0.81	<0.20	0.46	<0.20	<0.20	<0.20	<0.20	<0.20	0.73	0.56	0.20
Cobalt	0.109	0.371	0.286	0.048	0.434	0.233	0.147	0.100	0.064	0.070	0.262	0.116	0.020
Copper	0.962	1.28	1.53	0.505	2.03	1.24	0.818	0.992	1.12	0.718	1.13	1.41	0.050
Iron	91	384	526	27	329	52	63	52	69	39	66	307	10
Lead	1.04	1.68	1.71	1.14	0.545	1.57	1.74	0.491	0.793	2.08	1.74	0.695	0.010
Magnesium	523	760	783	206	853	198	268	777	343	195	277	1460	10
Manganese	57.3	64.4	33.2	7.91	34.6	11.6	26.2	35.0	41.8	9.89	13.0	18.8	0.10
Mercury	0.112	0.096	0.036	0.168	0.021	0.084	0.087	0.070	0.035	0.041	0.056	0.087	0.010
Molybdenum	<0.050	<0.050	0.051	<0.050	0.074	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.070	0.050
Nickel	0.356	0.446	0.662	0.086	0.641	0.572	0.266	<0.050	0.531	0.155	0.547	0.468	0.050
Phosphorus	512	357	397	214	441	206	284	491	465	202	250	476	10
Potassium	1500	1100	1610	786	1130	807	949	1490	1320	800	906	1700	10
Selenium	0.102	0.072	0.071	0.088	0.071	0.140	0.075	0.067	0.083	0.111	0.119	0.053	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	222	100	402	27	46	19	57	428	104	21	25	276	10
Strontium	18.8	26.6	68.1	6.21	12.1	5.99	10.9	16.6	6.25	8.24	15.5	10.1	0.10
Thallium	0.0021	0.0058	0.0106	0.0021	0.0073	0.0028	0.0022	0.0027	0.0044	<0.0020	<0.0020	0.0041	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	7.2	26.0	43.1	1.5	18.7	3.5	4.2	3.1	4.5	2.8	4.0	18.8	1.0
Uranium	0.0338	0.0353	0.103	0.0307	0.0836	0.0108	0.0344	0.0203	0.0219	0.0081	0.0131	0.0411	0.0020

Parameter[2]	L-44 (lichen)	L-45 (lichen)	L-46 (lichen)	L-47 (lichen)	L-48 (lichen)	L-49 (lichen)	L-50 (lichen)	L-51 (lichen)	L-52 (lichen)	L-53 (lichen)	L-54 (lichen)	L-55 (lichen)	RDL[3]
Vanadium	<0.20	0.50	0.92	<0.20	0.53	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.50	0.20
Zinc	14.7	20.3	14.9	8.57	15.8	11.1	11.8	18.0	13.6	9.48	11.9	14.7	0.20

[1] Collection sites were re-labelled following the 2013 field program to provide consistency between years and facilitate mapping; the lab results reported here are by the new Site ID and can be referenced to the Original Site ID in the 2013 Annual Terrestrial Monitoring Report, Table 6, Section 2.2.1

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Reportable Detection Limit (RDL)

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APPENDIX D. BIRD SPECIES OBSERVED WITHIN THE MARY RIVER PROJECT TERRESTRIAL REGIONAL STUDY AREA, 2006–2017

Table D-1 Bird species observed within the Mary River Project Terrestrial Regional Study Area, 2006 — 2017.

Species	Latin	2006	2007	2008	2012	2013	2014	2015	2016	2017
Snow Goose	*Chen caerulescens*	B	B	B	S	S	B	S	S	B
Brant	*Branta bernicla*	S	-	-	-	-	-	-	-	-
Cackling Goose	*Branta hutchinsii*	-	-	-	-	B	S	S	-	B
Canada Goose	*Branta canadensis*	-	-	-	-	B	S	S	S	B
Canada/Cackling Goose	*Branta* spp.	B	B	B	B	-	-	-	-	-
Tundra Swan	*Cygnus columbianus*	-	-	B	S	-	-	-	-	S
King Eider	*Somateria spectabilis*	B	B	B	S	S	-	S	-	S
Common Eider	*Somateria mollissima*	S	S	S	S	S	-	-	-	-
Long-tailed Duck	*Clangula hyemalis*	B	B	B	S	B	S	S	S	B
Red-breasted Merganser	*Mergus serrator*	B	B	B	S	S	-	S	-	S
Rock Ptarmigan	*Lagopus muta*	-	-	-	S	S	-	S	-	S
Willow Ptarmigan	*Lagopus lagopus*	-	-	-	-	-	-	-	-	S
Unspecified Ptarmigan	*Lagopus* spp.	-	-	S	-	-	S	-	S	-
Red-throated Loon	*Gavia stellata*	B	B	B	S	B	B	S	S	B
Pacific Loon	*Gavia pacifica*	B	B	B	S	S	S	-	-	-
Common Loon	*Gavia immer*	B	B	B	S	S	S	S	-	-
Yellow-billed Loon	*Gavia adamsii*	B	B	B	S	S	B	S	S	S
Northern Fulmar	*Fulmarus glacialis*	S	-	-	-	-	-	-	-	-
Rough-legged Hawk	*Buteo lagopus*	B	B	B	B	B	B	B	B	B
Gyrfalcon	*Falco rusticolus*	B	B	B	B	B	B	B	B	B
Peregrine Falcon	*Falco peregrinus tundris*	B	B	B	B	B	B	B	B	B
Sandhill Crane	*Grus canadensis*	B	B	B	S	B	B	S	S	S
American Golden-Plover	*Pluvialis dominica*	S	S	S	B	S	S	S	-	S
Semipalmated Plover	*Charadrius semipalmatus*	-	-	-	B	B	B	S	-	-
Common Ringed Plover	*Charadrius hiaticula*	S	-	-	-	S	B	S	-	-
Dunlin	*Calidris alpina*	-	-	-	S	-	-	-	-	-
White-rumped Sandpiper	*Calidris fuscicollis*	-	-	-	-	B	-	-	-	-
Baird's Sandpiper	*Calidris bairdii*	S	S	S	B	B	B	S	S	-
Pectoral Sandpiper	*Calidris melanotos*	-	-	-	S	-	-	-	-	-
Red Phalarope	*Phalaropus fulicarius*	-	-	-	S	S	-	-	-	-
Unspecified Phalarope	*Phalaropus* spp.	-	-	S	-	-	-	-	-	-
Herring Gull	*Larus argentatus*	-	-	-	B	-	-	-	S	-

Table D-1 Bird species observed within the Mary River Project Terrestrial Regional Study Area, 2006 — 2017.

Species	Latin	2006	2007	2008	2012	2013	2014	2015	2016	2017
Glaucous Gull	*Larus hyperboreus*	-	B	B	B	B	B	S	S	B
Thayer's Gull	*Larus thayeri*	-	-	-	-	B	-	S	-	-
Arctic Tern	*Sterna paradisaea*	-	S	S	-	-	-	-	-	-
Long-tailed Jaeger	*Stercorarius longicaudus*	-	-	-	S	-	-	S	-	-
Unspecified Jaeger	*Stercorarius* spp.	-	-	B	-	-	-	-	-	-
Snowy Owl	*Bubo scandiacus*	B	B	B	S	S	B	S	S	-
Short-eared Owl	*Asio flammeus*	-	-	S	-	-	-	-	-	-
Common Raven	*Corvus corax*	S	S	B	B	S	B	S	S	B
Horned Lark	*Eremophila alpestris*	S	S	S	B	S	S	S	S	S
Northern Wheatear	*Oenanthe oenanthe*	-	-	-	-	S	U	S	-	S
American Pipit	*Anthus rubescens*	S	S	S	B	B	-	S	-	B
Lapland Longspur	*Calcarius lapponicus*	S	S	S	B	B	S	S	S	B
Snow Bunting	*Plectrophenax nivalis*	S	S	S	B	B	S	S	S	B
Common Redpoll	*Carduelis flammea*	-	-	-	S	-	-	-	-	-
Hoary Redpoll	*Carduelis hornemanni*	-	-	-	S	-	-	-	-	-

Symbology: B = Confirmed Breeding; S = Confirmed Present; U = unconfirmed observation
*No formal bird surveys were conducted in 2017, and therefore all observations are incidental; from when qualified biologists were on site.