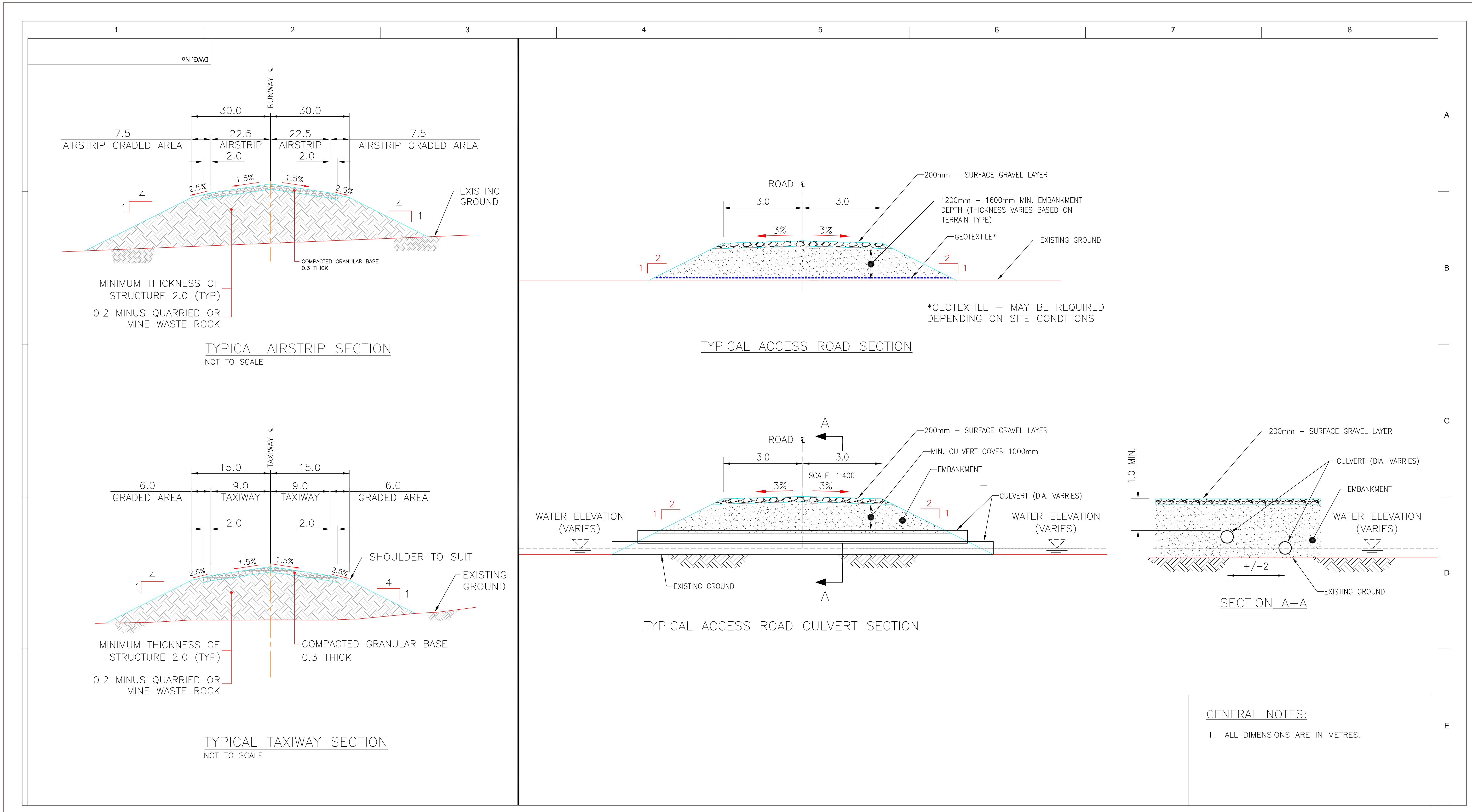

LEGEND

NOTES

Source: JDS Energy & Mining Inc. (2014)

STATUS

ISSUED FOR REVIEW

CLIENT

Sabina GOLD & SILVER CORP.

SABINA BACK RIVER PROJECT, NUNAVUT

Typical Sections

PROJECT NO.	DWN	CKD	APVD	REV
V15103033-02	MEZ	SL	DM	0

OFFICE	DATE
Tt EBA-VANC	October 8, 2014

Figure 5.2-2

Q:\Vancouver\Graphics\ENGINEERING\V151\V15103033-02\V15103033-02_Figure5-2-2.cdr

5.3.1 Temporary Laydown Area and Material Storage

An estimated laydown area of up to 1 ha will be required to store equipment, materials and fuel for future Project works. With the exception of large preassembly and modular equipment, materials arriving at the TLA will be housed in sea containers. The equipment and materials will be placed on dunnage or swamp mats to protect the permafrost.

The following equipment and materials will be stored at the TLA.

Table 5.3-1. Temporary Laydown Area Inventory

Equipment / Material	Quantity
Excavator - Cat 349F	1
Articulated Trucks - Cat 740B	2
Dozer - Cat D6T	1
Grader - Cat 140M	1
Drill - Cat MD5075	1
IT Loader - Cat 930K	1
Packer - Cat CS56B	1
65RT Crane	1
Mobile Crusher	1
Mobile Screener	1
Fuel Truck	1
Mechanic Truck	1
Water Truck	1
Tractor / Trailer	1
1-Ton Pickup Truck	2
Camp Genset - 125kw	2
Camp Modules	15
Double Wall Fuel Tanks - 100,000 L	6
Fuel Berms (136,000 l capacity)	6
Explosive Magazine - 40ft	1
Explosive Magazine - 20ft	1
Steel for 10 M litre Fuel Tank	1
Swamp Mats (8'x14')	550
Portable Shop	1

The TLA will be accessed from the barge landing area using swamp mats provisionally placed directly onto the tundra to preserve the permafrost. Once the equipment and fuel are stored, the swamp mats along this corridor will be removed and transported offsite with the outgoing barges.

To facilitate these efforts, personnel (10-14 staff) will be shuttled on a daily basis from the Goose Camp to the TLA. Minimal temporary structures (e.g. tents) will be used at the TLA site; these may include a first aid room, lunch room, and restrooms (pactos). Food, water, and waste will be temporarily stored and removed periodically. Local measures will be implemented to minimize wildlife attraction to the TLA.

5.3.2 Diesel Fuel Supply and Storage

Sabina will require 600,000 L of diesel fuel for future site preparation; this fuel will be shipped to the MLA (via barge) and stored in land-based steel tanks at the TLA. The tertiary containment for fuel tanks will be Arctic-grade manufactured instaberms or similar product. These will be placed on a stable foundation of interlocking swamp mats that will remain for the duration of the facility.

The capacity of each berm will be equal to the volume of the largest tank plus 10% of the volume of the remaining tanks or 110% volume of the largest tank, whichever is greater. In calculating the volume, the footprint of the smaller tanks is subtracted. The above basis is consistent with the document entitled *Design Rationale for Fuel Storage and Distribution Facilities* published by the Department of Public Works of the Northwest Territories (GNWT 2006; refer to Section 4.6 of these guidelines). The design of these containment products will be based on Arctic installation and industry storage standards. Fuel transfer will incorporate hoses and pumps within tertiary containment. Transfer methodology is described in the attached Oil Pollution Emergency Plan (OPEP), Appendix I of the Site Preparation Activities Application Package.

5.4 Goose Property Equipment Usage

Equipment to be used at the Goose Property during the 2015 site preparation activities is listed in Table 5.4-1. Additional equipment which is currently at site and predominately used for ongoing exploration activities may also be used to support the 2015 site preparation activities. These items include the fuel truck, water truck, and IT 28 Loader.

Table 5.4-1: Site Preparation Equipment Requirements

Equipment / Material	Quantity	Weight (tonnes)	Ground Pressure (N/M^2)
Excavator - Cat 320E	1	24.7	55,370
Loader - Cat 966H	1	23.7	225,105
Articulated Trucks - Cat 730C	3	24.1	338,541
Dozer - Cat D6M	1	16.5	37,000
Grader - Cat 140M	1	19.9	94,618
Drill - Cat MD5075	1	20.4	82,737
Packer - Cat CS56B	1	11.5	218,474
Mobile Crusher/Screener	1	71.0	60,000

5.5 Site Preparation Construction Schedule

The proposed site preparation works which, subject to securing necessary permits and approvals, will be undertaken at the Goose Property and MLA over a period of approximately 180 days, from February to August, 2015.

The following construction order is proposed for site preparation activities at the Goose Property. The majority of steps will be completed pre-thaw; however construction of the all-weather airstrip extension and secondary all-weather road construction can be completed post-thaw.

- After mobilizing site preparation personnel to site, the first activity to be undertaken will be construction of the ice-based airstrip on Goose Lake;

- The ice-road(s) will then be constructed from the existing airstrip to the Goose and Umwelt quarries, as well as to the two explosives magazines and to the diversion berm location;
- Once accessible by ice-road, the quarries will be developed using a drill-blast-crush-haul methodology;
- In-stream works and site preparation for the diversion berm will commence. Berm material, sourced from either the existing stockpile or 2015 quarry operations, will be placed at the proposed Rascal Lake outflow realignment;
- Sediment and erosions controls will be established for site preparation activities, as required;
- Initial construction of the all-weather road:
  - If Goose quarry is selected as the primary source of material, initial construction will connect the Goose quarry to the existing all-weather airstrip;
  - Alternatively, if the Umwelt quarry is selected as the primary source of material initial construction will focus on connecting the Umwelt quarry to the all-weather airstrip;
  - During initial construction, the crusher pad will be established;
- Concurrent with initial all-weather road construction, the main Rascal Lake outflow realignment will be constructed;
- Construction of the all-weather airstrip extension will then commence; and
- If Goose quarry is selected as the primary source of material for initial all-weather road construction, secondary construction will extend the all-weather road to Umwelt quarry. Concurrent to secondary all-weather road construction, the crossings for ephemeral watercourses will be built as the road reaches each crossing location.

The following activities will be completed over a period of approximately 25 days during the open-water season at the MLA:

- Two barges will arrive from a western route, either from the Lower Mainland or from Hay River and will land at the MLA;
- Swamp mats will be laid out along the access trail from the barge landing area to the TLA;
- Temporary structures, such as a lunch room (tent) and sanitary facilities, will be erected at the TLA;
- Swamp mats will be placed as a foundation to the TLA;
- Tertiary containment for the TLA fuel storage area will be erected;
- Barges will then be offloaded with seacans, bulk materials and equipment placed at the TLA first;
- Steel fuel storage tanks will then be offloaded and placed at the TLA within the tertiary containment;
- Fuel storage tanks will then be filled from the barge (details in Appendix I, OPEP); and
- Once all fuel, materials, and equipment have been placed at the TLA, the swamp mats along the access trail will be removed and loaded back onto the barges, which will then depart.

5.6 Site Preparation Workforce

It is estimated that approximately 45 personnel will be required for a period of approximately 180 days to complete the proposed activities. The work will be carried out by Sabina employees and contractors whose northern and Inuit employment and training policies will be applied. Sabina will put emphasis on the importance of these policies in the selection of contractors and it is estimated that the workforce will be approximately one third Inuit.

The total cost of the 2015 site preparation activities is estimated to be approximately $10 million.

6.0 ALTERNATIVES

Alternatives within the Project have been evaluated according to the following criteria:

- Technical feasibility;
- Cost implication in terms of implementation;
- Potential impacts to the environment;
- Amenability to reclamation, and
- Results of community engagement.

The following sections outline alternatives that were assessed for each component of the site preparation activities.

6.1 All-weather Road

The all-weather road is required as it links the Goose Property with the proposed Umwelt quarry. Its layout reflects best practices for avoiding sensitive areas, such as archaeology sites, rare plants and lichens, special landscape features, and wildlife habitat features such as nesting sites and dens. The road reflects the most efficient approach to the Umwelt quarry, and does not traverse land, so that it can be used outside of winter. During site preparation, it will be used to access the Umwelt quarry, in order to supply aggregate for site preparation activities, including the all-weather airstrip. During the construction phase of the Project, it will serve a similar purpose.

6.2 All-weather Airstrip Extension

Due to the remoteness and isolation of the Goose Property, air transportation is an essential component of the Project development. The air transportation alternatives considered for access include:

- Ice airstrips and open water float access using Goose lakes;
- All-weather airstrips up to 1,800 m to support year round access with up to Hercules, or equivalent sized, aircraft; and
- All-weather airstrips up to 2,800 m to support year round access with up to Boeing 767, or equivalent, and larger-sized aircraft.

The second option was selected based upon technical feasibility, project logistical demands and cost. Ice airstrips and open water float access alone do not provide enough capacity to service site preparation activities. As well, there is period of time between open water season and freeze-up when the lake cannot be used for landing.

The construction of an airstrip up to 2,800 m to accommodate Boeing 767 or equivalent was deemed as not necessary for site preparation activities. In addition, the locating of suitable characteristics (non-PAG material, subdued topography with appropriate length of approach) within proximity to the Goose Property was problematic.

Four locations were considered for the airstrip up to 1,800 m. Factors taken into consideration were:

- Distance from existing and planned facilities;
- Ground topography;
- Approach obstructions;
- Impact on waterbodies and watercourses;
- Available construction materials and proximity to sources;
- Direction of prevailing wind; and
- Character of superficial materials with particular reference to permafrost

Based on the technical and cost considerations the preferred option is to extend the existing 915 m airstrip to 1,524 m. This airstrip will be in service for the life of the Project.

6.3 Rascal Lake Outflow Stream Alignment

In order to construct a geotechnically stable airstrip extension on permafrost, a realignment of Rascal Stream East is required. This work will require that Sabina place a berm on the Rascal Stream East (RSE), realigning it to augment flows along the Rascal Stream West (RSW) watercourse. With the construction of a series of berms, RSE will be realigned towards an existing smaller catchment flowing into Gander Pond. The realigned RSW will generate increased flows into Gander Pond and create new fish habitat to mitigate the loss of habitat from RSE.

Based on available topography and flow model results, the location of the berms were generated in an iterative process to minimize the length of berm, while ensuring that no water shall impinge on the airstrip during the design events. The culvert location was selected based on stream slope and cross-sectional topography to minimize the fill required for the road crossing.

The Rascal Lake outflow stream alignment will be in place for the life of the Project. Culverts will be removed during closure.

6.4 Quarry Construction and Operation

Options for quarry material include:

- Local esker;
- Local bedrock locations – new areas; and
- Local bedrock locations – existing operations.

For environmental reasons, Sabina has selected to avoid extraction of esker material and have considered bedrock locations only. Suitable material needs to have the physical and geochemical stability to be used, and be accessible, minimize transport distance, and avoid culturally and environmentally sensitive areas.

The site preparation work will require a total of 550,000 m^3 of quarry rock, which would be obtained from the current quarry west of the Goose Camp and/or the proposed Umwelt quarry. Expansion of the existing quarry is proposed as the site is already operational, thus much of the disturbance activity has already occurred. The location of the Umwelt quarry was selected as it was the closest source of suitable material to the site preparation activities. Geochemical characterization indicates that the majority of the upper greywacke samples representing the proposed quarry areas within the Umwelt pit are classified as non-PAG or low S material with a limited potential for acid rock generation. Additionally, based on low solid phase arsenic concentrations, metal leaching is unlikely to be an issue.

The quarries will be in use through the construction phase of the Project.

6.5 Operation of a Temporary Laydown Area

The TLA occupies the same area (but with a smaller footprint) where the Project MLA is proposed. Thus, selection criteria for the TLA are the same as for the MLA.

In total, five potential Marine Laydown areas were considered for the Project. All were located on the southwest shore of Bathurst Inlet. Selection criteria were:

- Distance from Goose site;
- Shoreline topography for port construction;
- Land topography for road construction;
- Steepness of sea bed immediately offshore;
- Exposure to wind and sea ice;
- Nature of superficial material on shore;
- Stability of sea bed materials;
- Depth to bedrock; and
- Unavailability of sites due to conflicting permitting (BIPAR).

Taking all these factors into consideration resulted in the selection of the MLA and therefore the TLA. The TLA will be decommissioned following completion of construction.

7.0 LIFECYCLE

Table 7.0-1: Lifecycle of Proposed Site Preparation Activities

Equipment / Material	Classification	Rational
Quarry construction and operation	Permanent	To be used throughout the Project lifecycle
All-weather airstrip extension	Permanent	To be used throughout the Project lifecycle
Rascal Lake outflow stream realignment	Permanent	Permanent realignment of creek
Ice road and water use	Temporary	To be used in winter prior to commissioning of all-weather road
Construction and operation of an all-weather road	Permanent	To be used throughout the Project lifecycle
Construction and operation of a TLA)	Temporary	To be decommissioned at the end of the exploration phase of the Project

8.0 POTENTIAL IMPACTS

8.1 Valued Components

Potential impacts associated with site preparation activities were assessed for Valued Ecosystem Components (VECs), Valued Socioeconomic Components (VSECs), and Subjects of Note. The scoping involved Sabina-led public consultations, the use of Traditional Knowledge (TK), regulator consultations and regulatory considerations, and recommendations presented in the NIRB EIS guidelines (NIRB 2013). The *Inuit Traditional Knowledge of Sabina Gold & Silver Corp., Back River (Hannigayok) Project, Naonaiyaotit Traditional Knowledge Project* report (KIA 2012) was consulted extensively for TK information.

A screening analysis was carried out to determine which of these VECs, VSECs and subjects of note could potentially interact with the site preparation activities (in this report, these are collectively called VECs). These are presented in Table 8.1-1.

Table 8.1-1: Summary of VEC interactions with Site Preparation Activities

PROJECT ACTIVITIES - Exploration and Site Preparation		Atmospheric Environment	Air Quality	Noise and Vibration	Climate and Meteorology	Terrestrial Environment	Surface and Bedrock Geology	Permafrost	Eskers and Other Unique or Fragile Landscapes	Vegetation	Caribou, including Habitat and Migration Patterns	Grizzly Bear, including Habitat and Migration Patterns	Muskox, including Habitat and Migration Patterns	Wolverine/Furbearers, including Habitat and Migration Patterns	Birds, Including Habitat and Migration Raptors	Raptors	Freshwater Environment	Hydrology/ Limnology	Groundwater	Limnology and Bathymetry	Water Quality	Sediment Quality	Fish/Aquatic Habitat	Fish Community (lake trout, Arctic grayling)	Marine Environment	Physical Processes	Water Quality	Sediment Quality	Fish/Aquatic Habitat	Fish Community (Arctic char)	Seabirds/Seaducks	Ringed Seals	Human Environment	Archaeological and Cultural Historic Sites	Paleontological	Non-traditional Land and Resource Use	Socio-ec: Business and Economic Development	Socio-ec: Employment	Health, Safety and Community Well-being	Subsistence Economy and Land Use	Country Foods/Human Health
Goose Exploration Camp	Camp Operations		M	M				M		M	M	M	M	M	M						M	M	M														P	P	P		
	Resupply of Goose Camp		M	M							M	M	M	M	M																						P				
	Desiel fuel resupply and storage									M									M		M		M																		
	Machinery and Vehicle Refueling/Fuel Storage and Handling									M											M	M																			
	Explosive and ammonium nitrate storage									M											M	M	M	M												P	P				
Quarries Construction and Operation	Umwelt Quarry (cut and fill): Stripping, Drilling, Blasting, Excavation		M	M				M		M	M	M	M	M	M	M		M			M	M												M		M	P	P		M	
	Goose Quarry (cut and fill): Stripping, Drilling, Blasting, Excavation		M	M				M		M	M	M	M	M	M	M		M			M	M																P			
	Machinery and Vehicle Refueling/Fuel Storage and Handling									M											M	M																			
	Machinery and Vehicle Emissions		M		M					M																															
	Chemicals , Hazardous Material Transport, Storage and Handling									M											M	M																			M
	Explosive and ammonium nitrate storage									M											M	M	M	M					M	M											
All-weather Airstrip Extension	Stripping, Drilling, Blasting, Excavation		M	M				M		M	M	M	M	M	M	M		M			M	M																P			
	Machinery and Vehicle Refueling/Fuel Storage and Handling									M											M	M																			
	Machinery and Vehicle Emissions		M		M					M																															
	Explosive and ammonium nitrate storage																				M	M	M	M					M	M											
Rascal Lake Outflow Stream Realignmen t	Excavation and construction		M	M						M	M	M	M	M	M	M		M			M	M												M		M	P	P		M	
	Machinery and Vehicle Refueling/Fuel Storage and Handling																				M	M																			
	Machinery and Vehicle Emissions		M		M																																				
All-weather Road	Stripping, Drilling, Blasting, Excavation		M	M				M		M	M	M	M	M	M	M		M			M	M																P			
	Machinery and Vehicle Refueling/Fuel Storage and Handling									M											M	M																			
	Machinery and Vehicle Emissions		M		M					M																															
	Chemicals , Hazardous Material Transport, Storage and Handling									M											M	M																			M
	Explosive and ammonium nitrate storage									M											M	M	M	M					M	M											
Ice Roads and Airstrip	Water use for Winter Road construction and maintenance																																	M		M	P	P		M	
	Winter Road construction and use		M	M														M			M	M																P			
	Machinery and Vehicle Refueling/Fuel Storage and Handling									M											M	M																			
	Machinery and Vehicle Emissions		M		M																																				
Marine Laydown Area	Machinery and Vehicle Emissions		M		M					M																															
	Chemicals , Hazardous Material Transport, Storage and Handling									M											M	M																			M
	Marine Transport of Goods		N	N	N															M	M	M	M	M		M	M	M	M	M	M					P	P			M	

Please indicate in the matrix cells whether the interaction causes an impact and whether the impact is:

P: Positive

N: Negative and non-mitigatable

M: Negative and mitigatable

U: Unknown

If no impact is expected then please leave the cell blank

8.2 Atmospheric Environment

Atmospheric Environment VECs that could potentially interact with site preparation activities include Air Quality and Noise and Vibration. Air quality could be affected by construction and operation of the all-weather road, quarry operations, and Air Strip Extension, primarily through dust from blasting and vehicle operation, as well as vehicular emissions. Noise and Vibration quality can be affected by these same project-related activities. The assessed project activities are not anticipated to affect climate and meteorology, as these effects are local rather than regional in scale, and therefore will not be discussed further in this document.

8.2.1 Air Quality

8.2.1.1 Baseline Air Quality

The air quality in the West Kitikmeot of Nunavut can generally be classified as pristine. Local emissions are limited to stationary (power generation and heating) and mobile sources (trucks, snowmobiles, all-terrain vehicles, etc.) operated by local residents in the few communities within the West Kitikmeot region. Mines operating in Nunavut and the Northwest Territories (NWT) outside of the West Kitikmeot region represent the only major industrial emission sources. Because of the limited local emission sources, long-range transport of air contaminants is the main influence on ambient air quality. The atmospheric boundary layer in the Arctic is generally very stable and surface inversions occur frequently. As a result, dispersion of air contaminants can be less effective in the Arctic than in other regions.

Comprehensive baseline field programs were conducted to support the assessment of the Project, with the objectives being to:

- Understand existing conditions in the local and regional study areas of the Project;
- To provide a benchmark for evaluating the potential future effects of the Project and to characterize pre-disturbance conditions for the purpose of reclamation activities; and
- To support predictive modelling for effect analysis.

8.2.1.2 Potential Effects

Air quality is an important environmental factor in ensuring the conservation of local vegetation, wildlife, and human health values. The activities associated with the vehicle emissions, generated during road construction activities, quarrying, ice road construction and goods and personnel movement have the potential to generate emissions of criteria air contaminants (CACs) and also lead to dust and acid deposition. To assess the potential impact of these emissions, an air quality modelling study was conducted; Table 8.2-1 presents the contaminants assessed as part of the model.

Table 8.2-1: Air Contaminants included in the Air Quality Modelling Study

Species	Description
Criteria Air Contaminants (CACs)	
Sulphur dioxide (SO_2)	Fossil fuels contain a small amount of organic sulphur compounds. During fuel combustion, the sulphur is oxidized and emitted as SO_2 gas with the engine exhaust. In the atmosphere, SO_2 can further oxidize to sulphate particles, which contribute to acid deposition.
Oxides of nitrogen (NO_x)	NO_x gas primarily consists of nitrogen oxide (NO) and nitrogen dioxide (NO_2). The gasses are emitted with exhaust from combustion engines and products from blasting operations. NO_x can be converted to nitric acid in the atmosphere and thus contribute to acid deposition.
Carbon monoxide (CO)	Carbon monoxide is formed as a result of incomplete combustion of fossil fuels. The gas prevents oxygen from attaching to red blood cells and is therefore toxic at high concentrations.
Total suspended particulates (TSP) matter	TSP are airborne particles that have a diameter of 100 µm or less. Sources of TSP include vehicle and engine exhaust and fugitive dust. Most particles with diameters between 2 and 100 µm are a result of fugitive dust. Fugitive dust is derived from the mechanical disturbance of granular material exposed to the air. Common sources of fugitive dust include unpaved roads, aggregate storage piles and construction operations. Particles can be composed of a wide range of materials, including minerals (sand, rock dust), engine soot, organic materials or salt.
Particulate matter (PM_{10})	PM_{10} particles are a subset of TSP and are defined as particles with a diameter less than 10 µm.
Respirable particulate matter ($PM_{2.5}$)	$PM_{2.5}$ particles are a subset of TSP and are defined as particles with a diameter less than 2.5 µm. These particles are small enough to enter deep into the respiratory system. The majority of particulate matter emitted with diesel engine exhaust is $PM_{2.5}$.
Deposition	
Dust deposition	Small, dry, solid particles projected into the air by natural forces, such as wind or by man-made processes. Dust particles are usually in the size range from about 1 to 100 µm in diameter. They settle slowly under the influence of gravity and are deposited on the soil and vegetation.
Acid deposition	Acid deposition primarily occurs as a result of atmospheric oxidation of sulphur dioxide to sulphate (sulphuric acid) and oxidation of nitrogen dioxide to nitrate (nitric acid), which is then deposited on the soil and vegetation. Acid deposition can be quantified as potential acid input, which is a measure of the combined input of sulphur and nitrogen derived acid species.

Canada's national, provincial, and territorial governments have established ambient air quality thresholds for CACs that are intended to ensure long-term protection of public health and the environment. Table 8.2-2 summarizes the ambient air quality standards applicable to the Project.

Table 8.2-2. Federal, Provincial, and Territorial Ambient Air Quality Standards and Objectives

Contaminant	Averaging Period	Nunavut Ambient Air Quality Standards[a]	Dust and Acid Deposition Provincial Guideline Values	Canadian Ambient Air Quality Standards (2020)	National Ambient Air Quality Objectives[b]	
					Maximum Desirable	Maximum Acceptable
Sulphur dioxide (SO_2) (µg/m^3)	1-hour	450	-		450	900
	24-hour	150	-		150	300
	Annual	30	-		30	60
Nitrogen dioxide (NO_2) (µg/m^3)	1-hour	400	-		-	400
	24-hour	200	-		-	200
	Annual	60	-		60	100
Carbon monoxide (CO) (µg/m^3)	1-hour	-	-		15,000	35,000
	8-hour	-	-		6,000	15,000
Total suspended particulate (TSP) (µg/m^3)	24-hour	120	-		-	120
	Annual[c]	60	-		60	70
PM_{10} (µg/m^3)	24-hour		50[d]			
$PM_{2.5}$ (µg/m^3)	24-hour	30	-	27[e]	-	-
	Annual			8.8		
Dust deposition (mg/dm^2/day)	30-day	-	1.7[f]		-	-
Acid deposition (eq/ha/yr)	Annual	-	250 [g]		-	-

Notes:
[a] Government of Nunavut (2011)
[b] CCME (1999)
[c] Geometric mean: the average of the logarithmic values of a data set converted back to a base 10 number
[d] BC MOE (2009)
[e] The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.
[f] Most stringent provincial guideline (BC MOE 1979).
[g] The critical load guideline recommended for acidic, coarse parent materials (WHO 1999).

8.2.1.3 Potential Interactions with Project and Characterization

Potential interactions were identified using professional judgement and experience at other similar projects in Nunavut and the NWT. Table 8.2-3 presents the site preparation activities along with the nature of the potential interaction with each of the eight indicators. The identified interactions are characterized below.

Table 8.2-3. Potential Project Interaction with the VEC Air Quality

Project Activities: Site Preparation	NO_2	SO_2	CO	TSP	PM_{10}	$PM_{2.5}$	Dust Deposition	Acid Deposition
All-weather Road	X	X	X	X	X	X	X	X
Quarries	X	X	X	X	X	X	X	X
All-weather Airstrip Extension	X	X	X	X	X	X	X	X
Ice Road	X	X	X	X	X	X		X
Temporary Laydown Area								

Air Quality is potentially affected by all-weather road construction and use, the existing and new Umwelt quarry operations, and the airstrip extension construction and use. These Project components could interact with all eight air quality indicators. The TLA was not considered to affects air quality as the operation of equipment in the area will be very brief, to unload two barges. Dispersal due to high winds is also effective around the TLA. The emissions associated with the site preparation activities are expected to be less than those generated during the year with the highest emissions, which would occur during mine operations. The following sections characterize the potential effects of the site preparation activities on air quality due to each of the pollutants.

SO_2

Predicted maximum 1-hour, 24-hour and annual average SO_2 concentrations were all well below the Nunavut standards at all locations modelled. Since the results are predicted to be below the criteria, there are no anticipated residual effects.

NO_2

Predicted maximum 1-hour and 24-hour average NO_2 concentrations were below the Nunavut objective. Since the results are predicted to be below the criteria, there are no anticipated residual effects.

CO

Predicted maximum 1-hour and 8-hour average CO concentrations were all well below the Nunavut standards at all locations modelled. Since the results are predicted to be below the criteria, there are no anticipated residual effects.

TSP and PM_{10} and $PM_{2.5}$

The model was run for fugitive and non-fugitive sources separately and therefore the contribution from different sources could be assessed. Exceedances were identified during operations at Goose Camp, but not for site preparation. These exceedances can be attributed to emissions of dust from open pit quarry activities and unpaved road dust generated on onsite. The model has been run assuming no anthropogenic dust control. However, mitigation measures such as road watering will be implemented to reduce the amount of unpaved road dust.

Dust Deposition

Dust deposition rates were predicted to be below the referenced objectives at all locations modelled.

Acid Deposition

For site preparation, there are no exceedances of WHO critical load guidelines for acid deposition.

8.2.2 Identification of Mitigation and Management Measures

Mitigation measures involve taking a tangible action to avoid, minimize, restore on-site or offset Project effects. Mitigation measures that are recommended to reduce an adverse effect are technically, environmentally, and economically feasible and aim to avoid, reduce, control, eliminate, offset, or compensate potential project effects.

There are two main types of mitigation and management measures that will be put in place in order to reduce air quality impacts associated with site preparation activities: emission reduction measures and fugitive dust reduction measures. Emission reduction methods include ensuring proper equipment maintenance, and implementing a recycling program to reduce the amount of incinerated waste, as detailed in the Waste Management Plan (Appendix D of the Site Preparation Activities Application Package). Fugitive dust suppression measures include wetting work areas, roads, and storage piles, installing covers to equipment and loads carried by vehicles, installing windbreaks or fences, and using dust hoods and shields.

8.3 Noise and Vibration

8.3.1 Baseline Summary

Noise is an important environmental factor because a change in the noise environment may adversely affect wildlife, workers and local residents. Noise is defined as any undesirable sound that may irritate people, disturb rest or sleep, cause loss of hearing, or otherwise affect the quality of life of affected individuals. Noise can result in psychological and physiological effects (e.g., stress), mental health effects, and effects on residential behaviour (World Health Organization [WHO] 1999).

Vibration may be in the form of ground vibration or blasting overpressures, i.e., pressure waves in the atmosphere. These ground-borne or airborne vibrations can cause cosmetic and structural damage to buildings as well as disturbances to local residents, workers, and wildlife.

Aside from mine exploration activities, the noise environment in the Project area is pristine. There are no additional industrial sites or human settlements close enough to the Project to be audible; consequently, only natural sources such as wind, precipitation, and wildlife will contribute to background noise levels.

8.3.2 Potential Effects

Site Preparation work will introduce noise and vibration sources largely in the form of construction equipment, haul vehicles, blasting and vehicle and aircraft traffic. A review of the potential Project interactions with noise and vibration identified nine potential effects that may occur; seven potential effects on humans and two potential effects on wildlife. These nine potential effects are: sleep disturbance (humans), interference with speech communications (humans), complaints (humans), high annoyance (humans), noise-induced rattling (humans), noise-induced hearing loss (humans), cosmetic and structural damage of buildings (humans), loss of habitat (wildlife) and disturbance (wildlife). These are presented in Table 8.3-1.

Table 8.3-1. Potential Project Interactions with the VEC Noise and Vibration

Project Activities		Noise and Vibration Indicators								
		Effects on Humans							Effects on Wildlife	
		Sleep disturbance	Interference with speech communication	Complaints	High annoyance	Noise induced rattling	Noise induced hearing loss	Cosmetic and structural damage to buildings	Loss of wildlife habitat	Disturbance to wildlife
Site Preparation and Construction	All-weather Road	x	x	x	x				x	x
	Quarries	x	x	x	x				x	x
	Ice Road	x	x	x	x				x	x
	All-weather Airstrip Extension	x	x	x	x				x	x
	Temporary Laydown Area									

Quantitative noise modelling for the peak activity year at the Goose Property show that predicted noise levels are below the criteria for interference with speech communications (humans), complaints (humans), high annoyance (humans), noise induced rattling (humans) and noise induced hearing loss (humans). Similarly, there are not expected to be any cosmetic and structural damage of buildings (humans) effects from Project-generated vibration. However, during peak years noise levels are predicted to exceed relevant criteria for loss of habitat (wildlife) and disturbance (wildlife) at various identified receptors due to construction and operation activities, blasting, road traffic and aircraft movements.

Since only peak years are associated with any exceedance of noise level and vibration guidelines, it is not anticipated that site preparation activities will result in any ongoing deleterious effects.

8.3.3 Mitigation and Management

Noise control during the site preparation activities will be focused on material handling and transportation sources. Based on experience from other mine projects the following noise controls are being considered:

- Ensuring equipment is fitted with appropriate mufflers and silencers;
- Using enclosures, berms, acoustic screening and shrouding where stationary sources requiring control are identified; and
- Ensuring equipment is well maintained.

8.4 Terrestrial Environment

Terrestrial Environment VECs that could potentially interact with site preparation activities include Permafrost, Vegetation, Caribou including Habitat and Migration Pathways, Grizzly Bear including Habitat and Migration Pathways, Muskox including Habitat and Migration Pathways, Wolverine and furbearers including Habitat and Migration Pathways Birds including Habitat and Migration Pathways, and Raptors.

Mitigation and management for wildlife is presented at the end of the wildlife section, as much of the mitigation and management will be the same from species to species.

8.4.1 Permafrost

8.4.1.1 Baseline Summary

The Project is located within the continuous permafrost region of western Nunavut. A seasonally thawed active layer is present immediately beneath ground surface, with a mean maximum depth of approximately 2 m. Subsurface temperatures are perennially below 0 ^{o}C at depths up to approximately 500 m below ground surface, except beneath some surface waterbodies. Open taliks are present beneath surface waterbodies with depths exceeding 1.3 m. Through taliks that connect to the deep groundwater are inferred to be present beneath waterbodies with widths greater than 200 m at the Goose Property. Cryopegs are inferred to be present at the base of the permafrost and adjacent to deep talik, as the groundwater beneath the permafrost has been shown to be hyper-saline. The basal cryopeg located within the Goose Property is estimated to be 100 m thick.

8.4.1.2 Potential Effects

Areas supporting permafrost are very sensitive to changes in air and surface temperatures. Construction activities in permafrost areas can result in a thickening of the active layer, thaw settlement and subsidence, and can lead to localized terrain instability due to the loss of bearing capacity associated with permafrost degradation.

The quarries will cut into the permafrost, but not the access road or the airstrip. However, the depth will not exceed the depth of permafrost, thus no interaction with groundwater is expected.

Permafrost is also present at the TLA. However, no construction activity is proposed in this area, thus permafrost will not be compromised.

Site Development Activity	Effects on Permafrost
All-weather Road	
Quarries	X
All-weather Airstrip Extension	
Ice Road	
Temporary Laydown Area	

8.4.1.3 Mitigation and Management

The basic principle for mitigating alterations to permafrost is to maintain the integrity of the embankments and the structural core. This can be achieved through surface preservation, and avoiding cuts in fine-textured areas (which are more sensitive to thaw and solifluction).Control of erosion and sedimentation is critical; poor drainage over permafrost areas can cause surface water ponding, thermal erosion, thermokarst and/ or the formation of ice. These can all have a deleterious impact on environment, traffic, and overall life of the structure.

Permafrost will be protected at the TLA by placing all equipment and materials on dunnage or swamp mats and accessing the area from the barge landing area using swamp mats provisionally placed directly onto the tundra to preserve the permafrost.

8.4.2 Vegetation

8.4.2.1 Baseline Summary

Terrestrial ecosystem mapping (TEM) and rare plant surveys were conducted in 2012 within the vicinity of Goose Camp and the MLA. Vegetated ecosystems are dominated by mesic tundra, dry-sparse tundra, and moist shrub-dominated tundra. The mesic tundra association is characterized by extensive areas dominated by dwarf woody shrub species, with a highly variable component of herbs, graminoids, mosses, and lichens. Sparsely-vegetated ecosystems typically occur on thin morainal veneers or exposed bedrock, windswept esker crests, blocky tundra, marine beaches and other barren sites that limit vegetation establishment. Non-vegetated ecosystems dominated by freshwater lakes and ponds. Special landscape features, identified for their importance as wildlife habitat or potential to support rare plant species, include esker complexes, cliffs, bedrock outcrop and lichen-dominated ecosystems, riparian ecosystems, wetland ecosystems, and marine beaches and old beach heads.

A total of 890 plant species identifications were made during field surveys. The largest species group in the identified flora is that of the vascular plants, followed by the macro-lichens. Ninety rare plant and lichen species were identified and were mainly found close to the shoreline of Bathurst Inlet. Plants defined as rare included those having conservation-priority S-ranking (subnational conservation ranking), General Status ranking by the National General Status Working Group (NGSWG 2010), or others for which there is evidence of significant rarity. No species having status under the Species at Risk Act (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) were deemed to have habitat in the project area, or to be in geographical proximity that would allow for any significant chance of discovery during the surveys.

8.4.2.2 Potential Effects

The construction of the proposed infrastructure will result in the unavoidable disturbance of terrain, ecosystems, and vegetation within the immediate road footprint. The road alignment traverses an area that is dominated by terrain and ecosystems commonly found throughout the Arctic.

The proposed Goose Property Infrastructure will disturb existing ecosystems and vegetation, primarily through removal and burial during construction. Equipment and supplies will be placed on swamp mats to reduce the effects on vegetation and permafrost. However, some vegetation disturbance will occur. Additional alteration to ecosystems and vegetation adjacent to the all-weather road and quarries could potentially occur from dust deposition, the potential introduction and spread of invasive or non-native plant species into the area, and changes to local surface hydrology. These potential effects may occur during operation of the road during the summer months and can directly or indirectly affect the function and health of the plant species and ecosystems present.

A summary of ecosystems to be lost and degraded due to the construction and operation of the proposed Goose Property Infrastructure are presented in Tables 8.4-1 and 8.4-2, respectively. A total of 31.9 ha will be lost, with 90% of the ecosystems being represented by moist and mesic tundra associations. These ecosystems are the most common within the area. An additional 121.2 ha have the potential to be altered due to effects such as dust from road construction and use, quarry construction and use, and airstrip construction and use.

Table 8.4-1. Summary of Ecosystems Lost due to Construction of Infrastructure around Goose Property

Vegetation Association	Row Labels	Description	Sum of Area (ha)
Bedrock Lichen Veneer	BL	Sparse lichen and dwarf shrub community that occurs on skeletal soils on bedrock outcrops.	1.4
Bedrock outcrop	BR	A gentle to steep, bedrock escarpment or outcropping, with little soil development and sparse vegetative cover.	0.9
Mesic dwarf-shrub tundra	TL	Typical tundra that is dominated by dwarf shrubs. Occurs across extensive areas, normally gently sloping tills, and contains a substantial cover of shrub, herb, moss and lichen.	13.6
Shrubby tundra	TS	Moist (less commonly mesic) tundra that is dominated by thick dwarf birch. Typically occurs in water receiving slope positions and often has evidence of surface or subsurface water movement.	15.1
Raised bog complex	WB	Variable complex that contains severely mounded raised bogs with various other wetlands types in the inter-mound depressions. Low pH and little water movement.	0.8
Willow-sedge fen	WS	Fen association that is dominated by sedges and willow that typically occurs near moving water. Organic soils distinguish it from riparian associations	0.0
Grand Total			**31.9**

Table 8.4-2. Summary of Ecosystems Potentially Altered due to Construction of Infrastructure around Goose Property

Vegetation Association	Code	Description	Sum of Area (ha)
Bedrock Lichen Veneer	BL	Sparse lichen and dwarf shrub community that occurs on skeletal soils on bedrock outcrops.	2.8
Bedrock outcrop	BR	A gentle to steep, bedrock escarpment or outcropping, with little soil development and sparse vegetative cover.	7.1
Dry-sparse tundra	TH	Dry, rocky tundra that occurs in upper slope and crest locations, often complex with TB, BL or BR. Vegetation is variable, with dwarf shrubs and lichens often dominant.	2.4
Mesic dwarf-shrub tundra	TL	Typical tundra that is dominated by dwarf shrubs. Occurs across extensive areas, normally gently sloping tills, and contains a substantial cover of shrub, herb, moss and lichen.	82.3
Shrubby tundra	TS	Moist (less commonly mesic) tundra that is dominated by thick dwarf birch. Typically occurs in water receiving slope positions and often has evidence of surface or subsurface water movement.	22.6
Water sedge marsh	WA	Marsh community that is dominated by a near monoculture of water sedge. Restricted to very wet locations along low gradient watercourses and lake/pond margins.	0.2
Raised bog complex	WB	Variable complex that contains severely mounded raised bogs with various other wetlands types in the inter-mound depressions. Low pH and little water movement.	5.3
Cottongrass-sedge fen	WC	Cottongrass and sedge dominated fen. Slightly to strongly hummocked, often with obvious water movement.	0.9
Willow-sedge fen	WS	Fen association that is dominated by sedges and willow that typically occurs near moving water. Organic soils distinguish it from riparian associations	0.4
Grand Total			**121.2**

Table 8.4-3 presents the rare plants and lichens associated with site preparation activities. A zone of potential alteration (due to dust) was established using a 100 m buffer for roads and a 500 m buffer for the quarries. The 100 m before was established as it is within this area that the majority of the effects of dust due to roads are expected to occur, while 500 m is where the dust effects of quarries are substantially reduced. One rare lichen, *Siphula ceratites*, occur within the zone of alteration for the all-weather road, while two observations of the same lichen fall within the 500 m buffer around the quarries (Table 8.4-3). None of these are within the footprint of the proposed activities.

Although this lichen is classified as S2S3, with less than five observations in Nunavut, it is unlikely that the current available ranking reflects the reality of its occurrences, given that it was observed 14 times within the Project area, on a variety of habitats common across the landscape.

Table 8.4-3 Rare Plants and Lichens within Buffers of Site Preparation Activities.

Element Occurrence	Location	*Species*	*Lifeform*	*Rank*	*Definition*	Habitat
BRL26	Umwelt Pit zone of alteration	*Siphula ceratites*	*lichen*	*S1S2*	*five or fewer occurrences in Nunavut*	Low tundra depression, periodically flooded
BRL29	Existing pit zone of alteration	*Siphula ceratites*	*lichen*	*S1S2*	*five or fewer occurrences in Nunavut*	Low tundra depression, periodically flooded
BRL27	all weather access road zone of alteration	*Siphula ceratites*	*lichen*	*S1S2*	*five or fewer occurrences in the jurisdiction*	On tilted depression at edge of plateau