

Mactung Advanced Exploration – Project Proposal

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1.0 INTRODUCTION

1.1 Project Introduction

Tetra Tech Canada Inc. (Tetra Tech) has prepared this application to the Yukon Environmental and Socio-economic Assessment Board (YESAB) Designated Office in Watson Lake on behalf of the Government of the Northwest Territories (GNWT). The GNWT is seeking a Class 4 Quartz Mining Land Use Approval to proceed with advanced exploration activities at the Mactung property (Mactung), located in eastern-central Yukon, approximately 200 km northeast of Ross River. Previous activities at Mactung were permitted under Quartz Mining Land Use Approval LQ00253a, which is due to expire and can no longer be renewed. The principal activities of the project, described in more detail in Section 2.3 below, include mineral exploration, mineral resource assessment, baseline studies, and environmental management.

1.2 Proponent Information

The GNWT is the primary proponent for the project. Tetra Tech is assisting the GNWT with the application process.

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Additional information on the proponent (GNWT) is provided in Form 1, which will be submitted to the YESAB Online Registry as well as the Application for Class 3/4 Quartz Mining Land Use Approval form.

1.3 Project Location

The Mactung property is located within the Traditional Territories of the Ross River Dena Council, Liard First Nation, and the First Nation of Na-Cho Nyak Dun. The nearest settlement is the community of Ross River. The property is located on the Yukon side of the Yukon-Northwest Territories border, approximately 12 kilometres north of the Macmillan Pass airstrip (Figure 1-1). The site is most easily accessed directly via helicopter. The closest road to the property is the North Canol Road, which provides access to the Macmillan Pass airstrip. The property can be accessed by a tote road from the decommissioned portion of the North Canol Road in the NWT. Photographs of the site are shown in Photos 1-1 to 1-4.

1.4 Project Objectives

The objectives of the project are to allow for continued mineral exploration and mineral resource assessment as well as baseline studies and environmental management activities within the mining claims presented on Figure 1-2 and listed in Appendix A. There is currently no formal plan to carry out the activities proposed; GNWT is seeking a Quartz Mining Land Use Approval in part as a means of increasing the appeal of the Mactung property to prospective buyers.

1.5 Consultation

There has been no consultation conducted to date regarding the activities proposed at the Mactung property.

1.6 Regulatory Requirements

The project is assessable under the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) Section 47(2) as it:

- Is in Yukon
- Involves activities listed in Part 1, Item 1 of the Assessable Activities, Exceptions and Executive Committee Projects Regulations

Project activities will also respect the following:

- *Yukon Quartz Mining Act* and Quartz Mining Land Use Regulation
- *Yukon Wildlife Act*
- *Yukon Waters Act*
- *Yukon Environment Act*
- *Yukon Historic Resources Act*

2.0 PROJECT DESCRIPTION

2.1 Project Scope

The GNWT is applying for a Class 4 Quartz Mining Land Use Approval to allow for mineral exploration, mineral resource assessment, baseline studies, and environmental management activities to continue at the Mactung property. There is currently no formal plan to carry out the activities proposed. The GNWT is seeking a Quartz Mining Land Use Approval in part as a means of increasing the appeal of the Mactung property to prospective buyers. Previous activities at Mactung were permitted under Quartz Mining Land Use Approval LQ00253a, which is due to expire and can no longer be renewed.

2.2 Project Schedule

The GNWT is applying for a 10-year term on the Class 4 Quartz Mining Land Use Approval in part to maximize the attractiveness of the Mactung property to prospective buyers. There is no set schedule for the activities listed in Section 2.3.

2.3 Activities and Equipment List

The following project activities are proposed over a 10-year timeframe at Mactung:

2.3.1 Resource Assessment and Mineral Exploration

- A maximum of 50,000 metres of exploration drilling

2.3.2 Planning and Construction

- Construction of up to 5 kilometres of local exploration trails

2.3.3 Operations

- Geophysical surveys
- Surface exploration through sampling and drilling
- Exploration drilling site preparation
- Surface exploration using ground geophysics (would likely include clearing some trails)
- Mactung camp facilities and maintenance (approximately 25 people for 90 days)
- Road and trail maintenance

2.3.4 Decommissioning

- Exploration trails and roads
- Drill pads
- Camp

2.3.5 Baseline and Environmental Studies

- Water sampling
- Wildlife monitoring
- Other possible environmental studies

3.0 CURRENT ENVIRONMENTAL CONDITIONS

Data describing the biophysical and socio-economic conditions of the Mactung property were collected and compiled for a Project Proposal submitted to the Yukon Environmental and Socio-economic Assessment Board (YESAB) Executive Committee in 2008 (NATCL 2008). The project proposed at the time included an underground mining operation, a proposed new 35 km access road in Yukon to the mine site, upgrading of an existing 10 km service road, and an expansion of the Macmillan Pass airport. Data were also subsequently collected to support information requests generated by the review process as well as conditions presented in Quartz Mining Land Use Approval LQ00253 and the Operating Conditions contained in Schedule 1 of the Quartz Mining Land Use Regulation. These data have been used to inform this application.

3.1 Climate

The mean summer air temperature is typically between 5°C and 10°C, with daily maximums around 15°C and minimums around 5°C. The maximum air temperature recorded at the Mactung station over the study period is 20°C. Mean winter temperatures have more day-to-day variation, but are typically between -10°C and -20°C. The minimum air temperature recorded at the site over the period of record is -36.6°C. During the winter season, air temperatures rarely rise above freezing. The warmest period of the year is from June to late August. October through March represents the coldest period, with seasonal transitions occurring in April and May and from late August through September.

Precipitation in the Selwyn Mountains is generally moderate to high due to the rain shield effect that is caused by their topography on easterly-moving weather systems. Precipitation is moderate and locally heavy with annual amounts of 600 to 700 mm. These are the highest values for precipitation in Yukon outside of the coastal ranges (Yukon Ecoregions Working Group 2004).

Winds at the Mactung site originate from two prevailing wind directions at the Mactung camp station. This duality in prevailing wind direction is due to the orientation of the valley in which the Mactung property is located. Winds come from the west about 34% of the year and from the northeast approximately 24% of the year. During the winter months, winds blow more frequently from the northeast. Over the period of record, northeast winds in November 2006, February 2007 and March 2007 had a frequency of occurrence of more than 30%. In the summer, winds were observed to be blowing more frequently from the west and southwest.

A maximum wind gust of 23 m/s was recorded at the Mactung property between July 2005 and August 2007. The average maximum gust on a daily basis is approximately 7.0 m/s. On a calm day, maximum wind gusts are in the order of 4.0 m/s, whereas on a windy day maximum gusts are in the order of 10.0 m/s.

3.2 Air Quality

The Mactung property is located within a wilderness area that has no other sources that would affect the air quality. It is therefore generally assumed that the air quality in the area would be in the same range as background levels for the Canadian north.

There is currently no air quality monitoring equipment at the mine site or any other adjacent sites. The only ongoing air quality monitoring in the Yukon is conducted in Whitehorse. The Whitehorse station is part of the National Air Quality Surveillance (NAPS) Network. The air pollutants monitored in Whitehorse include carbon monoxide, nitrogen dioxide, nitric oxide, ground level ozone, and fine particulate matter (PM_{2.5}). The monitored ambient air pollutants in Whitehorse are compared with the National Air Quality Objectives (NAQOs). Recent NAPS reports

conclude that the ambient air pollutant levels monitored at the Whitehorse NAPS station are good and rarely exceed the levels specified in the NAQOs.

A direct comparison cannot be made between Whitehorse ambient air pollution levels and those at the Mactung property. However, it is assumed that due to the location of the proposed mine site, the comparatively lower levels of traffic and comparatively lower levels of wood burning than in Whitehorse, the ambient air quality is considered to be higher quality than in Whitehorse.

3.3 Noise

Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the ear can detect. If the pressure variations occur frequently (at least 20 times per second) they can be heard by the human ear and are called “sound”. The number of pressure variations per second is called the frequency of sound and is expressed in cycles per second and called Hertz (Hz). The relative loudness or intensity of sound energy is measured in decibels (dB).

Environmental noise is usually measured in A-weighted decibels (dBA) and typically fluctuates over time. A dBA is a decibel corrected for the variation in frequency response of the typical human ear at commonly encountered noise levels.

Noises in the rural or remote settings can seem amplified if there are no barriers to the source. Noise levels are reduced by increasing distance, air density, wind, and obstructions (trees, buildings, and natural landscape features).

The Mactung project is situated in a remote area where ambient (background) noise consists of natural sounds. Background sources of natural noise range from short-term soft sounds, as in the sound of the wind in the trees (30-50 db), to short-term loud cracks and rumbles, as in the sound of falling rocks (60-80 db). Ambient noise can also be loud and constant, as in the sound of a large waterfall (100 db). Ambient forest noise comes from both natural and human-caused sources. Some noise is short-term; some is constant.

Noise levels at the mine site are currently not monitored but would be commensurate with regular summer exploration activities, if and when they occur. Ambient noise is expected to be mainly of a temporary nature and will only affect the immediate vicinity of such activities.

3.4 Terrain and Topography

The Mactung Project is located within the Selwyn Mountain Ecoregion of the Taiga Cordillera Ecozone of Canada. Distinguishing characteristics of the region include the Hess and Logan Mountain ranges that form the border between the Yukon and Northwest Territories. Keele Peak is the highest point in the ecoregion at approximately 3,400 m.

The Selwyn Mountain Range is characterized by sharp peaks, steep side slopes, and narrow rounded valleys. This generally forms the landscape of the Mactung area, that varies from gentle to flat terrain on the valley floor to steep relief on the upper bedrock slopes. The lower valley areas were affected by continental ice sheets that deposited varying thicknesses of glacial moraine (till), while the upper elevations have been affected more recently by alpine glaciation. Valley slopes have also been covered in colluvium due to erosion processes, landslides and surface flow slides. Minor fluvial and periglacial geomorphological processes are active and a number of rock glaciers exist in the area. Elevations in the region range from 745 m a.s.l. to 2,970 m a.s.l.

Bedrock in the area of the Mactung deposit consists of laminated shales and phyllites, which are intruded by granitic rocks that form the higher, more resistant peaks. The project area is located in un-forested high alpine terrain, and forest stands occur only at lower elevations below about 1,400 m a.s.l. Upper bedrock and colluvium slopes are mostly bare and lower valley slopes and valley floors are typically vegetated with grasses, mosses, lichens and alpine willow and birch.

3.5 Soils and Geology

Soils in the Mactung area originate from glacial, colluvial and minor fluvial processes. The higher elevations have little or no soil development. The lower slopes and valley floors are covered with thin deposits of residual soils, overlying colluvium and glacial tills. Major rock types present are quartz monzonite, argillite, shale, hornfels, chert and limestone. The deposit occurs in skarn developed at the contact between a Cretaceous quartz monzonite stock and Lower Paleozoic calcareous sedimentary rocks. The landscape of the Mactung area varies from gentle to flat terrain on the valley floor to steep relief on glacially scoured, upper hillslope bedrock slopes.

Till (moraine) is the most common surficial material found in the area. Morainal deposit textures range from gravelly silty sand to silty sand and most commonly consists of a sand matrix with variable silt and gravel content. Colluvium on upper valley hillslopes is typically coarse, blocky material derived from ongoing erosion of upslope bedrock. Colluvium on lower valley hillslopes ranges from sandy gravel with some silt to silt with some sand.

3.6 Surface Water Resources

The Mactung property is located on the watershed divide that also delineates the border between Yukon and the Northwest Territories. Creeks generally flow west on the Yukon side of the border. Runoff from the Mactung site within Yukon is conveyed by unnamed creeks that are headwaters of the Hess River, which flows 200 km west to join the Stewart River, which in turn joins the Yukon River another 250 km to the west. For the purposes of the Project Proposal, local watercourses were referred to as Tributaries A, B, C and the Hess River South Tributary (Figure 3-1).

Tributary A drains the southern part of the Mactung project area and flows into the watercourse designated South Tributary of Hess River. The headwaters of this creek are located at approximately 1,800 m elevation; it reaches the confluence with the South Tributary at 1,100 m elevation. Tributary B has its headwater at elevation 1,929 m. It flows northeast for roughly 8.5 km before it joins Tributary A at elevation 1,200m. Tributary C originates just west of the camp site at about elevation 1,700 m and joins Tributary A at about elevation 1,150 m roughly 4 km downstream of the Tributary B confluence.

3.6.1 Surface Water Quantity

3.6.1.1 Tributary A

A hydrometric station was installed on Tributary A during the summer of 2006, about 7 km west of the Mactung camp (Figure 3-1). The station, which is at an elevation of 1,133 m, monitored discharge and water temperature. The drainage area above this station is 79.1 km². The station is located about 50 m downstream of the confluence with Tributary C and so includes the drainage areas of Tributaries B and C. The highest elevation within the basin is over 2,000 m.

At the location of the hydrometric station on Tributary A, the creek is approximately 11 m wide with a maximum water depth of 0.5 m. These dimensions vary with the creek discharge. The creek bed consists mostly of cobbles ranging from 10 to 200 cm in size. There is also some sand and gravel.

Flow hydrographs and water temperature records were developed from data recorded every 15 minutes at the hydrometric station from periods in 2006, 2007, and 2008. The average recorded flow for Tributary A for the period of record was 3.0 m³/s for 2006, 2.6 m³/s for 2007, and 3.6 m³/s for 2008. Short duration increases in flow were noted during the summer months and were in response to heavy rainstorms. A maximum recorded flow of 8.12 m³/s occurred on June 23, 2008.

3.6.1.2 Tributary C

Spot manual discharge measurements were carried out on Tributaries A and C throughout the course of the hydrology studies in order to develop a relationship between the flows in the two creeks. The average ratio of Tributary C to Tributary A flows was determined to be 0.3384. The ratio of the catchment areas is 0.302, which is consistent with this approach. Discharge hydrographs for Tributary C were generated using the flow ratio of 0.3384 and the flow data recorded by the hydrometric station on Tributary A. The average flow on Tributary C over the period of record was 0.85 m³/s. The maximum estimated summer flow on Tributary C was 2.6 m³/s.

3.6.2 Surface Water Quality

Water quality data were collected from the Hess River Tributary and Tributaries A and C of the Hess River to establish baseline conditions. Nine sampling events occurred between 2006, 2007, and 2008 (EBA 2007e, 2008c; Figure 3-1). Water samples were analyzed for total metals, dissolved ultra-low metals, total organic carbon, low-level nutrients and low-level routine water chemistry. The results were compared to the Canadian Council of Ministers of the Environment (CCME) guidelines for the Protection of Aquatic Life. Water quality baseline data were found to naturally exceed CCME guidelines on a regular basis for aluminum, cadmium, chromium, copper, iron, lead, nickel, selenium and zinc.

- Aluminum concentrations ranged from 0.0187 mg/L to 4.06 mg/L. WQ1 had the lowest aluminum concentration while WQ2A had the highest. Aluminum did not exhibit a seasonal trend. The CCME guideline for aluminum is 0.1 mg/L.
- Cadmium concentrations ranged from below detection (0.00005 mg/L) to 0.0055 mg/L. WQ3 had the lowest cadmium concentration while WQ2A had the highest. Cadmium did not exhibit a seasonal trend. The CCME guideline for cadmium is 0.00002 to 0.0003 mg/L.
- Copper concentrations ranged from 0.001 mg/L to 0.0164 mg/L. WQ3 had the lowest copper concentration while WQ2 had the highest. Copper did not exhibit a seasonal trend. The CCME guideline for copper is 0.002 mg/L.
- Iron concentrations ranged from 0.008 mg/L to 1.54 mg/L. WQ1 had the lowest iron concentration while WQ2A had the highest. Iron did not exhibit a seasonal trend. The CCME guideline for iron is 0.3 mg/L.
- Nickel concentrations ranged from 0.0023 mg/L to 0.132 mg/L. WQ3 had the lowest nickel concentrations while WQ2A had the highest. Nickel did not exhibit a seasonal trend. The CCME guideline for nickel is 0.025 to 0.065 mg/L.
- Selenium concentrations ranged from 0.0002 mg/L to 0.0044 mg/L. WQ3 had the lowest selenium concentrations while WQ1 had the highest. Selenium did not exhibit a seasonal trend. The CCME guideline for selenium is 0.001 mg/L.

- Zinc concentrations ranged from 0.0068 mg/L to 0.441 mg/L. WQ3 had the lowest zinc concentrations while WQ2A had the highest. Zinc did not exhibit a seasonal trend. The CCME guideline for zinc is 0.03 mg/L.

The pH values of the water samples were below the CCME guideline of 6.5 at WQ2 (6.11, May 2008). Electrical conductivity ranged from 80.5 ($\mu\text{S}/\text{cm}$) to 606 $\mu\text{S}/\text{cm}$, and total suspended solids (TSS) from below 3 mg/L to 29.9 mg/L. Dissolved oxygen was not measured during water quality sampling. However, it was measured during the Mactung fisheries and aquatics resources program in August 2006 and 2007. Dissolved oxygen concentrations were found to be elevated at certain stations. The CCME guideline for dissolved oxygen is 5.5 mg/L to 9.5 mg/L.

3.6.3 Acid Rock Drainage (ARD)

Natural acid rock drainage (ARD) is present in the Mactung area. Bedrock exposures in the mine site area vary in their sulphidic content and neutralization potential (NP) and contain both potentially acid generating (PAG) and non-acid generating (NAG) materials. Analyses conducted as part of the Project Proposal indicated that no significant metal leaching from the Mactung ore and waste rock that might be used in site construction activities would occur.

The overall pH of the water quality samples analyzed was slightly alkaline with pH values slightly above 7.0 (neutral) for most sites. The ore was found to contain traces of copper, silver, and gold but not in sufficient amounts to result in either a metal leaching problem or ARD. The pyrrhotite leaches slowly, but there is no evidence around the adit or the contiguous waste dumps (which were deposited about 30 years ago) to suggest an ARD/ML issue. Some of the rocks in the adit are calcareous and they will help to neutralize acid production that may take place. The adit is also permanently frozen (permafrost) to the back of the adit which tends to limit these types of chemical reactions.

3.7 Groundwater Resources

A Detailed Hydrogeological Assessment (DHA) was conducted by EBA (2008) for NATC to assess the groundwater conditions at the Mactung property. The project area encompassed the proposed mine site including all major mine components and areas downgradient of proposed mine infrastructure to the proposed ravine dam.

The DHA program involved collecting observations during the drilling of diamond drill holes (DDHs) at key locations in the project area, logging drill core, conducting hydraulic testing (packer tests and pumping tests), installing observation wells, installing instrumentation, and groundwater sampling, and chemical analysis.

A total of eight groundwater observation wells were installed in diamond drill holes (DDHs) in the project area to study the hydrogeological regime, and in particular, the groundwater conditions in areas of proposed mine infrastructure.

Groundwater flow divides are present in the project area to the north, east, and south. The groundwater flow direction generally mimics surface topography. Deep groundwater flows from the highest areas of Mt. Allan southwards, turning south-westerly or westerly in the valley of Tributary C (Photo 3-1). Shallow groundwater flow within overburden is characterized by local, small-scale flow cells, with its flow direction closely following local topography. Groundwater recharge typically occurs at higher elevations with groundwater ultimately discharging to surface water bodies at lower elevations in valleys. The presence of permafrost in the upland areas tends to reduce infiltration to groundwater. At lower elevations where permafrost is absent groundwater recharge occurs at the lower valley slopes in areas where a hydraulic connection exists between the shallow overburden and deep bedrock aquifers.



Photo 3-1: Approximate locations of observation wells within the project area.

3.8 Fish and Fish Habitat

A moderate number of fish bearing watercourses were documented along the proposed access road presented in the Project Proposal submission in 2008 (Figure 3-1). In total, five primary watercourse systems were assessed, one of which drains into the South MacMillan River system, and four of which drain into the Hess River system (all of which are part of the Yukon River drainage). Baseline studies conducted by EBA (2007d, unpublished data) have shown that only a portion of the watercourses that might have been influenced by the proposed access road, including at crossing locations, support fisheries resources. Fish habitat in the other tributaries also appear to be restricted primarily by factors such as poor water quality or a lack of suitable physical habitat features.

EBA’s above noted baseline studies confirmed the presence of several fish species in the lower main-stem tributary to the Hess River Tributary (into which Tributaries A, C, D, and E flow), including Dolly Varden, Arctic grayling, round whitefish, and slimy sculpin. It should be noted that only Dolly Varden were found in upper tributaries that were within direct influence of the proposed road development. No Salmon are known to utilize the watercourses in the project area or the downstream vicinity (EBA 2007c, EBA 2007d, EBA unpublished data, Yukon River Panel 2008)

3.9 Vegetation

The ecology of the areas in the vicinity of the Mactung property range from forested valleys and sedge meadow fens in level terrain to steep rugged mountains, typical of the Selwyn Mountain Range. Mid-elevations (approximately 1,550 m to 1,650 m asl) support willow thickets and avalanche chutes on steeper slopes. Above 1,700 m asl, talus slopes are dominant. Dry benches support fescue grasslands and birch-lichen communities.

Baseline studies by EBA (2007b, 2008, unpublished) consisted of ecosystem mapping and assessments of vegetation resources. The elevation ranges covered by the areas studied reflect a correspondingly wide range of vegetation characteristics. Boreal to subalpine vegetation is dominated by black spruce and subalpine fir; a few deeper riparian valleys supported larger (potentially merchantable) black spruce, with an understory consisting of *Sphagnum* and feather mosses, Labrador tea, and other commonly found herbaceous species.

The existing camp and mineral exploration site are located at high elevation in mostly vegetated but treeless terrain. These areas are primarily dominated by herbs, including grasses, sedges, and wetlands. In 2006, two rare species (*Rubus arcticus* and *Carex albo-nigra*) were observed in the Yukon portion of the study area, but not in areas that were part of the proposed mine footprint. In 2007, no rare species were observed in areas proposed for activity.

3.10 Wildlife

The abundance and distribution of wildlife in the Mactung area was assessed during environmental baseline studies conducted from 2005 to 2008 as part of the preparation of the Project Proposal (EBA 2006b, 2007b, 2008, and unpublished data). These studies focused on ungulates, carnivores, raptors, and migratory birds. Aside from these studies, the existing literature for this area is limited, with few recent government surveys having been conducted, and other baseline environmental studies dating back to the late 1970s or early 1980s (AMAX 1983).

3.10.1 Moose

Moose (*Alces alces*) are found throughout most of the Mactung area for which populations are currently assumed to be stable. Moose are not a species of conservation concern as listed under the Federal *Species at Risk Act* (SARA), by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or by the Yukon *Wildlife Act*. However, moose are of high social and economic significance throughout the territory as a hunted species.

Within the broad Mactung project wildlife regional area assessed, no previously identified key habitat areas for moose were identified (Yukon Government 2007). During a total of six aerial ungulate survey events and other studies completed by EBA (2007b and 2008), a total of 47 moose were observed. Based on these studies, it was determined that during the summer season (May through August), moose in the vicinity of the Mactung property are more sparsely distributed and were observed primarily in or adjacent to riparian areas that have extended lowland features such as willow thickets and open wetland vegetation. Preferred types of wetland habitat (e.g., those with submerged or emergent aquatic vegetation for feeding) also tend to be uncommon.

A survey of late winter distribution (March 2008) also confirmed a relatively low presence of moose in the vicinity of the Mactung property, at a density of only 6.36 moose/1,000 km² (total of 7 moose) (EBA 2008b). At this time, observations and tracks suggested that moose were not using the exploration area, but that they had presumably been forced to lower elevation riparian valleys by snow conditions (snow depths at higher elevations at Mactung can regularly exceed 1 m).

Moose harvest along the North Canol Road is generally highest during the late summer and fall but continues opportunistically off season by First Nations trappers (T.J. Grantham, pers. comm.). However, currently the North

Canol Road is not maintained for winter access. Consequently, as winter access to the Mactung property off the North Canol Road is by snowmobile only, winter hunting in the area is expected. The majority of winter subsistence hunters tend to concentrate along the Robert Campbell Highway and other routes that are ploughed in the winter.

3.10.2 Caribou

Woodland caribou (*Rangifer tarandus caribou*) ranges and populations have dwindled across North America, and as a result, COSEWIC listed nearly all woodland caribou populations in Canada either as Threatened or of Special Concern in 2002. The woodland caribou whose ranges coincide with the Mactung area are part of the Northern Mountain Caribou population and are currently listed under Schedule 1 of SARA as a species of Special Concern.

Woodland caribou exist throughout the Mactung area in the spring, summer, and fall (caribou belonging to the Redstone Herd). The Redstone herd's home range overlaps with the Mactung property and this herd is known to undergo an annual east-west migration between winter and summer. Consequently, caribou tend to only be in the project area throughout the summer months (June through September), and are absent through the winter. As of 2015, the Redstone herd was estimated at 10,000 individuals (Environment Yukon 2016). This herd was last surveyed in 2012. In 2007, a total of 524 woodland caribou (Northern Mountain Ecotype) were observed during both aerial surveys and incidental observations. During the July 2008 aerial ungulate survey, 383 caribou were detected within the broader regional study area.

In addition to the east-west migration of the Redstone herd, mountain ecotype caribou tend to exhibit directional movements from valleys to higher elevations in the spring and occupy alpine/subalpine areas from June to November, grazing in alpine environments and utilizing snow patches to reduce insect harassment (J. McLelland, pers.comm.). These characteristic habitat uses were noted by EBA during baseline studies in the Mactung area annually from 2005 through 2008 (EBA 2006b, 2007b, 2008, unpublished data). During this time, the majority of caribou observations were made well above the treeline where individuals to small groups were feeding or resting. Of the few observations made at lower elevations (below the treeline), nearly all were of lone bull caribou.

Where project exploration and the camp are located, caribou have been observed to use the pass for migration and movement throughout the summer and fall, however not in large concentrations. These movements appear to be in particular areas; caribou also tend to utilize much alpine terrain where visibility may be better for the species.

Currently, some hunting effort occurs in the broader Mactung area. Areas that are relatively accessible to hunters (until the snow accumulates) include the North Canol Road and the existing Mactung camp exploration road/trail network, much of which is only accessible via ATV. Information from the Yukon Government (unpublished data) indicate that from 1990 to 2007 a total of 157 caribou have been harvested (8.7 caribou/year, on average) in the vicinity of the Mactung property.

3.10.3 Mountain Sheep

Mountain sheep (*Ovis dalli*) are not a species of conservation concern as listed by SARA, COSEWIC, or the Yukon Territory. However, sheep have a high social and economic value as a hunted species in the Yukon.

Mountain sheep have previously been reported to occur within the project area (Gill 1978), and their critical habitat requirements (wintering areas, lambing areas, and mineral licks) have been noted during environmental baseline studies (EBA 2007b, 2008). However, the baseline studies conducted in support of the Project Proposal in 2008 indicated that important ranges no longer exist in the area for sheep. Only one single mature ram was observed during the summers of 2007 and 2008, each time within steep vegetated terrain at mid alpine elevations. Eight observations of mountain sheep sign (pellet groups and tracks) were recorded in 2006, and a single mountain sheep track (laid down approximately 2 – 4 weeks prior) was also documented along the North Canol Road in June 2007.

Additionally, a late winter aerial survey of a broader area surrounding the Mactung property resulted in no sheep being observed and only one confirmed sheep track (EBA 2008b). Based on these observations, the Mactung property is not considered to be important habitat for mountain sheep.

3.10.4 Wolves.

Wolves are the most common predator of ungulates within the Mactung area, and the Yukon in general. No existing estimates of wolf populations were found for the Mactung property as part of baseline studies. Observations of wolves in the vicinity of the Mactung property were limited over the three years baseline studies were conducted and did not allow for population estimates to be developed. In 2005, a pack of five wolves was observed in a forested area near the North Canol Road, immediately south of the Mactung project area (EBA 2006b). Four observations of wolf sign, including scat and tracks were also recorded in the Mactung project area during the 2005 – 2007 field programs (EBA 2006b; 2007b; 2008). Wolf sign during these studies was recorded within low valley habitats and subalpine valleys. Two wolves were also observed during 2008 field programs, one adjacent to the existing camp location, and another stalking a caribou herd in alpine habitat (EBA unpublished data).

3.10.5 Other Carnivores

Nationally, grizzly bears are listed as a species of Special Concern (COSEWIC 2007) but are not listed under the federal *Species at Risk Act* (SARA). In Yukon, special principals exist for the management of grizzly bear populations (Yukon Fish and Wildlife Co-Management 1997).

Since 2005, EBA (2006b, 2007b, 2008, unpublished data) reported a total of 61 grizzly bear observations including sightings, dens, tracks, and digs within the broader project area. Of the 61 grizzly bear observations, a total of 14 grizzly bears were seen in 2006, seven in 2007, and ten in 2008. Several of these observations included a sow with cubs. A sow with three cubs was seen approximately 2.5 km east of the Mactung camp in 2007, and an additional observation of a sow with three cubs was recorded approximately 3.8 km northwest of camp in 2008. It is assumed these observations included the same sow and represent a productive territory near the Mactung camp.

Wolverines are year-round residents and occupy a variety of habitats throughout the wildlife Mactung project area, including forested valleys to alpine tundra. Nationally, the wolverine is listed as a species of Special Concern by COSEWIC (2007) but is not listed under the federal SARA. Population densities of wolverines within the Yukon are unknown; however, wolverines are considered common (Government of Yukon 2007). EBA (2007b, 2008) observed two wolverines (female and kit) approximately 9.5 km southwest of camp, as well as wolverine tracks along riparian valleys in 2006.

3.10.6 Other Wildlife Observations

No specific studies were conducted on rodents or small mammals but incidental observations of the following were made: Arctic ground squirrels (*Spermophilus parryii*), Beaver (*Castor Canadensis*), Collared Pikas (*Ochotona princeps*) Hoary marmot (*Marmota caligata*) and snowshoe hare (*Lepus americanus*).

3.10.7 Birds

3.10.7.1 Passerines

Birds occur throughout all habitat types within the area assessed during environmental baseline studies. Some species are year-round residents while the majority are summer residents and are present only during their breeding periods. EBA conducted breeding bird surveys in 2006 and 2007. In 2006, a total of 39 breeding bird species were

detected; whereas, 34 breeding species were reported during the 2007 surveys (EBA 2007b). American Tree Sparrow, Wilson’s Warbler, White-crowned Sparrow, American Pipit, Yellow-rumped Warbler, Golden-crowned Sparrow, Common Redpoll, Savannah Sparrow, and Ruby-crowned Kinglet were the most common species (EBA 2007b).

3.10.7.2 Waterfowl

In 2008, 26 wetlands were surveyed among which 12 had waterfowl or shorebirds using the area. Based on the observation of a nest, nestlings or an agitated pair, American wigeon, Horned grebe, Green-winged teal and Wandering tattler appear to be nesting in wetlands within the local study area.

3.10.7.3 Raptors

According to the Yukon’s Wildlife Key Areas (2005), certain areas broadly located to the northwest and southeast of the Mactung property may be utilized by Golden Eagles (*Aquila chrysaetos*) and Gyrfalcon (*Falco rusticolus*) for summer nesting activities. Other raptors that were observed during 2007 and 2008 include: Bald Eagle (*Haliaeetus leucophalus*), Merlin (*Falco columbarius*), Northern Harrier (*Circus cyaneus*), Northern Hawk owl (*Surnia ulula*), Peregrine falcon, (*Falco peregrinus anatum*), and Short-eared owl (*Asio flammeus*). Peregrine Falcon is currently listed as Threatened (SARA Schedule 1) / Yukon *Wildlife Act* and Short-eared owl is listed as Special Concern (SARA Schedule 3).

4.0 CURRENT SOCIO-ECONOMIC CONDITIONS

4.1 First Nations

Mactung is located within the Traditional Territories of the Liard First Nation, the Ross River Dena Council and the First Nation of Na-Cho Nyak Dun. These First Nations have considerable experience with the mining industry in Yukon and are aware of some of the potential long-term environmental effects associated with mining operations.

4.1.1 Communities

The nearest communities to the Mactung property are Ross River (approximately 250 km away) and Faro (approximately 305 km away). The communities of Ross River and Faro are the most likely communities to be affected by project activities due to their proximity to Mactung. They too have considerable experience with the mining industry and are aware of potential long-term environmental effects.

4.1.2 Ross River

Ross River is located 10 km from the junction of the Canol Road and the Robert Campbell Highway. It is a Kaska First Nations community where the Ross River Dena Council is located in the community. According to the Second Quarter Population Report (Yukon Bureau of Statistics 2018), the population of Ross River is approximately 405.

4.1.3 Faro

Faro is located on the Pelly River, in the Anvil Mountains, northeast of Whitehorse on the Robert Campbell Highway. It was established in 1969 to support a lead and zinc mine which is no longer in operation. According to the Second Quarter Population Report (Yukon Bureau of Statistics 2018), the population of Faro is approximately 413.

4.1.4 Access

The Mactung property can be accessed by road during the summer months using the North Canol Road and an access trail that branches from the North Canol Road in the vicinity of the Macmillan Pass airstrip. Year-round access to the Mactung property, however, is generally via helicopter.

Hunters and trappers have been known to use the public road from about km 447 of the North Canol Road that travels 17.5 km northwest to Tributary E.

4.1.5 Aesthetics

The Mactung site is located in an isolated area. Except for the turn off to the road/train network from the North Canol Highway, the proposed Site is not visible by the general public. The camp between the Site and the North Canol Highway.

4.1.6 Economy

Ross River and Faro are the primary supply centres for the surrounding area.

4.2 Heritage Resources

Past archaeological investigations of the Mactung property (in 2007 and 2008) found little to no archaeological potential in most the area proposed for exploration facilities. No archaeological sites were discovered in 2007 and there are no previously recorded sites in this area (Points West Heritage Consulting Ltd. 2007).

In 2008, an archaeological assessment was completed along the proposed access and exploration roads (Points West Heritage Consulting Ltd. 2008). This assessment found two potential archaeological sites, both in areas where no development was planned.

4.3 Lifestyle/Traditional/Cultural

The project area is used for hunting, outfitting (concession #9) and trapping (registered trapping concession #112) by members of the Ross River Dena Council and the public.

5.0 ENVIRONMENTAL EFFECTS ASSESSMENT

5.1 Valued Components

The following environmental valued components were identified as part of the Project Proposal in 2008:

- Soil
- Vegetation
- Moose and Moose Habitat
- Caribou and Caribou Habitat
- Water Quality.

5.2 Environmental Effects Assessment

5.2.1 Soil

5.2.1.1 Effects Characterization

The project has the potential to increase soil erosion along the access and exploration roads, in camp and at surface exploration sites.

5.2.1.2 Proposed Mitigation

The following measures will be implemented during the project to minimize effects to soil and soil stability:

- During progressive reclamation related to any future exploration activities that may be conducted, the affected area will be re-sloped, contoured or otherwise stabilized. Re-seeding will occur in areas steep, prone to erosion or considered a sensitive alpine area. Seed mixes approved by YG Department of Environment will be used. Scrap metal or unburned garbage will be hauled to a recognized landfill.

5.2.1.3 Significance Determination

It was determined through a review of the potential effects and associated project activities that may be anticipated to occur for the duration of the authorization that the proposed project, with the recommended mitigation, is not likely to result in a significant, adverse effect to soil.

5.2.2 Vegetation

5.2.2.1 Effects Characterization

The project has the potential to disturb vegetation in areas where exploration activities and road/trail building might occur.

5.2.2.2 Proposed Mitigation

The following measures will be implemented to minimize effects to vegetation:

- Disturbance areas will be limited in size, where possible
- The vegetative mat will be re-established following disturbance, either through encroachment by native plant species or more deliberate means such as re-seeding with a certified weed free native plant mix suitable for use in the area. Seed mixes will be approved by YG Department of Environment.
- Progressive reclamation of future exploration activities may include re-sloping, contouring, and general stabilization of areas where soil was exposed. Areas with steep slopes that are prone to erosion or considered sensitive (e.g., alpine areas) would be suitable candidates for deliberate re-vegetation efforts, such as seeding.

5.2.2.3 Significance Determination

It was determined through a review of the potential effects and associated project activities that may be anticipated to occur for the duration of the authorization that the proposed project, with the recommended mitigation, is not likely to result in a significant, adverse effect to vegetation.

5.2.3 Moose

5.2.3.1 Effects Characterization

While recent baseline studies indicate that moose do not occur at high densities in the project area, moose are a species of high socio-economic and natural value in the Yukon that are susceptible to human-related effects.

Based on EBA's baseline studies, moose are not known to utilize the mineral exploration of camp areas during any season, nor do they use these areas as a regular travel corridor. As these areas are above the elevational extent of shrub growth, no browse for this species exists.

5.2.3.2 Proposed Mitigation

The following measures will be implemented during the course of the project as may be necessary to minimize potential effects on moose.

- A strict no hunting policy for all project staff at any project exploration areas.

- Voluntary no hunting request signs will be posted at the bottom of the existing access road to the Mactung camp to request that hunters not use the road/trail network for hunting purposes. While this is not expected to be an active mitigation, it may help to relieve a small amount of hunting through education.

5.2.3.3 Significance Determination

It was determined through a review of the potential effects and associated project activities that may be anticipated to occur for the duration of the authorization that the proposed project, with the recommended mitigation, will not result in a significant, adverse effect to local moose or moose habitat.

5.2.4 Caribou

5.2.4.1 Effects Characterization

Many of the potential effects on caribou are similar to those for moose. Within the project area, caribou are only present throughout the summer months, which is also when exploration activities are most likely to take place during the term of the authorization. Consequently, there could be some potential overlap between human activities and caribou from the Redstone Herd.

While future exploration and related activities do have the potential to result in temporary disturbance to or displacement of caribou from the immediate area, prior years of exploration (2006, 2007) have suggested that this effect is minimal for the following reasons:

- Caribou have been routinely observed grazing in and travelling through the exploration valley area (Tributary C valley) while past exploration activities were active (drilling, access trail construction, etc.).
- The proposed exploration activities will be concentrated on the North wall of the valley (deposit area), leaving activity in the valley bottom and opposite wall at a minimum.
- Most caribou activity during the summer months tends to be on alpine ridges and snow patches, and the current project area does not constitute critical habitat.

5.2.4.2 Proposed Mitigation

The following measures will be implemented during the course of the project as may be necessary to minimize potential effects on the Redstone Caribou herd: and their habitat:

- A strict no hunting policy shall be enforced for all project staff at any project exploration areas.
- Voluntary no hunting request signs will be posted at the bottom of the existing access road to the Mactung camp to request that hunters not use the road/trail network for hunting purposes. While this is not expected to be an active mitigation, it may help to relieve a small amount of hunting through education.

5.2.4.3 Significance Determination

It was determined through a review of the potential effects and associated project activities that may be anticipated to occur for the duration of the authorization that the proposed project, with the recommended mitigation, would not result in a significant, adverse effect to caribou and caribou habitat.

5.2.5 Water Quality

5.2.5.1 Effects Characterization

The project could introduce deleterious materials (debris, suspended solids, and ARD constituents) into the Hess River Tributaries and the South MacMillan River.

5.2.5.2 Proposed Mitigation

The following measures will be implemented during the project to minimize potential effects on local water quality

- Water use will be limited to water needed for the camp and potentially water needed for exploration drilling.
- Domestic water will be supplied from the pond of melt water above Mactung camp with Tributary C as a backup source. Bottled water will be used for drinking water.
- If exploration drilling is proposed during the term of the authorization, a maximum rate of water use including requirements to run drills is 240 m³ per day.
- Sewage from the camp will be stored in a septic tank. The septic tank will be emptied by a septic pump into a septic truck when the septic tank approaches capacity and the sewage will be hauled to a licensed facility for disposal.
- In the event of a fuel spill, the project's Spill Contingency Plan (Appendix B) will be implemented as appropriate to prevent the spill from entering a water body followed by clean up of the spill incident.

5.2.5.3 Significance Determination

It was determined through a review of the potential effects and associated project activities that may be anticipated to occur for the duration of the authorization that the proposed project, with the recommended mitigation, is not likely to result in a significant, adverse effect to water quality.

6.0 SOCIO-ECONOMIC EFFECTS ASSESSMENT

6.1 Valued Components

The following socio-economic valued components were identified as part of the Project Proposal in 2008:

- Aesthetics
- Economy
- Heritage Resources, and
- Lifestyle/Traditional/Cultural (including First Nations and Communities).

6.1.1 Aesthetics

6.1.1.1 Effects Characterization

Aesthetics will not be affected greatly for the general public due to the remote location of the Site. However; there may be visual effects associated with limited increased traffic traveling along the North Canal Road and would include temporary increases in vehicle noise and associated emissions.

6.1.1.2 Proposed Mitigation

The following measures will be implemented during the course of the project to minimize impacts on aesthetics:

- During decommissioning the camp and roads will be reclaimed upon project by re-seeding areas which are steep, prone to erosion or considered a sensitive alpine area. Seed mixes approved by YG Department of Environment will be used.
- Scrap metal or unburned garbage will be hauled to a recognized landfill.

6.1.1.3 Significance Determination

It was determined through a review of the potential effects and associated project activities that may be anticipated to occur for the duration of the authorization that the proposed project, with the recommended mitigation, is not likely to result in a significant, adverse effect to aesthetic considerations.

6.1.2 Economy

6.1.2.1 Effects Characterization

To the extent possible the project will provide business, training, and work opportunities thus helping the economy. This will be done through:

- The employment of up to 25 people in camp, contractors, and subcontractors
- The local purchasing of supplies and equipment
- On site training

6.1.2.2 Proposed Mitigation

No mitigative measures are recommended since these are positive effects.

6.1.2.3 Significance Determination

No significance determination was made for this valued component as these are considered to be positive effects.

6.1.3 Heritage Resources

6.1.3.1 Effects Characterization

Two previous archeological assessments have been completed at the Mactung site. No potential archaeological or paleontological artifacts have been found to date in the camp and mineral exploration areas. However, the area has historically been used by people and archaeological artifacts may still be found.

6.1.3.2 Proposed Mitigation

The following measure will be implemented during the project to minimize effects to Heritage Resources:

- If, during exploration activities, an archaeological or paleontological artifact is found activities will cease. First Nations and YG Heritage Resources will be contacted for further instructions.

6.1.3.3 Significance Determination

It was determined through a review of the potential effects and associated project activities that may be anticipated to occur for the duration of the authorization that the proposed project, with the recommended mitigation, is not likely to result in a significant, adverse effect to Heritage Resources.

6.1.4 Lifestyle / Traditional / Cultural

6.1.4.1 Hunting and Trapping

Effects Characterization

This project may result in more hunters coming up to the Mactung camp area.

Proposed Mitigation

- A strict no hunting policy shall be enforced for all project staff at any project exploration areas.
- Voluntary no hunting request signs will be posted at the bottom of the existing access road to the Mactung camp to request that hunters not use the road/trail for hunting purposes. While this is not expected to be an active mitigation, it may help to relieve a small amount of hunting through education.

Significance Determination

It was determined through a review of the potential effects and associated project activities that may be anticipated to occur for the duration of the authorization that the proposed project, with the recommended mitigation, would not result in a significant, adverse effect to Hunting and Trapping.

6.1.4.2 First Nations

Effects Characterization

The Mactung Project site is located within the traditional territories of Liard First Nation, Ross River Dena Council and Na-Cho Nyak Dun. The use of their land could reduce the environmental integrity of their land.

Proposed Mitigation

The following measures will be implemented during the project to minimize impacts on First Nations:

- Communications and engagement activities with the Liard First Nation, the Ross River Dena Council and the Na-Cho Nyak Dun will be ongoing.
- Efforts will be made by the Project to maximize First Nation business, training, and work opportunities.

Significance Determination

It was determined through a review of the potential effects and associated project activities that may be anticipated to occur for the duration of the authorization that the proposed project, with the recommended mitigation, would not result in a significant, adverse effect to First Nations.

6.1.4.3 Communities

Effects Characterization

The project is expected to provide business, training, and work opportunities for the communities.

Proposed Mitigation

No mitigative measures are recommended since these are positive effects.

Significance Determination

No significance determination was made for this valued component as these are positive effects.

7.0 SITE DECOMMISSIONING

In the event that the Mactung property has not been sold at end of the 10-year term for this Class 4 Quartz Mining Land Use Approval, the following decommissioning activities will take place.

7.1 Exploration Trails and Roads

Exploration trails and roads will be returned to a more natural condition through the removal of crossing structures (e.g., culverts and bridges, where applicable), the re-establishment of natural drainages, and the scarification of road surfaces. Scarified road surfaces will be re-seeded using a certified weed free native plant mix tailored to the area. Seed mixes will be approved by YG Department of Environment prior to their application at site.. Scrap metal or unburned garbage will be hauled to a recognized landfill.

7.2 Drill Pads

Drill pads will be decommissioned by removing any structures that remain and re-sloping or re-contouring the area to increase site stability, as required. Re-seeding may occur in areas prone to erosion or considered particularly sensitive in nature, using a certified weed free native plant mix tailored to the area. Seed mixes will be approved by YG Department of Environment prior to their application at site. Any scrap metal or unburned garbage that remains will be hauled to a recognized landfill.

7.3 Camp

All remaining structures will be removed from the site as part of decommissioning. The area will be re-sloped, contoured or otherwise stabilized. Re-seeding may occur in areas prone to erosion or considered particularly sensitive in nature, using a certified weed free native plant mix tailored to the area. Seed mixes will be approved by YG Department of Environment prior to their application at site. Any scrap metal or unburned garbage that remains will be hauled to a recognized landfill.

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