



Sahtu Land and Water Board
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Land Use Permit Application Form
 (Subsection 19(2) and Schedule 2 of the Mackenzie Valley Land Use Regulations)

1 Applicant Name: Applicant's Mailing Address: Section 1.0 of attached document		Fax no.: Section 1.0 of attached document
		Telephone no.: Section 1.0 of attached document
2 Head office address: Section 1.0 of attached document		Fax no.: Section 1.0 of attached document.
		Telephone no.: Section 1.0 of attached document.
Field supervisor: Section 2.0		Email address: Section 1.0 of attached document.
3 Other personnel (subcontractor, contractors, company staff etc.): Available Tulita District businesses and residents. Section 3.0 of attached document. Total number of persons on site: 20		
4 Eligibility (Refer to section 18 of the Mackenzie Valley Land Use Regulations): <input type="checkbox"/> (a)(i) <input type="checkbox"/> (a)(ii) <input type="checkbox"/> (a)(iii) <input checked="" type="checkbox"/> (b)		
5 Other rights, licences or permits related to this permit application (mineral rights, timber permits, water licences, etc.): <i>To complete this section of the Application Form, please see page 16 of the Board's Guide to the Land Use Permitting Process for more information.</i> A water licence and a quarry permit are required as described in Section 8.0 of the attached document.		
6 a) Summary of operation (describe purpose, nature and location of all activities). Refer to paragraph 19(3)(b) of the Mackenzie Valley Land Use Regulations: <i>To complete this section of the Application Form, please see page 15 of the Board's Guide to the Land Use Permitting Process for more information.</i> A summary of the operation is described in Section 5.0 of the attached document.		
b) Indicate if a camp is to be set up. If yes, indicate size of camp or describe camp. (Provide details on a separate page, if necessary): A summary of the camp requirements is described in Section 5.2 of the attached document.		

7 Summary of potential environmental and resource impacts and mitigation measures (describe the effects of the proposed land-use operation on land, water, flora and fauna and related socio-economic impacts). (Use separate page if necessary):

To complete this section of the Application Form, proponents are encouraged to use Appendix B of the Board's [Guide to the Land Use Permitting Process](#).

A summary of the potential environmental and resource impacts and mitigation measures are described in Section 6.0 of the attached document

8 Proposed restoration plans (Use a separate page if necessary):

To complete this section of the Application Form, please see page 16 of the Board's [Guide to the Land Use Permitting Process](#) for more information.

A summary of the restoration plan is described in Section 7.0 of the attached document.

Roads:

(Provide details on a separate page.)

Is this to be a pioneered (new) road?

Has the route been laid out or ground truthed?

9 Proposed disposal methods:

To complete this section of the Application Form, a waste management plan for the proposed activities is to be developed in accordance with the Board's [Guidelines for Developing a Waste Management Plan](#) and submitted as an attachment to the Application Form. A template for this Plan is provided in the Guidelines.

a) Garbage:

b) Sewage (Sanitary and grey water):

c) Brush & trees:

d) Overburden (Organic soils, waste material, etc.):

Please refer to Section 9.0 and Appendix G of the attached document.

10 Equipment (includes drills, pumps, etc.) (Use separate page if necessary):

Number

Type and Size

Proposed use

Please refer to Section 10.0 of the attached document.

11 Fuels:	Number of containers:	Capacity of containers:	Location:
Diesel			
Gasoline			
Aviation Fuel			
Propane			
Other			

Please refer to Section 11.0 of the attached document for information about fuels and fuel storage.

12 Containment fuel spill contingency plans (attach separate contingency plan if necessary):

A spill contingency plan for the proposed activities is to be developed in accordance with INAC's Guidelines for Spill Contingency Planning, April 2007 (accessible [here](#)). This Plan is to be submitted as an attachment to the Application Form.

Please refer to Section 12.0 and Appendix F of the attached document.

13 Methods of fuel transfer (to other tanks, vehicles, etc.):

Please refer to Section 13.0 of the attached document.

14 Period of operation (includes time to cover all phases of project work applied for, including restoration):

Please refer to Section 14.0 of the attached document.

15 Period of permit (up to five years, with maximum of two years of extension):

Please refer to Section 14.0 of the attached document.

16 Location of activities by map coordinates (attach maps and sketches):

To complete this part of the Application Form, please see the [Standards for Geographic Information Systems \(GIS\) Submissions](#).

Minimum latitude (degree, minute):

Maximum latitude (degree, minute):

Minimum longitude (degree, minute):

Maximum longitude (degree, minute):

Map Sheet no.: Please refer to Section

Please refer to Section 16.0 of the attached document for location of activities by map coordinates.

17 Applicant (print name in full, in upper case): ANN KULMATYCKI

Signature:



Date (DD/MM/YY): NOV 16 2018

18 Application fees for Type A or Type B permit (for federal and non-federal lands)¹:

a) Application fees for Type A or Type B permit (include the first two hectares) - \$150.00: \$ 0.00

AND

b) Land-use fees for federal public lands only:

If more than two hectares of federal public lands are being used, enter the number of hectares in excess of the two hectares included in the Application fee.

_____ hectares at \$50.00/hectare \$ 0.00

1. To help identify whether your activity is on federal lands, please see [this map](#).

Total fees²: \$ 0.00

2. Please make all cheques payable to the Receiver General for Canada.



Oscar Creek Bridge Relocation Geotechnical Investigation and Right of Way Clearing

Project Description Report

Government of the Northwest Territories – Department of Infrastructure

November, 2018



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1.0 APPLICANT'S NAME AND MAILING ADDRESS

1.1 Applicant

Department of Infrastructure (INF)
Government of the Northwest Territories
P.O. Box 1320
Yellowknife, NT X1A 2L9

Attention: Kamran Ata
Structural Standards Engineer
Phone: (867) 767-9083 ext. 31134
Email: Kamran_Ata@gov.nt.ca

1.2 Contractor

INF will identify the Contractor (not yet selected) and its key contacts prior to the start of the fieldwork.

2.0 FIELD CONTACT

The field supervisor and field contact numbers are not yet known.

3.0 OTHER PERSONNEL

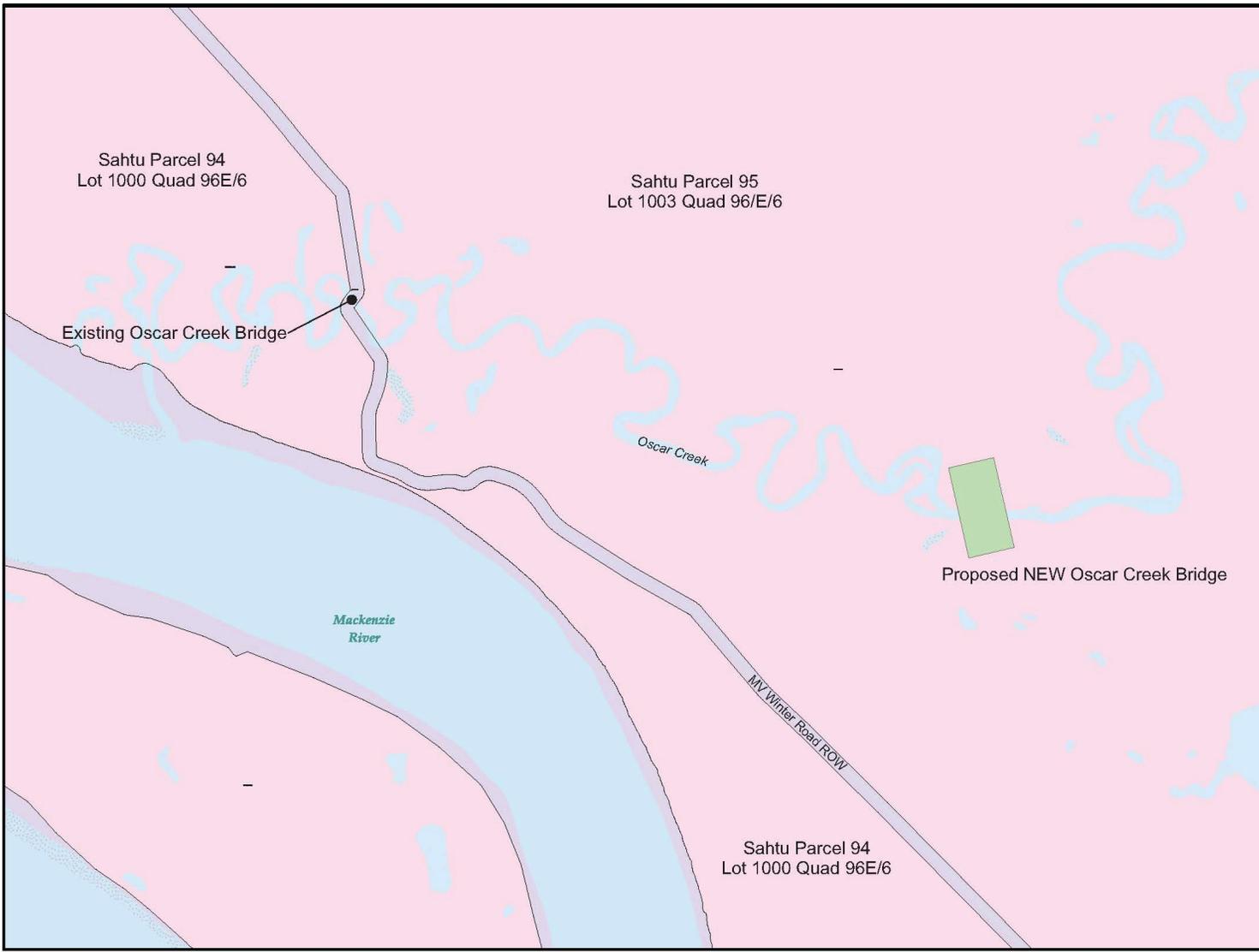
INF will use contractors, businesses and resources that are local to the Project area where possible and feasible. INF can identify specific businesses and names at the start of the fieldwork, if desired. The estimated 20 personnel that will be required will include equipment operators, drillers, laborers, camp staff and engineering/survey/environmental monitoring staff.

4.0 ELIGIBILITY

INF's eligibility for a permit is as described in Section 18 part (b) of the *Mackenzie Valley Land Use Regulations (MVLUR)*.

4.1 Current Land Ownership

The project is situated within Sahtu lands. A map of the prospects and water crossing locations where work is to be conducted is shown in Figure 1.



Oscar Creek Bridge
Proposed Recolation

Scale: 1:20,000

0 135 270 540 810 1,080
Meters

Date Printed: Tuesday, February 20, 2018
Drawn By: peembleton

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Department of Lands.
<http://atlas.lands.gov.nt.ca>

Figure 1 – Current Land Ownership

5.0 PROJECT DESCRIPTION

5.1 Summary of Operation

5.1.1 Purpose, Nature and Location

The Government of Northwest Territories (GNWT) Department of Infrastructure (INF) is planning to relocate the Oscar Creek Bridge, located along the Mackenzie Valley winter road from its current location to a location 6 km upstream. The new proposed location is the suggested location from the 1975 Public Works of Canada (PWC) alignment. The proposed winter road realignment has a cleared width of approximately 30m within a 60m right of way, and includes three separate watercourse crossings: Tributary 1 crossing, Oscar Creek crossing, and Tributary 2 crossing. Along with this proposed bridge relocation, the winter road will be cleared and realigned to the new crossing location at Oscar Creek as well as two tributaries. Maps of the Oscar Creek area showing the water crossing locations, material prospects, and a listing of the associated coordinates for the area is provided in Appendix D and section 15.0, respectively.

For this bridge relocation the Department of Infrastructure is continuing to work on the engineering design of the water crossings. Two critical and necessary elements for this work are the geotechnical data for the water crossings, and the identification of potential construction material sources in the surrounding area. A total of three (3) water crossings and three (3) material prospect sites will be investigated. The material prospects are all terrace landforms along Oscar Creek. The material prospects will be investigated using machine excavated test pits.

The purpose of this project is to gain access to the proposed sites in the winter by clearing a width of 30m within the right of way along the proposed winter road alignment in order to support site investigations using auger and core drills for the water crossings, and an excavator throughout the material prospect sites. This investigation will inform and support the work associated with a complete application package for a Land Use Permit and Water License for the relocation of the bridge on Oscar Creek, permanent realignment of the winter road, and any required aggregate sources to do this work. Boreholes and test pits will be logged, samples will be taken for laboratory analysis, and comprehensive reports will be developed to inform INF in finalizing the project. INF plans to use the services of a contractor for equipment and brush clearing, and the services of either a consultant or in-house staff for the geotechnical drilling and the material source investigations.

INF and the contractor may adjust the exact borehole locations, locations throughout the areas of interest based upon engineering judgment as well as field conditions. The material prospect site cut lines and test pit locations will be determined on site through the use of engineering judgement.

5.1.2 Access to Borehole Locations

In the Oscar Creek area there are existing cut lines from the winter road alignment work completed in the 1970's. The existing winter road alignment cut lines and existing trails will be used to access the

identified areas; the project is expected to use approximately 8.5 km of existing cut lines and 4.1 km of new cut lines for accessing all sites.

The existing cut lines are narrower than when they were first opened and it is expected that some clearing will be required to reopen them. Clearing for access to borrow sources will be no more than necessary to allow access and operation of the equipment; the maximum cutline width expected is 10 m. The cut line opening and clearing will be done by a tracked excavator with a mulcher head or a tracked mulcher. Tracked dozers may be used for this clearing work by installing shoes on the blade so it cannot cut into/disturb the frozen ground. With this method all timber over 125mm in diameter will be salvaged and placed along the edge of the clearing. If permitted, clearing in the vicinity of water courses will use the same methods; otherwise it will be done by hand.

The Department of Infrastructure is requesting approval for the access routes for the geotechnical and material investigation to be up to 10 m in width for a total disturbed access area of approximately 12.6 ha, of which 4.1 ha is estimated to be new disturbance. Although a maximum cut line width would be 10 m, INF anticipates that the average width will actually be 7.5 m; this would reduce the disturbed area to 9.5 ha, of which 3.1 ha would be newly disturbed. There are existing cut lines throughout the material source areas from past work which will be used to gain access to these areas, in addition to creating new cut lines to gain further access to the sites.

The borehole locations for the waterway crossings will require a 15 m wide clearing to accommodate all of the drilling equipment. At the watercourse crossing the drilling will be done as close to the watercourse as possible along the alignment without the drilling through the ice and water of the watercourse bed.

As the clearing of the access routes proceeds, the contractor will prepare the route as a winter road and prepare ice crossings for watercourses as required. Typical safety precautions such as signing will be used to protect and inform the public as well as to protect the safety of the work crews (see Section 5.1.6). The preparation of the winter road will involve the use of snowcats, drags and the addition of water as needed to produce and maintain a 10 cm thickness of compacted snow and ice surface over the original ground. The 10 cm base will also be maintained at the camp locations.

The preparation of watercourse crossings with all-season flow might require increasing the thickness of the natural ice cover to meet the weight-bearing capacity required for the equipment and vehicles. The flooding of the ice surface by pumping water from the watercourse (or from another water source) and/or by the addition and compaction of snow is proposed to establish and maintain safe crossings. Where the watercourse has no winter flow, a snow fill crossing will be constructed.

Water will be sourced from water bodies either on or off the cleared routes. If water sources off the access routes are selected, then further access trails to reach those sources will be required. DFO protocols for the withdrawal of water will be applied. The water use per source will be less than 100m³/day to remain below the threshold for requiring a water licence.

Taking into account the winter road realignment, access roads, camp(s), and bridges/culvert clearings, the estimated land use for this project is 36 ha, of which 19.7 ha is expected to be new clearings. There is limited time available for the permitting, contracting and completion of this Project's fieldwork by March 25, 2019.

5.1.3 Drilling Process

All boreholes will be advanced using an auger or core drill outside of the ordinary high water mark of the tributaries and Oscar Creek. Material displaced by the action of the drilling will be brought to surface by auger action or by core barrel. If refusal of the auger drill is experienced prior to the targeted limit of depth of investigation, then a total of 3 additional trial borehole locations might be attempted to establish the nature of refusal.

The method of core drilling will require small quantities of water. The core drilling work is limited to the bridge locations where coring of the bedrock to a depth of 3 m is required where encountered. It is estimated that each location requiring coring will use less than 0.5 m³ of water per borehole location. The auger drilling method does not require the use of water to advance the borehole. There will be 5 boreholes, two of which will be at the Oscar Creek crossing location (one on each bank); two at the tributary 2 crossing (one on each bank); and the last one will be at the tributary 1 crossing. The Department of Infrastructure estimates a bridge will be required for the Oscar Creek crossing as well as at tributary 2 (tributary NW of Oscar Creek), while tributary 1 (S of Oscar Creek) will require a culvert.

5.1.4 Number and Depth of Boreholes and Data Collected

INF is estimating that an auger drill(s) will drill 5 boreholes at the bridge location on Oscar Creek as well as both tributaries. The boreholes will be a minimum of 150 mm diameter. The use of a coring drill will be involved where bedrock is encountered at the bridge locations.

The logging of the boreholes is to include:

- Location and elevation,
- Soils descriptions and lithology,
- A record of sampling types and depths,
- The results of Standard Penetration test (SPT) once per 1.5 m of borehole depth, and
- Photographs related to the work.

The Unified Soil Classification system will be used for soil descriptions and classification. The minimum sampling requirements for testing each borehole are:

- Natural moisture at 1 m intervals,
- 2 Atterberg limits per borehole,
- 2 grain size analysis and hydrometer tests per borehole, and
- 1 soluble sulphate content test per borehole.

The depth of the culvert borehole at tributary 1 will be 18 m or refusal due to bedrock.

The depth of the bridge boreholes will be minimum 30 m or refusal due to bedrock. Where bedrock is encountered, the borehole will be advanced 3 m into the bedrock using a core drill.

If refusal of the auger drill is experienced prior to the targeted limit of depth of investigation, then up to 3 additional trial borehole locations will be attempted to establish the nature of refusal.

Upon completion of each borehole, the contractor will, unless otherwise directed, immediately backfill the hole with drill cuttings. While backfilling the borehole a bentonite clay or equivalent plug will be added to seal the holes.

5.1.5 Prospect Test Pitting

The prime resource areas in each of the prospect areas range in extent from 10 ha to 50 ha. Access to these prime areas will involve opening cut lines in a way that is accepted by the Land Use Authority. Initial test pitting will be conducted along the baseline of each site. From the results, cross cut lines will be cleared to allow further testing to confirm the material source viability and extent.

Test pitting will be conducted throughout the prospect sites using an excavator; they will be approximately 3m³ in volume and to a depth of 6m. Test pits will likely be spaced 150-200 m apart and in areas that show viable material sources, the spacing will be reduced to a spacing of 50-100 m. Each Test pit will be documented and the information collected will include:

- Location and elevation by hand held GPS
- Soils description and lithology
- A record of sampling types and depths
- Photographs related to the work

The Modified Unified Soil Classification system will be used for soil descriptions and classification.

The minimum sampling/testing for each prospect will include the determination of the soil gradation, plasticity and moisture. A minimum of 3 samples per site will be used for gradation and plasticity testing. The sampling and testing for moisture conditions will be enough to sufficiently represent variations within the thicknesses of the borrow material and to be representative of the overall site condition.

Upon completion of each test pit, the contractor will, unless otherwise directed, immediately backfill the pit with the excavated material and the material will be mounded to account for subsidence in the backfilled material.

Testing at the colluvium along the northern edges of the material prospected sites will be conducted to evaluate their respective metal leaching and acid rock draining (ML/ARD) potential. Test pitting will be done as well to assess the gradation and size of the material.

5.1.6 Safety

The Contractor will be required to conduct site orientation for all persons on site. The orientation shall include site safety, communications and emergency procedures. A daily on-site meeting is also required at the beginning of each workday to review the work plan and provide instructions as needed and to ensure the preparedness of all persons to operate safely on the site. The Contractor will send copies of the meeting notes to the designated Department of Infrastructure representative along with daily

reporting information. For field emergency preparedness the Contractor will maintain an operational portable satellite phone at the camp location and at active work locations.

5.2 Camps and Helicopter Landing Areas

A mobile camp will be used for the estimated 20 people that will be required for the project. It is anticipated that the camp will be composed of skid-mounted trailers and will include separate kitchen, wash and accommodation units. The number of accommodation units will be adjusted as needed to support the project's staffing needs.

The mobile camp will be set up at likely 1 or 2 locations on either side of Oscar Creek with the camp changing locations as the project progresses. The Department of Infrastructure and/or the contractor will discuss and seek approval of these camp locations from the land use inspector prior to clearing land for the camps. The camp clearing along the access roads will need to be 60 m by 50 m for the safe operation of the camp.

It is intended that potable water will be hauled to the camp by water truck however, the camp might also use local water sources identified as discussed in Section 1.3 for potable and non-potable uses if the water quality is acceptable.

Wastewater (sewage and grey water) will be disposed of in sumps located either on or off the access road. The sump will be located in an area that is a natural depression and a minimum of 100 m from any water body. If sump locations off the access road are selected, then access trails to reach those sumps will be required. The Sahtu Land and Water Board (SLWB) will be informed of the sump locations and any access routes.

At approximately 5 locations the field crew will prepare helicopter landing areas. These areas will provide helicopter access in case there is an emergency. The helicopter landing areas will be approximately 20 m by 20 m. Wherever possible, helicopter landing areas will utilize existing clearings.

6.0 SUMMARY OF POTENTIAL ENVIRONMENTAL AND RESOURCE IMPACTS

In evaluating the potential impacts of this Project, the following factors provide the correct context:

- 1) The Project is winter-only and temporary. It will occur over about 12 weeks between January and March 2019.
- 2) The Project is mobile. The work will constantly progress along the alignment so the disturbance impact at any particular location will be temporary in nature. The longest-term impacts would be at the camp locations, which will only be for a few weeks at any given location.
- 3) The Project will require some clearing of trees and brush but it will not require the removal of the surface organic layer.

- 4) The Project will not be opening up access to a new, undisturbed area. Most of the Project is on an existing cut line. For those locations where new cut is required, there are existing cut lines in the vicinity that already provide access into the general area.
- 5) The cumulative impacts of this Project are minimal and time limited.

6.1 Air Quality

There will be a low number of vehicles and equipment used for the Project with the typical localized and temporary effects on air quality that are associated with the use of such vehicles and equipment. While the camps will stay at specific locations for a number of weeks, the equipment and vehicles will be moving along the corridor as the work progresses, so the localized impacts on air quality will not be persistent at a particular location over the course of the Project. There will be no incineration or unusual air quality emissions or impacts.

Impact mitigation methods will include:

- 1) Vehicles and equipment will be maintained in proper operating condition.
- 2) Unnecessary idling will be discouraged.
- 3) Vehicles and equipment will be plugged in at camps to minimize the need to keep running during cold weather.

6.2 Noise

There will be a low number of vehicles and equipment used for the Project with the typical immediate vicinity impacts upon noise that is associated with the use of such vehicles and equipment. While the camps will stay at specific locations for a number of weeks, the equipment and vehicles will be moving along the corridor as the work progresses so the localized impacts on noise will be low, rapidly reversible and the impact will be to the local area within which the specific activity is occurring. There will be no blasting or other unusual loud noises. Adequate maintenance of equipment will reduce possible effects associated with construction noise.

Impact mitigation methods will include:

- 1) Vehicles and equipment will be maintained in proper operating condition.
- 2) Unnecessary idling will be discouraged.
- 3) Vehicles and equipment will be plugged in at camps to minimize the need to keep running during cold weather.

These mitigation methods are sufficient given the context of this Project.

6.3 Climate Change

It is not expected that this Project will have a consequential impact upon climate change.

Recognizing that climate change is a cumulative impact of human use of fossil fuels, this Project will take steps to avoid unnecessary greenhouse gas emissions. Impact mitigation methods will include:

- 1) The camp will be properly insulated and winterized to minimize the use of heating fuel.

- 2) Vehicles and equipment will be maintained in proper operating condition.
- 3) Unnecessary idling will be discouraged.
- 4) Vehicles and equipment will be plugged in at camps to minimize the need to keep running during cold weather.

These mitigation methods are sufficient given the context of this Project.

6.4 Permafrost

The term “permafrost” describes a ground thermal condition where the soil or rock remain below 0°C for two or more years, regardless of material type, ground ice distribution, or thermal stability. The two-year minimum stipulation is meant to exclude from the definition the overlying ground surface layer which freezes every winter and thaws every summer (called the “active layer”).

Oscar Creek lies within an intermediate discontinuous permafrost region with permafrost occurring beneath 24-65% of the land area (Heginbottom, 2000). Active layers in the Norman Wells area range from <1.0 m to <1.5m for undisturbed forested soil to >1.5 m for sites disturbed through clearing and >3m for cleared and filled sites (Robinson, S; Couture, R; Burgess, M, 2001). However, it should be noted that active layer thicknesses can be highly variable and are dependent on many variables including soil type, thickness of organic cover, exposure, etc.

The Project is located within the extensive discontinuous permafrost zone, with frozen ground that has variable proportions of ground ice (50% to 90% of land area underlain by permafrost). Ground temperatures are natural within the range of -1°C to -3°C, and are above zero adjacent to and below large waterbodies and in disturbed areas.

During the clearing of trees and brush to provide access for the Project, the surface organic layer will not be removed and root structures will be left intact wherever possible, which will help to protect the permafrost. The clearing of the trees and brush will nonetheless allow for the potential expansion of the active layer and the thawing of the ground-ice and permafrost in the future. This Project will not disturb the soils with the exception of the drilling of the boreholes. The drill cuttings will be placed back into the boreholes after sampling to mitigate that impact.

6.5 Water Quality and Quantity

6.5.1 Groundwater

6.5.1.1 Quantity

This Project will not use groundwater resources and so there will be no impact on groundwater quantity.

6.5.1.2 Quality

If the Contractor encounters groundwater during the drilling of the boreholes, that will be noted on the borehole logs. The augers used for the drilling will be free of any contaminants and so the intersection of the boreholes with groundwater will not introduce any contaminants to the groundwater. Further, each of the boreholes will be backfilled only with drill cuttings that came from that borehole so there will be no introduction of contaminants through backfilling.

The Spill Contingency Plan (SCP) will be in place to protect against spills and if any spills were to occur, they would be cleaned up promptly and thoroughly to prevent groundwater contamination. Further, since this Project will be occurring during winter conditions, it is unlikely that any spill would be able to move through the frozen overburden and enter the groundwater prior to it being cleaned up.

6.5.2 Surface Water

Surface water could be used for three purposes:

- 1) Use in the camp – potable and/or non-potable,
- 2) Preparing the winter road, and
- 3) Preparing the ice crossings.

Water will be sourced from water bodies either on or off the cleared alignment. The Department of Fisheries and Oceans (DFO) protocols for the withdrawal of water will be applied. Water use per source will be less than 100 m³/day, therefore a water license is not required.

6.5.2.1 Quantity

Although exact quantities are unknown, the quantity of water to be used is expected to be low and less than 100 m³/day per water source. DFO protocols regarding the removal of water will be applied.

6.5.2.2 Quality

There will be no impact upon surface water quality due to the Project as there will be no deposits of waste or other contaminants in surface water. Mitigation methods to protect surface water quality include:

- 1) Sumps for the disposal of wastewater will be located at least 100 m from any waterbody.
- 2) Any spills will be cleaned up properly in accordance with the SCP.
- 3) Any debris on the ice crossings will be removed by the end of the Project.

6.6 Sediment Control

By their nature, bridge and road construction activities have the potential to cause erosion and the consequent sedimentation of receiving streams and lakes. Sediment released into streams and lakes, both in suspended and settled forms, presents a risk to fish and fish habitat. The effects of sediment on fish and their habitat include, but are not limited to: degradation of potential spawning areas, smothering of eggs and the benthic invertebrate food supply; reduction in feeding efficiency; avoidance of potentially suitable habitats; and, abrasion of fish tissues (Lloyd et al. 1987; Birtwell 1999).

This phase of the Oscar Creek bridge relocation project will involve clearing of winter road areas and geotechnical investigations, and therefore poses very little risk relating to sediment control. Typical mitigation measures to be employed to control the release of sediments due to runoff include:

- Limiting the use of heavy equipment to the immediate project areas
- Minimizing vegetation removal and conducting progressive reclamation at the material sources (immediately in-filling the boreholes)
- Minimizing the use of heavy equipment on stream banks

6.6 Hydrology

This Project will not cause any significant impacts on hydrology. There will be no damming of flow or installation of water-control structures. Ice and/or snow crossings will melt in the spring with no residual impacts. Water withdrawn for the building of ice crossings will remain in the watercourse from which it was extracted. Water withdrawn from potential water sources for other purposes such as for building the winter road or use in the camp will be low volume and will adhere to applicable DFO protocols.

6.7 Fish and Fish Habitat

Fish resources are known to be living at least seasonably in Oscar Creek. The area possesses potential spawning, rearing and feeding habitat for fish. Species occurring or potentially occurring in the area include: longnose and white suckers, longnose and northern redbelly dace, lake and Arctic cisco, slimy Sculpin, Arctic grayling, northern pike, whitefish (mountain, humpback, round, broad and lake), burbot, Ninespine stickleback, walleye, flathead and lake chub, inconnu, Arctic lamprey and trout-perch (Oscar Creek PDR, 2003; Scott and Crossman, 1973; Richardson et al. 2001).

The Project will not cause any significant impacts on fish and fish habitat. The Project will occur in winter conditions with water bodies frozen over or frozen to the bottom. There will be no disposal of waste or other contaminants in water bodies. The extraction of water from potential water sources will be low volume and will adhere to applicable DFO protocols. While there might be disturbance impacts on fish from the use of the ice crossings and the drilling of boreholes near the watercourses, these impacts will be of a small magnitude, temporary and short-term in duration. Any spills will be cleaned up in accordance with the SCP with no resulting impacts upon fish or fish habitat. Overall, the project should have a net benefit on fish and fish habitat in Oscar Creek, since the permanent structure will reduce recurring construction activity for snow/ice fill crossing of Oscar Creek each winter.

6.8 Vegetation

Oscar Creek area is located within the Taiga Plains Ecoregion. Within this Ecoregion, Oscar Creek is located in the level IV Norman Range Low Subarctic (LS) Ecoregion of the Level III Taiga Plains LS Ecoregion (Ecosystem Classification Group, 2008). This Ecoregion is characterized by well-defined bedrock ridges, an eroded interior plateau, till deposits, and a deep meltwater channel. Vegetation includes mixed-wood forests of trembling aspen, Alaska paper birch, and white and black spruce with shrub understories on westerly slopes and lacustrine deposits, while mixed spruce stands are common on the interior plateau and slopes. Numerous intermittent streams drain the slopes, with Turton and Kelly lakes occupying the meltwater channel.

Much of the area, including the three borrow sources, were subject to extensive forest fires approximately 15 to 30 years ago, with substantial new regrowth occurring. Prior to the fire, the Project areas would have supported mature mixed black and white spruce, birch, and aspen forests. The surrounding lowlands are dominated by dense black spruce forests with an understory of Labrador tea and discontinuous muskeg. In a few cases, the muskeg transitioned to small unnamed ponds or small lakes. The majority of the soils are characterized by clayey silt, often overlying heavy gravel or decaying bedrock.

During the Traditional Knowledge Study, respondents identified a number of types of vegetation, including moss, lichen, rosehip bushes, birch fungus, wild mushrooms and various berries in the area. Aside from berries (blueberries, high bush cranberries, low bush cranberries, cloud berries, raspberries, gooseberries, blackberries and juniper berries), the Dene and Métis have harvested many plants and roots, often for medicinal purposes. Several types of trees also provide a source of medicine, such as spruce gum, used as a medicine and also as glue.

6.8.1 Impact Mitigation

Trees and brush will be cleared along the alignment and at the bridge and tributary locations. The size of the areas cut will be minimized to the extent possible taking into consideration safety and operational factors. During the clearing of the vegetation, care will be taken to not disturb the surface organic layer and to leave root structures intact. This will protect rare plant communities that are not known to be at a specific location. Equipment and vehicles used for the Project that are coming from outside of this area will be cleaned to prevent the spread of non-native plant species.

The areas cleared of trees and brush for this Project are intended to remain permanently cleared as part of the Mackenzie Valley Winter Road realignment and Oscar Creek bridge relocation. The Geotechnical Program at Oscar Creek will have minimal impact on vegetation of the area since the work will be predominantly on pre-disturbed landscape. In addition, the work will be completed in the winter when the ground is frozen. There should be no negative impacts on the area's land resources.

6.9 Effects on Wildlife

Due to the limited spatial extent, low magnitude of Project impacts, and short duration, there are no long-term or irreversible effects to wildlife anticipated as a result of this Project. Since the work will occur during the winter, only mammals that hibernate in the winter (i.e. bears) will be potentially impacted. However, the stream and tributary crossings do not possess the typical habitat characteristics bears look for when constructing a den and, consequently, no bears are expected to den near the project site. Noise levels produced by the heavy equipment and bush clearing will inevitably impact some mammals, but these noise levels will only occur during the Project and be of short duration.

6.9.1 Common Wildlife Impacts due to Linear Developments

The most common direct and indirect impacts on wildlife from linear developments include:

- Habitat loss and/or alteration (e.g. noise and visual disturbances)
- Reduction in habitat connectivity; and
- Wildlife mortality (direct and indirect)

6.9.1.1 Habitat Loss and/or Alteration

The estimated 35.9 ha of clearing done for this Project will remain permanently cleared for the new Winter Road alignment. The additional land cleared for this Project (access cut lines and granular test sites) will revegetate naturally. There will be little to no long-term direct or cumulative impacts on habitat loss and/or alteration due to this Project.

6.9.1.2 Habitat Connectivity and Fragmentation

There will be little reduction in habitat connectivity or increase in habitat fragmentation due to this Project. The clearing along the alignment will only be up to 30 m wide in most places with about 10 m of that width already present along most of the alignment. For the access to the granular prospect areas, there are already extensive cutlines that will be utilized, requiring only one new cutline of 4.1km to be created for access.

6.9.1.3 Vehicle-Wildlife Collisions

There will be a low number of Project vehicles and equipment moving at slow speeds along the access routes. It is not expected that vehicle-wildlife collisions will be an issue for this Project, however the issue will be mitigated with the general wildlife mitigation methods described in Section 6.9.10.

6.9.2 Birds

The Mackenzie River acts as a major flyway for Arctic breeding birds during spring and fall migrations. Numerous bird species, including waterfowl and waterbirds, raptors, and other upland birds use the Mackenzie River during migrations and disband along the route to appropriate breeding habitat. As with breeding territories, the migration routes between wintering and breeding grounds are traditional and are used each year. Migration is influenced and governed by weather (Terres 1982). Birds advance northward as the weather warms and return south when the weather cools. The speed of migration varies among species and is influenced by the annual prevailing weather patterns.

6.9.3 Caribou

Two subspecies of caribou may occur within the vicinity of the proposed Project. Woodland caribou (*Rangifer tarandus caribou*) remain in the region throughout the year, whereas barren-ground caribou (*Rangifer tarandus groenlandicus*) are known to infrequently use the area in winter.

Boreal Caribou, Boreal Population

Woodland caribou, boreal population (herein referred to as boreal caribou) are listed as Threatened under the Species at Risk (Northwest Territories) Act and the federal Species at Risk Act (SARA). By definition, this species will likely become endangered if limiting factors are not reversed. Habitat loss, degradation, and fragmentation are driving factors leading to a declining population. In the Northwest Territories, the boreal caribou population is estimated to be between 6,000 to 7,000 animals, with densities in the western Sahtu estimated at 1 caribou per 100 km² (ENR 2012; 2015). Boreal caribou are considered common near Norman Wells and their populations are thought to be increasing due to low incidents of disturbance from fire and lower harvest rates (Auld and Kershaw 2005).

Boreal caribou are found year round in the vicinity of the proposed Project area. Boreal caribou may occur in all forested habitats in the vicinity of the Project. They require expansive tracts of undisturbed habitat, principally mature or old growth coniferous forests (> 100 years old) associated with peatland complexes, lakes, and ponds and uplands with an abundance of ground and tree lichens and few predators (Species at Risk Committee 2012; Environment Canada 2008). Traditional knowledge also describes ridges and high hills in the Sahtu Settlement Area important for boreal caribou in the summer and fall, as well as muskeg, areas of dense vegetation including old growth forests, and shorelines

(Species at Risk Committee 2012; Environment Canada 2012). All habitat within the project area is considered boreal caribou habitat, except for the existing disturbed areas (e.g. winter road, cut lines).

Barren-Ground Caribou

Barren-ground caribou (*Rangifer tarandus groenlandicus*) are ranked by ENR as Sensitive under the general status program, but are not listed under the *Species at Risk (Northwest Territories) Act* and *SARA*.

Based on caribou collaring data, the Project area lies well outside the annual range of barren-ground caribou; however, satellite collared cow data from 1985 to 2007 provides evidence of a collared individual from the Bluenose-West herd overwintering further south than its known annual range (west of Norman Wells nearer to Great Bear Lake) (ACCWM 2014a; ENR 2012). Although Norman Wells is considered south of the main annual range, a few individuals may infrequently overwinter near the proposed Project area. The 2013 population estimate for the Bluenose West herd was 20,000 animals, and the population is likely stable (ENR 2012). Traditional knowledge indicates that caribou distribution and abundances cycle in response to feeding conditions, weather, and human activities (ACCWM 2014a; 2014b).

Caribou from the Bluenose West herd may occasionally be present in the vicinity of the Project during winter months (November to May). The Bluenose West herd calves and summers on the tundra and ruts in the fall near the tree line. By November, the herd begins migrating south to its winter range within the taiga forest, and remain there until spring migration (November to May). Occupied winter ranges are known to vary annually in response to food availability, snow depth, and predator abundance.

Winter is a critical period for caribou populations. Caribou dig craters in the snow and graze on the exposed vegetation, principally ground lichens. Habitats that provide winter foraging habitat include open, mature spruce forests with an abundance of lichen, and areas with low snow depths (e.g., hills and ridgelines). Lichens are an important food for caribou all year, but especially during the winter. Sedges and evergreen leaves are also eaten during the winter. During times with low snowfall, caribou will also feed in richer valleys and low lying lakeshores and wetlands. Carruthers et al. (1986) reported overwintering Bluenose caribou use open coniferous habitats in proportion to the habitat available in the landscape; whereas, all other habitat types, particularly fire regenerating habitats are used less. Suitable overwintering habitat is available throughout the proposed Access Road.

Caribou seek security from predators and travel in open habitats such as frozen lakes where wind action has hardened the snow and predators are easily visible (Carruthers et al. 1986). Carruthers et al. (1986) reported Bluenose caribou use lakes and open wetlands four times more often than their availability on the landscape.

Caribou are known to be sensitive to sensory disturbance (noise from machines, human presence and vehicles (Dyer et al. 2001)). Many factors affect the size of a zone of influence of a disturbance, such as topography, the presence of security cover, and environmental conditions such as wind and snow cover. Given the temporary and short-term nature of this Project and low level of activity, disturbance impacts are not expected to be significant. Given the nature and scope of this Project, the general wildlife impact

mitigation described in Section 6.9.10 is expected to be effective for caribou. During the October 2018 wildlife survey, no caribou or caribou signs (i.e., antler sheds) were observed.

6.9.4 Moose

Moose (*Alces americanus*) do not have any special conservation status but are considered to be a valued resource to the people in the Sahtu Settlement Area.

In the Northwest Territories, the moose population is estimated between 20,000 to 40,000 (ENR 2015), and are considered common along the Mackenzie River and near Norman Wells (Auld and Kershaw 2005; ENR 2015). In 1995, moose surveys west of Norman Wells reported 0.17 moose/km², which represented a population size of approximately 497 ± 490 (90% confidence interval) (Veitch et al. 1995). An unpublished survey from 2001 completed by Veitch and Popko found a decline in the same area, with a density of 0.07 moose/km² and an estimated population size of 196 ± 85 (90% C.I). Early winter moose surveys conducted by McLean (1994) in the Kelly Lake area and the Keele and Redstone River area reported that moose densities ranged from 0.06 moose/km² to 0.19 moose/km², with an average of 0.08 moose/km². Although moose are considered common now (Auld and Kershaw 2005), their densities have been reportedly low. A story presented by Auld and Kershaw (2005) indicated that moose were once “very scarce” along the Mackenzie River during the trading post times.

Moose are generally non-migratory and may occupy all habitats within the vicinity of the proposed Project throughout the year. Moose prefer semi-open early successional habitats, such as floodplains along the Mackenzie River, riparian areas, lakeshores, regenerating burns (approximately 15 to 30 years following the fire), and disturbance areas that have an abundance of willow and young deciduous trees/shrubs. Preferred habitats, particularly during the fall and winter are those dominated by shrubs and deciduous trees; most conifer dominated habitats provide sub-optimal moose feeding habitat but provide thermal cover. During the spring and summer when forbs, grasses, and aquatic plants are available the use of browse material declines. The use of wet and aquatic habitats for food commonly occur during all non-winter months, but tend to peak during late June to early August when plant nutrition and digestibility and insect harassment are highest (Peek 1998).

Moose also seek forests or tall shrub stands to reduce detection from bears and wolves, their primary predators. Shorelines and islands are also used to reduce predator encounters, particularly during calving (late May to early June).

Winter moose surveys conducted in the Sahtu have identified high moose densities within the riparian areas along the Mackenzie River and its tributaries. Winter track surveys conducted by Imperial Oil (2004) noted high moose use in recent burn areas in the Northern Taiga Ecological Zone and in mixed wood forests and black spruce-tamarack (i.e., open coniferous) and shrub habitats in the South Taiga Ecological Zone.

A total of 37 moose were observed throughout the Tulita District during the September 2010 reconnaissance field program (EBA 2011). Areas dominated by shrubs, including the fire breaks and shrub wetlands located near the proposed quarry, along the Mackenzie River, and in between the chain of lakes north of the proposed route provide high quality, year round moose habitat. There was a total

of 7 moose seen in the early winter survey completed in October 2018; 3 of them were seen in the Project area. One moose was observed amongst a birch tree stand and the other two were within the riparian area of Oscar Creek.

While moose may be somewhat more tolerant of disturbance than caribou, many factors affect the size of a zone of influence of a disturbance, such as topography, the presence of security cover, and environmental conditions such as wind and snow cover. Given the temporary and short-term nature of this Project and low level of activity, disturbance impacts are not expected to be significant.

While increased risk of hunting and predation is a known impact due to linear developments, it is not expected to be the case for this Project. The winter road will mostly follow an existing cut line, and will replace the alignment for the current existing winter road. Where new cut line will be created, there are other existing cut lines in the vicinity such that this Project will not be creating substantial new access to this area and therefore this is not expected to be a significant impact of this Project.

Given the nature and scope of this Project, the general wildlife impact mitigation described in Section 6.9.10 is expected to be effective for moose.

6.9.5 Grizzly Bears

Grizzly bears (*Ursus arctos*) (northern interior population) may be present in the area of the Project from time to time. Grizzly Bears are assessed by COSEWIC as Special Concern (as of May 2002), but have no status under SARA. In the Northwest Territories, grizzly bears are ranked by Environment and Natural Resources (ENR) as Sensitive under the general status program, and may require special attention or protection to prevent their population from becoming at risk in the future. Local threats to their population includes over hunting, defense kills, and disturbance from land developments (ENR 2012).

In the Northwest Territories, the estimated grizzly bear population is approximately 5,100 (ENR 2012). In the SSA, grizzly bears are most common in the Mackenzie Mountains west of Norman Wells; however, a few are expected to occasionally occur in the taiga forest near the proposed Access Road (Auld and Kershaw 2005). Both grizzly and black bears use similar habitat types and their distributions may overlap. Bears require extensive home ranges (on average, male ranges extend over 2,000 km²) with a variety of landforms and plant types to adequately provide food and cover.

Bears are omnivores and feed on a variety of plant material, small and large mammals, birds, fish, and insects. In the spring, bears gravitate towards areas with early-emerging vegetation such as roadsides and wetlands, as well as areas with winter-killed wildlife. Moose and caribou calves are also preyed upon opportunistically during this time. In summer, insect activity peaks and bears feed heavily on colonies of ants, bees, and wasps. By fall time, their diet shifts as berries become ripe and available. Forests regenerating from fires (at least 20 years prior) commonly provide summer and fall feeding habitat for bears as berry producing plants regenerate and ants invade downed and burned trees (Laviviere 2001; Snyder 1991).

Grizzly bears typically begin denning in September to early October with the first frosts and emerge from their dens beginning in April (Miller et al. 1982). Bears typically dig dens in till material available on mountain slopes, eskers, drumlins, stream banks, or in natural cavities.

During October 2018, a bear/wolf den and raptor nest survey was conducted by ENR out of Norman Wells. Stephanie Behrens led the survey, which consisted of flying transect lines about 200-300 m apart within the buffer zone of 1.5 km around the Project footprint (see map page 4, Appendix D). During the survey they were watching for any possible denning areas, wildlife tracks and raptor nests. Stephanie was assisted by two wildlife monitors hired by the Norman Wells Renewable Resource Council. The results from the survey concluded that there was no grizzly bear activity during the time of the survey; however, this does not mean that there are no bears within the Project area. Traditional Knowledge indicated that bears have been observed walking on the current winter road. Although a bear may be seen in the Project area, the denning survey results show that there are no active or inactive dens in the area. In the case that a bear is encountered, the proper mitigation measures will be taken as outlined in Section 6.9.10.

6.9.6 Black Bears

American black bears (*Ursus americanus*) are the most common bear species present in the area of the proposed Access Road (Auld and Kershaw 2005), and they are ranked by ENR as Secure under the general status program.

In the Northwest Territories, black bear densities are estimated at 10 bears/100 km² (ENR 2012). There have been no formal attempts to estimate black bear densities in the area; however, a black bear collaring program was undertaken for problem bears active at the Norman Wells solid waste facility in 1985-1988 (Clarkson 1993).

Black bears were most abundant in Clarkson's (1993) Norman Wells problem bear study; however, a couple of grizzly bears were also detected during this time. Both grizzly and black bears use similar habitat types and their distributions may overlap.

Bears require extensive home ranges with a variety of landforms and plant types to adequately provide food and cover. Black bear diets are similar to grizzly bears. They too are omnivores and feed on a variety of plant material, small and large mammals and birds, fish, and insects (Laviviere 2001; Snyder 1991).

Based on local black bear collaring data, black bears entered their dens in early to mid-October and emerged in late April to late May (Clarkson 1993). Bears typically dig dens in till material available on eskers, drumlins, stream banks, or in natural cavities. From the collaring data, black bears dens were excavated principally in sandy soil found in upland mixed spruce forests, and were located in a variety of landforms ranging from lowlands near the Mackenzie River to rock outcrops (Clarkson 1993). The majority of the dens were found on south facing slopes (Clarkson 1993). The den sites of three collared bears were found over two years. In subsequent years, all three bears were found to den in the same local area (ranging from approximately 12 to 28 km apart), but not the same den (Clarkson 1993). Suitable black bear denning habitat occurs in the Project area, particularly near the quarry sites.

During the October 2018 wildlife survey, there was no sign of any black bear activity or of any active or inactive dens in the Project area. Although the black bear collaring data suggests bears near Norman Wells do not reuse the same den in subsequent years (note this den was observed five years ago), the Town Quarry area is known to provide suitable denning habitat. During community engagement sessions, attendees were asked about their knowledge of the area and any known bear or wolf dens in the area; no responses were received. As per the Sahtu Land Use Plan, mitigation will include ceasing work activities within 800 m of all known active den sites during the specific species denning season. Due to the attracting nature that black bears have towards food and waste disturbance, they are susceptible to becoming habituated and therefore the proper mitigation measures will be taken as outlined in Section 6.9.10 with regards to food waste during the Project.

6.9.7 Grey Wolf

The grey wolf (*Canis lupus*) is assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as Not at Risk, and is ranked by ENR as Secure under the general status program. The density of wolves in the northern Northwest Territories is estimated at 1 wolf/944 km² (ENR 2012). During a muskox aerial survey across much of northern Sahtu Settlement Area, wolves were incidentally reported and their density was estimated at 1 wolf/1,000 km² (Veitch 1997).

Two different groups of grey wolves may occur in the area from time to time: migratory and resident. Migratory grey wolves (also known as tundra wolves) follow the barren-ground caribou herds and would infrequently occupy the area in the winter when barren-ground caribou are present. Resident wolves, also known as timber or boreal wolves remain below the tree line year round and would be present throughout the proposed Project area year round. These timber grey wolves depend on non-migratory prey such as moose, and their population densities cycle with prey abundance. Timber wolves maintain regular territories, which also vary in size depending on prey densities. Besides moose, wolf diets also include boreal caribou, snowshoe hares, small rodents, beaver, muskrat, birds, fish, eggs, and even small quantities of grass and other vegetable matter.

Wolf dens are traditional and may be used for many years; however, some wolves may have several dens in the territory and may relocate litters to another den if one is disturbed. Wolf dens are constructed in esker material, within a rock crevice, or along creeks or riverbanks. Suitable denning habitat may occur within the Project area, especially near the Prospect sources. Dens are commonly constructed near water or heights of land. The denning period typically begins in early May, and litters are born inside the den in late May or early June.

No wolves or any sign of wolves were observed in the vicinity of the Project during the October 2018 survey. There was also no sign of any active or inactive dens in the Project area.

6.9.8 Wolverine

Wolverines (*Gulo gulo*) are assessed by COSEWIC as Special Concern and ranked by ENR as Sensitive under the general status program; however, they have not been listed by SARA. In the boreal forests of the Northwest Territories, wolverine densities are unknown. The population of mature individuals across the Northwest Territories are estimated between 3,000 to 6,000, and the population is

considered to be stable (ENR 2012; Species at Risk Committee 2014). Threats to their population include oil and gas exploration, reduced prey abundance, and mortality of problem individuals and harvesting pressure (ENR 2012). The Sahtu Harvest Study (1999 to 2001) reported annual harvest rates between five and twelve wolverine per year (Bayha, pers. comm. as cited in COSEWIC 2003).

Wolverines live at low densities even under optimal conditions (Banci 1994; Species at Risk Committee 2014). They are opportunistic hunters and travel extensively in search of food. Their diet includes carrion, moose and caribou, small mammals, birds, fish, beaver, berries (Banci 1994; ENR 2012; Pasitschniak-Arts et al. 1995). Wolverines occupy multiple habitat types provided sufficient food resources are present, and require extensive ecologically intact areas (Species at Risk Committee 2014).

Although active year round, wolverines will construct snow dens to escape predators, cache food, and raise their young. Traditional Knowledge indicates kits (young) are born in June or July in a shallow pit dug in the ground, and scientific knowledge indicates kits are born between January and April within a constructed snow den (Species at Risk Committee 2014; Species at Risk Secretariat 2015). Nonetheless, natal dens have also been documented in abandoned beaver lodges and bear dens, in upturned roots and fallen logs, or rocks crevices (Banci 1994). Suitable year-round wolverine habitat exists throughout the proposed Access Road.

No wolverines were documented during the October 2018 survey. Although there weren't any wolverines observed during the survey or any sign of active or inactive dens, there were tracks observed on the creek. To ensure there aren't any encounters with wolverines in the Project area, the proper mitigation will be taken as outlined in Section 6.9.10.

6.9.9 Raptors

Raptors make up a small but important group of birds frequenting the area around Oscar Creek from time to time. Although this group covers a small number of species, it is diverse and includes hawks, eagles and osprey, falcons, and owls.

Sixteen raptor species have the potential to occur in the vicinity of the Project. The majority of these species are summer residents; however, five species (northern goshawk, gyrfalcon, northern hawk owl, great horned owl, and great grey owl) may overwinter, particularly years when prey densities are high. Little is known about the local population abundance of individual species. However, appropriate nest sites and food are the main resources that naturally limit breeding populations of peregrine falcon (Bromley 1992) and other raptors (Blood and Anweiler 1994).

Raptors breed where their habitat requirements are met. Some species nest in trees, while others nest on cliffs and on the ground. Raptors exhibit high nest site fidelity, potentially returning to the same nest or nesting area each year. Summer residents may appear within the area as early as mid-April and depart in October, while others overwinter. Other raptors are spring and/or fall migrants and may pass through en

route to and from their breeding ranges on the tundra.

A total of eighteen observations of raptors, representing six different species, were documented throughout the Tulita District during the September 2010 field program (EBA 2011). Of these, three

great gray owls, two northern harriers, and one osprey were observed northwest of Norman Wells, outside the local study area (EBA 2011). No nests were observed within the buffer zone of the project area.

6.9.10 General Wildlife Impact Mitigation

The mitigation measures presented in Tables 1 and 2 are expected to minimize and manage impacts on wildlife.

Table 1 Wildlife Impacts Mitigation

Potential Effects	Mitigation Measures
Habitat Loss and/or Alteration	<ul style="list-style-type: none"> • Clearing will be minimized to only those areas that are required. • Previously disturbed areas will be used wherever possible. • Personnel will not travel off corridor unless there is a specific requirement. • Project vehicles and equipment entering the area will be cleaned to minimize transport of non-native/invasive species of vegetation. • An approved Spill Contingency Plan will be followed to ensure spills are prevented and if they were to occur as a result of an accident, that they will be controlled to prevent the spills from impacting a large area
Sensory and other Disturbances	<ul style="list-style-type: none"> • Vehicles and equipment will be maintained in proper operating condition, including the use of mufflers. • Unnecessary idling will be discouraged. • Vehicles and equipment will be plugged in at camps to minimize the need to keep running during cold weather. • During construction, traffic along the alignment will be minimized by ensuring workers are transported to site via vans or extended crew cabs. • Observations of wildlife by project staff will be reported to ENR. • Operations will be temporarily suspended if caribou or moose are noticed within 500 m of Project activities. • In the event that an active den is identified, ENR will be consulted to determine an appropriate strategy. • Wildlife monitors will be on site to monitor wildlife and manage risks. • Snow banks along the alignment will be kept low and escape points will be ploughed out for wildlife crossing. Frequency and distance intervals will be discussed with the land use inspector and ENR. • Traffic volumes and speeds will kept be low.
Wildlife Incidents	<ul style="list-style-type: none"> • An appropriately designated supervisor will educate all field workers on wildlife mitigation measures • An appropriately designated supervisor will provide all field workers with wildlife response training and general wildlife awareness. • Workers will avoid all interactions with wildlife unless crew safety is at risk. • Workers will not feed, harass or approach wildlife. • All humans/wildlife conflicts and incidents will be reported to the appropriately designated supervisor and to INF. • All significant wildlife features, such as dens, will be documented and reported. • Firearms will not be allowed on-site except for firearms in the possession and control of authorized wildlife monitors. • No hunting or fishing by workers will be permitted. • All food and stored garbage will be kept in bear-proof areas or bear-proof containers to prevent wildlife attraction.

	<ul style="list-style-type: none"> • Any grease, oils, fuels stored on-site will be stored in bear-proof areas or containers and the Waste Management Plan will be followed. • Workers will be directed to report any suspicious activities related to wildlife. The appropriately designated supervisor will be responsible for obtaining and reporting this information to INF. • Wildlife sightings will be recorded (including GPS location data if possible), submitted to INF and ENR, and included in annual permit reporting to WLWB.
Wildlife Attraction to Site and Waste Management	<ul style="list-style-type: none"> • Waste products will be stored in secured containers and transported to appropriate receiver facilities where arrangements have been made to receive the waste, if necessary. • Wildlife deterrent mechanisms (including fencing and lights) will be used as needed. • The camp will be designed to prevent wildlife interactions. • Adequate outdoor lighting will be installed. • Personnel will follow an approved Waste Management Plan.
Wildlife Mortality	<ul style="list-style-type: none"> • Equipment and vehicle movements and speeds will be kept low, which should minimize risk of collisions. • Any wildlife injury or mortality will be immediately reported to INF which will then inform ENR and the WLWB. The cause will be investigated with potential new mitigation developed and applied. • Maintenance measures to reduce attraction of wildlife will be employed. • Additional mitigation, if required, to minimize impacts on wildlife will be developed.
Spills of Hydrocarbons or Toxic Substances Resulting in Injury to Wildlife and/or Wildlife Habitat	<ul style="list-style-type: none"> • Vehicles will be equipped with spill kits and fuelled 100 m away from waterbodies. • Fuel storage areas will be equipped with spill kits, will be located at least 100 m away from waterbodies and large fuel storage tanks (above 2,000 L) will be double walled. • Spill response and containment will be completed expeditiously in accordance with the Spill Contingency Plan and the contractor's HSE manual and procedures. • Appropriate deterrents will be used to discourage wildlife from entering the area. • ENR will be contacted immediately to determine appropriate course of action, which may include capturing, relocating or treating contaminated wildlife.

Table 2 Mitigation and Best Management Practices

Species or Species Group	Rationale	Mitigation and Best Management Strategies
Barren-ground Caribou	<ul style="list-style-type: none"> ▪ Only present near the proposed project in some winters, as the project is located outside their annual range. When present, sensitive to human disturbance and over-harvesting. 	<ul style="list-style-type: none"> ▪ A wildlife monitor may be present during project activities to monitor the location of overwintering caribou. ▪ Cease project activities if caribou are within 500 m (GNWT 2015). ▪ See general mitigation below.
Boreal Caribou	<ul style="list-style-type: none"> ▪ Boreal caribou are sensitive to disturbance year round, especially during winter and calving periods (November to July). ▪ Sensitive to human disturbance and over-harvesting year round. ▪ Listed as Threatened at territorial and federal levels. 	<ul style="list-style-type: none"> ▪ A wildlife monitor may be present during project activities to monitor the location of caribou. ▪ Cease during project activities if caribou are within 500 m (GNWT 2015). ▪ Avoid open, mature spruce habitats (near peatland complexes, lakes, and ponds) that have abundant ground and tree lichens, as much as possible. ▪ See general mitigation below. ▪ See mitigation specific to species at risk (Table 6-4).
Moose	<ul style="list-style-type: none"> ▪ Sensitive time is year round, especially winter (November to May). 	<ul style="list-style-type: none"> ▪ Minimize disturbance to riparian shrub communities and avoid lakes and ponds, as much as possible. ▪ See general mitigation below.
Furbearers, including bears and wolves	<ul style="list-style-type: none"> ▪ Sensitive time is year round, especially in the winter. 	<ul style="list-style-type: none"> ▪ Conduct an active den survey in the late fall prior to disturbing these areas to locate active den sites, including at and near the known bear den near the project and possible wolf denning area near the project. ▪ As per the SLUP, during project activities within 800 m of all known active den sites during the specific species denning season (mid-October to late May for bears; early May to late June for wolves; and either January to April or June to July for wolverines). ▪ See general mitigation below.
Raptors	<ul style="list-style-type: none"> ▪ The most sensitive time is nesting and fledging season (March 1 to August 1), but year round for some resident species. ▪ Raptors and their nests are protected under the applicable regulations. 	<ul style="list-style-type: none"> ▪ Avoid clearing during raptor nesting and fledging season (March to August) in all habitat types (this timing restriction includes early nesters such as owls and later nesters such as hawks). ▪ As indicated in the SLUP, avoid known raptor nesting sites by 1 km, and not cause adverse negative effects on nesting raptors from March 1 to August 1. ▪ Conduct a raptor nest survey within at least 1 km of the proposed footprint, including along Canyon Creek (nearest to km 0 to km 4.0 of the proposed Access Road). ▪ Construction monitoring of known active nests present within 1 km may be required to confirm project activities are not causing adverse negative effects.
General Wildlife	<ul style="list-style-type: none"> ▪ Suited for all wildlife species 	<ul style="list-style-type: none"> ▪ Minimize the project footprint to the extent possible. ▪ Manage snow bank heights during winter operations (e.g., less than 1 m high) and create breaks in snow berms and windrowed timber (e.g., breaks 10 m wide every 300 m) to allow wildlife passage. ▪ Discourage off-road vehicle access to the fire breaks and seismic lines/trails from the proposed project (i.e., soil mounding, placement of waste timber into windrows). ▪ Prohibit littering, and provide appropriate food and waste disposal bins. ▪ Policy giving all wildlife the right-of-way during project activities. ▪ Project-related employees and contractors prohibited from harassing wildlife.

6.10 Archaeological Resources

The results of the site file search completed by the Prince of Wales Northern Heritage Centre (PWNHC) indicated three previously recorded archaeological sites and one previously recorded paleontological site near the Oscar Creek borrow sources and road realignment. These four sites are located along the Oscar Creek embankment and include a contemporary cabin (LiRw-1), an historic cabin (LiRw-2), the Indigenous/historic Oscar Creek Trail (LiRw-4), and the paleontological Oscar Creek fossils (LiRw-3). LiRw-1 and LiRw-2 are located approximately 1km southwest from the northwest end of the winter road realignment, where it rejoins the existing winter road and will not be impacted. LiRw-4 is located approximately 875 m north/northeast of the Oscar Creek Crossing. No evidence for this trail was found within the proposed prospect sources or the winter road realignment and therefore it will not be impacted by the proposed activities.

LiRw-3 is located approximately 750 m southwest of Granular Prospect 2 and over 1km southeast of Granular Prospect 3 and will not be impacted. Available maps and imagery as well as ethnographies, histories, and archaeological reports for the study area were examined to determine the archaeological potential of each granular source and for the area along the road realignment. Criteria used to determine the potential for archaeological resources included: proximity to streams and water bodies, known heritage sites, known Indigenous or historic trails, topography, vegetation cover, and presence of fish and wildlife habitat.

After being granted permission in September 2017, a field team working from helicopter and foot visited the sites and planned access routes to confirm the planned development route and prime site areas. While the field team was assessing the sites a second team conducted an Archaeological Impact Assessment on the area, including the proposed new Oscar Creek bridge location, both tributaries, proposed borrow sources and their associated access routes. The site work involved foot reconnaissance of the site areas, and the excavation and backfill of hand-dug test pits to assess any archaeological potential.

These studies were both conducted by Stantec, and concluded that the program could proceed with low likelihood of disturbing any cultural or archaeological resources at the proposed locations. The report of the Archaeological Impact Assessment is attached as Appendix H. The Department of Infrastructure and the Contractor will adhere to conditions included in the LUP concerning the discovery of potential archaeological sites during the investigation.

6.11 Socio-Economic Impacts

This Project is temporary and short-term as it will start and end this winter over the course of about 8-12 weeks between January and March 2019. It is anticipated that there will be about 20 field workers although that number could vary depending upon the progress made and the need to complete the field work by the end of March. The Department of Infrastructure has not yet selected a Contractor for the Project, therefore cannot say with certainty where those workers will be coming from. However, it is our expectation that there will be short-term employment opportunities from this Project for residents of

local communities (Norman Wells, Tulita and Fort Good Hope), with wildlife monitors, truck drivers, equipment operators, camp workers and drillers being examples.

The Department of Infrastructure is working on the contracting process and will be issuing a public Request for Proposals. INF expects that businesses in the local communities will be part of the bidding process either as the primary Contractor or as sub-contractors.

While there are employment and business opportunities associated with the Project, given the low level and short period of activity, the Project will not create any significant or long-term impacts on employment and business for the local communities.

There is the possibility that Project could disrupt hunting or trapping activities. However, with the entire Project lasting only about 8 weeks, it is INF's view that this potential impact is minimal. As well, with the Project consistently progressing along the alignment, the disturbance will not be persistent at any particular location with the exception of the camps, which could be located in one place for several weeks. Through the Traditional Knowledge study conducted by the Norman Wells Renewable Resource Council, no current traditional uses in the area were identified. Finally, by notifying the local communities as to the start and end date for the field work as well as where the camps are located, INF believes that Project conflicts with hunting and trapping activities will be minimal to non-existent.

6.12 Traditional Knowledge

The Traditional Knowledge Study that was conducted by the Norman Wells Renewable Resource Council and outlined the traditional knowledge on the area. This study contained information on items such as

- Hunting and Trapping
- Burial Sites
- Plants and Berries
- Creeks and Lakes
- Cabins and Trails

This study was conducted to supplement the Traditional Knowledge that was collected in 2003, prior to the original construction of Oscar Creek Bridge. This project has taken into consideration all of the information in the TK Report, as well as leading up to the Study. INF does not anticipate that this Project will have any conflicts with the information provided in the TK report, which is attached as Appendix E.

7.0 PROPOSED RESTORATION PLAN

The clearing of the proposed winter road realignment, access routes and work clearings, are expected to be used during the Geotechnical Program as well as during the eventual relocation of the Oscar Creek Bridge as the winter road realignment route and haulage routes from the material source(s). It is intended that these areas will remain permanently cleared, with the areas not required for the project being allowed to re-vegetate naturally.

The ice crossings are intended to be snow-filled with possible ice thickening. The contractor will ensure that the ice crossings are clean of debris at the end of the project.

Drill cuttings and material excavated for test pits will be placed back into the respective boreholes and test pits. The material being placed back in the test pits will be compacted with the excavator bucket and the surface will be graded to the original grade.

At the end of the project the camp and all of the equipment/vehicles will be removed from the project area. Any garbage and debris will be cleaned from all areas.

8.0 OTHER RIGHTS, LICENSES OR PERMITS

8.1 Land Use Permit

The Department of Infrastructure has prepared and is submitting this Project Description Report in support of the land use permit application for the Geotechnical Investigation Program for Oscar Creek Bridge relocation.

8.2 Water License

No water license is required for this Project.

8.3 Solid Waste Disposal

INF will secure agreement for the disposal of solid waste from this Project at municipal waste management facilities. The solid waste disposal will be in Norman Wells. If required, INF can provide an update on this matter prior to the start of fieldwork.

8.4 Access to Sahtu Lands

The Department of Infrastructure has acquired permission to access Sahtu land for the purposes of this Project. The Tulita District Land Corporation provided an email granting INF access to Sahtu Lands for the purpose of conducting these investigations and clearing by email on October 29, 2018 from Executive Director Louise Reindeer. Please refer to Appendix D, page 63 for this email.

8.5 Conformity Requirements, Sahtu Land Use Plan

The Sahtu Land Use Planning Board (SLUPB) is one of three regional, co-management boards of public government that were established by the *Sahtu Dene and Métis Comprehensive Land Claim Agreement (SDMCLCA)* and, as with the SLWB, was given effect under the *Mackenzie Valley Resource Management Act (MVRMA)*. Working with the SLWB and the Mackenzie Valley Environmental Impact Review Board (MVEIRB), this board provides for an integrated and coordinated system of land and water management in the Sahtu.

As of August 8, 2013 licences, permits or other authorizations relating to the use of land or waters or the deposit of waste, are required to follow the plan. While the plan does not generate a new level of mandatory regulatory review, the SLUPB may make a conformity determination on a land use activity. This Project is located within Zone 63 of the SLUP. Zone 63 Deh Cho (Mackenzie River) is a Special

Management Zone. Under this zone the plan’s General Conformity Requirements (CRs) and the Special Management CRs are applicable. The determination of whether or not a project under development conforms to the land use plan is made by the SLUPB. The Proponent is developing the Project to conform to the plan. The CRs have been addressed as follows:

Requirement	Status	Supporting Evidence
1. Land Use Zoning	<ul style="list-style-type: none"> • Deh Cho Zone 63: Special Management Zone • No prohibitions except bulk water removal • Region identified as important regional and territorial transportation corridor (specific mention of winter road) • This project constitutes winter road improvement • No bulk water removal will be involved 	No bulk water removal
2. Community Engagement and TK	<ul style="list-style-type: none"> • TK Study updated by Norman Wells Renewable Resource Council (Attached Appendix E) • Multiple communications and meetings; Engagement completed in every Sahtu community between January – October 2018 • Early engagement in 2017 informed the need to delay the Project from Winter 2018 to Winter 2019, to allow for additional engagement, TK gathering, and wildlife survey. 	Appendix A Appendix B Appendix C Appendix D Appendix E
3. Community Benefits	Include but not limited to: <ul style="list-style-type: none"> • Infrastructure improvement • Early and continuous community involvement in project design • Operations and decisions • Improved access on the winter road • Improved resilience from climate change • Employment and economic activities, contract work 	Section 6.11
4. Archaeological sites and burial sites	AOA and AIA’s conducted in 2017 by Stantec <ul style="list-style-type: none"> • No significant archaeological, cultural, or heritage resources identified or suspected • No likelihood for project to have impact to known cultural or burial sites 	Appendix H Section 6.10
5. Watershed Management	<ul style="list-style-type: none"> • Proposed project has little to no reasonable potential to substantially alter quality, quantity, or rate of flow for waters that flow on, through or are adjacent to Sahtu lands. 	Section 6.5 Section 6.6
6. drinking water	<ul style="list-style-type: none"> • Proposed project will not result in the contamination of surface or groundwater within a community catchment. 	Section 6.5 Section 6.6

7. Fish and wildlife	<ul style="list-style-type: none"> Proposed work not likely to have significant impact on fish or wildlife Baseline fisheries assessment scheduled for July/August 2018 Den and Nest survey completed October 2018 Resulting project to relocate bridge will be designed and managed such that impacts to fish and wildlife are minimized or mitigated in an acceptable manner. 	Section 6.7 Section 6.9
8. Species introduced	<ul style="list-style-type: none"> The proposed project will take all reasonable precautions to prevent the introduction of non-native species or sub-species Equipment and vehicles used for the Project that are coming from outside of this area will be cleaned to prevent the spread of non-native plant species. 	Section 6.8.1
9. Sensitive Species and Features	<ul style="list-style-type: none"> According to Map 4: Sensitive Species and Features (p. 44 Sahtu Land Use Plan): No sensitive features identified in the region See section on Vegetation and impact mitigation See effects on wildlife 	Section 6.8 Section 6.9
10. Permafrost	<ul style="list-style-type: none"> Proposed project will be designed and carried out in a manner that prevents and/or mitigates adverse environmental impacts resulting from the degradation or aggradation of permafrost. Geotech will help to determine presence of permafrost in the area Tracked dozers may be used for this clearing work by installing shoes on the blade so it cannot cut into/disturb the frozen ground 	Section 6.4
11. Project-specific monitoring	<ul style="list-style-type: none"> TDB based on execution of project Wildlife monitor may be hired based on feedback received 	
12. Financial Security	Not applicable – GNWT does not need to provide financial security	
13. Closure and Reclamation	<ul style="list-style-type: none"> Described in PDR 	Section 7.0 Section 8.3 Section 9.0
14. Protection of Special Values	<ul style="list-style-type: none"> No indication of impact of project on archaeological and burial sites No lasting or irreversible impacts to water quality of wildlife, and impacts minor and will be minimized through mitigation measures outlined in PDR 	Throughout

9.0 PROPOSED DISPOSAL METHODS

The Waste Management Plan (WMP) for this Project is in Appendix G. The following are the primary waste management methods in the WMP:

- Non-hazardous garbage will be taken to an approved solid waste facility.
- Camp sewage and grey water will be disposed of in natural depressions used as sumps.
- Hazardous waste will be taken to an approved hazardous waste facility.
- Trees and brush cleared along the alignment will be mulched, or windrowed and compacted by heavy equipment along the side of the cleared area.
- Drill cuttings will be placed back into the borehole.

10.0 EQUIPMENT

The exact types, numbers, and weights of the equipment which will be used are not known until a contractor has been selected. However, equipment that would be used for a geotechnical project of this calibre would include: heavy construction equipment, a drill rig, pick-up trucks, a water truck, a sewage truck and possibly a fuel truck. The table below contains typical equipment and the associated information.

Table 3 Equipment List and Specifications

Equipment	Size	Weight (kg)	Number	Purpose
Snowcat	Various models	10,000	1 to 2	The opening and maintenance of cut lines and preparation of water crossings.
Grader	Various models	21,000	1 to 2	The opening and maintenance of cut lines and preparation of water crossings.
Plow truck	Tandem axle	25,000	1 to 2	The opening and maintenance of cut lines and preparation of water crossings.
Loader	Various models	Up to 40,000	1 to 2	Developing and maintaining ice crossings
Tracked Dozer	D8 or equivalent	Up to 40,000	2 to 3	The opening and maintenance of cutline access and preparation of water crossings.
Water truck	Tandem axle or semi-trailer	Up to 40,000	2	Provide water supply for winter access preparation, and for core drill operations.

Tracked Excavator equipped with or without mulcher head	Cat 320 or equivalent	Up to 40,000	1 to 2	For the opening of access cut lines, mulcher head will be used for this. Bucket attachment will be used for test pitting.
Tracked mulcher	Various models	Up to 60,000	1	The opening of cut lines and drill clearings.
Fuel truck	Tandem axle	25,000	1 to 2	Commercial, licensed fuel carrier to provide resupply of diesel and gasoline to portable tankage.
Helicopter	Various	N/A	1	Provide transport of personnel, supplies, fuel as required. Provide emergency transport ability.
Geotechnical drill rig (track or truck mounted)	Various	Up to 40,000	1 to 2	For use in advancing boreholes at bridge, culvert and centerline alignment locations.
Core drill unit (track, skid or truck mounted)	Various	Up to 40,000	1	For use specifically on BH locations at bridge sites to prove bedrock.
Service Pickup	½ to 5 ton capacity	5,000	5 to 10	Provide personnel transport, fuel transport by on board tidy tanks, mobile heavy equipment repair capacity.
Highway tractor with lowboy or highboy	Various	Winter Road legal axle weight	1 to 2	Winter road mobilization of equipment to the project site. Movement of equipment within the work site.
Skidoo		Up 300	4 to 10	Provide transport for personnel on cutline opening and tidying work. Provide transport for environment and wildlife monitors.
Chainsaw			4 to 12	For the opening of cutline in the vicinity of watercourses, if required.
Portable Diesel and Gas Generators			2 to 6	To provide electrical power at drill work sites.
Portable lighting/generator set			2 to 4	For illumination at drill/test pit site locations.
Various construction and winter road equipment		Up to 20,000		Carry out operations of opening and maintaining winter access and for support of site investigations.

11.0 FUELS

The contractor for the project will select the types of fuels and fuel storage tanks to meet the needs of the project as well as any storage tank volumes and locations. The Department of Infrastructure expects that diesel and gasoline will be the two primary fuels used. Diesel will be used for use in the mobile equipment and vehicles. Gasoline might not be required depending on the vehicles that are used.

INF expects the external fuel tanks required for the project will include: stationary fuel tanks for heating and powering the work camp and for vehicle refueling; fuel tanks mounted in the back of pickup trucks for refueling mobile equipment and vehicles away from the camp; and a designated fuel truck for refueling the camp.

Estimated fuel requirements are provided in Table 5. Mobile and stationary tanks used for the project will meet regulatory requirements. If required, INF will provide the Board with an updated list of fuels, tanks, and volumes prior to the start of the fieldwork.

Table 5 Type, Amount and Location of Fuels and Major Tanks

Type of Fuel	Capacity of Containers (L)	Number	Containment Type (including secondary)	Storage Location
diesel	25,000	2	Double wall enviro tanks	A local start up point
gasoline	5,000	2	Double wall enviro tanks	A local start up point

12.0 CONTAINMENT FUEL SPILL CONTINGENCY PLANS

The Spill Contingency Plan (SCP) for this Project is in Appendix F.

13.0 METHODS OF FUEL TRANSFER

The Contractor for this Project will select the exact methods of fuel transfer. However, INF expects that fuel will be transferred using pumps and hoses to stationary tanks and to equipment and vehicles from fuel tanks mounted in the back of pick-up trucks and/or a designated fuel truck. The staff conducting fuel transfer operations will be experienced.

Fuel transfer operations will follow the regulatory requirements that are included in the LUP such as maintaining fuel transfer set back distances from watercourses.

If the land use inspector notes concerns with fuel storage and transfer, INF and the Contractor will make changes to the equipment, operations and/or personnel as required to maintain regulatory compliance and to protect the environment.

14.0 PERIOD OF PERMIT

The date of mobilization of staff and equipment will be dependent upon the date of receipt of the LUP from the Sahtu Land and Water Board. INF intends to start the fieldwork as soon as possible after receipt of the LUP, aiming for the first week of January, 2019.

The completion of the fieldwork for this season, including all restoration work, is required by March 31, 2019 with the project reporting completed by May 31, 2019. INF is intending to complete this work by March 31, 2019, but is requesting a LUP that expires on March 31, 2021 in case any unexpected events delay the completion of the Project.

Upon completion of the fieldwork, INF will notify the Board that the LUP can be cancelled, with the agreement of the land use inspector. If all of the work cannot be conducted in the first winter season (2019), portions of the work will be postponed until next winter season (2020).

15.0 LOCATION OF ACTIVITIES BY MAP COORDINATES

Location	Coordinates (mid-point) North	West	SLUP Zone	Sahtu Settlement Land
Tributary 1 Crossing	65°25'38.38"N	127°22'37.22"W	63- Special Management Zone	Yes
Tributary 2 Crossing	65°26'53.37"N	127°26'16.07"W	63- Special Management Zone	Yes
Oscar Creek Crossing	65°26'05.41"N	127°22'52.31"W	63- Special Management Zone	Yes
Prospect 1	65°26'18.45"N	127°22'40.17"W	63- Special Management Zone	Yes
Prospect 2	65°26'53.68"N	127°21'16.70"W	63- Special Management Zone	Yes
Prospect 3	65°27'36.25"N	127°22'23.25"W	63- Special Management Zone	Yes

16.0 FEES

The GNWT is not required to pay any fees associated with acquiring land use permits.

18.0 CONSULTATION AND ENGAGEMENT

Please see Appendix (A, B, C and D) for consultation and engagement materials, including: Engagement Plan (Appendix A), Engagement Record (Appendix B); Summary of Community Engagement (Appendix C); and Information Documents (Appendix D).

19.0 SUPPORTING STUDIES

19.1 Traditional Knowledge Study

Please See Appendix E.

19.2 Heritage and Archaeological Resources

See Archaeological Impact Assessment (Appendix H).

20.0 REFERENCES

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