Mount Gaudet Access Road

Environmental Overview

Government of the Northwest Territories – Department of Infrastructure

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Abbreviations

cm	centimetre
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DCR	Dehcho Region
DFO	Department of Fisheries and Oceans Canada
DLUPC	Dehcho Land Use Planning Committee
ENR	Department of Environment and Natural Resources, Government of the Northwest Territories
GNWT	Government of the Northwest Territories
ha	hectare
Lands	Department of Lands, Government of the Northwest Territories
INAC	Indigenous and Northern Affairs Canada (now CIRNAC)
INF	Department of Infrastructure, Government of the Northwest Territories
kg	kilogram
km	kilometre
L	litre
LUP	Land Use Permit
m	metre
MGAR	Mount Gaudet Access Road
MVH	Mackenzie Valley Highway
MVLWB	Mackenzie Valley Land and Water Board
MVWR	Mackenzie Valley Winter Road
NWT	Northwest Territories
O&M	Operations and Maintenance
PDR	Project Description Report
PKFN	Pehdzéh Kį First Nation
PWC	Public Works Canada
SARA	Species at Risk Act
SARA (NWT)	Species at Risk Act (NWT)
SCP	Spill Contingency Plan

WL	Water Licence
WMP	Waste Management Plan

1 Introduction

1.1 Purpose of Document

This draft Environmental Overview has been developed by the Government of the Northwest Territories Department of Infrastructure (INF) for the construction of the Mount Gaudet Access Road (MGAR) (the Project). The document provides an overview of the environmental characteristics of area surrounding the Project, including climate, terrain, vegetative communities and locally occurring wildlife, aquatic habitat and aquatic species, as well as the socio-economic characteristics of the area. This document does not discuss mitigation measures that will be used during the Project to protect components of the environment, as this information is covered in the MGAR Project Description Report (PDR).

1.2 Contact Information

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Contractor

A contractor has not yet been selected for the Project. Information for the Contractor will be provided to the Mackenzie Valley Land and Water Board (MVLWB) upon award of the contract.

2 Project Description

The Project is located within the region north of Wrigley, Northwest Territories, within the traditional territory of the Pehdzéh Kí First Nation (PKFN). The proposed Mount Gaudet Access Road (MGAR) would start at the Mount Gaudet Quarry, located approximately 15km north of Wrigley and would end at the existing location of Hodgson Creek Bridge just north of Wrigley, or at the terminus of Highway 1 immediately south of Wrigley. An additional alignment is being considered to align the MGAR with the potential new location of Hodgson Creek Bridge, which may be required to address issues of spring melt-water and ice back-up at the existing bridge location.

Further geotechnical work, to be undertaken between now and the anticipated construction start date, will be required to determine the final alignment of the MGAR. The final alignment is dependent upon the review of the final report on the geotechnical work, further consultations with PKFN and applications for further funding (in progress). As such, the alignment of the road is described as segments:

- Segment 1 – Starts at the Mount Gaudet Quarry and follows the existing MVWR alignment south towards Wrigley for approximately 13 km. Funding is currently available for this segment.
- Segment 2 – Starts at the south end of Segment 1 to the location of Hodgson Creek Bridge - either to the current bridge location (Segment 2a) or the potential new Hodgson Creek bridge location (Segment 2b).
- Segment 3 – The Hodgson Creek Bridge would be raised at its current location (Segment 3a) or a new bridge will be installed further upstream (Segment 3b).
- Segment 4 – Starts at the final location of the Hodgson Creek Bridge to the end of Highway #1 – either from the current Hodgson Creek Bridge location following the current MVWR alignment (Segment 4a) or on a new alignment from the potential new Hodgson Creek Bridge location (4b).

INF currently has construction funding secured for Segments 1, 2 and 3. Funding is being sought for Segment 4. Segment 4 will not proceed to construction until funding is acquired.

The final, overall alignment of the MGAR is described in this PDR as two scenarios:

- Scenario 1: Represents a scenario where the existing Hodgson Creek Bridge is raised at its current location. Includes MGAR segments 1, 2a, 3a, and 4a.
- Scenario 2: Represents a scenario in which a new Hodgson Creek Bridge is installed upstream of the existing one, and Segments 2b and 4b are constructed to align the MGAR with this new bridge. Includes MGAR segments 1, 2b, 3b, and 4b.

In this document, the Project Footprint refers to the collective area covered by the 60 m right-of-way along the MGAR route under both construction scenarios, the area within Mount Gaudet Quarry boundaries, and the two bridge locations.

2.1 Project Location

The following table describes the coordinates associated with project activities:

Table 2-1 Project Area Co-ordinates

Description	Latitude	Longitude
MGAR Northern Extent	63° 21’ 31”	-123° 34’ 21”
MGAR Southern Extent	63° 12’ 31”	-123° 24’ 53”

Description	Latitude	Longitude
Existing Hodgson Creek Bridge	63° 14’ 01”	-123° 28’ 58”
Proposed New Bridge Location	63° 14’ 17”	-123° 27’ 55”
Mount Gaudet Quarry Corner 1	63°21'47"	-123°35'8"
Mount Gaudet Quarry Corner 2	63°21'47"	-123°34'29"
Mount Gaudet Quarry Corner 3	63°21'43"	-123°34'20"
Mount Gaudet Quarry Corner 4	63°21'20"	-123°34'23"
Mount Gaudet Quarry Corner 5	63°21'17"	-123°34'25"
Mount Gaudet Quarry Corner 6	63°21'17"	-123°34'50"
Mount Gaudet Quarry Corner 7	63°21'30"	-123°35'1"

Maps of the proposed Project activities can be found in the MGAR PDR.

3 Climate

The following section provides a description of climate parameters in the area surrounding the Project, including air temperature, relative humidity, wind speed and direction, precipitation, and solar radiation. The information in this section is based on historically gathered data from Wrigley Airport Air Monitoring Station (Wrigley A Station; 63°12'34'' N 123°26'12'' W; Climate ID: 2204000) (Environment Canada Historical Weather Data, Accessed March 2020). This station has been collecting daily temperature data discontinuously from 1943 to 2020, and precipitation and wind data from 1943 to 2007. Some of the climate data provided by this station can also be found in the 2012 Mackenzie Valley Highway Dehcho Region Project Description Report (Dessau, 2012).

The general climate of the Project area is considered sub-arctic (i.e. Boreal). This climate zone is characterized by long and very cold winters, and short, cool summers. Large variations in annual temperatures are also typical of this climate. The typical period of snow and ice cover in the area is October to May, and annual precipitation is generally moderate to low, with rain occurring more frequently in the warmer summer months (June to August) compared to the winter months. Summers usually last about one to three months.

Permafrost covers large portions of the region due to the fact that air temperatures are below zero for 5 to 7 months of the year, resulting in moisture freezing to considerable depths. The frost-free season tends to be short, and in most places, freeze conditions can occur during any month of the year.

3.1 Air Temperature

The average annual temperature at Wrigley is approximately -4°C, based on 30-year temperature averages from Wrigley A Station, shown in Table 3-1. The temperature ranges and distributions

recorded in the Wrigley area are typical of mid-to-high latitude climates in the northern hemisphere. July is the warmest month of the year, while January is the coldest, and below-zero temperatures typically last from October to April. The absolute low temperature over 20 years of monitoring was -53.3 ˚C, while the absolute high for this period was 37.0 ˚C. 30-year monthly temperature averages for the Wrigley area during the period of 1990 to 2019, summarized based on annual, monthly, and daily averages for this period, are provided in Table 3-1.

It should be noted that temperature has not been recorded continuously from Wrigley A Station over the 30-year period from 1990 - 2019, and data gaps occur during the entirety of 1999, 2011, 2012, 2016 and 2017, June to December of 1998, April and May of 2001, June and July of 2003, June of 2006, October and December of 2007, February of 2008, January and July to December of 2010, September, November, and December of 2014, March to December of 2015, and January to September of 2018.

Table 3-1 Average Monthly Temperature Data (in °C), Wrigley A Station, NWT (1990-2019)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Daily Maximum	-21.1	-17.2	-7.9	4.3	14.8	21.8	23.6	19.8	12.2	0.6	-13.2	-19.4	1.5
Daily Minimum	-30.1	-27.5	-21.9	-8.8	1.4	8.1	10.5	7.5	2.1	-6.4	-20.7	-27.8	-9.4
Daily Average	-25.5	-22.3	-14.9	-2.6	8	15	17	13.6	7	-3	-17	-23.6	-4.0
Absolute Maximum	6.5	6.5	12.7	21	34	37	35.5	32.5	27.2	21.2	6.2	-1.7	37
Absolute Minimum	-50	-48	-43	-36.2	-20.9	-3.3	-1	-3.5	-12.2	-27	-48	-46.1	-50.0

*Source: Environment Canada Historical Weather Data (Accessed March 2020)

3.2 Precipitation

Wrigley receives an annual average of 318.1 mm of precipitation based on data from 1988 to 2007 (Table 3-2). Rainfall in the Wrigley area tends to be highest between the months of May and September. Winter rainfall occurs extremely infrequently. The average annual snowfall in the area is 125.6 cm, and snowfall typically occurs during every month of the year except June, July and August. Snowfall makes up about 39% of Wrigley's total annual precipitation.

The historical maximum for annual rainfall during the period of 1988 to 2007 was 48.0 mm (July 18, 1991). The largest amount of snowfall which occurred from 1988 to 2007 was 25.0 cm (February 7th, 1993). Snow depth for Wrigley and the surrounding area is recorded at the end of each month. Environment Canada's 1988-2007 measurements for average snow depth at the end of each month are shown in Table 3-2. The majority of snowmelt occurs in May, while snow begins to accumulate in late September or October. The maximum recorded snow depth in the area was 132 cm (April 2, 1991). In general, maximum snow depth tends to occur in February, with an average of 47.5 cm of snow at the end of the month.

Table 3-2 Average Monthly Precipitation Data, Wrigley A Station, NWT (1988-2007)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Precipitation (mm)	16.5	14.6	11.4	6.6	23.6	38.4	65.2	41.9	34.4	26.4	21.1	17.8
Rainfall (mm)	0	0	0	0.3	20.2	38.8	65.2	41.9	32.2	6.3	0	0
Snowfall (cm)	19.8	15.7	13.1	6.7	3.8	0	0	0	2.1	20.1	25.5	18.8
Snow Depth at Month End (cm)	39.3	47.5	43.7	6.4	0	0	0	0	1	9.3	22.4	30.5

*Source: Environment Canada Historical Weather Data (Accessed March 2020)

3.3 Wind Speed and Direction

The historical data show that winds in Wrigley predominantly originate from the West (W, WNW; 24.4 % frequency of occurrence). East and South-East winds are the next highest in frequency. Calm winds (i.e. average hourly wind speeds below 1 m/s) occurred over 24.4 % of the record. Winds from the east and the south east are typical during autumn; however, west winds occur with high frequency throughout the year (Table 3-3).

The average annual wind speed in Wrigley is about 8.7 km/hr. Wind speeds tend to be slightly higher during the summer months, with the highest average wind speeds in August.

Table 3-3 Average Monthly Wind Data, Wrigley A Station, NWT (1998-2002)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Hourly Wind Speed (km/hr)	6.9	8.5	10.2	10	10.6	10.2	9.3	8.0	8.5	8.5	6.1	7.2
Predominant Wind Direction	W	E	W	W	W	W	W	W	SSE	ESE	E	W

*Source: Environment Canada Historical Weather Data (Accessed March 2020)

3.4 Air Quality

Ambient air refers to the air that surrounds a particular location or area. Components of ambient air quality include amounts of particulate matter, as well as the concentrations of molecular species such as Ozone (O_3), Carbon Monoxide (CO), Sulfur Dioxide (SO_2), and Nitrogen Dioxide (NO_2). Background levels refer to the natural concentrations of these components in a location or area. Ambient Air Quality Standards (AAQS) refer to the maximum acceptable concentrations of these components for human and environmental health purposes.

With regards to air-suspended particulate, $PM_{2.5}$ refers to small particulate which is less than 2.5 micrometers in diameter while PM_{10} refers to larger particulate matter which can be up to 10 micrometers in diameter. Both types of particulates can be hazardous to human respiratory health, although $PM_{2.5}$ is considered more harmful because it can penetrate deeper into the lungs. $PM_{2.5}$ is usually associated with emissions from human activities (for instance, vehicle emissions) or from forest fires.

Ozone is an important component of the earth's atmosphere which protects the Earth's surface from harmful radiation. Ozone which occurs at ground level, however, can negatively impact the health of plants (discolouration of leaves and reduced growth) and can contribute to human respiratory problems.

- Sulfur Dioxide (SO_2) is typically released into the air during the burning of sulfur-containing fossil fuels. High SO_2 levels can harm plant health and contribute to the formation of other pollutants.
- Nitrogen Dioxide (NO_2), like SO_2, is often a product of fossil fuel combustion. The compound can also be released into the air through vehicle exhaust fumes. NO_2 can be harmful to human health at high levels and can contribute to the formation of other pollutants.
- Carbon Monoxide (CO) may be emitted from sources such as home heating, vehicle exhaust and forest fires. The colorless, odourless gas is extremely hazardous to human health and may cause respiratory failure and death at high enough levels.

Ambient air quality in the NWT is monitored by four air monitoring stations operated by the Northwest Territories Department of Environment and Natural Resources (ENR). ENR's air quality monitoring stations are in Yellowknife, Inuvik, Norman Wells and Fort Smith. The Norman Wells station is the closest station to the Project site. Results from ENR's annual Northwest Territories Air Quality Reports (ENR, 2013 - 2016) are presented in Table 3-4 along with current Northwest Territories AAQSs. Measurements for particulate are provided in micrograms per meter cubed ($\mu g/m^3$) while other ambient air components are measured in Parts Per Billion (ppm), as this is how the data was presented in the air quality monitoring reports. CO levels are not included in this table, as this component is not measured by the Norman Wells monitoring station.

While the Norman Wells air quality station is located a few hundred kms from the Project area, the data from this station provides the best approximation of ambient air quality attributes in the Dehcho region, including the area around Wrigley.

SO_2 and NO_2 levels in the area are generally very low based on 2016 data. Concentrations of SO_2 and NO_2 tend to be higher during the winter due to the burning of fuel to heat homes and commercial facilities, with increases in NO_2 also being associated with increased idling of vehicles in the winter.

Ground level ozone (O_3) averages during the periods shown are below AAQS limits and are considered typical of remote northern areas in Northern Canada (ENR, 2016). The highest O_3 concentrations were measured by ENR during the month of April, which is also expected based on historical and natural trends for this region.

Levels of both small ($PM_{2.5}$) and large (PM_{10}) particulate often result from forest fires which occur during the summer months, and these levels can easily exceed the AAQS limits for air particulate levels. The effect of forest fires on air quality can be observed in the $PM_{2.5}$ and PM_{10} data for 2014, 2015, and 2016. Particulate levels also tend to increase during the spring months due to the greater generation of road dust immediately following snow melt. These elevated particulate concentrations continue through the summer months and partially into the fall.

Table 3-4 Norman Wells Baseline Air Quality (2013 - 2016)*

Air Component	NWT AAQ Standard		Maximum Levels Recorded			
	Maximum Concentration	Averaging Period	2013	2014	2015	2016
O_3	160 µg/ m^3 (82 ppb)	1 hour	55.9 ppb	52.3 ppb	53.5 ppb	47.2 ppb
	130 µg/ m^3 (65 ppb)	8 hours	54.7 ppb	46.8 ppb	47.9 ppb	44.3 ppb
SO_2	450 µg/m^3 (172 ppb)	1 hour	2.1 ppb	1.4 ppb	1.6 ppb	0.9 ppb
	150 µg/m^3 (57ppb)	24 hours	1.5 ppb	0.9 ppb	1.2 ppb	0.8 ppb
	30 µg/m^3 (11 ppb)	Annual	<1 ppb	<1 ppb	<1 ppb	0.3 ppb
NO_2	400 µg/m^3 (213 ppb)	1 hour	33 ppb	23.6 ppb	30.4 ppb	39.3 ppb
	200 µg/m^3 (106 ppb)	24 hours	12.7 ppb	9.8 ppb	12.7 ppb	15.6 ppb
	60 µg/m^3 (32 ppb)	Annual	2 ppb	1.4 ppb	1.8 ppb	<5 ppb
$PM_{2.5}$	30 µg/m^3	24 hours	16.8 µg/m^3	84.6 µg/m^3	31.6 µg/m^3	58.9 µg/m^3
PM_{10}	50 µg/m^3	24 hours	45.9 µg/m^3	175.8 µg/m^3	57.3 µg/m^3	129 µg/m^3

*Source: NWT Air Quality Monitoring Reports, 2013 – 2016 (ENR, 2013 – 2016)

3.5 Climate Change

Climate change refers to a change over time in regional or global climate patterns, and is usually associated with a change in the level of greenhouse gases (particularly CO_2) leading to greater or reduced amounts of solar radiating being retained within the Earth's atmosphere over time. The current trend of a warming global climate has been identified as the result of rising levels of greenhouse gases associated with human activities such as manufacturing, energy production, agriculture, and transportation. The effects of climate change are particularly apparent in the Northwest Territories, where the rate of warming is approximately 3 times the global average, and average temperatures are estimated to have increased 2.3°C between 1948 and 2016 (Bush & Flato, 2018). Rapid warming within the NWT has led to significant changes in ambient air temperatures, precipitation patterns, and patterns of permafrost thickness and distribution (permafrost refers to a condition in which a ground layer remains below 0°C for a continuous period of 2 years or more (Permafrost Subcommittee, 1988). By contrast, the active layer refers to the subsurface layer which freezes each winter and thaws each summer).

The following section summarizes the impacts of climate change in the Wrigley area, as reflected by changes in air temperatures, ground temperatures and ground permafrost thickness, and precipitation levels over time.

Temperature

The Government of the Northwest Territories, in partnership with the Scenarios Network for Alaska & Arctic Planning (SNAP), has developed a tool for projecting future temperature and precipitation trends for communities in Alaska and Canada's Territories.

Table 3-5 shows projected climate averages for the community of Wrigley between 2020 and 2050 (SNAP – NWT Climate Explorer, Accessed April 2020). The climate scenarios represent differences in the amount of solar radiation absorbed by the atmosphere relative to the amount reflected and reflect the rate at which human activities continue to emit greenhouse gases into the atmosphere. Temperatures represent an average of January, February, and December of each year.

Table 3-5 Wrigley Mean Temperature Projections (2020 – 2050) (in °C)*

Climate Scenario	2020	2030	2040	2050
Low	-24.4	-23.4	-23.1	-24.2
Medium	-24.3	-22.9	-22.9	-22.4
High	-24.6	-23.7	-22.4	-22.2

*Source: SNAP NWT Climate Explorer (Accessed April 2020)

Precipitation

With regards to precipitation projections, climate models have often produced mixed results and have been prone to overprediction (Nehtruh – EBA Consulting, 2011). Environment Canada's Climate Global Circulation

Model (CGCM2) projects an overall decrease in annual precipitation of 0% to 10% for the Lower Mackenzie Valley by 2050, and a net increase of the same magnitude for the Middle and Upper Valley regions to the south (Nehtruh – EBA Consulting, 2011).

The Government of the Northwest Territories, in partnership with the Scenarios Network for Alaska & Arctic Planning (SNAP) has developed a tool for projecting future temperature and precipitation trends for communities in Alaska and Canada's Territories.

Table 3-6 shows projected climate averages for the community of Wrigley between 2020 and 2050 (SNAP – NWT Climate Explorer, Accessed April 2020).

Table 3-6 Wrigley Mean Annual Precipitation Projections (2020 – 2050) (in mm)*

Climate Scenario	2020	2030	2040	2050
Low	33.6	31.7	31.1	31.8
Medium	30.3	31.8	31.5	32.2
High	30.6	33.7	35.2	33

*Source: SNAP NWT Climate Explorer (Accessed April 2020)

Permafrost

The Project area is located within the discontinuous permafrost zone, with 50 – 90% of the ground being underlain by permafrost (Hegginbottom, Dubreuil, and Harker, 1995).

Table 3-7 summarizes the average end-of-season thaw depth recorded by the Circumpolar Active Layer Monitoring Network (CALM) between 1993 and 2017 (CALM website, Accessed March 2020). CALM data is provided for the Ochre River (ID C13), approximately 13 km north of the Project site, and for the Willowlake River (ID C14), approximately 60 km south of the Project site. These annual thaw measurements were obtained using a thaw-tube.

Table 3-7 Active layer depth at Ochre River and Willow lake River

	Thaw Depth (cm)			
	1993	2003	2012	2017
Ochre River (63°27'59" N, 123°41'34" W)	<58	64	69	70
Willowlake River (62°41'48" N, 123° 3'54" W)	79	86	91	102**

*Data Source: Circumpolar Active Layer Monitoring (CALM) website (Accessed March 2020)

**Recorded in 2018. No data is available for this site for 2017.

The CALM data shows an increase in the thickness of the active layer at Ochre River from less than 58 cm in 1993 to 70 cm in 2017 and at Willowlake River from 79 cm in 1993 to 102 cm in 2018.

As indicated in Table 3-5 and Table 3-6 air temperatures and precipitation patterns in the Wrigley area are expected to be impacted by future climate change. Permafrost stability depends on stable ground temperatures to maintain the thickness of the active layer and prevent thaw (EBA 2010). Shorter periods of snow cover in the Wrigley area are expected to disrupt the thermal stability of permafrost, which is sensitive to minor changes in heat transfer at the ground surface, initiating thaw and decreasing ground stability (EBA 2010).

It is difficult to predict precisely how permafrost coverage and thickness will change with the general trends projected in existing climate models. Challenges in projecting future permafrost conditions are partially due to uncertainty about how the deepest layers of permafrost will respond to changes in climate (Derksen et al., 2018). Furthermore, changes in permafrost are likely to be influenced by a large number of factors including thaw slump caused by increased rainfall (Kokelj et al., 2015), increases in shrub growth leading to increased snow accumulation and ground warming (Lantz et al., 2013), accelerated permafrost degradation associated with the collapse of terrain features such as peat plateaus (Quinton & Baltzer, 2013), palsas (oval-shaped frost heaves) (Mamet et al., 2017), and gullies left behind by the melting of ice wedges (Godin, Fortier, and Levesque, 2016), and future wildfires which can increase ground warming and permafrost degradation through damage to vegetation and organic layers (Zhang et al., 2015). In general, however, permafrost conditions in Northern Canada, including in the Wrigley area, are expected to change considerably over the next few decades due to the effects of climate change.

4 Terrain and Topography

The proposed route lies within the northern portion of the Cordillera physiographic region, specifically within the Central Mackenzie Valley (HBb) Level IV Ecoregion (Ecosystem Classification Group, 2010). This region is characterized by low relief, thick morainal plains containing many glacio-fluvial features and deposits on both sides of the Mackenzie River, and spanning over generally flat-lying sedimentary rocks. Deep glacio-lacustrine and scattered glacio-fluvial deposits are located closer to the Mackenzie River.

Elevation (topographic relief) along this section is approximately 237 m a.s.l. at the Mount Gaudet end of the road to 103 m a.s.l. at the Wrigley end of the road (Google Earth, 2014). The terrain conditions along the proposed access road, summarized in the following sections, are based mainly on terrain analysis performed for the MGAR (GVM Geological Consulting, 2019).

4.1 Geological Setting

The MGAR alignment is located along a narrow and gently sloping plain above the Mackenzie River and below the Franklin Mountains. Streams flowing off the Franklin Mountains and into the Mackenzie River create a dense, integrated drainage network in the area. Mt. Gaudet consists of two limestone formations, the Bear Rock Formation on the east side and the Nahanni Formation on the west side, and is part of the larger geological formation of the Franklin Mountains.

The eastern part of the Project area overlaps with the Franklin Plain, which located between the Franklin Mountains and the Mackenzie River and is underlain by flat lying to gently dipping Fort Simpson shale, siltstone, and mudstone.

As the bedrock surface was once glaciated, the bedrock is now largely covered by a thin/discontinuous to thick/continuous cover of till-based ground moraine deposits. Thin to thick glaciofluvial deposits of sand and gravel were generated by meltwater associated with the advancing and retreating glaciers, and were deposited on till and bedrock in the gently sloping plains adjacent to the Mackenzie River. These deposits were formed in large, temporary lake basins during periods of deglaciation and were the result of isostatic depression of the surface combined with the damming of drainage behind retreating ice margins (Aylsworth, et. al. 2000). Following the drainage of the glacial lakes, exposed lake beds were subjected to wind and water erosion. Peat deposits developed on poorly drained fine-grained glaciolacustrine and till deposits, which contributed to the formation of Thermokarst features. At some locations, alluvial terraces formed due to the erosion of lacustrine sediments by the Mackenzie River and its tributaries as basin levels became reduced. Continued deposition of alluvial materials occurs in the floodplains of local rivers and creeks. Colluvial deposits have continuously formed along mountain slopes and along valleys cut in surficial deposits that overlie bedrock.

4.2 Bedrock Geology

Exposed and near-surface bedrock near the proposed highway route include the Bear Rock Formation, Nahanni Formation, Fort Simpson Formation, and Upper Devonian sandstone and limestone formations. The high-angled Camsell Thrust extends north to north-northeast across the MGAR alignment at the north end of Mt. Gaudet. Mt. Gaudet itself includes exposed strata of the Bear Rock and Nahanni formations, which form part of a raised hanging wall along the west side of Camsell Thrust.

The MGAR alignment south of Mount Gaudet mainly runs along the Upper Devonian shales and siltstones of the Fort Simpson Formation. At the north end of Mt. Gaudet, the MGAR alignment crosses a small, slightly exposed area of limestone along the west side of Camsell Thrust, which may be part of the Nahanni Formation. Farther north, the MGAR alignment is underlain by Fort Simpson strata.

4.3 Permafrost

The Project area is located within the discontinuous permafrost zone, with 50 – 90% of the ground being underlain by permafrost. The area contains some sections which are prone to thermokarst, a process in which variable ground subsidence occurs due to localized thawing of ground ice (Permafrost Subcommittee, 1988). Thermokarst is especially common in areas immediately surrounding large water bodies such as lakes and rivers. Karst, referring to a topographic landscape associated with the dissolution of soluble rocks, such as limestone, is also present throughout the area. Karst topography is generally characterized by the presence of features such as small narrow streams (*rills* or *runnels*), grikes (i.e. fissures between limestone slabs), subsidence, sinkholes, springs and caves.

The MGAR Project area contains sections with both thaw-stable and thaw-sensitive permafrost. Thaw-stable permafrost, also known as dry permafrost, is permafrost which does not contain free water or ice. Thaw-stable ground is perennially frozen and, upon thawing, does not tend to experience significant thaw settlement or loss of strength. Thaw-sensitive permafrost is perennially frozen ground that experiences significant thaw settlement and suffers loss of strength upon thawing. Thaw-sensitivity is a characteristic of permafrost areas which are ice-rich.

The presence of numerous lake depressions and wetlands within and around the Project footprint indicate localized thermokarst (that is, the melting of large patches of subsurface ice leading to ground subsidence), which in turn suggest areas of thawing ice-rich permafrost along the proposed alignment. GVM noted in its terrain analysis report for the MGAR (GVM, 2019) that much of the alignment is underlain by permafrost, although the permafrost tends to become more discontinuous toward the north end of the alignment. The thickness of the active layer varies considerably based on factors such as soil type, soil thickness, amount of organic cover, and exposure. Duchesne, Chartrand and Smith (2020), with the Geological Survey of Canada recorded an active layer thickness of 1 to 2 m at a site 4 km north east of Wrigley near Hodgson Creek, while the Circumpolar Active Layer Monitoring Network (CALM; Web Access May 2020) reports an active layer depth of .7 m near Ochre River, 29 km north of Wrigley, in 2017. GVM (2019) indicated that the active layer within the Project footprint is likely to range from 0.3 to 2.4 m in depth, and that permafrost generally extends to about 6.7m in depth (although some till outcrops could have permafrost extending up to 15.2 m in depth).

Thawing of permafrost can contribute to substantial thaw settlement in addition to the loss of the soil's structural integrity, which can lead to extremely adverse impacts on the stability of infrastructure.

4.4 Geohazards

Geohazards are generally defined as natural, existing or potential, geomorphic and geologic processes and formations that could lead to damage to engineering structures. Significant and relevant risks and vulnerabilities to the proposed road are primarily related to working in a permafrost environment on permafrost terrain.

Melting permafrost, present throughout much of the area, could create potential hazards such as sinkholes, expanding lakes, and retrogressive failures along river crossings. Wetland features, including peat plateaus and fens, could also present a hazard for road construction and maintenance.

Thermokarst and Permafrost Features

The melting of discrete bodies of massive ground ice and the thawing of ice-rich perennially frozen fine-grained soils produce a conspicuous irregular surface comprising isolated depressions and mounds characteristic of thermokarst.

Retrogressive Thaw Flows

According to Aylsworth et al. (2000), landslides in permafrost terrain are characterized by two distinct classes (flows and slides) based on mechanism of failure and morphology. Several different types of landslides make up each of these two major classes. Flows can be further subdivided into shallow active layer detachments (or skin flows), deeper retrogressive thaw flows, and rapid debris flows. Slides are subdivided into rotational slides and translational slides.

Peatlands and Wetlands

Peatlands are areas where the soils consist of partially decomposed organic materials, dominated by mosses and sedges and, to a lesser degree, shrubs and trees. The Mackenzie Valley is characterized by vast peatlands across both the continuous and discontinuous permafrost zones (Aylsworth, J.M. and Kettles, I.M. 2000).

Along the proposed Access Road, organic deposits that comprise peatlands are commonly found in the low-lying areas within undulating glaciolacustrine or till plains. Although there are many classes of peatland, bog and fen are the two main classes that are found along the proposed Access Road. Each of these peatland types has distinctive vegetation assemblages (bogs consist of Sphagnum and dwarf shrubs with a few stunted trees, whereas fens are dominated by grassy species, shrubs and scattered trees), morphologies, water regimes, and thermal conditions. Soils and organic deposits underlying the bog area are typically frozen (and ice-rich), while soils underlying fen deposits are typically unfrozen. Polygonal patterned ground and underlying wedge ice can be common occurrences in peatlands in the sub-arctic forest.

4.5 Terrain by Access Road Section

Table 4-1below describes the terrain characteristics for each portion of the MGAR alignment, as described in the MGAR terrain analysis report (GVM, 2019). Descriptions are provided for route scenario 1, which follow the existing MVWR alignment, and scenario 2, which diverges from the existing alignment to align with the proposed Hodgson Creek Bridge.

Table 4-1 MGAR Segments- Terrain and Topography*

MGAR Section (km range)	Terrain Description
MGAR Scenario 1 route	
Km 0 – 1.5	Area of glaciofluvial terrace deposits characterized by coarse-grained soils including sand and gravel. Permafrost is present, with soil containing ice crystals and soil particles being generally poorly bonded. The soil in this section is likely not thaw-sensitive; however, because the segment is within an area of existing linear disturbance, it is likely that the permafrost has been partially degraded.
Km 1.5 – 5	Consists of colluvial deposits along the approach slope to Hodgson Creek. Near-surface soils along this segment are of a similar texture as the coarse-grained soils which compose the parent materials at the top of the slope. Some fine-grained soils may also be present in some sections. The

MGAR Section (km range)	Terrain Description
	slope of the terrain in this area ranges from gentle to moderate. If permafrost is present, soils likely contain little ice and are poorly bonded, and are therefore expected to be thaw stable. Any permafrost which is present in this section has likely degraded below the existing winter road alignment, due to the existing disturbance associated with this alignment.
Km 5 – 5.3	This segment consists of a thick alluvial terrace alluvial plain combination terrain unit that includes coarse-grained soils within the historic floodplain of Hodgson Creek. Soils along this segment range from silty sands to sandy gravel or gravel. In undisturbed areas, a thin organic layer may be present at the ground surface. The terrain appears to be potentially unfrozen based on existing borehole data. If permafrost is present, the soils contain little ice and are poorly bonded. They are therefore expected to be thaw stable. Permafrost, if present, has likely degraded below the existing road alignment due to existing disturbance.
Km 5.3 – 6.7	Terrain consists of a glaciofluvial plain deposit, primarily characterized by a thick sequence of coarse-grained soils. Soil texture is expected to range from silty sands through coarse gravels. In undisturbed areas, a thin layer of organics may be present at the ground surface. The terrain appears to contain permafrost, and the soils contain ice crystals and are poorly bonded. The soils in this location are not expected to be thaw sensitive. Because this segment lies on a long-term existing linear disturbance, the permafrost in the area may be degraded.
Km 6.7 – 7.4	Consists of a complex sequence of colluvium and glaciofluvial materials. Soils are generally finer-grained may overlie coarser-grained glaciofluvial soils, which may be present near the ground surface in some locations. The parent soils at the top of the slope may range from clay to sand. The terrain contains permafrost, and the soils are expected to contain ice crystals and to be poorly bonded. Soils along this section are likely not thaw sensitive. The segment runs along existing linear disturbance, and it is possible that the permafrost has degraded.
Km 7.4 – 12.6	The area comprises a glaciolacustrine plain made up mainly of thick layers of fine-grained soils. Thermokarst processes are evident and widespread along this segment. Thermokarst is an indicator that the permafrost is highly discontinuous along this segment. Boreholes data indicates that the segment contains both unfrozen and frozen areas. Where permafrost is present, the soils contain ice crystals but may be poorly bonded, and the thaw sensitivity of the terrain may ranges from low to high. The glaciolacustrine soils in this area are generally expected to have higher ground ice contents, and may be less compact compared to the glaciofluvial and moraine deposits. Where the road alignment falls within the pre-existing disturbance, it is possible that any permafrost at these locations has degraded, reducing ice content and increasing soil compaction.
Km 12.6 – 12.7	Consists of a glaciolacustrine plain overlain by an unfrozen organic veneer. Contains thick layer of fine-grained mineral soils. Thermokarst appears to be widespread along the segment, and there may be high moisture content in the fen material. Permafrost is discontinuous in this segment, as evident from the extensive thermokarst. The segment contains both unfrozen and frozen areas, and where permafrost is present, the soils are expected to contain ice crystals but may be poorly

MGAR Section (km range)	Terrain Description
	bonded. Thaw sensitivity likely ranges from low to high. Permafrost within the existing disturbed corridor may have been degraded, decreasing the ground ice content and increasing soil compactness.
Km 12.7 – 15.5	This section is a glaciolacustrine plain consisting of a thick layer of fine-grained soils. Soils generally have higher ground ice contents, and may be less compact than glaciofluvial and moraine deposits. Organic layers may be present at the ground surface, and thermokarst processes are evident and widespread. Permafrost is discontinuous along this segment, and the terrain contains both frozen and unfrozen segments. Where permafrost is present, the soils contain ice crystals but may be poorly bonded. Thaw sensitivity of the terrain may range from low to high. Permafrost may be degraded due to existing linear disturbance.
Km 15.5 – 17	Terrain is a glaciolacustrine plain consisting of a thick layer of fine-grained soils. Organic layers may be present at the ground surface. Widespread thermokarst occurs along this segment, and the permafrost is generally discontinuous, with both frozen and unfrozen areas. Where permafrost is present, soils contain ice crystals but may be poorly bonded, and the thaw sensitivity of the terrain likely ranges from low to high. Disturbance associated with the existing corridor may have caused partial degradation of the permafrost.
Km 17 – 21	The segment comprises a colluvial deposit overlying bedrock. the near surface soils are similar in texture to the fine-grained soils which form the parent materials at the top of the slope. The soil composition ranges from clays through fine sands, and bedrock is present from depths of 4m or greater. Terrain includes both unfrozen and permafrost areas, and ice crystals are present in some fine-grained sediments. Thaw sensitivity along this segment likely ranges from low to moderate.
MGAR Scenario 2 route	
Km 0 – 0.3	A glaciofluvial plain deposit, generally comprised of thick sequences of coarse-grained soils, which range from silty sands to sandy gravel or gravel. The terrain along this segment likely contains permafrost, with soils containing little ice and being poorly bonded. Soils are likely not thaw sensitive.
Km 0.3 – 0.8	A glaciolacustrine plain composed of a thick layer of fine-grained sediments. Soils are mainly characterized by low to medium plastic clays and silts, with some localized sand zones. Permafrost is expected to be present based on surrounding topography and terrain conditions, although ice content in the area is likely to be low to medium.
Km 0.8 – 1.2	The segment consists of thick alluvial terrace comprised mostly of coarse-grained soils, and is within the Hodgson Creek historic floodplain. Soils within this section may range from silty sands to sandy gravel or gravel. The terrain may be unfrozen, based on existing borehole data. If permafrost is present, the soils likely contain little ice and are poorly bonded. Soils are therefore expected to be thaw stable. The segment may be prone to flooding during high water events during the spring and summer.
Km 1.2 – 2.7	Consists of a glaciofluvial plain deposit, characterized mainly by a thick sequence of coarse-grained soils. Soil texture may range from silty sands

MGAR Section (km range)	Terrain Description
	through coarse gravels and, in undisturbed areas, a thin layer of organics may be present at the ground surface. Borehole data indicates that this section contains permafrost, and the soils contain ice crystals and are poorly bonded. The soils along this segment are not expected to be thaw sensitive.

*Source: Mount Gaudet Access Road Terrain Analysis Report (GVM Geological Consulting, 2019)

4.6 Surface Water

Surface water bodies in the area include Hodgson creek as well as a few small lakes located off the side of the MVWR alignment. Additionally, there are a few smaller drainages which have been identified as either potentially crossing or very close to the alignment. Hydrology and bathymetry studies for drainages and water bodies along and adjacent to the proposed alignment are planned for the late spring or early summer of 2020, and will provide more detailed information on the characteristics of these water bodies.

Hodgson Creek

Hodgson Creek is formed by the convergence of several tributary streams originating in the Mackenzie Mountains, and drains into the Mackenzie River at approximately 63° 13’ 42”N, 123° 29’ 33” W. The drainage area for the creek is approximately 321 km^2 (Egginton, 1977). The creek crosses the MVWR alignment at 63° 13’ 01”N, 128° 23’ 57”N.

Table 4-2 describes the average monthly stream flow and water elevation values collected from Environment Canada’s hydrometric station 10HC007, at the co-ordinates 63° 14' 39'' N, 123° 28' 52'' W, between 2006 and 2014. This hydrometric station has been inactive since October 2014.

Annual peak flows for Hodgson Creek usually occur in early May following freshet, and vary from year to year based on the timing of ice melt, the total accumulation of snow over the winter period, and ground temperatures at the time of melt (Egginton, 1977). High amounts of runoff during spring rainfall events are also typical due to the high frost table (that is, the shallowest level of permafrost) and moist soil conditions in the area.

Table 4-2 Monthly Stream Flow and Water Level at Hodgson Creek (2006 -2014)*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Max Water Level (m)	3.58	4.22	4.89	5.29	3.86	3.02	2.90	2.90	2.92	2.92	3.09	3.08
Min Water Level (m)	3.01	3.25	3.45	3.89	2.98	2.66	2.77	2.71	2.68	2.74	2.86	2.82
Mean Water Level (m)	3.42	3.87	4.17	4.59	3.44	2.82	2.83	2.82	2.79	2.83	2.97	2.94
Max Discharge(m^3/s)	0.47	0.43	0.39	1.07	11.8	4.17	3.59	3.56	3.09	1.80	0.94	0.55
Min Discharge (m^3/s)	.069	.008	.002	.002	2.93	0.73	1.14	1.29	1.02	0.81	0.4	0.25
Mean Discharge (m^3/s)	0.25	0.19	0.16	0.45	8.05	2.43	2.47	2.21	1.88	1.23	0.63	0.38

*Source: Environment Canada Hydrometric Data – Station 10HC007 (Accessed March 2020)

Mackenzie River

The Project area runs adjacent to the Mackenzie River along its east bank. Project activities occurring at or near the current Hodgson Creek Bridge would be within about 700m – 1km of the Mackenzie River, and a water withdrawal point for the Project located at 63° 13’ 29.8” N, 123° 28’ 20.9” W would be within the river itself.

Water level data for the Mackenzie River near Wrigley covers the period from 1963 to 1994 and was recorded at Environment Canada Hydrometric Station 10HC001, (coordinates 63°15'58" N, 123°35'50" W)(Environment Canada Historical Hydrometric Data, Accessed April 2020).

No water flow data is available for the Mackenzie River near Wrigley. Water flow data for the Mackenzie River at Fort Simpson (Station ID 10GC001; 61°52'6"N, 121°21'32"W) covers the period from 1938-2017, while water flow data for the Mackenzie River near Norman Wells (Station ID 10KA001; 65°16'19"N, 126°50'60"W) covers the period from 1943 to 2017.

Monthly water level and flow data for the Mackenzie River are shown in Table 4-3. Locations of all hydrometric discussed here are shown in Figure 4-2.

The hydrometric station for the Mackenzie River near Wrigley is located at around the center point of the river’s width, where the river is relatively deep (~87 – 94 m). Peak water levels at this point along the river occur from May to July, and can be up to 5 or 6 meters higher than at other times of the year.

Peak flows typically occur during June both at Norman Wells, approximately 315 km downstream of Wrigley, and Fort Simpson, 230 km upstream of Wrigley, although flow in these areas can peak in July during some years. Variations in the flow of the Mackenzie River between years are lowest during the cold winter months, and are highest during the spring melt period. Flow volumes and variation in flow between years are also high during the summer months due to more frequent and annually variable precipitation events including rain-storms and associated flooding (Yang, Shi, & Marsh, 2015).

Table 4-3 Mackenzie River Average Water Level and Elevation*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Mackenzie River at Wrigley (Station ID 10HC001; 1963-1994)												
Max Water Level (m)	88.93	88.19	88.56	88.29	93.57	93.22	93.60	90.96	89.83	89.07	88.11	88.84
Mean Water Level (m)	88.93	88.19	88.02	87.52	91.49	91.42	90.61	89.43	88.66	88.39	87.77	88.84
Min Water Level (m)	88.93	88.19	87.47	86.99	90.54	89.38	89.05	87.67	87.58	87.75	87.44	88.84
Mackenzie River Near Fort Simpson (Station ID 10GC001; 1938-2017)												
Max Discharge(m^3/s)	4,280	4,150	4,070	5,680	14,300	19,700	18,700	16,900	14,900	10,200	7,170	4,880
Min Discharge (m^3/s)	2,060	1,670	1,590	1,860	6,690	9,330	7,790	5,270	3,040	2,610	2,560	2,170
Mean Discharge (m^3/s)	3,010	2,760	2,650	3,200	10,600	14,200	12,400	9,740	8,370	7,270	4,260	3,190
Mackenzie River Near Norman Wells (Station ID 10KA001; 1943-2017)												
Max Discharge(m^3/s)	6,680	4,960	4,670	4,920	18,700	24,400	24,700	18,100	13,700	13,400	10,000	18,100
Min Discharge (m^3/s)	2,260	2,130	2,190	2,430	6,680	10,000	8,540	6,920	6,590	6,270	2,340	2,250
Mean Discharge (m^3/s)	3,800	3,440	3,260	3,570	13,500	17,300	15,500	12,400	10,500	8,820	5,070	4,200

*Source: Environment Canada Hydrometric Data – Station 10HC001, 10GC001, 10KA001 (Accessed March 2020)

Figure 4-1 Hydrometric Stations

5 Vegetation

5.1 Ecosystem Classification Overview

The vegetation communities which are present in an area depend on the ecoregion in which an area is located. Ecoregions in Canada are divided into 4 different sub-levels, with higher sub-levels referring to smaller, more specific areas (Ecosystem Classification Group, 2010). Based on the definitions set by the NWT Ecosystems Classification Group, the MGAR Project area can be classified at four ecosystem levels as outlined follow.

- Level I (Ecozone) – Northwestern Forested Mountains
- Level II (Eco-province)- Boreal Cordillera
- Level III (Ecoregion) - Boreal Cordillera – High Boreal (BC HB)
- Level IV (Eco-district)- Central Mackenzie Valley (BC HBb)

The Northwest Forested Mountains level I ecoregion encompasses a large number of ecological landscapes which cover the mountainous regions of Northwestern and Central North America (Bowman et al., 2011), and includes a range of climate regions, from moist maritime climate in the Northwest to drier climates in the South-eastern Rocky Mountains. The Boreal Cordillera level II ecoregion covers the mountainous sections of the Northwest Territories and the Yukon. This region of mountains influences the climate, precipitation, and hydrology of nearby ecoregions. North slopes and south slopes within this region tend to support different vegetative communities, with mixed-wood forests being replaced by conifer woodlands and eventually tundra landscape as elevation increases. The Boreal Cordillera – High Boreal (BC HB) level III ecoregion is characterized by broad valleys and lowlands, deeply dissected plateaus, long ridges and rugged limestone peaks. The ecoregion has a relatively mild climate and is within the discontinuous permafrost zone. Vegetative communities in the Boreal Cordillera – High Boreal Ecoregion include tall, dense lowland spruce and deciduous forests, lodgepole pine stands, and spruce woodlands. Numerous wetlands and alpine tundra communities also occur in this eco-region. Land cover in the Project area is shown in Figure 5-2.

5.2 Vegetation in the Local Project Area

At the most specific level of ecosystem classification (level IV), the Project area is classified as part of the Central Mackenzie Valley (BC HBb). Vegetative communities in this ecoregion include trembling aspen, white spruce and mixed-wood stands, with diverse shrub and herbaceous understories occurring on level and well-sloping to imperfectly drained till. North of Wrigley, tall, closed-canopy upland forests become less common, primarily being found along river banks, on alluvial and glaciofluvial terraces and islands, and on slopes with favorable drainage and temperature conditions. North of Wrigley, black spruce – shrub – moss woodlands and forests are common on level to gently sloping lacustrine and till deposits, while peat plateaus can be found on gentle terrain. Areas regenerating from recent burns mainly contain shrubby and deciduous vegetation such as scattered jack pine stands on coarse-textured till and glaciofluvial deposits.

5.3 Rare and Threatened Plants in the Project Area

No rare plants have been recorded within close vicinity (<1 km) of the proposed Project activities (B. Fournier, ENR, Personal Communication).

Figure 5-1 Land Cover Classes

6 Wildlife

The distribution and abundance of wildlife species in the vicinity of the proposed MGAR will vary with season, life history stage, habitat availability, and hunting and trapping pressures. This section summarizes known and expected wildlife use in the vicinity of the proposed MGAR. This information is based on a variety of sources including the MVH Dehcho Region PDR (Dessau, 2012) and studies which were conducted in support of this document. Further information on wildlife in the general area is also provided by environmental surveys conducted by Imperial Oil (2004) in support of the Environmental Impact Statement for the Mackenzie Gas Project.

The proposed Access Road will be 16-21 km long and 30 - 60 m wide (total approximately 48 – 63 ha), and traverses 21 ha of previously disturbed habitat (i.e., winter road). The extent of the proposed quarry is 50 ha, of which, 3 ha extends over previously disturbed habitat. In total, the project is proposed to directly affect approximately 77 – 92 ha of previously undisturbed habitat.

The appropriate ecological context for identifying the wildlife occurring in the Project area is the Central Mackenzie Valley (BC HBb) ecoregion in which the Project occurs (Ecosystem Classification Group, 2010). The following wildlife section has been divided into mammals, birds and amphibians, with insect species in the area also being addressed briefly. A total of 31 species of mammals, 134 species of bird and 1 species of amphibian occur, or have the potential to occur in the Project area. A full list of species occurring in the Project area is provided in Appendix A.

6.1 Species Listed in Federally and Territorial Legislation

Species with federal or territorial conservation status in the Project area include 3 species of mammals, 10 species of birds, 4 species of insects, and 2 species of fish (discussed in section 7.4).

Species listed under federal and territorial legislation occurring in the Project area are listed in Table 6-1. The table indicates the status of each species under the *Species at Risk (NWT) Act* (SARA (NWT)), the *Species at Risk Act* (SARA), and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

SARA, SARA (NWT), and COSEWIC apply the following terminology when ranking the conservation status of species:

- **Endangered:** A wildlife species that is facing imminent extirpation or extinction.
- **Extirpated:** A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.
- **Threatened:** A species likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction.
- **Special Concern:** Species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
- **Not At Risk:** Species was assessed and found to be not at risk of extinction given the current circumstances.

- **Under Consideration:** A species that is being considered for listing Under SARA (NWT).
- **Not Assessed:** Species which has not been assessed under SARA (NWT).
- **No Status:** Species has not been listed under SARA (NWT).
- **Not Applicable:** SARA (NWT) does not apply to this species.

Table 6-1 Species Listed in Federally and Territorial Legislation *

Species	SARA (NWT) Status*	SARA Status**	COSEWIC Status**
Bank Swallow (*Riperia riperia*)	Not Applicable	Threatened	Threatened
Barn Swallow (*Hirundo rustica*)	Not Applicable	Threatened	Threatened
Bull Trout (*Salvelinus confluentus*)	Not Applicable	Special Concern	Special Concern
Common Nighthawk (*Chordeiles minor)*	Not Applicable	Threatened	Special Concern
Grizzly Bear (*Ursus arctos)*	No Status	Special Concern	Special Concern
Gypsy Cuckoo Bumble Bee (*Bombus bohemicus)*	No Status	Endangered	Endangered
Harris's Sparrow (*Zonotrichia querula)*	Not Applicable	Under Consideration	Special Concern
Horned Grebe (*Podiceps auritus*)	Not Applicable	Special Concern	Special Concern
Olive-sided Flycatcher (*Contopus cooperi)*	Not Applicable	Threatened	Special Concern
Peregrine Falcon (*Falco peregrinus)*	No Status	Special Concern	Not at Risk
Red-necked Phalarope (*Phalaropus lobatus*)	No Status	Special Concern	Special Concern
Rusty Blackbird (*Euphagus carolinus)*	No Status	Special Concern	Special Concern
Short-eared Owl (*Asio flameus*)	No Status	Special Concern	Special Concern
Shortjaw Cisco (*Coregonus zenithicus*)	Not Applicable	No Status	Threatened
Suckley's Cuckoo Bumble Bee (*Bombus suckleyi*)	No Status	Under Consideration	Threatened
Transverse Lady Beetle (*Coccinella transversoguttata)*	No Status	Under Consideration	Special Concern
Wolverine (*Gulo gulo)*	No Status	Special Concern	Special Concern
Woodland Caribou – Boreal Population (*Rangifer tarandus caribou)*	Threatened	Threatened	Threatened
Yellow-banded Bumble Bee (*Bombus terricola)*	No Status	Special Concern	Special Concern

*Source: NWT Species at Risk, List of Species at Risk (Accessed March 2020)

**Source: Government of Canada, Species at Risk Public Registry (Accessed March 2020).

6.2 Species Summaries

Mammals

Boreal Caribou

The boreal population of woodland caribou, henceforth referred to as boreal caribou, is listed as threatened under *SARA* and *SARA (NWT)*, and is also considered threatened by COSEWIC.

The proposed Project would take place within the general range for boreal caribou, as delineated in the *Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal population, in Canada* (Environment Canada, 2019). The MGAR would overlap with the Pehdzéh Kį N'deh proposed conservation zone, which contains good quality habitat for a several important wildlife species including boreal caribou (DLUPC, 2006).

According to a report produced by EBA Consulting (2003) for the Dehcho Land Use Planning Committee (DLUPC), boreal caribou prefer mature or old growth coniferous forests associated with bogs, lakes and rivers. Old coniferous forests greater than 100 years old are particularly favoured, as these habitats offer high concentrations of ground (caribou moss) and tree lichens (arboreal lichens). In winter, caribou tend to prefer uplands, bogs and south facing slopes where snow is not too deep. Caribou winter diet consists of up to 80 per cent ground and tree lichens. Preferred summer habitat includes forest edges, marshes and meadows that provide the fresh green growth of flowering plants and grasses.

Annual caribou collaring studies conducted in the Dehcho (Larter & Allaire, 2007 - 2019) identified some caribou movement within the proposed Project footprint, although all breeding and calving areas identified were far outside of this proposed footprint. Further analysis is needed to determine whether critical habitat such as winter or summer range overlaps with the proposed Project. Additional caribou collaring studies for the MGAR project area are currently underway as of the time of development for this Environmental Overview and, once completed, the results from these studies will be submitted to the MVLWB to support MGAR authorization process.

Moose

While moose has not been given conservation status under *SARA, SARA (NWT)*, or by COSEWIC, the species is considered to be "big game" for the purposes of section 52 (a) of the *Wildlife Act*. Moose also have considerable cultural and spiritual importance for first nations groups throughout the NWT, including in the Dehcho.

Moose primarily obtain their food through browsing, and require abundant food located near secure cover. High quality moose habitat includes semi-open, sub-climax forests dominated by deciduous trees and shrubs. Heavily used areas include river floodplains, riparian areas along creeks, wetlands, and regenerating burns (Maier et al, 2005). In winter, forage is a critical life requisite for moose. Willow species and red-osier dogwood are preferred winter forage species, while Conifer stands play a role in providing snow interception and thermal cover during winter.

Critical sources of secure cover in early spring calving season include dense tall shrub stands, shorelines and islands. Mineral licks are also a life requisite for moose.

The area of the proposed Project is considered to be year-round moose range (EBA, 2003). The Pehdzéh Kį Ndeh zone in which much of the Project will take place is considered to provide important habitat for moose (DLUPC, 2006). In particular, Traditional Knowledge studies for the MVH and public engagement on the MGAR indicate the presence of a high-value moose pasture area located just north of Mount Gaudet.

Grizzly Bears

Grizzly bears are designated as special concern by SARA and COSEWIC (Species at Risk Public Registry, Accessed March 2020), but do not have conservation status under SARA (NWT) (NWT Species at Risk – List of Species at Risk, Accessed March 2020). There are estimated to be about 4,000-5,000 grizzly bears in the NWT, with the highest concentration found in the Mackenzie Mountains (ENR Website, Accessed March 2020). In the NWT, grizzly bears are classified as a big game species and a furbearer and impacts on them are regulated under *NWT Wildlife Act*. The Project area is at the very edge of the estimated habitat range described by NWT Species at Risk Committee (2017). Additionally, den and nest surveys conducted in 2019 (Appendix B) did not find any bear dens within close vicinity of the proposed Project.

Grizzly bears have large home ranges relative to most other bear species. On average, a male's range can extend over 2000 km^2 while a female's range is about half that size. Habitat requirements for grizzly bears include adequate food supply, proper denning sites and protection from human disturbances. Grizzlies prefer open or semi-forested areas on all parts of their range and are most common in alpine and subalpine terrain or on the tundra, although sightings in the boreal forest are not uncommon. Bears eat a variety of different foods, with plants (horsetails, berries, legume roots and grasses) making up about 90 percent of the diet of grizzly bears in the Mackenzie Mountains. Caribou are another important part of grizzly bear diet, and they may also eat lemmings and ground squirrels. Grizzlies are opportunistic predators and will kill moose, muskoxen and sheep if the occasion arises. Grizzlies are also carrion eaters and the carcasses of winter-killed animals can provide a source of food in spring before vegetation is available.

Human activity can present significant issues for grizzly bears, as bears will frequently consume and be attracted by human-generated garbage. Where grizzlies appear near human infrastructure, they are sometimes shot in defense of life or property. Human activities can also affect grizzly bear populations through harvesting, habitat degradation or both. Bears tend to avoid humans when possible, and this avoidance can lead to bears abandoning large sections of their home range.

Wolverines

Wolverines are considered a species of special concern by SARA and COSEWIC, but have no conservation status under territorial legislation. However, increasing frequency and magnitude of threats, as well as their cumulative effects, could cause wolverines to be considered a species of Special Concern in the NWT (Species at Risk Committee, 2014).

Wolverines live at low densities (Banci, 1994). Wolverine home ranges are generally large and can cover several hundred square kilometers. An adult male typically uses an area several times larger than an adult female, and dispersing yearlings can typically cover over 1000 km^2. Wolverines use different parts of their home range at different times of the year. They are well-adapted to deep snow packs, and appear to require large sparsely inhabited wilderness areas to meet their life requisites (Banci, 1994). They are scavenging predators with foraging habits that vary between seasons. During winter, they are primarily scavengers relying on carrion (Petersen, 1997); and during the growing season they prey on small mammals including snowshoe hare, grouse, ptarmigan, ground squirrels, tree squirrels, mice and voles. Wolverines may also opportunistically take down moose and caribou calves.

Factors that may limit wolverine populations include harvest, disturbance of denning areas, threats to habitats, and fluctuations in wolves, bears, caribou and moose, as well as prey species. Transportation corridors are known to contribute to permanent, temporary or functional habitat losses (sensitivity to disturbance), which can destabilize populations. As wolverines have low reproduction rates, population recovery and habitat repopulation occurs slowly (Species at Risk Committee, 2014). Wolverines generally avoid areas of human activity, and disturbances near denning sites have adverse effects on wolverine reproduction in the long-term (Species at Risk Committee, 2014).

As wolverines occur throughout the NWT, there is potential for the species to occur in the Project area. However, den and nest surveys conducted in November of 2019 for the MGAR (Appendix B) did not indicate any presence of wolverine denning sites. Further den and nest surveys are planned prior to the start of construction.

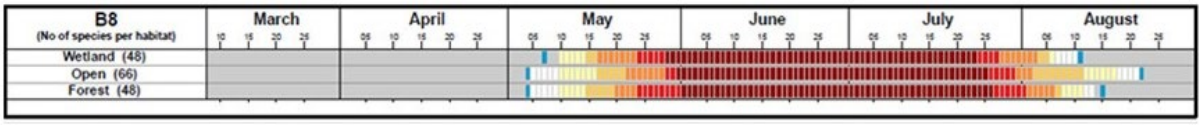
Birds

Several bird species with federal conservation status (SARA and COSEWIC) have ranges which overlap with the Project area, though none of these species are listed under the SARA (NWT). These include two species of raptor (Peregrine Falcon and Short-eared Owl), Bank Swallow, and Barn Swallow, Harris's Sparrow, Horned Grebe, Rusty Blackbird, Red-necked Palarope, and Olive-sided Flycatcher.

While some of these species have the potential to nest in the Project area, no bird nests were identified during den and nest surveys conducted for the MGAR (Appendix B), although a golden eagle nest was reported within 500 m of the MGAR alignment (B. Fournier, ENR, Personal Communication), indicating that the area contains suitable nesting habitat for raptor species. The majority of activities carried out during MGAR construction will occur in winter and are therefore unlikely to cause a disturbance to any birds in the area, although some activities could overlap with critical nesting periods for certain bird species.

According to Environment and Climate Change Canada, the Project occurs within nesting zone B8 for nesting birds (Environment and Climate Change Canada Website; Accessed May 2020). The nesting period for birds in this nesting zone lasts from Early May to Late August. Within zone B8, 48 species are known to nest in forest habitats, 66 in open, and 48 in wetland habitats.

Figure 6-1 Nesting Period for Birds in Project Nesting Zone



Insects

Three insect species with federal conservation status may occur within the Project area. These are the Gypsy Cuckoo Bumble Bee, the Yellow-banded Bumble Bee, and the Transverse Lady Beetle. The status of these species at a territorial level has not been determined.

MGAR construction activities are not expected to produce negative impacts that would be specific to insects.

Amphibians and Reptiles

The Project is located within the habitat range for the wood frog and the boreal chorus frog.

Wood frogs are common throughout the forested regions of the Northwest Territories, from the Alberta border north to the Mackenzie Delta (Conference of Management Authorities, 2017). According to the IUCN SSC Amphibian Specialist Group (2015a), wood frog populations are globally considered stable. Wood frog habitat includes a mix of forest types such as woodlands, grass-willow-aspen communities, ponds, streams and marshy areas, and the species is often found hidden under logs, rocks or among other leaf littered areas (IUCN, 2015). Wood frogs breed during early spring after the snow has melted (Government of Alberta, 2009), and females lay their eggs in clumps attached to aquatic vegetation in ponds absent of fish (IUCN, 2015). Following breeding, adult wood frogs move into damp woodland areas, remaining in close proximity to pond edges during the summer months (CMA, 2017). In the fall, frogs hibernate under forest floor debris such as leaves and logs where they spend the winter. The wood frog selects hibernacula sites under leaves and other debris on the forest floor and depends on snow cover for protection against the extreme cold (and its ability to tolerate slight (-6°C) sub-zero temperatures) to survive while hibernating (CMA, 2017).

Boreal chorus frogs occur throughout the southern NWT, and their range extends partially into the Mackenzie Valley (CMA, 2017). Populations of boreal chorus frogs are generally thought to be stable at the global level (IUCN SSC Amphibian Specialist Group 2015b), although there are no population estimates for boreal chorus frogs in the NWT. Boreal chorus frogs primarily inhabit damp, grassy or wooded areas, and can tolerate some freezing, allowing them to overwinter on land with adequate snow cover for insulation by burying under leaf litter and vegetation (ENR, 2009). Frogs may overwinter in upland sites near water bodies, and their breeding season typically occurs in early spring when ice may still be present on ponds (IUCN, 2015e). In the NWT, frogs breed from late May to early June but may breed into late June if spring arrives late. They usually breed in shallow pools without fish, which are potential predators, and which contain underwater

vegetation. Boreal chorus frogs have been known to breed in roadside ponds, gravel pits, other ponds, sloughs and lake edges (ENR, 2009).

Amphibian surveys conducted in the Dehcho and Sahtu in 2007 and 2008 (ENR, 2009) identified 3 wood frogs and 3 boreal chorus frogs within the area just south of Wrigley, with the closest sighting of each species being within about 10km of the proposed Project. No further surveys have been performed since this time, although it is presumed that wood frogs could occur near the Project area from time to time.

7 Fish and Fish Habitat

7.1 Hodgson Creek

The main fish-bearing water body of concern for this Project is Hodgson Creek. Fish species within Hodgson Creek include Arctic grayling (*Thymallus arcticus*), round whitefish (*Prosopium cylindraceum*), lake chub (*Couesius plumbeus*), longnose sucker (*Catostomus Catostomus*), and slimy sculpin (*Cottus cognatus*) (PWC, 1974). Small numbers of burbot (*Lota lota*) and northern pike (*Esox lucius*) have also been observed using the watercourse (McKinnon and Hnytka,1988). The creek bed is largely composed of rock and gravel, and the creek has many meandering channels consisting of both pools and riffles. The headwaters of Hodgson Creek provide overwintering habitat for Arctic grayling, slimy sculpin, lake chub, longnose sucker, burbot, and northern pike, while spawning and nursery habitat for Arctic grayling, lake chub, longnose sucker, round whitefish, and slimy sculpin are present throughout the creek (Stewart & Low, 2000).

Fish habitat potential at specific locations where the MGAR alignments would intersect the creek has not yet been assessed, but INF intends to carry out habitat studies at these locations prior to beginning Project activities.

7.2 Mackenzie River

No fish surveys are known to have been conducted in the Mackenzie River near Wrigley; However, the Mackenzie River basin is reported to contain 53 native fish species (Bodaly et al., 1989), including Arctic grayling, lake trout (*Salvelinus namaycush*), northern pike, lake whitefish (*Coregonus clupeaformis*), and a number of minnow species. The Project is not expected to have significant impacts on fish populations and habitat in the Mackenzie River.

7.3 Drainages and Lakes

A few small drainages have been identified either along or close to the proposed MGAR alignment. These drainages are located at:

- 63°14'13.40"N, 123°27'42.10"W
- 63°14'47.66"N, 123°29'52.70"W

- 63°15'25.45"N, 123°30'38.82"W
- 63°15'49.35"N, 123°31'38.75"W
- 63°15'57.18"N, 123°31'52.22"W
- 63°16'18.15"N, 123°32'18.79"W
- 63°16'24"N, 123°32'25.71"W
- 63°17'54.57"N, 123°34'50.66"W
- 63°18'35.26"N, 123°35'10.22"W
- 63°20'9.34"N, 123°34'54.12"W"

It is not known whether any of the drainages near or along the proposed MGAR are fish bearing.

A lake of approximately 7,500 m^3 in size has been identified within the boundaries of the Mount Gaudet Quarry at approximately 63°21'30"N, 123°34'26"W. It is not known whether this water body is natural or if it contains fish or fish habitat.

The lakes and drainages mentioned above will be included in fish habitat assessments to be conducted in late spring or early summer of 2020.

7.4 Aquatic Species of Conservation Concern

The ecological range of shortjaw cisco and bull trout overlaps with the proposed Project footprint. The shortjaw cisco is considered Special Concern by COSEWIC, and the bull trout is listed as Special Concern under SARA and by COSEWIC.

Shortjaw cisco is a member of the Salmonid family which occurs throughout the drainage basin for Great Slave Lake, including the Mackenzie River. Habitat for shortjaw cisco is generally limited to deep water between 55 and 144 m in depth (NWT Species at Risk Info-base; Accessed May 2020). The species inhabits water between 110 – 144 m in the spring, 55 – 71 m in the summer, and 73 – 91 m in winter. Ciscos mainly feed on micro-organisms within the lake water column and at the lake bottom, and are fed upon by larger fish such including Lake Trout and Burbot (Species at Risk Public Registry; Accessed May 2020). The species is considered to have low abundance within the NWT (NWT Species at Risk Info-base).

Bull trout, also a Salmonid, inhabits cold water lakes, streams, and rivers in western Canada including the NWT (NWT Species at Risk Info-base; Accessed May 2020). The species contains populations with different life strategies, with one form of the species spending their entire lives in rivers and streams (resident), another form which move between smaller spawning streams and larger streams (fluvial), and a third form which is similar to the fluvial form but which matures in lakes (adfluvial) (Species at Risk Public Registry; accessed May 2020). The anadromous form, which migrates between fresh water and marine habitats, only occurs in British Columbia. Bull trout usually spawn in the fall, when water temperatures are below 10° C, with typical spawning habitat consisting of cold and unpolluted moving streams with cobble or loose gravel substrates and

connected to groundwater sources (SARA Public Registry). Adult bull trout feed on a variety of smaller fish, while juveniles prefer to feed on insects and other small aquatic invertebrates (SARA Public Registry). Population trends for bull trout in the NWT are unknown (NWT Species at Risk Info-base).

Neither bull trout nor shortjaw cisco have not been reported to occur in Hodgson Creek, although suitable habitat for these species can be found within the Mackenzie River. As many water bodies and water flows near and within the MGAR footprint are linked to the Mackenzie River Basin, including Hodgson Creek, there is some potential for these species and their habitat to occur near the Project area. Planned fish and fish habitat studies should include particular emphasis on identifying the presence of these species and their habitat.

8 Socio-economic Environment

Most of the socio-economic impacts of the Project will be experienced by the community of Wrigley. Some socio-economic impacts may also be experienced by nearby communities in the Dehcho such as Fort Simpson.

8.1 Overview – Wrigley

The community of Wrigley is located along the banks of the Mackenzie River in the Dehcho region, approximately 190 km north of the village of Fort Simpson. Wrigley can be accessed year-round from the Mackenzie Highway (Highway 1) north of Fort Simpson, although part of the highway route between Fort Simpson and Wrigley involves the N'dulee Ferry, so the community cannot be accessed during break-up and freeze-up periods, when the ferry and ice road are not operational.

Wrigley is the third settlement of the Slavey Dene since the mid to late nineteenth century. The Slavey Dene originally settled at Old Fort Island, approximately 32 km north of the current location of Wrigley, where a Hudson's Bay Company trading post was established in 1870. A power plant and school teachers' residence were built in the late 1950s, and the population grew to 128 by 1960 (NWT Bureau of Statistics Website; Accessed April 2020). In 1965, the settlement was moved to the present site of Wrigley where a wartime airstrip had been constructed by the U.S. military for the Canol pipeline project. Many of the buildings were barged to the new site and fifteen new houses were built.

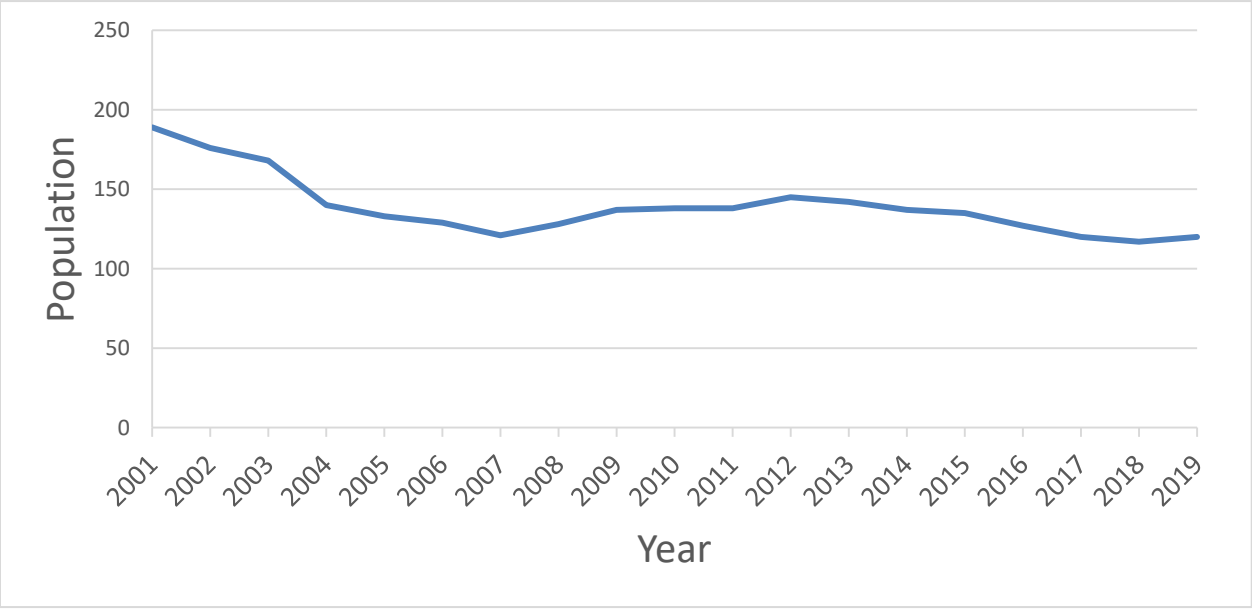
Today, traditional lifestyle in the community includes hunting, trapping, and fishing. 81.6% or residents have been reported to speak an Indigenous language as of 2014. In the DCR, the predominant traditional language is a dialect of the Dene language, known as South Slavey (sometimes called Dené Dháh or Dene Zhatıé). Wrigley is the home community of the Pehdzeh Ki First Nation (PKFN).

Population

The current population of Wrigley, as reported in 2019, is 120 people (Figure 8-1) (NWT Bureau of Statistics, 2019). The population of Wrigley has decreased by about 36.5% since 2001, although the

population has remained relatively stable since 2004. The NWT Bureau of Statistics projects a continued decrease in the population to 101 people by 2035. Decreases in Wrigley's population are most likely due to emigration from the community. Wrigley had an average of 2.5 births per year between 2008 and 2017, with an average death rate of 1 in this same period, indicating that without emigration from the community, Wrigley's population should be increasing over time.

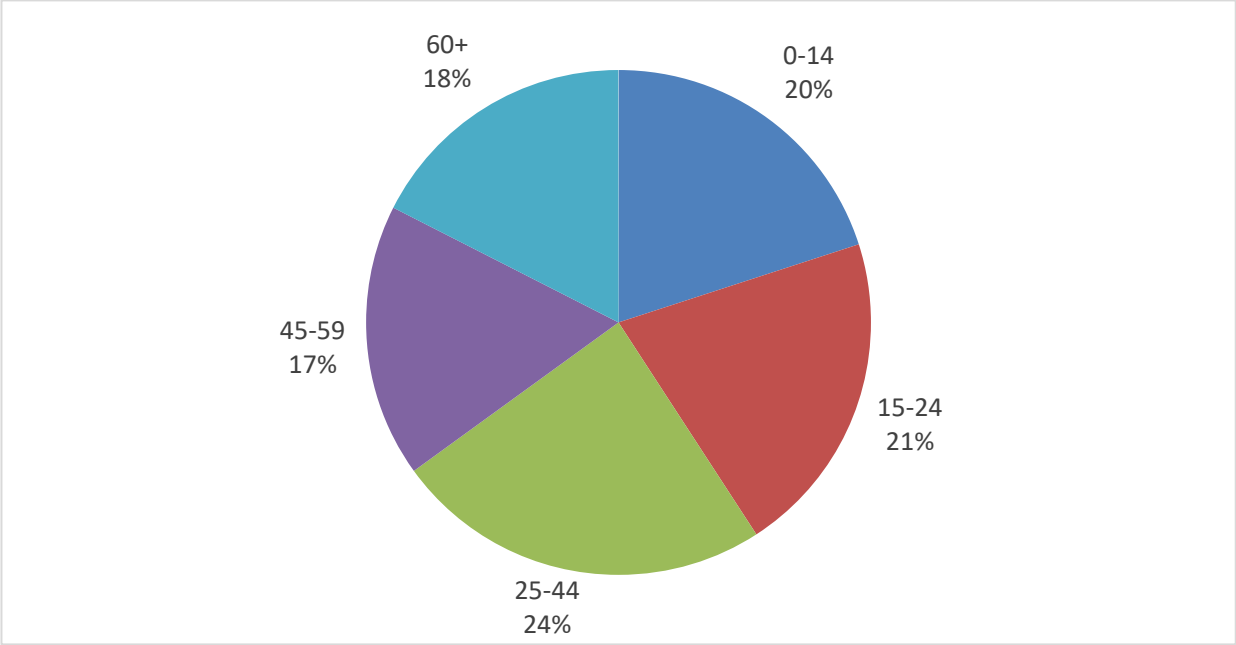
Figure 8-1 Community of Wrigley Population Trends, 2001 – 2019*



*Source: NWT Bureau of Statistics (Accessed March 2020)

The population by age group for Wrigley in 2019 is shown in Figure 8-2. The population is relatively young, with 65% of the population aged 44 or younger.

Figure 8-2 Wrigley Age Demographics, 2019*



*Source: NWT Bureau of Statistics (Accessed March 2020)

As shown in Table 8-1, there are more males (55% of population) than females (45%) in the community, and roughly 93% of the population is Indigenous.

Table 8-1 Wrigley Gender and Ethnicity Demographics*

Gender and Ethnicity	Population	Percent
Male	66	55%
Female	54	45%
Indigenous	112	93.3%
Non-Indigenous	8	6.6%

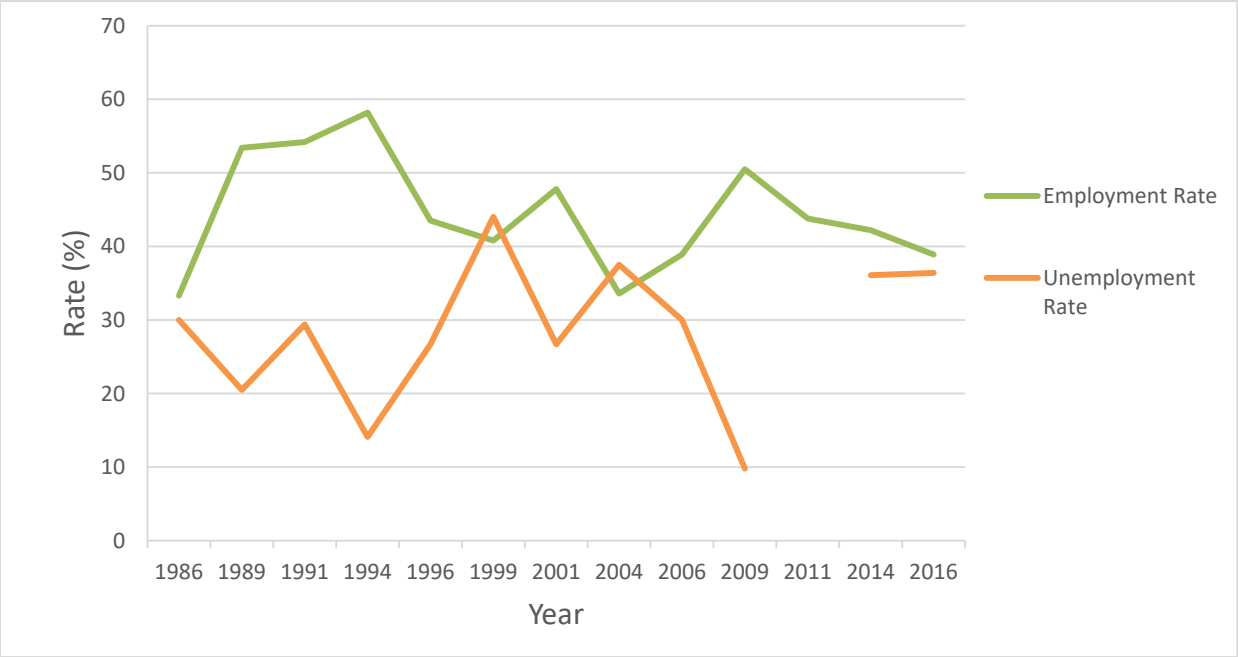
*Source: NWT Bureau of Statistics (Accessed March 2020)

Labour and Income

As of 2016, 61.1% of the community population was considered part of the labor force, with an employment rate of 38.9% and an unemployment rate of 36.4%. Over-all, the unemployment rate in Wrigley has fluctuated considerably over the last few years. This is likely to be partially due to the community's small population size. Of those who were employed in Wrigley in 2016, 71.4% worked in government, health, social services, and education, while 28.6% worked in goods production.

The average annual income for Wrigley residents was $62,068 in 2016, and the average family income in 2016 was $130,934.

Figure 8-3 Wrigley Employment and Unemployment Rate, 1986 – 2016*



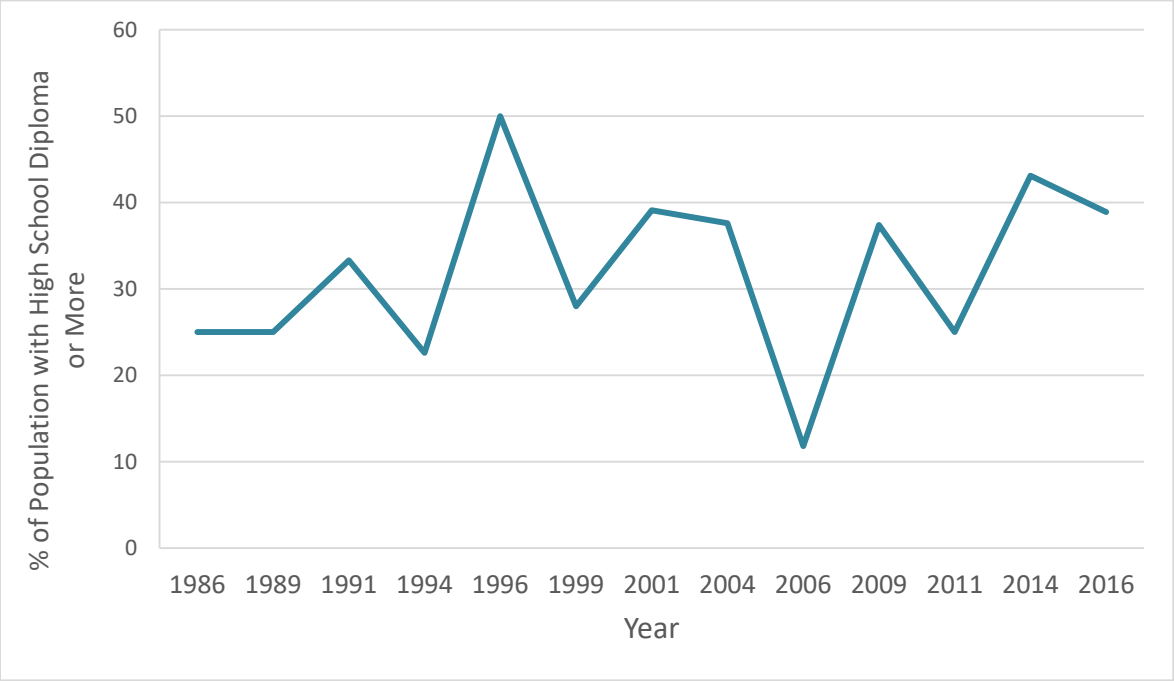
*Source: NWT Bureau of Statistics (Accessed March 2020)

Education

The percentage of Wrigley residents with a high school diploma or more has fluctuated since the 1986, although the percentage was approximately 14% higher in 2016 compared to 1986.

Of those Wrigley residents who obtained a high school diploma or more in 2014, 61.1% were employed. By comparison, 31% of residents without a high school diploma were reported as being employed in 2014.

Figure 8-4 Wrigley Education Level, 1986 – 2016*



*Source: NWT Bureau of Statistics (Accessed March 2020)

Traditional Economy

Traditional activities refer to the set practices which define the historical way of living for an Indigenous group of people. Traditional practices include land and resource uses, spiritual practices, and relationships to the land which have been passed down through many generations from a group's distant ancestors. Components of traditional lifestyle for Wrigley community members include hunting, fishing, trapping, arts and crafts, and the consumption of country foods. Table 8-2 shows the percentage of the overall population of Wrigley which engaged in various traditional activities in 2013.

Table 8-2 Wrigley Traditional Activities Profile, 2013*

Activity	Percent of Population
Hunting and Fishing	76.8%
Trapping	23.4%
Arts & Crafts	31.5%
Country Food Consumption	62.5%

*Source: NWT Bureau of Statistics (Accessed March 2020)

Community Infrastructure

Transportation infrastructure in Wrigley includes an all-weather access road (Highway 1) to the south of the community, and a winter road which leads north from the community to Tulita and other Sahtu communities. The winter road is typically operational for 2 - 3 months each winter, from around the end of December to mid-to-late March.

There is a community airport which includes an air terminal building, with scheduled air service available from Fort Simpson. A barge service from Hay River operates in the summer months, providing goods and materials to Wrigley and other communities located along the Mackenzie River. The community possesses a marine re-supply facility.

Water is delivered to households in Wrigley by truck, and liquid and solid waste disposal services are provided. Solid waste is trucked from the community and disposed of at a site 5 km northeast of Wrigley. Diesel-fuelled generators supply power with 200 kW of spare power capacity available and heat is provided by P-50 fuel oil.

Communication infrastructure in Wrigley consists of satellite phone, television (cable and satellite access), and internet service. The community has two radio stations, CBC Radio One, which provides public news, and local community radio produced by the Native Communications Society of the Northwest Territories (Wikipedia; Accessed May 2020). In 2014, 34% of households were reported to have internet access.

Other facilities in Wrigley include a community gym, a fire hall, a school (Chief Julian Yendo, K – 9) and a health cabin. Contracting services in the community are provided by Pehdzéh Kį Contracting Ltd. (PKCL), PKCL provides economic and employment opportunities for the community by capturing business opportunities within the Pehdzéh Kį traditional territory. Services provided by PKFN include general contracting services, including equipment rentals, and maintenance work for the all-weather highway, winter road maintenance, and local airport.

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Appendix A

Wildlife in Project Area

Table A-1 Wildlife (Mammals, Birds, and Amphibians) Occurring in the Project Area

Common Name	Scientific Name	Conservation Status		
		SARA (NWT)	SARA	COSEWIC
Mammals				
American Black Bear	*Ursus americanus*	Secure	Not listed	Not at Risk
American Marten	*Martes americanus*	Secure	Not Assessed	Not Assessed
American Mink	*Neovison vison*	Secure	Not Assessed	Not Assessed
American Pygmy Shrew	*Sorex hoyi*	Secure	Not Assessed	Not Assessed
Arctic Shrew	*Sorex arcticus*	Secure	Not Assessed	Not Assessed
Beaver	*Castor canadensis*	Secure	Not Assessed	Not Assessed
Boreal Caribou	*Rangifer tarandus caribou*	Threatened	Threatened	Threatened
Canadian Lynx	*Lynx canadensis*	Secure	Not Assessed	Not At Risk
Coyote	*Canis latrans*	Secure	Not Assessed	Not Assessed
Dusky Shrew	*Sorex monticolus*	Secure	Not Assessed	Not Assessed
Eastern Heather Vole	*Phenacomys ungava*	Secure	Not Assessed	Not Assessed
Gray Wolf	*Canis lupus*	Secure	Not Assessed	Not At Risk
Grizzly Bear	*Ursus arctos*	Sensitive	Under Consideration	Special Concern
Least Chipmunk	*Neotamias minimus*	Secure	Not Assessed	Not Assessed
Least Weasel	*Mustela nivalis*	Secure	Not Assessed	Not Assessed
Masked Shrew	*Sorex cinereus*	Secure	Not Assessed	Not Assessed
Meadow Vole	*Microtus pennsylvanicus*	Secure	Not Assessed	Not Assessed
Moose	*Alces americanus*	Secure	Not Assessed	Not Assessed
Muskrat	*Ondatra zibethicus*	Secure	Not Assessed	Not Assessed
North American Deer Mouse	*Peromyscus maniculatus*	Secure	Not Assessed	Not Assessed
North American Porcupine	*Erethizon dorsatum*	Secure	Not Assessed	Not Assessed
North American River Otter	*Lontra canadensis*	Secure	Not Assessed	Not Assessed
Northern Bog Lemming	*Synaptomys borealis*	Secure	Not Assessed	Not Assessed
Northern Flying Squirrel	*Glaucomys sabrinus*	Secure	Not Assessed	Not Assessed
Northern Red-backed Vole	*Myodes rutilus*	Secure	Not Assessed	Not Assessed
Red Fox	*Vulpes vulpes*	Secure	Not Assessed	Not Assessed
Red Squirrel	*Tamiasciurus hudsonicus*	Secure	Not Assessed	Not Assessed
Short Tailed Weasel (Ermine)	*Mustela erminea*	Secure	Not Assessed	Not Assessed

Common Name	Scientific Name	Conservation Status		
		SARA (NWT)	SARA	COSEWIC
Snowshoe Hare	*Lepus americanus*	Secure	Not Assessed	Not Assessed
Taiga (Chestnut-cheeked) Vole	*Microtus xanthognathus*	Secure	Not Assessed	Not Assessed
Wolverine	*Gulo Gulo*	Not At Risk	Under Consideration	Special Concern
Birds				
Alder Flycatcher	*Empidonax alnorum*	Secure	Not Assessed	Not Assessed
American Golden Plover	*Pluvialis dominica*	Sensitive	Not Assessed	Not Assessed
American Kestrel	*Falco sparverius*	Secure	Not Assessed	Not At Risk
American Pipet	*Anthus rubescens*	Undetermined	Not Assessed	Not Assessed
American Redstart	*Setophaga ruticilla*	Secure	Not Assessed	Not Assessed
American Robin	*Turdus migratorius*	Secure	Not Assessed	Not Assessed
American Three-toed Woodpecker	*Picoides dorsalis*	Secure	Not Assessed	Not Assessed
American Tree Sparrow	*Spizelloides arborea*	Secure	Not Assessed	Not Assessed
American Wigeon	*Mareca americana*	Secure	Not Assessed	Not Assessed
Arctic Tern	*Sterna paradisaea*	Secure	Not Assessed	Not Assessed
Baird's Sandpiper	*Calidris bairdii*	Secure	Not Assessed	Not Assessed
Bald Eagle	*Haliaeetus leucocephalus*	Secure	Not Assessed	Not At Risk
Bank Swallow	*Riparia riparia*	At Risk	Threatened	Threatened
Barn Swallow	*Hirundo rustica*	At Risk	Threatened	Threatened
Bay-breasted Warbler	*Setophaga castanea*	Secure	Not Assessed	Not Assessed
Belted Kingfisher	*Megaceryle alcyon*	Secure	Not Assessed	Not Assessed
Black-and-white Warbler	*Mniotilta varia*	Secure	Not Assessed	Not Assessed
Black-backed Woodpecker	*Picoides arcticus*	Secure	Not Assessed	Not Assessed
Black-bellied Plover	*Pluvialis squatarola*	Sensitive	Not Assessed	Not Assessed
Blackpoll Warbler	*Setophaga striata*	Secure	Not Assessed	Not Assessed
Blue-winged Teal	*Anas discors*	Secure	Not Assessed	Not Assessed
Bohemian Waxwing	*Bombycilla garrulus*	Secure	Not Assessed	
Bonaparte's Gull	*Chroicocephalus philadelphia*	Secure	Not Assessed	Not Assessed
Boreal Chickadee	*Poecile hudsonica*	Sensitive	Not Assessed	Not Assessed
Boreal Owl	*Aegolius funereus*	Secure	Not Assessed	Not At Risk

Common Name	Scientific Name	Conservation Status		
		SARA (NWT)	SARA	COSEWIC
Bufflehead	*Bucephala albeola*	Secure	Not Assessed	Not Assessed
Cackling Goose	*Branta hutchinsii*	Secure	Not Assessed	Not Assessed
Canada Goose	*Branta canadensis*	Secure	Not Assessed	Not Assessed
Canvasback	*Aythya valisineria*	Secure	Not Assessed	Not Assessed
Chipping Sparrow	*Spizella passerina*	Secure	Not Assessed	Not Assessed
Cliff Swallow	*Petrochelidon phyrrhonota*	Secure	Not Assessed	Not Assessed
Common Goldeneye	*Bucephala clangula*	Secure	Not Assessed	Not Assessed
Common Loon	*Gavia immer*	Secure	Not Assessed	Not At Risk
Common Nighthawk	*Chordeiles minor*	At Risk	Threatened	Special Concern
Common Merganser	*Mergus merganser*	Secure	Not Assessed	Not Assessed
Common Raven	*Corvus corax*	Secure	Not Assessed	Not Assessed
Common Redpoll	*Acanthis flammea*	Secure	Not Assessed	Not Assessed
Dark-eyed Junco	*Junco hyemalis*	Secure	Not Assessed	Not Assessed
Downy Woodpecker	*Picoides pubescens*	Secure	Not Assessed	Not Assessed
Eastern Kingbird	*Tyrannus tyrannus*	Secure	Not Assessed	Not Assessed
Eastern Phoebe	*Sayornis phoebe*	Secure	Not Assessed	Not Assessed
Fox Sparrow	*Passerella iliaca*	Secure	Not Assessed	Not Assessed
Golden Eagle	*Aquila chrysaetos*	Secure	Not Assessed	Not At Risk
Gray Jay	*Perisoreus canadensis*	Secure	Not Assessed	Not Assessed
Gray-cheeked Thrush	*Catharus minimus*	Secure	Not Assessed	Not Assessed
Great Gray Owl	*Strix nebulosa*	Secure	Not Assessed	Not At Risk
Great Horned Owl	*Bubo virginiansis*	Secure	Not Assessed	Not Assessed
Greater Scaup	*Aythya marila*	Secure	Not Assessed	Not Assessed
Greater White-fronted Goose	*Answer albifrons*	Secure	Not Assessed	Not Assessed
Green-winged Teal	*Anas crecca*	Secure	Not Assessed	Not Assessed
Gyrfalcon	*Falco rusticolus*	Secure	Not Assessed	Not At Risk
Hairy Woodpecker	*Picoides villosus*	Secure	Not Assessed	Not Assessed
Harris's Sparrow	*Zonotrichia querula*	Undetermined	Not Assessed	Special Concern
Herring Gull	*Larus argentatus*	Secure	Not Assessed	Not Assessed
Hoary Redpoll	*Acanthis hornemanni*	Undetermined	Not Assessed	Not Assessed

Common Name	Scientific Name	Conservation Status		
		SARA (NWT)	SARA	COSEWIC
Horned Grebe	*Podiceps auritus*	Sensitive	Special Concern	Special Concern
Horned Lark	*Eremophila alpestris*	Secure	Not Assessed	Not Assessed
Killdeer	*Charadrius vociferus*	Secure	Not Assessed	Not Assessed
Lapland Longspur	*Calcarius lapponicus*	Secure	Not Assessed	Not Assessed
Least Flycatcher	*Empidonax minimus*	Secure	Not Assessed	Not Assessed
Least Sandpiper	*Calidris minutilla*	Sensitive	Not Assessed	Not Assessed
Lesser Scaup	*Aythya affinis*	Secure	Not Assessed	Not Assessed
Lesser Yellowlegs	*Tringa flavipes*	Sensitive	Not Assessed	Not Assessed
Lincoln's Sparrow	*Melospiza lincolnii*	Secure	Not Assessed	Not Assessed
Long-tailed Duck	*Clangula hyemalis*	Sensitive	Not Assessed	Not Assessed
Magnolia Warbler	*Setophaga magnolia*	Secure	Not Assessed	Not Assessed
Mallard	*Anas platyrhynchos*	Secure	Not Assessed	Not Assessed
Merlin	*Falco columbarius*	Secure	Not Assessed	Not At Risk
Mew Gull	*Larus canus*	Secure	Not Assessed	Not Assessed
Northern Flicker	*Colaptes auratus*	Secure	Not Assessed	Not Assessed
Northern Goshawk	*Accipiter gentilis*	Secure	Not Assessed	Not At Risk
Northern Harrier	*Circus cyaneus*	Secure	Not Assessed	Not At Risk
Northern Hawk Owl	*Surnia ulula*	Secure	Not Assessed	Not At Risk
Northern Pintail	*Anas acuta*	Sensitive	Not Assessed	Not Assessed
Northern Shoveler	*Anas clypeata*	Secure	Not Assessed	Not Assessed
Northern Shrike	*Lanius excubitor*	Secure	Not Assessed	Not Assessed
Northern Waterthrush	*Parkesia noveboracensis*	Secure	Not Assessed	Not Assessed
Olive-sided Flycatcher	*Contopus cooperid*	At Risk	Threatened	Special Concern
Orange-crowned Warbler	*Oreothlypis celata*	Secure	Not Assessed	Not Assessed
Osprey	*Pandion haliaetus*	Secure	Not Assessed	Not Assessed
Pacific Loon	*Gavia pacifica*	Secure	Not Assessed	Not Assessed
Palm Warbler	*Setophaga palmarum*	Secure	Not Assessed	Not Assessed
Pectoral Sandpiper	*Calidris melanotos*	Secure	Not Assessed	Not Assessed
Peregrine Falcon	*Falco peregrinus*	Sensitive	Special Concern	Special Concern
Pine Grosbeak Range	*Pinicola enucleator*	Secure	Not Assessed	Not Assessed

Common Name	Scientific Name	Conservation Status		
		SARA (NWT)	SARA	COSEWIC
Pine Siskin	*Spinus pinus*	Secure	Not Assessed	Not Assessed
Red Crossbill	*Loxia curvirostra*	Secure	Not Assessed	Not Assessed
Red-breasted Merganser	*Mergus seraator*	Secure	Not Assessed	Not Assessed
Red-tailed Hawk	*Aquila chrysaetos*	Secure	Not Assessed	Not At Risk
Red-throated Loon	*Gavia stellata*	Secure	Not Assessed	Not Assessed
Ring-necked Duck	*Aythya collaris*	Secure	Not Assessed	Not Assessed
Red-breasted Nuthatch	*Sitta canadensis*	Secure	Not Assessed	Not Assessed
Red-eyed Vireo	*Vireo olivaceous*	Secure	Not Assessed	Not Assessed
Red-necked Grebe	*Podiceps grisegena*	Secure	Not Assessed	Not At Risk
Red-necked Phalarope	*Phalaropus lobatus*	Sensitive	Special Concern	Special Concern
Red-winged Blackbird	*Agelaius phoeniceus*	Secure	Not Assessed	
Rock Ptarmigan	*Lagopus muta*	Secure	Not Assessed	Not Assessed
Rough-legged Hawk	*Buteo lagopus*	Secure	Not Assessed	Not At Risk
Ruby-crowned Kinglet	*Regulus calendula*	Secure	Not Assessed	Not Assessed
Ruffed Grouse	*Bonasa umbellus*	Secure	Not Assessed	Not Assessed
Rusty Blackbird	*Euphagus carolinus*	Sensitive	Special Concern	Special Concern
Savannah Sparrow	*Passerculus sandwichensis*	Secure	Not Assessed	Not Assessed
Semipalmated Plover	*Charadrius semipalmatus*	Secure	Not Assessed	Not Assessed
Semipalmated Sandpiper	*Calidris pusilla*	Sensitive	Not Assessed	Not Assessed
Sandhill Crane	*Grus canadensis*	Secure	Not Assessed	Not Assessed
Sharp-shinned Hawk	*Accipiter striatus*	Secure	Not Assessed	Not At Risk
Sharp-tailed Grouse	*Tympanuchus phasianellus*	Secure	Not Assessed	Not Assessed
Short-eared Owl	*Asio flammeus*	Sensitive	Special Concern	Special Concern
Smith's Longspur	*Calcarius pictus*	Undetermined	Not Assessed	Not Assessed
Snow Bunting	*Plectrophenax nivalis*	Secure	Not Assessed	Not Assessed
Snowy Owl	*Bubo scandiacus*	Secure	Not Assessed	Not At Risk
Sora	*Porzana Carolina*	Secure	Not Assessed	Not Assessed
Spotted Sandpiper	*Actitus macularius*	Secure	Not Assessed	Not Assessed
Spruce Grouse	*Falcipennis canadensis*	Secure	Not Assessed	Not Assessed
Surf Scoter	*Melanitta perspicillata*	Sensitive	Not Assessed	Not Assessed

Common Name	Scientific Name	Conservation Status		
		SARA (NWT)	SARA	COSEWIC
Swainson's Thrush	*Catharus ustulatus*	Secure	Not Assessed	Not Assessed
Swamp Sparrow	*Melospiza georgiana*	Secure	Not Assessed	Not Assessed
Tennessee warbler	*Oreothlypsis peregrina*	Secure	Not Assessed	Not Assessed
Townsend's Solitaire	*Myadestes townsendi*	Secure	Not Assessed	Not Assessed
Tree Swallow	*Tachycineta bicolor*	Secure	Not Assessed	Not Assessed
Tundra Swan	*Cygnus columbianus*	Secure	Not Assessed	Not Assessed
Varied thrush	*Ixoreus naevius*	Undetermined	Not Assessed	Not Assessed
Warbling Vireo	*Vireo gilvus*	Secure	Not Assessed	Not Assessed
Western Tanager	*Piranga ludoviciana*	Secure	Not Assessed	Not Assessed
White-crowned Sparrow	*Zonotrichia leucophrys*	Secure	Not Assessed	Not Assessed
White-throated Sparrow	*Zonotrichia albicollis*	Secure	Not Assessed	Not Assessed
White-winged Crossbill	*Loxia leucoptera*	Secure	Not Assessed	Not Assessed
White-winged Scoter	*Melanitta fusca*	Sensitive	Not Assessed	Not Assessed
Willow Ptarmigan	*Lagopus lagopus*	Secure	Not Assessed	Not Assessed
Wilson's Snipe	*Gallinago delicata*	Undetermined	Not Assessed	Not Assessed
Wilson's Warbler	*Cardellina pusilla*	Secure	Not Assessed	Not Assessed
Yellow Warbler	*Setophaga petechia*	Secure	Not Assessed	Not Assessed
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Secure	Not Assessed	Not Assessed
Yellow-rumped Warbler	*Setophaga coronata*	Secure	Not Assessed	Not Assessed
Amphibians				
Wood Frog	*Lithobates sylvaticus*	Secure	Not Assessed	Not Assessed
Boreal Chorus Frog	*Pseudacris maculata*	Secure	Not Assessed	Not Assessed
Fish				
Arctic Cisco	*Coregonus autumnalis*	Sensitive	Not Assessed	Not Assessed
Arctic Grayling	*Thymallus arcticus*	Secure	Not Assessed	Not Assessed
Bering Cisco	*Coregonus laurettoe*	Presence Expected	Not Assessed	Not Assessed
Broad Whitefish	*Coregonus nasus*	Secure	Not Assessed	Not Assessed
Brook Stickleback	*Culaea inconstans*	Secure	Not Assessed	Not Assessed
Bull Trout	*Salvelinus confluentus*	Sensitive	Special Concern	Special Concern
Burbot	*Lota lota*	Secure	Not Assessed	Not Assessed

Common Name	Scientific Name	Conservation Status		
		SARA (NWT)	SARA	COSEWIC
Chinook Salmon	*Oncorhyncus tshawytscha*	Vagrant	Endangered	Not Assessed
Chum Salmon	*Oncorhyncus keta*	Undetermined	Not Assessed	Not Assessed
Cisco	*Coregonus arted*	Secure	Not Assessed	Not Assessed
Coho Salmon	*Oncorhyncus kisutch*	Vagrant	Threatened	Not Assessed
Dolly Varden	*Salvelinus malma*	Sensitive	Special Concern	Special Concern
Flathead Chub	*Platygobio gracilis*	Secure	Not Assessed	Not Assessed
Goldeye	*Hiodon alosoides*	Secure	Not Assessed	Not Assessed
Inconnu	*Stenodus leucichthys*	Sensitive	Not Assessed	Not Assessed
Lake Chub	*Couesius plumbeus*	Secure	Threatened	Threatened
Lake Trout	*Salvelinus namaycush*	Secure	Not Assessed	Special Concern
Lake Whitefish	*Coregonus clupeaformis**	Secure	Not Assessed	Not Assessed
Largescale Sucker	*Catostomus macrocheilus*	Presence Expected	Not Assessed	Not Assessed
Least Cisco	*Coregonus sardinela*	Secure	Not Assessed	Not Assessed
Longnose Sucker	*Catostomus catostomus*	Secure	Threatened	Threatened
Mountain Whitefish	*Prosopium willimsoni*	Secure	Not Assessed	Not Assessed
Northern Pike	*Esox lucius*	Secure	Not Assessed	Not Assessed
Pink Salmon	*Oncorhyncus gorbuscha*	Vagrant	Not Assessed	Threatened
Round Whitefish	*Prosopium cylindraceum*	Secure	Not Assessed	Not Assessed
Shortjaw Cisco	*Coregonus zenithicus*	At Risk	Threatened	Threatened
Slimy Sculpin	*Cottus cognatus*	Secure	Not Assessed	Not Assessed
Sockeye Salmon / Kokanee	*Oncorhyncus nerka*	Vagrant	Threatened	Endangered
Spoonhead Sculpin	*Cottus ricel*	Secure	Not at Risk	Not Assessed
Spottail Shiner	*Notropis hudsonius*	Secure	Not Assessed	Not Assessed
Trout-Perch	*Percopsis omiscomaycus*	Secure	Not Assessed	Not Assessed
Walleye	*Sander vitreus*	Secure	Not Assessed	Not Assessed
White Sucker	*Catostomus commersonii*	Secure	Not Assessed	Not Assessed
Yellow Perch	*Perca flavescens*	Undetermined	Not Assessed	Not Assessed

Appendix B

Den and Nest Survey Results

Black Bear, Wolverine and Wolf Denning, and Raptor Nest Survey

Field Report, November 2019

Prepared by Ève Lamontagne, ENR

Introduction

The Government of the Northwest Territories (GNWT) Department of Infrastructure (INF) plans to start Phase 2 of the Mackenzie Valley Highway project: construct the access road from Wrigley to Mount Gaudet. The Department of Environment and Natural Resources (ENR) was requested to conduct a denning/nesting survey of black bears, wolverines, wolves and any Raptor species.

The objective of this survey is to locate any dens or signs of denning by bears, wolverines and wolves in the proposed work site as well as to locate any raptor nests in the proposed work site. Once dens and nests are found, mitigations can be put in place to ensure healthy populations.

The species included in this project are important furbearer and raptor species in the Wrigley area and Traditional Knowledge (TK) indicates that these species utilize the area proposed for the access road. Industrial development presents several threats to wildlife populations including the potential for increased destruction of problem animals, potential for collisions with vehicles, alteration and fragmentation of habitat, and easier access for harvesters.

Construction-related disturbances are likely to provoke an early den emergence which could lead to the bear not being able to continue hibernating. Since there are few natural food sources available in winter, the chances of having a bear seeking food near human infrastructure increases. At any time of the year, wolves and black bears seen in and around populated areas are susceptible to habituation. Once they are habituated they have the potential to become problem wildlife. If they pose a threat to the public they would then have to be destroyed. Wolverines, unlike black bears and wolves, have a low tolerance to human disturbance. They are less likely to seek food sources near human infrastructure, although they could still be impacted by the construction of the road for the reasons mentioned previously.

The NWT is home to many raptor species such as, but not limited to, Bald Eagle, American Kestrel, Northern Goshawk, Northern Harrier, Osprey and Peregrine Falcon. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed the Peregrine Falcon as a species of *Special Concern*. A once frequently used insecticide, dichlorodiphenyltrichloroethane commonly known as DDT, caused thinning in the falcon's egg shell resulting in low reproduction and a crash in their numbers in the 1960s and 1970s. Since the banning of DDT, the populations have been increasing.

Methods

The survey took place on November 12, 2019 in the area surrounding the proposed Wrigley-Mount Gaudet access road. The survey crew was composed of 1 ENR biologist, 1 ENR wildlife officer and 1 wildlife monitor recommended by Pehdzeh Ki First Nation. The crew surveyed the area within 3 km of the proposed Wrigley-Mount Gaudet access road by flying transects lines, measured at 250 meters apart and following the proposed access road with an east to west bearing (Figure 1). Prior to the survey, a meeting with the wildlife monitor was done to discuss the process of the survey and to gain some Traditional Knowledge of the study area.

The helicopter flight was planned for late October. This is when a majority of bears have denned and dens are still visible, and the low snow cover can reveal tracks leading to the den or potential denning sites. However, crew availability delayed the flight until November.

Signs of an active den include: a freshly dug up mound of dirt with no vegetation growing on it and fresh tracks in the snow leading to the den. When a den has been collapsed and there are no signs of wildlife such as tracks we can conclude that this would be an inactive den. Potential denning area would include traits such as near water features, south facing slopes, large fallen trees, near large boulders and areas with soft soil. Potential raptor nest areas would include features such as rock outcrops, cliffs, ridges, knolls, stream banks, coniferous, and cottonwood forests. Tracks of all wildlife species were also sought after. If any tracks, dens or nests were observed, waypoints from a GPS and photos would be taken.

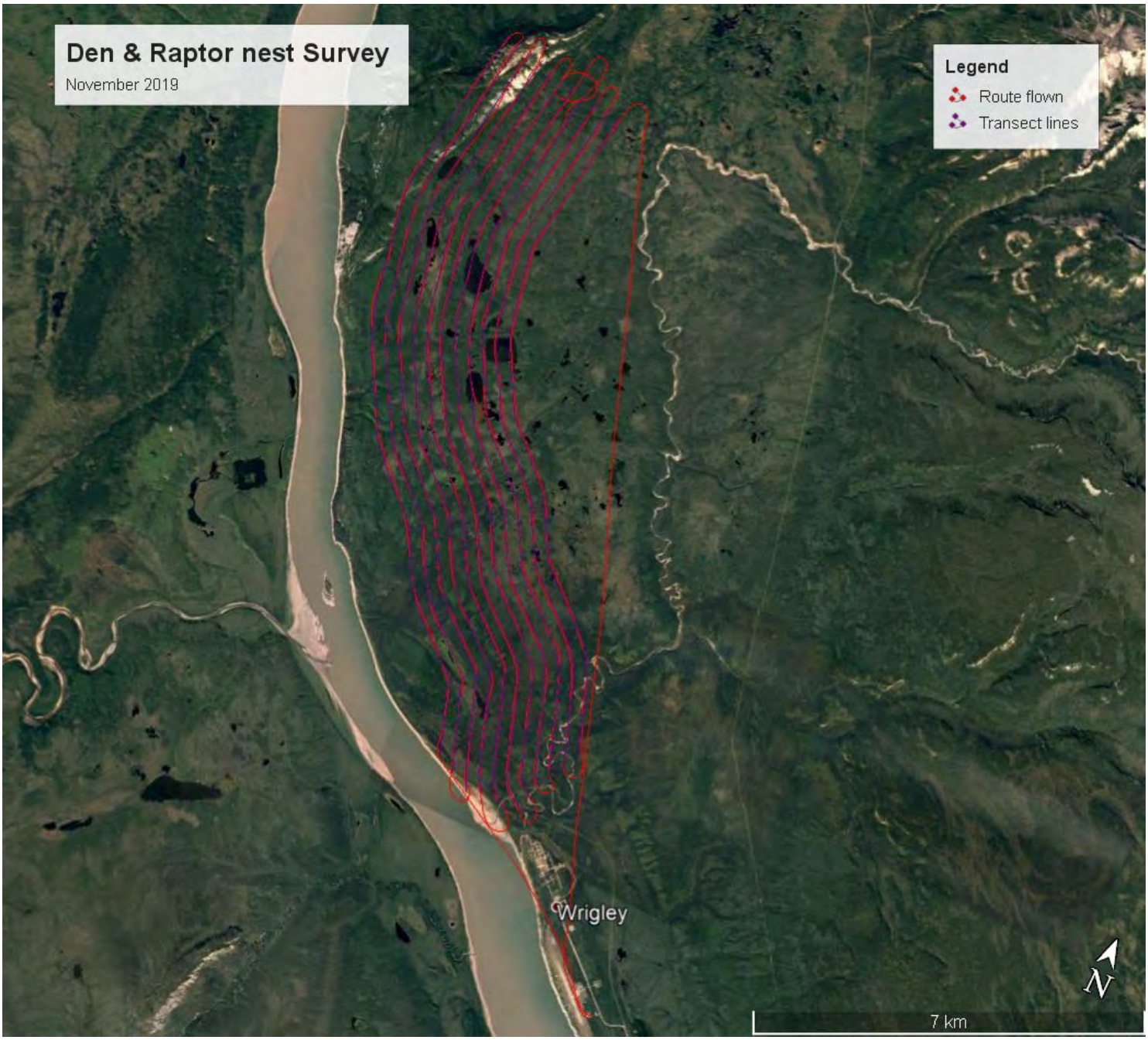

Figure 1. Transect lines with flown Route overlay

Results

The weather conditions were suitable for tracking but the recent snow fall made it difficult to see signs of potential dens. Even if the snow cover helps locate wildlife activity, no tracks, dens, potential den sites, nests or wildlife were identified. Through discussions with the wildlife monitor, it was predicted that there would not be raptor nests observed in the survey area except onto the ridge of Mount Gaudet where there could be a possibility of observing some. None was observed on the day of the survey. There was no sign of any bears, wolves or wolverines in the survey area as expected by the wildlife monitor. The village of Wrigley is used to seeing wolves and bears roaming around but no den has been identified in the project area; the denning might occur in another area. There was no sign of other wildlife in the survey area but Traditional Knowledge indicates that this area has been used for trapping and is known to have occurrences of wildlife such as boreal caribou, moose, bears, wolves and other furbearers. All personnel associated with this project will have to show their due diligence in properly maintaining their waste and have continued wildlife monitoring to ensure the safety of both wildlife and people.

Acknowledgements

Thanks to the help of staff at the Pehdzeh Ki First Nation for providing the wildlife monitor, M. Charlie Tale. INF provided the funding to conduct the work and Heather Sayine-Crawford provided administrative and logistical support.