19.0 ASSESSMENT OF POTENTIAL EFFECTS ON WILDLIFE AND WILDLIFE HABITAT

Wildlife and Wildlife Habitat is a valued component (VC) because it provides ecological, aesthetic, recreational, economic, and cultural value to Indigenous Governments, Indigenous Organizations, and other affected parties. Having access to wildlife and wildlife habitat is important to communities, particularly resource users that continue to practice traditional and recreational hunting and trapping activities throughout the region.

Wildlife and wildlife habitat will potentially be affected by the Mackenzie Valley Highway Project (the "Project"). The assessment of potential effects on wildlife and wildlife habitat considers requirements outlined in the Project Terms of Reference (ToR) for the wildlife and wildlife habitat subject of note (SON) (MVEIRB, 2015 [PR#66]).

Changes to vegetation and wetlands (see Chapter 18) resulting from project-related land clearing will reduce habitat availability. Changes in noise (see Chapter 13) and water quality (see Chapter 16) could affect terrestrial and aquatic habitats, which in turn may affect wildlife health. Residual effects on vegetation and wetlands, noise, and water and sediment quality were also used to support the assessment of potential effects of the Project on wildlife and wildlife habitat.

Changes in wildlife and wildlife habitat may also influence other VCs. For example, changes in wildlife and wildlife habitat can affect biodiversity (see Chapter 21). Traditional land and resource use, including harvesting by Indigenous Governments and Indigenous Organizations may be affected if the Project alters the distribution and abundance of wildlife species of cultural importance (see Chapter 11).

In this assessment, the term "wildlife" considers mammals, amphibians, and insects, including species at risk (SAR) and species of conservation concern (SOCC). Separate VC assessments have been provided for birds and bird habitat (see Chapter 20) and caribou and moose (see Chapter 10), reflecting the ToR SON and key lines of inquiry (KLOI; MVEIRB, 2015). Species at risk are defined as species listed as special concern, threatened, or endangered under the *Species at Risk (NWT) Act* (GNWT, 2020a) or under Schedule 1 of the federal *Species at Risk Act* (SARA; Government of Canada, 2021). Species of conservation concern are defined as species listed as special concern, threatened, or endangered by the NWT Species at Risk Assessment Committee (GNWT, 2020a) or the Committee on the Status of Endangered Wildlife in Canada (COSEWIC; Government of Canada, 2021). This is consistent with the Wildlife and Wildlife Habitat Technical Data Report (TDR; K'alo-Stantec, 2023; Appendix 19A).

Numerous wildlife species inhabit the Mackenzie Valley due to the widespread availability of wetlands, rivers, lakes, forests and rock formations as key habitats. It is not feasible to assess all species having potential to occur in the region; therefore, the assessment of wildlife and wildlife habitat focused on a select group of species and species assemblages that are representative of the wildlife species present and have the greatest potential to be affected by the Project, including SAR, SOCC, and harvested species.

The assessment of potential effects on wildlife and wildlife habitat concludes that with the application of mitigation measures, residual effects resulting from the Project on wildlife and wildlife habitat will be adverse. Residual effects and cumulative effects will not cause or further contribute to the exceedance of a conservation-based threshold or threaten the long-term persistence or viability of SAR/SOCC, or species of cultural or traditional importance and therefore will be not significant.

19.1 Scope of Assessment

19.1.1 Regulatory and Policy Setting

The assessment of potential project-related environmental effects on wildlife and wildlife habitat is guided by the ToR (MVEIRB, 2015 [PR#66]) and notable federal and territorial legislation and guidance, and the Sahtu Land Use Plan (SLUP), as outlined in the following sections.

19.1.1.1 Federal

The SARA provides protection for SAR in Canada. The legislation provides a framework to facilitate recovery of species listed as threatened, endangered, or extirpated and to prevent species listed as special concern from becoming threatened or endangered. Species at risk and their habitats are protected under SARA, which prohibits: (1) the killing, harming, or harassing of endangered or threatened SAR (SARA sections 32 and 36); and (2) the destruction of critical habitat of and endangered or threatened SAR (SARA sections 58, 60, and 61).

19.1.1.2 Territorial

The *Species at Risk (NWT) Act* is used to identify, protect, and recover plant and animal SAR in the Northwest Territories (NWT). The Act provides for the process of assessment and management of species and their habitats to prevent further declines and to promote recovery.

The *Wildlife Act* provides general provisions for regulating the activities relating to the harvest and protection of wild animals in NWT. Section 1(1) defines “wildlife" as “all species of vertebrates and invertebrates found wild in nature in the Northwest Territories” (GNWT, 2018), which includes all wild animals except fish and marine mammals. This means that “wildlife” includes mammals, birds, reptiles, amphibians, insects and other invertebrates. Other animals can be listed as wildlife in the regulations.

19.1.1.3 Sahtu Land Use Plan

Specific to the areas to which the SLUP applies, the Project must meet the 13 general conformity requirements (CR) of the SLUP (Sahtú Land Use Planning Board [SLUPB], 2023). The SLUP's conformity requirements include consideration of wildlife in CR#7, species introduced in CR#8 and sensitive species and features in CR#9, which are reproduced below as they relate to the Wildlife and Wildlife Habitat VC (which excludes fish, birds, caribou and moose):

> CR#7: *"1) Land use activities must be designed using the most current information for identified species of interest and species at risk as obtained from the GNWT-ECC* [Environment and Climate Change], *CWS* [Environment and Climate Change Canada - Canadian Wildlife Service], *DFO* [Fisheries and Oceans Canada], Parks Canada Agency, *the Sahtú Renewable Resources Board (SRRB) and the local Renewable Resources Council (RRC)s.*
>
> *2) Impacts to wildlife, their habitat and migration patterns, and important community harvesting areas must be prevented or mitigated to the extent possible."*
>
> *"a) In particular, all reasonable steps should be taken to follow the horizontal setbacks and minimum flight altitudes identified in Table 4 [of the SLUP] when near habitat sites during sensitive periods described in that table, unless human safety is of concern, and measures are developed with the appropriate organizations and the RRC to mitigate impacts to these species and their habitat."*
>
> CR#8: *"Land use activities must not result in the intentional introduction of non-native plant and animal species, or of domestic animal species."*
>
> CR#9: *"1) Any land use activity requiring a land use permit or water license must be designed using the most current available information on the location of rare or may-be-at-risk plants, hot and warm springs, mineral licks, karst topography, amphibian sightings, and ice patches and carried out in a manner that minimizes impacts to these features."*

Conformity Requirement #2 requires that *"The proposed activities must be designed and carried out with due regard for community concerns and incorporate relevant traditional knowledge."*

Additionally, per CR#14, the Project must be designed and carried out in a manner that protects, respects, or takes into account the values of the Conservation Zones (CZ) and Special Management Zones (SMZ) potentially affected by the Project as directed in the SLUP's Zone Descriptions (SLUPB, 2023), including the following:

- Petiniɀah (Bear Rock) CZ (Zone #32)
- Mio Lake CZ (Zone #36)
- Norman Range SMZ (Zone #50)
- K'ąąlǫ Tué (Willow Lake Wetlands) Special Management Zone (SMZ) (Zone #62)
- Deh Cho (Mackenzie River) SMZ (Zone #63)

19.1.2 Influence of Engagement

The Government of the Northwest Territories (GNWT) has engaged with Indigenous Governments, Indigenous Organizations, and other affected parties. Detailed information regarding these engagement activities is presented in Chapter 2 (Consultation and Engagement), Chapter 3 (Traditional Knowledge), and Chapter 11 (culture and traditional land use) of this Developer's Assessment Report (DAR). The GNWT has recently initiated Consultation with Indigenous Governments and Indigenous Organizations.

Through the project-specific engagement program delivered between 2010-2012 and 2021-2023, including project-specific traditional land and resource use (TLRU) studies, and through a review of publicly available TLRU information, Indigenous Governments, Indigenous Organizations, and other affected parties shared information, expressed concerns, and provided recommendations related to wildlife and wildlife habitat. This feedback has been considered and summarized in Table 19.1 and has been integrated into the assessment of potential effects on wildlife and wildlife habitat that follows. .

19.1.2.1 Regulatory Engagement

The GNWT Department of Infrastructure (INF) has engaged and collaborated with the GNWT Department of Environment and Climate Change (GNWT-ECC) throughout the development the DAR, and the GNWT-ECC has aided in addressing data gaps relative to the Project ToR (MVEIRB, 2015) and reviewing development of the TDR (K'alo-Stantec, 2023; Appendix 19A), Draft Wildlife Management and Monitoring Plan (WMMP; Volume 5) and DAR within its mandate.

Table 19.1 Summary of Engagement Feedback

Comment	Source	GNWT Response	Where Addressed
Engaged Indigenous Governments and Indigenous Organizations identified wildlife species of importance.	Auld and Kershaw, 2005; Dehcho First Nations, 2011; IMG-Golder Corporation, 2006; McDonald, 2010; NWRRC, 2023; TRRC, 2022; SRRB, 2021b, 2007; SLUPB, 2023	The GNWT has reviewed and considered the species of importance and important habitats identified by Indigenous Governments and Indigenous Organizations.	For information about wildlife species of importance and important wildlife habitat, see Section 19.2.2.1 (Table 19.5 and Table 19.6). See also Section 11.2.3.1 and Section 11.2.3.4 for additional information about important harvesting areas and harvested species.
Engaged Indigenous Governments and Indigenous Organizations identified important wildlife habitats and areas, and hunting and trapping locations near the Project.	DCLUPC, 2006; Dessau, 2012 (PR#13); NWRRC, 2023; TRRC, 2022; SLUPB, 2022		
Community engagement participants expressed concern about ecosystems and wildlife, and in particular caribou, moose, muskox, bears, bats, beaver, and other furbearers. They expressed concern that effects on wildlife and wildlife habitat may negatively affect culturally significant sites. They attributed these effects to construction activities, increased noise, increased traffic collisions, harvesting pressure, and climate change.	August 2021 Engagement; April to July 2022 Engagement; November to December 2022 Engagement; November 2022 to February 2023 Engagement	The GNWT has identified mitigation measures to reduce the effects of the Project on wildlife and wildlife habitat. A Wildlife Management and Monitoring Plan (WMMP) will be developed and implemented. A project-specific Spill Contingency Plan (SCP) will include procedures to prevent and respond to spills.	For mitigation measures to reduce effects of the Project on wildlife and wildlife habitat, see Table 19.9. See also: Section 19.4.2 (Change in Habitat) Section 19.4.3 (Change in Movement) Section 19.4.4 (Change in Mortality Risk) Chapter 25 (Assessment of Potential Accidents or Malfunctions) Volume 5 for management plans.
Dehcho First Nations reported concern about the consumption of potentially contaminated bear meat from bears that forage in dumps or other contaminated sites.	Dehcho First Nations, 2011		

Comment	Source	GNWT Response	Where Addressed
Norman Wells Renewable Resources Council (NWRRC) study participants raised concerns about the effects of spills on wildlife health.	NWRRC, 2023	*(cont'd from above)* The GNWT is committed to ongoing engagement with Indigenous Governments, Indigenous Organizations, and other affected parties during advancement of project design and planning. The GNWT will continue to implement existing wildlife monitoring programs consistent with its role as wildlife resource manager but recognizes that new programs and additional resources may be required to address issues specific to the Project. The GNWT will continue to refine the WMMP for this project throughout the EA process and is open to and interested in discussions with Indigenous Governments, Indigenous Organizations, and other affected parties on how best to incorporate their recommendations. The GNWT will work with SRRB and other resource managers to address uncertainty regarding the effects of increased access created by the Project on harvested resources in the study areas. This would include monitoring of harvest that can be used to identify the need for management actions to be taken by the appropriate resource management organization.	

19.1.3 Potential Effects, Pathways and Measurable Parameters

Table 19.2 summarizes the potential effects of project activities on wildlife and wildlife habitat, the pathways by which they may affect wildlife and wildlife habitat, and the measurable parameters used for evaluating effects. Potential effects and measurable parameters were selected based on professional judgment, recent environmental assessments for road projects in NWT, and regulatory concern for certain species.

Table 19.2 Potential Effects, Effects Pathways, and Measurable Parameters for Wildlife and Wildlife Habitat

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in habitat	Construction and operations and maintenance of the Project could result in a: • direct loss or alteration of wildlife habitat (e.g., vegetation clearing) • indirect loss or alteration of wildlife habitat (e.g., sensory disturbance1, edge effects)	• Quantitative evaluation of the amount (hectares [ha]) of habitat directly lost or altered for: – general wildlife habitat – little brown myotis (*Myotis lucifugus*) – grizzly bear (*Ursus arctos*) • Qualitative evaluation[2] of the amount of habitat directly lost or altered for: – wolverine (*Gulo gulo*) – invertebrate SAR/SOCC • Qualitative evaluation of the amount of indirect habitat loss or altered for wildlife, including the species listed • Area (ha) of other formally defined habitat areas (e.g., Important Wildlife Areas [IWAs]) directly affected • Area (ha) of formally defined SAR critical habitat directly or indirectly affected, if present • Number of formally defined SAR residences (e.g., dens) directly or indirectly affected
Change in movement	Construction and operations and maintenance could result in alteration of wildlife movement patterns[1] or movement corridors	• Qualitative evaluation of project effects on wildlife movement (e.g., barrier permeability)

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in mortality risk	Construction and operations and maintenance of the Project could result in a: • direct increase in mortality risk or number of wildlife fatalities (e.g., vegetation clearing activities, vehicular collisions, human-wildlife conflicts) • indirect increase in mortality risk or number of wildlife fatalities (e.g., altered predator-prey dynamics, harvest pressure)	• Qualitative evaluation of direct mortality risk: – Risk of mortality due to vegetation clearing, site preparation, and maintenance – Risk of collisions with project vehicles (e.g., increase in annual daily traffic volumes) or infrastructure – Risk of human-wildlife conflict • Qualitative evaluation of indirect mortality risk: – Predation risk due to change in predator-prey dynamics (e.g., change in predator mobility) – Hunting/trapping harvest pressure (e.g., year-round access or access to new areas)
Change in wildlife health	Construction and operations and maintenance could expose wildlife to contaminants or other emissions that may affect the health and condition of wildlife	• Qualitative evaluation of the effects of the Project on wildlife health and condition based on information provided in the air quality and surface water and sediment quality assessments.

Notes:

1 Daily and fine-scale effects on wildlife movement patterns (e.g., avoidance behaviour) are assessed as an indirect effect of change in habitat (i.e., reduced ecological effectiveness of habitats adjacent to the Project).

2 Quantitative habitat assessments for wolverine (*Gulo gulo*) and invertebrate species are not included as these species occupy broad habitat types and an assessment based on quantified habitat loss or alteration is uninformative.

19.1.4 Boundaries

19.1.4.1 Spatial Boundaries

The Project Development Area (PDA), Local Assessment Area (LAA), and Regional Assessment Area (RAA) for the assessment of effects on wildlife and wildlife habitat are shown in Figure 19.1. These spatial boundaries are used to assess project effects, including residual and cumulative effects, on wildlife and wildlife habitat.

- **PDA:** The area of direct project disturbance within which works and activities will occur (footprint). This includes a new two-lane gravel highway, 60 metres (m) wide highway right-of-way (ROW) mostly following the Mackenzie Valley Winter Road (MVWR), laydown and staging areas, maintenance yards, construction camps, and quarry/borrow sites with access roads on a 30 m ROW.
- **LAA:** The area within which measurable project-related effects (direct or indirect) are expected to occur. This is a 1-kilometre (km) buffer around the preliminary road alignment route centerline, and a 2 km buffer around the extent of borrow sources and quarries. The size of the buffer is based on measurable effects of noise on birds and mammals (e.g., Benitez-Lopez et al., 2010) while also considering recommended setback distances for wildlife and wildlife habitat features (Appendix 19B, Table 19B.1; GNWT, 2015). The size of the LAA is also consistent with guidance provided by Environment and Climate Change Canada (ECCC) (Dufour, 2020, pers. comm.).
- **RAA:** The area that provides context for determining significance of project-specific effects and cumulative effects. The RAA is an area within approximately 15 km of the PDA that is used to capture a wide range of wildlife species and wildlife habitats that could potentially be affected cumulatively by the Project and other past, present, and reasonably foreseeable projects. This RAA is consistent with other highway projects in the NWT (e.g., Inuvik to Tuktoyaktuk Highway [Kiggiak – EBA, 2011]) and follows recommendations from ECCC (Dufour, 2020, pers. comm.).

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 8/3/2023
TR by AJ on 8/3/2023

Client/Project
144903025-0030 REVB

Government of the Northwest Territories
Mackenzie Valley Highway Project

Figure No.
19.1

Title
Wildlife and Wildlife Habitat Assessment Areas

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: GNWT (Government of the Northwest Territories) Centre for Geomatics. n.d. Inventory of Landscape Change Map Viewer, GNWT. Centre for Geomatics. n.d. Open Data, MVLWB. n.d. Public Registry, Sahtu Land and Water Board. n.d. Public Registry, Environment and Natural Resources GNWT, Government of Canada, Stantec, Wilson and Haas 2012, and Caslys Consulting Ltd.
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS. Imagery date: 2021

19.1.4.2 Temporal Boundaries

The temporal boundaries are based on the Project phases described in Section 5.4.1.

- **Construction phase**: The Project will take approximately 10 years to construct over a timeframe of up to 20 years. The conceptual schedule assumes the highway will be constructed in three consecutive segments, beginning in approximately 2026: Wrigley north to the Dehcho–Sahtu border (102 km); Tulita south to the Dehcho–Sahtu border (134 km); and Tulita north to the Prohibition Creek Access Road (45 km). The conceptual schedule assumes the Project would be fully constructed and provide all-season connection to Norman Wells sometime between 2041 and 2046.
- **Operations and maintenance phase**: The operations and maintenance phase will commence in a staged manner once construction of each segment has been completed. The operations and maintenance phase is considered indeterminate as the highway is intended to be permanent infrastructure.

A closure and reclamation phase is not applicable to the Project. Closure and reclamation of temporary workspaces, and borrow sources and quarries used only for construction are included within the construction phase.

19.1.5 Residual Effects Characterization

Table 19.3 presents definitions for the characterization of residual effects on wildlife and wildlife habitat. Residual effects are those that remain after mitigation measures have been implemented.

Table 19.3 Characterization of Residual Effects on Wildlife and Wildlife Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Adverse:** A residual effect that moves measurable parameters of wildlife and wildlife habitat in a negative direction relative to baseline **Neutral:** No net change in measurable parameters for wildlife and wildlife habitat relative to baseline
Likelihood	The probability that the residual effect will occur	**Unlikely –** the residual effect is almost certainly not to occur **Possible –** the residual effect could occur **Certain –** the residual effect will certainly occur
Magnitude	The amount of change in wildlife habitat[1]	***Change in Habitat (Direct)*** **Low:** Project changes less than 10% of general wildlife habitat in the LAA, or less than 5% of habitat for wildlife SAR and SOCC in the LAA **Moderate:** Project changes 10-20% of general wildlife habitat in the LAA, or 5-10% of habitat for wildlife SAR and SOCC in the LAA **High:** Project changes more than 20% of wildlife habitat in LAA, or more than 10% of habitat for wildlife SAR and SOCC in the LAA Effects on formally defined SAR critical habitat (if present), SAR residences, and habitat areas will be characterized based on professional judgement and potential effects on the species or habitat.
	The change in wildlife abundance and/or distribution	***Change in Habitat (Indirect), Movement, Mortality Risk, and Health*** **Negligible:** A measurable change in the abundance of wildlife in the LAA is not anticipated **Low:** A measurable change in the abundance of wildlife in the LAA is not anticipated, although temporary local shifts in distributions in the LAA might occur **Moderate:** A measurable change in the abundance and/or distribution of wildlife in the LAA might occur **High:** A measurable change in the abundance and/or distribution of wildlife may exceed the LAA
Geographic Extent	The geographic area in which a residual effect occurs	**PDA:** Residual effects are restricted to the PDA **LAA:** Residual effects extend into the LAA **RAA:** Residual effects interact with those of other projects in the RAA

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Timing	Considers when the residual effect is expected to occur. Timing considerations are noted in the evaluation of the residual effect, where applicable or relevant	**No sensitivity:** The residual effect does not occur during critical life stage (e.g., bear denning period) or timing does not affect the VC **Moderate sensitivity:** The residual effect may occur during a lower sensitive period of a critical life stage; for many species this is the start or end of the critical period **High sensitivity:** The residual effect occurs during a critical life stage
Duration	The time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured	**Short-term:** The residual effect occurs during one segment of the construction phase, or less than 5 years **Medium-term:** The residual effect lasts through construction (up to 20 years) **Long-term:** The residual effect extends beyond construction, or throughout operations (> 20 years)
Frequency	Identifies how often the residual effect occurs and how often during the project or in a specific phase	**Single event:** The residual effect occurs once **Multiple irregular event:** The residual effect occurs at no set schedule **Multiple regular event:** The residual effect occurs at regular intervals **Continuous:** The residual effect occurs continuously
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible:** The residual effect is likely to be reversed after activity completion and reclamation **Irreversible:** The residual effect is unlikely to be reversed

Note:

[1] Based on benchmarks used for other recent environmental assessments (KHLP, 2012; Nalcor, 2012; JRP, 2014; Manitoba Hydro, 2016)

19.1.6 Significance Definition

A significant adverse residual effect on wildlife and wildlife habitat is one that, following the application of avoidance and mitigation measures, causes or further contributes to the exceedance of a conservation-based threshold or threatens the long-term persistence or viability of SAR/SOCC, or species of cultural or traditional importance.

Specific to the assessment of potential effects of the Project on wildlife and wildlife habitat, persistence refers to the likelihood of population survival over the long term (Middleton and Nisbet 1997, EC 2011). The determination of significance considers whether habitats might be altered in such a way as to cause a change or decline in the distribution or abundance of a viable population (locally or regionally) that is dependent upon that habitat, such that the likelihood of long-term population survival is substantially reduced as a result. The determination of significance also considers whether there is a direct (e.g., collision risk) and/or indirect (e.g., increased predation pressure) increase in mortality risk such that the likelihood of persistence is substantially reduced as a result.

19.2 Existing Conditions for Wildlife and Wildlife Habitat

Residual effects (Section 19.4) are assessed relative to the existing condition for wildlife and wildlife habitat. This section provides a brief overview of the existing conditions for wildlife and wildlife habitat, including the occurrence of SAR, SOCC, and harvested species within the LAA and RAA, which are reported in the Wildlife and Wildlife Habitat TDR (K'alo-Stantec, 2023; Appendix 19A).

19.2.1 Methods

The Wildlife and Wildlife Habitat TDR (K'alo-Stantec, 2023; Appendix 19A) was completed to address the ToR (MVEIRB, 2015) using a literature review of currently available information. The literature review incorporated review of relevant wildlife literature, Traditional Knowledge, and traditional land and resource use information (K'alo-Stantec, 2023; Appendix 19A, Section 3). Results are used to characterize the existing conditions for wildlife and wildlife habitat within the LAA and RAA.

19.2.2 Overview

The biophysical characteristics of the LAA are influenced by the Mackenzie River (Deh Cho) valley that defines the landscape and is dominated by coniferous forest habitats interspersed with wetlands and watercourses. The RAA contains potential habitat for 43 species of mammal, 2 species of amphibian, and numerous invertebrate species (GNWT, 2020b). The RAA is also within the range of four mammal SAR, three invertebrate SAR, and one mammal and one invertebrate SOCC (Table 19.4; GNWT, 2020a, 2020c; Government of Canada, 2021).

Table 19.4 Wildlife Species at Risk and Species of Conservation Concern with Potential to Occur in the RAA

Species		Status in NWT[2]		Status in Canada[3]	
Common Name	**Scientific Name**	**SARC Assessment**	***Species at Risk (NWT) Act***	**COSEWIC**	**SARA**
Mammals					
Little brown myotis	*Myotis lucifugus*	Special Concern	Special Concern	Endangered	Endangered
Grizzly bear	*Ursus arctos*	Special Concern	Not Listed	Special Concern	Special Concern
Wolverine	*Gulo gulo*	Not at Risk	Not Listed	Special Concern	Special Concern
Boreal caribou[1]	*Rangifer tarandus caribou*	Threatened	Threatened	Threatened	Threatened
Barren-ground caribou[1]	*Rangifer tarandus groenlandicus*	Threatened	Threatened	Threatened	Not Listed◊
Invertebrates					
Gypsy cuckoo bumble bee	*Bombus bohemicus*	Data deficient	Not Listed	Endangered	Endangered
Suckley's cuckoo bumble bee*	*Bombus suckleyi*	Not Assessed	Not Listed	Threatened	Not Listed◊
Yellow-banded bumble bee	*Bombus terricola*	Not at Risk	Not Listed	Special Concern	Special Concern
Transverse lady beetle	*Coccinella transversoguttata*	Not Assessed	Not Listed	Special Concern	Special Concern

Notes:

1 The assessment of effects on caribou is available in Chapter 10

2 Species at risk in NWT assessed by the Species at Risk Committee (SARC) and listed under the territorial *Species at Risk (NWT) Act* (GNWT, 2022)

3 Species at risk in Canada assessed by COSEWIC and listed under Schedule 1 of the federal *Species at Risk Act* (Government of Canada, 2021)

* Species of conservation concern

◊ Under consideration for Schedule 1 status change

19.2.2.1 Wildlife Species of Interest to Indigenous Governments, Indigenous Organizations, and Other Affected Parties

Through a review of publicly available literature and project-specific TLRU studies with Indigenous Governments, Indigenous Organizations, and other affected parties engaged on the Project, wildlife species of interest have been identified and listed in Table 19.5 (Auld and Kershaw, 2005; Dehcho First Nations, 2011; IMG-Golder Corporation, 2006; McDonald, 2010; NWRC, 2023; TRRC, 2022; SRRB, 2021b, 2007; SLUPB, 2023). As well, important wildlife habitat areas, and specific harvesting and trapping locations have been identified in the LAA and RAA as described in Table 19.6 (Dessau, 2012 [PR#13]; Dehcho First Nations, 2011; NWRRC, 2023; SLUPB, 2023; SLUBP, 2022; TRRC, 2022). The wildlife assessment used a habitat-based approach (see Section 19.4.1) to assess potential project effects on SAR/SOCC including those considered to have cultural importance to Indigenous Governments, Indigenous Organizations, or other affected parties. All species identified by Indigenous Governments, Indigenous Organizations, and other affected parties have been considered through the habitat-based approach, with the exception of Dall sheep and mountain goat, which are typically found further west in the Mackenzie Mountains

Table 19.5 Culturally Important Wildlife Species Identified by Indigenous Governments, Indigenous Organizations, and Other Affected Parties with Potential to Occur in the RAA

Common Name	Scientific Name	Identified By
Arctic fox	*Alopex lagopus*	Sahtu Renewable Resources Board (SRRB); NWRRC
Arctic hare	*Lepus arcticus*	SRRB; Tulita Renewable Resources Council (TRRC)
Arctic ground squirrel	*Spermorphilus parryii*	SRRB
Beaver	*Castor canadensis*	Dehcho First Nations; Pehdzéh Kį First Nation; Wrigley Community; SRRB; TRRC; NWRRC
Black bear	*Ursus americanus*	Dehcho First Nations; Pehdzéh Kį First Nation; SRRB; NWRRC
Black scoter	*Melanitta nigra*	SRRB
Cougar	*Felis concolor*	SRRB
Coyote	*Canis latrans*	SRRB
Dall sheep	*Ovis dalli*	SRRB
Duck	Various	Dehcho First Nations; Pehdzéh Kį First Nation; Wrigley Community; TRRC; NWRRC
Ermine (Weasel)	*Mustela erminea*	Pehdzéh Kį First Nation; SRRB
Fisher	*Martes pennanti*	Pehdzéh Kį First Nation; SRRB

Common Name	Scientific Name	Identified By
Grizzly bear	*Ursus arctos*	Dehcho First Nations; Pehdzéh Kį First Nation; SRRB
Least weasel	*Mustela nivalis*	Pehdzéh Kį First Nation
Lynx	*Lynx canadensis*	Pehdzéh Kį First Nation; SRRB; NWRRC
Marmot	*Marmota spp.*	SRRB
Marten	*Martes americana*	Pehdzéh Kį First Nation; Wrigley Community; SRRB; NWRRC
Mink	*Neovison vison*	Pehdzéh Kį First Nation; SRRB; NWRRC
Mountain goat	*Oreamnos americanus*	SRRB
Muskrat	*Ondatra zibethica*	Dehcho First Nations; Pehdzéh Kį First Nation; SRRB; TRRC; NWRRC
Muskox	*Ovibos mochatus*	SRRB; TRRC; NWRRC
Northern river otter/otter	*Lontra canadensis*	SRRB; Pehdzéh Kį First Nation
Porcupine	*Erethizon dorsatum*	Dehcho First Nations; Pehdzéh Kį First Nation: SRRB
Red fox	*Vulpes vulpes*	Pehdzéh Kį First Nation; SRRB; NWRRC
Red squirrel	*Tamiasciurus hudsonicus*	SRRB
Snowshoe hare	*Lepus americanus*	Pehdzéh Kį First Nation; SRRB; TRRC
Squirrel	Various	Pehdzéh Kį First Nation
White-tailed deer	*Odocoileus virginianus*	SRRB
Wolf	*Canis lupus*	Pehdzéh Kį First Nation; Sahtu Dene and Métis; SRRB; TRRC; NWRRC
Wolverine	*Gulo gulo*	Pehdzéh Kį First Nation; SRRB; NWRRC

Table 19.6 Wildlife Harvesting and Habitat Identified by Indigenous Governments and Indigenous Organizations Relative to the Project

Location	Within LAA	Within RAA[3]	Identified By:
White Sand Creek (trapping)	✓*	-	Pehdzéh Kı̨ First Nation
Dam Creek (trapping)	-	✓	Pehdzéh Kı̨ First Nation
Along the Mackenzie Valley Winter Road (between Tulita and Norman Wells; 'Drive-by' hunting)	✓*	-	NWRRC TLRU study participants
Prohibition Creek (wildlife harvesting/trapping)	-	✓	NWRRC TLRU study participants
Vermilion Creek (wildlife harvesting/trapping)	-	✓	NWRRC TLRU study participants
Canyon Creek (wildlife harvesting/trapping)	-	✓	NWRRC TLRU study participants
Around Bear Rock (Petınızah) (harvesting/wildlife habitat)	✓	-	NWRRC TLRU study participants; TRRC TLRU study participants
Three Day Lake (trapping)	-	✓	NWRRC TLRU study participants
Bluefish Creek (trapping)	-	✓	NWRRC TLRU study participants
Fish Lake[1] (trapping)	-	✓	NWRRC TLRU study participants
Great Bear River in the LAA and RAA (harvesting/wildlife habitat)	✓*	✓	Sahtu Dene and Métis
Pehdzéh Kı̨ N'deh[2] (wildlife habitat)	-	✓	Pehdzéh Kı̨ First Nation; Dehcho First Nations
North of Tulita Airport (wildlife habitat)	-	✓	TRRC TLRU study participants
Four Mile Creek (wildlife habitat)	-	✓	TRRC TLRU study participants
Sucker Creek (wildlife habitat)	-	✓	NWRCC TLRU study participants
Bennett Field (wildlife habitat)	-	✓	NWRCC TLRU study participants

Notes:

1 Fish Lake is a common lake name, and the location is not identified in this report

2 Pehdzéh Kı̨ N'deh area boundary of this area was not identified or disclosed in the report

3 Occurs within the RAA outside the LAA and PDA

* May occur within PDA

Dehcho First Nations have observed increased bear populations throughout the Dehcho Region. (Dehcho First Nations, 2011).

Tulita Renewable Resources Council reported an increase in muskox populations in the Tulita area (TRRC, 2022). Local knowledge from TRRC attributed the increase of muskox to previous road construction and operations in the Tulita area (TRRC, 2022). Participants of a NWRRC study noted they have observed muskox eating all types of vegetation in the TLRU study area, including the grasses, low bush, and the willows and explained that muskox are pushing caribou out of the area (NWRRC, 2023).

Wildlife habitat in the Dehcho Region portion of the LAA is dominated by coniferous forest (43.6%), wetlands (19.8%), and open water (19.3%), while the LAA that overlaps the Sahtu Region is dominated by coniferous forest (28.7%), wetlands (25.2%), and shrubland (20.6%; Table 19.7). Between 1960 and 2019, 18.5% of the LAA within the Deh Cho Region and 75.2% of the LAA within the Sahtu Region has been subject to forest fire (see Appendix 18A; K'alo-Stantec, 2022).

Other than communities, the Norman Wells Pipeline, and other developments such as borrow sources and quarries, a fibre line, and bridges associated with the MVWR, the LAA and RAA are relatively undisturbed by human activities (see Table 19.7). Oil and gas exploration and production infrastructure in the RAA occurs on the west side of and within the Mackenzie River Valley near Norman Wells (Auld and Kershaw, 2005).

Table 19.7 Land Cover Composition[1] in the LAA and RAA for the Dehcho Region and Sahtu Region

Land Cover Category	Land Cover Class[2]	Dehcho Region			Sahtu Region		
		PDA	LAA	RAA	PDA	LAA	RAA
		ha (%)	ha (%)	ha (%)	ha (%)	ha (%)	ha (%)
Upland	Broadleaf Dense	11.6 (1.4%)	1,037.4 (3.9%)	43,781.3 (12.2%)	75.1 (5.0%)	2,523.1 (5.2%)	34,259.4 (5.3%)
	Broadleaf Open	2.1 (0.3%)	114.8 (0.4%)	4,154.7 (1.2%)	27.0 (1.8%)	1,103.9 (2.3%)	14,627.9 (2.2%)
	Coniferous Dense	39.2 (4.9%)	3,374.9 (12.6%)	25,120.5 (7.0%)	18.1 (1.2%)	917.8 (1.9%)	18,580.5 (2.9%)
	Coniferous Open	98.9 (12.2%)	4,600.6 (17.2%)	40,034.2 (11.2%)	147.1 (9.8%)	6,678.1 (13.8%)	113,316.2 (17.4%)
	Coniferous Sparse	42.6 (5.3%)	3,725.0 (13.9%)	51,491.5 (14.3%)	116.2 (7.7%)	6,332.6 (13.0%)	71,845.9 (11.0%)
	Mixedwood Dense	16.6 (2.1%)	1,035.1 (3.9%)	6,786.9 (1.9%)	11.1 (0.7%)	387.3 (0.8%)	7,494.4 (1.1%)
	Mixedwood Open	1.8 (0.2%)	117.1 (0.4%)	2,728.5 (0.8%)	47.1 (3.1%)	2,514.0 (5.2%)	23,834.7 (3.7%)
	Mixedwood Sparse	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.5 (<0.1%)	6.3 (<0.1%)	11.7 (<0.1%)

Land Cover Category	Land Cover Class[2]	Dehcho Region			Sahtu Region		
		PDA	LAA	RAA	PDA	LAA	RAA
		ha (%)	ha (%)	ha (%)	ha (%)	ha (%)	ha (%)
Upland (cont'd)	Shrub Low	4.9 (0.6%)	567.4 (2.1%)	39,005.2 (10.9%)	146.2 (9.7%)	7,903.4 (16.3%)	72,607.6 (11.1%)
	Shrub Tall	3.2 (0.4%)	320.6 (1.2%)	1,616.4 (0.5%)	49.9 (3.3%)	2,091.3 (4.3%)	16,525.8 (2.5%)
	Herbaceous	6.6 (0.8%)	50.6 (0.2%)	1,300.1 (0.3%)	12.1 (0.8%)	210.9 (0.4%)	4,093.2 (0.6%)
	Bryoids	0.0 (0.0%)	7.0 (<0.1%)	20.4 (<0.1%)	0.4 (<0.1%)	6.2 (<0.1%)	137.0 (<0.1%)
	Rock/Rubble	2.1 (0.3%)	45.1 (0.2%)	4,916.4 (1.4%)	3.8 (0.3%)	107.3 (0.2%)	10,285.3 (1.6%)
	Exposed Land[3]	478.6 (59.2%)	1,338.0 (5.0%)	4,862.2 (1.4%)	626.3 (41.5%)	1,713.2 (3.5%)	9,897.9 (1.5%)
	Total	*708.3 (87.7%)*	*16,333.6 (60.9%)*	*225,848.3 (62.9%)*	*1,280.9 (85.0%)*	*32,495.5 (66.9%)*	*397,517.5 (61.0%)*
Wetland	Wetland Herbaceous	12.1 (1.5%)	856.8 (3.2%)	12,668.3 (3.5%)	52.5 (3.5%)	2,976.9 (6.1%)	44,854.8 (6.9%)
	Wetland Shrub	47.1 (5.8%)	2,222.9 (8.3%)	44,730.3 (12.5%)	78.3 (5.2%)	4,503.7 (9.3%)	55,337.6 (8.5%)
	Wetland Treed	34.5 (4.3%)	2,218.9 (8.3%)	46,859.8 (13.1%)	75.5 (5.0%)	4,771.6 (9.8%)	64,769.1 (9.9%)
	Total	*93.6 (11.6%)*	*5,298.5 (19.8%)*	*104,258.6 (29.0%)*	*206.3 (13.7%)*	*12,252.1 (25.2%)*	*164,961.5 (25.3%)*
Water		6.0 (0.7%)	5,187.5 (19.3%)	28,835.2 (8.0%)	20.1 (1.3%)	3,792.3 (7.8%)	89,302.6 (13.7%)
No Data		0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	163.9 (<0.1%)
GRAND TOTAL		***807.9 (100%)***	***26,819.7 (100%)***	***359,038.0 (100%)***	***1,507.3 (100%)***	***48,539.9 (100%)***	***651,945.5 (100%)***

Notes:

1 Measured in hectares (ha)

2 From EOSD NWT (NRCan and GNWT, 2017; K'alo-Stantec, 2022 [Appendix 18A])

3 Exposed land includes areas which naturally have less than 5% vegetative cover, such as shorelines of rivers and lakes, exposed rock, recently burned areas, and moraines, and includes cleared areas such as the existing MVWR, Norman Wells Pipeline, and other areas of infrastructure development

Key results and findings of the TDR (K'alo-Stantec, 2023; Appendix 19A) include:

- Many wildlife species are culturally important to local communities (e.g., bears and furbearers), including for trapping (Auld and Kershaw, 2005; DLUPC, 2006; SLUPB, 2023; SRRB, 2021; TRRC, 2022).
- Harvest composition of large mammals in the Sahtu Region is dominated by barren-ground caribou (*Rangifer tarandus groenlandicus*; 88%), followed by moose (*Alces alces*; 8%), woodland caribou (*Rangifer tarandus caribou*; 3%), and other species (1%; e.g., muskox [*Ovibos moschatus*]; SRRB, 2021).
- The Petiniʔah (Bear Rock) CZ is a large karst formation west of Tulita that is a sacred site and subject to traditional storytelling that also provides habitat for a wide variety of wildlife species (SLUPB, 2023).
- Historical wildlife SAR and SOCC records within the LAA and RAA include observations of little brown myotis, wolverine, and all four invertebrate species.
- Critical habitat for the gypsy cuckoo bumble bee has been identified in the SARA Recovery Strategy for the Gypsy Cuckoo Bumble Bee (*Bombus bohemicus*) in Canada [Proposed] (ECCC, 2022). Critical habitat does not overlap the PDA or LAA, however, a portion of critical habitat intersects the RAA near Norman Wells.
- The LAA is located partly within four IWAs each designated as important habitat for specific wildlife species including beaver (*Castor canadensis*), lynx (*Lynx canadensis*), muskox, and the moose (Sahtu rivers IWA)
- Sensitive wildlife features that wildlife rely on (e.g., mineral licks, overwintering hibernacula, denning sites) are not well-documented within the LAA despite information suggesting that the LAA and RAA have the potential to support these features.

19.3 Project Interactions with Wildlife and Wildlife Habitat

Anticipated interactions between project activities (as described in Section 5.4) and the VC leading to a potential effect (Section 19.1.3) are identified in Table 19.8 with a check mark (✓). These potential interactions are discussed in detail in Section 19.4, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. Justification for no effect (indicated by a dash [–]) is provided following the table.

Project-related environmental effects can influence wildlife and wildlife habitat directly or indirectly and positively or negatively. A direct effect is characterized by an interaction that occurs and exhibits no intermediate steps (e.g., mortality resulting from vehicle collision), whereas an indirect effect is characterized by an interaction that occurs with intermediary steps (e.g., altered predator-prey dynamics following clearing; Hegmann et al., 1999). Most interactions will affect wildlife and wildlife habitat adversely, but in some cases the effects are positive for certain species or project activities (e.g., creation of edge habitat). Positive effects are described but not characterized further.

Table 19.8 Project Interactions with Wildlife and Wildlife Habitat

Physical Activities	Timing	Environmental Effects			
		Change in Habitat	Change in Movement	Change in Mortality Risk	Change in Wildlife Health
Construction Phase					
Mobilization of equipment, materials, and fuel, resupply, and demobilization	Summer and winter	✓	✓	✓	✓
Establishment and operation of camps	Year-round	✓	✓	✓	–
Site preparation of ROW and workspaces	Winter	✓	✓	✓	✓
Borrow source and quarry development and operations, including blasting, crushing, sorting, and stockpiling	Year-round	✓	✓	✓	✓
Material haul	Year-round	✓	✓	✓	✓
Embankment and quarry access road construction, including road cuts	Winter; road cuts in summer or winter	✓	✓	✓	✓
Culvert installations	Summer or winter	✓	✓	–	–
Road base placement, compaction, and surfacing	Summer	✓	✓	✓	✓
Water withdrawal to support construction activities	Year-round	–	–	–	–
Closure and reclamation of MVWR and temporary borrow sources quarries, camps, and workspaces	Summer	✓	✓	✓	–
Employment and contracted goods and services[1]	Year-round	–	–	–	–
Operations and Maintenance Phase					
Borrow source and quarry operations, including blasting, crushing, sorting, and stockpiling	Summer	✓	✓	✓	✓
Material haul and stockpiling	Summer	✓	✓	✓	✓
Operation of, and activities at, maintenance yards	Year-round	✓	✓	✓	✓
Water withdrawal for dust control	Summer	–	–	–	–
Employment and contracted goods and services[1]	Year-round	–	–	–	–
Presence and use of the highway	Year-round	✓	✓	✓	✓

Physical Activities	Timing	Environmental Effects			
		Change in Habitat	Change in Movement	Change in Mortality Risk	Change in Wildlife Health
Highway and access road maintenance including snow clearing, repair, grading, dust control	Year-round	✓	✓	✓	–
Vegetation control	Summer	✓	✓	✓	–
Bridge and culvert maintenance	As needed	✓	✓	✓	–

Notes:

✓ Potential interaction

– No interaction

[1] Project employment and expenditures are generated by most project activities and components and are the main drivers of many socio-economic effects. Rather than acknowledging this by placing a check mark against each of these activities, "Employment and contracted goods and services" have been introduced as an additional component under each project phase.

Employment and contracted goods and services activities are not expected to result in a change in habitat, mortality risk, movement, or wildlife health for the lifetime of the Project, as there is no pathway for these activities to interact with wildlife and wildlife habitat.

During construction, establishment and operation of camps and closure and reclamation of MVWR and temporary borrow sources/quarries, camps, and workspaces activities are not anticipated to result in a change in wildlife health.

Water withdrawal for construction activities and dust control will only occur at authorized locations and is regulated to protect fish and fish habitat and will not result in a change in habitat, movement, mortality risk or wildlife health (i.e., changes to water levels will be protective of aquatic ecosystems, see Chapter 15 [water quantity]).

During operations and maintenance, water withdrawal for dust control activities is not anticipated to result in a change in wildlife habitat, movement, mortality risk or wildlife health as this will occur intermittently and will not disturb the connectivity of aquatic or terrestrial habitats. Operations and maintenance activities associated with snow removal, repairs, as well as bridge and culvert maintenance are not expected to interact with wildlife health. In addition, vegetation control is not expected to result in a change in wildlife health because the application of pesticides/herbicides is not proposed.

19.4 Assessment of Residual Effects on Wildlife and Wildlife Habitat

This section discusses the interaction pathways for the project activities identified in Table 19.8 (Section 19.3) that can affect habitat, movement, mortality risk, or wildlife health, including analytical assessment techniques, mitigation, and residual effects.

Based on project interactions with the environment identified in Table 19.8, the Project may affect wildlife and wildlife habitat. Potential effects, effect pathways, and mitigation measures that will reduce or eliminate the effects on wildlife and wildlife habitat are identified in Table 19.9. Residual effects and associated analytical assessment techniques are described.

Table 19.9 Potential Effects and Mitigation Measures for Wildlife and Wildlife Habitat

Effect Name	Effect Pathway	Mitigation Measures
Change in Habitat	Direct and/or indirect loss or alteration of wildlife habitat	The Project will use previously disturbed areas for project activities and project infrastructure and workspaces to the extent possible.
		Clearing will be limited to areas required for construction and safe operations.
		Project vehicles will be confined to existing roads and trails to avoid disturbing vegetated areas.
		Removal of vegetation will be limited to the width of the ROW and workspaces.
		Vegetation buffers will be used as visual barriers and to protect riparian vegetation, as appropriate.
		Organic material and topsoil will be set aside for use during reclamation, where possible.
		Erosion and sedimentation control measures will be implemented per the Erosion and Sedimentation Control Plan (ESCP) and will be in place prior to construction activities and before the spring melt/freshet. A draft ESCP is included in Volume 5.
		Beaver dam removal will be done in accordance with the code of practice: Beaver dam breaching and removal (DFO, 2022) and conditions of a GNWT General Wildlife Permit.
		Drainage culverts will be constructed along the roadway to facilitate water movement and maintain drainage patterns.
		Riparian vegetation will be maintained whenever possible.

Effect Name	Effect Pathway	Mitigation Measures
Change in Habitat (cont'd)		A WMMP will be developed and implemented. The WMMP will contain detailed monitoring and mitigation measures to be implemented for the duration of the construction and operations of the Project. A draft WMMP is included in Volume 5.
		Construction and quarry development activities will adhere to the applicable recommended setbacks and timing restrictions for wildlife outlined in the WMMP, where possible.
		Vegetation clearing will be completed outside the core maternity roosting period for bats of May 1 to August 31. If habitat tree removal or general tree clearing is required during the maternity roosting period, a qualified biologist will review the trees to make a determination on bat occupancy before removal.
		Wildlife monitors will assess for the presence of wildlife on or near the PDA during project activities.
		A pre-construction bear den survey will be completed to identify potential den sites if Project construction activities are planned to occur during the black bear or grizzly bear denning period (October 1 to May 30). If a bear den is confirmed to be active, a site-specific setback buffer will be applied to protect denning bears depending on project activity.
		Personnel will undergo a wildlife awareness program, which will include prevention measures for wildlife mortality (e.g., bear safety) and reporting procedures for wildlife-related incidents and protocols to follow when a nest, den, or wildlife species of management concern is observed. This includes completing wildlife sighting and wildlife incident report forms included in the WMMP.
		Closure and reclamation will promote re-establishment of vegetation.
		Site grading at closure will approximate pre-development conditions.
		Borrow source vegetated surface material, where present, will be replaced after development is completed.
		A dust control program using water will be implemented during construction and operations and maintenance.
		Vehicle speeds will be limited to 50 kilometres per hour (km/h) on unfinished project road surfaces.

Effect Name	Effect Pathway	Mitigation Measures
Change in Movement	Construction and operations and maintenance could result in alteration of wildlife movement patterns or movement corridors	Vegetation buffers will be used as visual barriers and to protect riparian vegetation, as appropriate.
		A buffer strip of undisturbed vegetation of at least 30 m wide will be maintained between the highway ROW and other new areas to be cleared.
		Drainage culverts will be constructed along the roadway to facilitate water movement and maintain drainage patterns.
		A project-specific ESCP will be developed and implemented
		The height of snowbanks will be limited to the extent possible and to a height of less than 1 m.
		Quarry operations will be located a minimum of 100 m from the ordinary high-water mark of any waterbody.
		Blasting activities will be limited to daytime hours, to the extent practical.
		Vehicles and equipment will be equipped with manufacturer-recommended noise muffling equipment.
		Construction and quarry development activities will adhere to the applicable recommended setbacks and timing restrictions for wildlife outlined in the WMMP, where possible.
		Wildlife monitors will assess for the presence of wildlife on or near the PDA during project activities, in accordance with the WMMP.
		Personnel will undergo a wildlife awareness program, which will include prevention measure for wildlife mortality (e.g., bear safety) and reporting procedures for wildlife-related incidents and protocols to follow when a nest, den, or wildlife species of management concern is observed. This includes completing wildlife sighting and wildlife incident report forms included in the WMMP.
		Closure and reclamation will promote re-establishment of vegetation.
		Site grading at closure will approximate pre-development conditions.
		Borrow source vegetated surface material, where present, will be replaced after development is completed.

Effect Name	Effect Pathway	Mitigation Measures
Change in Mortality Risk	Direct and/or indirect increase in mortality risk or number of wildlife fatalities	Vegetation clearing will be completed outside the core maternity roosting period for bats of May 1 to August 31. If habitat tree removal or general tree clearing is required during the maternity roosting period, a qualified biologist will review the trees to make a determination on bat occupancy before removal.
		Wildlife monitors will assess for the presence of wildlife on or near the PDA during project activities, in accordance with the WMMP.
		A pre-construction bear den survey will be completed to identify potential den sites if Project construction activities are planned to occur during the black bear or grizzly bear denning period (October 1 to May 30). If a bear den is confirmed to be active, a site-specific setback buffer will be applied to protect denning bears depending on Project activity.
		A pre-construction beaver dam and lodge survey will be conducted, as per the WMMP, to identify those potentially to be impacted by construction. Beaver dam removal will be done in accordance with the code of practice: Beaver dam breaching and removal (DFO, 2022) and conditions of a GNWT General Wildlife Permit.
		Personnel will undergo a wildlife awareness program, which will include prevention measure for wildlife mortality (e.g., bear safety) and reporting procedures for wildlife-related incidents and protocols to follow when a nest, den, or wildlife species of management concern is observed. This includes completing wildlife sighting and wildlife incident report forms included in the WMMP.
		An electric fence will be set up around temporary camps if deemed necessary to deter wildlife.
		Personnel will not feed or harass wildlife while working on the Project.
		Project personnel will be prohibited from hunting and fishing while housed in work camps for the Project.
		Construction and quarry development activities will be limited during sensitive periods for wildlife in accordance with the WMMP.
		Food and other wildlife attractants will be stored in bear-proof containers.
		Crews will be trained on wildlife awareness.
		Food waste will be stored and disposed of in a manner to avoid attracting wildlife.

Effect Name	Effect Pathway	Mitigation Measures
Change in Mortality Risk (cont'd)		Equipment, wastes and contaminated soils will be removed once construction is completed.
		The Project will use previously disturbed areas for project activities and project infrastructure and workspaces, to the extent practical.
		Clearing will be limited to areas required for construction and safe operations.
		A buffer strip of undisturbed vegetation of at least 30 m wide will be maintained between the highway ROW and other new areas to be cleared.
		Vegetation buffers will be used as visual barriers and to protect riparian vegetation, as appropriate.
		Vehicle speeds will be limited to speed of 50 km/h on unfinished project road surfaces.
		Speed limits will be posted on the public highway
Change in Wildlife Health	Construction and operations and maintenance could expose wildlife to contaminants or other emissions that may affect the health and condition of wildlife	A Spill Contingency Plan (SCP) will be developed and implemented. The SCP will include procedures to prevent and respond to spills. A draft SCP is included in Volume 5.
		Areas and containers used to store project wastes will be constructed, operated, and maintained in a manner to prevent waste from discharging to the surrounding environment.
		Maintenance yards will have a liner or concrete installed under areas of vehicle storage and maintenance.
		Vehicles parked for more than 2 hours will use drip trays.
		A minimum of 10 centimetres (cm) of packed snow or ice will be used on winter access roads.
		Project vehicles will travel on designated winter roads or constructed embankment only.
		Clearing of new areas will be completed when the ground is frozen to limit disturbance to soils and permafrost
		Placement of embankment will occur primarily during winter (December 15 to April 1), during frozen conditions. If work is to be completed under non-frozen conditions, equipment will be equipped with mushroom shoes.
		Borrow source floors will be sloped to reduce ponding of water.
		Travel of vehicles will be confined to existing infrastructure roads and trails as much as possible to avoid disturbing vegetated areas.

Effect Name	Effect Pathway	Mitigation Measures
Change in Wildlife Health (cont'd)		A project-specific ESCP will be developed and implemented.
		Sediment and erosion control measures will be regularly inspected to confirm they are performing as intended.
		Ponded water will be directed away from watercourses.
		Only material with low acid rock drainage and metal leaching potential will be used for the Project.
		Rip rap will be free of silt and other debris.
		Sediment control measures will be in place prior to construction activities and before the spring melt/freshet.
		Riparian vegetation will be maintained whenever possible.
		Excavated material will be placed at least 30 m from a watercourse.
		Snow fill temporary crossings will be constructed of clean snow fill.
		Vegetation buffers will be used as visual barriers and to protect riparian vegetation, as appropriate.
		Machinery on-site will be in a clean condition and free of invasive species and noxious weeds.
		Washing, refueling, and servicing machinery and storage of fuel and other materials for machinery will be conducted a minimum of 100 m from the high-water mark and in a manner to prevent any deleterious substances from entering the water.
		Machinery will not be left in any waterbody.
		Quarry operations will be located a minimum of 100 m from the ordinary high-water mark of any waterbody.
		Blast rock will not enter a waterbody or watercourse.
		Material stockpiles will be kept a minimum of 30 m from a watercourse or waterbody with the appropriate erosion control mitigation in place to prevent sediment from entering a watercourse or waterbody.
		Equipment will be maintained in good working order.
		Blast mats will be used when blasting near receptors sensitive to noise.
		A dust control program using water will be implemented during construction and operations and maintenance.
		Vehicle speeds will be limited to 50 km/h on unfinished project road surfaces.

Effect Name	Effect Pathway	Mitigation Measures
Change in Wildlife Health (cont'd)		Incinerators will be operated in accordance with manufacturer's specifications and emissions will meet Canadian Council of Ministers of the Environment Canada Wide Standards for Dioxins & Furans and Mercury.
		Equipment, wastes, and contaminated soils will be removed once construction is completed.

19.4.1 Analytical Assessment Techniques

The general approach to assessing potential effects on wildlife and wildlife habitat follows the sequence and methods outlined in Chapter 4 – Assessment Methods. Analytical assessment techniques specific to each potential effect are described.

19.4.1.1 Change in Habitat

Change in habitat was assessed by comparing direct and indirect changes in habitat availability from baseline conditions to the residual condition in the LAA, including for key wildlife species (Table 19.2) and for each project phase (i.e., construction, operations and maintenance). The quantitative assessment using land cover types did not include wolverine because they use a broad range of habitat types to meet seasonal foraging and denning requirements (COSEWIC, 2014a). In addition, physical feature data (e.g., deadfall trees, landslide debris) to identify potential denning habitat at site-specific scales (COSWEIC, 2014a) was not possible using broad scale mapping. Similarly, a quantitative assessment using land cover data was not completed for invertebrates because they also use a broad range of habitat types to meet their habitat needs (i.e., a variety of plants are used to obtain nectar and pollen). Therefore, effects on these species are assessed qualitatively.

Direct change in habitat (e.g., vegetation clearing) was calculated as the loss of wildlife habitat that is no longer available to wildlife in the PDA; these effects do not extend into the LAA. In general, once vegetation clearing is completed during the construction component, most of the PDA will provide no suitable wildlife habitat, except for a few species that may take advantage of developed sites. Portions of the PDA will be reclaimed after construction, including 6 of 15 quarries/borrow sources. Land cover classes considered as habitat for each wildlife species or species group; see Table 19.2) are summarized in Table 19.10 and were established using relevant scientific literature, life history information, and professional judgment.

Indirect change in habitat (e.g., sensory disturbance) was assessed qualitatively as the area of reduced habitat effectiveness; these effects are confined to the LAA.

Land cover classes were quantified using Earth Observation of Sustainable Development of Forests Northwest Territories geospatial data (NRCan and GNWT, 2017). This dataset is part of the Multi-source Vegetation Inventory Project (NRCan, 2020) and uses an unsupervised classification and cluster analysis to classify land cover. The dataset includes cover type and density classes and

forest structure height and volume information based on Landsat imagery collected from 2007 to 2013. Mapping was done at a scale of 1:250,000 and was refined through field evaluation by the GNWT (NRCan and GNWT, 2017). Detailed land cover classification methods for this Project are in the Vegetation and Wetlands TDR (K'alo-Stantec, 2022; Appendix 18A).

Table 19.10 Land Cover Classes used to Quantify Habitat Availability for Wildlife

Land Cover Category	Land Cover Class[1]	Wildlife	Grizzly Bear[2]	Little Brown Myotis[3]
Upland	Broadleaf Dense	✓	✓	✓
	Broadleaf Open	✓	✓	✓
	Broadleaf Sparse	✓	✓	–
	Coniferous Dense	✓	✓	–
	Coniferous Open	✓	✓	–
	Coniferous Sparse	✓	✓	–
	Mixedwood Dense	✓	✓	✓
	Mixedwood Open	✓	✓	✓
	Mixedwood Sparse	✓	✓	–
	Shrub Low	✓	✓	–
	Shrub Tall	✓	✓	–
	Herbaceous	✓	✓	–
	Bryoids	✓	✓	–
	Rock/Rubble	✓	✓	–
	Exposed Land	✓	✓	–
Wetland	Wetland Herbaceous	✓	–	–
	Wetland Shrub	✓	–	–
	Wetland Treed	✓	–	–
Water		✓	–	–

Notes:

✓ Land cover class considered habitat for wildlife

– Land cover class not considered habitat for wildlife

1 From EOSD NWT (NRCan and GNWT, 2017; K'alo-Stantec, 2022 [Appendix 18A])

2 Denning habitat: upland land cover classes limited to those with steep slopes ≥ 10 degrees

3 Maternal roosting habitat: upland land cover classes limited to those unburned within the past 40 years or cliff areas (> 30 degrees)

19.4.1.2 Change in Movement, Mortality Risk, and Wildlife Health

Change in movement, mortality risk, and wildlife health were assessed qualitatively through evaluating the relative change in direct and indirect sources of movement (e.g., bisecting migratory corridors), mortality (e.g., vehicle collisions, human-wildlife conflict), and wildlife health (e.g., contamination) compared to the existing condition. The qualitative assessment included a combination of literature review and professional judgment to predict effects on wildlife and wildlife habitat.

19.4.1.3 Assumptions and the Conservative Approach

A conservative approach is used to address uncertainty in the environmental effects assessment, which increases confidence in the final determination of significance. The assessment used a habitat-based approach, which focuses on identifying the quantity and composition of land cover types (i.e., habitats) affected by the Project relative to the availability of those habitats in the LAA and RAA. This approach is considered conservative as it assumes that wildlife species are present if the habitat is available, which is not always the case (e.g., some animals may not be present in a habitat recently affected by fire until the habitat returns to its pre-fire state following the vegetation successional process that require several years). Land cover classes that represent disturbed lands (i.e., exposed land) (47.8% [1,104.91 ha] of the PDA) are also included in the quantification of direct habitat loss, despite providing limited value for most wildlife species. The PDA is conservatively assumed to be lost to wildlife but there are portions that will be reclaimed, and some species will use disturbed sites. The prediction confidence of the assessment for wildlife and wildlife habitat (Section 19.7) incorporates these assumptions.

19.4.2 Change in Habitat

19.4.2.1 Effects Pathways

19.4.2.1.1 Construction

During construction, removal of upland and wetland vegetation has potential to result in direct loss or alteration of habitat within the PDA. The Project also has potential to result in indirect loss or alteration of habitat adjacent to the PDA through emissions and waste management activities (i.e., sensory disturbance and dust deposition) and through the edge effects and fragmentation created by vegetation clearing (from the construction activities in the PDA). Project-related sensory disturbance (i.e., noise and light) from most construction activities (e.g., heavy equipment operation, infrastructure construction, increased traffic volumes) can disturb wildlife and change the use of habitat around the site or road (e.g., habitat avoidance, fine-scale changes in individuals' movement and associated energetic costs).

Vegetation clearing can also result in an indirect alteration of habitats adjacent to the PDA by creating an unnatural transition (i.e., edge effects) between the PDA and adjacent habitat. Edge effects can include changes in microclimate (e.g., Murcia, 1995) and vegetation structure (e.g., Harper et al., 2005), which can result in changes in the wildlife community in those habitats. Dust deposition associated with project construction can affect vegetation composition adjacent to the PDA (e.g., Gill and Lantz, 2014), which may alter habitat use by wildlife. Indirect loss or alteration of habitat creates an area adjacent to the PDA that exhibits some degree of reduced ecological effectiveness, compared to the existing condition; this typically varies by effect pathway and wildlife species.

19.4.2.1.2 Operations and Maintenance

Operations and maintenance of the Project is not anticipated to result in the direct loss or alteration of habitat for wildlife and some disturbed habitats may become habitat for wildlife following reclamation and natural succession. Beaver dam removal may be required during bridge and culvert maintenance activities. An indirect loss or alteration of habitat is likely to occur adjacent to the PDA due to emissions (i.e., sensory distance and dust deposition) and presence of the highway (i.e., continuation of edge effects) (Table 19.8).

Sensory disturbance and dust deposition associated with activities during the operations and maintenance phase of the Project (i.e., borrow source and quarry operations, including blasting, crushing, sorting and stockpiling; material haul and stockpiling; operation of, and activities at, maintenance camps; presence of the highway) can result in reduced ecological effectiveness (i.e., indirect habitat loss) of habitats adjacent to the PDA, as described for the construction phase.

In addition, the presence and use of the highway will lead to increased traffic, which might also result in, sensory disturbance and dust deposition. These indirect effects can result in a change in habitat and have been shown to result in fine-scale changes in wildlife movements near roads (e.g., wolverine [Scrafford et al., 2018]). Presence of the highway will maintain fragmentation and edge effects over the long term that were established during the construction phase.

19.4.2.2 Mitigation

As discussed in Chapter 5, project routing and design have integrated the existing MVWR ROW, to the extent possible, which will reduce change in habitat. In addition to a project-specific WMMP that will be implemented during the construction and operations and maintenance phases, standard industry practices and mitigation measures will also be implemented and are presented in Table 19.9. Key mitigation measures to avoid or reduce change in habitat include:

- The Project will use previously disturbed areas for project activities and infrastructure and workspaces, to the extent possible.

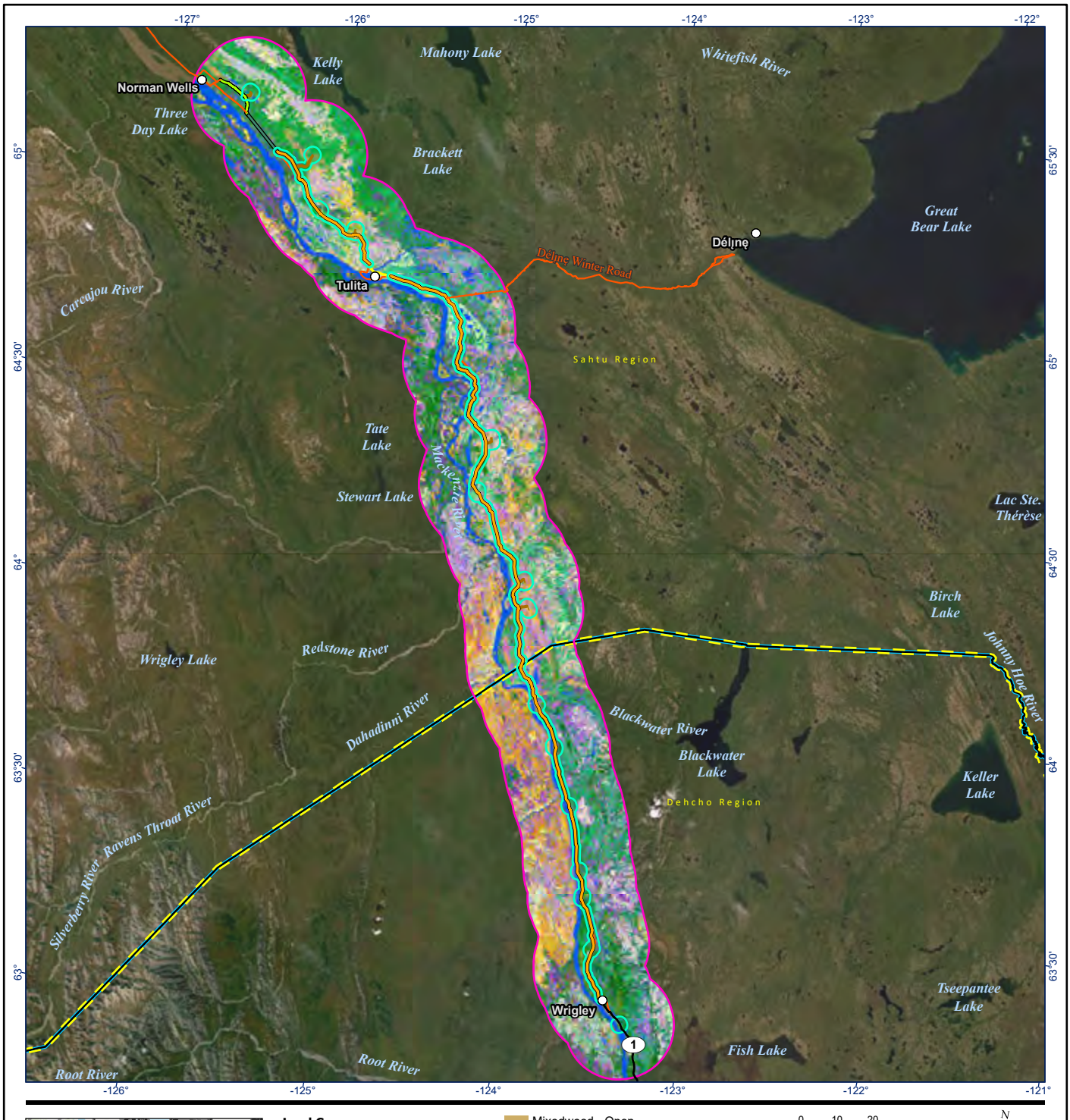
- Vegetation clearing will be completed outside the core maternity roosting period for bats of May 1 to August 31. If habitat tree removal or general tree clearing is required during the maternity roosting period, a qualified biologist will review the trees to make a determination on bat occupancy before removal. Although new bridges are not part of the Project, if bat roosts are encountered during bridge maintenance activities, site-specific mitigation will be developed in accordance with the WMMP.
- Wildlife monitors will assess for the presence of wildlife on or near the PDA during project activities.
- Personnel will undergo a wildlife awareness program, which will include prevention measures for wildlife mortality (e.g., bear safety) and reporting procedures for wildlife-related incidents and protocols to follow when a nest, den, or wildlife species of management concern is observed. This includes completing wildlife sighting and wildlife incident report forms included in the WMMP.
- Closure and reclamation will promote re-establishment of vegetation.
- Borrow source vegetated surface material, where present, will be replaced after development is completed.

19.4.2.3 Residual Effects

19.4.2.3.1 Construction

The project highway alignment routing has reduced the amount of new ROW required by primarily widening of the existing MVWR ROW (from 30 m to 60 m), where feasible. Where needed, new ROW has been designed to avoid sensitive areas and wetlands, reduce slopes and/or sharp curves to accommodate higher traffic speeds, and increase transportation safety. Construction of the Project will result in the direct loss of 2,315.2 ha of wildlife habitat within the LAA (Table 19.11), a 3.1% decrease from existing conditions. However, 47.8% (1,104.91 ha) of this direct loss is exposed land that is subject to existing anthropogenic disturbances (i.e., existing MVWR and quarries), which provide limited suitability for most wildlife species (Figure 19.2). Therefore, construction of the Project will result in the direct loss of 1,210.3 ha of natural land cover within the LAA, a 2.1% decrease from existing conditions.

Development of the PDA, including vegetation clearing, will result in a direct loss or alteration of 1,989.2 ha of upland terrestrial habitats (including 1,104.9 ha of exposed land) and 300.0 ha of wetland habitats (a change of 1.7%) within the LAA (Table 19.7). The Project will remove terrestrial habitat and, to a lesser extent, wetland habitat for wildlife. However, widening the existing MVWR for most of the Project's length will limit direct habitat loss, most of which is already subject to indirect habitat alteration due to the MVWR.



Notes

1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: GNWT (Government of the Northwest Territories) Centre for Geomatics. n.d. Inventory of Landscape Change Map Viewer. GNWT, Centre for Geomatics. n.d. Open Data, MVLWB. n.d. Public Registry, Sahtu Land and Water Board. n.d. Public Registry, Environment and Natural Resources GNWT, Government of Canada, Stantec, Wilson and Haas 2012, and Caslys Consulting Ltd.
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS. Imagery date: 2021

Land Cover

- Water
- Rock/Rubble
- Exposed Land
- Bryoids
- Shrub - Tall
- Shrub - Low
- Wetland - Treed
- Wetland - Shrub
- Wetland - Herb
- Herb
- Coniferous - Dense
- Coniferous - Open
- Coniferous - Sparse
- Broadleaf - Dense
- Broadleaf - Open
- Mixedwood - Dense
- Mixedwood - Open
- Mixedwood - Sparse

- Proposed Mackenzie Valley Highway Project Route
- Canyon Creek All Season Access Road (Constructed)
- Prohibition Creek Access Road (In Construction)
- Proposed Great Bear River Bridge
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- Local Assessment Area
- Regional Assessment Area
- Community
- Northwest Territories Highway
- Winter Road
- Region Boundary
- Settlement Area Boundary

0 10 20 Kilometres

(At original document size of 8.5x11)
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N

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Project Location
Wrigley to Norman Wells, NWT

Prepared by CES on 8/3/2023
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Mackenzie Valley Highway Project

Figure No.
19.2

Title
Land Cover Classes in the RAA

Table 19.11 Residual Change in Habitat within the LAA

Land Cover Category	Land Cover Class[1]	Existing Condition in LAA (ha)			Residual Condition in LAA (ha/% change)		
		Dehcho Region	Sahtu Region	Total	Dehcho Region	Sahtu Region	Total
Upland	Broadleaf Dense	1,037.4	2,523.1	3,560.6	1,025.8 (-1.1%)	2,448.0 (-3.0%)	3,473.9 (-2.4%)
	Broadleaf Open	114.8	1,103.9	1,218.7	112.7 (-1.8%)	1,076.9 (-2.4%)	1,189.6 (-2.4%)
	Coniferous Dense	3,374.9	917.8	4,292.6	3,335.7 (-1.2%)	899.7 (-2.0%)	4,235.3 (-1.3%)
	Coniferous Open	4,600.6	6,678.1	11,278.6	4,501.7 (-2.1%)	6,531 (-2.2%)	11,032.6 (-2.2%)
	Coniferous Sparse	3,725.0	6,332.6	10,057.7	3,682.4 (-1.1%)	6,216.4 (-1.8%)	9,898.9 (-1.6%)
	Mixedwood Dense	1,035.1	387.3	1,422.4	1,018.5 (-1.6%)	376.2 (-2.9%)	1,394.6 (-2.0%)
	Mixedwood Open	117.1	2,514	2,631.1	115.3 (-1.6%)	2,466.9 (-1.9%)	2,582.2 (-1.9%)
	Mixedwood Sparse	0.0	6.3	6.3	0.0 (0.0%)	5.8 (-8.2%)	5.8 (-8.2%)
	Shrub Low	567.4	7,903.4	8,470.9	562.5 (-0.9%)	7,757.2 (-1.8%)	8,319.9 (-1.8%)
	Shrub Tall	320.6	2,091.3	2,411.9	317.4 (-1.0%)	2,041.4 (-2.4%)	2,358.8 (-2.2%)
	Herbaceous	50.6	210.9	261.5	44.0 (-13.1%)	198.8 (-5.7%)	242.8 (-7.2%)
	Bryoids	7.0	6.2	13.2	7.0 (<0.1%)	5.8 (-6.3%)	12.8 (-3%)
	Rock/Rubble	45.1	107.3	152.4	43 (-4.6%)	103.5 (-3.6%)	146.5 (-3.9%)
	Exposed Land[3]	1,338.0	1,713.2	3,051.2	859.4 (-35.8%)	1,086.9 (-36.6%)	1,946.3 (-36.2%)
	Total	*16,333.6*	*32,495.4*	*48,829.1*	*15,625.3 (-4.3%)*	*31,241.5 (-3.9%)*	46,839.9 (-4.1%)

Land Cover Category	Land Cover Class[1]	Existing Condition in LAA (ha)			Residual Condition in LAA (ha/% change)		
		Dehcho Region	Sahtu Region	Total	Dehcho Region	Sahtu Region	Total
Wetland	Wetland Herbaceous	856.8	2,976.9	3,833.6	844.7 (-1.4%)	2,924.4 (-1.8%)	3,769.0 (-1.7%)
	Wetland Shrub	2,222.9	4,503.7	6,726.6	2,175.8 (-2.1%)	4,425.4 (-1.7%)	6,601.2 (-1.9%)
	Wetland Treed	2,218.9	4,771.6	6,990.4	2,184.4 (-1.6%)	4,696.1 (-1.6%)	6,880.5 (-1.6%)
	Total	*5,298.6*	*12,252.2*	*17,550.6*	*5,205.0 (-1.8%)*	*12,045.9 (-1.7%)*	17,250.6 (-1.7%)
Water[2]		5,187.5	3,792.3	8,979.8	5,181.5 (-0.1%)	3,772.2 (-0.5%)	8,953.7 (-0.3%)
PDA		807.9	1,507.3	2,315.2	807.9 (100%)	1,507.3 (100%)	2,315.2 (100%)

Notes:

1 From EOSD NWT (NRCan and GNWT, 2017; K'alo-Stantec, 2022 [Appendix 18A])

2 Development of the PDA is not anticipated to result in the direct loss of open water habitats and the residual condition is an artifact of the resolution of the land cover classification.

3 Exposed land includes areas which naturally have less than 5% vegetative cover, such as shorelines of rivers and lakes, exposed rock, recently burned areas, and moraines, and includes cleared areas such as the existing MVWR, Norman Wells Pipeline, and other areas of infrastructure development

Species most likely to be affected by a direct loss of habitat are those that inhabit forested and shrub habitats, such as furbearers (e.g., American marten [*Martes americana*]) and black bear (*Ursus americanus*), which are also important to current land and resource users for traditional purposes (Auld and Kershaw, 2005; DLUPC, 2006; SLUPB, 2023; SRRB, 2021). Aquatic and semi-aquatic species, such as beaver, may be displaced to other areas of suitable habitat or existing alternate lodges (Labrecque-Foy et al., 2020) if existing beaver dam or lodge removal is required, however it is anticipated that wetland habitat connectivity will remain during construction. A pre-construction beaver dam and lodge survey will be completed to determine site-specific mitigation.

Closure and reclamation of the MVWR and temporary borrow sources/quarries, camps, and workspaces are expected to recover over time due to natural revegetation or reclamation activities designed to promote vegetation communities (see Chapter 18 Vegetation and Wetlands). The recovery of vegetation communities will provide potential habitat for a variety wildlife species depending on site conditions, successional stage and species-specific habitat associations (van Rensen et al., 2015, Wilson and Bayne, 2019).

There is no formally defined SAR critical habitat that will be directly or indirectly affected by construction of the Project. There are no formally defined SAR residences that will be directly or indirectly affected by construction of the Project.

Construction of the Project will result in the direct loss of wildlife habitat within four IWAs, ranging from a decrease of 3.0% to 3.7 % (Table 19.12; Appendix 19A, Figure 3.6 [K'alo-Stantec, 2023]). Mineral lick IWAs and the Willow Lakes IWA are outside the LAA and are not anticipated to interact with the Project. Mineral licks have been reported near Bear Rock (Petınıʔah) (K'alo-Stantec, 2023; TRRC, 2022) and may interact with the Project depending on proximity to the Project .

Table 19.12 Residual Change in Important Wildlife Areas within the LAA

Important Wildlife Area	Existing Condition (ha)	Residual Condition (ha / % change)
Dehcho beaver concentration areas	27,504.5	26,662.3 (-3.1%)
Dehcho lynx concentration areas	21,355.2	20,555.8 (-3.7%)
Sahtu muskox areas	2,435.6	2,360.1 (-3.1%)
Sahtu rivers	1,999.4	1,939.4 (-3.0%)

An indirect loss or alteration of wildlife habitat is expected through sensory disturbance (i.e., noise and artificial light), dust deposition, edge effects, and fragmentation that can result in habitat avoidance and reduced habitat effectiveness for wildlife, including SAR, in areas adjacent to the PDA.

Sensory disturbance from noise and light during construction will not occur along the entire length of the Project, and instead will occur in smaller segments staggered over a period of several years. The conceptual schedule (see Sections 19.1.4.2 and 5.4.1) assumes the alignment will be constructed in three segments: Wrigley north to the Dehcho/Sahtu border (102 km); Tulita south to the Dehcho/Sahtu border (134 km); and Tulita north to the Prohibition Creek Access Road (45 km). Noise-related effects on wildlife have been reported to occur when noise levels exceed 40 dBA, resulting in avoidance by some bird species (e.g., red-eyed vireo) and amphibians (Shannon et al., 2016). However, physiological consequences (e.g., stress) to terrestrial mammals has not been identified below 52 dBA. Foraging efficiency of bats has not been adversely affected below 80 dBA (Shannon et al., 2016). Baseline noise in the region without any development or winter traffic has been estimated at 35 and 32 dBA during the day and night, respectively (IOL, 2004; see Section 13.2.2). The distance at which the noise associated with construction activities is expected to attenuate to 40 dBA is 2.0 km for road construction activities and 2.5 km for quarry and borrow source activities (see Section 13.4.2). However, measurable effects on wildlife outside of the LAA resulting from sensory disturbance are unlikely and the LAA will continue to support wildlife. Sensory disturbances associated with construction will also cease following the conclusion of construction activities in a particular segment.

Dust deposition resulting from construction of the Project can alter wildlife habitat adjacent to the PDA. Effects of dust deposition on vegetation are likely to be limited to within 40 m of the PDA (see Section 18.4; Meininger and Spatt, 1988; Gleason et al., 2007).

Edge effects and fragmentation will result from vegetation clearing activities, particularly where the PDA intersects forested habitats of the LAA. However, the existing MWVR and other exposed lands (e.g., quarries) have already created edge effects and the Project will contribute a minor additive increase because a large proportion of the preliminary alignment routing overlaps these previously disturbed lands. Project routing that predominantly follows the MVWR has also reduced the potential for adverse effects on wildlife and wildlife habitat resulting from habitat fragmentation, and core areas of large habitat patches will continue to be available in the LAA.

Indirect effects associated with sensory disturbance, dust deposition, edge effects, and fragmentation will be partially mitigated through routing that largely follows the existing MVWR already subject to these disturbances, resulting in reduced ecological effectiveness and avoidance by wildlife. Construction of the Project is anticipated to exacerbate habitat alteration within the LAA, however, by increasing the amount and duration (i.e., year-round at times) of these indirect effects. Species most likely to be affected are those that are sensitive to linear developments and/or anthropogenic disturbances, such as grizzly bear and wolverine.

An assessment of project effects relating to change in habitat on wildlife SAR (Table 19.2) is presented in the following subsections.

19.4.2.3.1.1 Little Brown Myotis

Little brown myotis forage over a wide variety of upland and wetland habitats but require different specialized habitats for maternal roosting sites and overwintering hibernacula (COSEWIC, 2013, Wilson et al., 2014). Although there are no overwintering hibernacula identified as critical habitat in the RAA (ECCC, 2018), karst topography containing caves (i.e., typical features used as overwintering hibernacula) exists within the LAA at the Bear Rock (Petınıʔah) formation north of Tulita (Appendix 19A, Section 3.2.2.5; K'alo-Stantec, 2023). Maternal roosting sites include natural features, such as tree cavities that are generally readily available, in the environment and individuals may travel hundreds of kilometres from overwintering hibernacula to maternal roosting sites for the breeding season (COSEWIC, 2013).

Construction of the Project will result in the direct loss or alteration of 102.8 ha of maternal roosting habitat (i.e., upland land cover classes unburned within the past 40 years or cliff areas > 30 degrees) within the LAA for little brown myotis, a decrease of 2.0% from baseline conditions within the LAA (i.e., 5,176.0 ha; Figure 19.3). Vegetation clearing may also result in indirect habitat loss or alteration by increasing fragmentation and creating edge effects in forest habitats adjacent to the PDA that may support breeding bats (i.e., by altering microclimate).

- Roosting Habitat
- Proposed Mackenzie Valley Highway Project Route
- Canyon Creek All Season Access Road (Constructed)
- Prohibition Creek Access Road (In Construction)
- Proposed Great Bear River Bridge
- Proposed Borrow / Rock Quarry Site and Access
- Local Assessment Area
- Regional Assessment Area
- Community
- Northwest Territories Highway
- Winter Road
- Region Boundary
- Settlement Area Boundary

0 10 20 Kilometres

(At original document size of 8.5x11)
1:1,600,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

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Mackenzie Valley Highway Project

Figure No.
19.3

Little Brown Myotis Roosting Habitat in the RAA

Notes
1. Coordinate System: NAD 1983 Northwest Territorries Lambert
2. Data Sources: GNWT (Government of the Northwest Territories) Centre for Geomatics. n.d. Inventory of Landscape Change Map Viewer, GNWT. Centre for Geomatics. n.d. Open Data, MVLWB. n.d. Public Registry, Sahtu Land and Water Board. n.d. Public Registry, Environment and Natural Resources GNWT, Government of Canada, Stantec, Wilson and Haas 2012, and Caslys Consulting Ltd.
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS. Imagery date: 2021

Little brown myotis are relatively tolerant of anthropogenic disturbance and have been shown to use anthropogenic structures for both maternal roosting sites and overwintering hibernacula (COSEWIC, 2013). Currently, little brown myotis breeding within the LAA are subject to limited amounts of anthropogenic disturbance during the breeding season when the MVWR is not in operation. Sensory disturbance associated with construction activities can alter bat activity adjacent to chronic industrial noise (Bunkley et al., 2015) and highway construction (The California Department of Transportation, 2016). However, bats use natural and anthropogenic linear features for commuting and foraging and have been shown to tolerate noise roadways (Abbott et al., 2012); yet in some cases bats have been shown to avoid foraging near busy roadways (Finch et al., 2020).

19.4.2.3.1.2 Grizzly Bear

Grizzly bears are habitat generalists, using a wide variety of tundra, alpine, subalpine, and semi-forested boreal habitats. Denning site and food availability are key habitat requirements (COSEWIC, 2012; SARC, 2017). Denning sites are sensitive to disturbance and are generally found on well-drained, steep slopes where bears may remain in hibernation for over six months (McLoughlin et al., 2002, COSEWIC, 2012; SARC, 2017). Although grizzly bear den sites are frequently found on south facing slopes (McLoughlin et al., 2002, SARC, 2017), grizzly bears also select den sites with cooler aspects (e.g., east, north) (McLoughlin et al., 2002, Smereka et al., 2017). Construction of the Project will result in the direct loss or alteration of 140.9 ha of denning habitat (i.e., upland land cover classes with slopes ≥ 10 degrees) within the LAA for grizzly bear, a decrease of 2.9% from baseline conditions within the LAA (i.e., 4,794.9 ha; Figure 19.4). A direct loss of 2.9% of habitat in the LAA is considered a low magnitude residual effect (i.e., less than 5% change; see Table 19.3).

Grizzly bear may be attracted to cleared sites where there is increased forage availability (which may have survival consequences); but in general, the species is sensitive to, and is likely to avoid, anthropogenic disturbance (COSEWIC, 2012; SARC, 2017). Direct habitat loss will result in a relatively small amount of habitat loss for grizzly bear; most affected habitats are previously disturbed due to the MVWR and existing quarries. Indirect habitat loss due to sensory disturbance during construction can also affect grizzly bear, particularly denning females (SARC 2017). Overall, indirect habitat loss due to sensory disturbance is not expected to result in a measurable change in the abundance of grizzly bear in the LAA; however, temporary local shifts in distributions in the LAA might occur (see Table 19.3).

Sensory disturbance is expected to decrease in the LAA when the noise levels and human activity associated with construction activities are completed within each segment of the PDA. In the NWT, effects of habitat fragmentation on grizzly bear are expected to be low (SARC, 2017) and there is a low density of linear features within the LAA to promote fragmentation.

- Denning Habitat
- Proposed Mackenzie Valley Highway Project Route
- Canyon Creek All Season Access Road (Constructed)
- Prohibition Creek Access Road (In Construction)
- Proposed Great Bear River Bridge
- Proposed Borrow / Rock Quarry Site and Access
- Local Assessment Area
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Figure No.
19.4

Title
Grizzly Bear Denning Habitat in the RAA

Notes
1. Coordinate System: NAD 1983 Northwest Territorries Lambert
2. Data Sources: GNWT (Government of the Northwest Territories) Centre for Geomatics. n.d. Inventory of Landscape Change Map Viewer, GNWT. Centre for Geomatics. n.d. Open Data, MVLWB. n.d. Public Registry, Sahtu Land and Water Board. n.d. Public Registry, Environment and Natural Resources GNWT, Government of Canada, Stantec, Wilson and Haas 2012, and Caslys Consulting Ltd.
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS. Imagery date: 2021

19.4.2.3.1.3 Wolverine

Wolverines are habitat generalists that use a wide variety of boreal and tundra habitats and are typically distributed relative to the availability of a diverse prey base, which includes small mammals and large ungulates (e.g., caribou), rather than specific habitat types (COSEWIC, 2014a; SARC, 2014). Wolverines tend to avoid anthropogenic disturbance (COSEWIC, 2014a), particularly high densities of linear features (e.g., Krebs et al., 2007; Bowman et al., 2010) or those that result in increased recreational activity and human presence; however, they have also been shown to be tolerant of some human activity disturbance when a concentrated food source is available (e.g., Heinemeyer et al., 2017). The winter denning period (February-March) is a critical period for wolverine, and they are particularly sensitive to disturbance during this time (SARC, 2014).

Direct habitat loss will result in a relatively small amount of habitat loss for wolverine; most affected habitats are already subject to disturbance from the MVWR and existing quarries (although dens would be occupied prior to the seasonal opening of the MVWR). Sensory disturbance associated with construction activity also can affect wolverine, particularly denning females, which are known to abandon dens if human activity is nearby (Pulliainen, 1968). However, a measurable change in the abundance of wolverine in the LAA is not anticipated, although temporary local shifts in distributions in the LAA might occur.

Sensory disturbance will cease following the conclusion of construction activities in a particular portion of the LAA (i.e., up to five years). In the NWT, effects of habitat fragmentation on wolverine are expected to be low (SARC, 2014) and there is a low density of linear features within the LAA promoting fragmentation. Wolverine has been assessed as not at risk in the NWT and the species' population has been stable-to-increasing, with reported northward range expansion (SARC, 2014).

19.4.2.3.1.4 Invertebrates

Invertebrate SAR/SOCC (Table 19.4) have broad distributions in Canada and in western NWT and are habitat generalists, occupying a variety of habitats such as meadows, riparian areas, and coniferous forests (COSEWIC, 2014b, 2015, 2016, 2020). Open habitats along the edges of the MVWR ROW (i.e., ditches) that support preferred vegetation communities and flowering plants are likely to provide habitat for invertebrates. Construction of the Project is expected to temporarily remove much of the existing habitat along the MVWR (i.e., through widening of the MVWR). But once construction has been completed, habitat for invertebrates is expected to return to its existing condition following a period of regrowth.

19.4.2.3.1.5 Characterization of Residual Effects for Change in Habitat During Construction

Following the implementation of mitigation measures, residual effects for general wildlife habitat, little brown myotis, grizzly bear, and invertebrate SAR/SOCC are summarized in Table 19.13. The overall residual effects for change in habitat during construction are characterized by the following:

- **Direction is adverse:** There will be a direct and indirect loss or alteration of wildlife habitat
- **Likelihood is certain**: The residual effect will certainly occur
- **Magnitude is low**: Direct loss will result in a < 10% change in wildlife habitat and a < 5% change SAR and SOCC habitat; indirect loss or alteration is not anticipated to result in a measurable change in the abundance of any wildlife species in the LAA, although temporary local shifts in distributions in the LAA might occur
- **Geographic extent is the LAA:** Direct and indirect loss or alteration of habitat associated with sensory disturbance is unlikely to exceed the LAA
- **Timing is high sensitivity:** Although vegetation clearing will occur in the winter, construction will likely occur through the year, including during sensitive periods for wildlife
- **Duration is medium- to long-term:** Sensory disturbance will cease following the construction phase (i.e., up to 20 years) but edge effects and fragmentation will persist into the operations and maintenance phase (i.e., > 20 years)
- **Frequency is continuous:** Effects will occur throughout the construction phase
- **Change is irreversible:** Sensory disturbance will cease following the construction phase, but most effects associated with direct and indirect habitat loss or alteration will persist throughout the life of the Project

19.4.2.3.2 Operations and Maintenance

A direct loss of wildlife habitat is not expected to occur during the operations and maintenance phase of the Project, but beaver dam removal may occasionally be required to maintain proper bridge and culvert operations and avoid flooding. Presence of the highway will maintain fragmentation and edge effects over the long term that were established during the construction phase. Vegetation control within the ROW will occur approximately every three years and will involve mowing dense shrub growth, which could remove habitat for some wildlife species, but the conservative approach taken in this assessment assumes the ROW provides no habitat for wildlife.

Sensory disturbances associated with the presence of the highway, highway and access road maintenance, vegetation control, and bridge and culvert maintenance may also occur. Noise-related effects on wildlife have been reported to occur when noise levels exceed 40 dBA, resulting in avoidance by some bird species (e.g., red-eyed vireo) and amphibians (Shannon et al., 2016). However, physiological consequences (e.g., stress) to terrestrial mammals has not been identified

below 52 dBA, and foraging efficiency of bats has not been adversely affected below 80 dBA (Shannon et al., 2016). The distribution of wildlife relative to linear disturbances can also vary over time and space. For example, while American marten have been shown to avoid open areas (Hargis et al., 1999; Slough, 1988; Lofroth and Steventon, 1990) and roads (Robitaille and Robitaille, 2000), they have also been shown to disperse across expanses of open habitat (Buskirk, 2002) and use linear features as travel corridors (Tigner et al., 2015).

Baseline noise in the region that was assessed in remote areas without any development or winter traffic has been estimated at 35 and 32 dBA during the day and night, respectively (IOL, 2004; see Section 13.2.2). Expected traffic volume is 50 vehicles per day for an indeterminate time, whereas the MVWR experiences the same daily volume but only for the winter. The distance at which noise associated with operations and maintenance activities are expected to attenuate to 40 dBA is 100 m for highway traffic and 2.5 km for quarry and borrow source activities (see Section 13.4.2), which are only expected to occur irregularly. Also, it is anticipated that quarries and borrow sources will not be operated at night; in general, noise emissions at night during the operations and maintenance phase are expected to be minor. Overall, most studies show the effects of roads on mammals to not extend beyond 500 m (Benitez-Lopez et al., 2010).

Highway and access road maintenance, vegetation control, and bridge and culvert maintenance are anticipated to occur infrequently and will contribute a negligible incremental increase in sensory disturbance.

Dust deposition during the operations and maintenance phase will continue to affect vegetation adjacent to the PDA, as described during the construction phase (i.e., within approximately 40 m of the PDA), which includes the potential for altering vegetations communities over time (e.g., increased herbaceous and deciduous tree and shrub habitats, reduction in mosses and lichens; see Section 18.4.2.1).

Presence of the highway during the operations and maintenance phase of the Project, including sensory disturbance, dust deposition, fragmentation, and edge effects, can collectively reduce the ecological effectiveness of wildlife habitat adjacent to the PDA. However, this is expected to be a relatively small incremental increase compared to the existing conditions. While some species may avoid the LAA, particularly habitats close to the PDA, the LAA will continue to support wildlife without disrupting natural population cycles. Edge habitats are likely to provide increased forage opportunities for some wildlife species (e.g., black bear, muskox).

19.4.2.3.2.1 Little Brown Myotis

Sensory disturbance and dust deposition resulting from vehicular traffic during the operations and maintenance phase of the Project, along with maintenance of habitat fragmentation and edge effects, can reduce habitat effectiveness for breeding bats adjacent to the PDA. Currently, little brown myotis breeding within the LAA are subject to limited amounts of anthropogenic disturbance during the breeding season when the MVWR is not in operation. However, sensory disturbance associated with operations and maintenance of roads can alter bat activity (The California Department of Transportation, 2016). Bats use natural and anthropogenic linear features

for commuting and foraging and have been shown to tolerate noise roadways (Abbott et al., 2012); however, in some cases bats have been shown to avoid foraging near busy roadways (Finch et al., 2020). In addition, bats might use existing bridges as potential roosting sites (GNWT 2022), which could result in disturbance during bridge maintenance activities if scheduled to occur during the active bat season. If bridge maintenance activities are scheduled to occur during the active bat season, mitigation measures (e.g., timing, deterrents) will be implemented to reduce potential disturbance. Overall, operations and maintenance activities are unlikely to produce similar amounts and volumes of noise emitted by the examples previously cited.

19.4.2.3.2.2 Grizzly Bear

Sensory disturbance and dust deposition resulting from vehicular traffic during the operations and maintenance phase of the Project, along with maintenance of habitat fragmentation and edge effects, can reduce habitat effectiveness for grizzly bear adjacent to the PDA (similar to the effects described for the construction phase). Grizzly bear may be attracted to roadway ditches where there is increased forage availability and adverse effects associated with dust deposition altering vegetation communities. However, in general, the species is sensitive to, and is likely to avoid, anthropogenic disturbance (COSEWIC, 2012; SARC, 2017).

The distance at which noise associated with operations and maintenance activities are expected to attenuate to 40 dBA is 100 m for highway traffic and 2.5 km for quarry and borrow source activities (see Section 13.4.2). Denning females may be particularly sensitive to disturbance; however, females currently select den sites each year prior to opening of the MVWR and are then subject to sensory disturbance over the winter. During the operations and maintenance phase of the Project, traffic will occur year-round and there will be no disturbance to denning initiated part way through the critical denning period. Although noise associated with quarry and borrow source activities would result in relatively higher levels of potential sensory disturbance to female bears denning nearby, operations and maintenance activities at these sites are expected to occur infrequently.

19.4.2.3.2.3 Wolverine

Sensory disturbance and dust deposition resulting from vehicular traffic during the operations and maintenance phase of the Project, along with maintenance of habitat fragmentation and edge effects, can reduce habitat effectiveness for wolverine adjacent to the PDA (similar to the effects described for the construction phase). The distance at which noise associated with operations and maintenance activities is expected to attenuate to 40 dBA is 100 m for highway traffic and 2.5 km for quarry and borrow source activities (see Section 13.4.2). Denning females may be particularly sensitive to disturbance; however, females currently select den sites each year prior to opening of the MVWR and are then subject to sensory disturbance over the winter.

During the operations and maintenance phase of the Project, traffic will occur year-round and there will be no disturbance to denning initiated part way through the critical denning period. Risks to denning females are higher near the quarries and borrow sources, which will be used infrequently but which will be a greater source of sensory disturbance. Dust deposition may alter vegetation communities adjacent to the PDA, but wolverine is typically not distributed relative to cover type.

19.4.2.3.2.4 Invertebrates

Sensory disturbance and dust deposition resulting from vehicular traffic during the operations and maintenance phase of the Project, along with maintenance of habitat fragmentation and edge effects, are unlikely to reduce habitat effectiveness for invertebrate SAR/SOCC adjacent to the PDA. As habitats within (i.e., ditches) and adjacent to the PDA mature, it is expected that more open habitat types that support preferred food plants will become established, comparable to existing conditions along the MVWR.

19.4.2.3.2.5 Characterization of Residual Effects for Change in Habitat During Operations and Maintenance

Following the implementation of mitigation measures, residual effects during operations and maintenance for general wildlife habitat, little brown myotis, grizzly bear, wolverine and invertebrate SAR/SOCC are summarized in Table 19.13 and overall residual effects for change in habitat during operations and maintenance are characterized by the following:

- **Direction is adverse:** There will be an indirect loss or alteration of wildlife habitat.
- **Likelihood is possible**: The residual effect could occur.
- **Magnitude is low**: Indirect loss or alteration is not anticipated to result in a measurable change in the abundance of any wildlife species in the LAA, although temporary local shifts in distributions in the LAA might occur.
- **Geographic extent is the LAA:** Indirect loss or alteration of habitat associated with sensory disturbance is unlikely to extend beyond the LAA.
- **Timing is high sensitivity:** Operations and maintenance of the Project will occur year-round.
- **Duration is long-term:** The residual effect on wildlife habitat will persist into the operations and maintenance phase (i.e., > 20 years).
- **Frequency is continuous:** Effects will occur throughout the operations and maintenance phase.
- **Change is irreversible:** Effects are irreversible due to the indefinite duration of operations and maintenance of the Project.

Table 19.13 Summary of Residual Effects on Change in Habitat

Wildlife Species	Residual Effects Characterization*								
	Project Phase	Direction	Likelihood	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
General Wildlife Habitat	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Little Brown Myotis	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Grizzly Bear	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Wolverine	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Invertebrate	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	U	L	LAA	HS	LT	C	I

KEY

*See Table 19.3 for detailed definitions

Project Phase
C: Construction
O: Operations and maintenance

Direction:
A: Adverse
N: Neutral

Likelihood:
U: Unlikely
P: Possible
CE: Certain

Magnitude:
No: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Timing
NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

19.4.3 Change in Movement

19.4.3.1 Effect Pathways

Effects on fine-scale wildlife movements (e.g., avoidance) are considered under change in habitat (Section 19.4.2; i.e., reduced habitat effectiveness). The following section considers potential effects on wildlife movement patterns (e.g., seasonal migrations) and movement corridors that may result from the combined effects of a physical (i.e., the all-season road) and sensory barrier to wildlife.

19.4.3.1.1 Construction

All project activities during the construction phase, except for employment and contracted goods and services, can contribute to a change in movement (Table 19.8). Sensory disturbance associated with the emissions and waste management activity (i.e., noise and light) is a pathway for a change in movement, as is the general construction activity and the creation of a wider linear feature. These project activities can create physical or sensory barriers that may temporarily affect wildlife movement in the LAA.

The ability to move between resource patches is important for species' persistence; barriers can reduce access to key resources, lead to range shifts, and alter seasonal movement patterns and dispersal events (Ament et al., 2014; Nathan et al., 2008; Johnson et al., 1992). Increased noise levels can also result in decreased opportunity costs (i.e., time), increased exposure (Beyer et al., 2014), and increased energy expenditure, especially during winter when energy costs are relatively higher (Bradshaw et al., 1998, Saher and Schmiegelow, 2005). The extent to which construction activities alter wildlife movement in the LAA will vary by the duration, frequency, and intensity (e.g., noise level) of disturbance, as well as by wildlife species. The Project is most likely to alter movement for small mammal species that have limited dispersal capabilities.

In addition to upgrading the existing MVWR to a wider ROW (from 30 m to 60 m) for most of the length of the Project, there will be some creation of new highway ROW, in addition to quarries, borrow sources, and access roads, which contribute to increased habitat fragmentation. During construction, the physical presence of these features may present a barrier to wildlife; however, many of the sources of sensory disturbance will only occur seasonally.

19.4.3.1.2 Operations and Maintenance

As with the construction phase, all project activities during the operations and maintenance phase, except for employment and contracted goods and services, can contribute to a change in movement (Table 19.8). The presence of the highway may create a physical barrier to wildlife movement, and the associated highway traffic and other operations and maintenance activities can reduce barrier permeability due to contributions of sensory disturbance. Sensory disturbances associated with the operations and maintenance of the highway, including the associated public vehicle traffic, will become year-round pathways of effects that can result in a change in wildlife movement. Snow clearing may also present a physical barrier to some wildlife species that have difficulty crossing snow ridges adjacent to the highway.

19.4.3.2 Mitigation

As discussed in Chapter 5, project routing and design have integrated the existing MVWR, to the extent practicable, which will reduce potential project interactions with change in movement. In addition to the project-specific WMMP that will be implemented during the construction and operations and maintenance phases, standard industry practices and mitigation measures will also be implemented and are presented in Table 19.9. Key mitigation measures to avoid or reduce change in movement include:

- A buffer strip of undisturbed vegetation of at least 30 m wide will be maintained between the highway ROW and other new areas to be cleared.
- Vegetation buffers will be used as visual barriers and to protect riparian vegetation, as appropriate.
- Drainage culverts will be constructed along the roadway to facilitate water movement and maintain drainage patterns.
- The height of snowbanks will be limited to the extent possible and to a height of less than 1 m.
- Construction and quarry development activities will adhere to the applicable recommended setbacks and timing restrictions for wildlife outlined in the WMMP, where possible.
- Closure and reclamation will promote re-establishment of vegetation.

19.4.3.3 Residual Effects

19.4.3.3.1 Construction

Project routing has been used to reduce the amount of new ROW required, primarily involving widening of the existing MVWR ROW (from 30 m to 60 m) and the creation of new ROW that is limited to specific areas to reduce slopes and/or sharp curves to accommodate higher traffic speeds and increase safety on the highway. The Project also includes new access roads (30 m wide ROW) that will be developed for the borrow sources and quarries.

Construction of the Project can result in the alteration of wildlife movement, including traditional or seasonal movement corridors, over space and time for some wildlife species through the modification or development of the PDA (i.e., a physical barrier) and through sensory disturbance from vehicles, equipment, and personnel. A reduction in barrier permeability (i.e., the PDA may become more difficult to cross) is possible for less mobile species (e.g., small mammals, amphibians). However, because the Project predominately involves widening an existing linear feature that is used for part of the year, this is expected to be a relatively minor change to wildlife movement for some wildlife species. Aquatic habitats will remain connected through the construction of culverts and maintenance of existing bridges, which will facilitate movement for aquatic and semi-aquatic species (e.g., beaver).

Construction will be completed in sections and effects associated with sensory disturbance are expected to be localized and short-term in any given location. Two existing quarries proposed for use on the Project overlap two muskox IWAs (i.e., areas that consistently contain a relatively high number of individuals) near Norman Wells (Appendix 19A, Figure 3.6; K'alo-Stantec, 2023). As such, there is potential for the Project to temporarily affect local movement of muskox during construction; however, proposed mitigation (timing and setback distances) are expected to reduce potential effects associated with sensory disturbance. Overall, construction will be completed in sections and effects associated with sensory disturbance are expected to be localized and short-term in any given location.

Following the implementation of the mitigation measures, residual effects for change in wildlife movement during construction are characterized as follows:

- **Direction is adverse:** Construction activities may alter wildlife movements.
- **Likelihood is possible**: The residual effect could occur.
- **Magnitude is low**: A measurable change in the abundance of wildlife in the LAA is unlikely, although temporary local shifts in distributions in the LAA might occur.
- **Geographic extent is the LAA:** Residual effects will not extend into the RAA.
- **Timing is high sensitivity:** Although vegetation clearing will occur in the winter, construction will likely occur through the year, including during sensitive periods for wildlife.
- **Duration is medium- to long-term:** Sensory barriers will cease following the construction phase (i.e., up to 20 years) but physical barriers may persist throughout the life of the Project (i.e., >20 years).
- **Frequency is continuous:** Effects will occur throughout the construction phase.
- **Change is irreversible:** Effects are irreversible due to the indefinite duration of the operations and maintenance phase.

Operations and maintenance of the Project might result in the alteration of wildlife movement for certain species (e.g., wolverine [see Scrafford et al., 2018]), as the presence of the highway and associated traffic will present year-round disturbance (i.e., estimated 50 vehicles/day). Wildlife currently interact with the existing MVWR, which might act as a permeable, semi-permeable or impermeable barrier depending on species-specific road avoidance behaviours. Although the Project will result in a small incremental increase in the width of the road, an increase in traffic volume even at relatively low levels can affect wildlife movement depending on species (Mace et al. 1996, Beyer et al 2014, Scrafford et al. 2018). Additionally, snow clearing is already part of existing MVWR operations and maintenance activities, and snow berm heights will remain below 1 m for the larger all-season road. The potential effects of the Project on wildlife movement will be monitored as part of the WMMP.

Following the implementation of the mitigation measures, residual effects for change in wildlife movement during operations and maintenance are characterized as follows:

- **Direction is adverse:** Operations and maintenance activities may alter wildlife movements.
- **Likelihood is possible**: The residual effect could occur.
- **Magnitude is low**: A measurable change in the abundance of wildlife in the LAA is unlikely, although temporary local shifts in distributions in the LAA might occur.
- **Geographic extent is the LAA:** Residual effects will not extend into the RAA.
- **Timing is high sensitivity:** The Project will operate indeterminately, including during sensitive periods for wildlife.
- **Duration is long-term:** Effects on movement will persist during the operations and maintenance phase (i.e., > 20 years).
- **Frequency is continuous:** Effects will occur throughout the operations and maintenance phase.
- **Change is irreversible:** The Project will operate indeterminately.

19.4.4 Change in Mortality Risk

19.4.4.1 Effect Pathways

19.4.4.1.1 Construction

All project activities during the construction phase, except for employment and contracted goods and services, can contribute to a direct change in mortality risk as they involve the removal of upland and wetland habitats (i.e., vegetation clearing, ground disturbance) and/or the movement of machinery and traffic within the PDA (Table 19.8). Vegetation clearing and ground disturbance is most likely to increase mortality risk for less mobile wildlife species (e.g., rodents, amphibians), those that burrow/hibernate beneath the surface (e.g., black bear), or those that inhabit trees (e.g., bats). Project-related transportation and heavy equipment also can crush or collide with less mobile wildlife (e.g., amphibians). Accidental human-caused mortality is more likely in areas where amphibians are concentrated such as breeding ponds/waterbodies or overwintering sites (CMA 2017). Human-wildlife encounters or conflicts (e.g., food waste, garbage) may occur, primarily at camps, which can lead to wildlife mortality through trapping of rodents or destroying larger problem wildlife species such as black bear or red fox.

19.4.4.1.2 Operations and Maintenance

All project activities during the operations and maintenance phase, except for employment and contracted goods and services, have the potential to contribute to a direct and/or indirect change in mortality risk (Table 19.8). During operation, project-related transportation within the LAA and public traffic resulting from the presence of the highway are the primary pathways with potential to increase wildlife mortality risk by increasing the potential for vehicle-wildlife collisions and

mortality, primarily along the highway portion of the PDA (i.e., risk is lower along access roads). Wildlife may also encounter traffic and heavy machinery associated with maintenance activities. Wildlife species most at risk include small (e.g., rodents, snowshoe hare) and large (e.g., muskox, black bear) mammals that may cross the highway or be attracted to the PDA, where an altered vegetation community provides an abundance of forage or where the road provides a mineral source for wildlife.

The presence of the highway and other linear features (e.g., borrow source and quarry access roads) can result in an indirect change in mortality risk for some species. Increased access for predators and hunters/trappers is the primary pathway for an indirect change in mortality risk. The Project will enhance access along a continuous linear feature that may increase predator efficiency and hunter/trapper ease of travel while providing all-season access to portions of the LAA that were previously more isolated. Species most like to be affected include prey species and harvested species such as furbearers (e.g., American marten) and muskox, or those attracted to an abundance of forage along the PDA (e.g., black bear, grizzly bear).

19.4.4.2 Mitigation

As discussed in Chapter 5, project routing and design have integrated the existing MVWR, to the extent practicable, which will reduce potential project interactions with wildlife, resulting in change in mortality risk. In addition to a Project-specific WMMP that will be implemented during the construction and operations and maintenance phases, standard industry practices and mitigation measures will also be implemented and are presented in Table 19.9. Key mitigation measures to avoid or reduce change in mortality risk include:

- Vegetation clearing will be completed outside the core maternity roosting period for bats of May 1 to August 31. If habitat tree removal or general tree clearing is required during the maternity roosting period, a qualified biologist will review the trees to make a determination on bat occupancy before removal.
- Wildlife monitors will assess for the presence of wildlife on or near the PDA during project activities, in accordance with the WMMP.
- Personnel will undergo a wildlife awareness program, which will include prevention measures for wildlife mortality (e.g., bear safety) and reporting procedures for wildlife-related incidents and protocols to follow when a nest, den, or wildlife species of management concern is observed. This includes completing wildlife sighting and wildlife incident report forms included in the WMMP.
- Personnel will not feed or harass wildlife while working on the Project.
- Project personnel will be prohibited from hunting and fishing while housed in work camps for the Project.
- Construction and quarry development activities will be limited during sensitive periods for wildlife in accordance with the WMMP.
- Food and other wildlife attractants will be stored in bear-proof containers.

- Equipment, wastes, and contaminated soils will be removed once construction is completed.
- Speed limits will be posted on the public highway.

19.4.4.3 Residual Effects

19.4.4.3.1 Construction

Construction activities, including vegetation clearing and earthworks, will follow mitigation measures that consider timing restrictions for wildlife species, including sensitive periods for overwintering mammals. Vegetation clearing will be timed to reduce potential effects on little brown myotis bats as they will have dispersed from maternity roosts prior to the start of clearing activities.

During construction, there is potential for increased mortality risk to small mammals due to their limited mobility (e.g., crushed by construction equipment). Overwintering mammals are also at greater risk as they may encounter heavy machinery during ground disturbance activities. A pre-construction bear den survey will be completed, and appropriate timing restrictions and setback buffers will be applied to reduce mortality risk to denning black and grizzly bears.

Vehicle-related wildlife mortality has the potential to affect a wider range of species, including SAR and SOCC. While traffic volumes will increase during construction, speeds will remain slow and will limit the risk of vehicle-wildlife collisions. Vehicles will abide by posted speed limits and multi-passenger vehicles will be used, where practical, to reduce the potential for vehicle-wildlife collisions. Species most likely to be involved in vehicle-wildlife collisions are small mammals (e.g., rodents) and large mammals attracted to the PDA that provide increased foraging opportunities (e.g., black bear, muskox). Proper management of wastes, including at temporary camps, will reduce the potential for wildlife to be attracted to the construction site (e.g., black bear), thus reducing the potential for mortality risk related to human-wildlife conflict.

Following the implementation of the mitigation measures, residual effects for change in mortality risk during construction are characterized as follows:

- **Direction is adverse:** Construction activities will increase wildlife mortality risk.
- **Likelihood is possible**: The residual effect could occur.
- **Magnitude is low**: A measurable change in the abundance of wildlife in the LAA is unlikely, although temporary local shifts in distributions in the LAA might occur.
- **Geographic extent is the LAA/RAA**: Direct mortality risk limited to LAA; however, indirect mortality risk could extend to the RAA.
- **Timing is high sensitivity:** Although vegetation clearing will occur in the winter, construction will occur through the year, including during sensitive periods for wildlife.
- **Duration is medium- to long-term:** Direct effects will cease following the construction phase (i.e., up to 20 years) but indirect effects will persist into the operations and maintenance phase (i.e., > 20 years).

- **Frequency is multiple irregular event:** construction activities may result in direct and/or indirect wildlife morality, but potential mortalities are expected to occur infrequently at no set schedule following the implementation of mitigation measures.
- **Change is irreversible:** Effects are irreversible due to the indefinite duration of operation of the Project.

19.4.4.3.2 Operations and Maintenance

A direct change in mortality risk is most likely to occur through the presence of the highway and the associated traffic (i.e., through wildlife-vehicle collisions), which is generally an effect driven by both traffic volume and speed. The MVWR has an approximate average traffic load of 50 vehicles per day, driving 50 km/h or less, and is open from December 23 to March 28 between Wrigley and Tulita and from December 25 to April 1 between Tulita and Norman Wells (20-year average; see Section 5.3.1).

Species most likely to be affected are those that that are attracted to mineral deposits or the altered vegetation communities along the PDA that provide an abundance of forage (e.g., muskox, black bear). The highway will allow for increased traffic speeds, which may increase wildlife mortality risk, but the widening of the ROW and maintenance and removal of dense brush along the highway ditches will improve visibility of wildlife, which will reduce collision and mortality risk. Mortality risk associated with other maintenance activities will result from increased traffic volumes or the use of heavy machinery will generally occur infrequently and is anticipated to result in a negligible change in mortality risk.

An indirect change in mortality risk is likely to occur as the Project will provide all-season access to the LAA for hunters and trappers, and by altering predator-prey dynamics. Linear features provide an efficient mechanism to move across the landscape that also provides relatively clear, elevated sightlines that are desirable to resource users and predators. There may be areas along the MVWR that were previously more difficult to access outside of the winter season, which may experience increased hunting and trapping pressure once the Project is operational. Similarly, linear features have the potential to increase predator efficiency. Mineral deposits and altered vegetation communities along the ROW may increase the presence of species such as moose, that in turn results in an increased presence of gray wolf, which can increase predation pressure on other wildlife species in the LAA.

While there is potential for increased harvest pressure due to increased access to areas proximal to the Project, the relative increase in the number of harvesters, the species to be harvested and the spatial distribution of increased harvest cannot be predicted. This uncertainty and the need for additional monitoring is discussed in Sections 19.7.2 and 19.8.

Following the implementation of the mitigation measures, residual effects for change in mortality risk during operations and maintenance are characterized as follows:

- **Direction is adverse:** Operations and maintenance activities will increase mortality risk.
- **Likelihood is possible**: The residual effect could occur.
- **Magnitude is low**: A measurable change in the abundance of wildlife in the LAA is unlikely, although temporary local shifts in distributions in the LAA might occur.
- **Geographic extent is the LAA**: Residual effects will not extend into the RAA.
- **Timing is high sensitivity:** The Project will operate indeterminately, including during sensitive periods for wildlife.
- **Duration is long-term:** The residual effect will persist during the operations and maintenance phase (i.e., > 20 years).
- **Frequency is multiple irregular event:** operations and maintenance activities may result in direct and/or indirect wildlife morality, but potential mortalities are expected to occur infrequently at no set schedule following the implementation of mitigation measures.
- **Change is irreversible:** The Project will operate indeterminately.

19.4.5 Change in Wildlife Health

19.4.5.1 Effect Pathways

An exposure pathway must be present for there to be an increased risk to wildlife health, and includes the ingestion of soil, sediment, food, or water and/or direct contact with soil, sediments, or water that may contain contaminants. The effect pathways that may result in a change in wildlife health include:

- Deposition of rock and dust may release contaminants into the surrounding terrestrial and aquatic environment during extraction (e.g., blasting, stockpiling), crushing, transport, and road construction and operations and maintenance.
- Sedimentation and runoff from project activities may release contaminants into surface water, affecting aquatic flora and fauna.

Increasing abundance of bear populations is associated with growing concerns raised by harvesters, including the consumption of potentially contaminated bear meat from bears that forage in dumps or other contaminated sites (Dehcho First Nations, 2011). Dehcho First Nations also expressed concerns regarding wildlife contaminated through exposure to oil and other contaminants to the environment (Dehcho First Nations, 2011).

Sensory disturbance during the construction and operations and maintenance phases of the Project may adversely affect the physical condition of wildlife through increased stress and energy expenditure resulting in a change in wildlife health (Gaynor et al., 2019).

19.4.5.1.1 Construction

During construction, potential effects on wildlife health may occur within the LAA due to one or more of the exposure pathways including site preparation of ROW, access and workspaces, culvert installations, as well as emissions and waste management (Table 19.8). Construction associated with site preparation of ROW, access, and workspaces and embankment and quarry access road construction, including road cuts and culvert installations activities, will occur adjacent to aquatic habitats and have potential to reduce surface water quality in aquatic environments through sedimentation and runoff.

19.4.5.1.2 Operations and Maintenance

As described for the construction phase, there are many activities in the operations and maintenance phase that are likely to result in pathways that are considered under the emissions and waste management activity. During operation, the sedimentation and runoff exposure pathway is not anticipated to result in a change in wildlife health, but deposition of dust will persist and the presence of the highway and associated public traffic is the primary pathways for dust to enter the terrestrial and aquatic environments. Potential effects associated with air emissions from vehicular traffic (i.e., 50 vehicles/day) is not anticipated to result in a change in wildlife health.

19.4.5.2 Mitigation

As discussed in Chapter 5, project routing and design have integrated the existing MVWR, to the extent practicable, which will reduce potential project interactions with change in wildlife health. In addition to a project-specific WMMP that will be implemented during the construction and operations and maintenance phases, standard industry practices and mitigation measures will also be implemented and are presented in Table 19.9. Key mitigation measures to avoid or reduce change in wildlife health include:

- The SCP will include procedures to prevent and respond to spills.
- Maintenance yards will have a liner or concrete installed under areas of vehicle storage and maintenance.
- Vehicles parked for more than 2 hours will use drip trays.
- Placement of embankment will occur primarily during winter (December 15 to April 1), during frozen conditions. If work is to be completed under non-frozen conditions, equipment will be equipped with mushroom shoes.
- A project-specific ESCP will be developed and implemented.
- Washing, refueling, and servicing machinery and storage of fuel and other materials for machinery will be conducted a minimum of 100 m from the high-water mark and in a manner to prevent any deleterious substances from entering the water.
- Blast rock will not enter a waterbody or watercourse.

- A dust control program using water will be implemented during construction and operations and maintenance.
- Equipment, wastes, and contaminated soils will be removed once construction is completed.

19.4.5.3 Residual Effects

19.4.5.3.1 Construction

During construction, there is potential for increased risk to wildlife health through the mobilization of sediment into aquatic habitats and dust deposition.

The Project will follow applicable regulatory requirements and the application of mitigation measures for aquatic resource protection, which will reduce risks to wildlife and wildlife habitat and potential effects are anticipated to be negligible.

Dust deposition is expected to result in minor and localized changes to vegetation and wildlife habitat adjacent to the PDA (i.e., within 40 m; Section 19.4.2.3). Dust deposition resulting from construction activities is not anticipated to contain chemicals of potential concern that could harm wildlife or wildlife habitat.

Harvested wildlife species in NWT, such as beaver, snowshoe hare (*Lepus americanus*), and muskox, have been shown to have limited environmental contamination (Appendix 19A, Section 3.2.2.1; K'alo-Stantec, 2023) and construction of the Project is not expected to result in a change in wildlife health within the LAA.

Following the implementation of the mitigation measures, residual effects for change in wildlife health during construction are characterized as follows:

- **Direction is adverse:** Construction activities will increase risks to wildlife health.
- **Likelihood is unlikely:** The residual effect is almost certainly not to occur.
- **Magnitude is negligible:** A measurable change in the abundance of wildlife in the LAA is not anticipated.
- **Geographic extent is the LAA:** Residual effects will not extend into the RAA.
- **Timing is high sensitivity:** Construction will likely occur through the year, including during sensitive periods for wildlife.
- **Duration is medium-term:** Effects will cease following the construction phase (i.e., up to 20 years).
- **Frequency is continuous:** Effects will occur throughout the construction phase.
- **Change is irreversible:** Potential effects of change in health through exposure to contaminants and sensory disturbance may be reduced following the construction phase, but the all-season highway and associated traffic are expected to persist throughout the life of the Project.

19.4.5.3.2 Operations and Maintenance

Dust deposition is expected to result in minor and localized changes to vegetation and wildlife habitat adjacent to the PDA (i.e., within 40 m; Section 19.4.2.3). However, given the lack of chemicals of potential concern contained within dust emissions and the amount of dust expected from 50 vehicles/day, it is unlikely to result in a measurable change in the abundance of wildlife in the LAA. This is consistent with determinations in other similar projects in the NWT (i.e., Tłı̨chǫ Highway [Golder, 2017]).

Harvested wildlife species in NWT have been shown to have limited environmental contamination (Appendix 19A, Section 3.2.2.1; K'alo-Stantec, 2023) and operations and maintenance of the Project is not expected to result in a change in wildlife health within the LAA.

Following the implementation of the mitigation measures, residual effects for change in wildlife health during operations and maintenance are characterized as follows:

- **Direction is adverse:** Operations and maintenance activities will increase risk to wildlife health.
- **Likelihood is unlikely:** The residual effect is almost certainly not to occur.
- **Magnitude is negligible:** A measurable change in the abundance of wildlife in the LAA is not anticipated.
- **Geographic extent is the LAA:** Residual effects will not extend into the RAA.
- **Timing is high sensitivity:** The Project will operate indeterminately, including during sensitive periods for wildlife.
- **Duration is long-term:** The residual effect will persist during the operations and maintenance phase (i.e., > 20 years).
- **Frequency is continuous:** Effects will occur throughout the operations and maintenance phase.
- **Change is irreversible:** The Project will operate indefinitely.

19.4.6 Summary of Residual Effects

Table 19.14 summarizes the residual effects on wildlife and wildlife during the construction and operations and maintenance phases of the Project.

With the implementation of the mitigation measures, the Project is anticipated to meet the SLUP conformity requirement related to fish and wildlife and consideration of engagement input and incorporation of Traditional Knowledge.

The design of the Project and mitigation measures for protection of wildlife and wildlife habitat will protect the karst formation of Petiniʔah (Bear Rock) and respect the values of the Petiniʔah (Bear Rock) CZ, Norman Range SMZ, K'ą̀ą̀lǫ Tué (Willow Lake Wetlands) SMZ and Deh Cho (Mackenzie River) SMZ, as areas with important furbearer and bear habitat.

Table 19.14 Residual Effects on Wildlife and Wildlife Habitat

Residual Effect	Residual Effects Characterization*								
	Project Phase	Direction	Likelihood	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Change in Habitat	C	A	CE	L	LAA	HS	MT-LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Change in Movement	C	A	P	L	LAA	HS	MT-LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Change in Mortality Risk	C	A	P	L	LAA	HS	MT-LT	IR	I
	O	A	P	L	LAA	HS	LT	IR	I
Change in Wildlife Health	C	A	U	NMC	LAA	HS	MT	C	I
	O	A	U	NMC	LAA	HS	LT	C	I

KEY

*See Table 19.3 for detailed definitions

Project Phase
C: Construction
O: Operations and maintenance

Direction:
A: Adverse
N: Neutral

Likelihood:
U: Unlikely
P: Possible
CE: Certain

Magnitude:
NMC: No Measurable Change
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Timing
NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

19.5 Assessment of Cumulative Effects on Wildlife and Wildlife Habitat

Project residual effects described in Section 19.4 are likely to interact cumulatively with residual environmental effects from other physical activities including past, present, and reasonably foreseeable projects. The effects of past and current projects contribute to baseline conditions upon which Project effects are assessed. Cumulative effects are described as those resulting from residual Project effects combined with the effects of past, present, and reasonably foreseeable projects and activities.

Future projects that are reasonably foreseeable are those that (a) have obtained the necessary authorizations to proceed or are in the process of obtaining the required authorization, or (b) have been publicly announced with the intention to seek the necessary authorizations to proceed.

Two conditions must be met to initiate an assessment of cumulative effects on a VC:

- The Project is assessed as having measurable adverse residual environmental effects on a VC.
- The adverse residual effects from the Project overlap spatially and temporally with measurable residual effects of other physical activities on a VC.

If either condition is not met, the assessment of cumulative effects is not warranted because the Project is not considered to interact cumulatively with other projects or activities. Except for change in wildlife health, both conditions apply for change in habitat, movement and mortality risk and a cumulative effects assessment is presented below.

The Project is predicted to result in no measurable residual effects on wildlife health (Table 19.14). As such, the Project is not expected to interact cumulatively with residual effects from other physical activities (past, present and reasonably foreseeable). Although, changes in air and water quality can result in changes in the quality of food sources (e.g., plants, fish, small mammals) consumed by wildlife, the conclusions in the cumulative effects assessments for air quality (Volume 4, Chapter 12, see Section 12.5 of the DAR) and surface water and sediment quality (Volume 4, Chapter 16, see Section 16.5) indicate that there is no potential for cumulative effects on air or surface water quality; and therefore, there is no potential for cumulative effects on wildlife health due to changes in air or water quality. In the absence of cumulative effects pathways, wildlife health will not be further assessed.

19.5.1 Residual Effects Likely to Interact Cumulatively

The project and activity inclusion list (Table 19.15) identifies known past, present, and reasonably foreseeable projects and physical activities that could interact cumulatively with the residual effects. Chapter 4 of the DAR presents the names, proponents, use or activity, descriptions, status, and location of these projects and activities.

Table 19.15 Projects with the Potential to Contribute to Cumulative Effects in the RAA

Other Projects and Physical Activities with Potential for Cumulative Effects	Environmental Effects			
	Change in Habitat	Change in Movement	Change in Mortality Risk	Change in Wildlife Health
Past and Present Physical Activities and Resource Use (Base Case)				
Geotechnical	–	–	–	–
Oil, Gas & Seismic*				
Tulita 2D Seismic Program	✓	✓	✓	–
EL 466 Drilling Program	✓	✓	✓	–
Windy Island Drilling Program	✓	✓	✓	–
Summit Creek Drilling Program	✓	✓	✓	–
Slater River Project	✓	✓	✓	–
Little Bear Staging Area	✓	✓	✓	–
Infrastructure				
Mackenzie Valley Winter Road, including bridges and bridge-sized culverts	✓	✓	✓	–
Canyon Creek All Season Access Road	✓	✓	✓	–
Norman Wells Pipeline	✓	✓	✓	–
Mackenzie Valley Fibre Link	✓	✓	✓	–
Délı̨nę Winter Road	✓	✓	✓	–
Mackenzie Highway No.1	✓	✓	✓	–
Prohibition Creek Access Road (PCAR)	✓	✓	✓	–
Quarries and Borrow Sources				
HRN Quarry	✓	✓	✓	–
Little Bear River Quarry	✓	✓	✓	–

Other Projects and Physical Activities with Potential for Cumulative Effects	Environmental Effects			
	Change in Habitat	**Change in Movement**	**Change in Mortality Risk**	**Change in Wildlife Health**
Mining & Exploration				
Wrigley Zinc Property Drilling Program	✓	✓	–	–
Municipal Operations, including water, waste, power, and community development				
Wrigley Municipal Activities	✓	✓	✓	–
Tulita Municipal Activities	✓	✓	✓	–
Norman Wells Municipal Activities	✓	✓	✓	–
Project-Related Physical Activities (Project Case)				
Mackenzie Valley Highway Project	✓	✓	✓	–
Reasonably Foreseeable Physical Activities (Reasonably Foreseeable Case)				
Quarries				
Dhu-1 Quarry	✓	✓	✓	–
Infrastructure				
Great Bear River Bridge	✓	✓	✓	–
Oil and Gas				
Enbridge Maintenance Camp	✓	✓	✓	–

Notes:

✓ = Other projects and physical activities whose residual effects are likely to interact cumulatively with Project residual effects.

– = Interactions between the residual effects of other projects and residual effects of the Project are not expected.

* = Includes support activities such as production, exploration, remediation, drilling, wells, associated infrastructure, facilities, camp, and staging areas where they occur within the RAA.

19.5.2 Change in Habitat

19.5.2.1 Cumulative Effects Pathways

Potential cumulative effects on wildlife habitat due to reasonably foreseeable activities have similar effects pathways as those identified for the Project (see Section 19.4.2.1) including direct loss or alteration of habitat from vegetation clearing and indirect effects due to sensory disturbance (e.g., noise, artificial lights), dust deposition, edge effects, and fragmentation generated during project construction and operations and maintenance of the Project.

19.5.2.2 Mitigation for Cumulative Effects

Mitigation measures and regional initiatives applicable to limiting cumulative effects on wildlife habitat, including for SAR, within the RAA (including other reasonably foreseeable projects) include adhering to the project-specific WMMP and other management and monitoring plans used to protect and monitor the environment during project construction and operations and maintenance, including the:

- ESCP
- Permafrost Protection Plan (PPP)
- SCP
- Waste Management Plan (WMP)
- Quarry Development Plans (QDP)

19.5.2.3 Cumulative Effects

Past and present activities including oil and gas development (e.g., Norman Wells Pipeline), the MVWR and other winter roads, quarries and borrow sources, mining and exploration activities as well as municipal and community development have resulted in the loss of wildlife habitat in the RAA. These past and current projects and activities reflect the existing (baseline) conditions in the RAA. Although these projects and activities have altered the regional landscape and contributed to existing cumulative effects on wildlife habitat, the amount of existing anthropogenic disturbance (i.e., exposed land) in the Dehcho RAA (1.4%) and Sahtu RAA (1.5%) is relatively low (see Table 19.7). At baseline, the Dehcho Region RAA contains an abundance of wildlife habitat dominated by coniferous forest (43.6%), wetlands (19.8%), and open water (19.3%) whereas the Sahtu Region RAA contains primarily coniferous forest (28.7%), wetlands (25.2%), and shrubland (20.6%) (Table 19.7).

Ongoing and reasonably foreseeable activities and projects will result in additional direct habitat loss and alteration as well as potential sensory disturbance (e.g., noise), which will contribute to cumulative effects on wildlife habitat including SAR/SOCC in the RAA. Specifically, the Dhu-1 Quarry (including camp and winter access road) will result in a direct loss of 23 ha, Great Bear River Bridge, 46.5 ha and PCAR, 77.8 ha. The estimated project development area for the Enbridge Maintenance Camp is not available. Overall, the ongoing and future projects are relatively small in spatial scale and some projects such as the PCAR overlap the existing MVWR, which will reduce cumulative effects on wildlife habitat.

The Project will contribute to existing cumulative effects on habitat, however, the change in habitat (2,315.2 ha) represents a 0.2% decrease from the existing condition in the RAA (1,010,983.5 ha), which includes 1,104.9 ha of exposed land and existing anthropogenic disturbances (i.e., existing MVWR and quarries) (see Table 19.11). The Project is anticipated to contribute 1,404.9 ha of new exposed land cover in the RAA, a 7.5% increase from the existing condition (15,970.4 ha).

The Project will also result in a direct loss or alteration of 102.8 ha of little brown myotis maternity roosting habitat (i.e., a 0.2% decrease from the existing condition in the RAA), and 140.9 ha of grizzly bear denning habitat (i.e., a 0.5% decrease from the existing condition in the RAA). Similarly, for wolverine and invertebrate SAR, which were assessed qualitatively, the Project is expected to result in a low magnitude of change in habitat availability within the RAA relative to the existing condition.

With mitigation, the residual cumulative effects on wildlife habitat from past, present, and reasonably foreseeable projects and physical activities, including the Project are predicted to be low in magnitude and occur over the long-term.

19.5.3 Change in Movement

19.5.3.1 Cumulative Effects Pathways

Potential cumulative effects on wildlife movement arising from past, present, and reasonably foreseeable activities have similar pathways as those resulting from the Project (Section 19.4.3.1), which includes potential physical and sensory barriers generated during Project construction and operations and maintenance of the Project.

19.5.3.2 Mitigation for Cumulative Effects

Mitigation measures and regional initiatives applicable to limiting cumulative effects on wildlife movement, including for SAR, within the RAA (including other reasonably foreseeable projects) include the following:

- A WMMP will be developed and implemented.
- The Project will use previously disturbed areas for project activities and project infrastructure and workspaces, to the extent possible.

19.5.3.3 Cumulative Effects

Past and present activities likely have contributed to cumulative changes in wildlife movement in the RAA due to potential physical and sensory barriers associated with the construction and operation of the Norman Wells Pipeline, the MVWR and other winter roads, quarries and borrow sources. Ongoing and reasonably foreseeable activities and projects including the Dhu-1 Quarry, Great Bear River Bridge, PCAR and Enbridge Maintenance Camp have potential to contribute to existing cumulatively effects on wildlife movement in the RAA. Overall, the reasonably foreseeable projects are expected to contribute to cumulative effects on wildlife movement including SAR/SOCC; however, the project footprints are relatively small and some projects such as the PCAR overlap the existing MVWR; and therefore, the potential for these projects to contribute to potential changes in regional wildlife movement is limited.

The Project will contribute to residual cumulative effects on wildlife movement due to potential physical barriers and sensory disturbance expected to occur during construction as well as operations and maintenance. With mitigation, the residual cumulative effect on wildlife movement from past, present, and reasonably foreseeable projects and physical activities, including the Project, are predicted to be low in magnitude and expected to occur over the long-term.

19.5.4 Change in Mortality Risk

19.5.4.1 Cumulative Effects Pathways

Potential cumulative effects on wildlife mortality risk arising from past, present, and reasonably foreseeable activities have similar pathways as those resulting from the Project (Section 19.4.2.1), which includes site preparation activities (e.g., vegetation clearing, earthworks), traffic-related mortality, and increased access opportunities for hunters and predators.

19.5.4.2 Mitigation for Cumulative Effects

Mitigation measures and regional initiatives applicable to limiting cumulative effects on mortality risk within the RAA include the following:

- A WMMP will be developed and implemented.
- The Project will use previously disturbed areas for project activities and project infrastructure and workspaces, to the extent possible.
- Speed limits will be posted on the public highway.

19.5.4.3 Cumulative Effects

Existing linear features including the Norman Wells Pipeline, the MVWR and other winter roads, quarries and borrow sources have contributed to past and existing cumulative effects on wildlife mortality risk in the RAA. Ongoing and reasonably foreseeable activities and projects including the Dhu-1 Quarry, the Great Bear River Bridge, PCAR, and the Enbridge Maintenance Camp have potential to contribute to existing cumulative effects on wildlife mortality risk in the RAA. However, implementation of standard industry practices (e.g., timing restrictions, setbacks) are expected to reduce potential residual cumulative effects on mortality risk. Overall, the reasonably foreseeable projects will result in additional cumulative effects on wildlife mortality risk; however, these projects are comparatively small, involving limited amounts of clearing and vehicle traffic, which will limit the incremental increase in mortality risk.

The Project has potential to contribute to residual cumulative effects on direct and indirect mortality risk (e.g., harvesting) during construction as well as operations and maintenance. However, implementation of mitigation measures and monitoring are expected to reduce wildlife mortality risk during construction and operations and maintenance phases.

With mitigation, the residual cumulative effects on wildlife mortality risk from past, present, and reasonably foreseeable projects and physical activities, including the Project, are predicted to be low in magnitude. Residual cumulative effects will occur as multiple irregular events as reasonably foreseeable projects and physical activities go forward and will occur over the long term during operations.

19.5.5 Summary of Cumulative Effects

Past and present activities as well as reasonably foreseeable projects have and will continue to result in cumulative effects on wildlife habitat, movement and mortality risk. The Project's contributions to direct change in habitat will be low in magnitude following mitigation. Indirect effects on habitat resulting from project noise and activity are expected to be localized, low in magnitude and occur over the long term.

When current and future activities and project effects on wildlife and wildlife habitat are considered, the Project's contribution to direct change in movement and mortality risk will be low in magnitude following mitigation.

Table 19.16 summarizes cumulative effects on wildlife and wildlife habitat.

Table 19.16 Summary of Cumulative Effects

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Likelihood	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Change in Habitat	A	CE	L	RAA	HS	LT	IR	I
Contribution from the Project to the residual cumulative effect	The Project will result in the direct loss or alteration of 0.2% of wildlife habitat in the RAA compared to existing conditions. Direct loss or alteration of little brown myotis maternity roosting habitat and grizzly bear denning habitat is expected to be low, with a change of 0.2% and 0.5% from existing conditions in the RAA, respectively. Similarly, the Project is expected to result in a low magnitude of change in habitat availability within the RAA for wolverine and invertebrate SAR compared to the existing condition. With mitigation, the contribution from the Project to residual cumulative effects on habitat is expected to be low.							
Change in Movement	A	P	L	RAA	HS	LT	IR	I
Contribution from the Project to the residual cumulative effect	The Project has potential to result in changes to local, daily or seasonal wildlife movement due to physical and sensory barriers. The height of snowbanks will be limited to the extent possible and to a height of less than 1 m to facilitate wildlife movement. With mitigation, the contribution from the Project to residual cumulative effects on wildlife movement is expected to be low.							
Change in Mortality Risk	A	P	L	RAA	HS	LT	IR	I
Contribution from the Project to the residual cumulative effect	The Project will result in increased wildlife mortality risk due to vegetation removal and increased traffic volumes. However, pre-construction surveys and other mitigation measures (e.g., reduced speed limits) will reduce mortality risk along roads. With mitigation, the contribution from the Project to residual cumulative effects on wildlife mortality risk is expected to be low.							

KEY

*See Table 19.3 for detailed definitions

Direction:
A: Adverse
N: Neutral

Likelihood:
U: Unlikely
P: Possible
CE: Certain

Magnitude:
No: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Timing
NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

19.6 Determination of Significance

19.6.1 Significance of Residual Effects

The Project will result in the direct loss or alteration of 2,315.2 ha (< 3.1%) of wildlife habitat within the LAA, including 1,104.9 ha of exposed lands that are subject to existing anthropogenic disturbances (i.e., existing MVWR and quarries) and provide limited suitability for most wildlife species. The Project will result in the direct loss or alteration of < 5.0% of habitat within the LAA for little brown myotis and grizzly bear. Similarly, for wolverine and invertebrate SAR assessed qualitatively, the Project is expected to result in a low magnitude of change in habitat availability within the LAA compared to the existing condition.

Vegetation clearing will occur outside of spatial and temporal sensitivities for wildlife and the low traffic volume during operations and maintenance of the Project is unlikely to result in a notable increase in wildlife mortality risk, including for SAR/SOCC. Increased access opportunities for hunters may result in increased harvest rates of harvested species.

The Project is anticipated to have a negligible effect on wildlife health.

Following the application of avoidance and mitigation measures, residual effects on wildlife and wildlife habitat are not expected to threaten the long-term persistence or viability of SAR/SOCC or species of cultural or traditional importance, and there are no established conservation-based thresholds for species considered in this VC. In conclusion, the project effects on wildlife and wildlife habitat are not significant.

19.6.2 Significance of Cumulative Effects

The Project will result in the direct loss or alteration of 2,315.2 ha (< 0.2%) of wildlife habitat within the RAA, including 1,104.9 ha of exposed lands that are subject to existing anthropogenic disturbances (i.e., existing MVWR and quarries) and provide limited suitability for most wildlife species. Development of the Project will result in a direct loss or alteration of 102.8 ha of little brown myotis maternity roosting habitat (i.e., a 0.2% decrease from the existing condition in the RAA), and a 140.9 ha of grizzly bear denning habitat (i.e., a 0.5% decrease from the existing condition in the RAA). Similarly, for wolverine and invertebrate SAR, which were assessed qualitatively, the Project is expected to result in a low magnitude of change in habitat availability within the RAA compared to the existing condition.

Indirect effects of habitat loss or alteration are not expected to extend into the RAA. While the Project may interact cumulatively with several other, relatively small reasonably foreseeable projects within the RAA, the Project will contribute a small incremental change in habitat for wildlife. Habitat for wildlife throughout the year will remain abundant in the RAA, including for SAR/SOCC.

The Project will interact cumulatively with past, present, and reasonably foreseeable projects and activities but vegetation clearing will include avoidance of sensitive wildlife features and the low traffic volume during operations and maintenance of the Project is unlikely to result in a notable increase in wildlife mortality risk, including for SAR/SOCC. Increased access opportunities for hunters may result in increased harvest rates of wildlife.

Following the application of mitigation and environmental protection measures, residual cumulative effects on wildlife and wildlife habitat are not expected to threaten the long-term persistence or viability of SAR/SOCC or species of cultural or traditional importance, and there are no established conservation-based thresholds for species considered in this VC. In conclusion, the effects on wildlife and wildlife habitat are not significant.

19.6.3 Project Contribution to Cumulative Effects

The Project will contribute a small incremental increase in both a change in habitat through vegetation clearing, sensory disturbance, dust deposition, edge effects, and fragmentation, and a change in mortality risk (vegetation clearing, wildlife-vehicle collisions, hunter and predator access).

19.7 Prediction Confidence

The prediction confidence in the final determination of significance is considered moderate. This level of confidence is based on the factors listed, which includes assumptions as well as gaps and uncertainties discussed in Sections 19.7.1 and 19.7.2.

- The quantity and quality of data available
- The conservative approach taken to assessment (Section 19.4.1.3)
- Professional judgement and experience with similar projects
- Effectiveness of mitigation measures, which reflect best industry practices and those used on similar highways Projects in the NWT (e.g., Tłı̨chǫ Highway).

Prediction confidence is expected to increase following the completion of pre-construction surveys and proposed monitoring programs.

19.7.1 Assumptions

A conservative approach is used to address uncertainty in the environmental effects assessment, which increases confidence in the final determination of significance. The assessment used a habitat-based approach, which focuses on identifying the quantity and composition of land cover types (i.e., habitats) affected by the Project relative to the availability of those habitats in the LAA and RAA. This approach is considered conservative as it assumes that wildlife species are present if the habitat is available, which is not always the case (e.g., some wildlife species may not be present in a habitat recently affected by fire until the habitat returns to its pre-fire state following the vegetation successional process that require several years). Additionally, land cover classes that

represent disturbed lands (i.e., exposed land) are included in the quantification of direct habitat loss, despite providing limited value for most wildlife species, and comprises 47.8% (1,104.91 ha) of the PDA. The PDA is conservatively assumed to be lost to wildlife but there are portions that will be reclaimed, and some species will use disturbed sites.

19.7.2 Gaps and Uncertainties

A systematic survey of bear dens within the LAA in the Dehcho Region has yet to be completed and the number and location of dens with potential to interact with the Project is unknown. A pre-construction bear den survey (Section 19.8) in this area will help to inform mitigation measures to protect denning bears. Additionally, the number and location of mineral licks within the LAA is unknown. As such, there is some uncertainty related to potential project effects on these sensitive features. Completing bear den and mineral lick surveys prior to construction will contribute to an increase in prediction confidence.

While there is potential for increased harvest pressure due to increased access to areas proximal to the Project, the relative increase in the number of harvesters, the species to be harvested and the spatial distribution of increased harvest cannot be predicted.

There is uncertainty related to the potential direct and indirect effects of climate change on wildlife distribution and abundance due to potential changes in forage quality and quantity, movement and dispersal, interspecific competition, and predator-prey dynamics (Malpeli et al., 2020, Davidson et al., 2020).

19.8 Follow-up and Monitoring

Pre-construction wildlife surveys will be completed prior to vegetation clearing where the Project can interact with sensitive features such as bear dens and mineral licks. A pre-construction beaver dam and lodge survey will be conducted to identify those with potential to be impacted by construction. Wildlife monitors will assess for the presence of wildlife on or near the PDA during Project activities. Details of proposed monitoring programs are provided in the Draft WMMP (Volume 5).

The database for wildlife-vehicle collisions, implemented und maintained by GNWT-ECC, will be extended to include the MVWR ROW and completed sections of the highway during and after construction.

The GNWT will work with SRRB and other resource managers to address uncertainty regarding the effects of increased access created by the Project on harvested resources in the study areas. This would include monitoring of harvest that can be used to identify the need for management actions to be taken by the appropriate resource management organization.

Monitoring programs will be implemented to evaluate if mitigation measures are implemented and operate as planned. This includes monitoring in accordance with the terms and conditions of permit approvals and development and implementation of a WMMP. The GNWT-INF will establish two positions dedicated to assisting with the implementation of the WMMP.

The GNWT-ECC will continue to implement existing wildlife monitoring programs consistent with its role as wildlife resource manager but recognizes that new programs and additional resources may be required to address issues specific to the Project. The GNWT will continue to refine the WMMP for this project throughout the EA process and is open to and interested in discussions with Indigenous Governments, Indigenous Organizations, and other affected parties on how best to incorporate their recommendations.

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20.0 ASSESSMENT OF POTENTIAL EFFECTS ON BIRDS AND BIRD HABITAT

Birds and Bird Habitat is a Valued Component (VC) because it provides ecological, aesthetic, recreational, economic, and cultural value to Indigenous Governments, Indigenous Organizations, other affected parties. Having access to birds and bird habitat is important to communities, particularly resource users that continue to practice traditional and recreational hunting activities throughout the Dehcho and Sahtu regions.

Birds and bird habitat may be affected by the Mackenzie Valley Highway Project (the Project). The Terms of Reference (ToR) identify birds and bird habitat as a subject of note (SON; MVEIRB, 2015). Potential effects on birds and bird habitat are related to other VCs. For example, changes to vegetation and wetlands (see Chapter 18) resulting from project-related land clearing will reduce habitat availability. Changes in noise (see Chapter 13) and water quality (see Chapter 16) could affect terrestrial and aquatic habitats, which in turn may affect bird health. As such, the residual effects of the Project on vegetation and wetlands, noise, surface water and sediment quality were used to assess potential project effects on birds and bird habitat.

Changes in birds and bird habitat may cause changes to other VCs. For example, changes in birds and bird habitat have the potential to affect biodiversity (see Chapter 21), and land and resource use associated with hunting and areas used by Indigenous Governments, Indigenous Organizations, and other affected parties by altering the distribution and abundance of bird species of cultural importance (see Chapter 11).

In this assessment, the term “bird” considers all bird species that occur within the Mackenzie Valley, including species at risk (SAR) and species of conservation concern (SOCC), while separate assessments have been provided for potential effects of the Project on wildlife and wildlife habitat (see Chapter 19) and caribou and moose (see Chapter 10), reflecting the ToR’s SON and key lines of inquiry (MVEIRB, 2015). Here, SAR are species listed as special concern, threatened, or endangered under the *Species at Risk (NWT) Act* (GNWT, 2020a) or under Schedule 1 of the federal *Species at Risk Act* (SARA; Government of Canada, 2021). SOCC are species assessed as special concern, threatened, or endangered by the NWT Species at Risk Assessment Committee (GNWT, 2020a) or the Committee on the Status of Endangered Wildlife in Canada (Government of Canada, 2021). This is consistent with the Birds and Bird Habitat Technical Data Report (TDR; K’alo-Stantec, 2023; Appendix 20A), which describes existing conditions for the VC.

Numerous bird species inhabit the Mackenzie Valley due to the widespread availability of wetlands, rivers, lakes, forests, and rock formations. As it is not feasible to assess the effects of the Project on all species having potential to occur in the assessment areas (Section 20.2.2), the assessment focuses on a select group of species and species assemblages that are representative of the bird species that have the greatest potential to be affected by the Project (Table 20.2), including SAR, SOCC, and harvested species (e.g. grouse, ptarmigan, ducks, geese). Although there was a focus on SAR, SOCC and harvested species, other forest songbirds were assessed as part of the landbirds

category using a habitat-based approach (e.g., warblers; see Table 20.10 in Section 20.4.1). A full list of bird species with potential to occur in the LAA is presented in Table A.2 of Appendix 20A.

The assessment of potential effects on birds and bird habitat concludes that with the application of mitigation measures, residual effects of the Project on birds and bird habitat will be adverse. Residual effects and cumulative effects will not cause or further contribute to the exceedance of a conservation-based threshold or threaten the long-term persistence or viability of SAR/SOCC, or species of cultural or traditional importance and therefore will be not significant.

20.1 Scope of Assessment

20.1.1 Regulatory and Policy Setting

The assessment of potential project-related environmental effects on birds and bird habitat is guided by the project ToR (MVEIRB, 2015 [PR#66]), the following notable federal and territorial legislation and guidance, and the Sahtu Land Use Plan (SLUP).

20.1.1.1 Federal

The *Migratory Birds Convention Act* (MBCA), and specifically s.5(1) and s.6(a) of the Migratory Birds Regulations, prohibits the destruction or take of a migratory bird, or the disturbance, destruction, or take of a nest or egg of a migratory bird. The protection of birds under the Act is afforded to all native bird species expected to occur in the assessment areas, except upland gamebirds, raptors, belted kingfisher, owls, corvids, and icterid blackbirds, which are protected under territorial legislation (Section 20.1.1.2).

The SARA provides protection for SAR in Canada. The legislation provides a framework to facilitate recovery of species listed as threatened, endangered, or extirpated and to prevent species listed as special concern from becoming threatened or endangered. Bird SAR and their habitats are protected under SARA, which prohibits: (1) the killing, harming, or harassing of endangered or threatened SAR (SARA sections 32 and 36); and (2) the destruction of critical habitat of an endangered or threatened SAR (SARA sections 58, 60, and 61).

20.1.1.2 Territorial

The *Species at Risk (NWT) Act* is used to identify, protect, and recover plant and animal SAR in the Northwest Territories (NWT). This Act facilitates the process of assessment and management of species and their habitats to prevent further declines and to promote recovery.

The *Wildlife Act* provides general provisions for regulating the activities relating to the harvest and protection of wild animals in NWT. Section 1(1) defines “wildlife" as “all species of vertebrates and invertebrates found wild in nature in the Northwest Territories,” and Section 51(1) includes protections for birds and bird nests.

20.1.1.3 Sahtu Land Use Plan

Specific to the areas to which the SLUP applies, the Project must meet the 13 general conformity requirements (CR) of the SLUP (Sahtú Land Use Planning Board [SLUPB], 2023). The SLUP's conformity requirements include consideration of wildlife in CR#7, which are reproduced below as they relate to the Birds and Bird Habitat VC:

> CR#7: *"1) Land use activities must be designed using the most current information for identified species of interest and species at risk as obtained from the GNWT--ECC* [Environment and Climate Change], *CWS* [Environment and Climate Change Canada - Canadian Wildlife Service], *DFO* [Fisheries and Oceans Canada], Parks Canada Agency, *the Sahtú Renewable Resources Board (SRRB) and the local Renewable Resources Council (RRC)s*
>
> *2) Impacts to wildlife, their habitat and migration patterns, and important community harvesting areas must be prevented or mitigated to the extent possible."*
>
> *"a) In particular, all reasonable steps should be taken to follow the horizontal setbacks and minimum flight altitudes identified in Table 4 [of the SLUP] when near habitat sites during sensitive periods described in that table, unless human safety is of concern, and measures are developed with the appropriate organizations and the RRC to mitigate impacts to these species and their habitat."*

Conformity Requirement #2 requires that *"The proposed activities must be designed and carried out with due regard for community concerns and incorporate relevant traditional knowledge."*.

Additionally, per CR#14, the Project must be designed and carried out in a manner that protects, respects, or takes into account the values of the Conservation Zones (CZ) and Special Management Zones (SMZ) potentially affected by the Project as directed in the SLUP's Zone Descriptions (SLUPB, 2023), including the following:

- Petiniʔah (Bear Rock) CZ (Zone #32)
- Mio Lake CZ (Zone #36)
- Norman Range SMZ (Zone #50)
- K'ąąlǫ Tué (Willow Lake Wetlands) Special Management Zone (SMZ) (Zone #62)
- Deh Cho (Mackenzie River) SMZ (Zone #63)

20.1.2 Influence of Engagement

The Government of the Northwest Territories (GNWT) has engaged with Indigenous Governments, Indigenous Organizations, and other affected parties. Detailed information regarding these engagement activities is presented in Chapters 2 (Consultation and Engagement), 3 (Traditional Knowledge), and 11 (Culture and Traditional Land Use) of this Developer's Assessment Report (DAR). The GNWT has recently initiated Consultation with Indigenous Governments and Indigenous Organizations.

Through the project-specific engagement program delivered between 2010-2012 and 2021-2023, including project-specific traditional land and resource use (TLRU) studies, and through a review of publicly available TLRU information, Indigenous Governments, Indigenous Organizations, and other affected parties shared information, expressed concerns, and provided recommendations related to birds and bird habitat. This feedback has been considered and summarized in Table 20.1 and has been integrated into the assessment of potential effects on birds and bird habitat that follows.

20.1.2.1 Regulatory Engagement

The GNWT-INF has engaged territorial (the Government of the Northwest Territories - Environment and Climate Change [GNWT-ECC]) and federal (Environment and Climate Change Canada [ECCC]) regulatory wildlife agencies throughout the development the DAR, including:

- The GNWT-ECC has been continually involved in the Project, including aiding in addressing data gaps relative to the project ToR (MVEIRB, 2015 [PR#66]) and reviewing development of the TDR and DAR within its mandate.
- Environment and Climate Change Canada has and will continue to be engaged to better understand their concerns relating to migratory birds and SAR.

Table 20.1 Summary of Engagement Feedback

Comment	Source	GNWT Response	Where Addressed
Important bird habitat and harvesting locations have been identified near the Project by Sahtu Dene and Métis, Pehdzéh Kį First Nation, Dehcho First Nations, and Norman Wells Renewable Resources Council (NWRRC) and Tulita Renewable Resources Council (TRRC) study participants through project-specific TLRU studies.	5658 NWT Ltd. and GNWT, 2011 (PR#16); Dehcho First Nations, 2011; Dessau, 2012 (PR#13); IMG-Golder, 2006; NWRRC, 2023; SLUPB, 2022; SLUPB, 2023; TRRC, 2022	The GNWT has reviewed and considered the bird species of importance and important habitats and harvesting areas identified by Indigenous Governments and Indigenous Organizations.	For information about bird species of interest and important wildlife habitat, see Section 20.2.2.1 (Table 20.5 and Table 20.6). See also Section 11.2.3.5 for additional information about important harvesting areas and harvested species.
Engaged Indigenous Governments, Indigenous Organizations and specific other affected parties identified bird species of importance.	Auld and Kershaw, 2005; Dehcho First Nations, 2011; IMG-Golder Corporation, 2006; McDonald, 2010; NWRC, 2023; TRRC, 2022; SRRB, 2021b, 2007; SLUPB, 2023		
Local knowledge from TRRC and NWRRC study participants identified the proposed Great Bear River Bridge area and Bluefish Creek to Sucker Creek (chain of lakes) as important migration routes and habitat for migratory birds.	NWRRC, 2023; TRRC, 2022	The GNWT has identified mitigation measures to reduce effects on birds and bird habitat. A Wildlife Management and Monitoring Plan (WMMP) will be developed and implemented. The WMMP will contain detailed monitoring and mitigation measures to be implemented for the duration of the construction and operations of the Project. The WMMP will outline how risks to migratory birds will be managed.	For information about bird species of importance and important habitat and harvesting locations, see Section 20.2.2.1. For mitigation measures to reduce effects on birds and bird habitat, see Table 20.9 Potential Effects and Mitigation Measures for Bird and Bird Habitat See also: Section 20.4.2 (Change in Habitat) Section 20.4.3 (Change in Mortality Risk) Chapter 11 (culture and traditional land use, including harvesting)
Sahtu Dene and Métis reported that Petiniɂah (Bear Rock) CZ (Zone #32) provides habitat for a variety of bird species, including nesting areas for raptors. Dehcho First Nations and Pehdzéh Kį First Nation identified the Pehdzéh Kį N'deh area[1] as important wetland habitat for waterfowl around the Wrigley area and north of Blackwater River. Dehcho First Nations and Pehdzéh Kį First Nation also identified all drainages intersecting the Project as potential waterfowl habitat.	SLUPB, 2023; Dessau, 2012 (PR#13)		

Comment	Source	GNWT Response	Where Addressed
NWRRC study participants reported that changes have been observed in bird migration and expressed concern that birds are moving in a different direction and are not observed as often in the TLRU study area as previously before.	NWRRC, 2023	*(cont'd from above)* Vegetation clearing will be done outside of the migratory bird nesting season. Wildlife monitors will assess for the presence of nesting birds on or near workspaces during project activities. The GNWT is committed to ongoing engagement with Indigenous Governments, Indigenous Organizations, and other affected parties during advancement of project design and planning. The GNWT will work with SRRB and other resource managers to address uncertainty regarding the effects of increased access created by the Project on harvested resources in the NWRRC and TRRC TLRU study areas. This would include monitoring of harvest that can be used to identify the need for management actions to be taken by the appropriate resource management organization.	*(cont'd from above)* Volume 5 for management plans.
NWRRC study participants communicated that birds stop along the Mackenzie Valley Winter Road (MVWR) to eat.	NWRRC, 2023		
Community engagement participants reported that protection of songbirds and their respective habitat is a priority.	November 2022 to February 2023 Engagement		

Comment	Source	GNWT Response	Where Addressed
TRRC study participants raised concerns about potential effects on waterfowl during construction and operations and maintenance along Great Bear River and explained that migration patterns have already shifted because of changing weather in the Sahtu Region.	TRRC, 2022	The proposed construction of the Great Bear River Bridge is not in the scope of the Project; however, the project WMMP will outline how risks to migratory birds will be managed during highway operations.	Chapter 5 (Project Description) Volume 5 for WMMP

Note:

[1] Pehdzéh Kį N'deh area boundary was not identified or disclosed in the report.

20.1.3 Potential Effects, Pathways and Measurable Parameters

Table 20.2 summarizes the potential effects of project activities on birds and bird habitat, the pathways by which they may affect birds and bird habitat, and the measurable parameters used for evaluating effects. Potential effects and measurable parameters were selected based on professional judgment, recent environmental assessments for road projects in NWT, and regulatory concern for certain species.

Table 20.2 Potential Effects, Effects Pathways and Measurable Parameters for Birds and Bird Habitat

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in habitat	Construction, and operations and maintenance of the Project could result in a: • Direct loss or alteration of bird habitat (e.g., vegetation clearing) • Indirect loss or alteration of bird habitat (e.g., sensory disturbance, edge effects)	• Quantitative evaluation of the amount (hectares [ha]) of habitat directly lost or altered for: – general bird habitat – species groups, including those important to Indigenous Governments, Indigenous Organizations, and other affected parties: ▪ waterbirds (e.g., waterfowl, shorebirds) ▪ upland gamebirds (e.g., grouse, ptarmigan) ▪ birds of prey (e.g., raptors, owls) ▪ landbirds (e.g., passerines) – SAR and SOCC, including: ▪ peregrine falcon (*Falco peregrinus anatum/tundrius*) ▪ yellow rail (*Coturnicops noveboracensis*) ▪ lesser yellowlegs (*Tringa flavipes*) ▪ red-necked phalarope (*Phalaropus lobatus*) ▪ short-eared owl (*Asio flammeus*) ▪ olive-sided flycatcher (*Contopus cooperi*) ▪ rusty blackbird (*Euphagus carolinus*) ▪ horned grebe (*Podiceps auritus*) • Qualitative evaluation[1] of the amount of habitat directly lost or altered for: – SAR and SOCC, including: ▪ bank swallow (*Riparia riparia*) ▪ barn swallow (*Hirundo rustica*) ▪ Harris's sparrow (*Zonotrichia querula*) • Qualitative evaluation of the amount of indirect habitat loss or altered for the bird groups and species listed

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in habitat (cont'd)		• Area (ha) of other formally defined habitat areas (e.g., Important Bird Areas [IBAs]) directly affected • Area (ha) of formally defined SAR critical habitat directly or indirectly affected, if present • Number of formally defined SAR residences (e.g., bank swallow nests) directly or indirectly affected
Change in mortality risk	Construction, and operations and maintenance of the Project could result in a: • Direct increase in mortality risk or number of bird fatalities (including nests/eggs; e.g., vegetation clearing activities, vehicular collisions, human-bird conflicts) • Indirect increase in mortality risk or number of bird fatalities (e.g., altered predator-prey dynamics, harvest pressure)	• Qualitative evaluation of direct mortality risk: – Risk of mortality due to vegetation clearing, site preparation, and maintenance – Risk of collisions with project vehicles (e.g., equipment or support vehicles) or infrastructure • Qualitative evaluation of indirect mortality risk: – Predation risk due to change in predator-prey dynamics (e.g., change in predator mobility) – Hunting pressure (e.g., year-round access or access to new areas)
Change in bird health	Construction, and operations and maintenance of the Project could expose birds to contaminants or other emissions that may affect the health and condition of birds	• Qualitative evaluation of the of effects of the Project on bird health and condition based on information provided in the air quality and surface water and sediment quality assessments

Note:

[1] Bank swallow and barn swallow inhabit specific habitat features (i.e., riverbanks and anthropogenic structures, respectively) that are not amenable to formal quantification and Harris's sparrow does not typically breed near the Project and quantification of habitat would be overstated.

20.1.4 Boundaries

20.1.4.1 Spatial Boundaries

The Project Development Area (PDA), Local Assessment Area (LAA), and Regional Assessment Area (RAA) for the assessment of effects on birds and bird habitat are shown in Figure 20.1. These spatial boundaries are used to assess project effects, including residual and cumulative effects, on birds and bird habitat.

- **Project Development Area (PDA):** the area of direct project disturbance within which physical works and activities will occur (footprint). This includes a new two-lane gravel highway, 60 metres (m) wide highway right-of-way (ROW), laydown and staging areas, maintenance yards, construction camps, and quarry/borrow sources with access roads on a 30 m ROW.
- **Local Assessment Area (LAA):** The area within which measurable project-related effects (direct or indirect) are expected to occur, which is a 1 kilometre (km) buffer around the preliminary road alignment route centerline and access roads, and a 2 km buffer around borrow source and quarry extents. The size of the buffer is based on measurable effects of noise on birds (e.g., Benitez-Lopez et al., 2010; Shannon et al., 2016) while also considering recommended setback distances for birds and bird habitat features (Appendix 20B, Table 20B.1; GNWT, 2015). The size of the LAA is also consistent with guidance provided by ECCC (Dufour, 2020, pers. comm.).
- **Regional Assessment Area (RAA):** The area that provides context for determining the significance of project-specific effects and potential cumulative effects. The RAA is the area within approximately 15 km of the PDA that is used to capture a wide range of bird species and bird habitats that could potentially be affected cumulatively by the Project and other past, present, and reasonably foreseeable projects. This RAA is consistent with other highway projects in the NWT (e.g., Inuvik to Tuktoyaktuk Highway [Kiggiak-EBA, 2011]) and follows recommendations from ECCC (Dufour, 2020, pers. comm.).

- Proposed Mackenzie Valley Highway Project
- Canyon Creek All Season Access Road (Constructed)
- Prohibition Creek Access Road (In Construction)
- Proposed Great Bear River Bridge
- Local Assessment Area
- Regional Assessment Area
- Community
- Northwest Territories Highway
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary

0 10 20 Kilometres

(At original document size of 8.5x11)
1:1,600,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by DS on 8/3/2023
TR by AJ on 8/3/2023

Client/Project
144903025-0030 REVB

Government of the Northwest Territories
Mackenzie Valley Highway Project

Figure No.
20.1

Title
Birds and Bird Habitat Assessment Areas

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: GNWT (Government of the Northwest Territories) Centre for Geomatics. n.d. Inventory of Landscape Change Map Viewer, GNWT. Centre for Geomatics. n.d. Open Data, MVLWB. n.d. Public Registry, Sahtu Land and Water Board. n.d. Public Registry, Environment and Natural Resources GNWT, Government of Canada, Stantec, Wilson and Haas 2012, and Caslys Consulting Ltd.
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS. Imagery date: 2021

20.1.4.2 Temporal Boundaries

The temporal boundaries for the Project consist of the following phases, which are described in more detail in Section 5.4.1:

- **Construction phase**: The Project will take approximately 10 years to construct over a timeframe of up to 20 years. The conceptual schedule assumes the highway will be constructed in three consecutive segments, beginning in approximately 2026: Wrigley north to the Dehcho–Sahtu border (102 km); Tulita south to the Dehcho–Sahtu border (134 km); and Tulita north to the Prohibition Creek Access Road (45 km). The conceptual schedule assumes the Project would be fully constructed and provide all-season connection to Norman Wells sometime between 2041 and 2046.
- **Operations and maintenance phase**: The operations and maintenance phase will commence in a staged manner once construction of each segment has been completed. The operations and maintenance phase is considered indeterminate as the highway is intended to be permanent infrastructure.

A closure and reclamation phase is not applicable to the Project. Closure and reclamation of temporary workspaces, and borrow sources and quarries used only for construction are included within the construction phase.

20.1.5 Residual Effects Characterization

Table 20.3 presents definitions for the characterization of residual effects on birds and bird habitat. Residual effects are those that remain after mitigation measures have been implemented.

Table 20.3 Characterization of Residual Effects on Birds and Bird Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Adverse:** A residual effect that moves measurable parameters of birds and bird habitat in a negative direction relative to baseline **Neutral:** No net change in measurable parameters for birds and bird habitat relative to baseline
Likelihood	The probability that the residual effect will occur	**Unlikely:** The residual effect is almost certainly not to occur. **Possible**: The residual effect could occur. **Certain**: The residual effect will certainly occur.

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in bird habitat[1]	***Change in Habitat (Direct)*** **Low:** Project changes less than 10% of general bird habitat in the LAA, or less than 5% of habitat for bird SAR and SOCC in the LAA **Moderate:** Project changes 10-20% of general bird habitat in the LAA, or 5-10% of habitat for bird SAR and SOCC in the LAA **High:** Project changes more than 20% of bird habitat in LAA, or more than 10% of habitat for bird SAR and SOCC in the LAA Effects on formally defined SAR critical habitat (if present), SAR residences, and habitat areas will be characterized based on professional judgement and potential effects on the species or habitat.
	The change in bird abundance and/or distribution	***Change in Habitat (Indirect), Mortality Risk, and Bird Health*** **Negligible:** A measurable change in the abundance of birds in the LAA is not anticipated. **Low:** A measurable change in the abundance of birds in the LAA is not anticipated, although temporary local shifts in distributions in the LAA might occur. **Moderate:** A measurable change in the abundance and/or distribution of birds in the LAA might occur. **High:** A measurable change in the abundance and/or distribution of birds may extend beyond the LAA.
Geographic Extent	The geographic area in which a residual effect occurs	**PDA:** Residual effects are restricted to the PDA. **LAA:** Residual effects extend into the LAA. **RAA:** Residual effects interact with those of other projects in the RAA.
Timing	Considers when the residual effect is expected to occur. Timing considerations are noted in the evaluation of the residual effect, where applicable or relevant	**No sensitivity:** The residual effect does not occur during critical life stage (e.g., nesting period) or timing does not affect birds and bird habitat. **Moderate sensitivity:** The residual effect may occur during a lower sensitive period of a critical life stage; for many species this is the start or end of the critical period. **High sensitivity:** The residual effect occurs during a critical life stage.
Duration	The time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured	**Short-term:** The residual effect occurs during one segment of the construction phase, or less than 5 years. **Medium-term:** The residual effect lasts through construction (up to 20 years). **Long-term:** The residual effect extends beyond construction, or throughout operations (>20 years).

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event:** The residual effect occurs once. **Multiple irregular event:** The residual effect occurs at no set schedule. **Multiple regular event:** The residual effect occurs at regular intervals. **Continuous:** The residual effect occurs continuously.
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible:** The residual effect is likely to be reversed after activity completion and reclamation. **Irreversible:** The residual effect is unlikely to be reversed.

Note:

[1] Based on benchmarks used for other recent environmental assessments (KHLP, 2012; Nalcor, 2012; JRP, 2014; Manitoba Hydro, 2016). The change in habitat categories for SAR and SOCC represent a cautionary approach based on species conservation status and sensitivity to incremental habitat loss.

20.1.6 Significance Definition

A significant adverse residual effect on birds and bird habitat is one that, following the application of avoidance and mitigation measures, causes or further contributes to the exceedance of a conservation-based threshold or threatens the long-term persistence or viability of SAR/SOCC, or species of cultural or traditional importance.

Specific to the assessment of potential effects of the Project on birds and bird habitat, persistence refers to the likelihood of population survival over the long term (Middleton and Nisbet 1997, EC 2011). The determination of significance considers whether habitats might be altered in such a way as to cause a change or decline in the distribution or abundance of a viable population (locally or regionally) that is dependent upon that habitat, such that the likelihood of long-term population survival is substantially reduced as a result. The determination of significance also considers whether there is a direct (e.g., collision risk) and/or indirect (e.g., increased predation pressure) increase in mortality risk such that the likelihood of persistence is substantially reduced as a result.

20.2 Existing Conditions for Birds and Bird Habitat

Residual effects (Section 20.4) are assessed relative to the existing condition for birds and bird habitat. This section provides a brief overview of the existing conditions for birds and bird habitat, including the occurrence of SAR, SOCC, and harvested species within the LAA and RAA, which are reported in the Birds and Bird Habitat TDR (K'alo-Stantec, 2023; Appendix 20A).

20.2.1 Methods

The Birds and Bird Habitat TDR (K'alo-Stantec, 2023; Appendix 20A) has been completed to address the ToR (MVEIRB, 2015) using a literature review of currently available information. The literature review incorporates relevant bird literature, Traditional Knowledge and traditional land and resource use information (K'alo-Stantec, 2023; Appendix 20A, Section 3). The TDR and supplementary 2022 Avian Survey report (K'alo-Stantec, 2022a; Appendix 20C) also contains field survey results for breeding songbirds and SAR within the LAA. The results of the literature review and field surveys are used to characterize the existing conditions for birds and bird habitat within the LAA and RAA.

20.2.2 Overview

The biophysical characteristics of the LAA are influenced by the Mackenzie River (Deh Cho), hereafter referred to as Mackenzie River Valley that defines the landscape and is dominated by coniferous forest habitats interspersed with wetlands and watercourses. The RAA has the potential to provide habitat for 213 species of bird, including 85 waterbird species, 5 upland gamebird species, 19 bird of prey species, and 104 landbird species (Smith et al. 2019, GNWT, 2020b, ECCC 2020, eBird 2021). The RAA also has the potential to provide habitat for 11 SAR/SOCC (Table 20.4; GNWT, 2020a, 2020c; Government of Canada, 2021).

Table 20.4 Bird Species at Risk and Species of Conservation Concern (*) with Potential to Occur in the Regional Assessment Area

Species		Status in NT[1]		Status in Canada[2]	
Common Name	**Scientific Name**	**SARC Assessment**	***Species at Risk (NWT) Act***	**COSEWIC**	**SARA**
Yellow rail	*Coturnicops noveboracensis*	Not Applicable	Not Applicable	Special Concern	Special Concern
Lesser yellowlegs*	*Tringa flavipes*	Not Applicable	Not Applicable	Threatened	Not Listed◊
Red-necked phalarope	*Phalaropus lobatus*	Not Applicable	Not Applicable	Special Concern	Special Concern
Short-eared owl	*Asio flammeus*	Not Assessed	No Status	Threatened	Special Concern◊
Common nighthawk	*Chordeiles minor*	Not Applicable	Not Applicable	Special Concern	Threatened◊
Olive-sided flycatcher	*Contopus cooperi*	Not Applicable	Not Applicable	Special Concern	Threatened◊
Bank swallow	*Riparia riparia*	Not Applicable	Not Applicable	Threatened	Threatened
Barn swallow	*Hirundo rustica*	Not Applicable	Not Applicable	Special Concern	Threatened◊
Harris's sparrow*	*Zonotrichia querula*	Not Applicable	Not Applicable	Special Concern	Special Concern ◊
Rusty blackbird	*Euphagus carolinus*	Not Assessed	No Status	Special Concern	Special Concern
Horned grebe	*Podiceps auritus*	Not Applicable	Not Applicable	Special Concern	Special Concern

Notes:

1 Species at risk in NWT assessed by the Species at Risk Committee (SARC) and listed under the territorial *Species at Risk (NWT) Act* (GNWT, 2022). Not applicable: *Species at Risk* (NWT) *Act* does not apply to this species (GNWT, 2022)

2 Species at risk in Canada assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and listed under Schedule 1 the federal *Species at Risk Act* (Government of Canada, 2021)

* Species of conservation concern

◊ Under consideration for Schedule 1 status change

20.2.2.1 Bird Species of Interest to Indigenous Governments, Indigenous Organizations, and Other Affected Parties

Birds of interest identified by Indigenous Governments, Indigenous Organizations, and specific other affected parties engaged on the Project, through a review of publicly available literature, and project-specific TLRU studies, are listed in Table 20.5 (Auld and Kershaw, 2005; Dehcho First Nations, 2011; IMG-Golder Corporation, 2006; McDonald, 2010; NWRC, 2023; TRRC, 2022; SRRB, 2021b, 2007; SLUPB, 2023).

Availability of birds and bird habitat is important to harvesters throughout the Dehcho and Sahtu regions. Several bird harvesting sites (Table 20.6) have been identified through the project-specific engagement program, a review of publicly available literature, and project-specific TLRU studies. Sahtu Dene and Métis and Dehcho First Nations reported 20 locations within the PDA, LAA, and RAA that are of interest relative to birds and bird habitat, as described in Table 20.6 (see Figure 11.3) (SLUPB, 2023; Dessau, 2012 [PR#13]; 5658 NWT Ltd. and GNWT, 2011 [PR#16]; Dehcho First Nations, 2011; IMG-Golder Corporation, 2006).The wildlife assessment used a habitat-based approach (see Section 20.4.1) to assess potential effects of the Project on bird SAR/SOCC including those considered to have cultural importance to Indigenous Governments and Indigenous Organizations.

Table 20.5 Culturally Important Bird Species Identified by Indigenous Governments, Indigenous Organizations, and Specific Other Affected Parties with Potential to Occur in the RAA

Common Name	Latin Name	Identified By
American widgeon	*Mareca americana*	SRRB
Arctic loon	*Gavia arctica*	SRRB
Barrows goldeneye	*Bucephala islandica*	SRRB
Black scoter	*Melanitta nigra*	SRRB
Blue-winged teal	*Anas discors*	SRRB
Brant goose	*Branta bernicla*	SRRB
Bufflehead	*Bucephala albeola*	SRRB
Canada goose	*Branta canadensis*	SRRB; NWRRC
Canvasback	*Aythya valisineria*	SRRB
Common goldeneye	*Bucephala clangula*	SRRB
Common loon	*Gavia immer*	SRRB
Common merganser	*Mergus merganser*	SRRB
Duck	Various	Dehcho First Nations; Pehdzéh Kį First Nation; Wrigley Community; TRRC; NWRRC
Goose	Various	Dehcho First Nations; Pehdzéh Kį First Nation; Wrigley Community; NWRRC

Common Name	Latin Name	Identified By
Greater scaup	*Aythya marila*	SRRB
Greater white-fronted goose	*Anser albifrans*	SRRB
Green-winged teal	*Anas crecca*	SRRB
Grouse/ptarmigan (e.g., willow ptarmigan/chicken)	Various (e.g., *Lagopus lagopus*)	Pehdzéh Kį First Nation; Wrigley Community; TRRC; NWRRC
Harlequin	*Histrionicus histronicus*	SRRB
Kingfisher	*Megaceryle alcyon*	NWRRC
Lesser scaup	*Aythya affinis*	SRRB
Northern pintail	*Anas acuta*	SRRB
Northern shoveler	*Anas clypeata*	SRRB
Oldsquaw	*Clangula hyemalis*	SRRB
Pacific loon	*Gavia pacifica*	SRRB
Red breasted merganser	*Mergus serrator*	SRRB
Red-throated loon	*Gavia stella*	SRRB
Ring-necked duck	*Aythya collaris*	SRRB
Rock ptarmigan	*Lagopus mutus*	SRRB
Ruffed grouse	*Bonasa umbellus*	SRRB
Sandhill crane	*Grus canadensis*	SRRB
Sharp-tailed grouse	*Tympanuchus phasianellus*	SRRB; NWRRC
Snow goose	*Chen caerulescens*	SRRB
Snowy owl	*Nyctea scandiacus*	SRRB
Song birds	*Oscines*	NWRRC
Spruce grouse	*Canachites canadensis*	SRRB; NWRRC
Surf scoter	*Melanitta perspicllata*	SRRB
Trumpeter swan	*Cygnus buccinator*	Pehdzéh Kį First Nation; SRRB; NWRRC
Tundra swan	*Cygnus columbianus*	Pehdzéh Kį First Nation; SRRB; NWRRC
White-winged scoter	*Melanitta fusca*	SRRB
Whiskey jack (Canada jay)	*Perisoreus canadensis*	NWRRC
Yellow-billed loon	*Gavia adamsii*	SRRB

Table 20.6 Bird Habitat and Harvesting Locations Identified by Indigenous Governments, Indigenous Organizations and Other Affected Parties Relative to the Project

Location	Within LAA	Within RAA[2]	Identified By:
Petiniɂah (Bear Rock) CZ (Zone #32) (harvesting/habitat)	✓	-	Sahtu Dene and Métis; NWRRC
Between KM 840 and KM 850 (Between Norman Wells and Tulita) (harvesting)	✓*	-	Sahtu Dene and Métis
Sahtu Region (harvesting/habitat)	✓*	✓	Sahtu Dene and Métis
Blackwater River (as it intersects with the LAA and PDA) (habitat/harvesting)	✓*	-	Dehcho First Nations; Pehdzéh Kį First Nation
Ochre River (as it intersects with the LAA and PDA) (habitat)	✓*	-	Dehcho First Nations; Pehdzéh Kį First Nation
Vermillion Creek South (harvesting)	-	✓	Dehcho First Nations; Pehdzéh Kį First Nation; NWRRC
Prohibition Creek (harvesting)	-	✓	NWRRC
Canyon Creek (harvesting)	-	✓	NWRRC
Bluefish Creek (harvesting/habitat)	-	✓	NWRRC
Sucker Creek (harvesting/habitat)	-	✓	NWRRC
Four Mile Island (harvesting)	✓	✓	Sahtu Dene and Métis
Ten Mile Island (harvesting)	-	✓	NWRRC
Four Mile Creek (harvesting)	-	✓	TRRC
Little Bear River (habitat)	-	✓	Sahtu Dene and Métis
Pehdzéh Kį N'deh area[1] (habitat/harvesting)	✓	✓	Dehcho First Nations; Pehdzéh Kį First Nation
Great Bear River (habitat/harvesting)	-	✓	Dehcho First Nations; Pehdzéh Kį First Nation; TRRC
Proposed Great Bear River Bridge (area overhead) (habitat)	✓	-	TRRC
Wrigley (area) (habitat)	✓*	-	Dehcho First Nations; Pehdzéh Kį First Nation
Tulita (area) (harvesting)	✓*	-	TRRC
Mackenzie River (habitat)	✓	✓	Dehcho First Nations; Pehdzéh Kį First Nation

Notes:

[1] Pehdzéh Kį N'deh area boundary of this area was not identified or disclosed in the report

[2] Occurs within the RAA outside the LAA and PDA

* May occur within PDA.

Norman Wells Renewable Resource Council TLRU study participants stated that changes have been observed in bird migration and expressed concern that birds are moving in a different direction and are not observed as much in the LAA and RAA as previously before (NWRRC, 2023). Bird habitat in the Dehcho Region portion of the LAA is dominated by coniferous forest (43.6%), wetlands (19.8%), and open water (19.3%), while the LAA that overlaps the Sahtu Region is dominated by coniferous forest (28.7%), wetlands (25.2%), and shrubland (20.6%; Table 20.7). Between 1960 and 2019, 18.5% of the LAA within the Dehcho Region and 75.2% of the LAA within the Sahtu Region has been subject to forest fire (K'alo-Stantec, 2022b; see Appendix 18A).

Other than communities, the Norman Wells Pipeline, and other developments such as borrow sources and quarries, a fibre line, and bridges associated with the MVWR, the LAA and RAA are relatively undisturbed by human activities (see Table 20.7). Oil and gas exploration and production infrastructure in the RAA occurs on the west side of, and within, the Mackenzie River Valley near Norman Wells.

Table 20.7 Land Cover Composition[1] in the LAA and RAA for the Dehcho Region and Sahtu Region

Land Cover Category	Land Cover Class[2]	Dehcho Region			Sahtu Region		
		PDA	LAA	RAA	PDA	LAA	RAA
		ha (%)	ha (%)	ha (%)	ha (%)	ha (%)	ha (%)
Upland	Broadleaf Dense	11.6 (1.4%)	1,037.4 (3.9%)	43,781.3 (12.2%)	75.1 (5.0%)	2,253.1 (5.2%)	34,259.4 (5.3%)
	Broadleaf Open	2.1 (0.3%)	114.8 (0.4%)	4,154.7 (1.2%)	27.0 (1.8%)	1,103.9 (2.3%)	14,627.9 (2.2%)
	Coniferous Dense	39.2 (4.9%)	3,374.9 (12.6%)	25,120.5 (7.0%)	18.1 (1.2%)	917.8 (1.9%)	18,580.5 (2.9%)
	Coniferous Open	98.9 (12.2%)	4,600.6 (17.2%)	40,034.2 (11.2%)	147.1 (9.8%)	6,678.1 (13.8%)	113,316.2 (17.4%)
	Coniferous Sparse	42.6 (5.3%)	3,725.0 (13.9%)	51,491.5 (14.3%)	116.2 (7.7%)	6,332.6 (13.0%)	71,845.9 (11.0%)
	Mixedwood Dense	16.6 (2.1%)	1,035.1 (3.9%)	6,786.9 (1.9%)	11.1 (0.7%)	387.3 (0.8%)	7,494.4 (1.1%)
	Mixedwood Open	1.8 (0.2%)	117.1 (0.4%)	2,728.5 (0.8%)	47.1 (3.1%)	2,514.0 (5.2%)	23,834.7 (3.7%)
	Mixedwood Sparse	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.5 (<0.1%)	6.3 (<0.1%)	11.7 (<0.1%)
	Shrub Low	4.9 (0.6%)	567.4 (2.1%)	39,005.2 (10.9%)	146.2 (9.7%)	7,903.4 (16.3%)	72,607.6 (11.1%)
	Shrub Tall	3.2 (0.4%)	320.6 (1.2%)	1,616.4 (0.5%)	49.9 (3.3%)	2,091.3 (4.3%)	16,525.8 (2.5%)
	Herbaceous	6.6 (0.8%)	50.6 (0.2%)	1,300.1 (0.3%)	12.1 (0.8%)	210.9 (0.4%)	4,093.2 (0.6%)

Land Cover Category	Land Cover Class[2]	Dehcho Region			Sahtu Region		
		PDA	LAA	RAA	PDA	LAA	RAA
		ha (%)	ha (%)	ha (%)	ha (%)	ha (%)	ha (%)
Upland (cont'd)	Bryoids	0.0 (0.0%)	7.0 (<0.1%)	20.4 (<0.1%)	0.4 (<0.1%)	6.2 (<0.1%)	137.0 (<0.1%)
	Rock/Rubble	2.1 (0.3%)	45.1 (0.2%)	4,916.4 (1.4%)	3.8 (0.3%)	107.3 (0.2%)	10,285.3 (1.6%)
	Exposed Land[3]	478.6 (59.2%)	1,338.0 (5.0%)	4,862.2 (1.4%)	626.3 (41.5%)	1,713.2 (3.5%)	9,897.9 (1.5%)
	Total	*708.3 (87.7%)*	*16,333.6 (60.9%)*	*225,848.3 (62.9%)*	*1,280.9 (85.0%)*	*32,495.5 (66.9%)*	*397,517.5 (61.0%)*
Wetland	Wetland Herbaceous	12.1 (1.5%)	856.8 (3.2%)	12,668.3 (3.5%)	52.5 (3.5%)	2,976.9 (6.1%)	44,*854*.8 (6.9%)
	Wetland Shrub	47.1 (5.8%)	2,222.9 (8.3%)	44,730.3 (12.5%)	78.3 (5.2%)	4,503.7 (9.3%)	55,*337*.6 (8.5%)
	Wetland Treed	34.5 (4.3%)	2,218.9 (8.3%)	46,859.8 (13.1%)	75.5 (5.0%)	4,771.6 (9.8%)	64,*769*.1 (9.9%)
	Total	*93.6 (11.6%)*	*5,298.5 (19.8%)*	*104,258.6 (29.0%)*	*206.3 (13.7%)*	*12,252.1 (25.2%)*	*164,961.5 (25.3%)*
Water		6.0 (0.7%)	5,187.5 (19.3%)	28,835.2 (8.0%)	20.1 (1.3%)	3,792.3 (7.8%)	89,302.6 (13.7%)
No Data		0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	0.0 (0.0%)	163.9 (<0.1%)
TOTALS		***807.9 (100%)***	***26,819.7 (100%)***	***359,038.0 (100%)***	***1,507.3 (100%)***	***48,539.9 (100%)***	***651,945.5 (100%)***

Notes:

1 Measured in hectares (ha)

2 From Earth Observation of Sustainable Development of Forests Northwest Territories (EOSD NWT) (NRCan and GNWT, 2017; K'alo-Stantec, 2022b [Appendix 18A])

3 Exposed land includes areas which naturally have less than 5% vegetative cover, such as shorelines of rivers and lakes, exposed rock, recently burned areas, and moraines, and includes cleared areas such as the existing MVWR, Norman Wells Pipeline, and other areas of infrastructure development.

Key results and findings of the TDR (K'alo-Stantec, 2023; Appendix 20A) include:

- Many bird species are culturally important to local communities (e.g., birds of prey) and for subsistence hunting (e.g., waterbirds, upland gamebirds; e.g., Auld and Kershaw, 2005; SLUPB, 2023; SRRB, 2021; TRRC, 2022).
- The Petiniʔah (Bear Rock) CZ is a large karst formation west of Tulita that is a sacred site and subject to traditional storytelling that also provides habitat for a wide variety of wildlife species, including nesting raptors (SLUPB, 2023). The Petiniʔah (Bear Rock) has also been identified as an Important Wildlife Area (IWA) for peregrine falcon (Wilson and Haas, 2012; K'alo-Stantec, 2023; see Appendix 20A, Figure 3.6).
- The RAA is within the breeding range of 10 bird SAR and 2 bird SOCC (see Table 20.4).
- Historical records exist within the LAA and RAA for 11 of 12 SAR/SOCC (all but yellow rail) with the potential to occur in the RAA (Government of Canada, 2021; GNWT, 2020a, 2020b, 2020c; eBird, 2021; ECCC, 2020).
- The LAA is not expected to provide a notable source of habitat for bird SAR and SOCC when compared to other areas in the RAA and NWT, as these species are generally widely distributed and/or at the northern edge of their range. However, data availability is limited for some SAR.
- The LAA is partially within the Middle Mackenzie River IBA that provides a notable source of staging and migration habitat for migratory birds, especially waterfowl and other waterbird species (IBA Canada, 2020a).
- Brackett Lake IBA also provides a notable source of breeding and migration habitat for waterbird species; it is located in the RAA and outside of the LAA (IBA Canada, 2020b).
- Other sensitive features for birds such as nests, primarily for raptors, are located throughout the LAA and RAA (GNWT, 2020c).
- Notable concentrations of raptor nests exist in the Petiniʔah (Bear Rock) CZ (Zone #32), within the RAA, which is also a culturally sacred site (SLUPB, 2023; GNWT, 2020c).

20.3 Project Interactions with Birds and Bird Habitat

Anticipated interactions between project activities and birds and bird habitat leading to potential effects (Section 20.1.3) are identified in Table 20.8 with a check mark (✓). These potential interactions are discussed in detail in Section 20.5, in the context of effects pathways, standard and project-specific mitigation/enhancement, and residual effects. Justification for no effect (indicated by a dash [–]) is provided following the table.

Table 20.8 Project Interactions with Bird and Bird Habitat

Physical Activities	Timing	Environmental Effects		
		Change in Habitat	Change in Mortality Risk	Change in Bird Health
Construction Phase				
Mobilization of equipment, materials, and fuel, resupply, and demobilization	Summer and winter	✓	✓	✓
Establishment and operation of camps	Year-round	✓	✓	–
Site preparation of ROW, access, and workspaces	Winter	✓	✓	✓
Borrow source and quarry development and operations, including blasting, crushing, sorting, and stockpiling	Year-round	✓	✓	✓
Material haul	Year-round	✓	✓	✓
Embankment and quarry access road construction, including road cuts	Winter; road cuts in summer or winter	✓	✓	✓
Culvert installations	Summer or winter	✓	✓	✓
Road base placement, compaction, and surfacing	Summer	✓	✓	✓
Water withdrawal to support construction activities	Year-round	–	–	–
Closure and reclamation of MVWR and temporary borrow sources/quarries, camps, and workspaces	Summer	✓	✓	✓
Employment and contracted goods and services[1]	Year-round	–	–	–
Operations and Maintenance Phase				
Borrow source and quarry operations, including blasting, crushing, sorting, and stockpiling	Summer	✓	✓	✓
Material haul and stockpiling	Summer	✓	✓	✓
Operation of, and activities at, maintenance yards	Year-round	✓	✓	–
Water withdrawal for dust control	Summer	–	✓	–
Employment and contracted goods and services[1]	Year-round	–	–	–
Presence and public use of the highway	Year-round	✓	✓	–
Highway and access road maintenance including snow clearing, repair, grading, dust control	Year-round	✓	✓	–
Vegetation control	Summer	✓	✓	–
Bridge and culvert maintenance	As needed	✓	✓	–

Notes:

✓ Potential interaction

– No interaction

[1] Project employment and expenditures are generated by most project activities and components and are the main drivers of many socio-economic effects. Rather than acknowledging this by placing a check mark against each of these activities, "Employment and contracted goods and services" have been introduced as an additional component under each project phase.

Project-related environmental effects can influence birds and bird habitat directly or indirectly and positively or negatively. A direct effect is characterized by an interaction that occurs at the same time and place and exhibits no intermediate effects (e.g., mortality resulting from vehicle collisions), whereas an indirect effect is characterized by an interaction that occurs at a later time and space because it has intermediary steps leading to the effect (e.g., project-related clearing leads to altered predator-prey dynamics; Hegmann et al., 1999). Most interactions will affect birds and bird habitat adversely, but in some cases the effects are positive for certain species or project activities (e.g., creation of edge habitats). Positive effects are described but not characterized further.

Employment and contracted goods and services activities are not expected to result in a change in habitat, mortality risk, or bird health for the lifetime of the Project as there is no pathway for these activities to interact with birds and bird habitat.

During construction, water withdrawal will only occur at authorized location, regulated to protect fish and fish habitat, and will not result in a change in habitat (i.e., changes to water levels will be protective of aquatic ecosystems; see Chapter 15 [water quantity]).

Establishment and operation of camps, water withdrawal, presence of the highway, highway and access road maintenance, vegetation control, and bridge and culvert maintenance are not anticipated to result in a change in bird health, as there are no pathways for harmful substances to enter the environment.

20.4 Assessment of Residual Effects on Birds and Bird Habitat

This section discusses the interaction pathways for the project activities identified in Table 20.8 (Section 20.3) that have the potential to affect habitat, mortality risk, or bird health, and includes analytical assessment techniques, mitigation, and residual effects.

Based on project interactions with the environment identified in Table 20.8, the Project may affect birds and bird habitat. Potential effects, effect pathways, and mitigation measures that will reduce or eliminate the effects on birds and bird habitat are identified in Table 20.9. These residual effects and associated analytical assessment techniques are described.

Table 20.9 Potential Effects and Mitigation Measures for Bird and Bird Habitat

Effect Name	Effect Pathway	Mitigation Measures
Change in Habitat	Direct and/or indirect loss or alteration of bird habitat	The Project will use previously disturbed areas for project activities and project infrastructure and workspaces, to the extent practical.
		Clearing will be limited to areas required for construction and safe operations.
		Project vehicles will be confined to existing roads and trails to avoid disturbing vegetated areas.
		Removal of vegetation will be limited to the width of the ROW and workspaces.
		Vegetation buffers will be used as visual barriers and to protect riparian vegetation, as appropriate.
		Organic material and topsoil will be set aside for use during reclamation, where possible.
		Erosion and sedimentation control measures will be implemented per the Erosion and Sedimentation Control Plan (ESCP) and will be in place prior to construction activities and before the spring melt/freshet. Draft management plans are included in Volume 5.
		Riparian vegetation will be maintained whenever possible.
		A WMMP will be developed and implemented. The WMMP will contain detailed monitoring and mitigation measures to be implemented for the duration of the construction and operations of the Project (see Volume 5).
		Construction and quarry development activities will adhere to the applicable recommended setbacks and timing restrictions for wildlife outlined in the WMMP, where possible.
		Wildlife monitors will assess for the presence of nesting birds on or near workspaces during project activities.
		The WMMP will outline how risks to migratory birds will be managed in accordance with ECCC's Guidelines to Reduce Risk to Migratory Birds (ECCC, 2021) if activities that could result in risk of harm cannot be avoided (e.g., pre-clearing nest surveys).
		The WMMP will be complied with in relation to species of birds not under GNWT's authority in addition to species under GNWT's authority.

Effect Name	Effect Pathway	Mitigation Measures
Change in Habitat (cont'd)		Vegetation clearing will be completed outside the migratory bird nesting period, which extends from May 1 to August 31. This considers Nesting Zone B8 (May 4 to August 22 for Zone B8; ECCC, 2018) and potential species at risk. Vegetation clearing will also consider the Critical Breeding Periods for Raptor Species of the Northwest Territories (Shank and Poole, 2016) to avoid disturbing species that breed prior to the migratory bird nesting period.
		If an active bird nest is found, beneficial management practices (GNWT, 2020d) will be followed, including applying an appropriate setback and timing restriction and the GNWT-ECC and/or ECCC will be consulted, as appropriate.
		Project staff will take the GNWT's Migratory Bird Awareness Training Webinar and obtain a certificate to demonstrate proof of training.
		Personnel will undergo a wildlife awareness program, which will include prevention measures for wildlife mortality (e.g., bear safety) and reporting procedures for wildlife-related incidents and protocols to follow when a nest, den, or wildlife species of management concern is observed. This includes completing wildlife sighting and wildlife incident report forms included in the WMMP.
		Closure and reclamation will promote re-establishment of vegetation.
		Site grading at closure will approximate pre-development conditions.
		Borrow source vegetated surface material, where present, will be replaced after development is completed.
		A dust control program using water will be implemented during construction and operations and maintenance.
		Vehicle speeds will be limited to 50 km/h on unfinished project road surfaces.
		The Project will use previously disturbed areas for project activities and project infrastructure and workspaces, to the extent practical.
		Vegetation clearing will be completed outside the migratory bird nesting period, which extends from May 1 to August 31. This considers Nesting Zone B8 (May 4 to August 22 for Zone B8; ECCC, 2018) and potential species at risk. Vegetation clearing will also consider the Critical Breeding Periods for Raptor Species of the Northwest Territories (Shank and Poole, 2016) to avoid disturbing species that breed prior to the migratory bird nesting period.

Effect Name	Effect Pathway	Mitigation Measures
Change in Mortality Risk		The WMMP will outline how risks to migratory birds will be managed in accordance with ECCC's Guidelines to Reduce Risk to Migratory Birds (ECCC, 2021) if activities that could result in risk of harm cannot be avoided (e.g., pre-clearing nest surveys).
		The WMMP will be complied with in relation to species of birds not under GNWT's authority in addition to species under GNWT's authority.
		If an active bird nest is found, beneficial management practices (GNWT, 2020d) will be followed, including applying an appropriate setback and timing restriction and the GNWT-ECC and/or ECCC will be consulted, as appropriate.
		Wildlife monitors will assess for the presence of nesting birds on or near workspaces during project activities.
		Project staff will take the GNWT's Migratory Bird Awareness Training Webinar and obtain a certificate to demonstrate proof of training.
		Personnel will undergo a wildlife awareness program which will include prevention measures for wildlife mortality (e.g., bear safety) and reporting procedures for wildlife-related incidents and protocols to follow when a nest, den, or wildlife species of management concern is observed. This includes completing wildlife sighting and wildlife incident report forms included in the WMMP.
		Personnel will not feed or harass wildlife while working on the Project.
		Project personnel will be prohibited from hunting and fishing while housed in work camps for the Project.
		Construction and quarry development activities will be limited during sensitive periods for wildlife in accordance with the WMMP.
		Food and other wildlife attractants will be stored in bear-proof containers.
		Crews will be trained on wildlife awareness.
		Food waste will be stored and disposed of in a manner to avoid attracting wildlife.
		Equipment, wastes, and contaminated soils will be removed once construction is completed.
		The Project will use previously disturbed areas for project activities and project infrastructure and workspaces, to the extent practical.
		Clearing will be limited to areas required for construction and safe operations.

Effect Name	Effect Pathway	Mitigation Measures
Change in Mortality Risk (cont'd)		A buffer strip of undisturbed vegetation of at least 30 m wide will be maintained between the highway ROW and other new areas to be cleared.
		Vegetation buffers will be used as visual barriers and to protect riparian vegetation, as appropriate.
		Speed limits will be posted on the public highway.
		The Spill Contingency Plan (SCP) will include procedures to prevent and respond to spills.
		Areas and containers used to store project wastes will be constructed, operated, and maintained in a manner to prevent waste from discharging to the surrounding environment.
Change in Bird Health	Construction, operations and maintenance could expose wildlife to contaminants or other emissions that may affect the health and condition of birds	Maintenance yards will have a liner or concrete installed under areas of vehicle storage and maintenance.
		Vehicles parked for more than 2 hours will use drip trays.
		A minimum of 10 centimetres (cm) of packed snow or ice will be used on winter access roads.
		Construction equipment will travel on designated winter roads or constructed embankment only.
		Clearing of new areas will be completed when the ground is frozen to reduce disturbance to soils and permafrost
		Placement of embankment will occur primarily during winter (December 15 to April 1), during frozen conditions. If work is to be completed under non-frozen conditions, equipment will be equipped with mushroom shoes.
		Borrow source floors will be sloped to reduce ponding of water.
		Travel of vehicles will be confined to existing infrastructure roads and trails as much as possible to avoid disturbing vegetated areas.
		A project-specific ESCP will be developed and implemented.
		Sediment and erosion control measures will be regularly inspected to confirm they are performing as intended.
		Ponded water will be directed away from watercourses.
		Only material with low acid rock drainage and metal leaching potential will be used for the Project.
		Rip rap will be free of silt and other debris.
		Sediment control measures will be in place prior to construction activities and before the spring melt/freshet.
		Riparian vegetation will be maintained whenever possible.
		Excavated spoil material will be placed at least 30 m from the watercourse.

Effect Name	Effect Pathway	Mitigation Measures
Change in Bird Health (cont'd)		Snow fill temporary crossings will be constructed of clean snow fill.
		Vegetation buffers will be used as visual barriers and to protect riparian vegetation, as appropriate.
		Machinery onsite will be in a clean condition and free of invasive alien plant species.
		Washing, refueling, and servicing machinery and storage of fuel and other materials for machinery will be conducted a minimum of 100 m from the high-water mark and in a manner to prevent any deleterious substances from entering the water.
		Machinery will not be left in any waterbody.
		Quarry operations will be located a minimum of 100 m from the ordinary high-water mark of any waterbody.
		Blast rock will not enter a waterbody or watercourse.
		Material stockpiles will be kept a minimum of 30 m from a watercourse or waterbody with the appropriate erosion control mitigation in place to prevent sediment from entering a watercourse or waterbody.
		Equipment will be maintained in good working order.
		Blast mats will be used when blasting near receptors sensitive to noise.
		A dust control program using water will be implemented during construction, operations and maintenance.
		Vehicle speeds will be limited to 50 km/h on unfinished project road surfaces.
		Incinerators will be operated in accordance with manufacturer's specifications and emissions will meet Canadian Council of Ministers of the Environment Canada Wide Standards for Dioxins & Furans and Mercury.
		Equipment, wastes, and contaminated soils will be removed once construction is completed.

20.4.1 Analytical Assessment Techniques

The general approach to assessing potential effects on birds and bird habitat follows the sequence and methods outlined in Chapter 4 - Assessment Methods. Analytical assessment techniques specific to each potential effect are described.

20.4.1.1 Change in Habitat

Change in habitat was assessed by comparing direct and indirect changes in habitat availability from baseline conditions to the residual condition in the LAA, including for key bird species (Table 20.2) and for each project phase (i.e., construction, and operations and maintenance).

Direct change in habitat (e.g., vegetation clearing) was calculated as the loss of habitat that is no longer available to birds resulting from the PDA; effects do not extend into the LAA. In general, once vegetation clearing is completed during the construction component, the PDA will provide no suitable bird habitat, except for a few species that may take advantage of developed sites (e.g., barn swallow). Portions of the PDA will be reclaimed after construction and 9 of 15 quarries/borrow sources will continue to be used during operations and maintenance but may provide altered habitats for some wildlife species. Land cover classes considered as habitat for each bird species or species group are summarized in Table 20.10 and were established using relevant scientific literature, life history information, and professional judgment.

Indirect change in habitat (e.g., sensory disturbance) was assessed qualitatively as the area of reduced habitat effectiveness; effects are confined to the LAA.

Land cover classes were quantified using EOSD NWT geospatial data (NRCan and GNWT, 2017). This dataset is part of the Multi-source Vegetation Inventory Project (NRCan, 2020) and uses an unsupervised classification and cluster analysis to classify land cover. The dataset includes cover type and density classes and forest structure height and volume information based on Landsat imagery collected from 2007 to 2013. Mapping was done at a scale of 1:250,000 and was refined through field evaluation by the GNWT (NRCan and GNWT, 2017). Detailed land cover classification methods for this Project are in the Vegetation and Wetlands TDR (K'alo-Stantec, 2022b; Appendix 18A).

Table 20.10 Land Cover Classes used to Quantify Breeding Habitat by Species/Species Groups

Land Cover Category	Land Cover Class[1]	All Bird Habitats	Waterbirds[2]	Birds of Prey[3]	Landbirds[4]	Peregrine Falcon[5]	Yellow Rail[6]	Lesser Yellowlegs[7]	Red-necked Phalarope[8]	Short-eared Owl[9]	Common Nighthawk[10]	Olive-sided Flycatcher[11]	Rusty Blackbird[12]	Horned Grebe[13]
Upland	Broadleaf Dense	✓	–	✓	✓	✓	–	–	–	–	✓	✓	–	–
	Broadleaf Open	✓	–	✓	✓	✓	–	–	–	–	✓	✓	–	–
	Broadleaf Sparse	✓	–	–	✓	✓	–	–	–	–	✓	✓	–	–
	Coniferous Dense	✓	–	✓	✓	✓	–	–	–	–	✓	✓	✓	–
	Coniferous Open	✓	–	✓	✓	✓	–	–	–	–	✓	✓	✓	–
	Coniferous Sparse	✓	–	–	✓	✓	–	–	–	–	✓	✓	✓	–
	Mixedwood Dense	✓	–	✓	✓	✓	–	–	–	–	✓	✓	✓	–
	Mixedwood Open	✓	–	✓	✓	✓	–	–	–	–	✓	✓	✓	–
	Mixedwood Sparse	✓	–	–	✓	✓	–	–	–	–	✓	✓	✓	–
	Shrub Low	✓	–	–	✓	✓	–	–	–	–	✓	–	–	–
	Shrub Tall	✓	–	–	✓	✓	–	–	–	–	✓	–	–	–
	Herbaceous	✓	–	–	✓	✓	–	–	–	✓	–	–	–	–
	Bryoids	✓	–	–	✓	✓	–	–	–	✓	✓	–	–	–
	Rock/ Rubble	✓	–	–	✓	✓	–	–	–	–	✓	✓	–	–
	Exposed Land	✓	–	–	✓	✓	–	–	–	–	✓	✓	–	–

Land Cover Category	Land Cover Class[1]	All Bird Habitats	Waterbirds[2]	Birds of Prey[3]	Landbirds[4]	Peregrine Falcon[5]	Yellow Rail[6]	Lesser Yellowlegs[7]	Red-necked Phalarope[8]	Short-eared Owl[9]	Common Nighthawk[10]	Olive-sided Flycatcher[11]	Rusty Blackbird[12]	Horned Grebe[13]
Wetland	Wetland Herbaceous	✓	✓	–	✓	–	✓	✓	✓	–	–	–	–	–
	Wetland Shrub	✓	✓	–	✓	–	–	✓	✓	–	–	–	✓	–
	Wetland Treed	✓	✓	–	✓	–	–	✓	✓	–	–	✓	✓	–
Water		✓	✓	–	–	–	–	✓	✓	–	–	–	–	✓

Notes:

✓ Land cover class considered habitat for each species/species group

– Land cover class not considered habitat for each species/species group

1 From EOSD NWT (NRCan and GNWT, 2017; K'alo-Stantec, 2022b [Appendix 18A])

2 Wetland land cover classes limited to within 50 m of open water

3 Upland land cover classes limited to within 100 m of rivers or lakes (open water ≥ 10 ha) and cliff areas (> 30 degrees)

4 Landbirds includes upland gamebird species

5 Upland land cover classes limited to cliff areas (> 30 degrees)

6 Wetland land cover classes limited to those ≥ 10 ha

7 Includes all wetland shrub, wetland treed, and water (excluding rivers) land cover classes and wetland herbaceous within 50 m of other wetland/water classes

8 Wetland land cover classes limited to within 50 m of open water (excluding rivers)

9 Upland land cover classes limited to patches ≥50 ha

10 Includes all sparse forest classes and all other forest land cover classes burned within the past 20 years

11 Includes all open and sparse coniferous and mixedwood forest land cover classes and remaining forest classes burned within the past 20 years or within 20 m of rock/rubble, exposed land, and water

12 Upland land cover classes limited to those within 50 m of water

13 Waterbodies ≤ 10 ha in size (excluding rivers)

20.4.1.2 Change in Mortality Risk and Bird Health

The remaining effects were assessed qualitatively through evaluating the relative change in direct and indirect sources of mortality (e.g., vehicle collisions, increased hunting pressure) and bird health (e.g., contamination) compared to the existing condition. The qualitative assessment included a combination of literature review and professional judgment to predict effects on birds and bird habitat.

20.4.1.3 Assumptions and the Conservative Approach

A conservative approach is used to address uncertainty in the effects assessment, which increases confidence in the final determination of significance. The assessment used a habitat-based approach, which focuses on identifying the quantity and composition of land cover types (i.e., habitats) affected by the Project relative to the availability of those habitats in the LAA and RAA. This approach is considered conservative as it assumes that bird species are present if the habitat is available, which is not always the case (e.g., some birds may not be present in a habitat recently affected by fire until the habitat returns to its pre-fire state following the vegetation successional process that requires several years).

Additionally, land cover classes that represent disturbed lands (i.e., exposed land) are included in the quantification of direct habitat loss, despite providing limited value for most bird species, and comprises 47.8% (1,104.91 ha) of the PDA. The PDA is conservatively assumed to be lost to wildlife, however, there are portions that are already disturbed (i.e., MVWR) and portions that will be reclaimed, which will provide habitat for some species that use disturbed sites. The prediction confidence of the assessment for birds and bird habitat (Section 20.7) incorporates these assumptions.

20.4.2 Change in Habitat

20.4.2.1 Effects Pathways

20.4.2.1.1 Construction

During construction, removal of upland and wetland vegetation has potential to result in direct loss or alteration of upland and wetland habitat in the PDA due to establishment and operation of camps; clearing of the ROW, access, and workspaces; borrow source and quarry development and operations, including blasting, crushing, sorting, and stockpiling; embankment and borrow source/quarry access road construction, including road cuts; and culvert installations (Table 20.9). An indirect loss or alteration of habitat adjacent to the PDA is also possible through sensory disturbance (e.g., noise, light) and potential edge effects and fragmentation created by vegetation clearing (from the construction activities in the PDA listed). Vegetation clearing will result in an indirect alteration of habitats adjacent to the PDA by creating an unnatural transition (i.e., edge effects) between the PDA and adjacent habitat. Edge effects can include changes in microclimate

(e.g., Murcia, 1995) and vegetation structure (e.g., Harper et al., 2005) which can in turn result in changes in the bird community in those habitats.

Project-related sensory disturbance (i.e., noise and light) from most construction activities (e.g., heavy equipment operation, infrastructure construction, increased traffic volumes) has the potential to disturb birds and change the use of habitat around the site or road (e.g., habitat avoidance, fine-scale changes in individuals' movement and associated energetic costs). Dust deposition associated with project construction can affect vegetation composition adjacent to the PDA (e.g., Gill and Lantz, 2014) which may alter habitat use by birds. Indirect loss or alteration of habitat creates an area adjacent to the PDA that exhibits some degree of reduced ecological effectiveness, compared to the existing condition, that typically varies by effect pathway and bird species.

During construction, the PDA will provide limited bird habitat but there may be species that opportunistically exploit altered habitats (e.g., barn swallow).

20.4.2.1.2 Operations and Maintenance

Operations and maintenance of the Project will not result in the direct loss or alteration of habitat for birds and some disturbed habitats may become habitat for birds following reclamation and natural succession. However, an indirect loss or alteration of habitat is likely to occur adjacent to the PDA due to, sensory distance and dust deposition and presence of the highway (i.e., continuation of edge effects) (Table 20.9). Vegetation control within the ROW (i.e., ditches) will occur approximately every three years and will involve mowing dense shrub growth, which could remove habitat for some bird species; but may still provide potential nesting and/or foraging habitat for bird species known to use roadside habitats (e.g., killdeer [*Charadrius vociferus*]) (Abrahams et al. 2010).

Sensory disturbance and dust deposition associated with activities during the operations and maintenance phase of the Project (i.e., borrow source and quarry operations, including blasting, crushing, sorting, and stockpiling; material haul and stockpiling; operation of, and activities at, maintenance camps; presence of the highway; highway and access road maintenance; vegetation control; and bridge and culvert maintenance) have the potential to result in reduced ecological effectiveness of habitats adjacent to the PDA, as described for the construction phase. The presence of the highway will lead to traffic and associated effect pathways (i.e., sensory disturbance and dust deposition). These indirect effects are assessed and have the potential to result in a change in habitat and alter bird movements (i.e., avoidance). Additionally, presence of the highway will maintain fragmentation and edge effects over the long term that were established during the construction phase and while over time these effects may be ameliorated as shrubs soften the edges, these habitats may experience reduced ecological effectiveness or be avoided by some species.

20.4.2.2 Mitigation

As discussed in Chapter 5, project routing and design have integrated the existing MVWR ROW to the extent practicable, which will reduce change in habitat. In addition to a project-specific WMMP that will be implemented during the construction and operations and maintenance phases, standard industry practices and mitigation measures will also be implemented and are presented in Table 20.9. Key mitigation measures to avoid or reduce changes in habitat include:

- The Project will use previously disturbed areas for project activities and project infrastructure and workspaces, to the extent practical.
- Vegetation clearing will be completed outside the migratory bird nesting period, which extends from May 1 to August 31. This considers Nesting Zone B8 (May 4 to August 22 for Zone B8; ECCC, 2018) and potential species at risk. Vegetation clearing will also consider the Critical Breeding Periods for Raptor Species of the Northwest Territories (Shank and Poole, 2016) to avoid disturbing species that breed prior to the migratory bird nesting period.
- The WMMP will be complied with in relation to species of birds not under GNWT's authority in addition to species under GNWT's authority.
- If an active bird nest is found, beneficial management practices (GNWT, 2020d) will be followed, including applying an appropriate setback and timing restriction and the GNWT-ECC and/or ECCC will be consulted, as appropriate.
- Project staff will take the GNWT's Migratory Bird Awareness Training Webinar and obtain a certificate to demonstrate proof of training.
- Wildlife monitors will assess for the presence of nesting birds on or near the PDA during project activities.
- Personnel will undergo a wildlife awareness program, which will include prevention measures for wildlife mortality (e.g., bear safety) and reporting procedures for wildlife-related incidents and protocols to follow when a nest, den, or wildlife species of management concern is observed. This includes completing wildlife sighting and wildlife incident report forms included in the WMMP.
- Closure and reclamation will promote re-establishment of vegetation.
- Borrow source vegetated surface material, where present, will be replaced after development is completed.

20.4.2.3 Residual Effects

20.4.2.3.1 Construction

The project highway alignment routing has considered reducing the amount of new ROW required by primarily widening the existing MVWR ROW (from 30 m to 60 m) where feasible, and the creation of new ROW that is limited to specific areas to avoid sensitive areas and wetlands, reduce slopes and/or sharp curves to accommodate higher traffic speeds, and increase safety on the highway. Construction of the Project will result in the direct loss of 2,315.2 ha of potential bird habitat within the LAA (Table 20.11), a 3.1% decrease in habitat from existing conditions. However, 47.8% (1,104.9 ha) of this direct loss is exposed land that is subject to existing anthropogenic disturbances (i.e., existing MVWR and quarries), which provide limited suitability for most bird species. In other words, construction of the Project will result in the direct loss of 1,210.3 ha of natural land cover within the LAA, a 2.1% decrease from existing conditions.

Development of the PDA, including vegetation clearing, will result in a direct loss or alteration of 1,989.2 ha of upland terrestrial habitats (including 1,104.9 ha of exposed land) and 300.0 ha of wetland habitats within the LAA (see Table 18.4). The Project will remove terrestrial, and to a lesser extent wetland, habitats for birds. However, widening the existing MVWR for most of the Project's length will limit direct habitat loss, most of which is already subject to indirect habitat alteration due to the MVWR. Species most likely to be affected by a direct loss of habitat are those that inhabit forested and shrub habitats, such as upland gamebirds (e.g., spruce grouse [*Canachites canadensis*]), which are also important to current land and resources users for traditional purposes (Auld and Kershaw, 2005; SLUPB, 2023; SRRB, 2021). Species that nest on disturbed sites (e.g., common nighthawk [*Chordeiles minor*]) or on anthropogenic sites (e.g., barn swallow) are also most likely to be affected by a direct loss of habitat. Effects on species groups (i.e., waterbirds, upland gamebirds, birds of prey, landbirds) and SAR/SOCC are described in greater detail in their respective subsections.

Closure and reclamation of MVWR and temporary borrow sources/quarries, camps, and workspaces are expected to recover over time due to natural revegetation or reclamation activities designed to promote vegetation communities (see Chapter 18 Vegetation and Wetlands). The recovery of vegetation communities will provide potential habitat for a variety bird species depending on site conditions, successional stage, and species-specific habitat associations (van Rensen et al. 2015, Wilson and Bayne 2019).

Construction of the Project will result in the direct loss of 884.3 ha of the Middle Mackenzie River Islands IBA within the LAA, a 3.1% decrease from existing conditions (see Waterbirds subsection for additional detail; Appendix 20A, Figure 3.6; K'alo-Stantec, 2023). The Bracket Lake IBA is outside of the LAA and not anticipated to interact with the Project.

Construction of the Project will result in the direct loss of 136.4 ha of the Petiniʔah (Bear Rock) CZ (Zone #32) within the LAA, a 4.3% decrease from existing conditions (see Birds of Prey subsection for additional detail; Appendix 20A, Figure 3.6; K'alo-Stantec, 2023).

There is no formally defined SAR critical habitat that will be directly or indirectly affected by construction of the Project. There are no formally defined SAR residences that will be directly or indirectly affected by construction of the Project.

Table 20.11 Residual Change in Habitat in the LAA

Land Cover Category	Land Cover Class[1]	Existing Condition (ha)			Residual Condition (ha / % change)		
		Dehcho Region	Sahtu Region	Total	Dehcho Region	Sahtu Region	Total
Upland	Broadleaf Dense	1,037.4	2,523.1	3,560.6	1,025.8 (-1.1%)	2,448.0 (-3.0%)	3,473.9 (-2.4%)
	Broadleaf Open	114.8	1,103.9	1,218.7	112.7 (-1.8%)	1,076.9 (-2.4%)	1,189.6 (-2.4%)
	Coniferous Dense	3,374.9	917.8	4,292.6	3,335.7 (-1.2%)	899.7 (-2.0%)	4,235.3 (-1.3%)
	Coniferous Open	4,600.6	6,678.1	11,278.6	4,501.7 (-2.1%)	6,531 (-2.2%)	11,032.6 (-2.2%)
	Coniferous Sparse	3,725.0	6,332.6	10,057.7	3,682.4 (-1.1%)	6,216.4 (-1.8%)	9,898.9 (-1.6%)
	Mixedwood Dense	1,035.1	387.3	1,422.4	1,018.5 (-1.6%)	376.2 (-2.9%)	1,394.6 (-2.0%)
	Mixedwood Open	117.1	2,514	2,631.1	115.3 (-1.6%)	2,466.9 (-1.9%)	2,582.2 (-1.9%)
	Mixedwood Sparse	0.0	6.3	6.3	0.0 (0.0%)	5.8 (-8.2%)	5.8 (-8.2%)
	Shrub Low	567.4	7,903.4	8,470.9	562.5 (-0.9%)	7,757.2 (-1.8%)	8,319.9 (-1.8%)
	Shrub Tall	320.6	2,091.3	2,411.9	317.4 (-1.0%)	2,041.4 (-2.4%)	2,358.8 (-2.2%)
	Herbaceous	50.6	210.9	261.5	44.0 (-13.1%)	198.8 (-5.7%)	242.8 (-7.2%)
	Bryoids	7.0	6.2	13.2	7.0 (<0.1%)	5.8 (-6.3%)	12.8 (-3%)
	Rock/Rubble	45.1	107.3	152.4	43 (-4.6%)	103.5 (-3.6%)	146.5 (-3.9%)
	Exposed Land[3]	1,338.0	1,713.2	3,051.2	859.4 (-35.8%)	1,086.9 (-36.6%)	1,946.3 (-36.2%)
	Total	*16,333.6*	*32,495.4*	*48,829.1*	*15,625.3 (-4.3%)*	*31,241.5 (-3.9%)*	*46,839.9 (-4.1%)*

Land Cover Category	Land Cover Class[1]	Existing Condition (ha)			Residual Condition (ha / % change)		
		Dehcho Region	Sahtu Region	Total	Dehcho Region	Sahtu Region	Total
Wetland	Wetland Herbaceous	856.8	2,976.9	3,833.6	844.7 (-1.4%)	2,924.4 (-1.8%)	3,769.0 (-1.7%)
	Wetland Shrub	2,222.9	4,503.7	6,726.6	2,175.8 (-2.1%)	4,425.4 (-1.7%)	6,601.2 (-1.9%)
	Wetland Treed	2,218.9	4,771.6	6,990.4	2,184.4 (-1.6%)	4,696.1 (-1.6%)	6,880.5 (-1.6%)
	Total	*5,298.6*	*12,252.2*	*17,550.6*	5,205.0 (-1.8%)	12,045.9 (-1.7%)	17,250.6 (-1.7%)
Water[2]		5,187.5	3,792.3	8,979.8	5,181.5 (-0.1%)	3,772.2 (-0.5%)	8,953.7 (-0.3%)
PDA		807.9	1,507.3	2,315.2	807.9 (100%)	1,507.3 (100%)	2,315.2 (100%)

Notes:

1 From EOSD NWT (NRCan and GNWT, 2017; K'alo-Stantec, 2022b [Appendix 18A])

2 Development of the PDA is not anticipated to result in the direct loss of open water habitats and the residual condition is an artifact of the resolution of the land cover classification.

3 Exposed land includes areas which naturally have less than 5% vegetative cover, such as shorelines of rivers and lakes, exposed rock, recently burned areas, and moraines, and includes cleared areas such as the existing MVWR, Norman Wells Pipeline, and other areas of infrastructure development.

An indirect loss or alteration of bird habitat is expected through sensory disturbance (i.e., noise and artificial light), dust deposition, edge effects, and fragmentation that can result in habitat avoidance and reduced habitat effectiveness for birds, including SAR, in areas adjacent to the PDA.

Sensory disturbance emitted during construction will not occur along the entire length of the Project, and instead will occur in smaller segments staggered over a period of several years and the conceptual schedule (see Sections 20.1.4.2 and 5.4.1) assumes the alignment will be constructed in three segments: Wrigley to the Dehcho/Sahtu border (102 km); Tulita south to the Dehcho/Sahtu border (134 km); and Tulita north to the Prohibition Creek Access Road (45 km).

Noise-related effects on some bird species have been reported to occur when noise levels exceed 40 A-weighted decibels (dBA), which may result in avoidance and other behavioural changes (e.g., altered song characteristics of songbirds), and population or physiological consequences (e.g., altered species abundance and/or richness, stress) to birds have been identified ≥ 45 dBA (Shannon et al., 2016). Baseline noise in the region that was assessed in remote areas without any development or winter traffic has been estimated at 35 and 32 dBA during the day and night, respectively (IOL, 2004; Chapter 13, Section 13.2.2). The distance at which the noise associated with construction activities is expected to attenuate to 40 dBA is 2.0 km for road construction

activities and 2.5 km for quarry and borrow source activities (see Section 13.4.2). However, measurable effects on birds outside of the LAA are unlikely and the LAA will continue to support birds throughout all seasons. Sensory disturbances emitted during construction will also cease following the conclusion of construction activities in a particular segment.

Dust deposition resulting from construction of the Project has the potential to alter wildlife habitat adjacent to the PDA. Effects of dust deposition on vegetation are likely to be limited to within 40 m of the PDA (see Section 18.4 of the Developer's Assessment Report; Meininger and Spatt, 1988; Gleason et al., 2007).

Edge effects and fragmentation will result from vegetation clearing activities, particularly where the PDA intersects forested habitats of the LAA. However, the existing MWVR and other exposed lands (e.g., quarries) have already created edge effects and the Project will contribute a minor additive increase because a large proportion of the PDA, as based on the current preliminary alignment routing, incorporates these previously disturbed lands. Project routing that predominantly follows the MVWR has also reduced the potential for adverse effects on birds and bird habitat resulting from habitat fragmentation, and core areas of large habitat patches will continue to be available in the LAA.

Indirect effects associated with edge effects and fragmentation have primarily been mitigated as based on the current preliminary alignment routing that largely follows the existing MVWR, where the LAA is already subject to these disturbances that have resulted in reduced ecological effectiveness and avoidance by most bird species. Construction of the Project is anticipated to exacerbate habitat alteration within the LAA by increasing the amount and duration (i.e., year-round at times) of these indirect effects.

20.4.2.3.1.1 Waterbirds

Project routing avoids wetland habitats where possible, mitigating direct and indirect habitat loss and alteration for waterbirds. Construction of the Project will result in the direct loss of 37.4 ha of waterbird habitat within the LAA, a 0.3% decrease from existing conditions (Table 20.12). Waterbird habitat includes open water and wetland land cover classes within 50 m of open water (Table 20.10) that support birds throughout the year, including during the breeding and migration seasons.

Direct and indirect habitat loss or alteration is most likely to affect breeding waterbird species commonly found within the LAA, such as common loon (*Gavia immer*), lesser scaup (*Aythya affinis*), and Canada goose (*Branta canadensis*; Appendix 20A, Section 3.2.2.2; K'alo-Stantec, 2023). Construction of the Project will result in the direct loss of 884.3 ha of the Middle Mackenzie River Islands IBA, a 3.1% decrease from existing conditions. While the PDA will remove upland habitats within the Middle Mackenzie River Islands IBA, it has been primarily established to support migrating waterbirds (IBA Canada, 2020a) and the breeding habitats within it will remain physically undisturbed by the Project (i.e., the Mackenzie River). However, construction will result in an increase in sensory disturbance. The PDA generally remains > 800 m from the Mackenzie River shoreline and breeding waterbirds most likely to be affected are those in smaller wetlands

adjacent to the PDA. The Brackett Lake IBA is outside of the LAA and while the Project will not interact with the IBA, it does provide a notable breeding area for waterbirds within the RAA (IBA Canada, 2021b).

Important migratory stopover sites within the LAA are limited to the Middle Mackenzie River Islands IBA, which supports large numbers of waterfowl species each year, including greater white-fronted goose (*Anser albifrons*), Canada goose, tundra swan (*Cygnus columbianus*), and snow goose (*Anser caerulescens*; Appendix 20A, Section 3.2.2.2; K'alo-Stantec, 2023) that are important to current land and resources users for traditional purposes (Auld and Kershaw, 2005; SLUPB, 2023; SRRB, 2021).

Construction of the Project will not result in the direct loss or alteration of aquatic habitats that support migrating waterbirds within the IBA (i.e., the Mackenzie River); however, construction will result in an increase in sensory disturbance in localized areas that are associated with construction activities. For example, while most of the PDA is contained within the IBA (i.e., within 5 km), most of the PDA follows the existing MVWR and/or remains > 800 m from the Mackenzie River shoreline. Migrating waterbirds are unlikely to use the smaller wetlands adjacent to the PDA as stopover sites in the same capacity as the IBA, and construction of the Project is unlikely to result in a notable indirect loss or alteration of waterbird migration habitat in the LAA.

In general, research has shown that effects of anthropogenic disturbance on the breeding success of waterfowl ranges from a positive (Roy, 2018; Skaggs et al., 2020) to neutral or weak adverse relationship (e.g., Kemkin et al., 2019; Singer et al., 2020). This is consistent with a broader examination of literature that have found similar relationships between roads and birds (e.g., Fahrig and Rytwinski, 2009; Morelli et al., 2014). While the relationship is not consistently adverse, the addition of noise is a change from the existing condition and considered an adverse effect.

Other effect pathways, including dust deposition, edge effects, and fragmentation, have the potential to reduce habitat availability for waterbirds, as described, but effects will be greatest where the PDA is constructed immediately adjacent to wetland and water land cover classes. Ultimately, the indirect loss or alteration of breeding waterbird habitat during construction is anticipated to result in an area of reduced ecological effectiveness adjacent to the PDA, although for breeding waterfowl it may not extend far into the LAA.

Overall, the direct and indirect habitat loss or alteration of waterbird habitat due to the Project is relatively small and are unlikely to result in a measurable change in the abundance of breeding and migrating waterbirds in the LAA (Table 20.13).

20.4.2.3.1.2 Upland Gamebirds

Construction of the Project will result in the direct loss of 2,289.2 ha of the upland gamebird habitat, a 3.5% decrease from existing conditions (Table 20.12). Upland gamebird habitat includes all upland and wetland (i.e., used for foraging) cover classes that support birds throughout the year (Table 20.10). Upland gamebird species are important to current land and resources users for traditional purposes (Auld and Kershaw, 2005; SLUPB, 2023; SRRB, 2021).

Direct and indirect habitat loss or alteration is most likely to affect breeding ruffed grouse (*Bonasa umbellus*) and spruce grouse (*Canachites canadensis*) that are common and abundant within the LAA, and to a lesser extent sharp-tailed grouse (*Tympanuchus phasianellus*), which are uncommon (Appendix 20A, Section 3.2.2.3; K'alo-Stantec, 2023). There are no documented sharp-tailed grouse leks (traditional mating grounds) within the RAA. Willow ptarmigan (*Lagopus lagopus*) and rock ptarmigan (*Lagopus muta*) breed in more northern latitudes and move into the RAA during the non-breeding season, and construction of the Project is unlikely to affect breeding habitat for these species.

Indirect loss or alteration of habitat outside of the breeding season will affect all upland gamebird species; however, this is a less sensitive period of the year for birds and habitat in the LAA remains abundant. Other effect pathways, including dust deposition, edge effects, and fragmentation, have the potential to reduce habitat availability for upland game birds as described, but effects will be greatest where the PDA is constructed immediately adjacent to wetland and water land cover classes.

20.4.2.3.1.3 Birds of Prey

Construction of the Project will result in the direct loss of 50.7 ha of the habitat for birds of prey, a 1.2% decrease from existing conditions (Table 20.12). Habitat for birds of prey includes all upland cover classes within 100 m of rivers or lakes (open water ≥ 10 ha) and cliff areas (> 30 degrees) that support breeding raptors (Table 20.10). The LAA has the potential to support 19 bird of prey species (Appendix 20A, Section 3.2.2.4; K'alo-Stantec, 2023), including many owl and raptors species that do not have specialized nesting habitat requirements. Several raptor species have unique nesting requirements adjacent to waterbodies (i.e., bald eagle [*Haliaeetus leucocephalus*], osprey [*Pandion haliaetus*]) or on cliff areas (i.e., peregrine falcon, golden eagle [*Aquila chrysaetos*]) that are limited in the LAA. These species are most likely to be affected by a direct or indirect change in habitat resulting from project construction, as their nest sites are sensitive to anthropogenic disturbance.

Construction activities have the potential to affect important nesting sites within the LAA. Two active peregrine falcon nests were observed during the 2021 aerial raptor nest survey for the Project that are in, or immediately adjacent to, proposed quarry sources (Appendix 20A, Figure 3.7; K'alo-Stantec, 2023). There are also historical records of raptor nests within the PDA and LAA that represent important raptor nesting habitats that have the potential to interact with the Project (Appendix 20A, Figure 3.7; K'alo-Stantec, 2023). For example, the PDA traverses the Petiniʔah (Bear Rock) CZ (Zone #32) that is an important raptor nesting area for bald eagle, golden eagle, and

peregrine falcon (Appendix 20A, Figure 3.7; K'alo-Stantec, 2023) and is a culturally sacred site (SLUPB, 2023; Appendix 20A, Section 3.1.2.2; K'alo-Stantec, 2023). While the PDA will primarily follow the existing MWVR while traversing the Petiniʔah (Bear Rock) CZ (Zone #32), straightening of the PDA is required (i.e., alternate routing) to safely allow traffic to cross the karst formation that rises 400 m above the Mackenzie River (Appendix 20A, Figure 3.6; K'alo-Stantec, 2023). Additionally, a permanent quarry is proposed within the Petiniʔah (Bear Rock) CZ (Zone #32) that is immediately adjacent to a historical nesting site for golden eagle. Construction of the Project will result in the direct loss of 136.4 ha of the Petiniʔah (Bear Rock) CZ (Zone #32), a 4.3% decrease from existing conditions.

Other effect pathways, including dust deposition, edge effects, and fragmentation, have the potential to reduce habitat availability for birds of prey as described, but effects will be greatest where the PDA is constructed immediately adjacent to rivers, lakes, or cliff areas. Outside of the critical breeding period, adverse effects relating to the direct and indirect loss or alteration of habitat on birds of prey will be negligible, including during the migration season.

20.4.2.3.1.4 Landbirds

Construction of the Project will result in the direct loss of 2,289.2 ha of the landbird habitat, a 3.5% decrease from existing conditions (Table 20.12). Landbird habitat includes all upland cover classes and wetland cover classes (Table 20.10) that support landbirds during the breeding season.

There are no upland land cover classes that will be disproportionately affected by construction of the PDA as there will be proportional losses of broadleaf forest (-3.9% residual change in the LAA), mixedwood forest (-3.6%), coniferous forest (-3.5%), and shrubland (-3.7%) land cover classes (Table 20.12). Following construction of the Project, habitat for landbirds within the LAA will remain abundant relative to the existing condition due to the LAA currently being subject to limited levels of anthropogenic disturbance, as is evident by a residual change of exposed lands by a 55.6% decrease from existing conditions. Direct and indirect habitat loss or alteration is most likely to affect breeding landbird species commonly detected within the LAA, such as Swainson's thrush (*Catharus ustulatus*), hermit thrush (*Catharus guttatus*), chipping sparrow (*Spizella passerina*), Tennessee warbler (*Leiothlypis peregrina*), and white-throated sparrow (*Zonotrichia albicollis*; Appendix 20A, Section 3.2.2.5; K'alo-Stantec, 2023). Landbird species detected most often within each land cover class are presented in Appendix 20A, Section 3.2.2.5 (K'alo-Stantec, 2023).

An indirect loss or alteration of landbird habitat is expected through sensory disturbance, dust deposition, edge effects, and fragmentation that can collectively result in habitat avoidance and reduced habitat effectiveness for landbirds in areas adjacent to the PDA.

In general, it is well-documented that the effects of anthropogenic noise on the breeding success of landbirds is typically adverse, with effects ranging from behavioural changes such as altered song characteristics, to population or physiological consequences such as altered species abundance and/or richness and increased stress (Benitez-Lopez et al., 2010; Shannon et al., 2016). However, bird response to noise is species-specific and in some cases road construction noise has been shown to not affect the distribution and nesting success of breeding passerines (Long et al., 2017).

Other effect pathways, including dust deposition, edge effects, and fragmentation, have the potential to contribute to an area of reduced ecological effectiveness adjacent to the PDA, but the Project will follow much of the existing MVWR and as described, these effects are already present within the LAA, except for dust deposition. These effects are also expected to vary by species and local bird movement. For example, forest-interior species are disproportionately affected compared to edge-tolerant species that are unaffected by roads (Laurance et al., 2004). Additionally, although birds are highly mobile, there is some evidence to suggest that natural and anthropogenic (e.g., roads or utility corridors) forest gaps may impede landscape-level movements of some bird species (Bélisle and St. Clair, 2001).

Breeding landbirds currently experience limited interaction with anthropogenic noise sources within the LAA as the MVWR does not operate during the breeding season. However, presence of the existing MVWR and other linear features (e.g., Norman Wells Pipeline ROW) has likely altered the breeding bird community composition and abundance or distribution within the LAA, as has been documented on other similar and recent highway projects in the NWT (i.e., Tłı̨chǫ Highway; Golder, 2021). Studies for the Tłı̨chǫ Highway concluded that routing the highway along an existing road and applying industry standard mitigation measures limited residual effects on birds to the extent possible, including for SAR (Golder, 2021). Thus, routing the Project along the MVWR as much as possible and applying the mitigation measures will similarly limit residual effects on birds to the extent practicable.

20.4.2.3.1.5 Species at Risk and Species of Conservation Concern

A direct loss of habitat for SAR/SOCC is expected through vegetation clearing and an indirect loss or alteration of habitat is expected through sensory disturbance, dust deposition, edge effects, and fragmentation that can collectively result in habitat avoidance and reduced habitat effectiveness for landbirds in areas adjacent to the PDA. Effect pathways as described are applicable to SAR as is described for the respective bird groups (i.e., effects on olive-sided flycatcher [*Contopus cooperi*] will be consistent with those described for landbirds). However, the direct and indirect loss of breeding habitat has the potential to result in greater consequences for SAR and as a result more conservative residual effects criteria for magnitude are used to assess direct loss of habitat for these species (Table 20.3).

Construction of the Project will result in a direct loss of < 5.0 % for bird habitat, species groups, and SAR/SOCC, except for common nighthawk (Table 20.12).

Common nighthawk breeding habitat includes disturbed sites, such as quarries or the existing MVWR ROW, and a residual change of 5.9% in habitat for the species is expected to be overestimated. For example, of the 1,477.7 ha of common nighthawk habitat within the PDA, 1,104.9 ha (74.8%) is along the existing MVWR. Additionally, the Project will likely provide habitat opportunities for the species following construction (e.g., reclaimed areas, quarries) as the species is relatively common and widespread throughout the LAA and tolerant of anthropogenic disturbance (Appendix 20A, Section 3.2.2.6; K'alo-Stantec, 2023).

Table 20.12 Change in Habitat for Bird Species/ Species Group in the LAA and RAA

Bird Species/Species Group[1]	LAA		RAA	
	Existing Condition (ha)	Residual Condition (ha / % change)	Existing Condition (ha)	Residual Condition (ha / % change)
General habitat	75,359.6	73,044.4 (-3.1%)	1,010,447.4	1,008,132.2 (-0.2%)
Waterbirds	11,110.6	11,073.3 (-0.3%)	151,438.2	151,400.9 (<0.1%)
Upland gamebirds	66,247.1	63,958.0 (-3.5%)	890,881.9	888,592.8 (-0.3%)
Birds of prey	4,254.40	4,203.7 (-1.2%)	65,163.4	65,112.7 (-0.1%)
Landbirds	66,247.1	63,958.0 (-3.5%)	890,881.9	888,592.8 (-0.3%)
Peregrine falcon	462.5	443.9 (-4.0%)	2,713.2	2,694.5 (-0.7%)
Yellow rail	173.6	171.6 (-1.1%)	6,537.4	6,535.5 (<0.1%)
Lesser yellowlegs	19,224.7	18,959.2 (-1.4%)	284,696.6	284,431.0 (-0.1%)
Red-necked phalarope	4,949.9	4,936.5 (-0.3%)	61,792.1	61,778.7 (<0.1%)
Short-eared owl	0.0	0.0 (0.0%)	0.0	0.0 (0.0%)
Common nighthawk	24,852.3	23,374.6 (-5.9%)	304,016.8	302,539.1 (-0.5%)
Olive-sided flycatcher	24,871.9	24,392.0 (-1.9%)	319,871.3	319,391.4 (-0.2%)
Rusty blackbird	16,824.6	16,565.3 (-1.5%)	255,028.8	254,769.5 (-0.1%)
Horned grebe	619.7	613.6 (-1.0%)	8,124.1	8,118.0 (-0.1%)

Note:

[1] See Table 20.10 for habitat descriptions

Direct loss of habitat for bank swallow is anticipated to be negligible, as natural habitats that support these species (i.e., vertical banks) are not abundant in the LAA and culvert installation locations do not occur at steep vertical banks. Quarries or borrow sources will be subject to species-specific mitigation (Section 20.4.4.2). Species-specific surveys in 2022 did not identify any bank swallow nesting activity within the LAA (K'alo-Stantec, 2022a; Appendix 20C).

Direct loss of habitat for barn swallow is possible where structures that support breeding barn swallow exist (e.g., bridges) and must be temporarily used and/or rehabilitated during construction. Species-specific surveys in 2022 identified potential barn swallow nesting activity at three bridge crossings within the LAA (K'alo-Stantec, 2022a; Appendix 20C).

Direct loss of habitat for Harris's sparrow is anticipated to be negligible, as the species typically breeds in more northern latitudes and while its range overlaps the RAA, it is not expected to regularly breed within the LAA.

20.4.2.3.1.6 Characterization of Residual Effects for Change in Habitat During Construction

Following the implementation of mitigation measures described, residual effects on bird habitat, bird species groups as well as species at risk are summarized in Table 20.13. The overall residual effects for change in habitat during construction are characterized by the following:

- **Direction is adverse:** There will be a direct and indirect loss or alteration of bird habitat.
- **Likelihood is certain**: The residual effect will certainly occur.
- **Magnitude is low to moderate:** Direct loss will result in a < 10% change in bird habitat and a < 5% change for SAR and SOCC habitat, except for common nighthawk, but indirect loss or alteration may result in a measurable change in the abundance of birds of prey in the LAA.
- **Geographic extent is the LAA:** Direct and indirect loss or alteration of habitat associated with sensory disturbance is unlikely to exceed the LAA, although temporary local shifts in distributions in the LAA might occur.
- **Timing is high sensitivity:** Although vegetation clearing will occur in the winter, construction will likely occur through the year, including during sensitive periods for birds.
- **Duration is medium- to long-term:** Sensory disturbance will cease following the construction phase (i.e., up to 20 years) but edge effects and fragmentation will persist into the operations and maintenance phase (i.e., > 20 years).
- **Frequency is continuous:** Effects will occur throughout the construction phase.
- **Change is irreversible:** Sensory disturbance will cease following the construction phase, but most effects associated with direct and indirect habitat loss or alteration will persist throughout the life of the Project.

Table 20.13 Summary of Residual Effects on Change in Bird Habitat

Bird Species Group	Residual Effects Characterization*								
	Project Phase	Direction	Likelihood	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
General Bird Habitat	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Waterbirds	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Upland Gamebirds	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Birds of Prey	C	A	CE	M	LAA	HS	MT/LT		I
	O	A	P	L	LAA	HS	LT	C	I
Landbirds	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Peregrine falcon	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Yellow rail	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Lesser yellowlegs	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Red-necked phalarope	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Short-eared owl	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Common nighthawk	C	A	CE	M	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Olive-sided flycatcher	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Rusty blackbird	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I

Bird Species Group	Residual Effects Characterization*								
	Project Phase	Direction	Likelihood	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Horned grebe	C	A	CE	L	LAA	HS	MT/LT	C	I
	O	A	P	L	LAA	HS	LT	C	I

KEY

***** See Table 20.3 for detailed definitions

Project Phase
C: Construction
O: Operations and maintenance

Direction:
A: Adverse
N: Neutral

Likelihood:
U: Unlikely
P: Possible
CE: Certain

Magnitude:
No: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Timing
NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

20.4.2.3.2 Operations and Maintenance

A direct loss of bird habitat is not expected to occur during the operations and maintenance phase of the Project. Presence of the highway will maintain fragmentation and edge effects over the long term that were established during the construction phase and while over time these effects may be ameliorated as shrubs soften the edges, these habitats may experience reduced ecological effectiveness or be avoided by some species. This may be exacerbated by sensory disturbances associated with the presence of the highway.

An indirect loss or alteration of bird habitat is possible through sensory disturbance (i.e., noise and artificial light), dust deposition, edge effects, and fragmentation that can result in habitat avoidance and reduced habitat effectiveness for birds, including SAR, in areas adjacent to the PDA.

Noise-related effects on some wildlife species have been reported to occur when noise levels exceed 40 dBA, which may result in avoidance. Other behavioural changes (e.g., altered song characteristics of songbirds) and population or physiological consequences (e.g., altered species abundance and/or richness, stress) to birds have been identified ≥ 45 dBA (Shannon et al., 2016). Baseline noise in the region that was assessed in remote areas without any development or winter traffic has been estimated at 35 and 32 dBA during the day and night, respectively (IOL, 2004; see Section 13.2.2). Expected traffic volume is 50 vehicles per day for an indeterminate time but the

distance at which noise associated with operations and maintenance activities is expected to attenuate to 40 dBA is 100 m for highway traffic and 2.5 km for quarry and borrow source activities (see Section 13.4.2), which are only expected to occur irregularly.

Dust deposition during the operations and maintenance phase will continue to affect vegetation adjacent to the PDA, as described during the construction phase (i.e., within approximately 40 m of the PDA), which includes the potential for altering vegetation communities over time (e.g., increased herbaceous and broadleaf tree and shrub habitats, reduction in mosses and lichens).

Sensory disturbance, dust deposition, fragmentation, and edge effects associated with the use of the highway, once constructed, have the potential to collectively reduce the ecological effectiveness of bird habitat adjacent to the PDA. However, this is expected to be a small incremental increase compared to the existing conditions. Additionally, while some species may avoid the LAA, particularly habitats close to the PDA, the LAA will continue to support birds without disrupting natural population cycles, and edge habitats are likely to provide increased forage opportunities for some bird species (e.g., upland gamebirds).

20.4.2.3.2.1 Waterbirds

Sensory disturbance and dust deposition resulting from vehicular traffic during the operations and maintenance phase of the Project, along with maintenance of habitat fragmentation and edge effects, have the potential to reduce habitat effectiveness for breeding waterbirds adjacent to the PDA.

In general, research has shown that effects of roads (and associated sensory disturbance) on the breeding success of waterfowl ranges from a positive (Roy, 2018) to neutral or weak adverse relationship (e.g., Kemink et al., 2019; Singer et al., 2020). This is consistent with a broader examination of literature that have found similar relationships between roads and birds (e.g., Fahrig and Rytwinski, 2009; Morelli et al., 2014). While the relationship is not consistently adverse, the addition of noise is a change from the existing condition and considered an adverse effect. However, operations and maintenance activities are unlikely to produce similar noise levels emitted by these examples.

The PDA is generally routed away from the Middle Mackenzie River Islands IBA, as described during the construction phase, and waterbirds are highly mobile and will adjust their daily distributions relative to sensory disturbance. However, most waterbirds are likely to become acclimatized to the low traffic levels associated with the use of the highway during operations and maintenance. Additionally, migrating birds are unlikely to rely heavily on wetlands adjacent to the PDA where sensory disturbance will be greatest.

Dust deposition that alters aquatic vegetation communities adjacent to the PDA may reduce habitat suitability for breeding waterbirds; however, dust deposition resulting from the expected traffic volume of 50 vehicles/day is likely to only result in a small incremental increase in dust deposition adjacent to the PDA.

20.4.2.3.2.2 Upland Gamebirds

Sensory disturbance and dust deposition resulting from vehicular traffic associated with the presence of the highway during the operations and maintenance phase of the Project, along with maintenance of habitat fragmentation and edge effects, have the potential to reduce habitat effectiveness for upland gamebirds adjacent to the PDA.

While sensory disturbance may result in avoidance of habitats adjacent to the PDA, dust deposition will continue to affect vegetation adjacent to the PDA, as described during the construction phase (i.e., within approximately 40 m of the PDA), which includes the potential for altering vegetation communities over time (e.g., increased herbaceous and broadleaf tree and shrub habitats). These altered habitats provide more open habitats and increased foraging opportunities that attract grouse and ptarmigan throughout the year. However, grouse are already subject to the effects due to the presence and operation of the MVWR and the Project is anticipated to contribute a small incremental change.

20.4.2.3.2.3 Birds of Prey

Sensory disturbance and dust deposition resulting from vehicular traffic during the operations and maintenance phase of the Project, along with maintenance of habitat fragmentation and edge effects, have the potential to reduce habitat effectiveness for birds of prey within the LAA.

Noise associated with the operations and maintenance of the Project, particularly quarry and borrow source operation, has the potential to disturb breeding birds of prey, particularly nesting raptors. Raptors may avoid the LAA near quarries and borrow sources, but some raptor species have been shown to have higher abundances in proximity to roads that is typically attributed to increased hunting and scavenging opportunities (Benitez-Lopez et al., 2010). Effects associated with edges and fragmentation are likely to function in a similar manner and dust deposition may affect birds of prey if the prey community is altered as a result.

The Project includes a large proportion of previously altered habitats that provide more open habitat and increased foraging opportunities that attract birds of prey throughout the year. These species are already subject to the effects due to the presence and operation of the MVWR and the Project is anticipated to contribute a small incremental increase in change.

20.4.2.3.2.4 Landbirds

Sensory disturbance and dust deposition resulting from vehicular traffic during the operations and maintenance phase of the Project, along with maintenance of habitat fragmentation and edge effects, have the potential to reduce habitat effectiveness for breeding landbirds within the LAA.

In general, it is well-documented that the effects of road disturbance on the breeding success of landbirds is typically adverse and effects range from behavioural changes, such as altered song characteristics, to population or physiological consequences, such as altered species abundance and/or richness and increased stress (Benitez-Lopez et al., 2010; Shannon et al., 2016). Other effect

pathways, including dust deposition, edge effects, and fragmentation, have the potential to contribute to an area of reduced ecological effectiveness adjacent to the PDA. However, the Project will follow much of the existing MVWR and as described, these effects are already present within the LAA. Breeding landbirds currently experience limited interaction with anthropogenic noise sources within the LAA as the MVWR does not operate during the breeding season.

However, presence of the existing MVWR (i.e., presence of a linear feature) has likely altered the breeding bird community composition and abundance or distribution within the LAA, as has been documented on other similar and recent highway projects in the NWT (i.e., Tłı̨chǫ Highway; Golder, 2021). Additionally, studies for the Tłı̨chǫ Highway concluded that routing the highway along an existing road and applying industry standard mitigation measures limited residual effects on birds to the extent possible, including for SAR (Golder, 2021). Thus, routing the Project along the MVWR as much as possible and applying the mitigation measures will similarly limit residual effects on birds to the extent practicable.

Meta-analyses suggest that the effects of roads on breeding birds are species-specific and do not extend beyond 1 km (Benitez-Lopez et al., 2010). Given that the Project will have low daily traffic volumes and it is primarily upgrading an existing road, effects on breeding landbirds are not expected to extend far into the LAA. Additionally, most studies examining the effects of roads on breeding birds have traffic volumes of several thousand vehicles per days and some studies excluded analyzing roads where traffic volumes were ≤ 50 vehicles/hour (Parris and Schneider, 2008). The anticipated traffic level for the Project is comparatively negligible (i.e., 50 vehicles/day).

20.4.2.3.2.5 Species at Risk and Species of Conservation Concern

Sensory disturbance and dust deposition resulting from vehicular traffic during the operations and maintenance phase of the Project, along with maintenance of habitat fragmentation and edge effects, have the potential to reduce habitat effectiveness for breeding SAR/SOCC within the LAA.

Effect pathways are anticipated to interact with SAR/SOCC as described for the respective bird groups (i.e., effects on olive-sided flycatcher will be consistent with those described for landbirds). Additionally, as described for the construction phase, the Project will have limited interaction with many SAR/SOCC, which also includes indirect habitat loss or alteration during the operations and maintenance phase. In general, the Project includes a large proportion of previously altered habitats and SAR/SOCC are already subject to direct and indirect effects of change in habitat due to the presence and operation of the MVWR. As a result, the Project is anticipated to contribute a small incremental increase in change that will further reduce ecological effectiveness in the LAA. However, the Project may provide habitat and/or nesting opportunities for species that prefer edge habitats, disturbed habitats, and/or reclaimed habitats (e.g., borrow sources), or anthropogenic structures (e.g., bridges) for species such as common nighthawk, olive-sided flycatcher, bank swallow, and barn swallow.

20.4.2.3.2.6 Characterization of Residual Effects for Change in Habitat During Operations and Maintenance

Following the implementation of mitigation measures, residual effects for each measurable parameter are summarized in Table 20.13 and overall residual effects for change in habitat during operations and maintenance are characterized by the following:

- **Direction is adverse:** There will be an indirect loss or alteration of bird habitat.
- **Likelihood is possible**: The residual effect could occur.
- **Magnitude is low:** Indirect loss or alteration is not anticipated to result in a measurable change in the abundance of any bird species in the LAA, although temporary local shifts in distributions in the LAA might occur.
- **Geographic extent is the LAA:** Indirect loss or alteration of habitat associated with sensory disturbance is unlikely to extend beyond the LAA.
- **Timing is high sensitivity:** Operations and maintenance of the Project will occur year-round.
- **Duration is long-term:** There will be indeterminate effects on bird habitat adjacent to the PDA.
- **Frequency is continuous:** Effects will occur throughout the operations and maintenance phase.
- **Change is irreversible:** Effects will occur throughout the operations and maintenance phase.

20.4.3 Change in Mortality Risk

20.4.3.1 Effect Pathways

20.4.3.1.1 Construction

All project activities during the construction phase, except for employment and contracted goods and services, have the potential to contribute to a direct change in mortality risk as they involve the removal of upland and wetland habitats (i.e., vegetation clearing, ground disturbance) and/or the movement of machinery and traffic within the PDA (Table 20.9). Vegetation clearing and ground disturbance is most likely to increase mortality risk for less mobile individuals (e.g., fledglings) or nests. Project-related transportation and heavy equipment also have the potential to crush or collide with birds.

20.4.3.1.2 Operations and Maintenance

All project activities during the operations and maintenance phase, except for employment and contracted goods and services, have the potential to contribute to a direct and/or indirect change in mortality risk (Table 20.9). During operation, project-related transportation within the LAA, and public traffic resulting from the presence of the highway, are the primary pathways with potential to increase bird mortality risk by increasing the potential for vehicle-bird collisions and mortality, primarily along the highway portion of the PDA (i.e., risk is low along access roads). Wildlife may also encounter traffic and heavy machinery associated with maintenance activities. Species most at risk include less mobile species (e.g., upland gamebirds) or those that may cross the highway, particularly near wetlands (e.g., waterfowl), or those that are attracted to the PDA (e.g., upland gamebirds, birds of prey).

The presence of the highway and other linear features (e.g., borrow source and quarry access roads) have the potential to result in an indirect change in mortality risk for some species. Increased access for predators and hunters is the primary pathway for an indirect change in mortality risk. The Project will enhance access along a continuous linear feature that may increase predator efficiency and hunter ease of travel while providing all-season access to portions of the LAA that were previously more isolated. Species most like to be affected include prey species (e.g., passerines), harvested species (e.g., waterfowl), and those attracted to the PDA (e.g., upland gamebirds).

20.4.3.2 Mitigation

As discussed in Chapter 5, project routing and design have integrated the existing MVWR to the extent practicable, which will reduce potential project interactions with birds, resulting in change in mortality risk. In addition to a project-specific WMMP that will be implemented during the construction and operations and maintenance phases, standard industry practices and mitigation measures will also be implemented and are presented in Table 20.9. Key mitigation measures to avoid or reduce changes in mortality risk include:

- Wildlife monitors will assess for the presence of wildlife on or near the PDA during project construction activities.
- Vegetation clearing will be completed outside the migratory bird nesting period of May 4 to August 22 (Zone B8; ECCC, 2018) and will consider the Critical Breeding Periods for Raptor Species of the Northwest Territories (Shank and Poole, 2016) to avoid disturbing species that breed prior to the migratory bird nesting periods.
- The WMMP will outline how risks to migratory birds will be managed in accordance with ECCC's Guidelines to Reduce Risk to Migratory Birds (ECCC, 2021) if activities that could result in risk of harm cannot be avoided (e.g., pre-clearing nest surveys).
- The WMMP will be complied with in relation to species of birds not under GNWT's authority in addition to species under GNWT's authority.

- Quarries will be maintained in accordance with beneficial management practices (GNWT 2020d) to reduce the potential for nesting by bank swallow.
- If an active bird nest is found, beneficial management practices (GNWT, 2020d) will be followed, including applying an appropriate setback and timing restriction and the GNWT-ECC and/or ECCC will be consulted, as appropriate.
- Personnel will undergo a wildlife awareness program, which will include prevention measures for wildlife mortality (e.g., bear safety) and reporting procedures for wildlife-related incidents and protocols to follow when a nest, den, or wildlife species of management concern is observed. This includes completing wildlife sighting and wildlife incident report forms included in the WMMP.
- Personnel will not feed, harass, or hunt wildlife while working on the Project.
- Construction and quarry development activities will be limited during sensitive periods for wildlife in accordance with the WMMP.
- Food and other wildlife attractants will be stored in bear-proof containers.
- Equipment, wastes, and contaminated soils will be removed once construction is completed.
- Speed limits will be posted on the public highway.

20.4.3.3 Residual Effects

20.4.3.3.1 Construction

Construction activities, including vegetation clearing and earthworks, will follow mitigation measures that consider timing restrictions for bird species, including sensitive periods for nesting and migrating birds. Vegetation clearing will be timed to reduce potential effects on breeding birds.

During construction, there is potential for increased mortality risk to young birds due to their limited mobility (e.g., crushed by construction equipment). Vehicle-related bird mortality has the potential to affect a wider range of species, including SAR and SOCC. While traffic volumes will increase during construction, speeds will remain slow and will limit the risk of vehicle-bird collisions. Vehicles will abide by posted speed limits and multi-passenger vehicles will be used, where practical, to reduce the potential for vehicle-bird collisions. Species most at risk include less mobile species (e.g., upland gamebirds) or those that may cross the highway, particularly near wetlands (e.g., waterfowl), or those that are attracted to the PDA (e.g., upland gamebirds, birds of prey).

Proper management of wastes, including at temporary camps, will reduce the potential for birds to be attracted to the construction site (e.g., common raven [*Corvus corax*]), thus reducing the potential for mortality risk related to human-bird conflict.

Following the implementation of the mitigation measures, residual effects for change in mortality risk during construction are characterized as follows:

- **Direction is adverse:** Construction activities will increase bird mortality risk.
- **Likelihood is possible**: The residual effect could occur.
- **Magnitude is low:** A measurable change in the abundance of birds in the LAA is unlikely, although temporary local shifts in distributions in the LAA might occur.
- **Geographic extent is the LAA:** Residual effects will not extend into the RAA.
- **Timing is high sensitivity:** Although vegetation clearing will occur in the winter, construction will occur through the year, including during sensitive periods for birds.
- **Duration is medium- to long-term:** Direct effects will cease following the construction phase (i.e., up to 20 years) but indirect effects will persist into the operations and maintenance phase (i.e., > 20 years).
- **Frequency is multiple irregular event:** construction activities may result in direct and/or indirect bird morality, but potential mortalities are expected to occur infrequently at no set schedule following the implementation of mitigation measures.
- **Change is irreversible:** Direct effects will cease following the construction phase, but effects associated with indirect mortality risk will persist throughout the life of the Project.

20.4.3.3.2 Operations and Maintenance

A direct change in mortality risk is likely to occur through the presence of the highway and the associated traffic (i.e., through vehicle-bird collisions), which is generally an effect driven by both traffic volume and speed. Species most likely to be affected are those that that are attracted to the PDA where there is an increase in forage or prey availability (e.g., upland gamebirds, birds of prey). The highway will allow for increased traffic speeds (up to 80 km/h) which may increase bird mortality risk, but the widening of the ROW and maintenance and removal of dense brush along the highway ditches will limit the number of birds adjacent to highway and improve visibility of birds, which will reduce collision and mortality risk. Other maintenance activities will generally occur infrequently and will result in increased traffic volumes and/or the use of heavy machinery; these activities are anticipated to result in a negligible change in mortality risk.

An indirect change in mortality risk is likely to occur as the Project will provide year-round access to the LAA for hunters and by altering predator-prey dynamics. Linear features provide an efficient mechanism to move across the landscape that also provides relatively clear sightlines that are desirable to resource users and predators. There may be areas that were previously more difficult to access outside of the winter season which may experience increased hunting pressure once the Project is operational and harvested species are most at risk (e.g., waterfowl, upland gamebirds).

Following the implementation of the mitigation measures, residual effects for change in mortality risk during operations and maintenance are characterized as follows:

- **Direction is adverse:** Operations and maintenance activities will increase mortality risk.
- **Likelihood is possible**: The residual effect could occur.
- **Magnitude is low:** A measurable change in the abundance of birds in the LAA is unlikely.
- **Geographic extent is the LAA:** Residual effects will not extend into the RAA.
- **Timing is high sensitivity:** The Project will operate indeterminately, including during sensitive periods for birds, although temporary local shifts in distributions in the LAA might occur.
- **Duration is long-term:** Effects on mortality risk will persist during the operations and maintenance phase (i.e., > 20 years).
- **Frequency is multiple irregular event:** operations and maintenance activities may result in direct and/or indirect bird morality, but potential mortalities are expected to occur infrequently at no set schedule following the implementation of mitigation measures.
- **Change is irreversible:** The Project will operate indeterminately and effects will persist throughout the life of the Project.

20.4.4 Change in Bird Health

20.4.4.1 Effect Pathways

An exposure pathway must be present for there to be an increased risk to bird health, and includes the ingestion of soil, sediment, food, or water and/or direct contact with soil, sediments, or water that may contain contaminants. The effect pathways that may result in a change in bird health include:

- Deposition of rock and dust may release contaminants into the surrounding terrestrial and aquatic environment during extraction (e.g., blasting, stockpiling), crushing, transport, and road construction and operations and maintenance.
- Sedimentation and runoff from project activities may release contaminants into surface water, affecting aquatic flora and fauna.

20.4.4.1.1 Construction

During construction, a change in bird health in the LAA due to release of contaminants related to deposition of rock and dust associated with site preparation of the ROW, access, workspaces, blasting, stockpiling, and culvert installations (Table 20.8). In addition, construction associated with site preparation of the ROW, and quarry access roads including road cuts and culvert installations, will occur adjacent to aquatic habitats and have potential to reduce surface water quality in aquatic environments through sedimentation and runoff.

20.4.4.1.2 Operations and Maintenance

As described for the construction phase, there are activities during the operations and maintenance phase (e.g., quarry operations) that could adversely affect bird health due to potential release of contaminants into the surrounding terrestrial environment. During operation, the sedimentation and runoff exposure pathway is not anticipated to result in a change in bird health, but deposition of dust will persist. Maintenance activities and the use of the highway are the primary pathway for dust to enter the terrestrial and aquatic environments.

20.4.4.2 Mitigation

As discussed in Chapter 5, project routing and design have integrated the existing MVWR to the extent practicable, which will reduce potential project interactions with change in bird health. In addition to a project-specific WMMP that will be implemented during the construction and operations and maintenance phases, standard industry practices and mitigation measures will also be implemented and are presented in Table 20.9. Key mitigation measures to avoid or reduce changes in bird health include:

- The SCP will include procedures to prevent and respond to spills.
- Maintenance yards will have a liner or concrete installed under areas of vehicle storage and maintenance.
- Vehicles parked for more than 2 hours will use drip trays.
- Placement of embankment will occur primarily during winter (December 15 to April 1), during frozen conditions. If work is to be completed under non-frozen conditions, equipment will be equipped with mushroom shoes.
- A project-specific ESCP will be developed and implemented.
- Washing, refueling, and servicing machinery and storage of fuel and other materials for machinery will be conducted a minimum of 100 m from the high-water mark and in a manner to prevent any deleterious substances from entering the water.
- Blast rock will not enter a waterbody or watercourse.
- A dust control program using water will be implemented during construction and operations and maintenance.
- Equipment, wastes, and contaminated soils will be removed once construction is completed.

20.4.4.3 Residual Effects

20.4.4.3.1 Construction

During construction, there is potential for increased risk to bird health through the mobilization of sediment into aquatic habitats and dust deposition.

The Project will follow applicable regulatory requirements and apply mitigation measures for aquatic resource protection, which will reduce risks to birds and bird habitat. Residual effects are anticipated to be negligible.

Dust deposition is expected to result in minor and localized changes to vegetation and bird habitat adjacent to the PDA (i.e., within 40 m; Section 20.4.2.3), but dust deposition resulting from construction activities is not anticipated to contain chemicals of potential concern that could harm birds or bird habitat.

Harvested wildlife species in NWT, such as upland gamebirds, have been shown to have limited environmental contamination (Appendix 20A, Section 3.2.2.1; K'alo-Stantec, 2023) and construction of the Project is not expected to result in a change in bird health within the LAA.

Following the implementation of the mitigation measures, residual effects for change in bird health during construction are characterized as follows:

- **Direction is adverse:** Construction activities will increase risks to bird health.
- **Likelihood is unlikely**: The residual effect is almost certainly not to occur.
- **Magnitude is negligible:** A measurable change in the abundance of birds in the LAA is not anticipated.
- **Geographic extent is the LAA:** Residual effects will not extend into the RAA.
- **Timing is high sensitivity:** Construction will likely occur through the year, including during sensitive periods for birds.
- **Duration is medium-term:** Effects will cease following the construction phase (i.e., up to 20 years).
- **Frequency is continuous:** Effects will occur throughout the construction phase.
- **Change is reversible:** Effect pathways associated with construction activities will cease following completion of project construction.

20.4.4.3.2 Operations and Maintenance

Dust deposition is expected to result in minor and localized changes to vegetation and bird habitat adjacent to the PDA (i.e., within 40 m; Section 20.4.2.3). However, given the lack of chemicals of potential concern contained within dust emissions and the amount of dust expected from 50 vehicles/day, it is unlikely to result in a measurable change in the health and condition of birds in the LAA. Additionally, this is consistent with determinations in other similar projects in the NWT (i.e., Tłı̨chǫ Highway [Golder, 2017]).

Harvested bird species in NWT have been shown to have limited environmental contamination (Appendix 20A, Section 3.2.2.1; K'alo-Stantec, 2023), and operations and maintenance of the Project is not expected to result in a change in bird health within the LAA.

Following the implementation of the mitigation measures, residual effects for change in bird health during operations and maintenance are characterized as follows:

- **Direction is adverse:** Operations and maintenance activities can increase risk to bird health.
- **Likelihood is unlikely**: The residual effect is almost certainly not to occur.
- **Magnitude is negligible:** A measurable change in the health and condition of wildlife in the LAA is not anticipated.
- **Geographic extent is the LAA:** Residual effects will not extend into the RAA.
- **Timing is high sensitivity:** The Project will operate indeterminately, including during sensitive periods for birds.
- **Duration is long-term:** Effects on bird health will persist during the operations and maintenance phase (i.e., > 20 years).
- **Frequency is continuous:** Effects will occur throughout the operations and maintenance phase.
- **Change is irreversible:** The Project will operate indeterminately and effects will persist throughout the life of the Project.

20.4.5 Summary of Residual Effects

Table 20.14 summarizes the residual effects on bird and bird during the construction and operations and maintenance phases of the Project.

Table 20.14 Residual Effects on Bird and Bird Habitat

Residual Effect	Residual Effects Characterization*								
	Project Phase	Direction	Likelihood	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Change in Habitat	C	A	CE	L	LAA	HS	MT-LT	C	I
	O	A	P	L	LAA	HS	LT	C	I
Change in Mortality Risk	C	A	P	L	LAA	HS	MT-LT	IR	I
	O	A	P	L	LAA	HS	LT	IR	I
Change in Bird Health	C	A	U	N	LAA	HS	MT	C	I
	O	A	U	N	LAA	HS	LT	C	I

KEY

*See Table 20.3 for detailed definitions

Project Phase
C: Construction
O: Operations and maintenance

Direction:
A: Adverse
N: Neutral

Likelihood:
U: Unlikely
P: Possible
CE: Certain

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Timing
NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

With the implementation of the mitigation measures, the Project is anticipated to meet the SLUP conformity requirements related to fish and wildlife, and consideration of engagement input and incorporation of Traditional Knowledge.

The design of the Project and mitigation measures for protection of birds and bird habitat will respect the values of the Petiniɂah (Bear Rock) CZ, Mio Lake CZ, Norman Range SMZ, K'ąąlǫ Tué (Willow Lake Wetlands) SMZ and Deh Cho (Mackenzie River) SMZ, as areas with important bird habitat.

20.5 Assessment of Cumulative Effects on Birds and Bird Habitat

Project residual effects described in Section 20.4 are likely to interact cumulatively with residual environmental effects from other physical activities including past, present, and reasonably foreseeable projects.

The effects of past and current projects contribute to baseline conditions upon which Project effects are assessed. Cumulative effects are described as those resulting from residual Project effects combined with the effects of past, present, and reasonably foreseeable projects and activities.

Future projects that are reasonably foreseeable are those that: (a) have obtained the necessary authorizations to proceed or are in the process of obtaining the required authorization, or (b) have been publicly announced with the intention to seek the necessary authorizations to proceed.

Two conditions must be met to initiate an assessment of cumulative effects on a VC:

- The Project is assessed as having measurable adverse residual environmental effects on a VC.
- The adverse residual effects from the Project overlap spatially and temporally with measurable residual effects of other physical activities on a VC.

If either condition is not met, the assessment of cumulative effects is not warranted because the Project is not considered to interact cumulatively with other projects or activities. Except for change in bird health, both conditions apply for change in habitat and mortality risk and a cumulative effects assessment is presented below.

The Project is predicted to result in no measurable residual effects on bird health (Table 20.14); and therefore, the Project is not expected to interact cumulatively with residual effects from other physical activities (past, present and reasonably foreseeable). Although, changes in air and water quality can result in changes in the quality of food sources (e.g., plants, fish) consumed by birds, the conclusions in the cumulative effects assessments for air quality (Volume 4, Chapter 12, see Section 12.5 of the DAR) and surface water and sediment quality (Volume 4, Chapter 16, see Section 16.5) indicate that there is no potential for cumulative effects on air or surface water quality; and therefore, there is no potential for cumulative effects on bird health due to changes in air or water quality. In the absence of cumulative effects pathways, bird health will not be further assessed.

20.5.1 Residual Effects Likely to Interact Cumulatively

The project and activity inclusion list (Table 20.15) identifies known past, present, and reasonably foreseeable projects and physical activities that could interact cumulatively with the residual effects. Chapter 4 of the DAR presents the names, proponents, use or activity, descriptions, status, and location of these projects and activities.

Table 20.15 Projects with the Potential to Contribute to Cumulative Effects in the RAA

Other Projects and Physical Activities with Potential for Cumulative Effects	Environmental Effects		
	Change in Habitat	Change in Mortality Risk	Change in Bird Health
Past and Present Physical Activities and Resource Use (Base Case)			
Geotechnical	–	–	–
Oil, Gas & Seismic*			
Tulita 2D Seismic Program	✓	✓	–
EL 466 Drilling Program	✓	✓	–
Windy Island Drilling Program	✓	✓	–
Summit Creek Drilling Program	✓	✓	–
Slater River Project	✓	✓	–
Little Bear Staging Area	✓	✓	–
Infrastructure			
Mackenzie Valley Winter Road, including bridges and bridge-sized culverts	✓	✓	–
Canyon Creek All Season Access Road	✓	✓	–
Norman Wells Pipeline	✓	✓	–
Mackenzie Valley Fibre Link	✓	–	–
Délı̨nę Winter Road	✓	–	–
Mackenzie Highway No.1	✓	✓	–
Prohibition Creek Access Road	✓	✓	–
Quarries and Borrow Sources			
HRN Quarry	✓	✓	–
Little Bear River Quarry	✓	✓	–

Other Projects and Physical Activities with Potential for Cumulative Effects	Environmental Effects		
	Change in Habitat	Change in Mortality Risk	Change in Bird Health
Mining & Exploration			
Wrigley Zinc Property Drilling Program	✓	–	–
Municipal Operations, including water, waste, power, and community development			
Wrigley Municipal Activities	✓	✓	–
Tulita Municipal Activities	✓	✓	–
Norman Wells Municipal Activities	✓	✓	–
Project-Related Physical Activities (Project Case)			
Mackenzie Valley Highway Project	✓	✓	–
Reasonably Foreseeable Physical Activities (Reasonably Foreseeable Case)			
Quarries			
Dhu-1 Quarry	✓	✓	–
Infrastructure			
Great Bear River Bridge	✓	✓	–
Oil and Gas			
Enbridge Maintenance Camp	✓	✓	–

Notes:

✓ = Other projects and physical activities whose residual effects are likely to interact cumulatively with project residual effects.

– = Interactions between the residual effects of other projects and residual effects of the Project are not expected.

* = Includes support activities such as production, exploration, remediation, drilling, wells, associated infrastructure, facilities, camp, and staging areas.

Change in bird health is not expected to interact cumulatively with other projects or activities because there is no measurable change in bird health due to the Project (Table 20.14).

20.5.2 Change in Habitat

20.5.2.1 Cumulative Effects Pathways

Potential cumulative effects on bird habitat due to reasonably foreseeable activities have similar effects pathways as those identified for the Project (see Section 20.4.2.1) including direct loss or alteration of habitat from vegetation clearing and indirect effects due to sensory disturbance (e.g., noise, artificial light), dust deposition, edge effects, and fragmentation generated during project construction and operations and maintenance of the Project.

20.5.2.2 Mitigation for Cumulative Effects

Mitigation measures and regional initiatives applicable to limiting cumulative effects on bird habitat, including for SAR, within the RAA (including other reasonably foreseeable projects) include the following:

- Adherence to the project-specific WMMP and other environmental management and monitoring plans used to protect and monitor the environment during Project construction and operations and maintenance, including the:
  - ESCP
  - Permafrost Protection Plan (PPP)
  - SCP
  - Waste Management Plan (WMP)
  - Quarry Development Plans

20.5.2.3 Cumulative Effects

Past and present activities including oil and gas development (e.g., Norman Wells Pipeline), the MVWR and other winter roads, quarries and borrow sources, mining and exploration activities as well as municipal and community development have resulted in the loss of bird habitat in the RAA. These past and current projects and activities reflect the existing (Baseline) conditions in the RAA. Although these projects and activities have altered the regional landscape and contributed to existing cumulative effects on bird habitat, the amount of existing anthropogenic disturbance (i.e., exposed land) in the Dehcho RAA (1.4%) and Sahtu RAA (1.5%) is relatively low (see Table 20.7). At Baseline, the Dehcho Region RAA contains an abundance of wildlife habitat dominated by coniferous forest (43.6%), wetlands (19.8%), and open water (19.3%) whereas the Sahtu Region RAA contains primarily coniferous forest (28.7%), wetlands (25.2%), and shrubland (20.6%) (Table 20.7). The Prohibition Creek Access Road is under construction and will contribute an additional 77.8 ha of direct habitat loss in the RAA.

Reasonably foreseeable activities and projects will result in additional direct habitat loss and alteration as well as sensory disturbance (e.g., noise), which will contribute to cumulative effects on bird habitat including SAR/SOCC in the RAA. Specifically, the Dhu-1 Quarry (including camp and winter access road) will result in a direct loss of 23 ha, and Great Bear River Bridge, 46.5 ha. The estimated project development area for the Enbridge Maintenance Camp is not available. Overall, the future projects are relatively small in spatial scale and some of these projects such as the Great Bear River Bridge at least partially overlap the existing MVWR, which will reduce cumulative effects on bird habitat.

The Project will contribute to cumulative effects on bird habitat, however, the change in habitat (2,315.2 ha) represents a 0.2% decrease from the existing condition in the RAA (1,010,983.5 ha), which includes 1,104.9 ha of exposed land and existing anthropogenic disturbances (i.e., existing MVWR and quarries) (see Table 20.11). The Project is anticipated to contribute 1,404.9 ha of new exposed land cover in the RAA, a 7.5% increase from the existing condition (15,970.4 ha).

Overall, the Project's contribution to cumulative change in bird habitat is relatively small representing < 0.1 to 0.7% from the existing condition depending on the species or species group (Table 20.12). Similarly, for species assessed qualitatively (e.g., bank swallow, barn swallow), the Project is expected to result in a low magnitude of change in habitat availability within the RAA relative to the existing condition.

20.5.3 Change in Mortality Risk

20.5.3.1 Cumulative Effects Pathways

Potential cumulative effects on bird mortality risk due to reasonably foreseeable activities have similar effects pathways as those identified for the Project (Section 20.4.3.1). Reasonably foreseeable activities would include site preparation activities (e.g., vegetation clearing, earthworks) and future road and bridge development, which can result in increased mortality risk including traffic-related mortality, and increased access opportunities for hunters and predators.

Notable past and present activities and projects that contribute to cumulative effects of mortality risk in the LAA and RAA are the Norman Wells Pipeline (inspections and maintenance), Highway No.1, Canyon Creek All Season Access Road and municipal operations.

20.5.3.2 Mitigation for Cumulative Effects

Mitigation measures and regional initiatives applicable to limiting cumulative effects on mortality risk within the RAA include the following:

- A WMMP will be developed and implemented. The WMMP will contain detailed monitoring and mitigation measures to be implemented for the duration of the construction and operations of the Project.

- Vegetation clearing will be completed outside the migratory bird nesting period, which extends from May 1 to August 31. This considers Nesting Zone B8 (May 4 to August 22 for Zone B8; ECCC, 2018) and potential species at risk. Vegetation clearing will also consider the Critical Breeding Periods for Raptor Species of the Northwest Territories (Shank and Poole, 2016) to avoid disturbing species that breed prior to the migratory bird nesting period.
- Closure and reclamation will promote re-establishment of vegetation.
- The Project will use previously disturbed areas for project activities and project infrastructure and workspaces, to the extent practical.
- Speed limits will be posted on the public highway.

20.5.3.3 Cumulative Effects

Existing activities contribute to cumulative effects on bird mortality risk in the RAA. During construction and operations, reasonably foreseeable activities and projects have potential to contribute to increased bird mortality risk in the RAA including the Dhu-1 Quarry, the Great Bear River Bridge, the Prohibition Creek Access Road and the Enbridge Maintenance Camp. The reasonably foreseeable projects are expected to contribute to cumulative effects on bird mortality risk; however, these projects are comparatively small, involving limited amounts of clearing and vehicle traffic and the Prohibition Creek Access Road overlaps the existing MVWR, which will limit the amount of vegetation clearing associated with increased bird mortality risk. In addition, it is assumed pre-construction surveys and other site-specific mitigation (e.g., setbacks) will be implemented for future projects, which will reduce residual cumulative effects on bird mortality risk.

With mitigation, the residual cumulative effects on wildlife mortality risk from past, present, and reasonably foreseeable projects and physical activities, including the Project, are predicted to be low in magnitude. Residual cumulative effects will occur as multiple irregular events as reasonably foreseeable projects and physical activities go forward and will occur over the long-term during operations.

20.5.4 Summary of Cumulative Effects

The Project is located in a corridor within the Mackenzie Valley that is subject to disturbance from past and present activities and projects, including existing linear infrastructure. Since the Project proposes to use the existing MVWR ROW and watercourse crossing structures to the extent possible, cumulative effects on direct change in habitat are reduced and the Project's contribution to direct change in habitat is predicted to be low in magnitude. Indirect effects on habitat resulting from project noise and activity are expected to be localized and are also low in magnitude and irreversible, despite some areas being reclaimed after construction.

Similarly, the Project's contribution to cumulative change in mortality risk will be low in magnitude given implementation of mitigation, particularly given that PDA clearing will occur outside of the sensitive breeding period for birds.

Table 20.16 summarizes cumulative effects on birds and bird habitat.

Table 20.16 Summary of Cumulative Effects

Residual Cumulative Effect	Residual Cumulative Effects Characterization							
	Direction	Likelihood	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Change in Habitat	A	CE	L	RAA	HS	LT	IR	I
Contribution from the Project to the residual cumulative effect	The Project will result in the direct loss or alteration of 0.2% of bird habitat in the RAA compared to existing conditions. Similarly, direct habitat loss for SAR is expected to be low, ranging from < 0.1 to 0.7% compared to existing conditions, depending on the species or species group. With mitigation, the contribution from the Project to residual cumulative effects on bird habitat is expected to be low.							
Change in Mortality Risk	A	P	L	RAA	HS	LT	IR	I
Contribution from the Project to the residual cumulative effect	The Project will result in increased mortality risk due to vegetation removal during construction and vegetation maintenance (mowing) along the ROW during operations and maintenance. Mitigation measures (e.g., avoid vegetation clearing during bird nesting periods and pre-construction bird nest searches) will be completed to reduce mortality risk, as required. With mitigation, the contribution from the Project to residual cumulative effects on bird mortality risk is expected to be low.							

KEY

* See Table 20.3 for detailed definitions

Direction:
A: Adverse
N: Neutral

Likelihood:
U: Unlikely
P: Possible
CE: Certain

Magnitude:
No: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PDA: Project Development Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Timing
NS: No sensitivity
MS: Moderate sensitivity
HS: High sensitivity

Duration:
ST: Short-term
MT: Medium-term
LT: Long-term

Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

20.6 Determination of Significance

20.6.1 Significance of Residual Effects

The Project will result in the direct loss or alteration of 2,315.2 ha (< 3.1%) of bird habitat within the LAA, including 1,104.9 ha of exposed lands that includes existing anthropogenic disturbances (i.e., existing MVWR and quarries) and provide limited suitability for most bird species. The Project will result in the direct loss or alteration of < 5.0% of habitat within the LAA for all bird SAR, except for common nighthawk (5.9 % change from the existing condition). Similarly, for species assessed qualitatively (e.g., bank swallow, barn swallow), the Project is expected to result in a low magnitude of change in habitat availability within the LAA compared to the existing condition. Common nighthawk are common in the LAA and readily nest in disturbed habitats (e.g., quarries and borrow sources) and following construction of the Project, some quarries and borrow sources will be reclaimed and will provide habitat for the species. Habitat within the RAA for common nighthawk will remain abundant. Indirect effects of habitat loss or alteration are expected to be greatest near active quarries and borrow sources but are generally localized and limited to within the LAA.

Vegetation clearing will occur outside of the nesting period for birds and the low traffic volume during operations and maintenance of the Project is unlikely to result in a notable increase in bird mortality risk, including for SAR/SOCC. Increased access opportunities for hunters may result in increased harvest rates of upland gamebirds and waterfowl, but harvested game species are generally abundant within the LAA.

With the application of avoidance and mitigation measures, residual effects on birds and bird habitat are not expected to threaten the long-term persistence or viability of SAR/SOCC or species of cultural or traditional importance and there are no conservation-based thresholds for species considered in this VC. In conclusion, the project effects on birds and bird habitat are not significant.

20.6.1.1 Significance of Cumulative Effects

The Project will result in the direct loss or alteration of 2,315.2 ha (< 0.2%) of bird habitat within the RAA, including 1,104.9 ha of exposed lands that are subject to existing anthropogenic disturbances (i.e., existing MVWR and quarries) and provide limited suitability for most bird species (Section 20.4.2.3). The Project will result in the direct loss or alteration of < 0.7% of habitat within the RAA for all bird SAR and for species assessed qualitatively (e.g., bank swallow, barn swallow); therefore, the Project is expected to result in a low magnitude of change in habitat availability within the RAA compared to the existing condition. Indirect effects of habitat loss or alteration are not expected to extend into the RAA. While the Project may interact cumulatively with several other, relatively small reasonably foreseeable projects within the RAA, the Project will contribute a small incremental change in habitat for birds. Habitat for birds, including migration, breeding, and winter habitat, will remain abundant in the RAA, including for SAR/SOCC.

The Project will interact cumulatively with past, present, and reasonably foreseeable projects and activities. However, vegetation clearing will occur outside of the nesting period for birds and the low traffic volume during operations and maintenance of the Project is unlikely to result in a notable increase in bird mortality risk, including for SAR/SOCC. Increased access opportunities for hunters may result in increased harvest rates of upland gamebirds and waterfowl, but harvested game species are generally abundant within the LAA.

With the application of mitigation and environmental protection measures, residual cumulative effects on birds and bird habitat are not expected to threaten the long-term persistence or viability of SAR/SOCC, or species of cultural or traditional importance. In conclusion, the cumulative effects on birds and bird habitat are not significant.

20.6.2 Project Contribution to Cumulative Effects

The Project will contribute a small incremental increase in both a change in habitat through vegetation clearing, sensory disturbance, dust deposition, edge effects, and fragmentation, and a change in mortality risk (vegetation clearing, bird-vehicle collisions, hunter access).

20.7 Prediction Confidence

The prediction confidence in the final determination of significance is considered moderate. This level of confidence is based on the factors listed, which includes assumptions as well as gaps and uncertainties discussed in Sections 20.7.1 and 20.7.2.

- The quantity and quality of data available, which includes limited Traditional Knowledge and traditional land and resource use information for portions of the LAA
- The conservative approach taken to assessment (Section 20.4.1.3)
- Professional judgement and experience with similar projects
- Effectiveness of mitigation measures, which reflect best industry practices and those used on similar highways Projects in the NWT (e.g., Tłı̨chǫ Highway)

Prediction confidence is expected to increase following the completion of pre-construction surveys and monitoring programs.

20.7.1 Assumptions

A conservative approach is used to address uncertainty in the environmental effects assessment, which increases confidence in the final determination of significance. The assessment used a habitat-based approach, which focuses on identifying the quantity and composition of land cover types (i.e., habitats) affected by the Project relative to the availability of those habitats in the LAA and RAA. This approach is considered conservative as it assumes that bird species are present if the habitat is available, which is not always the case (e.g., some birds may not be present in a habitat recently affected by fire until the habitat returns to its pre-fire state following the vegetation successional process that require several years). Additionally, land cover classes that represent

disturbed lands (i.e., exposed land) are included in the quantification of direct habitat loss (and comprise 47.8% [1,104.91 ha] of the PDA) despite providing limited value for most bird species. The PDA is conservatively assumed to be lost to birds but there are portions that will be reclaimed, and some species will use disturbed sites.

20.7.2 Gaps and Uncertainties

A systematic survey of raptor nests within the LAA in the Dehcho Region has yet to be completed and the number of nests with potential to interact with the Project is unknown. A pre-construction raptor nest survey (Section 20.8) in this area will help to inform mitigation measures to protect nesting raptors. The Project may increase harvest opportunities and mortality risk and the degree to which this may affect the populations of some species (e.g., upland gamebirds) within the LAA is uncertain. Completing a raptor nest survey and implementing the WMMP is expected to increase prediction confidence.

In addition, there is uncertainty related to the potential direct and indirect effects of climate change on bird distribution and abundance (Stralberg et al. 2015, Duclos et al. 2019, Micheletti et al. 2021). In the NWT, some bird species have been reported to be positively affected whereas others are negatively affected due to potential changes in climatic suitability, fire regimes, vegetation communities as well as forest growth and mortality (Micheletti et al. 2021).

20.8 Follow-up and Monitoring

Pre-construction bird surveys will be completed prior to vegetation clearing where the Project has the potential to interact with sensitive features such as raptor nests or bank swallow colonies in existing quarries. Monitoring programs will be implemented to evaluate if mitigation measures are implemented and operating as planned. These include monitoring in accordance with the terms and conditions of permit approvals and the development and implementation of a WMMP.

The GNWT will continue to refine the WMMP for this project throughout the EA process and is open to and interested in discussions with Indigenous Governments, Indigenous Organizations, and other affected parties on how best to incorporate their recommendations.

Migratory bird species at risk will be monitored to determine species presence and relative abundance during construction. Similar to avian baseline surveys completed to support the DAR, effect monitoring surveys will be designed to focus on migratory bird species at risk most likely to interact with the Project (e.g., bank swallow [*Riparia riparia*], barn swallow [*Hirundo rustica*]) using recommended survey protocols. Specific survey objectives, study design and monitoring methods will be determined in consultation with ECCC and GNWT-ECC.

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20.9.2 Personal Communications

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21.0 ASSESSMENT OF POTENTIAL EFFECTS ON BIODIVERSITY

Biodiversity is an important component of the environment that promotes social, economic, cultural, spiritual, and ecological benefits. In addition, there are international (United Nations Convention on Biological Diversity), federal (Canadian Biodiversity Strategy [Environment Canada {EC}, 2005]), and territorial (Northwest Territories Biodiversity Action Plan [Northwest Territories Biodiversity Team [NTBT], 2004]) initiatives that have been developed to enhance biodiversity conservation. A shared central goal in the federal and territorial initiatives is to conserve biodiversity and use biological resources in a sustainable manner.

Mammal and bird biodiversity is relatively high in the Mackenzie River (Deh Cho) valley and plant and wildlife biodiversity is highest in the Northwest Territories (NWT) where mixedwood forests provide habitat opportunities for a greater diversity of species (Aurora Research Institute, 2013).

This chapter provides a description of the changes to biodiversity from the construction and operations and maintenance of the Mackenzie Valley Highway Project (the Project) in consideration of the requirements outlined in the Terms of Reference (ToR; Mackenzie Valley Environmental Impact Review Board [MVEIRB], 2015 [Public Registry {PR}#66]), which are:

- Ecosystem and habitat loss
- Habitat fragmentation/barriers to movement and gene flow
- Ability of habitat or species to recover
- Response to edge effects
- Changes to species distribution and abundance
- Invasive/non-native species (hereafter referred to as alien and invasive alien species)
- Changes to special management areas and species of special management concern

In this chapter, these changes to the components of biodiversity are summarized from the assessment of potential effects on relevant valued components (VC) presented in: Chapter 18 (vegetation and wetlands); Chapter 19 (wildlife and wildlife habitat); Chapter 20 (birds and bird habitat); and Chapter 10 (caribou and moose). These changes are described in local and regional contexts and in relation to how the Project could result in potential changes to vegetation and wildlife (includes mammals, birds, and invertebrates) biodiversity using a habitat-based approach. Specifically, the biodiversity assessment considers 213 birds, 42 mammals, 4 invertebrates and 2 amphibians. A comprehensive list of mammal and amphibian species with potential to occur in the Local Assessment Area (LAA), including species at risk (SAR)/species of conservation concern (SOCC), are provided in Appendix 19A, Appendix A.2 (K'alo-Stantec, 2023a) and a list of birds is provided in Appendix 20A, Appendix A.2 (K'alo-Stantec, 2023b).

21.1 Residual Effects on Biodiversity

A significant adverse residual effect on biodiversity is one that, following the application of avoidance and mitigation measures, threatens the long-term persistence or viability of plant or animal SAR/SOCC (see Chapter 19 and Chapter 20). The assessment of potential effects on biodiversity considers the following changes. Pathways of effects are discussed within each section:

- Ecosystem and habitat loss
- Habitat fragmentation and barriers to movement
- Ability of habitat or species to recover
- Response to edge effects
- Changes to species distribution and abundance
- Alien and invasive alien species
- Changes to special management areas and species of special management concern

21.2 Ecosystem and Habitat Loss

Fire and anthropogenic disturbances affect the availability of large areas of secure, undisturbed habitat for boreal caribou in the NWT. Recent data published by ECCC estimates that, across their NWT range, 35% of boreal caribou habitat has been disturbed, with 28% from wildfires and 9% from anthropogenic sources (ECCC, 2020). Regionally, the percentage of undisturbed habitat in 2017 was approximately 79% in the Sahtu Region and 53% in the Southern NWT (i.e., the Dehcho and South Slave regions combined) (GNWT, 2019). The other portions of the NT1 range, the Inuvialuit, Gwich'in, and Wek'èezhìı regions, also have high amounts of undisturbed boreal caribou habitat (98%, 72%, and 66% respectively) (GNWT, 2019) (Section 10.2.2.1).

The Project will result in direct habitat loss and indirect habitat loss for wildlife and bird VCs as discussed in Chapter 10, Chapter 19, and Chapter 20. Direct habitat loss will occur through clearing and development of the Project Development Area (PDA) - the area of direct project disturbance or "footprint". Indirect habitat loss results from sensory disturbance, dust deposition, edge effects, and fragmentation.

21.2.1 Direct Habitat Loss

The Project will result in direct habitat loss within the PDA. Construction activities that require vegetation clearing and road placement will result in loss of upland and wetland habitats. Closure and reclamation of the Mackenzie Valley Winter Road (MVWR) and temporary borrow sources/ quarries, camps, and workspaces will be reclaimed to promote re-establishment of vegetation (Chapter 18 - vegetation and wetlands), which is expected to provide potential wildlife habitat as vegetation communities become established over time. The ability for these areas to support wildlife species will vary with successional stage and species-specific habitat requirements.

Construction of the Project will result in the direct loss of 2,315.2 hectares (ha) of land cover within the wildlife LAA (i.e., a 1 kilometre [km] buffer of the preliminary road alignment and a 2 km buffer around quarries and borrow source), which is a 3.1% decrease from existing conditions. However, 47.8% (1,104.91 ha) of this direct loss is exposed land that contains existing anthropogenic disturbances (i.e., existing MVWR, Norman Wells Pipeline, Mackenzie Valley Fibre Link, and borrow sources), which provide limited suitability for most wildlife species (Section 19.4.2.3).

Overall, construction of the Project will result in the direct loss of 1,210.3 ha of natural land cover for wildlife within the LAA, which represents a 2.1% decrease from existing conditions. Similarly, habitat loss for SAR and SOCC is anticipated to be relatively low. For example, the Project will result in an estimated direct loss of 2% of little brown myotis maternal roosting habitat, 2.9% of grizzly bear denning habitat, and 1.9% of olive-sided flycatcher habitat (Sections 19.4.2.3, 20.4.2.3). Although the Project will result in direct habitat loss for SAR/SOCC, project-related changes to habitat may benefit some species that take advantage of anthropogenic disturbances (Section 20.4.2.3.1.5).

Project routing and design have integrated the existing cleared MVWR right-of-way (ROW) to the extent practicable, which will reduce incremental ecosystem and habitat loss or alteration caused by the Project. For example, edge effects are already present along the entire length of the MVWR. Although there will be a small decrease in patch size for coniferous forest and shrubland (Section 18.4.2.3), core areas of large habitat patches will continue to be available in the LAA. In addition to a project-specific Wildlife Management and Monitoring Plan (WMMP) that will be implemented during the construction and operations and maintenance phases, standard industry practices and mitigation measures will be implemented to reduce the effects of habitat loss on ecosystem VCs. A list of key mitigation measures to reduce potential project effects on change in habitat (direct and indirect habitat loss) are provided.

Key mitigation measures to avoid or reduce direct habitat loss include:

- The area of direct ground disturbance will be limited by following the pre-existing Mackenzie Valley Winter Road (MVWR) road alignment to the extent possible.
- The Project will use previously disturbed areas for project activities and project infrastructure and workspaces, to the extent practical.
- Clearing will be limited to areas required for construction and safe operations.
- Project vehicles will be confined to existing roads and trails as much as possible to avoid disturbing vegetated areas.
- Riparian vegetation will be maintained whenever possible.
- The WMMP will outline how risks to migratory birds will be managed in accordance with ECCC's Guidelines to Reduce Risk to Migratory Birds (ECCC, 2021) if activities that could result in risk of harm cannot be avoided (e.g., pre-clearing nest surveys).
- Closure and reclamation will promote re-establishment of vegetation.

Operations and maintenance of the Project will not result in additional direct loss or alteration of habitat for vegetation and wildlife and some disturbed habitats may become habitat for vegetation and wildlife following reclamation and natural succession after construction.

21.2.2 Indirect Habitat Loss

An indirect loss or alteration of habitat is likely to occur adjacent to the PDA through sensory disturbance, dust deposition, edge effects, and fragmentation (Sections 10.4.2.1, 19.4.2.1, 20.4.2.1). Project-related sensory disturbance (i.e., noise and light) from most construction activities including equipment operation, infrastructure construction, and blasting has the potential to disturb wildlife and change the use of habitat around the PDA (e.g., habitat avoidance, fine-scale changes in individuals' movement and associated energetic costs). Vegetation clearing will result in an indirect alteration of habitats adjacent to the PDA by creating an unnatural transition (i.e., edge effects) between the PDA and adjacent habitat (Sections 10.4.2.3, 19.4.2.3, 20.4.2.1). Edge effects are discussed in Section 21.5. Dust deposition associated with project construction can affect vegetation composition adjacent to the PDA (e.g., Gill and Lantz, 2014), which may alter habitat use by wildlife. Indirect loss or alteration of habitat creates an area adjacent to the PDA that exhibits some degree of reduced ecological effectiveness, compared to the existing condition, that typically varies by effect pathway and vegetation and wildlife species. Measurable effects on wildlife outside of the LAA resulting from sensory disturbance are unlikely (Sections 19.4.2.3, 20.4.2.3); however, indirect habitat loss may occur in the larger Caribou and Moose LAA (Section 10.4.2.3.1.3).

The indirect loss or alteration of habitat created during construction is likely to persist adjacent to the PDA during operations and maintenance due to sensory disturbance and dust deposition associated with the presence and use of the highway by the public (i.e., continuation of edge effects and fragmentation). As a result, the ecological effectiveness of habitats adjacent to the PDA will be reduced (Section 19.4.2.3).

These indirect effects have the potential to result in a change in habitat and have been shown to result in fine-scale changes in wildlife movements (e.g., wolverine [Scrafford et al., 2018]). Additionally, the presence of the highway will maintain fragmentation and edge effects established during the construction phase. Although edge effects will be maintained due to maintenance activities within the ROW (i.e., periodic brushing and mowing every three years), the distance of edge influence in the adjacent forest may be reduced over time as vegetation communities respond to maintained edges (Harper et al., 2005, 2015, Section 18.4.2.3).

Indirect effects associated with sensory disturbance, dust deposition, edge effects, and fragmentation have primarily been mitigated based on the current preliminary alignment routing that largely follows the existing MVWR, where habitat is already subject to these disturbances and associated reduced ecological effectiveness and avoidance by wildlife. Construction of the Project will result in habitat alteration within the LAA by increasing the amount and duration (i.e., year-round at times) of these indirect effects.

Although there will direct and indirect loss of wildlife habitat in the LAA residual effects on vegetation and wildlife, including on SAR/SOCC, are predicted to be not significant. However, the Project will increase the amount of anthropogenic disturbance in the Caribou and Moose LAA, though relatively small, will contribute to an existing exceedance of a conservation-based threshold for boreal caribou (i.e., 65% undisturbed habitat). Therefore, residual effects on boreal caribou from change in habitat are predicted to be significant (Section 10.6.1.1).

21.2.3 Cumulative Effects on Biodiversity from Habitat Loss

Residual effects arising from past, present, and reasonably foreseeable activities have similar pathways of effects as those arising from the Project and have the potential to result in a cumulative increase in wildlife habitat loss or alteration during the construction and operations and maintenance of the Project. These effects pathways are the direct loss or alteration of wildlife habitat through vegetation clearing and indirect effects through sensory disturbance, dust deposition, edge effects, and fragmentation.

Notable past and present activities and projects that contribute to cumulative effects of habitat loss in the LAA and Regional Assessment Area (RAA i.e., a 15 km buffer of the PDA) are the Norman Wells Pipeline, the MVWR and other winter roads, and quarries and borrow sources. Reasonably foreseeable activities and projects are the Dhu-1 Quarry, the Great Bear River Bridge, and the Prohibition Creek Access Road Project that occur within the LAA and RAA. Although additive, the reasonably foreseeable projects are comparatively small, involving limited amounts of clearing and vehicle traffic, and their respective residual effects are anticipated to be minimal following the application of project-specific mitigation measures.

Mitigation measures and regional initiatives applicable to limiting cumulative effects on wildlife habitat within the RAA (including other reasonably foreseeable projects) include adherence to the project-specific WMMP and other management and monitoring plans used to protect and monitor the environment during the project construction, and operations and maintenance phases (see Section 21.2.1).

Development of the Project, including vegetation clearing, will result in a direct loss or alteration of 2,315.2 ha of habitat for wildlife, a 0.2% decrease from the existing condition in the RAA (1,010,983.5 ha). This includes 1,104.9 ha of exposed land that is subject to existing anthropogenic disturbances (i.e., existing MVWR and quarries). Past and present activities and projects have resulted in the direct loss or alteration of wildlife habitat in the RAA, including for SAR/SOCC.

Although residual cumulative effects on vegetation and wildlife including SAR/SOCC, are predicted to be not significant, the Project will contribute to an existing cumulative effect in the Caribou and Moose LAA and further contribute to an exceedance of a conservation-based threshold for boreal caribou (i.e., 65% undisturbed habitat). Therefore, residual cumulative effects on boreal caribou from change in habitat are predicted to be significant (Section 10.6.2.1).

21.3 Habitat Fragmentation/Barrier to Movement and Gene Flow

Construction of the Project has the potential to affect wildlife movement through the creation of fragmented habitats and physical and sensory barriers that may affect wildlife movement in the LAA. The ability to move between resource patches is important for a species' persistence and barriers can reduce access to key resources, reduce gene flow, lead to range shifts, and alter seasonal movement patterns and dispersal events (Ament et al., 2014; Nathan et al., 2008; Johnson et al., 1992). Increased noise levels can also result in decreased opportunity costs (i.e., time), increased exposure (Beyer et al., 2014), and increased energy expenditure, especially during winter when energy costs are relatively higher (Bradshaw et al., 1998; Saher and Schmiegelow, 2005). The extent to which construction activities alter wildlife movement in the LAA will vary by the duration, frequency, and intensity (e.g., noise level) of disturbance as well as by wildlife species (Shannon et al., 2016). Overall, the Project will contribute to existing habitat fragmentation through a small decrease in average and maximum patch size for some land cover types and an increase in perimeter to area ratio for all land cover types (i.e., edge) (see Chapter 18 - vegetation and wetlands).

21.3.1 Physical Barriers to Movement

In addition to widening the existing MVWR ROW (from 20 metres [m] to 60 m) for most of the length of the Project, there will be some creation of new highway ROW, in addition to quarries, borrow sources, and access roads, that contribute to increased habitat fragmentation. During construction, the physical presence of these features may present a barrier to wildlife but many of the sources of sensory disturbance will only occur seasonally. Habitat fragmentation also has the potential to increase wildlife mortality risk through increased access opportunities and hunting efficiency for hunters, trappers, and predators.

Effects associated with habitat fragmentation will persist into the operations and maintenance phase and the presence of the highway may create a physical barrier to wildlife movement. The associated highway traffic and other operations and maintenance activities also have the potential to reduce barrier permeability due to contributions of sensory disturbance. Sensory disturbances associated with the operations and maintenance of the highway, including the associated public vehicle traffic, will become year-round pathways of effects that have the potential to result in a change in wildlife movement (Sections 10.4.3.3, 19.4.3.3).

Project routing and design have integrated the existing MVWR ROW to the extent possible, which will reduce habitat fragmentation and the creation of new barriers to movement. In addition to a project-specific WMMP that will be implemented during the construction, and operations and maintenance phases, standard industry practices and mitigation measures will also be implemented.

Key mitigation measures to avoid or reduce change in movement include:

- A buffer strip of undisturbed vegetation of at least 30 m wide will be maintained between the highway ROW and other new areas to be cleared.
- Vegetation buffers will be used as visual barriers and to protect riparian vegetation, as appropriate.
- Drainage culverts will be constructed along the roadway to facilitate water movement and maintain drainage patterns.
- The height of snowbanks will be limited to the extent possible and to a height of less than 1 m.
- Construction and quarry development activities will adhere to the applicable recommended setbacks and timing restrictions for wildlife outlined in the WMMP, where possible.
- Closure and reclamation will promote re-establishment of vegetation.

21.3.2 Change in Movements

Construction of the Project has potential to result in the alteration of movement patterns, including traditional or seasonal movement corridors, over space and time for some wildlife species through sensory disturbance from vehicles, equipment, and personnel. A reduction in barrier permeability (i.e., the PDA may become more difficult to cross) is possible for less mobile species (e.g., small mammals, amphibians), or other wildlife species where roads and traffic volumes can affect movement including wolverine (Scrafford et al. 2018, Section 19.4.3.1.1) as well as moose and caribou (Section 10.4.3.1.1). Project routing that predominantly follows the MVWR has also reduced the potential for adverse effects on wildlife habitat resulting from habitat fragmentation; core areas of large habitat patches will continue to be available in the LAA. Additionally, aquatic habitats will remain connected through the construction of culverts and bridges and a change in movement for aquatic species (e.g., beaver [*Castor canadensis*]) is not anticipated.

Two existing quarries proposed for use on this Project overlap two muskox (*Ovibos moschatus*) important wildlife areas (IWAs) (i.e., areas that consistently contain a relatively high number of individuals) near Norman Wells. As such, there is potential for the Project to temporarily affect local movement of muskox during construction; however, proposed mitigation measures (timing and setback distances) are expected to reduce potential effects associated with sensory disturbance. Overall, construction will be completed in sections and effects associated with sensory disturbance are expected to be localized and short-term in any given location.

Operations and maintenance of the Project has potential to influence the movement of some wildlife species and result in the alteration of wildlife movement patterns, including traditional or seasonal movement corridors, as the presence of the highway and associated traffic will present year-round disturbance (i.e., estimated 50 vehicles/day). Wildlife currently interact with the existing MVWR, which might act as a permeable, semi-permeable or impermeable barrier depending on species-specific road avoidance behaviours. Although the Project will result in a small incremental increase in the width of the road, an increase in traffic volume at relatively low levels

can affect wildlife movement depending on species (Mace et al. 1996, Beyer et al. 2014, Scrafford et al. 2018).

Overall, the LAA will remain connected and relatively undisturbed, and the Project will contribute a small incremental increase in habitat fragmentation. Residual effects on vegetation and wildlife (including SAR/SOCC) associated with project-related habitat fragmentation and barriers to movement are predicted to be not significant (Sections 18.6, 19.6).

21.3.3 Cumulative Effects on Biodiversity from Habitat Fragmentation and Barriers to Movement

Residual effects arising from past, present, and reasonably foreseeable activities have similar pathways as those arising from the Project and have the potential to result in a cumulative barrier to wildlife movement and gene flow. These pathways include physical and sensory barriers.

Notable past and present activities and projects that contribute to cumulative effects on wildlife movement in the LAA and RAA (e.g., creation of linear infrastructure and semi-permeable barriers) are the Norman Wells Pipeline, the MVWR and other winter roads, Prohibition Creek Access Road, and quarries and borrow sources. Reasonably foreseeable activities and projects that have potential to interact with residual effects on wildlife movement include the Dhu-1 Quarry and the Great Bear River Bridge that occur within the LAA and RAA. Although additive, the reasonably foreseeable projects are comparatively small, involving limited amounts of clearing and sensory disturbance, and their respective residual effects are anticipated to be minimal following the application of project-specific mitigation measures Section 19.5).

The Project primarily follows the existing MVWR and given that reasonably foreseeable projects are relatively small, a measurable change in wildlife movement and gene flow in the LAA is not anticipated, although temporary local shifts in distributions in the LAA might occur. Cumulative effects extending into the RAA are not anticipated.

The Project will contribute a small incremental increase in habitat fragmentation and the creation of barriers associated with the construction and operation of the Project (Sections 10.4.2.1, 18.4.2.3, 19.4.2.3). Cumulative effects on vegetation and wildlife (including SAR/SOCC) associated with habitat fragmentation and wildlife movement are predicted to be not significant.

21.4 Ability of Habitat or Species to Recover

The Project will result in the direct and indirect loss or alteration of habitat for vegetation and wildlife. While most habitat will be permanently lost, closure and reclamation of the MVWR and temporary borrow sources/quarries, camps, and workspaces are expected to recover over time due to natural revegetation or reclamation activities designed to promote vegetation communities (see Chapter 18 - vegetation and wetlands). The recovery of vegetation communities will provide potential habitat for a variety of wildlife species depending on site conditions, successional stage and species-specific habitat associations (van Rensen et al., 2015; Wilson and Bayne, 2019).

Construction and operations and maintenance of the Project has the potential to affect the survival and recovery of SAR/SOCC by resulting in a change in habitat, movement, mortality risk, and wildlife health in the LAA. The RAA contains habitat for four mammal, three invertebrate, and two bird SAR, and one mammal, one invertebrate, and one bird SOCC.

A comprehensive assessment of project effects on SAR/SOCC was completed within each respective VC (Chapters 10, 19 and 20), and each respective significance definition considers how residual effects affect the long-term persistence or viability of SAR/SOCC. With the application of avoidance and mitigation measures, residual effects and residual cumulative effects on the wildlife and wildlife habitat, birds and bird habitat, and caribou and moose are not expected to threaten the long-term persistence or viability of SAR/SOCC, or species of cultural or traditional importance.

21.5 Response to Edge Effects

Construction in the PDA will result in the removal of upland and wetland habitats through vegetation clearing. This will result in an indirect alteration of habitats adjacent to the PDA by creating an unnatural transition (i.e., edge effects) between the PDA and adjacent habitat. Edge effects can include changes in microclimate (e.g., Murcia, 1995) and vegetation structure (e.g., Harper et al. 2005), which can in turn result in changes in the vegetation and wildlife community in those habitats. It can also result in increased mortality risk and reduced reproductive success for species, particularly birds, that inhabit edge habitats.

Dust deposition associated with project construction can affect vegetation composition adjacent to the PDA (e.g., Gill and Lantz, 2014), which may further alter habitat suitability for vegetation and wildlife. Indirect loss or alteration of habitat creates an area adjacent to the PDA that exhibits some degree of reduced ecological effectiveness, compared to the existing condition, that typically varies by effect pathway and vegetation and wildlife species.

During operations and maintenance, the presence of the highway will maintain fragmentation and edge effects that were established during the construction phase. Although edge effects will be maintained due to maintenance activities within the ROW (i.e., periodic brushing and mowing every three years), the distance of edge influence in the adjacent forest may be reduced over time as vegetation communities respond to maintained edges (Harper et al., 2005, 2015, See Chapter 18 - vegetation and wetlands). Closure and reclamation of the MVWR and temporary borrow sources/quarries, camps, and workspaces will promote re-establishment of vegetation

(Chapter 18), which is expected to provide potential wildlife habitat as vegetation communities become established over time. The ability for these areas to support wildlife species will vary with successional stage and species-specific habitat requirements.

Project routing and design have integrated the existing MVWR ROW to the extent practicable, which will reduce the additional incremental edge effects caused by the Project. In addition to a project-specific WMMP that will be implemented during the construction, and operations and maintenance phases, standard industry practices and mitigation measures will also be implemented.

Construction, and operations and maintenance of the Project will result in an adverse residual effect relating to edge effects on vegetation and wildlife that will result from vegetation clearing activities, particularly where the PDA intersects forested habitats. However, the existing MVWR and other exposed lands (e.g., quarries) have already created edge effects and the Project will contribute a minor additive increase because a large proportion of the PDA, as based on the current preliminary alignment routing, overlaps these previously disturbed lands. Additionally, dust deposition associated with project construction has the potential to alter habitats adjacent to the PDA. Effects of dust deposition on vegetation are likely to be limited to within 40 m of the PDA (see Section 18.4; Meininger and Spatt, 1988; Gleason et al., 2007).

Edge habitats typically alter vegetation and wildlife species composition but can increase species diversity, particularly for bird species, where transitional habitats occur. For example, the creation of a linear feature through a large patch of coniferous forest may reduce suitability for interior forest songbird species but the open or transitional habitats created may be suitable for several other species. Regardless, the creation of edge habitats alters the vegetation and wildlife community composition and may also increase habitat opportunities for alien and invasive alien species.

Overall, the LAA will remain relatively undisturbed, and the Project will contribute a small incremental increase in edge habitats. Residual effects on vegetation or wildlife (including SAR/SOCC) associated with project-related creation of edge habitat are predicted to be not significant.

21.5.1 Cumulative Effects on Biodiversity from Edge Effects

Residual effects arising from past, present, and reasonably foreseeable activities have similar pathways as those arising from the Project and have the potential to result in a cumulative increase in edge effects during the construction and operations and maintenance of the Project. Notable past and present activities and projects that contribute to cumulative edge effects in the wildlife LAA and RAA are the Norman Wells Pipeline, the MVWR and other winter roads, and quarries and borrow sources. Reasonably foreseeable activities and projects are the Dhu-1 Quarry, the Great Bear River Bridge, and the Prohibition Creek Access Road Project that occur within the LAA and RAA. Although additive, the reasonably foreseeable projects are comparatively small, involving limited amounts of clearing, and their respective residual effects are anticipated to be minimal following the application of project-specific mitigation measures.

Mitigation measures and regional initiatives applicable to limiting cumulative effects on vegetation and wildlife within the RAA (including other reasonably foreseeable projects) include adherence to the project-specific WMMP and other management and monitoring plans used to protect and monitor the environment during project construction and operations and maintenance.

The Project will contribute a relatively small incremental increase in the amount of edge habitat within the RAA. Highway routing will reduce the amount of new edge habitat created and over time edge habitats along the PDA are expected to soften as shrubs grow and some project components are reclaimed.

Overall, the RAA will remain relatively undisturbed, and the Project will contribute a small incremental increase in edge habitats. Cumulative effects on vegetation and wildlife (including SAR/SOCC) associated with edge effects are predicted to be not significant.

21.6 Changes to Species Distribution and Abundance

The construction and operation of linear features, such as highways, creates an unnatural disturbance that can alter the distribution and abundance of species through environmental effects associated with direct (e.g., vegetation clearing) and indirect (e.g., sensory disturbance, edge effects) habitat loss or alteration, altered movement patterns, and increased direct (e.g., vehicle collisions) and indirect mortality risk related to altered predator-prey dynamics and increased access for harvesters, which might increase based on year-round improved access (see Chapter 10). The GNWT will work with the Sahtu Renewable Resources Board and other resource managers to address uncertainty regarding the effects of increased access created by the Project on harvested resources in the study areas. This would include monitoring of harvest that can be used to identify the need for management actions to be taken by the appropriate resource management organization.

Project routing and design have integrated the existing MVWR ROW to the extent practicable, which will reduce effects on vegetation and wildlife. In addition to a project-specific WMMP that will be implemented during the construction, and operations and maintenance phases, standard industry practices and mitigation measures will also be implemented.

The wildlife VCs (i.e., wildlife and wildlife habitat, birds and bird habitat, and caribou and moose) considered how these project-related environmental effects alter the distribution and abundance of wildlife. In general, a measurable change in the abundance of wildlife in the LAA is not anticipated, although temporary local shifts in distributions in the LAA might occur (e.g., during periods of increased construction activity) which is characterized as a low magnitude effect.

Similarly, the vegetation VC considered how environmental effects relating to landscape diversity, community diversity, species diversity, and wetland function can result in a change in the distribution and abundance of vegetation and wetlands. In general, residual effects on vegetation and wetlands are not anticipated to extend beyond the vegetation LAA, however, the Project may result in the loss of plant species of interest to Indigenous Governments, Indigenous Organizations, and other affected parties and effects are considered moderate to high magnitude. It is possible,

though unlikely, that occurrences of a plant species of interest to Indigenous Governments, Indigenous Organizations, and other affected parties removed from the PDA are the only occurrences of that species in the LAA or RAA. This determination includes uncertainty in the occurrence of May Be At Risk plants and the potential use by Indigenous Governments, Indigenous Organizations, and other affected parties. Project effects are not expected to result in the local or regional loss of secure or non-native plants and although abundance will be reduced, species of these plants occurring in the LAA are expected to remain abundant.

A comprehensive assessment of project effects on vegetation and wildlife was completed and the respective significance definitions consider how residual effects affect the long-term persistence or viability of species (i.e., which includes the distribution and abundance of species within the LAA and RAA). With the application of avoidance and mitigation measures, residual effects and residual cumulative effects on the wildlife and wildlife habitat, birds and bird habitat, and caribou and moose are not expected to threaten the long-term persistence or viability of SAR/SOCC, or species of cultural or traditional importance.

21.7 Alien and Invasive Alien Species

For the purposes of the Developer's Assessment Report (DAR), alien species include plants, animals and other organisms that are introduced, deliberately or inadvertently, by humans into an ecosystem that is beyond their natural range (GNWT, 2020b; NWT CISPP, 2023). Invasive alien species are those with potential to threaten biodiversity (e.g., native ecosystems), the economy, or society (NWT CISPP, 2023). This does not include species that naturally occur but are undergoing range expansion.

Invasive alien species can adversely affect biodiversity by displacing native species (e.g., competition), introducing pathogens and disease, increasing predation, or altering habitats (e.g., forest defoliation) and ecosystem degradation occurs when native species or endemic populations decline or become extirpated or extinct (GOC, 2017).

21.7.1 Vegetation

Desktop review revealed records of 16 alien plant species and four invasive alien plant species in the RAA (Table B.1 in Appendix 18A). Specific locations of these occurrences are not available but are assumed to be along ditches adjacent to human infrastructure.

Habitat fragmentation (e.g., construction of linear features) generally results in a change in plant community composition, including providing invasive alien species with additional habitat which results in increased abundances of such species. Vehicles using newly constructed roads may spread non-native invasive species by bringing in seed in mud and plant material on tires. However, mitigation will be implemented during construction, which will include regular inspection for invasive alien plant occurrences and mowing to reduce introduction and spread of weeds in the PDA and surrounding natural vegetation (see Chapter 18).

21.7.2 Wildlife

Rock pigeon (*Columba livia*), European starling (*Sturnus vulgaris*), and house sparrow (*Passer domesticus*) are invasive alien species (i.e., introduced from outside North America) that occur within the LAA, but breeding habitats for these species are associated with anthropogenic habitats such as residential areas. The presence of invasive alien species may affect native bird species in these altered habitats. Although European starlings can compete for nesting sites with native cavity-nesting birds (e.g., woodpeckers), potential adverse effects on native birds varies by species and does not necessarily result in severe effects on all native cavity-nesting bird populations (Koenig, 2003).

There are 68 alien invertebrate species that inhabit the NWT but there are additional species that have yet to be assessed and are also alien species (Working Group on General Status of NWT Species, 2021). Local knowledge provided by Tulita Renewable Resources Council (TRRC) through a project-specific Traditional Land and Resource Use (TLRU) study indicated that different species of birds are starting to appear around Tulita that have not been observed in the past, specifically magpies (TRRC, 2022). However, TRRC study participants reported that Sahtu harvesters and land users in the Tulita area are not sure why this is occurring (TRRC, 2022).

While there are no mammal or amphibian species that would be considered invasive alien or non-native species that occur within the RAA, there are some mammal species that have exhibited relatively recent range expansion into the RAA. There have been reports suggesting changes to the number and type of prey species that were once absent or uncommon in the RAA, such as white-tailed deer (*Odocoileus virginianus*) and muskox. It is believed that the northerly range expansion of white-tailed deer is responsible for the increased number of cougar (*Puma concolor*) observations in the Dehcho Region, but these are not expected to occur within the LAA.

Overall, the LAA will remain relatively undisturbed and residual effects on vegetation or wildlife, including on SAR/SOCC, due to invasive/non-native species are predicted to be not significant.

21.8 Changes to Special Management Areas and Species of Special Management Concern

The assessment of potential effects on the wildlife and birds VCs (see Chapters 19 and 20) quantitatively evaluated direct habitat loss or alteration within the LAA on:

- Important Wildlife Areas (Wilson and Haas, 2012):
  - Dehcho beaver concentration areas (3.1% decrease compared to existing conditions)
  - Dehcho lynx concentration areas (3.7% decrease compared to existing conditions)
  - Sahtu muskox areas (3.1% decrease compared to existing conditions)
  - Sahtu rivers (i.e., important moose habitat) (3.0% decrease compared to existing conditions)

- Important Bird Areas (IBAs):
  - Middle Mackenzie River Islands IBA (4.3% decrease compared to existing conditions)
- Conservation Zones (CZs; from the Sahtu Land Use Plan [SLUPB, 2023]):
  - Petiniʔah (Bear Rock) CZ (Zone #32) (3.1% decrease compared to existing conditions)

The Project overlaps Special Management Zones (SMZs) for the Sahtu Deh (Great Bear River) SMZ (Zone #33) and the Deh Cho (Mackenzie River) SMZ (Zone #63), and the Project is anticipated to result in a relatively small amount of direct habitat loss within those SMZ compared to availability within the LAA. The Project protects and respects the values of the SMZ and CZs, as assessed in Chapter 10, 18, 19 and 20).

Overall, the Project is anticipated to have a low magnitude effect on special management areas.

21.9 Summary

The assessment of potential effects on the vegetation, wildlife, and birds VCs (see Chapters 10, 18, 19 and 20) specifically evaluated Project effects on SAR/SOCC and the determination of significance for each respective VC chapter predicted that adverse residual effects would be not significant, except for effects on boreal caribou from habitat loss, which are predicted to be significant as they contribute to an existing exceedance of a conservation threshold. The residual effects of the Project on biodiversity are predicted to be not significant because the Project will not threaten the long-term persistence or viability of plant or animal SAR/SOCC).

Overall, the Project largely follows the existing MVWR and other mitigation measures, such as reclamation of the MVWR and temporary borrow sources/ quarries, camps, and workspaces, will further reduce potential project effects on biodiversity in the RAA.

Given the similarities in effects pathways and factors contributing to effects on biodiversity as described in this chapter, residual effects associated with predicted ecosystem and habitat loss, habitat fragmentation and barriers to movement/gene flow, changes to species distribution and abundance, alien and invasive alien species, and changes to special management areas, residual and cumulative effects on biodiversity are predicted to be not significant.

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22.0 ASSESSMENT OF POTENTIAL EFFECTS ON HERITAGE RESOURCES

The *Mackenzie Valley Resource Management Act* (MVRMA) defines heritage resources as archaeological or historical sites; burial sites; artifacts and other objects of historical, cultural or religious significance; and historical or cultural records.

Heritage Resources are a Valued Component (VC) as these are unique and non-renewable resources that are tangible evidence of thousands of years of human history. These resources reinforce the link between modern communities and land use history. For Indigenous Governments and Indigenous Organizations, heritage resources can be considered one component of traditional land and resource use (TLRU), extending into the deep past. As a result, sharing information between TLRU, and heritage resources assessment teams provides a more comprehensive assessment of potential effects of a project on heritage resources. Archaeological site potential, in particular, is typically evaluated through landscape attributes, including terrain, geology, soils, fauna (fish, wildlife, birds), and vegetation. These features are incorporated into the evaluation of site potential as these attributes play major roles in where people have lived, harvested, and travelled for thousands of years.

Heritage resources are included in the Terms of Reference (ToR) for the Mackenzie Valley Highway Project (the Project), as issued by the Mackenzie Valley Environmental Impact Review Board (MVEIRB, 2015 [Public Registry {PR}#66]), as a subject of note of the human environment. This chapter summarizes information contained within the territorial sites database relative to known sites and heritage resource potential, which is presented in greater detail within the Heritage Resources Technical Data Report (TDR) for the Project, provided in Appendix 22A (K'alo-Stantec, 2022).

Precontact archaeological, historical, and traditional land use sites represent discrete episodes of past activities. They are non-renewable and can be removed or altered by project development. Precontact and historical archaeological resources are tangible expressions of past land use activities. The archaeological interpretation of the resources depends on site contents such as artifacts, buildings, or trails, but also on the spatial relationship of site contents to one another and to the landscape. They are constantly at risk of disturbance and disappearance through both natural processes over time and human use and development of the land. They are therefore fragile, ephemeral, and the product of unique processes and conditions of preservation. Once they have been disturbed, they cannot be replaced, recreated, or restored. Archaeological resources are finite in quantity.

Heritage resources can be affected by the Project through activities that cause surface and/or subsurface disturbance, including vegetation removal, topsoil stripping, and/or excavation, including blasting.

The assessment of potential effects on heritage resources concludes that if all requirements issued by the Territorial regulators and stipulated by the Sahtu Land Use Plan (SLUP) are fulfilled prior to project construction, the residual effects and cumulative effects on heritage resources are predicted to be not significant.

22.1 Scope of Assessment

22.1.1 Regulatory and Policy Setting

The Government of the Northwest Territories (GNWT) Guidelines for Developers for the Protection of Archaeological Sites in the Northwest Territories summarizes the relevant legislation and regulations.

Heritage Resources are protected and regulated under the Northwest Territories Archaeological Sites Regulations pursuant to the *Archaeological Sites Act* (S.N.W.T., 2014, c.9) which applies to all lands and waters other than those within the administration and control of His Majesty in right of Canada. The Regulations state that:

> *4. No person shall search for archaeological sites or archaeological artifacts, or survey an archaeological site, without a Class 2 or Class 2 permit.*
>
> *5. No person shall excavate, alter or otherwise disturb an archaeological site, or remove an archaeological artifact from an archaeological site without a Class 2 permit.*

Additional legislative protection is provided through the MVRMA, regulated through the Mackenzie Valley Land Use Regulations (MVLUR) and the *Historical Resources Act* (territorial). Under Part 5 of the MVRMA, any "impact on the environment" includes any effect on the social and cultural environment or on heritage resources. Two sections of the MVLUR are relevant to archaeological sites:

> *6 (a). Unless expressly authorized by a permit or in writing by an inspector, no permittee shall conduct a land use operation within 30 m of a known monument or a known or suspected historical, archaeological site or burial ground; and*
>
> *12. Where, in the course of a land-use operation, a suspected historical or archaeological site or burial ground is discovered, (a) the permittee shall immediately suspend operations on the site or burial ground and notify the Board or an inspector; and (b) the Board or inspector shall notify any affected First Nation and the department of the Government of the Northwest Territories responsible therefor of the location of the site or burial ground and consult them regarding the nature of the materials, structures or artifacts and any further actions to be taken.*

Specific to the areas to which the SLUP applies, the Project must meet the 13 general conformity requirements (CR) of the SLUP (Sahtú Land Use Planning Board [SLUPB], 2023). The SLUP's conformity requirements include consideration of effects of the Project on heritage resources and engagement input in CR#2:

> *"1) For all applications for land use activities, community organizations and potentially affected community members must be adequately engaged with respect to:*
>
> *…b) Potential impacts of the proposed activities on specific locations, including heritage resources, and other issues of concern identified in the engagement…"*
>
> *"2) The proposed activities must be designed and carried out with due regard for community concerns and incorporate relevant traditional knowledge."* (SLUPB, 2023)

Requirements related to archaeological sites and burial sites are included in CR#4:

> *"1) Land use activities must not be located within 500 m of known or suspected burial sites, or within 150 m of known or suspected archaeological sites, unless measures are developed in cooperation with the Prince of Wales Northern Heritage Centre, affected communities, or, in the case of burial sites, with affected families where possible, to fully mitigate all impacts to the site.*
>
> *2) In areas where there is a high risk of impact to known or suspected archaeological sites, as determined by the Prince of Wales Northern Heritage Centre (PWNHC), an archaeological impact assessment must be conducted prior to commencement of the land use activity."* (SLUPB, 2023)

Additionally, per CR#14, the Project must be designed and carried out in a manner that protects, respects, or takes into account the values of the Conservation Zones (CZ) and Special Management Zones (SMZ) potentially affected by the Project as directed in the SLUP's Zone Descriptions (SLUPB, 2023), including the following, which each require protection of archaeological and burial sites:

- Petiniɀah (Bear Rock) CZ (Zone #32)
- Mio Lake CZ (Zone #36)
- Norman Range SMZ (Zone #50)
- K'ąąlǫ Tué (Willow Lake Wetlands) Special Management Zone (SMZ) (Zone #62)
- Deh Cho (Mackenzie River) SMZ (Zone #63)

22.1.2 Influence of Engagement

The GNWT has engaged with Indigenous Governments, Indigenous Organizations, and other affected parties. Detailed information regarding these engagement activities is presented in Chapter 2 (Consultation and Engagement), Chapter 3 (Traditional Knowledge), and Chapter 11 (culture and traditional land use). The GNWT has recently initiated Consultation with Indigenous Governments and Indigenous Organizations.

Through the project-specific engagement program delivered between 2010-2012 and 2021-2023, including project-specific TLRU studies, Indigenous Governments, Indigenous Organizations, and other affected parties shared information, expressed concerns, and provided recommendations related to heritage resources, including habitation sites, spiritual sites, trails, and travel routes. This feedback has been considered and summarized in Table 22.1 and has been integrated into the assessment of potential effects of the Project on heritage resources that follows.

The SLUP speaks to the importance and protection of heritage resources, Consulting with Indigenous Governments and Indigenous Organizations, and engaging with affected parties relative to proposed development projects. It is accepted practice to engage and include Indigenous knowledge holders in field assessments for Archaeological Impact Assessments (AIAs). This has resulted in direct inclusion of TLRU information in the identification and interpretation of heritage resources. The GNWT has been engaging with affected parties and Consultation has recently been initiated with Indigenous Governments and Indigenous Organizations and will continue throughout the life of the Project. The information shared to date on this Project and previous projects will result in more informed archaeological practice. For instance, site interpretation and identification information included in the Northwest Territories Archaeological Sites Data Base has provided the basis for an initial estimate of TLRU sites within the Heritage Resources TDR (Appendix 22A; K'alo-Stantec, 2022).

It is expected that additional Consultation and engagement will occur relative to completion of an AIA for the Project. Possible activities include providing opportunities for input from Indigenous Governments and Indigenous Organizations to guide selection of field assessment target areas, inclusion of Indigenous knowledge holders and/or community members on field crews, and presentation of the results of the assessment to Indigenous Governments and Indigenous Organizations to provide guidance for site interpretation and mitigation. These opportunities will facilitate integration of Traditional Knowledge relative to the concerns addressed relative to burial sites, trails, historic cabins and campsites, historical sites, and spiritual and sacred sites.

Regulatory engagement was initiated early in the Project's conceptual development. Recent engagement with the Culture and Heritage Division, Department of Education, Culture, and Employment (ECE) includes the review of the two desktop Archaeological Overview Assessments (AOAs) as well as liaison relative to the 2021 AIA of select borrow and quarry sources. Given the approval of the two AOAs by the territorial Assessment Archaeologist, these results will form the basis for additional field assessments (i.e., AIAs) to occur once the Project's footprint becomes more certain during detailed design, and prior to construction.

Table 22.1 Summary of Engagement Feedback

Comment	Source	GNWT Response	Where Addressed
Engaged Indigenous Governments, Indigenous Organizations and specific other affected parties identified cultural and heritage use sites and areas.	Dessau, 2012 (PR#13); EBA, 2006; 5658 NWT Ltd. and GNWT, 2011 (PR#16); Golder, 2015; IMG-Golder Corporation, 2006; GNWT, 2018; NWRRC, 2023; SHPSJWG, 2000; SLUPB, 2023; TRRC, 2022	The GNWT has reviewed and considered the cultural and heritage use sites and areas identified by Indigenous Governments, Indigenous Organizations and specific other affected parties.	For information about cultural and heritage use sites and areas, see Section 22.2.2.1. See also Section 11.2.5 for additional information about cultural and heritage use sites and areas.
The Project has potential to affect previously recorded trails and travelways and navigability identified by Pehdzéh Kį First Nation and Sahtu Dene and Métis.	IMG-Golder, 2006; Dehcho First Nations, 2011; NWRRC, 2023; TRRC, 2022	The GNWT has identified mitigation measures to reduce the effects of the Project on heritage resources. A Heritage and Sites Protection Plan (HSPP) will be developed and implemented. The GNWT is committed to ongoing engagement with Indigenous Governments, Indigenous Organizations, and other affected parties during advancement of project design and planning.	For mitigation measures to reduce effects of the Project on heritage resources, see Table 22.5 See also: Section 22.4.2 Loss of Site Contents and Contexts Volume 5 for management plans.
Community engagement participants stated that there are burials sites, trails, historic cabins and campsites, historical sites, and spiritual and sacred sites located in the RAA. Participants expressed concern that they will be disturbed by the Project and noted that many of the areas are still in use.	August 2021 Engagement; April to July 2022 Engagement; November to December 2022 Engagement; November 2022 to February 2023 Engagement		
Community engagement participants requested that an archaeological monitoring plan be put in place for the Project.	November to December 2022 Engagement		

22.1.3 Potential Effects, Pathways and Measurable Parameters

Table 22.2 summarizes the potential effects of project activities on heritage resources and the pathways by which these activities may affect heritage resources. From a scientific perspective, heritage resources are evaluated largely based on site contents (e.g., material culture/artifacts; features such as hearths, pits, and trails; structures such as buildings) and the spatial relationship of material culture components to one another, to their environment, and to the landscape. These site contents and contexts can be affected by project activities that result in surface and/or subsurface effects. The Heritage Resources VC does not have a clear and defined parameters that can be applied to measure project effects because there is no measurable count of heritage resources (e.g., archaeological sites) that are contained within the assessment areas (defined in Section 22.1.4.1). Individual sites are of variable heritage value and each must be assessed individually to determine effects, rather than assessing effects on the comprehensive VC.

Table 22.2 Potential Effects, Effects Pathways and Measurable Parameters for Heritage Resources

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Loss of site contents and contexts	Direct loss or alteration of archaeological sites due to surface and subsurface disturbance	Not applicable

22.1.4 Boundaries

Spatial and temporal boundaries for the effects assessment are described in the sections that follow.

22.1.4.1 Spatial Boundaries

Three basic assessment areas are used to assess project effects on Heritage Resources and to provide a broader context. These are the Project Development Area (PDA), Location Assessment Area (LAA), and Regional Assessment Area (RAA). The TDR (Appendix 22A; K'alo-Stantec, 2022) also uses the Project Area to quantify known sites and areas of archaeological site potential, to allow for footprint changes as the Project design progresses. Accordingly, the Project Area is also defined. The preliminary highway alignment, LAA, and RAA are illustrated in Figure 22.1, relative to known archaeological sites on record with the Culture and Heritage Division, ECE.

- **Project Development Area (PDA):** the area of direct project disturbance within which physical works and activities will occur (footprint). This includes a new two-lane gravel highway, 60 metres (m) wide highway right-of-way (ROW), laydown and staging areas, maintenance yards, construction camps, and quarry/borrow sources with access roads on a 30 m ROW. Following completion of design, the evaluation of the effects of the Project on Heritage Resources can be completed on the PDA only.

- **Project Area:** This is the area to be used by the Project and includes the preliminary highway alignment route with a 100 m buffer on either side, as well as the temporary and permanent quarry and borrow sources with associated access roads. A wider area is applied to allow for footprint changes as project design progresses. Archaeological site locations recorded in the territorial database prior to the use of handheld global positioning system (GPS) units may be inaccurate, while site centrepoints provided within the database do not accurately reflect larger site areas. The wider study area provides a more inclusive sample of sites that may intersect with the Project.
- **Local Assessment Area (LAA):** This is the area within which project-related effects are expected to occur. This is the area within approximately 1 km of the PDA.
- **Regional Assessment Area (RAA):** This is the area within approximately 5 km of the PDA, intended to provide greater contextual information given that there are relatively few heritage resources recorded within the overall region. It is the same as the Regional Study Area (RSA) used to characterize existing heritage resources in K'alo-Stantec (2022); see Section 22.2.

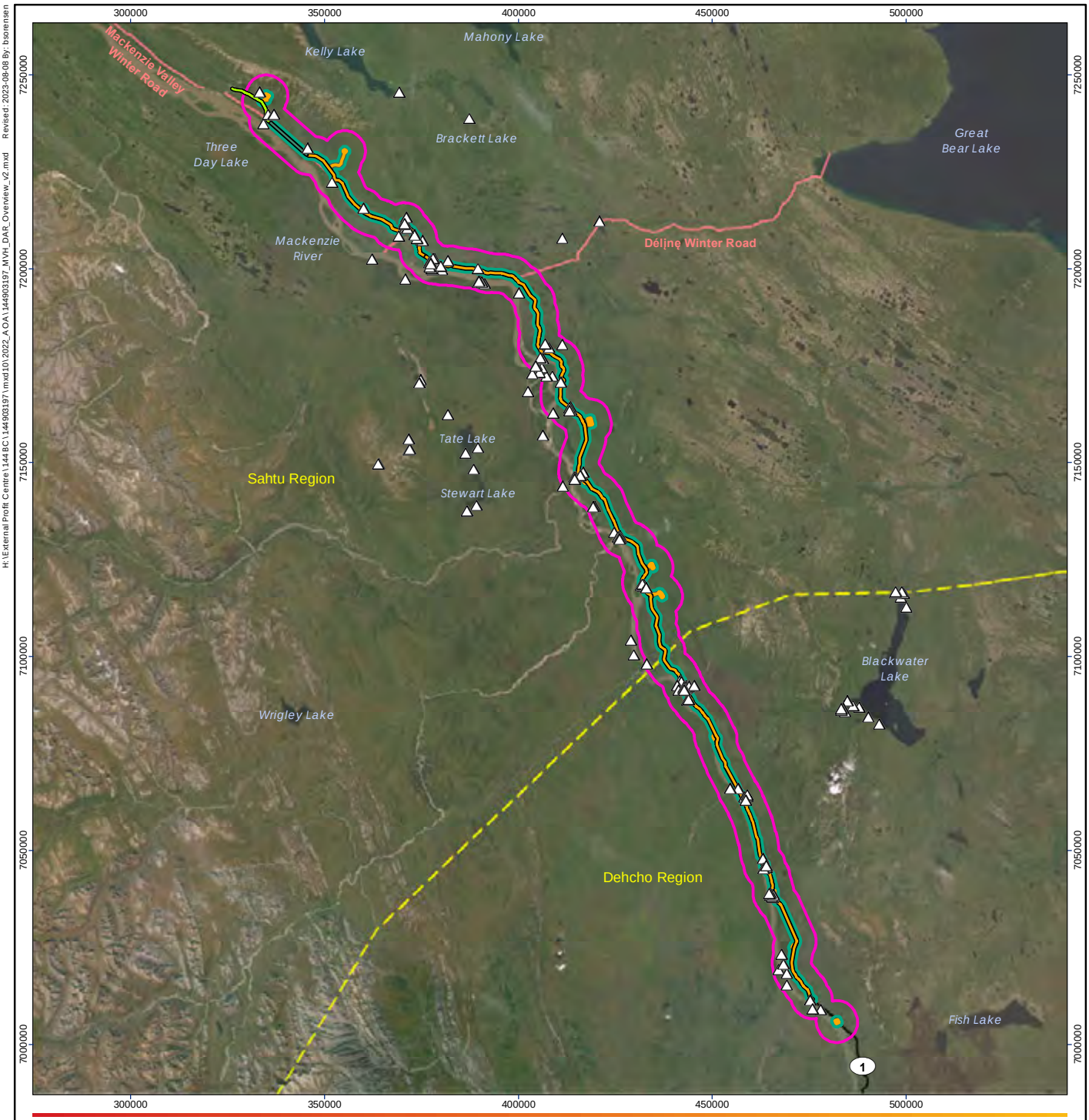
22.1.4.2 Temporal Boundaries

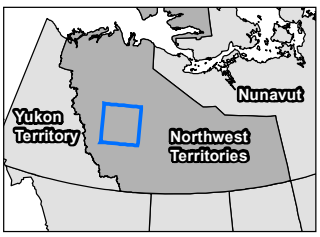
The potential effects of the Project on heritage resources are assessed relative to the following phases:

- **Construction Phase:** The Project will take approximately 10 years to construct, over a timeframe of up to 20 years. The schedule used for this assessment is conceptual and reflects a phased approach to construction, such that the Project is not likely to be constructed as a single, continuous project. The conceptual schedule assumes the highway will be constructed in three segments: Wrigley north to the Dehcho/Sahtu border (102 km); Tulita south to the Dehcho/Sahtu border (134 km); and Tulita north to the Prohibition Creek Access Road (45 km).
- **Operations and maintenance phase:** The operations and maintenance phase of the Project will likely commence in a similarly staged approach once construction of a particular segment has been completed. The operations and maintenance phase does not have an end date as the Project will not be decommissioned.

A closure and reclamation phase is not applicable to the Project. Closure and reclamation of temporary workspaces, and borrow sources and quarries used only for construction are included within the construction phase.

Primary effects on heritage resources will occur during the construction phase. Assessments and mitigation must be completed prior to (e.g., AIA) or during (e.g., chance find protocol) construction of the Project to receive regulatory approval.





- Archaeological Site
- Proposed Mackenzie Valley Highway Project
- Canyon Creek All Season Access Road (Constructed)
- Prohibition Creek Access Road (In Construction)
- Local Assessment Area
- Regional Assessment Area
- Northwest Territories Highway
- Winter Road
- Region Boundary

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: Centre for Geomatics Government of the Northwest Territories, Government of Canada, Stantec
3. Background: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community. Imagery date 2021.
4. Archaeological Site Data provided by the Prince of Wales Northern Heritage Centre; (c) Government of the Northwest Territories, Education, Culture, and Employment

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N

Kálo·Stantec

Project Location
Wrigley to Norman Wells, NWT

144903197
Prepared by BSorensen on 2022-12-20
Revised by BSorensen on 2023-08-08

Client/Project
Client: Government of the Northwest Territories
Mackenzie Valley Highway Project

Figure No.
22.1

Title
Heritage Resources Assessment Areas and Recorded Sites

22.1.5 Residual Effects Characterization

Surface disturbance, such as vegetation removal and vehicle traffic, has potential effects on surface and/or near-surface archaeological sites. Subsurface disturbance during activities such as stripping, grading, and excavation has potential to affect archaeological sites. The potential effects on heritage resources include the loss of site contents and contexts. Heritage resources may be of significance not only from a scientific, archaeological perspective but from the perspective of local and Indigenous Governments and Indigenous Organizations, because they are tangible reflections of TLRU.

Heritage resources are spatially fixed and defined, non-renewable resources. Site-specific effects are regulated at the territorial level. Project-specific effects on heritage resources are continually mitigated to the standards established by territorial regulators. In this context, after implementation of the required mitigation measures issued by the regulatory agency, there are no residual effects from a scientific perspective. Consulting with Indigenous Governments and Indigenous Organizations and engaging with affected parties can provide site-specific mitigation measures. After implementation of these mitigation measures as provided by Indigenous Governments, Indigenous Organizations, and specific other affected parties such as renewable resources councils, there should be no residual effects from the Project on heritage resources from the perspective of Indigenous Governments and Indigenous Organizations. As a result, there is no further characterization of residual effects on this VC.

22.1.6 Significance Definition

There are no formal thresholds for determining heritage value of heritage resources as a single, comprehensive VC. Effects on these resources must be approved by the territorial regulatory agency and/or Minister (Department of Education, Culture and Employment, Culture and Heritage Division).

While site-specific recommendations for project approval and/or additional work are formulated by a Senior Archaeologist and presented in AOA and/or AIA reports submitted to the territorial regulators at GNWT-ECE, the final requirements are stipulated based on regulatory review.

Heritage values as outlined in the permit reports are considered on a site-by-site basis, but there are no guidelines or standards for loss as defined for the VC as a single entity. Mitigation requirements and/or project approvals are determined by the territorial heritage regulators based primarily on individual site integrity and perceived scientific value based on data collected during an AIA. Concerns raised during Consultation or engagement have the potential to influence or alter the final dispensation of individual sites within this VC.

22.2 Existing Conditions for Heritage Resources

This section includes a brief overview of the existing conditions for heritage resources, including information on known sites on record with ECE and areas of archaeological site potential. Greater detail on existing conditions is provided in the Heritage Resources TDR (Appendix 22A; K'alo-Stantec, 2022).

22.2.1 Methods

Information on known sites on record was requested from the Culture and Heritage Division at the PWNHC through an Archaeological Sites Data Base Access Request. This information was updated through a site data licence acquired in May 2022. This request was submitted for the RSA as outlined in the Heritage Resources TDR (Appendix 22A; K'alo-Stantec, 2022).

Portions of the LAA and Project Area have been subject to previous AOAs and AIAs; these reports (with associated GIS data, site forms, and field notes) were accessed, where available.

Palaeontological resources are not protected under territorial legislation. Palaeontological locations are identified when recorded within the territorial Archaeological Sites Database.

Where available, TLRU information is integrated; many of the archaeological sites on record reflect relatively recent ("contemporary") and historic local community use. The archaeological site information provided through the Culture and Heritage Division is reviewed relative to community use. Sites which definitively or possibly reflect TLRU were identified.

Areas of archaeological potential were reviewed primarily through two recent AOAs. The first is an AOA of MVWR upgrades from Prohibition Creek to Mount Gaudet (Krahulic, 2020). The second is an AOA of 39 proposed granular and bedrock sources along the project alignment (Peach, 2021). These two AOAs involved review of previous AOAs (where available), AIAs, and associated spatial data, field notes, maps, and site forms. These AOAs form the basis of the current assessment because they represent recent and comprehensive desktop assessments of the project highway corridor. Based on the results of the AOAs, the GNWT has initiated AIAs in high potential areas such as borrow and quarry sources. The reports of these AIAs are not yet approved by the regulator at the time of submission of the DAR.

Baseline data is summarized in the Heritage Resources TDR (Appendix 22A; K'alo-Stantec, 2022).

22.2.2 Overview

The Mackenzie Valley corridor has been subject to archaeological desktop studies (AOAs) as well as field assessments (AIAs) since the early 1970s. Each of these studies has addressed slightly different footprints related primarily to proposed roadway expansions, the Mackenzie Gas Project and, more recently, the Mackenzie Valley Fibre Link. These AIAs have resulted in the identification of archaeological sites and other heritage resources and have contributed to the evaluation of archaeological site potential. The recent AOAs (Krahulic, 2020; Peach, 2021) have incorporated the results of these AIAs to identify data gaps between the Project and previous field assessments and in the evaluation of resource potential within these unassessed areas.

Evaluations of archaeological site potential were based largely on landscape attributes drawn from National Topographic System (NTS) maps, satellite imagery, and Arctic Digital Elevation Model (DEM) data. Areas of existing anthropogenic disturbance were used in the evaluation of archaeological site potential given the importance of site integrity as a key attribute in evaluating heritage value of a site and therefore assessing the likelihood of effects on sites of high heritage value.

A total of 133 sites are currently on record with the Culture and Heritage Division within the RSA. Sites can range in size from a point (e.g., one isolated artifact) to a large campsite, village, trading post, or trail. This range in site size and in the differing accuracy of locational data due to decades of site records means that the likelihood of spatial overlap between a resource and the Project is approximate. As a result, potential project effects on known heritage resources must be considered with caution.

Of the 133 sites within the RAA, 50 of these lie within the Local Study Area (LAA; see Appendix 22A; K'alo-Stantec, 2022) and 13 fall within the PDA. Until a final footprint/PDA has been defined, the likelihood of effects on the majority of these recorded sites is unknown.

Of these 133 sites within the RSA, 63 may reflect TLRU based on the available site descriptions. Five of these sites are recorded as consisting of or including graves/burials.

Areas of particular site density are at the confluences of the Mackenzie River (Deh Cho) and Ochre River, White Sand Creek, Dam Creek, Blackwater River, Steep Creek, Saline River, Little Smith Creek, Big Smith Creek, and Great Bear River.

A total of 33 areas of high archaeological site potential have been identified within the 2020 AOA footprint (Krahulic, 2020). Nine areas of high archaeological site potential have been identified within the 2021 AOA footprint for borrows, quarries, and associated access within the Project Area. Additionally, previously unknown sites may be recorded in these areas of high archaeological site potential during the AIA field assessment. Previously unknown sites may be encountered during project construction.

22.2.2.1 Cultural and Heritage Use Sites and Areas Identified by Indigenous Governments, Indigenous Organizations, and Other Affected Parties

Cultural and Heritage use sites and areas were identified through a review of publicly available literature and project-specific TLRU studies by the Norman Wells Renewable Resources Council (NWRRC) and Tulita Renewable Resources Council (TRRC), and during engagement feedback provided by Indigenous Governments, Indigenous Organizations, and specific other affected parties. They are described in Table 22.3. For further details, including a figure mapping traditional trails and travelways, spiritual, heritage, and habitation sites, and other cultural sites and areas within the TLRU LAA and TLRU RAA see Chapter 11 (Figure 11.7).

Table 22.3 Cultural and Heritage Use Sites and Areas Identified by Indigenous Governments, Indigenous Organizations, and Other Affected Parties

Location	Within TLRU LAA	Within TLRU RAA[5]	Identified By
Spiritual and Cultural Use Sites and Areas			
Bear Rock (Petınıʔah)	✓*	-	Sahtu Region; Sahtu Dene and Métis; TRRC; NWRRC
Mackenzie River (Deh Cho)	✓*	-	Pehdzéh Kı̨ First Nation; Dehcho First Nations
Pehdzéh Kı̨ N'deh area[1]	✓*	-	Pehdzéh Kı̨ First Nation; Dehcho First Nations
Blackwater River (between MVWR kilometre marker [KM] 783 and 785)	✓*	-	Pehdzéh Kı̨ First Nation; Dehcho First Nations
Tulita	✓*	-	Sahtu; Shúhta Got'ı̨nę
Blackwater Creek	✓*	-	Dehcho First Nations; Pehdzéh Kı̨ First Nation
Great Bear River Watershed	✓	✓	Sahtu Dene and Métis; TRRC
Great Bear River Bridge (area)	✓	-	Sahtu Dene and Métis
Mount Gaudet (in Pehdzéh Kı̨́Ndeh)	-	✓	Pehdzéh Kı̨́First Nation
Heritage Resources			
Mackenzie River (Deh Cho)	✓*	-	Sahtu Region knowledge holders and land users; Pehdzéh Kı̨ First Nation; Dehcho First Nations
Blackwater River	✓*	-	Pehdzéh Kı̨ Fist Nations; Dehcho First Nations
Pehdzéh Kı̨ N'deh area[2]	✓*	✓	Pehdzéh Kı̨ First Nation; Dehcho First Nations

Location	Within TLRU LAA	Within TLRU RAA[5]	Identified By
Ochre River	✓	-	Pehdzéh Kį First Nation; Dehcho First Nations
Hodgson Creek (Near Wrigley)	✓*	-	Pehdzéh Kį First Nation
Prohibition Creek	✓	-	Sahtu Dene and Métis
Great Bear River	✓	-	Sahtu Dene and Métis
White Sand Creek	-	✓	Pehdzéh Kį First Nation; Dehcho First Nations
Vermilion Creek	✓	✓	Pehdzéh Kį First Nation; Dehcho First Nations
Steep Creek	✓	-	Sahtu Region knowledge holders and land users (SRRB)
Saline River	✓	-	Sahtu Region knowledge holders and land users (SRRB)
Little Smith Creek	-	✓	Sahtu Region knowledge holders and land users (SRRB)
Archaeological Site behind Bear Rock (Petınıɀah)	✓		NWRRC
Habitation Sites			
Pehdzéh Kį N'deh area[3]	✓*	-	Pehzdeh Ki First Nation; Dehcho First Nations
Great Bear River (around Bear Rock [Petınıɀah])	✓	-	Elders in the K'ásho Got'ıne and Tuilita regions; TRRC; NWRRC
Proposed Great Bear River Bridge (area) (camping)	✓*	✓	TRRC
Mackenzie River (Deh Cho)	✓	-	Sahtu Dene and Métis; Pehdzéh Kį First Nation; Dehcho First Nations
Blackwater River	-	✓	Pehdzéh Kį First Nation; Dehcho First Nations
Ochre River	-	✓	Pehdzéh Kį First Nation; Dehcho First Nations
Four Mile Creek (camping area)	✓*	-	TRRC
Tulita	✓*	-	TRRC
Cabins in Tulita (along the MVWR)[4]	✓*	-	TRRC
White Sand Creek	✓*	-	Pehdzéh Kį First Nation; Dehcho First Nations
Dam Creek	-	✓	Pehdzéh Kį First Nation; Dehcho First Nations

Location	Within TLRU LAA	Within TLRU RAA[5]	Identified By
Wrigley	✓	-	Pehdzéh Kį First Nation
Cabin along the Project KM 772 to 774	✓*	-	Project-specific engagement program
Cabins (Locations confidential)	✓	-	Project-specific engagement program
Bluefish Creek (fish camp area)	-	✓	NWRRC
Near Bluefish Creek (cabin)	-	✓	NWRRC
Canyon Creek (cabin)	-	✓	NWRRC
Prohibition Creek (cabin)	-	✓	NWRRC
Birch Creek (across from Twenty Mile Island) (cabin)	-	✓	NWRRC
Vermilion Creek (safety cabin/camping area)	✓	✓	NWRRC
Vermilion Creek (cabin)	-	✓	NWRRC
Twelve Mile Point (cabin)	-	✓	NWRRC

Notes:

* May occur within PDA

[1] Pehdzéh Kį N'deh area as described in Dessau (2012)

[2] Pehdzéh Kį N'deh area as described in Dessau (2012)

[3] Pehdzéh Kį N'deh area as described in Dessau (2012)

[4] Specific locations were not identified

[5] Occurs within the RAA outside the LAA and PDA

Sources: Dessau, 2012 (PR#13); EBA, 2006; Golder, 2015; IMG-Golder Corporation, 2006; GNWT, 2018; NWRRC, 2023; SHPSJWG, 2000; SLUPB, 2023; TRRC, 2022; project-specific engagement program (2021-2023)

Pehdzéh Kį First Nation identified spiritual sites in the Pehdzéh Kį N'deh area and a spiritual site associated with hunting moose in the Mackenzie Valley (south of Blackwater Creek) (Dessau, 2012 [PR#13]).

Pehdzéh Kį First Nation and Dehcho First Nations identified burial sites, which are located on both sides of the Mackenzie Valley Winter Road (MVWR) just north of Blackwater River and east of Mackenzie River (Deh Cho), hereafter referred to as Mackenzie River (between Mackenzie Valley Winter Roads KM 783 and 785) (Dessau, 2012 [PR#13]).

Bear Rock (Petınıɂah) is reported as one of the most sacred sites, associated with the story of Yamoria, for Sahtu Dene and Métis and has cultural value, and Sahtú Deh (Great Bear River watershed) in its entirety is considered an important heritage resource. (EBA, 2006; NWRRC, 2023, TRRC, 2022).

Pehdzéh Kį First Nation indicated that their traditional hunting grounds in the vicinity of White Sand Creek are located near concentrations of archaeological sites; historic camps, cabins, historic traps, historic trails, trading posts, and graves have been identified at the confluence of Hodgson Creek and Mackenzie River, as well as at Vermilion Creek South around Wrigley; and Pehdzéh Kį N'deh area, which contains the Old Wrigley town site, as well as burial sites and traditional travel routes near its western boundaries (Dessau, 2012 [PR#13]).

Pehdzéh Kį First Nation and Dehcho First Nations noted that there are historical cabins along Mackenzie River (north and south of Wrigley) accessible by land and water that are often used seasonally by local trappers (IMG-Golder Corporation, 2006).

Sahtu Dene and Métis reported that the Deh Cho (Mackenzie River) SMZ (Zone #63) includes archaeological and burial sites and Mackenzie River is a symbolic focal point of Sahtu Dene and Métis culture and history, containing important heritage harvest and subsistence use locations for Indigenous people in and outside of the Sahtu Region (SLUPB, 2023; 5658 NWT Ltd. and GNWT, 2011 [PR#16]).

Through the project-specific engagement program and in publicly available literature, participants identified Fish Lake[1] as a sacred burial site which should not be disturbed.

NWRRC study participants advised that there are no known archaeological sites in the TLRU study area; however, participants noted that old tools, such as flints, have been found along the river going into Fort Good Hope (NWRRC, 2023). NWRRC study participants noted that previous archaeological excavations occurred behind Bear Rock (Petınıʔah), but it is unknown if any artifacts or resources were recovered (NWRRC, 2023).

Pehdzéh Kį First Nation identified lookout towers: one is located in the northwest corner, one west of Fish Lake, and one on the east bank of the Mackenzie River north of Wrigley (IMG-Golder Corporation, 2006).

Cabins were identified through project-specific TLRU studies, including: along the MVWR (near Tulita), along the MVWR between KM 772 and 774, (near) Bluefish Creek, Canyon Creek, Prohibition Creek, Birch Creek (across from Twenty Mile Island), Vermilion Creek, Twelve Mile Point (NWRRC, 2023; TRRC, 2022). NWRRC study participants identified a safety cabin at Vermilion Creek (NWRRC, 2023).

Sahtu Dene and Métis have identified historic camps, cabins, graves, historic features; historic trails have been identified by Sahtu knowledge holders and land users along the terraces of Steep Creek, Saline River, Little Smith Creek, and various locations along the previous proposed highway route (5658 NWT Ltd. and GNWT, 2011 [PR#16]; IMG-Golder Corporation, 2006).

Study participants of the NWRRC and TRRC TLRU identified camping sites at Bluefish Creek, Vermilion Creek, Four Mile Creek, around Great Bear River (around Bear Rock [Petınıʔah]), and around the proposed Great Bear River Bridge (NWRRC, 2023; TRRC, 2022).

[1] Fish Lake is a common lake name and may refer to Trout Lake

Pehdzéh Kį First Nation in the Dehcho Region reported traditional travel routes near the Pehdzéh Kį N'deh area western boundary, and several cabins and traplines in the area around the lakes connecting Wrigley by traditional trails, several of which are found along the MVWR (Dessau, 2012 [PR#13]; IMG-Golder Corporation, 2006). Pehdzéh Kį First Nation and Dehcho First Nations indicated that historic trails have been identified at the confluence of Hodgson Creek and Mackenzie River, and trails are found around Vermilion Creek South and along Blackwater and Ochre rivers (Dessau, 2012 [PR#13]).

Participants of the TRRC study identified several trails, accessible from the community of Tulita and from Four Mile Creek, which lead to important harvesting, hunting, and other areas of interest to Tulita community members (TRRC, 2022). Participants of the NWRRC study reported that there is an old cutline connecting Kelly Lake to Bluefish Creek that is now used as skidoo trail; a dogsled trail head starts at Sucker Creek; a walking trail that connects Prohibition Creek to Canyon Creek; a trail that connects Bluefish Creek to Kelly Lake; an old trail connects Twenty Mile Island to Sucker Creek; and a trail around Windy Island, which connects the island to the mainland (used for harvesting sheep on Windy Island) (NWRRC, 2023).

Both TRRC and NWRRC study participants identified that the existing Norman Wells pipeline ROW is used as a skidoo trail and access trail for harvesting wildlife along the ROW, and that the MVWR is used for harvesting and hunting on a drive-by basis when wildlife are available (most often when travelling from Tulita to Norman Wells) during the winter or when the MVWR is open (NWRRC, 2023; TRRC, 2022). Sahtu Dene have noted that the Sucker Lake/Three Day Lake (DehdéleĮǫ Tué) area is the location of traditional trails to the mountains and traditional trails are present at Petiniʔah (Bear Rock) CZ (Zone #32). Great Bear River has been the most well-used travel route to Great Bear Lake and is part of many traditional stories and place names. (Dessau, 2012 [PR#13]; IMG-Golder Corporation, 2006; TRRC, 2022; NWRRC, 2023; Golder, 2015).

Pehdzéh Kį First Nation previously stated that, given the importance of traditional practices in the areas surrounding the Project, the cultural value of these areas may be affected, resulting in a diminished historical and social identity for the community, which maintains right and title within their asserted traditional territory (IMG-Golder Corporation, 2006).

22.3 Project Interactions with Heritage Resources

Potential interactions between project activities and heritage resources are identified by a check mark in Table 22.4. These potential interactions are discussed in Section 22.4, in the context of effects pathways as well as standard and project-specific mitigation. Heritage Resources are non-renewable resources which are immoveable and spatially defined. Activities that result in surface and/or subsurface disturbance, such as those involving clearing, excavation, or blasting have the potential to affect known and/or potential heritage resources through the loss of site contents and/or site contexts. These effects will occur during the construction phase. They are not limited or defined by season of activity.

Table 22.4 Project-Environment Interactions with Heritage Resources*

Physical Activities	Timing	Environmental Effect
		Loss of site contents and contexts
Construction Phase		
Mobilization of equipment, materials, and fuel, resupply, and demobilization	Summer and winter	–
Establishment and operation of camps	Year-round	✓
Site preparation of ROW, access, and workspaces	Winter	✓
Borrow source and quarry development and operations, including blasting, crushing, sorting, and stockpiling	Year-round	✓
Material haul	Year-round	–
Embankment and quarry access road construction, including road cuts	Winter; road cuts in summer or winter	✓
Culvert installations	Summer or winter	✓
Road base placement, compaction, and surfacing	Summer	✓
Water withdrawal to support construction activities	Year-round	–
Closure and reclamation of MVWR and temporary borrow sources/quarries, camps, and workspaces	Summer	✓
Employment and contracted goods and services[1]	Year-round	–
Operations and Maintenance Phase		
Borrow source and quarry operations, including blasting, crushing, sorting, and stockpiling	Summer	–
Material haul and stockpiling	Summer	–
Operation of, and activities at, maintenance yards	Year-round	–
Water withdrawal for dust control	Summer	✓
Employment and contracted goods and services[1]	Year-round	–
Presence and public use of the highway	Year-round	–
Highway and access road maintenance including snow clearing, repair, grading, dust control	Year-round	-
Vegetation control	Summer	-
Bridge and culvert maintenance	As needed	-

Notes:

✓ = Potential interaction

– = No interaction

[1] Project employment and expenditures are generated by most project activities and components and are the main drivers of many socio-economic effects. Rather than acknowledging this by placing a check mark against each of these activities, "Employment and contracted goods and services" have been introduced as an additional component under each project phase.

22.4 Assessment of Residual Effects on Heritage Resources

Based on potential project interactions with the environment identified in Table 22.4, the Project may affect heritage resources. Potential effects, effect pathways, and mitigation measures that will reduce or eliminate the effects on heritage resources are identified in Table 22.5.

As discussed in Section 22.1.5, with implementation of mitigation measures issued by the regulatory agency, there are no residual effects from a scientific perspective. After implementation of these and other mitigation measures as may be provided by Indigenous Governments, Indigenous Organizations, and other affected parties, there should be no residual effects from the Project on heritage resources from the perspective of Indigenous Governments, Indigenous Organizations, and other affected parties.

Table 22.5 Potential Effects and Mitigation Measures for Heritage Resources

Effect Name	Effect Pathway	Mitigation Measures
Loss of site contents and contexts	Surface and subsurface ground disturbance can affect archaeological sites, artifacts, and features.	The GNWT will submit project information to GNWT-ECE as required by regulation
		The GNWT will complete and comply with requirements as issued by GNWT-ECE for mitigating effects on heritage resources
		The GNWT will develop a Heritage and Sites Protection Plan.
		The area of direct ground disturbance will be limited by following the pre-existing Mackenzie Valley Winter Road (MVWR) road alignment to the extent possible.
		The highway route will be aligned to existing MVWR watercourse crossing structures (bridges and bridge-sized culverts) to reduce new disturbance in and near watercourses.
		The GNWT will investigate and/or mitigate 'known and suspected sites' as identified by Indigenous Governments and Indigenous Organizations during Consultation, affected parties during engagement, and/or through TLRU studies.
		In areas designated in the Sahtu Land Use Plan, land use activities will not be located within 500 m of known or suspected burial sites, or within 150 m of known or suspected archaeological sites, unless measures are developed in cooperation with the Prince of Wales Northern Heritage Centre, affected communities, or in the case of burial sites, with affected families where possible, to fully mitigate all impacts to the site.
		The GNWT will develop and maintain compliance with a chance find protocol (including worker education) for cultural materials and sites identified during construction.

22.4.1 Analytical Assessment Techniques

Heritage value is assessed individually for each site rather than for the single, comprehensive VC. The relative interpretive potential of a heritage resource must be determined to understand the ways in which it will affect the Project and to formulate the mitigation measures that will be used to resolve or reduce any project conflicts. Site content and context are applied as indicators of interpretive capacity and each site is evaluated in a pre-effect setting from the perspective of scientific value. Community value will also contribute to the evaluation of a heritage resource.

The basic attributes of scientific value are the capacity of an archaeological site to contribute to the current understanding of cultural or natural history and development and its potential to address current research problems within the discipline. Scientific value can be applied to precontact, historic, or palaeontological concerns. Although site integrity is the primary indicator of scientific value, several other factors are also considered. Scientific value is the primary method for assessing interpretive potential at most historic resource sites.

22.4.2 Loss of Site Contents and Contexts

Anticipated loss of site contents and contexts was determined through the consideration of project activities and the likelihood of each activity to result in surface or subsurface disturbance. These activities have the potential to affect known and as yet unidentified heritage resources. There are known heritage resources within the PDA, Project Area, and LAA; there are also areas of evaluated high site potential. There are no formal thresholds for determining heritage value of archaeological resources as a single, comprehensive VC; heritage value from a scientific/regulatory perspective and from an Indigenous/TLRU perspective has not yet been incorporated into the assessment. This will be included on an ongoing basis as the Project progresses, as territorial regulatory requirements are issued and fulfilled, Consultation with Indigenous Governments and Indigenous Organizations occurs, and engagement activities with affected parties occur.

22.4.2.1 Effects Pathways

Surface disturbance, such as vegetation removal and off-road travel, have potential to affect surface and/or near-surface archaeological sites. Subsurface disturbance during activities such as stripping, grading, blasting and excavation have potential to affect subsurface archaeological sites.

22.4.2.2 Mitigation

Mitigation measures relative to the Project include the submission of the TDR (K'alo-Stantec, 2022) and Developer's Assessment Report (DAR) to the Culture and Heritage Division, ECE. It is expected that the Territorial regulators for Heritage Resources will review the project information and issue requirements intended to initiate a staged process of mitigating project effects. These requirements are expected to include completion of:

- An AOA to identify assessment gaps relative to a final footprint/PDA
- An AIA prior to construction in areas with known or suspected high archaeological potential

Fulfilling these requirements will contribute to the mitigation of project effects. Additional requirements may be issued by the Territorial regulators for heritage resources identified during the AIA completion. These requirements may include avoidance of sites through project redesign or fencing/protection during construction, archaeological mitigative excavation, controlled surface collection of cultural materials, historic structure recording, archival/documentary research, construction monitoring, or other mitigative approaches. Similar requirements of 'known and suspected sites' as identified by Indigenous Governments and Indigenous Organizations during Consultation, affected parties during engagement, and/or through TLRU studies will also serve to mitigate project effects.

Mitigation measures will be developed in cooperation between the ECE regulators, Indigenous Governments and Indigenous Organizations, and/or families (in the case of known or suspected burials) to fully mitigate effects on known and/or suspected burials and sites, as per the SLUP conformity requirements. Preferred measures are avoidance of effect, with buffers of 500 m for burial sites and 150 m for archaeological sites. The final mitigation measure is the development and application of a chance find protocol for cultural materials, features, and sites during project construction. A workers' education program can be developed to further the objectives of the chance find protocol. Chance finds may result in additional requirements issued by the territorial regulators.

22.4.2.3 Residual Effects

Site-specific recommendations are typically formulated by a Senior Archaeologist and presented in AOA/AIA reports submitted to the territorial regulators; final requirements are stipulated based on regulatory review, as described. These agencies issue project approvals under territorial legislation. As such, Project-specific effects on heritage resources are continually mitigated to the standards established by the territorial regulators. In this context, after implementation of the required mitigation measures issued by the regulatory agency, there is no residual effect from the Project on heritage resources from a scientific perspective. Engagement activities with affected parties and Consultation with Indigenous Governments and Indigenous Organizations can, however, provide suggested site-specific mitigation measures. Assuming implementation of these mitigation measures as provided by Indigenous Governments, Indigenous Organizations, and other affected parties, there should be no residual effects from the Project on heritage resources from the perspective of Indigenous Governments, Indigenous Organizations, and other affected parties.

With the implementation of the mitigation measures, the Project is anticipated to meet the SLUP conformity requirements related to archaeological sites and burial sites, and consideration of engagement and Consultation input and incorporation of Traditional Knowledge. The design of the Project and mitigation measures for protection of heritage resources will protect the archaeological sites and burial sites of the Petiniɂah (Bear Rock) CZ, Mio Lake CZ, Norman Range SMZ, K'ąąlǫ Tué (Willow Lake Wetlands) SMZ and Deh Cho (Mackenzie River) SMZ.

22.5 Determination of Significance

22.5.1 Significance of Residual Effects

If all requirements issued by the territorial regulators and via the SLUP are fulfilled prior to project construction, the territorial government considers there to be no significant residual effects for heritage resources. Requirements may include additional desktop and field assessments (AOAs, AIAs), mitigation, and Consultation with Indigenous Governments and Indigenous Organizations, continued engagement opportunities, as well as development and implementation of a chance find protocol.

22.5.2 Significance of Cumulative Effects

If all requirements issued by the territorial regulators and via the SLUP are fulfilled prior to project construction, the territorial government considered there to be no significant cumulative effects for Heritage Resources.

22.6 Prediction Confidence

Provided that regulatory requirements issued by territorial regulators for the Project have been fulfilled and approval is obtained under territorial heritage legislation, confidence in the VC assessment is ranked as high.

22.6.1 Assumptions

The key assumption is that the current regulatory environment (legislation, systems and processes, mitigative options) will continue throughout the life of the Project construction.

22.6.2 Gaps and Uncertainties

The key gap reflects the nature of the heritage resources database, which is incomplete as the majority of heritage resources are unknown. Once a final PDA is defined, it is expected that an AIA will be completed to fulfil requirements of the Culture and Heritage Division of ECE relative to the Project. Completion of the AIA and any subsequently issued regulatory requirements to mitigate project effects (e.g., archaeological excavation, controlled surface collection of artifacts, detailed mapping/recording of historical structures, documentary/archival research) will provide additional information and fill some gaps within the project-specific heritage resources database. Archaeological assessment is always limited to a sample of the overall PDA, however, and it is not possible to identify every resource within the PDA.

Uncertainties include the effects of the gaps and assumptions, as well as additional TLRU information. These uncertainties will be resolved during the application of identified mitigation measures.

22.7 Follow-up and Monitoring

There are no commitments for follow-up or monitoring relative to Heritage Resources at this time. However, early engagement with Indigenous Governments, Indigenous Organizations, and other affected parties has resulted in a recommendation for a monitoring program. Without additional detail, the nature of the monitoring program—whether during the construction or operations and maintenance phases or both—is unknown. Further engagement as well as Consultation with Indigenous Governments and Indigenous Organizations is recommended to consider and develop a monitoring program. Territorial heritage regulators at ECE may also require a monitoring program; this will not be known until regulatory review of the AIA final permit report has been completed and a response issued.

22.8 References

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APPENDIX 12A

Air Quality, Greenhouse Gas Emissions and Climate Baseline Technical Data Report

Mackenzie Valley Highway Project
Technical Data Report—Air Quality, Greenhouse Gas Emissions and Climate Baseline

Prepared for:

Government of the Northwest Territories

Prepared by:

K'alo-Stantec Limited

December 2022

Project No.: 144903025

K'alo-Stantec

Limitations and Sign-off

This document entitled Mackenzie Valley Highway Project Technical Data Report—Air Quality, Greenhouse Gas Emissions and Climate Baseline was prepared by K'alo-Stantec Limited ("K'alo-Stantec") for the account of Government of the Northwest Territories (the "Client") to support the regulatory review process for its Developer's Assessment Report (DAR) (the "Application") for the Mackenzie Valley Highway Project (the "Project"). In connection therewith, this document may be reviewed and used by the Department of Infrastructure (INF) for the Government of the Northwest Territories participating in the review process in the normal course of its duties. Except as set forth in the previous sentence, any reliance on this document by any other party or use of it for any other purpose is strictly prohibited. The material in it reflects K'alo-Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between K'alo-Stantec and the Client. The information and conclusions in the document are based on the conditions existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, K'alo-Stantec did not verify information supplied to it by the Client or others, unless expressly stated otherwise in the document. Any use that another party makes of this document is the responsibility and risk of such party. Such party agrees that K'alo-Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other party as a result of decisions made or actions taken based on this document.

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Executive Summary

The Government of the Northwest Territories (GNWT) Department of Infrastructure (INF) is proposing the Mackenzie Valley Highway Project (the "Project") that extends the Mackenzie Highway (Northwest Territories Highway #1) from Wrigley to Norman Wells. The Project includes construction of approximately 281 kilometres (km) of new all-season highway and the construction and operation of temporary and permanent quarry and borrow sources. The project highway alignment will pass through the Dehcho Region and a portion of the Tulita District of the Sahtu Region within the Northwest Territories (NT).

This technical data report presents detailed data and analysis for baseline ambient air quality, greenhouse gas (GHG) emissions, and existing and forecasted climate conditions in the study area. The report includes results from traditional knowledge and traditional use studies that have been completed in the Sahtu Region and the Dehcho Region in the last two decades.

Existing criteria air contaminants (CAC) emissions for NT originate from a variety of sources, including human and natural. Criteria Air Contaminant emissions are reported annually by industries for all of Canada as part of the National Pollutant Release Inventory. There are no major industrial sources of air contaminants near the Project.

All measured air contaminants (except the particulate matter (PM_{10}) concentrations) are below the applicable Northwest Territories Ambient Air Quality Standards (NWT AAQS) or the Canadian Ambient Air Quality Standards (CAAQS). Particulate matter sources near the Norman Wells station include forest fire smoke as well as dust/sand from gravel and sand roads, which are exposed after being snow covered during the winter months. There may also be local sources that have contributed in 2019.

When baseline CAC concentrations are compared against the four color-coded management levels of the federal Air Quality Management System (AQMS), all CACs concentrations fall into the green category (lowest concentration of air pollutants, requiring the lowest level of air quality management) with the exception of the maximum 24-hour average and annual average of $PM_{2.5}$ concentrations and the maximum 98th percentile of the daily one-hour average nitrogen dioxide (NO_2) concentration, which both fall into the yellow category (second lowest level of air quality management). The green and the yellow category both indicate that concentrations are well below the maximum levels.

Historical climate data from 1981-2010 was obtained from the Norman Wells station, near the northern end of the Project and the Fort Simpson station, located approximately 200 km southeast of the southern end of the Project (Wrigley, NT). The prevailing climate conditions include short warm summers and long, cold winters. Annual average temperatures range from -2.8 degree Celsius (°C) at Fort Simpson to -5.8°C at Norman Wells. Annual total precipitation values are low; most of the rain occurs during the summer months and peak snowfall occurs from October to December. Winds are usually light, below 3 metres per second at both locations. The prevailing wind directions at Norman Wells are from the west and east. At Fort Simpson, the dominant wind directions are north, northwest, and southeast. Visibility at both locations is usually greater than 9 km for most times of the year. Low visibility (i.e., less than 1 km), if it occurs, occurs mostly during the fall months.

Climate in the NT has and is expected to continue to change due to global warming induced by anthropogenic activities emitting GHGs. This change in climate is anticipated to occur more rapidly for northern countries than for the rest of the continental climate in North America. Canada overall is warming twice as fast as the rest of the world, on average; however, the north of Canada has been warming at a rate three times the global average (Government of Canada, 2019). Climate prediction data under the highest GHG emissions scenario (representative concentration pathway (RCP) 8.5) indicate that the trends measured from the last two decades are going to continue. By 2100, the annual average temperature at Norman Wells is forecasted to increase to 1.3°C and total precipitation is predicted to increase by 28% when compared to the average total precipitation measured during 1951-1980.

The climate is changing with increasing global GHG concentrations. The NT reported annual GHG emissions are considered small: they only account for 0.2% of the federal reported total. The largest source of GHG emissions in NT are from the energy sector (e.g., mining, commercial and institutional, domestic aviation, and road transportation).

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Abbreviations

%	percent
µg/m^3	micrograms per cubic metre
µm	micrometre
AQMS	Air Quality Management System
BC AAQO	British Columbia Ambient Air Quality Objectives
CAAQS	Canadian Ambient Air Quality Standards
CAC	criteria air contaminant
CCME	Canadian Council of Ministers of the Environment
cm	centimetre
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
D1HM	daily maximum 1-hour average concentrations
DAR	Developer's Assessment Report
ECCC	Environment and Climate Change Canada
GHG	greenhouse gas
GNWT	Government of the Northwest Territories
GNWT-ENR	Government of the Northwest Territories - Environment and Natural Resources
INF	Department of Infrastructure
km	kilometre
KM	kilometre marker
kPa	kilopascal
kt	kilotonne
LSA	Local Study Area
m	metre
m/s	metres per second
mm	millimetre
Mt	megatonne
MVH	Mackenzie Valley Highway

MVRMA ..... *Mackenzie Valley Resource Management Act*
MVWR ..... Mackenzie Valley Winter Road
NAPS ..... National Air Pollution Surveillance
NO ..... nitric oxide
NO_2 ..... nitrogen dioxide
NO_x ..... nitrogen oxide
NPRI ..... National Pollutant Release Inventory
NT/NWT ..... Northwest Territories
NWT AAQS ..... Northwest Territories Ambient Air Quality Standards
O_3 ..... ozone
ON AAQC ..... Ontario Ambient Air Quality Criteria
PM ..... particulate matter
PM_{10} ..... Particulate Matter aerodynamic diameters less than 10 µm
$PM_{2\,5}$ ..... Particulate Matter aerodynamic diameters less than 2.5 µm
RCP ..... representative concentration pathway
RSA ..... Regional Study Area
SO_2 ..... sulphur dioxide
SO_x ..... sulphur oxides
tCO_2e ..... tonnes of carbon dioxide equivalent
TDR ..... Technical Data Report
the Project ..... Mackenzie Valley Highway Project
ToR ..... Terms of Reference
TSP ..... total suspended particulate
UNFCC ..... United Nations Framework Convention on Climate Change
VOC ..... volatile organic compounds

Glossary

Air Quality Objectives (AQO)	Regulatory criteria for air quality are a suite of ambient air quality criteria that have been developed provincially and nationally to inform decisions on the management of air contaminants.
Criteria Air Contaminants (CACs)	Emissions of criteria air contaminants contribute to poor air quality and human health issues.
Local Study Area (LSA)	The Project footprint and a buffer on either side of the road alignment that considers the extents of the Project's dispersion of air emissions which are primarily dust from the movement of the vehicles over the unpaved road surface.
Regional Study Area (RSA)	The Project footprint and double of the LSA buffer (defined above). This is to account for the other existing and future physical activities that may act cumulatively with the Project air emissions.

1 Introduction

The Government of the Northwest Territories (GNWT) Department of Infrastructure (INF) is proposing the Mackenzie Valley Highway Project (the "Project") that will extend the Mackenzie Highway (Northwest Territories Highway #1) from Wrigley to Norman Wells to replace the Mackenzie Valley Winter Road (MVWR) along this portion. The Project includes construction of approximately 281 kilometres (km) of new all-season highway, and the construction and operation of temporary and permanent quarry and borrow sources. The project highway alignment will pass through the Dehcho Region and a portion of the Tulita District of the Sahtu Region within the Northwest Territories (NT; Figure 2.1).

The Project is subject to an environmental assessment and the requirements of Part 5 of the *Mackenzie Valley Resource Management Act* (MVRMA). This technical data report (TDR) presents the existing (baseline) conditions for air quality, greenhouse gases (GHG) emissions, and climate to support development of the Developer's Assessment Report (DAR) as required by the Terms of Reference (ToR) (MVEIRB, 2015).

The required elements specified in the ToR with respect to climate are to describe the existing or baseline climate conditions and climatic variability and trends for:

- location of recording stations and length of record (for air quality measurements see Section 4.1.2; for climate measurements see Section 4.3)
- prevailing climatic conditions, seasonal variations, predominant winds including direction and velocity, temperature, and precipitation (snowfall, snow depth, rain, fog, wind) (see Section 4.3)
- spatial and temporal boundaries for the description of climate (see Section 4.3)
- any current climate-related extreme events that may affect the highway, and frequency of occurrence (to be assessed in the DAR section that describes the potential effects of the environment on the Mackenzie Valley Highway [MVH] Project) (see Section 4.3)

In particular, the baseline or existing information presented for climate should:

- define the variability/trends within the "current" climate normal period and within the historical period of instrument record (see Section 4.3)
- discuss the contribution of traditional knowledge to the understanding of climate conditions and variability (see Section 3.1)
- identify the location of recording stations and length of record for any meteorological data presented (for air quality measurements see Section 4.1.2, for climate measurements see Section 4.3)

Specific to air quality, this ToR describes existing air quality in the highway area, including airsheds, emission sources, seasonal variations, existing and historical air quality, and visibility (as related to highway safety such as known fog areas).

2 Study Area

The Project is in the Mackenzie Valley region of the NT between the current terminus of the existing all-weather highway in Wrigley (Highway #1, kilometre marker [KM] 690) and Norman Wells (KM 1011 of MVWR). The highway portion of the Project parallels the Mackenzie River to its east and passes through the community of Tulita (KM 938) (Figure 2.1).

The study area has long cold winters and short cool summers. Solar radiation on the earth's surface and in atmosphere is the key driver for the climate in the study area. The strength of this radiation is determined primarily by latitude. Snow cover, clouds and large variations in daylight and sun elevation are also factors. The sun's heat is the driving force for the movement of masses of air. During winter, the air flows from the polar region. The Mackenzie Mountains protect this polar air mass from the milder, moister Pacific air. In summer, the air circulation pattern changes. The Arctic air retreats, allowing low pressure systems to gain access from the southwest. Along with this change, the air flow from the south combines with the long hours of sunlight to make the Mackenzie Valley the warmest region for its latitude in all of Canada. Temperature inversions (i.e., warmer air on top of colder more dense air) are common in the Mackenzie Valley. Precipitation is restricted partly due to the rain shadow effect of the Mackenzie Mountains. Precipitation decreases at the more northern latitudes. Overall, the climate patterns are subject to the influences of the Mackenzie Mountains and the annual fluctuations in the incoming solar radiation and sun elevation (Auld and Kershaw, 2009).

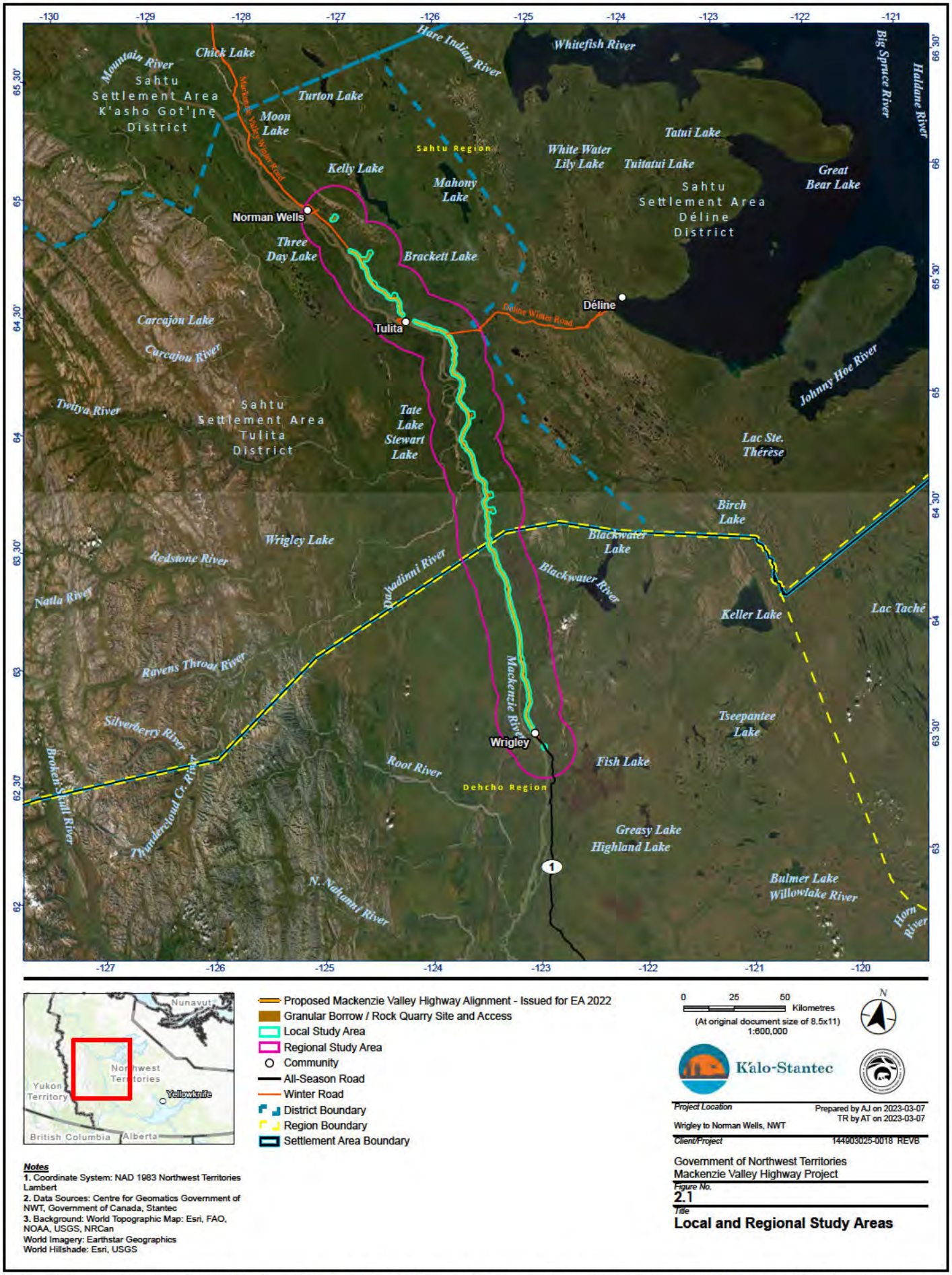
2.1 Local and Regional Study Area

The local and regional study areas presented in this TDR are the areas where data was compiled/collected to allow for an understanding of the environment in support of the project-specific effects assessment and the cumulative effect assessment. Long term air quality and climate monitoring records are available in Norman Wells, and these are sufficient to describe climate in the northern section of the study areas (defined below). Existing air quality and climate information for the southern portion of the study areas is available at Fort Simpson, which is located approximately 200 km southeast of Wrigley along the Mackenzie Highway.

The local study area (LSA) for air quality and climate is a 15 km buffer around the centerline of the highway alignment and around the footprint of the proposed borrow sources. The size of the LSA is consistent with recent environmental assessment and DARs for road projects in the same region (e.g., Prairie Creek All Season Road and the Inuvik-Tuktoyaktuk Highway). It coincides with the maximum geographic extent to which the air emissions, mostly particulate matter (PM) or "fugitive dust", from the MVH road traffic is expected to blow or disperse until the concentrations are undiscernible from the background PM concentrations. Most of the fugitive dust generated by unpaved road traffic is total suspended particulate (TSP) and the larger sized PM (PM_{10}) that falls to the ground at short distances from the source under the influence of gravity.

The size of the regional study area (RSA) also considered the dispersion of other types of air emissions (e.g., gaseous contaminants) from the various phases of the Project. The RSA is a 30 km (double the size of the LSA) buffer around the centerline of the highway alignment and around the footprint of the proposed borrow sources. The RSA accounts for other existing and future physical activities that may act cumulatively with the air emissions from the Project. Physical activities located beyond the 30 km buffer are not expected to interact with project residual air quality effects due to air dispersion over distance.

Figure 2.1 shows a map of the air quality LSA and RSA.



- Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022
- Granular Borrow / Rock Quarry Site and Access
- Local Study Area
- Regional Study Area
- Community
- All-Season Road
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary

0 25 50 Kilometres
(At original document size of 8.5x11)
1:600,000

N

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Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS

Project Location
Wrigley to Norman Wells, NWT

Prepared by AJ on 2023-03-07
TR by AT on 2023-03-07

Client/Project
144903025-0018 REVB

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
2.1

Title
Local and Regional Study Areas

3 Review of Existing Data

Several information sources were reviewed for existing conditions of air quality, GHG emissions, and climate. In most cases, the long-term records are available from monitoring stations that are maintained and operated by the GNWT or Environment and Climate Change Canada (ECCC). The information sources were reviewed and approved by members of the Government of the Northwest Territories - Environment and Natural Resources (GNWT-ENR) air quality and climate change teams (Fischer, 2020, pers. comm.; Rudkevitch, 2020, pers. comm.).

3.1 Traditional Knowledge and Traditional Use

Traditional knowledge of the study area has been passed on between generations for centuries through a variety of means, including legends, stories, songs, dances, and experience (Auld and Kershaw, 2009). The knowledge continues to be relevant today because the traditions and activities (such as hunting, trapping, and fishing) are still practiced.

Traditional knowledge studies have been completed in the Sahtu Region and the Dehcho Region in the past two decades. Traditional knowledge obtained through the review of publicly available studies has been incorporated into the description of the existing air quality, GHG emissions, and climate conditions for the Project. When additional information related to atmospheric environment traditional knowledge and traditional use becomes available, it will be included in the DAR.

3.1.1 Methods

The following studies were reviewed for traditional knowledge and traditional use related to air quality, GHG emissions, and climate:

- The draft report on Renewable Resource Assessment of the Pehdzeh Ki Ndeh Area of Interest (IMG-Golder Corporation, 2006).
- Traditional Knowledge Assessment of Boreal Caribou (Mbedzih) in the Dehcho Region (Dehcho First Nations, 2011).
- Mackenzie Valley Highway Extension Pehdzeh Ki Ndeh – Dehcho Region. Project Description Report. Prepared for Government of the Northwest Territories, Department of Transport. (Dessau, 2012)
- Boreal Caribou Traditional Knowledge Collection Study: The Sahtu Settlement Area. Edited by Andrea Hrynkiw and Glen Guthrie and McDonald. For the Canadian Wildlife Service, Environment Canada. (McDonald, 2010)
- 5658 NWT Ltd. and the Government of the Northwest Territories. 2011. Project Description Report for Construction of the Mackenzie Valley Highway Tulita District, Sahtu Settlement Area. (5658 NWT Ltd. and GNWT, 2011)
- Central Mackenzie Surface Water and Groundwater Baseline Assessment. Report 1: Technical State of Knowledge. Report Number: 1401835 Final Report 1. May 21, 2015. (Golder, 2015)

3.1.2 Results

IMG-Golder Corporation (2006) indicated that:

- Commercial fishing efforts in the region are likely to be faced with restricting factors such as cold climate.
- There have been successful efforts to produce vegetable and even grain crops in the mid-1900s in area's challenging climate at the communities of Aklavik and Inuvik in the Mackenzie Delta.
- Meteorological data from the climate station at the Wrigley Airport (operated by ECCC) would be useful for studying the feasibility of incorporating wind-energy electricity to replace diesel generator derived electricity.

Dehcho First Nations (2011) indicated that:

- The Dehcho region is clearly getting warmer and wetter overall, with more rainfall in August and September and even into October. This change is creating more incidences of ice crusting along the ground which may make it more difficult for boreal caribou to forage for ground lichens. Sudden thaws and melting during winter months also create crusts on the snow that make it difficult for boreal caribou to move around and escape predators. In some instances, frost heaves that harbor lichens are diminishing or melting entirely, which reduces availability of this particularly rich habitat site. Wetter summers and falls are resulting in higher water levels on small rivers and streams, increasing boat access (particularly jet boat access) into boreal caribou habitat areas previously difficult to access at these times of year.
- Climate change does not yet appear to be affecting ground or hanging lichens, although some monitoring of future changes to lichen due to climate change should be undertaken.
- Recent changes in climate are significant which include warmer temperatures, increased rain in November, milder winters and increasing summer storms. Boreal woodland caribou food sources are affected by precipitation. During colder times, food becomes less accessible because it is covered by more snow, making it harder for caribou to access.
- More detailed analysis of critical habitat characteristics (with a focus on boreal caribou calving and over-wintering habitat as well as lichen availability, quality, density, and vulnerability) is needed in the context of development, airborne pollution, and climate change. These recommendations were to be considered by the Canadian Wildlife Service in its development of a National Recovery Strategy and Action Plan.
- Global climate change may be impacting caribou populations in a variety of ways
- Forest fire prevalence has increased since the 1960s, with one possible factor begin increased lightning strikes
- An interviewee indicated that climate change is affecting the way people use the land: freeze up is later and at a different place than before, making conditions unsafe for travel
- Fall rain and freezing rain during early winter was mentioned by several of the people who were interviewed. The freezing rain causes a thicker crust to form on the ice, making it difficult for the caribou to travel.

- The crust on the snow can also happen with warm winter winds, although it is unclear if these winds are related to climate change or happen with some regularity
- Not all interviewees agreed that climate change was the root of the changes seen on the land. Some wondered if natural cyclical weather patterns were the reason for the freezing rain conditions seen recently and causing trouble for caribou

The Pehdzeh Ki/ Dehcho First Nations indicated that:

- During the Wrigley Community Consultation (January 25-26th, 2012) the additional concerns that were identified included more dust, contaminants hauled through the land, and more pollution on the road (Dessau, 2012)

Sahtu participants indicated that:

- Weather plays a significant role in the health and well-being of boreal woodland caribou. Increasing extremes in annual temperatures and flooding negatively impact herds (McDonald, 2010).
- Warmer temperatures, melting permafrost and other environmental changes create concerns related to the environment (5658 NWT Ltd. and GNWT, 2011).

The Golder study (2015) indicated that:

- Community members have reported that winds in the area are stronger than in the past, and southerly winds have become more frequent.

3.2 Literature Review

The following information sources were reviewed for existing information related to air quality, GHG emissions, and climate:

- Mackenzie Gas Project (MGP) Environmental Impact Statement (EIS) Volume 3: Biophysical Baseline Part A Environmental Setting, Air Quality and Noise (IORVL, 2004)
- Environmental Impact Statement (EIS) for Construction of the Inuvik to Tuktoyaktuk Highway, NT (Kiggiak – EBA, 2011)
- National Inventory Report (NIR) 1990-2019: Greenhouse Gas Sources and Sinks in Canada, Part 3 (ECCC, 2022a)
- Northwest Territories Air Quality Report 2018 (GNWT, 2018)
- National Air Pollution Surveillance (NAPS) Program Information web site (ECCC, 2022b)
- Canada's Changing Climate Report (Government of Canada, 2019)
- Guidelines for Ambient Air Quality Standards in the Northwest Territories (GNWT, 2014)
- Canadian Ambient Air Quality Standards (CAAQS) (CCME, 2022)
- Climate Data for a Resilient Canada (ECCC, 2019a)

- National Pollutant Release Inventory (NPRI) online datasets for the latest available years (2017 to 2019) (Government of Canada, 2022a)
- Canadian Climate Normals (ECCC, 2022c)
- Online forest fire maps (Natural Resources Canada, 2022)

3.2.1 Methods

The ToR were reviewed to determine the specific existing air quality and climate data that were relevant to the Project. The most appropriate sources for the existing information were identified during discussions with the GNWT-ENR staff for air quality, climate, and climate change (Fischer, 2020, pers. comm.; Rudkevitch, 2020, pers. comm.).

3.2.2 Results

Following discussions with GNWT-ENR staff it was determined that the acceptable sources of ambient air quality information are the latest available Northwest Territories Air Quality Report (GNWT, 2018) and the NAPS program information web site (ECCC, 2022b). The NAPS website provided ambient air quality results for the Norman Wells station. The ECCC NPRI online program information website was the acceptable source of data for criteria air contaminant (CAC) emissions for 2017 to 2019 in the NT (Government of Canada, 2022a). The acceptable source of data for the GHG emissions in the NT is the latest edition of the ECCC National Inventory Report (ECCC, 2022a). The acceptable source of data relating to climate normals is the online ECCC climate normal web site (ECCC, 2022c). The acceptable sources of information related to the climate change predictions applicable to the Project are the Climate Data for a Resilient Canada online tool (ECCC, 2022d) and Canada's Changing Climate Report (Government of Canada, 2019).

The detailed results of data analysis from these sources define the Project's existing conditions for ambient air quality, CAC emissions, GHG emissions, current climate conditions, and the predictions for future climate conditions. These are summarized in Section 4.

4 Key Results and Findings

This section summarizes results of ambient air quality monitoring (see Section 4.1.2), reported existing CAC emissions (see Section 4.1.3), reported GHG emissions (see Section 4.2), and climate normals (see Section 4.3) for the study area. In addition to the historical climate description, this section also includes projections for future climate (see Section 4.4).

4.1 Air Quality

Ambient air, the air in the outdoor environment, mainly contains nitrogen, oxygen, a small amount of carbon dioxide and water vapor. Ambient air, however, also contains a small amount of PM and several other chemicals (also called pollutants). Naturally occurring chemicals and PM are considered part of background levels for air quality.

Air quality is defined as the ambient concentrations of pollutants, defined as the amount of a pollutant in a defined volume of air, usually expressed in micrograms per cubic metre ($\mu g/m^3$). Air quality changes are a result of CAC emissions released from natural or anthropogenic sources, and local meteorological conditions influencing air dispersion (e.g., wind speed, atmospheric stability, and precipitation). The assessment of air quality is valuable for its importance to the health and well-being of people, wildlife, vegetation, and other biota of ecosystems.

This baseline report describes the following CAC pollutants: sulphur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter (inhalable $PM_{2.5}$, coarse PM_{10}, and TSP), ground level ozone (O_3), and carbon monoxide (CO). These CACs are selected because they are included in Northwest Territories Ambient Air Quality Standards (NWT AAQS) or related standards.

The following sections outline the regulatory objectives applicable to air quality in the study area (Section 4.1.1), summarize current air quality concentrations representative of the study area (Section 4.1.2), and list the current emissions released as they are reported to NPRI (Government of Canada, 2022a) (Section 4.1.3).

4.1.1 Air Quality Regulatory Objective

Air quality objectives are a suite of ambient air quality criteria that have been developed provincially and federally to inform decisions on the management of air contaminants. In the NT, the NWT AAQS are used (GNWT-ENR, 2014). Note that the NWT AAQS do not have a standard for PM_{10}. For this review, 50 $\mu g/m^3$ criteria from other jurisdictions (e.g., British Columbia and Ontario) is adopted (see Table 4.1).

Federally, the Canadian Ambient Air Quality Standards (CAAQS) are used to manage air quality such that human health is protected and clean air remains clean. This is managed through the federal Air Quality Management System (AQMS) (CCME, 2022). The Canadian Council of Ministers of Environment (CCME) have stated that achievement of the CAAQS is determined on an airshed and air zone basis, which cover broad geographical areas. They are regional ambient standards. They are not intended to be

applied to individual projects and facilities and are not intended to be used as fenceline standards (CCME, 2019). A fenceline is generally defined as the perimeter of a disturbed area where public access is restricted (BC ENV, 2015). The CAAQS are used by provinces and territories to guide air zone management actions intended to reduce ambient concentrations below the CAAQS and prevent CAAQS exceedances.

Under the federal AQMS, air quality management actions are assigned based on ambient pollutant concentrations within an air zone. Concentration levels are categorized into four management levels associated with specific management actions. This helps to ensure that the CAAQS are not seen as a pollute-up-to levels. The highest level (i.e., red) indicates that concentrations are at or exceeding the CAAQS and require action plans for improvement, the middle management levels (orange and yellow) indicate the need for continuous improvement and action plans to improve air quality. Finally, the lowest management level (green) is considered the baseline; the least impacted or influenced by anthropogenic sources and little action to improve air quality is needed; however, monitoring is ongoing. Suggested air quality management actions are provided for each management level and include, air quality monitoring, emission inventories, stakeholder engagement, developing air zone management plan, implementation plan, reporting, and public education (Table 4.2). In 2025, the CAAQS will become more stringent. There is a slight change in the upper bounds of the red and orange management levels for the 2025 CAAQS (CCME, 2022).

Table 4.1 Applicable Regulatory Criteria

Parameter	NWT AAQS ($\mu g/m^3$)	CAAQS 2020 ($\mu g/m^3$)	CAAQS 2025 ($\mu g/m^3$)	Other Criteria ($\mu g/m^3$) (BC AAQO; ON AAQC)
Sulphur Dioxide (SO_2)				
Maximum of 1-hour average	450	-	-	-
Statistics of 1-hour average [a]	-	183	170	-
Maximum of 24-hour average	150	-	-	-
Annual average	30	13	10	-
Nitrogen Dioxide (NO_2)				
Maximum of 1-hour average	400	-	-	-
Statistics of 1-hour average [b]	-	113	79	-
Maximum of 24-hour average	200	-	-	-
Annual average	60	32	23	-
Fine Particulate Matter ($PM_{2.5}$)				
Statistics of 24-hour average [c]	28	27	-	-
Statistics of Annual average [d]	10	8.8	-	-
Coarse Particulate Matter (PM_{10})				
Maximum of 24-hour average	-	-	-	50
Total Suspended Particulate (TSP)				
Maximum of 24-hour average	120	-	-	-
Maximum of Annual average	60	-	-	-
Ground Level Ozone (O_3)				
Statistics of 8-hour average [e]	126	122	118	-

Parameter	NWT AAQS ($\mu g/m^3$)	CAAQS 2020 ($\mu g/m^3$)	CAAQS 2025 ($\mu g/m^3$)	Other Criteria ($\mu g/m^3$) (BC AAQO; ON AAQC)
Carbon Monoxide (CO)				
Maximum of 1-hour average	15,000	-	-	-
Maximum of 8-hour average	6,000	-	-	-

Notes:

$\mu g/m^3$: micrograms per cubic metre

All ambient air quality measurements will be referenced to standard conditions of 25°C and 101.3 kPa.

"-" not applicable

[a] Achievement based on the 3-year average of the annual 99th percentile of the SO_2 D1HM.

[b] Achievement based on the 3-year average of the annual 98th percentile of the NO_2 D1HM.

[c] Achievement based on the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.

[d] Achievement based on the 3-year average of the daily 24-hour average concentrations.

[e] Achievement based on the 3-year average of the annual 4th highest of the daily maximum 8-hour average ozone concentrations.

Sources:

NWT AAQS: GNWT-ENR (2014).

CAAQS: CCME (2022).

BC AAQO (British Columbia Ambient Air Quality Objectives): Government of BC (2021)

ON AAQC (Ontario Ambient Air Quality Criteria): Ontario Ministry of Environment (2020)

Table 4.2 Canadian Ambient Air Quality Standards Air Quality Management Levels

Air Quality Management Levels	8-hour Ozone (µg/m³)		24-hour $PM_{2.5}$ (µg/m³)		Annual $PM_{2.5}$ (µg/m³)		1-hour Sulphur Dioxide (µg/m³)		Annual Sulphur Dioxide (µg/m³)		1-hour Nitrogen Dioxide (µg/m³)		Annual Nitrogen Dioxide (µg/m³)	
	2020	2025	2015	2020	2015	2020	2020	2025	2020	2025	2020	2025	2020	2025
Red	>122	>118	>28	>27	>10.0	>8.8	>183	>170	>13	>10	>113	>79	>32	>23
Orange	>110 and ≤122	>110 and ≤118	>19 and ≤28	>19 and ≤27	>6.4 and ≤10.0	>6.4 and ≤8.8	>131 and ≤183	>131 and ≤170	>8 and ≤13	>8 and ≤10	>58 and ≤113	>58 and ≤79	>13 and ≤32	>13 and ≤23
Yellow	>98 and ≤110		>10 and ≤19		>4.0 and ≤6.4		>79 and ≤131		>5 and ≤8		>38 and ≤58		>4 and ≤13	
Green	≤98		≤10		≤4.0		≤79		≤5		≤38		≤4	

Source: CCME website: https://ccme.ca/en/air-quality-report#slide-7

4.1.2 Measured Air Quality

The NAPS program is the main source of monitored ambient air quality data in Canada. The program began in 1969 and consists of more than 250 monitoring stations across Canada. The goal of NAPS is to provide accurate and long-term air quality data of a uniform standard across Canada (Government of Canada, 2022b). The GNWT operates four continuous monitoring stations as part of NAPS: Fort Smith, Yellowknife, Norman Wells, and Inuvik (ECCC, 2022b).

Data from the Norman Wells and Fort Smith monitoring stations are used to describe the existing ambient air quality in the study area (Table 4.3). The Norman Wells station is used because it is located within the study area, at its northern end, and hence considered most representative. Since the Norman Wells station does not monitor CO concentrations, representative data from the Fort Smith monitoring station is used for CO only. The Fort Smith station is located 960 km southeast of Norman Wells; however, it is considered representative of the project site based on similarity of nearby emissions sources and meteorological conditions that influence air dispersion. This station was selected for the conservative use of the highest measured CO concentrations in 2018 of all the NAPS station in NT.

Table 4.3 NAPS Ambient Air Quality Monitoring Stations near the Project

NAPS Monitoring Station	ID	Latitude	Longitude	Elevation	Monitoring Variables
Norman Wells[1]	129102	65.279	-126.813	60 m	SO_2, NO_2, NO, NO_x, O_3, $PM_{2.5}$, PM_{10}
Fort Smith[1]	129601	60.005	-111.893	680 m	CO

Note:

[1] The Norman Wells and the Fort Smith stations have been operational since 2006 and 2015, respectively.

Source: ECCC (2022b)

Measured ambient concentrations of the CACs from the Norman Wells and Fort Smith stations are listed in Table 4.4 and compared against the air quality objectives. Achievement for each parameter and time averaging interval is as described in the notes section of Table 4.1. Note that the statistical forms for the time averaging intervals vary slightly between some NWT AAQS and the CAAQS. For example, the achievement of the NWT AAQS SO_2 1-hour average value of 450 µg/m^3 is based on the maximum 1-hour average value measured within a year, whereas the achievement of the CAAQS 1-hour average of 183 µg/m^3 is based on the 3-year average of the annual 99th percentile of the SO_2 D1HM.

Except for one CAC, the measured CAC concentrations are well below the applicable federal and territorial criteria. This is expected because the area is relatively undeveloped with very few anthropogenic sources and activities that could affect the quality of air. The exception is spike concentrations of PM_{10}, which can be related to nearby forest fires or dust and sand sources close to the monitoring station, especially during the summer. The seasonal trends for the gaseous air contaminants are documented in the 2018 Air Quality Report prepared by GNWT (GNWT, 2018). The following sections provide more detail for each of the pollutants.

Table 4.4 Summary of Existing Air Quality at Noman Wells

Parameter	Existing Air Quality Concentration (µg/m³)	NWT AAQS (µg/m³)	CAAQS 2020 (µg/m³)	CAAQS 2025 (µg/m³)	Other Criteria (µg/m³) (BC AAQO; ON AAQC)
Sulphur Dioxide (SO_2)					
Maximum of 1-hour average	2.1	450	-	-	-
Statistics of 1-hour average [a]	2.5	-	183	170	-
Maximum of 24-hour average	1.6	150	-	-	-
Annual average	0.5	30	13	10	-
Nitrogen Dioxide (NO_2)					
Maximum of 1-hour average	48.0	400	-	-	-
Statistics of 1-hour average [b]	41.1	-	113	79	-
Maximum of 24-hour average	17.7	200	-	-	-
Annual average	3.2	60	32	23	-
Fine Particulate Matter ($PM_{2.5}$)					
Statistics of 24-hour average [c]	15.0	28	27	-	-
Statistics of Annual average [d]	4.6	10	8.8	-	-
Coarse Particulate Matter (PM_{10})					
Maximum of 24-hour average	162.0	-	-	-	50
Total Suspended Particulate (TSP)					
Maximum of 24-hour average	-	120	-	-	-
Maximum of Annual average	-	60	-	-	-
Ground Level Ozone (O_3)					
Statistics of 8-hour average [e]	86.3	126	122	118	-
Carbon Monoxide (CO)					
Maximum of 1-hour average	2,164 [f]	15,000	-	-	-
Maximum of 8-hour average	1,099 [f]	6,000	-	-	-

Notes:

µg/m³: micrograms per cubic metre

All ambient air quality measurements will be referenced to standard conditions of 25°C and 101.3 kPa.

"-": not applicable

Converted based on ppbv (parts per billion by volume) (parts per million by volume (ppmv) used for CO only) using conversion factors at standard conditions of 25°C and 101.3 kPa.

[a] Achievement based on the 3-year average of the annual 99th percentile of the SO_2 D1HM.

[b] Achievement based on the 3-year average of the annual 98th percentile of the NO_2 D1HM.

[c] Achievement based on the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.

[d] Achievement based on the 3-year average of the annual average of the daily 24-hour average concentrations.

[e] Achievement based on the 3-year average of the annual 4th highest of the daily maximum 8-hour average ozone concentrations.

[f] There are no CO measurements at Norman Wells station, therefore the maximum of 2019 measurements from the Fort Smith NAPS station in NT is presented

Sources: As detailed in the notes of Table 4.1

4.1.2.1 Sulphur Dioxide

Sulphur dioxide is part of sulphur-containing gases called sulphur oxides (SO_x). Sulphur dioxide has a strong odor and is mainly emitted from the combustion of fossil fuels that contain sulphur, but also from natural gas processing, oil refineries and other industrial activities. Forest fires and volcanic eruptions can be a source of natural SO_2 however human activity is the main source of SO_2 emissions. Sulphur dioxide is considered harmful to humans' respiratory system. Sulphur dioxide also contributes to acid deposition and smog, and it can aid in the formation of secondary $PM_{2.5}$ through chemical reactions (GNWT, 2018; CCME, 2017).

All measured SO_2 values are less than the NWT AAQS and CAAQS. The 24-hour and annual average SO_2 values are low at 1.6 µg/m^3 and 0.5 µg/m^3, respectively. The measured 1-hour average value is 2.1 µg/m^3 when calculated for the NWT AAQS, and 2.5 µg/m^3 when calculated for the CAAQS (i.e., 3-year average of the annual 99th percentile of the SO_2 D1HM) (Table 4.4).

These ambient SO_2 concentrations fall into the green category of the AQMS management levels. The green management category has the least requirements of the four management categories. Little action is needed to improve the air quality and maintaining good air quality is achieved through proactive air management measures that include continuous air quality monitoring, reporting, and public education (CCME, 2019).

4.1.2.2 Nitrogen Dioxide

Nitrogen dioxide (NO_2) belongs to a group of gases that is called nitrogen oxides (NO_x). Nitric oxide (NO) is another one of this group. Both these emissions (NO_2 and NO) are formed when fossil fuels are combusted (e.g., vehicles, industries, heating). During combustion, mainly NO is emitted, however, once released in the air it converts to NO_2. Nitrogen dioxide is also linked to formation of ozone, secondary PM, and acid rain. Nitrogen dioxide is harmful to humans and can cause adverse respiratory effects (GNWT, 2014; CCME, 2017).

All measured NO_2 values are less than the NWT AAQS and CAAQS. The 24-hour and annual average NO_2 values are low at 17.7 µg/m^3 and 3.2 µg/m^3, respectively. The measured 1-hour average value is 48.0 µg/m^3 when calculated for the NWT AAQS, and 41.1 µg/m^3 when calculated for the CAAQS (i.e., 3-year average of the annual 98th percentile of the NO_2 D1HM) (Table 4.4).

The annual measured NO_2 value falls into the green category of the AQMS management levels. However, the 98th percentile of the daily one-hour maximum concentration falls into the yellow category (Table 4.2). The yellow air quality management level has more suggested actions to maintain good air quality than the green category. In addition to all the management actions of the green category, the yellow category adds the following action items: compiling an emission inventory, stakeholder engagement, developing an air zone management plan and prepare air zone specific reports (CCME, 2019).

4.1.2.3 Particulate Matter

Particulate matter is divided by size: fine particulate matter is $PM_{2.5}$, whereas coarse PM is called PM_{10}. $PM_{2.5}$ is potentially dangerous to humans as they can easily be inhaled and can aggravate existing pulmonary and cardiovascular disease. PM_{10} is associated with dust and can be a nuisance. Particulate matter further can also degrade visibility and it is a major contributor to smog. Particulate matter is either solid or liquid particles. Sources of $PM_{2.5}$ in the NT include industrial activities, heating, vehicle emissions and forest fires. Besides being directly emitted (primary PM), PM can form due to reaction of precursor pollutants (secondary PM) (CCME, 2017). The following sections report on measured ambient concentrations of $PM_{2.5}$ and PM_{10}.

Fine Particulate Matter $PM_{2.5}$

The $PM_{2.5}$ maximum 24-hour average and annual average from the Norman Wells monitoring station are less than the NWT AAQS. Regarding the CAAQS air quality management levels, the annual average $PM_{2.5}$ value of 4.6 µg/m^3 and the maximum 24-hour average $PM_{2.5}$ value of 15.0 µg/m^3 fall into the yellow AQMS management level and could indicate an ongoing need to improve air quality, such as management plans and stakeholder engagements (CCME, 2019). However, as the next section will show, shorter term peaks of $PM_{2.5}$ are often influenced by forest fire smoke, especially during summer, and not due to direct human activities. Further in-depth analysis of $PM_{2.5}$ data is provided below.

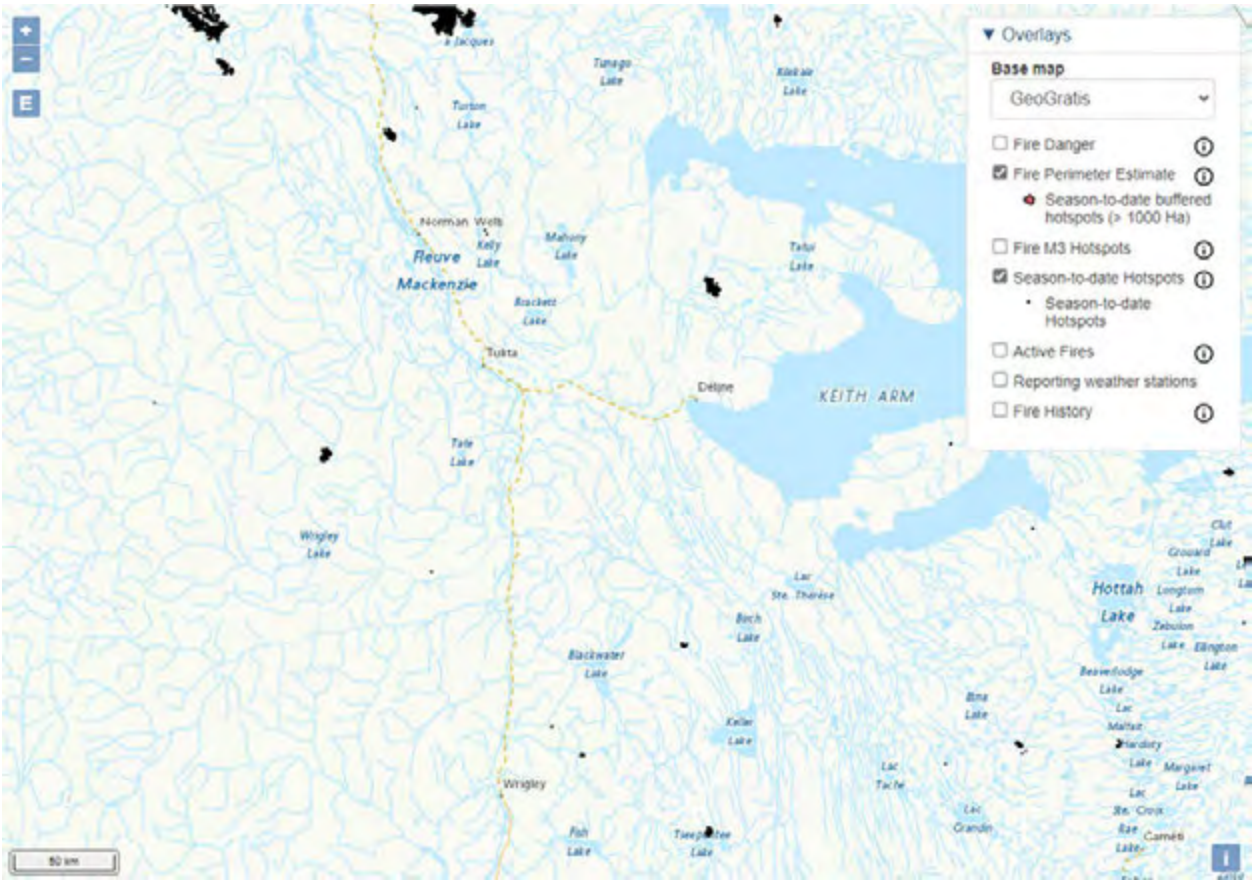
Daily $PM_{2.5}$ data from the Norman Wells NAPS station for 2017 until 2019 has been plotted in Figure 4.1. Each figure presents data for one year. Daily averages were calculated from the hourly data if at least 18 hours of data were available per day. Days with less valid hours are not shown in the graph (18 hours represent 75% data completeness following guidance from CCME, 2011).

For context purpose the 24-hour $PM_{2.5}$ NWT AAQS of 28 µg/m^3 is also shown in the figures. It is for context purpose only, as this achievement is based on the 3-year average of the annual 98th percentile of the daily 24-hour average concentrations. Data in each figure is from one year and only a straight average of the hourly values per day. Daily $PM_{2.5}$ average concentrations are greater than the NWT AAQS in August 2017, and July and August 2019. No concentrations greater that the NWT AAQOs were recorded in 2018.

The interactive fire map from Natural Resources Canada (2022) confirmed the presence of fires in the Sahtu and Dehcho regions in July and August 2017 and 2019, which corresponds to the period with peaks in $PM_{2.5}$ concentration. This suggests that the higher levels of $PM_{2.5}$, specifically during the summer months, may be attributable to forest fire smoke, although it may be due to other local sources given the distance from the fires to Norman Wells (approximately 50 km in 2016 and 100 km away in 2019). Figure 4.2, Figure 4.3 and Figure 4.4 show the summarized season-to-date fire perimeter estimate and season-to-date hotspots near the end of the fire season around September from 2017 to 2019. The figures show that the year 2017 had more fire activity than 2018 and 2019.

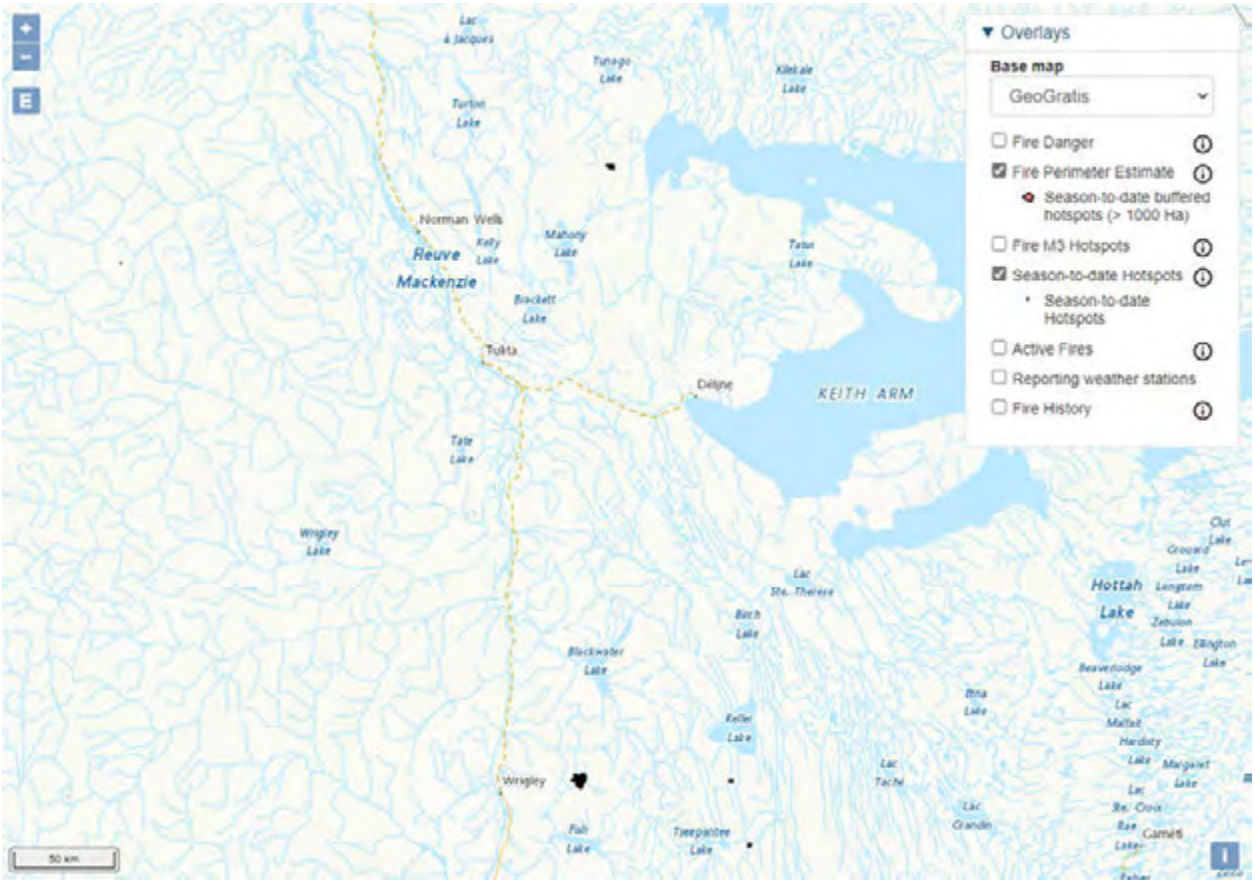
Figure 4.1 Daily Average $PM_{2.5}$ Concentration at Norman Wells in 2017-2019

Figure 4.2 Forest Fire Interactive Map in the Sahtu and Dehcho Regions - 2017



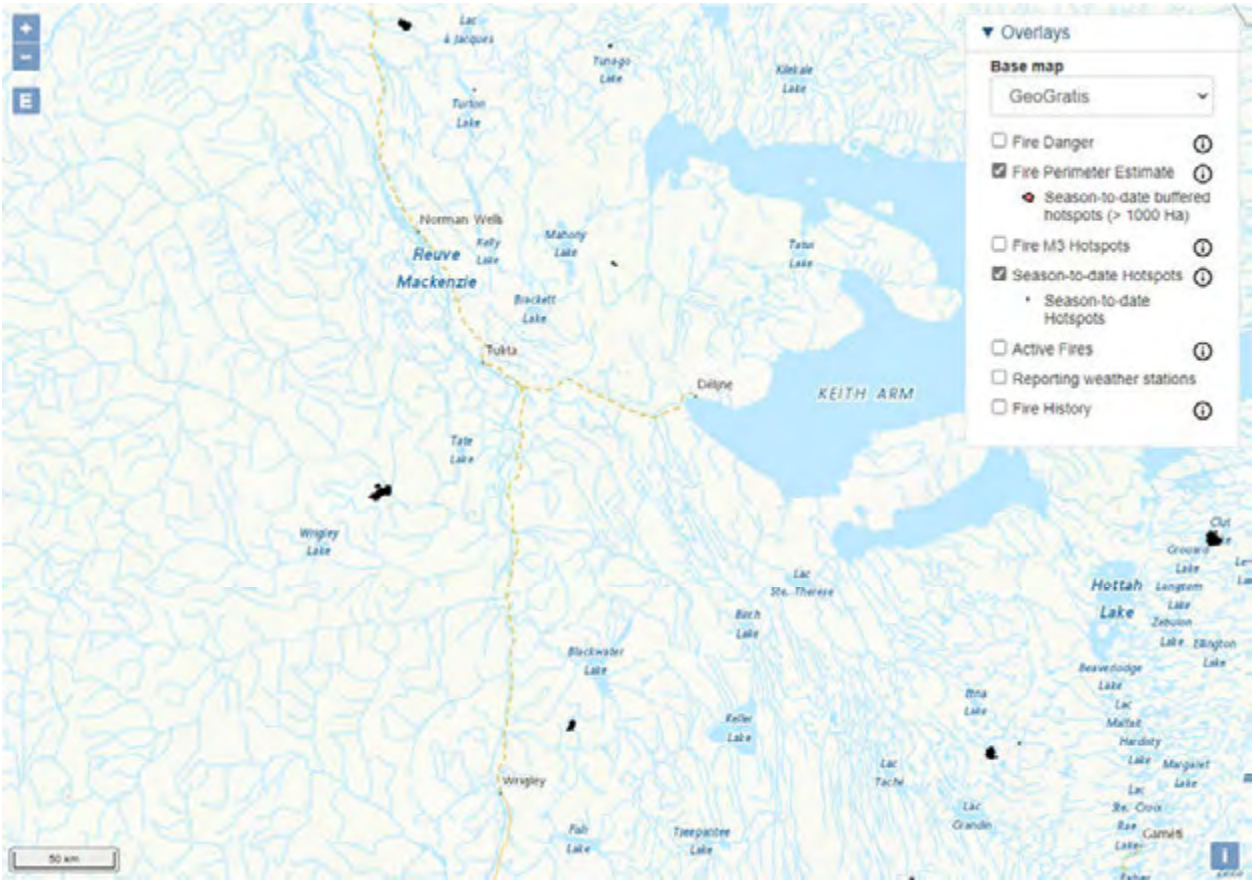
Source: Natural Resources Canada (2022)

Figure 4.3 Forest Fire Interactive Map in the Sahtu and Dehcho Regions - 2018



Source: Natural Resources Canada (2022)

Figure 4.4 Forest Fire Interactive Map in the Sahtu and Dehcho Regions - 2019



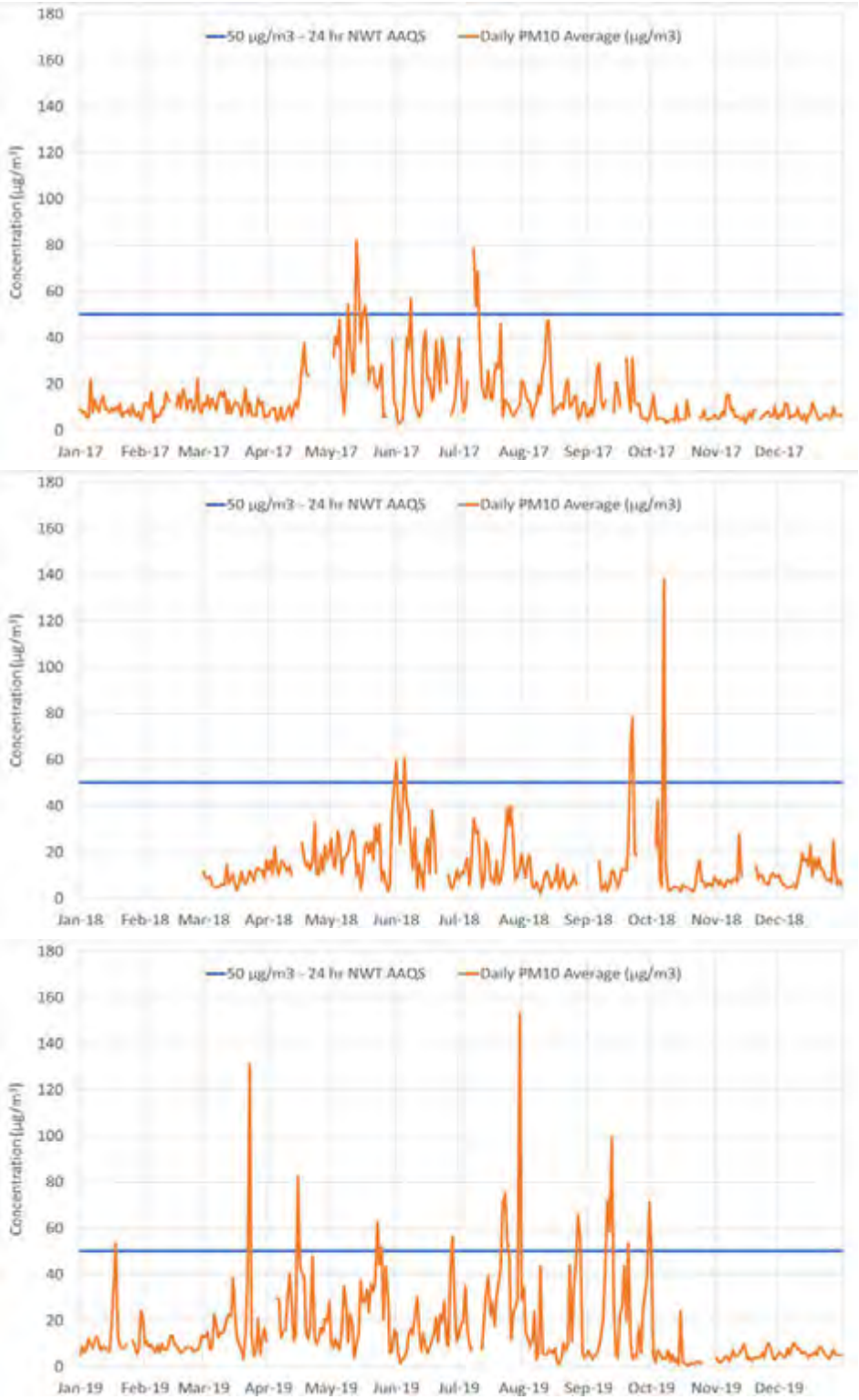
Source: Natural Resources Canada (2022)

Coarse Particulate Matter PM_{10}

Measured PM_{10} data showed that the maximum 24-hour average of 162 µg/m^3 exceeded the 50 µg/m^3 criteria from other jurisdictions (British Columbia Ambient Air Quality Objectives [BC AAQO], Ontario Ambient Air Quality Criteria [ON AAQC]) (Table 4.1).

Daily PM_{10} concentrations for the years 2017 to 2019 are plotted in Figure 4.5. Each graph presents data for one year. Daily averages were calculated from the hourly data if at least 18 hours of data were available per day, where 18 hours of data was not available information is shown as gaps in the graphs.

Figure 4.5 Daily Average PM_{10} Concentration at Norman Wells in 2017-2019



A main source of PM_{10} includes road dust. Exceedances of the BC AAQO of 50 µg/m^3 are observed during the spring and summer months of all three years. This coincides with the time after the snow has melted and sand and gravel roads are exposed. Vehicles or wind cause dust to form on roads. Since there are many gravel roads in the vicinity of Norman Wells, this is likely the main reason for fluctuating concentrations and exceedances of the AAQO throughout the spring and summer months (GNWT, 2018).

Like $PM_{2.5}$, PM_{10} can also be an indicator for forest fires. If the forest fire is occurring nearby the monitoring station, then PM_{10} level can also spike due to larger ash particles falling out of the air near the station. Exceedances of the BC AAQO of 50 µg/m^3 of PM_{10} are observed during the spring and summer months during 2017, and during summer and fall 2018. Exceedances are also more numerous in 2019 than in the previous two years. As the $PM_{2.5}$ concentrations are showing peaks at the same time as the PM_{10} peaks for July 2019 (compare Figure 4.1 and Figure 4.4), forest fires or other combustion activity may be the source in that case; however, the $PM_{2.5}$ concentrations are not showing peaks at the same time for the other periods, and therefore combustion activities are likely not the source.

Discussions with the air quality branch of the GNWT-ENR have confirmed that the peaks up to the period of 2018 are valid and are not erroneous data. They are most likely due to local industrial activity nearby the Norman Wells monitoring station (McKay, 2020, pers. comm.).

4.1.2.4 Total Suspended Particulate

Total suspended particulate combines airborne solid and liquid particles of different sizes, also referred to as “dust”. It represents a somewhat outdated regulatory measure as $PM_{2.5}$ and PM_{10} particles are included when amounts of TSP are discussed. Most regulatory air quality standards and objectives are focusing on $PM_{2\,5}$ and PM_{10} instead of TSP. Note that TSP is not monitored at the Norman Wells or Inuvik station. Since this assessment focuses on $PM_{2.5}$ and PM_{10} measurements and compares them against CAAQS and BC AAQS, no further analysis is required on TSP.

4.1.2.5 Ozone

Ground level O_3 is the same gas as the stratospheric O_3, however at ground level it is considered dangerous as it can cause human health concerns. Ground level ozone is not directly emitted but rather formed during chemical reactions with so-called precursor pollutants (e.g., volatile organic compounds [VOC] and NO_x) and with sunlight. Therefore, O_3 is called a secondary pollutant. Ozone is also a contributor to smog, and it acts as a GHG. Ozone is harmful to humans, specifically to the respiratory system (GNWT, 2014; CCME, 2017).

The measured ozone level of 86.3 µg/m^3 at the Norman Wells station, based on the 3-year average of the annual 4th highest of the daily maximum 8-hour average ozone concentrations, is below the NWT AAQS of 126 µg/m^3 and the CAAQS of 122 µg/m^3 and falls into the green AQMS management level. The green management level indicates that there is little concern regarding ozone concentrations and only little action is required according to the air quality managements actions including continuous air quality monitoring, reporting and public education (CCME, 2019).

4.1.2.6 Carbon Monoxide

CO usually forms during incomplete combustion of hydrocarbon fuels (e.g., diesel, gasoline) and is emitted from vehicle tailpipes. Other sources of CO are from wood combustion, for example, by the forestry industry, by residential heating by wood, and by forest fires. Carbon monoxide is an odorless gas and highly toxic to humans (GNWT, 2014). High concentrations of CO generally occur in areas with heavy traffic congestion (cities) due to vehicle exhaust (US EPA, 2018).

Since the pollutant CO is not measured at the Norman Wells station, data from the Fort Smith station has been assessed. Fort Smith is the location in the Northwest Territories with the most conservative monitoring results for CO and it is in a similar remote northern environmental setting as Norman Wells and neither location experiences heavy traffic congestion. The 1-hour and 8-hour maximum concentrations of 2,164 µg/m^3 and 1,099 µg/m^3 are well below the NWT AAQS of 15,000 µg/m^3 and 6,000 µg/m^3, respectively. There are no federal air quality objectives for CO emissions.

4.1.3 Existing Emissions

As mentioned earlier, air quality is impacted by releases of pollutants (e.g., gases and particles) to the atmosphere from a specific source. A source can be a human activity (e.g., industrial facilities, transportation, and home heating, among others) or a natural activity (e.g., forest fires) (CCME, 2017).

Existing pollutant releases to air are monitored by ECCC on an annual basis through the NPRI. All Canadian industrial, commercial, and institutional facilities must report on their releases, disposals, and transfers of a predetermined list of pollutants and other substances of concern if they meet the reporting threshold. Emissions are inventoried on a per-emitter basis (e.g., individual facilities). This inventory is nationwide and publicly accessible (Government of Canada, 2022a). Reporting industries include, mines, oil and gas operations, power plants and manufacturing facilities. Table 4.5 lists the reported CAC releases to the atmosphere in NT for 2017, 2018 and 2019. Most of the reported CAC emissions have been decreasing since 2017, except for the Coarse Particulate Matter (PM_{10}) and the TSP.

Table 4.5 Summary of Emissions Reported in 2017, 2018 and 2019 NPRI for Northwest Territories

Substance Name	Total Air Emissions (2017) (tonne)	Total Air Emissions (2018) (tonne)	Total Air Emissions (2019) (tonne)
sulphur dioxide (SO_2)	257	261	211
nitrogen dioxide (NO_2)	7,735	7,707	7,277
fine particulate matter ($PM_{2.5}$)	339	361	318
coarse particulate matter (PM_{10})	383	517	482
total suspended particulate (TSP)	412	687	646
carbon monoxide (CO)	1,866	1,732	1,711

Note:
Emissions are presented when the NPRI inventory for each year is filtered for the NT economic region
Source: Government of Canada (2022a).

There are no major industrial sources of air contaminants in the study area, as confirmed by the NPRI inventory (Government of Canada, 2022a). There are, however, smaller industrial facilities in the study area. Reporting industrial facilities in the study area include NWT Power Corporation generating stations (Norman Wells, Tulita, and Wrigley), Enbridge Pipelines facilities (between Norman Wells and Wrigley), and Imperial Oil Resources producing wells and a central processing facility (Norman Wells). Besides these small industrial sources, other emission sources in the study area include aviation activities, community sources (such as traffic and heating), and natural sources (such as forest fires).

4.2 GHG Emissions

Greenhouse gas emissions are federally and provincially/territorially managed in Canada. Industrial facilities that emit more than 10,000 tonnes of carbon dioxide equivalent (tCO_2e) per year are required to report their annual GHG emissions to the federal government to the GHG Reporting Program (Government of Canada, 2020a). Emissions included in these reports are included in the national GHG inventories. Every year, Canada prepares and submits a national GHG inventory to the United Nations Framework Convention on Climate Change (UNFCC) on anthropogenic (human-caused) emissions by sources, removals by sinks, and annual emissions estimates dating back to 1990. The national GHG inventory report presents emissions at the provincial and territorial level in the following four categories: energy, industrial processes and product use, agriculture, and waste. See Table 4.6 for annual GHG emissions reported in NT in comparison to Canadian total GHG emissions.

Table 4.6 Summary of GHG Emissions for Northwest Territories

Greenhouse Gas Categories	Selected Years (kilotonne (kt) CO_2e)							
	1999	**2005**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Energy	1,220	1,570	1,470	1,680	1,560	1,260	1,350	1,310
Industrial Processes and Product Use	9	20	28	27	27	26	28	29
Agriculture	-	-	-	-	-	-	-	-
Waste	38	39	36	36	37	38	39	40
Total NT	**1,260**	**1,630**	**1,530**	**1,740**	**1,620**	**1,320**	**1,420**	**1,380**
Total Canada	**710,000**	**739,000**	**723,000**	**723,000**	**707,000**	**716,000**	**728,000**	**730,000**
NT as percentage of Canada	0.18%	0.22%	0.21%	0.24%	0.23%	0.18%	0.20%	0.19%

Notes:
"-" indicates no emissions.
The total does not match the sum of energy, industrial processes and product use, agriculture, and waste due to rounding
Source: ECCC (2022a).

Canada's total emissions for 2019 were 730 megatonnes (Mt) of CO_2e. Emissions from NT account for a small portion of this, 1,380 kilotonnes (kt) of CO_2e, which is about 0.19% of the federal total. Since the total annual GHG emissions from NT are small, the change in emissions from year to year can appear quite large. For example, emissions dropped by about 20% from 2016 to 2017. These changes are mostly due to factors such as increasing or decreasing use of off-road diesel for large construction projects or the utilization of aviation fuel for mining exploration and fighting wildfires. Changes in these main activities can alter the year-to-year total noticeably.

The energy sector makes up most of the annual emissions in the NT. In 2019, emissions from the energy sector attributed for 95% of the total reported emissions. The largest contributors to the energy category in 2019 were road transportation (612 kt CO_2e: 44%), mining (192 kt CO_2e: 14%), aviation (146 kt CO_2e: 11%), other transportation (93 kt CO_2e: 7%), and commercial and institutional (69 kt CO_2e: 5%).

Despite the NT's low total GHG emissions, if the emissions are assessed on a per capita basis, then NT (30.8 tCO_2e/capita in 2019) is well above the national average (19.4 tCO_2e/capita in 2019). These high per capita emissions are mainly due to a low population number, long distances between communities, energy-intensive resource industry, reliance on diesel power generation and long, cold winters (GNWT, 2020).

A Climate Lens Assessment has been completed for the Project, the intent this Infrastructure Canada's program is to "incent behavioral change and consideration of climate impacts into the planning of infrastructure projects with a view to implementing Canada's mid-century goals of a clean growth low-carbon economy" (Infrastructure Canada, 2018). A GHG Mitigation Assessment (Part I of a Climate Lens Assessment) and Climate Change Resilience Assessment (Part II of the Climate Lens Assessment) have been prepared for the Project. Part I estimates the expected GHG emissions associated with the Project and estimates the potential changes in GHG emissions associated with the Project compared to a functionally equivalent baseline scenario. Part II identifies the climate risks to the Project at a broad systems-level based on a future climate scenario and provides an understanding of the climate impacts on the Project over its construction and operational life. Part II is intended to inform the design team of projected changes in climate and associated risks to consider at the project's detailed design stage. Further details are provided in the DAR.

4.3 Climate

Climate is defined as the weather conditions prevailing in an area over a long period of time, typically 30 years. If weather variables such as temperature, precipitation and wind are averaged over such a long time, they can summarize the average climatic condition of a particular location. To describe the average climate in the study area, the 30-year Canadian Climate Normals data from 1981-2010 were assessed. These are the most recent climate normals data available. Although there is data available prior to 1981, the most recent climate normal information is sufficient to quantify the baseline climate conditions. The stations nearest to the Project with climate normals data available are operated by ECCC and are shown in Figure 2.1:

- The Norman Wells Airport station (ID: 2202800), located at 65°16'57" N, 126°48'01" W, at an elevation of 73 meters (m). This station is located at the airport in the town of Norman Wells in the northern portion of the study area.
- The Fort Simpson Airport station (ID: 2202101), located at 61°45'37" N,121°14'12" W at an elevation of 169 m. This station is located at the airport south of the town of Fort Simpson, roughly 200 km southeast of Wrigley.

Both stations monitor temperature, precipitation, wind speed and direction and visibility. Climate normals data from 1981-2010 for Norman Wells and Fort Simpson are shown in Table 4.7 and Table 4.8. See the following sections for a detailed summary.

4.3.1 Air Temperature

In general, the climate in NT can be described as subarctic, which usually involves short warm summers and long, cold winters (Phillips, 1990). Measured climate normal temperature data confirm this annual temperature pattern. Daily average temperatures are below 0°C for 7 months at Norman Wells and Fort Simpson station with the coldest month being January, where daily average temperatures reach as low as -24.2°C at Fort Simpson and -26.1°C at Norman Wells. Summer months (June, July, and August) average daily temperatures reach the high teens, with the warmest month being July with average temperatures of 17.1°C and 17.4°C, respectively, at the two stations. Extreme temperatures have a range from -53.3°C (February 3, 1968) to 36.6°C (July 25, 1994) at Fort Simpson and -54.4°C (February 4, 1947) to 35.0°C (July 14, 1989) at Norman Wells. In general, the temperature data indicates that the climate near Fort Simpson is warmer than at Norman Wells (annual average temperature of -2.8°C versus -5.1°C). Annual daily minimum, average and maximum temperatures are shown graphically in Figure 4.6 for both stations.

Table 4.7 Climate Normal Data, Norman Wells Airport Station a, NT (1981-2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature													
Daily Average (°C)	-26.1	-24	-18.4	-5.1	6.4	15	17.1	13.8	6.6	-4.7	-18.7	-23.4	-5.1
Standard Deviation	4.5	3.9	3.5	3.1	2.3	1	1.5	1.6	1.9	2.4	4	3.6	1.1
Daily Maximum (°C)	-22.2	-19.5	-12.5	1	12.1	20.7	22.5	19	11	-1.6	-15.2	-19.6	-0.4
Daily Minimum (°C)	-29.9	-28.4	-24.2	-11.1	0.6	9.3	11.5	8.4	2	-7.7	-22.2	-27.1	-9.9
Extreme Maximum (°C)	12.4	7.9	11.1	20	31.3	33.5	35	32.4	27.1	21	13.3	5.7	35
Extreme Minimum (°C)	-52.2	-54.4	-46.1	-37.2	-17.8	-2.8	-1.1	-6.1	-15.7	-31.7	-42.8	-47.8	-54.4
Precipitation													
Rainfall (mm)	0.2	0	0.1	1.2	13.3	42.4	41.8	41.1	26.7	4.6	0	0.2	171.7
Snowfall (cm)	21.1	19.9	14.4	12.8	6.4	0.4	0	0.7	6.9	27.3	26	25.9	161.5
Snow Water Equivalent (mm)	15.4	14.9	10.6	9.9	5.7	0.3	0	0.7	6.4	22.1	18.7	18	122.7
Precipitation (mm)	15.6	14.9	10.7	11.1	19	42.7	41.8	41.8	33.1	26.7	18.7	18.2	294.4
Extreme Daily Rainfall (mm)	3	0.9	5.6	12.4	19.6	45.1	49.3	48.5	42.8	21.4	5.8	2	
Extreme Daily Snowfall (cm)	23.1	27	13	28.4	20.6	15	2	7.6	16.8	18.8	16.8	17	
Extreme Daily Precipitation (mm)	24.6	20.6	9.6	26.7	20.6	45.1	49.3	48.5	50.8	21.8	16.5	17	
Wind													
Maximum Hourly Speed (m/s)	22.2	20.6	18.3	18.9	16.4	18.1	16.9	22.2	19.4	17.5	18.6	20.0	22.2
Direction of Maximum Hourly Speed	W	NW	SE	W	NW	NW	NW	W	NW	NW	NW	E	W

Note:

[a] Location: 65°16'57.000" N, 126°48'01.000" W; Elevation: 72.5m. Climate Station ID: 2202800

Source: ECCC (2022c)

Table 4.8 Climate Normal Data, Fort Simpson Airport Station [a], NT (1981-2010)

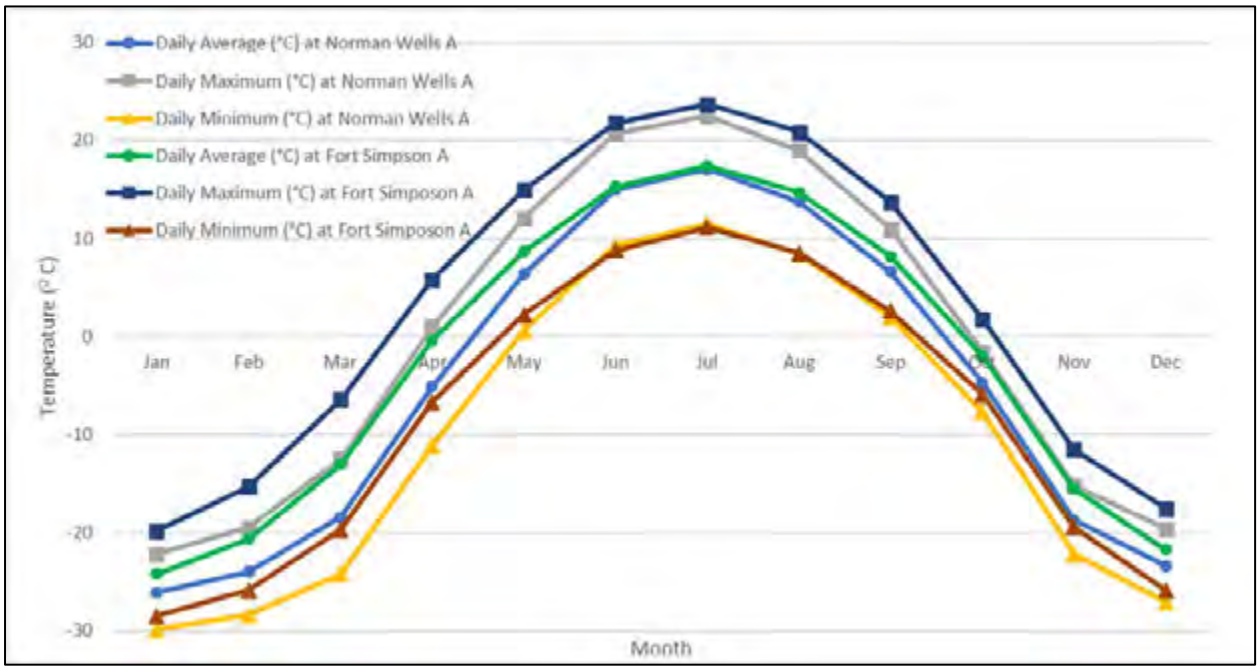
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature													
Daily Average (°C)	-24.2	-20.6	-13	-0.4	8.7	15.3	17.4	14.7	8.2	-2	-15.5	-21.7	-2.8
Standard Deviation	4.6	3.5	3.6	2.6	2.2	1.1	1.2	1.6	2	2	3.8	3.6	4.1
Daily Maximum (°C)	-19.8	-15.3	-6.4	5.8	15	21.8	23.7	20.9	13.7	1.8	-11.5	-17.5	2.7
Daily Minimum (°C)	-28.5	-25.9	-19.7	-6.7	2.2	8.8	11.2	8.5	2.6	-5.9	-19.4	-25.9	-8.2
Extreme Maximum (°C)	13.2	14.4	16.1	25.5	32.8	33.9	36.6	35.4	30	24.9	12.2	14.5	36.6
Extreme Minimum (°C)	-50	-53.3	-42.2	-38.3	-17.5	-2.2	-1.1	-3.7	-20.6	-27.7	-41.7	-50.6	-53.3
Precipitation													
Rainfall (mm)	0.2	0	0.1	2.5	21	51.2	61.1	60.9	28.5	12.9	0.1	0	238.6
Snowfall (cm)	27.4	24.2	19	17.4	7.6	0.1	0	0.5	4.2	29	33.4	24.3	187
Snow Water Equivalent (mm)	18.7	17.6	15.3	14.5	8.4	0.1	0	0.5	3.7	26.5	24.7	19.1	149
Precipitation (mm)	18.9	17.6	15.4	17	29.4	51.3	61.1	61.4	32.2	39.4	24.8	19.1	387.6
Extreme Daily Rainfall (mm)	2.4	0.8	2.6	10.7	30.8	85.8	57.2	52.4	42.4	45.9	4.3	0	
Extreme Daily Snowfall (cm)	13.5	27	19.3	33.8	29.5	1.8	0	15.2	14.6	22.8	30.4	16.2	
Extreme Daily Precipitation (mm)	12.7	14.2	18.8	38.4	30.8	85.8	57.2	52.4	42.4	45.9	27	13.3	
Wind													
Maximum Hourly Speed (m/s)	12.8	16.4	13.9	15.6	16.4	12.8	13.3	18.3	18.1	13.9	12.8	13.3	18.3
Direction of Maximum Hourly Speed	NW	NW	N	SW	N	NW	S	SW	NW	N	N	NW	SW

Note:

[a] Location: 61°45'37.000" N, 121°14'12.000" W; Elevation: 169.2m. Climate Station ID: 2202101

Source: ECCC (2022c)

Figure 4.6 Summary of Daily Temperatures at Norman Wells Airport and Fort Simpson Airport (1981 to 2010)



4.3.2 Precipitation

Precipitation includes rain and snowfall, with rain occurring mostly from May to September and snow from October to April for both stations. Most of the annual rain occurs during the three summer months (June, July, and August). At both climate stations, roughly 70% of the annual rainfall occurs during these months. For snowfall, the peak snow months for both climate stations are October to December; roughly 50% of the total annual snowfalls occurs during these months. However, for those peak months (October to December) the total amount of precipitation (rain and snow) is relatively low, when compared to the Canadian precipitation climatology (Government of Canada, 2020b).

Recorded extreme daily rainfall amounts range from 49.3 millimetres (mm; July 19, 1967) at Norman Wells in July to 85.8 mm (June 30, 1988) at Fort Simpsons in June. Extreme daily snowfall values are 28.4 centimetres (cm; April 29, 1972) at Norman Wells and 33.8 cm (April 25, 1981) at Fort Simpson, both recorded in the month of April.

Annual total rainfall at Fort Simpson is higher than at Norman Wells (238.6 mm versus 171.7 mm); whereas annual total snowfall is similar between the two stations with Fort Simpson recording 187 cm and Norman Wells 161.5 cm. Annual rainfall, snow water equivalent and total precipitation values are shown graphically in Figure 4.7 and Figure 4.8. Snow water equivalent values are obtained by deducting monthly rainfall values from monthly precipitation values. The snow water equivalent describes the depth of water that would result if the snow were melted instantaneously.

Figure 4.7 Summary of Monthly Precipitation at Norman Wells Airport (1980 to 2010)

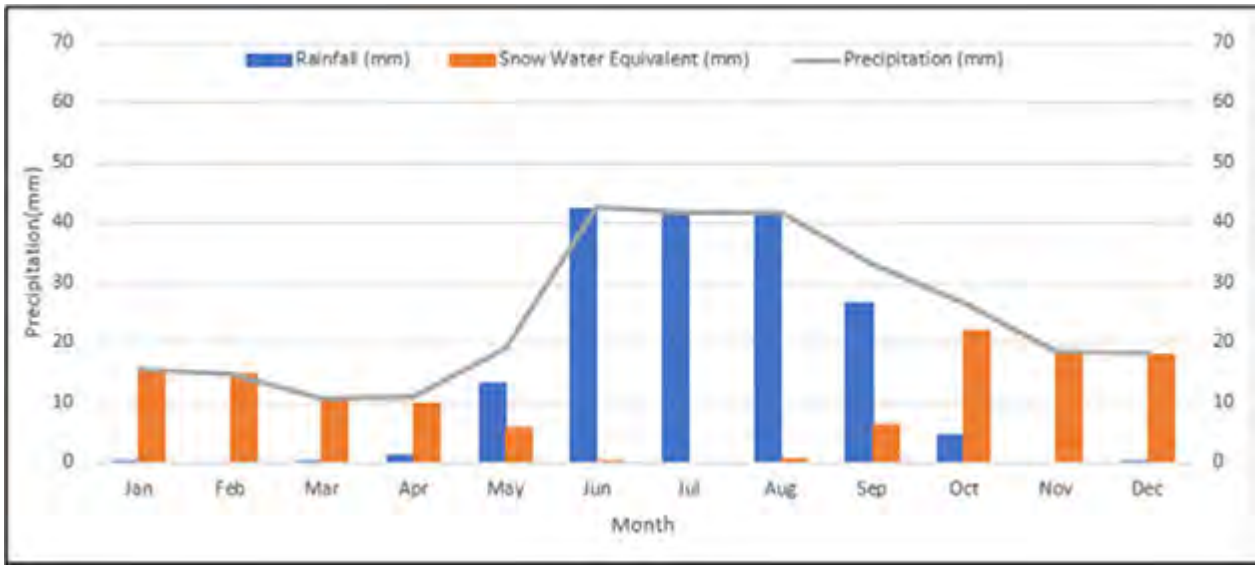
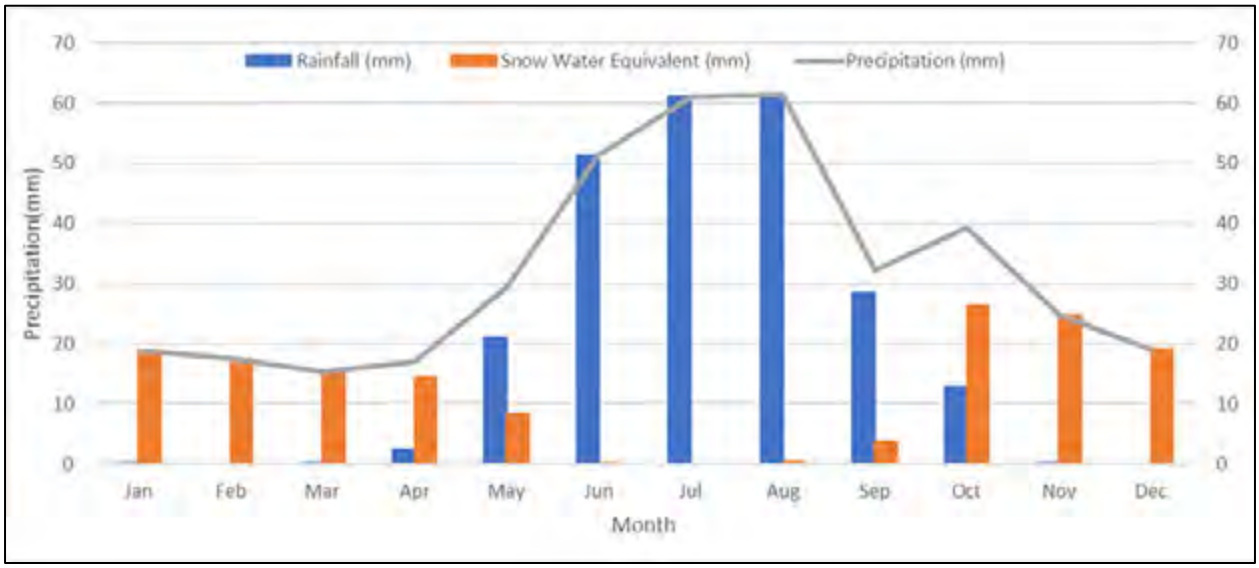


Figure 4.8 Summary of Monthly Precipitation at Fort Simpson Airport (1980 to 2010)



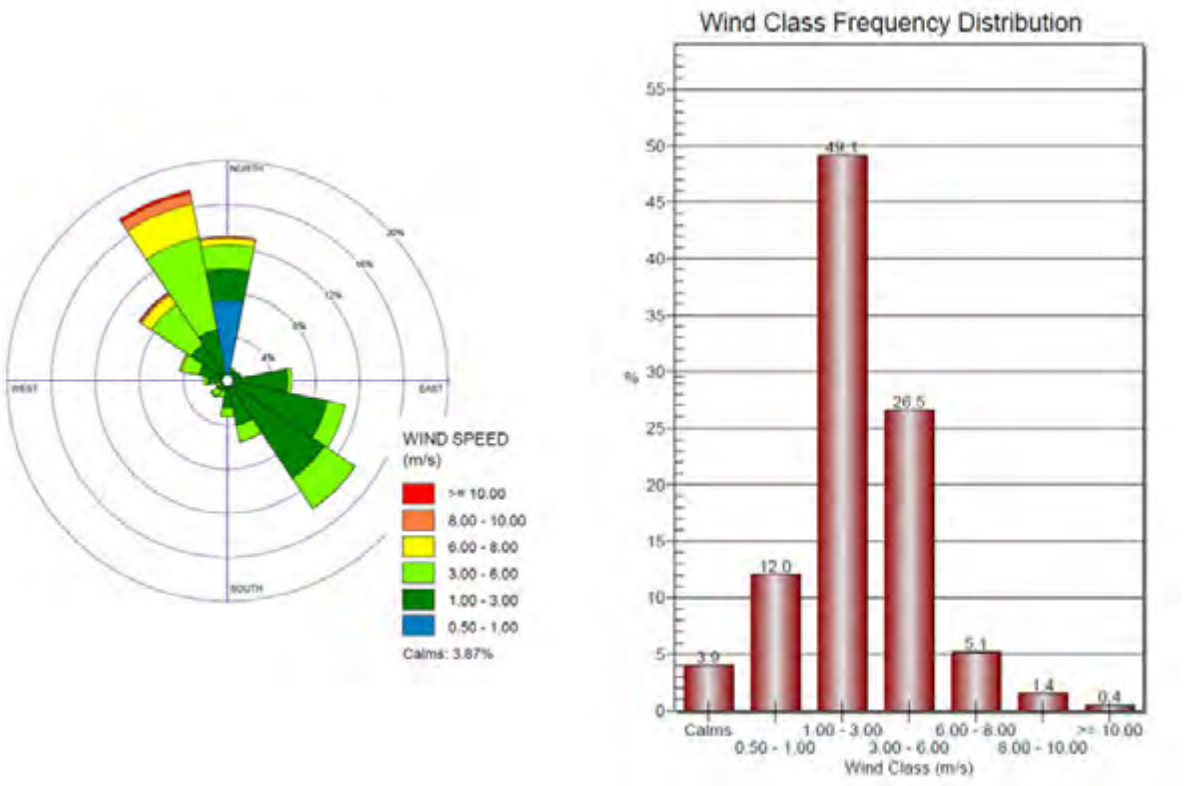
4.3.3 Wind Speed and Direction

Wind roses and wind class frequency distribution are shown in Figure 4.9 and Figure 4.10. Wind roses summarize graphically how wind speed and direction are typically distributed. The length of each spoke indicates how frequent that the wind blows from a particular direction, with the color showing the wind speed frequency associated with each direction. The wind class frequency distribution is shown in the same figures.

At Fort Simpson, 91.5% of the hourly wind speeds recorded are below 6 m/s. Most of the time (i.e., 49.1%), wind speeds are between 1 metre per second (m/s) to 3 m/s. Only 0.4% of all the hourly wind speeds are higher than 10 m/s. Prevailing wind directions are north-northwest, north, and southeast. Stronger winds (i.e., wind speed greater than 10 m/s) tend to be from the northerly directions (Figure 4.9).

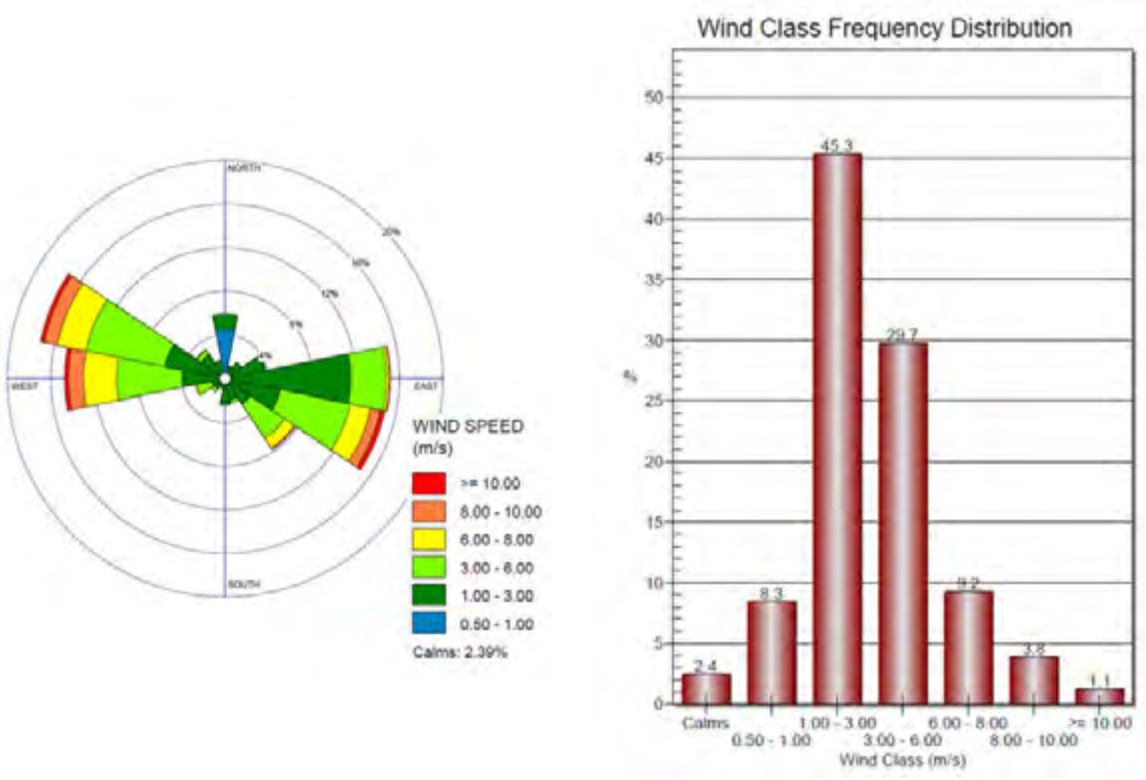
Wind speeds are greater at Norman Wells compared to Fort Simpson. At Norman Wells, 85.7% of the hourly wind speeds recorded are below 6 m/s, 13.2% of the wind speeds are between 6 m/s and 10 m/s, and 1.1% of the hourly wind speeds are above 10 m/s. Prevailing wind directions are east-southeast, east, west-northwest, and west, with strong winds (i.e. wind speed greater than 10 m/s) coming from east-southeast, west-northwest, and west directions (Figure 4.10).

Figure 4.9 Summary of Hourly Wind Speeds at Fort Simpson Airport (2021)



Source: ECCC Historical Data (2022e)

Figure 4.10 Summary of Hourly Wind Speeds at Norman Wells Airport (2021)



Source: ECCC Historical Data (2022e)

4.3.4 Visibility

Visibility describes the distance at which an object of suitable size can be seen and identified. Atmospheric visibility can be impacted by precipitation, fog, haze, or other suspended particles in the air such as snow or dust (Government of Canada, 2020c). Visibility, as recorded in the climate normals, is separated into three categories: less than 1 km, between 1 km and 9 km and more than 9 km (ECCC, 2022c).

Visibility at Norman Wells and Fort Simpson is similar, with roughly 8,000 hours out of a possible 8,760 hours a year having a visibility of more than 9 km. This is 92% of the year. The highest frequency of high visibility (greater than 9 km) is for the summer months (700.8 hours for Norman Wells and 703.1 hours for Fort Simpson). For approximately 70 hours per year, the visibility is less than 1 km for both stations, with most of these hours occurring during the fall months (Table 4.9 and Table 4.10).

Table 4.9 Summary of Monthly Average Visibility, Norman Wells A Station, NT (1981-2010)

Parameter	Average				
	DJF	MAM	JJA	SON	Annual
Visibility (hours with)					
< 1 km	6.9	1	4.5	10.1	67.4
1 to 9 km	86.2	30.7	30.8	108.5	768.5
> 9 km	628.8	696.3	700.8	617.4	7,929.6

Notes:
DJF=December, January, and February; MAM=March, April, May; JJA=June, July, August; SON=September, October, November.

Table 4.10 Summary of Monthly Average Visibility, Fort Simpson A Station, NT (1981-2010)

Parameter	Average				
	DJF	MAM	JJA	SON	Annual
Visibility (hours with)					
< 1 km	4.5	2.8	4.6	11.2	68.8
1 to 9 km	76.6	25.7	28.3	98.2	686.4
> 9 km	640.9	699.6	703.1	626.6	8,010.5

Notes:
DJF=December, January, and February; MAM=March, April, May; JJA=June, July, August; SON=September, October, November.

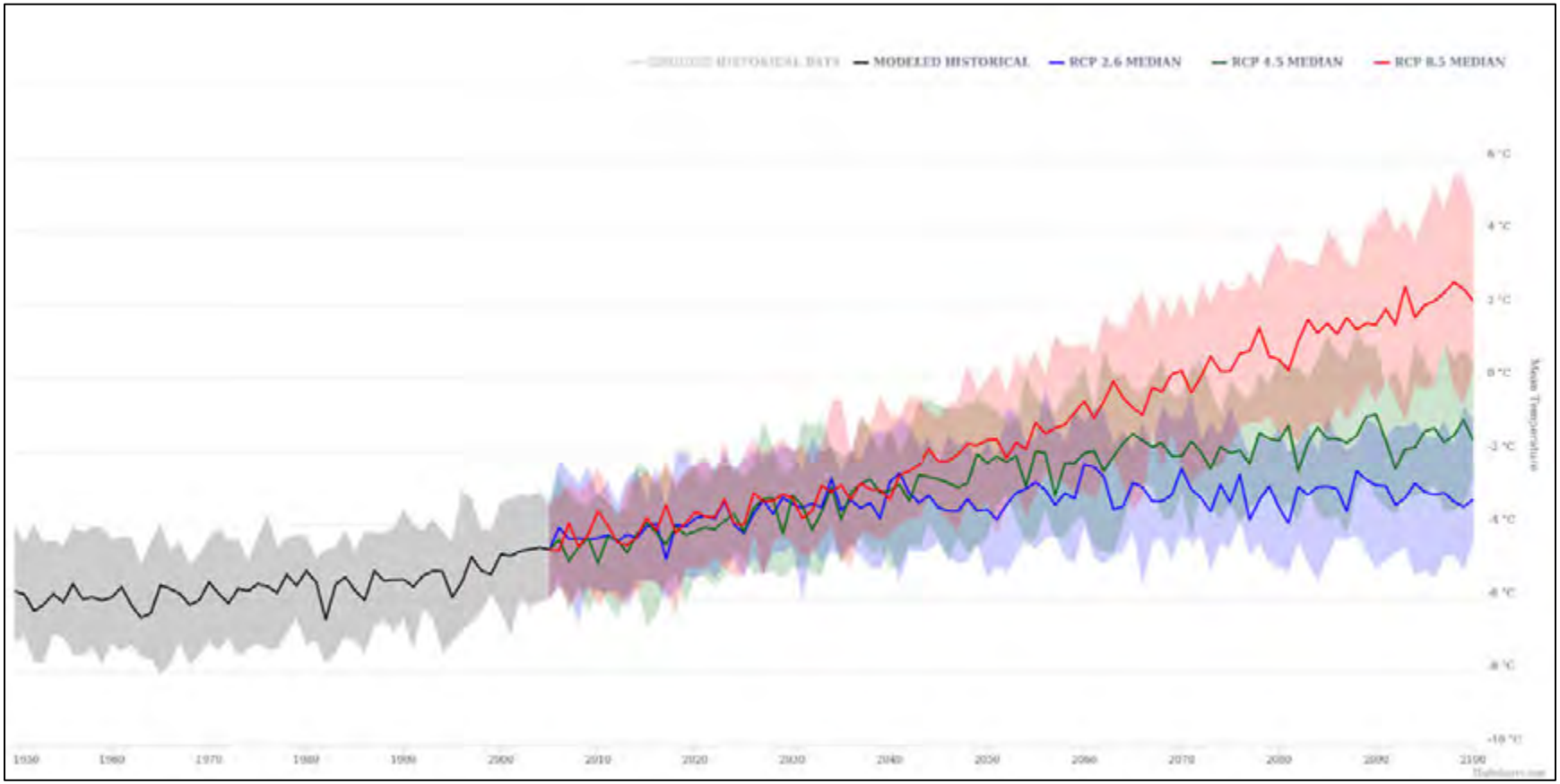
4.4 Climate Change

Climate change is defined as the long-term continuous increase or decrease of any statistical form of climatic variables such as temperature and precipitation. The statistical form can be mean, variability or extreme (ECCC, 2022d).

Climate change is observed at a more rapid rate in the Arctic regions than in southern regions around the world. This is apparent in the temperature changes over the last three decades in the NT compared to temperature changes observed in the rest of North America. Specifically, the Mackenzie Valley is considered a warming hotspot. Greatest warming and increases in precipitation are observed during the winter months. This trend is expected to continue in the future (Government of Canada, 2019).

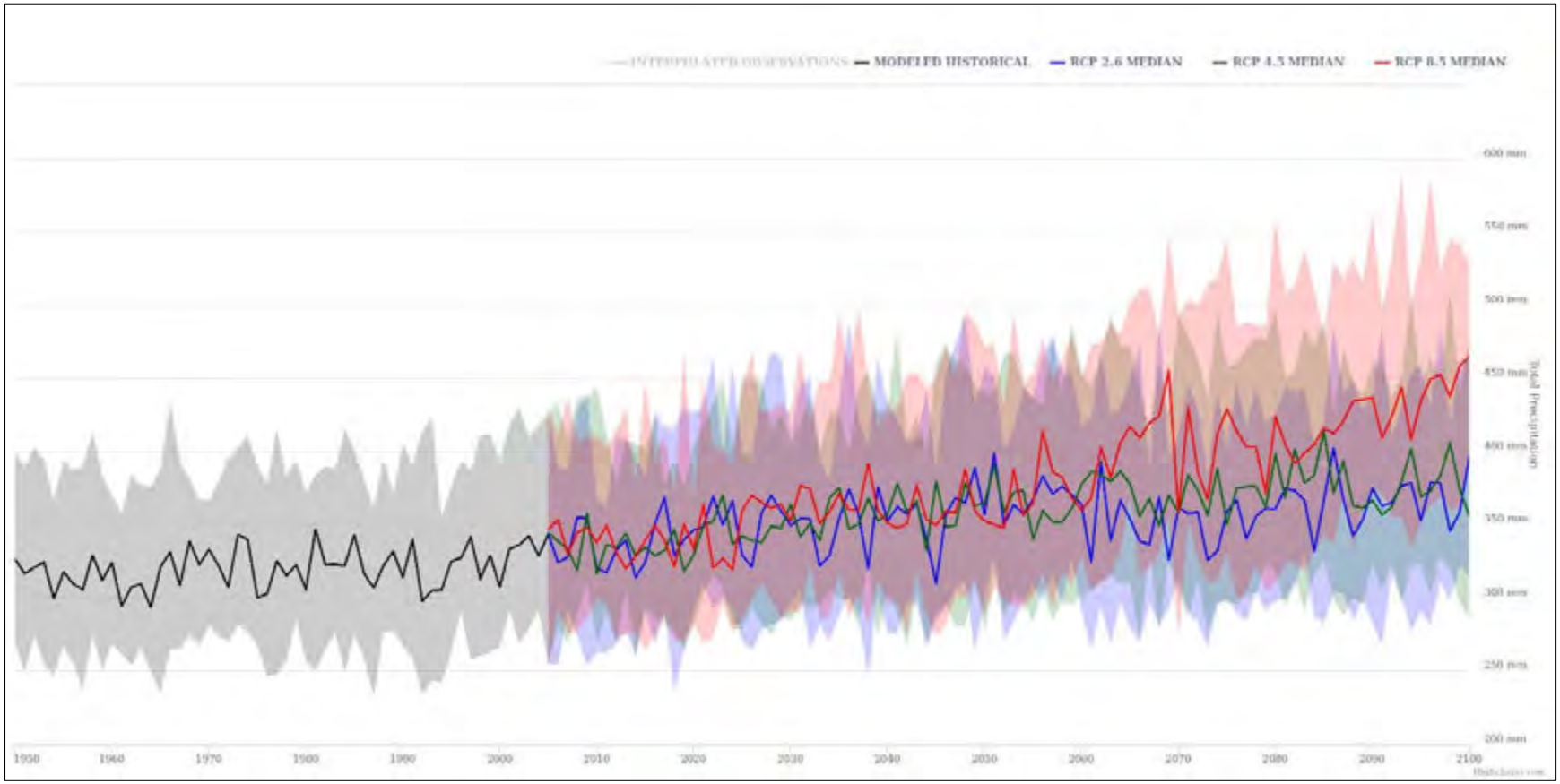
Climate change predictions for Norman Wells shown in Table 4.11, Figure 4.11, and Figure 4.12 were obtained from ClimateData (ECCC, 2022d). ClimateData is a collaboration between ECCC and several climate modelling institutes across Canada, providing climate forecast data for all of Canada. Although there are many sources of regional meteorology and climate information (e.g., GNWT-ENR Forest Management Division fire weather stations, Geological Survey of Canada, regional research stations), ClimateData is widely recognized as a reliable source of climate change forecast information.

Figure 4.11 Norman Wells Climate Change Projection for Average Annual Temperature



Source: Figure sourced from ECCC (2022d)

Figure 4.12 Norman Wells Climate Change Projection for Annual Total Precipitation



Source: Figure sourced from ECCC (2022d)

Table 4.11 Climate Change Predictions for Norman Wells

Parameter	Climate Change Prediction				
	1951-1980	1981-2010	2021-2050	2051-2080	2071-2100
Annual Average Temperature (°C)	-5.8	-5.2	-2.9	-0.5	1.3
Annual Total Precipitation (mm)	328	294	358	393	419

Note:
The future projections represent the median under the RCP8.5 scenario (high emission scenario) for Norman Wells. Past data for 1951-1980 and for 1981-2010 is based on measured climate normal data.

Source: Future climate predictions from ClimateData (ECCC, 2022d), historical climate data information from climate normal for Norman Wells from ECCC (2022c)

Data from ClimateData is based on 24 climate models used to simulate global climate response to varying concentrations of GHGs. These varying concentrations are represented by three scenarios: the so-called representative concentration pathways (RCP). These pathways consider different assumptions regarding demographic and socioeconomic development or technological change. The three scenarios are low emission scenario RCP2.6, moderate emission scenario RCP4.5, and high emission scenario RCP8.5. For this assessment, the RCP8.5 scenario is assumed to occur, which results in the highest level of global warming and climate change. This scenario assumes that GHG concentrations will continue to increase in the atmosphere at the same rate as they are now, leading to the highest GHG concentration in the atmosphere for the various RCPs.

Measured annual average temperature values for the 1951-1980 period for Norman Wells were -5.8°C. For the most recent climate normals period from 1981-2010, the annual average temperature was 0.6°C warmer, reaching -5.2°C (ECCC, 2022c). Under a high emissions scenario, this value is expected to increase further. For the period of 2021-2050 the annual average temperature is forecasted to be -2.9°C, -0.5°C for the period of 2051-2080, and 1.3°C for the last thirty years of this century. This indicates a change from a negative annual average temperature to a positive temperature (Table 4.11) (ECCC, 2022d).

Similarly, annual total precipitation values are forecasted to increase to 358 mm for 2021-2050, to 393 mm for 2051-2080 and to 419 mm for 2071-2100. This indicates a 28% increase for the period of 2071-2100 when compared to the average value from 1951-1980 of 328 mm (Table 4.11) (ECCC, 2022c). Forecasted annual total precipitation and annual average temperature for Norman Wells are also shown graphically in Figure 4.11 and Figure 4.12. Data shown as a grey line is historical modelled data for Norman Wells from 1950-2005. Data in color represents forecasted data based on the three RCPs in the future until 2100. The shaded area in the graphs represent the 90th percentile and the 10th percentile of the model results. The bold line in the middle of the shading indicates the median value of all the climate models, which indicates half of the model predictions are above the median line and half are below (ECCC, 2022d).

For more information on how a changing climate may affect the Project, refer to the Effects of the Environment on the Project section/chapter in the MVH DAR. For additional information on how a changing climate may impact other physical environments, see the individual technical data reports (e.g., Technical Data Report, Soils, Vegetation, Terrain, and Permafrost).

5 References

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5.2 Personal Communications

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Rudkevitch, Logan. 2020. Personal communication. Email correspondence and telephone discussions (October 15, 2020) between Dan Jarratt, P.Eng. (K'alo-Stantec Ltd.) and Logan Rudkevitch (GNWT-ENR Climate Change Information Management Specialist) regarding the preferred information sources for climate change predictions for the MVH Project.

APPENDIX 13A

Acoustic Environment Baseline Technical Data Report

Mackenzie Valley Highway Project Technical Data Report—Acoustic Environment Baseline

Prepared for:

Government of the Northwest Territories

Prepared by:

K'alo-Stantec Limited

December 2022

Project No.: 144903025

K'alo-Stantec

Limitations and Sign-off

This document entitled Mackenzie Valley Highway Project Technical Data Report—Acoustic Environment Baseline was prepared by K'alo-Stantec Limited ("K'alo-Stantec") for the account of Government of the Northwest Territories (the "Client") to support the regulatory review process for its Developer's Assessment Report (DAR) (the "Application") for the Mackenzie Valley Highway Project (the "Project"). In connection therewith, this document may be reviewed and used by the Department of Infrastructure (INF) for the Government of the Northwest Territories participating in the review process in the normal course of its duties. Except as set forth in the previous sentence, any reliance on this document by any other party or use of it for any other purpose is strictly prohibited. The material in it reflects K'alo-Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between K'alo-Stantec and the Client. The information and conclusions in the document are based on the conditions existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, K'alo-Stantec did not verify information supplied to it by the Client or others, unless expressly stated otherwise in the document. Any use that another party makes of this document is the responsibility and risk of such party. Such party agrees that K'alo-Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other party as a result of decisions made or actions taken based on this document.

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Executive Summary

The Government of the Northwest Territories (GNWT), Department of Infrastructure (INF) is proposing the Mackenzie Valley Highway Project (the "Project") that will extend the Mackenzie Highway (Northwest Territories Highway #1) from Wrigley to Norman Wells to replace the Mackenzie Valley Winter Road (MVWR) along this portion. The Project includes construction of approximately 281 kilometres (km) of new all-season highway, and the construction and operation of temporary and permanent quarry and borrow sources. The project highway alignment will pass through the Dehcho Region and a portion of the Tulita District of the Sahtu Region within the Northwest Territories (NT).

This technical data report (TDR) presents detailed technical data and analysis of the baseline acoustic environment for the Project.

Data and information reviewed for this report included traditional knowledge (TK) and traditional use (TU) information pertaining to acoustic environment. Traditional knowledge relevant to this TDR specifically focused on caribou behavioral responses to noise. The reviewed TK and TU indicates that interviewees generally agreed that caribou are not necessarily impacted by construction equipment or vehicular traffic and become accustomed over the years; however, not all interviewees agreed with this.

Other documents reviewed included the baseline noise survey results conducted in the area from the Mackenzie Gas Project (as reported in 2004) and Enbridge Pipelines Project. Based on the average measurement results from these projects, the baseline day-night sound level (L_{dn}) for the Mackenzie Valley Highway (MVH) Project is assumed to be 38 dBA (A-weighted decibels). The measurement locations in the Mackenzie Gas Project and Enbridge Pipelines Project are representative of remote areas without any development, similar to the acoustic local study area (LSA) and regional study area (RSA) for the MVH Project baseline noise levels are assumed the same for the project footprint along the proposed highway route and near the proposed borrow sources.

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Abbreviations

ATV ..... all-terrain vehicle

BC OGC ..... British Columbian Oil and Gas Commission

DAR ..... Developer's Assessment Report

dB ..... decibel

dBA ..... A-weighted decibels

GNWT ..... Government of the Northwest Territories

HC ..... Health Canada

INF ..... Department of Infrastructure

km ..... kilometre

L_d ..... daytime sound level

L_{dn} ..... day-night sound level

L_{max} ..... maximum sound level

L_n ..... nighttime sound level

LSA ..... Local Study Area

m ..... metre

MVH ..... Mackenzie Valley Highway

MVRMA ..... *Mackenzie Valley Resource Management Act*

MVWR ..... Mackenzie Valley Winter Road

NT ..... Northwest Territories

RSA ..... Regional Study Area

TDR ..... Technical Data Report

the Project ..... Mackenzie Valley Highway Project

TK ..... traditional knowledge

ToR ..... Terms of Reference

TU ..... traditional use

Glossary

A-Weighting Sound (dBA)	A weighting of the frequencies in a sound that approximates the response of the human ear to frequencies in moderately loud sounds (sound pressure levels in the range of 45-65 dBA).
Daytime	A time period from 7:00 AM to 10:00 PM
Daytime Sound Level (L_d)	L_d - Daytime period equivalent sound level (15 hours from 7:00 AM to 10:00 PM)
Day-night Sound Level (L_{dn})	L_{dn} - An equivalent continuous sound level taken over 24 hours, with the night-time (10:00 PM to 7:00 AM) sound contributions increased by 10 decibels (dB). A 10 dB penalty added to the nighttime period to account for the increased sensitivity to noise during the night.
24-hour equivalent Sound Level (LA_{eq}-24hr)	An energy-average sound level taken over a 24-hour period of time. It represents the average sound pressure encountered for the period. L_{eq} is usually A-weighted. An L_{eq} value expressed in A-weighted dB (dBA) is a good, single value descriptor of the annoyance of noise.
Decibel (dB)	A logarithmic unit of measurement that expresses the magnitude of sound pressure level relative to reference level (20 micro-Pascals). It is dimensionless unit since it expresses the ratio of two quantities with the same unit.
MVH Project Area (Project Area)	The area to be utilized by the Project and includes the proposed alignment of the MVH between Wrigley and Norman Wells and a 100 m buffer on either side. It also includes the temporary and permanent borrow sources and associated access roads.
Nighttime	A time period from 10:00 PM to 7:00 AM.
Nighttime Sound Level (L_n)	Ln - Nighttime period equivalent sound level (9 hours from 10:00 PM to 7:00 AM).

Noise	Unwanted sound.
Sound	Acoustic energy added to the ambient air in the form of fluctuating pressure.

1 Introduction

The Government of the Northwest Territories (GNWT), Department of Infrastructure (INF) is proposing the Mackenzie Valley Highway Project (the "Project") that will extend the Mackenzie Highway (Northwest Territories Highway #1) from Wrigley to Norman Wells to replace the Mackenzie Valley Winter Road (MVWR) along this portion. The Project includes construction of approximately 281 kilometres (km) of new all-season highway, and the construction and operation of temporary and permanent quarry and borrow sources. The project highway alignment will pass through the Dehcho Region and a portion of the Tulita District of the Sahtu Region within the Northwest Territories (NT; Figure 1.1).

The Project is subject to an environmental assessment and the requirements of Part 5 of the *Mackenzie Valley Resource Management Act* (MVRMA). As part of the environmental assessment process, the Developer's Assessment Report (DAR) assesses how development of the proposed Project could affect the acoustic environment.

This technical data report (TDR) presents the existing conditions (baseline) for the acoustic environment to support development of the DAR as required by the Terms of Reference (ToR; MVEIRB, 2015).

The required elements specified in the ToR with respect to baseline conditions include describing the existing acoustic environment "along the proposed highway route", including noise sources, types and boundaries, and any relevant standards, guidelines, or objectives. This report describes the existing acoustic environment within the acoustic local and regional study areas.

Relevant territorial, provincial, and federal noise guidelines are discussed in this TDR with the focus on their purpose and use in determining baseline sound levels.

- Proposed Mackenzie Valley Highway Alignment - Issued for EA 2022
- Granular Borrow / Rock Quarry Site and Access
- Quarry
- Local Study Area
- Regional Study Area
- Community
- All-Season Road
- Winter Road
- District Boundary
- Region Boundary
- Settlement Area Boundary

0 10 20 Kilometres

(At original document size of 8.5x11)
1:600,000

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Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by AT on 2023-03-07
TR by AJ on 2023-03-07

Client/Project
144903025-0029 REVB

Government of Northwest Territories
Mackenzie Valley Highway Project

Figure No.
1.1

Title
Project Location, Local Study Area, and Regional Study Area

Notes
1. Coordinate System: NAD 1983 Northwest Territories Lambert
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Topographic Map: Esri, FAO, NOAA, USGS, NRCan
World Imagery: Earthstar Geographics
World Hillshade: Esri, USGS

2 Regulatory Framework

The GNWT has developed guidelines that, along with legislation, regulations and policies, help manage the environment in the NT. However, there is no dedicated regulation or guideline that regulates the acoustic environment.

In the absence of territorial noise regulations, noise guidelines from Alberta and British Columbia are included to provide additional information for the estimation of baseline sound levels for the Project.

In addition to provincial noise guidelines, federal noise guidance such as the Health Canada (HC) Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise (HC, 2017) can be referenced for noise assessment of large infrastructure projects. The HC document provides generic guidance on predicting health risks related to sound predicted in federal environmental assessments of proposed major resource and infrastructure projects. The guidance includes recommendations for estimating baseline sound levels.

3 Noise Descriptors

The noise descriptors commonly used in federal and provincial guideline documents are the daytime (L_d), nighttime (L_n), day-night (L_{dn}) and maximum (L_{max}) sound levels. L_d and L_n are the continuous equivalent (energy-averaged) sound levels calculated over the daytime (07:00 AM – 10:00 PM) and nighttime (10:00 PM – 07:00 AM) periods, respectively. L_{dn} is the day-night average sound level over a 24-hour period with 10 decibels (dB) penalty added to nighttime sound level because of increased sensitivity to nighttime noise.

Health Canada guidance widely uses L_d, L_n and L_{dn} parameters for estimation of baseline noise levels and assessment of the effects of project-related noise from construction activities and project operation. This baseline TDR uses the same parameters to describe the Project's baseline acoustic environment.

4 Study Area

The Project is located in the Mackenzie Valley region of the NT between the current terminus of the existing all-weather highway in Wrigley (Northwest Territories Highway #1) and Prohibition Creek (approximately 28 km south of Norman Wells). The Project highway alignment parallels the Mackenzie River to its east and passes through the community of Tulita. The Project is located in sparsely populated areas except those parts of the highway alignment near the communities of Wrigley, Tulita and Norman Wells. The existing acoustic environment is dominated mostly by the sounds of natural environment such as wind, rainfall, running water and wildlife. Noise contributions from human activity are present near the settlements of Wrigley, Tulita and Norman Wells and along the footprint of the existing Mackenzie Valley Winter Road. These human activities are transient in nature and include local traffic, operation of off-road vehicles and snow-machines, helicopter, and aircraft flyovers.

The local and regional study areas presented in this TDR are the areas where data were compiled/collected to allow for an understanding of the environment in support of the project-specific effects assessment and the cumulative effect assessment.

The local and regional study areas (LSA and RSA respectively) presented in this TDR partially overlap with the local and regional study areas of Mackenzie Gas Project (IORVL, 2004). As part of Mackenzie Gas Project environmental impact studies (IORVL, 2004) and Enbridge Pipelines Project (Enbridge, 2018), baseline sound surveys were conducted near Norman Wells and at other remote locations with acoustic environments similar to the LSA and RSA. The baseline sound survey results obtained at these remote locations are considered representative of the acoustic LSA and RSA because of the similar acoustic environment. In addition, noise effects near the existing MVWR during the four months of operation is referenced from the Mackenzie Valley Highway Extension Pehdzeh Ki Ndeh – Dehcho Region Project Description Report (Dessau, 2012).

4.1 Local Study Area

The LSA for the characterization of existing conditions is a 1.5 km buffer around the centerline of the highway alignment and quarry/borrow access roads and 1.5 km buffer around the footprint of the proposed quarry/borrow sources. Potential quarry/borrow sources in Sahtu Region and in the Dehcho Region are shown in Figure 1.1. Project-related noise effects are expected to occur within the LSA; outside the LSA, noise effects are expected to be negligible due to natural atmospheric attenuation and ground absorption. Project residual noise effects are not expected to extend beyond the LSA. Figure 1.1 shows the spatial boundaries of the acoustic environment LSA.

4.2 Regional Study Area

The RSA for the characterization of existing conditions was set as a 3 km (double of LSA) buffer around centerline of the highway alignment and 3 km buffer around the footprint of the proposed quarry/borrow sources. Potential quarry/borrow sources in Sahtu Region and in the Dehcho Region are shown in Figure 1.1. The RSA is to account for other existing and future physical activities that may have effects that act cumulatively with the project effects and to provide context for project specific effects and cumulative effects. Physical activities located beyond the 3 km buffer are not expected to interact with project residual acoustic effects due to natural atmospheric attenuation and ground absorption. Figure 1.1 shows the spatial boundaries of the acoustic environment RSA.

5 Review of Existing Data

This section of TDR presents a summary of baseline sound level information obtained from past projects and Health Canada guidance. It also presents a summary of traditional knowledge and traditional use related to the acoustic environment.

5.1 Traditional Knowledge and Traditional Use

The Traditional Knowledge Assessment of Boreal Caribou (Mbedzih) in the Dehcho Region (Dehcho First Nations, 2011) report was reviewed for traditional knowledge (TK) and traditional use (TU) related to the acoustic environment. This report presents TK related to caribou behavior, specifically caribou responses to noise. The TK and TU information provided in the report is based on interviewee responses to noise and light disturbance related questions. The interview questionnaire asked the following noise and light disturbance related questions:

1. Have you observed noise or light disturbance from aircraft, skidoos, all-terrain vehicles (ATVs), or industry affecting woodland caribou in your area?
2. If so, how is it affecting the caribou?
3. Do you notice areas where it is more of a problem?
4. Do you have suggestions for how to address this?

The findings described below do not give a strong indication of the existing anthropogenic noise in the LSA; however, they provide information on the possible impact of the noise related to project activities on wildlife.

The report (Dehcho First Nations, 2011) summarizes that: “Interviewees generally agreed that woodland caribou, like most animals, will not necessarily be impacted by machines or industrial noise such as graders or pumping stations, or a skidoo driven at a reasonable pace”.

Some of the interviewees indicated that: “in the past, animals including caribou and moose were more likely to be frightened by industrial or vehicular noises but have become accustomed over the years”. Not all interviewees agreed that caribou become accustomed to anthropogenic noise. There were some interviewees who feel that industrial and vehicular noise would be negative for the caribou and cause them to flee.

Boreal Caribou TK Collection Study (McDonald et al., 2010) for the Sahtu Settlement Area was also reviewed for TK and TU information related to the acoustic environment. The study acknowledges that noise from general construction activities and from construction traffic is a major disturbance factor for the boreal woodland caribou. According to the study: “*caribou prefer old growth areas and have a tendency to stay away from winter roads because of noise pollution*”. That study recommends that any development should not occur during the calving season or near caribou habitat.

Project activities (construction and operation) have potential to impact other important harvested species, such as moose. The reviewed TK and TU information for the Dehcho Region (Dehcho First Nations, 2011) and the Sahtu Settlement Area (McDonald et al., 2010) is focused on the impacts of human-induced changes to caribou habitat as an important harvested species. That TK and TU information does not provide any specific data on the impacts of increased anthropogenic sound levels to the habitats of other harvested species, such as moose. There is currently a gap in information related to harvested species other than caribou.

5.2 Mackenzie Gas Project and Enbridge Pipelines Project

Baseline sound surveys were conducted for two projects located near the Project area. The LSA and RSA presented in this TDR partially overlap with the LSA and RSA of the Mackenzie Gas Project (IORVL, 2004), and the Enbridge Pipelines Project (Enbridge, 2018) is located approximately 200 km south of the acoustic environment LSA. Baseline sound surveys were conducted near Norman Wells, Niglintgak, and Inuvik Area for the Mackenzie Gas Project, and near Fort Simpsons for the Enbridge Pipelines Project. The baseline sound survey results obtained at these locations are considered representative of the acoustic LSA and RSA for the Mackenzie Valley Highway (MVH) Project because of the similar acoustic environment for remote areas without any development. Further, the Norman Wells survey location is within the acoustic RSA. Baseline sound survey results based on the Mackenzie Gas Project and Enbridge Pipelines Project are provided in Table 5.1. The summer L_{dn} are higher than the winter L_{dn} for the Niglintgak and Inuvik Area Facility locations. The range of values in the results indicate variability due to season and locations. The estimated average baseline sound level is 34 A-weighted decibels (dBA) and 31 dBA, based on the logarithmic average of measured L_d and L_n for all locations. The equivalent L_{dn} of 38 dBA is based on the L_d of 34 dBA and L_n of 31 dBA.

Table 5.1 Baseline Sound Survey Results – Mackenzie Gas Project and Enbridge Pipelines Project

Reference Project	Sound Survey Location and Time	Daytime L_d (dBA)	Nighttime L_n (dBA)	Day-Night L_{dn} (dBA)
Mackenzie Gas Project	Winter Sound Levels at Niglintgak. Nov 30 – Dec 1, 2002	37	33	40
	Summer Sound Levels at Niglintgak. July 6 – 7, 2003	38	36	43
	Winter Sound Levels at the Inuvik Area Facility. Dec 3 – 4, 2002	21	19	26
	Summer Sound Levels at the Inuvik Area Facility. July 5 – 6, 2003	33	25	34
	Summer Sound Levels at Norman Wells. July 10 – 11, 2003	32	32	38
Enbridge Pipelines Project	Spring Sound Levels at Fort Simpsons. April 2 – 4, 2018	27	22	29
	Average baseline sound level	34	31	38

5.3 Mackenzie Valley Winter Road

Baseline sound level information for MVWR was reviewed in project description documents for the Dehcho Region (Dessau, 2012) and Sahtu Region (5658 NWT Ltd. and GNWT, 2011).

The MVH highway alignment largely follows the route of the existing MVWR, which is used only during winter for a 4-month period (Dessau, 2012). In winter months, the traffic noise from MVWR is not continuous due to low traffic volume: the annual average number of vehicles travelling on the MVWR is 50 to 99 vehicles according to GNWT Department of Transportation data for 2006 (Dessau, 2012). Based on approximate traffic volume, the project description for Dehcho Region estimates that LA_{eq}-24hr levels within narrow strip around the MVWR (approximately 25 metres [m] from road centerline) are 50 dBA (Dessau, 2012).

The project description for the Sahtu Settlement Area (5658 NWT Ltd. and GNWT, 2011) states that the highway construction noise is expected to have limited, localized, and temporary impacts in the vicinity of the MVWR. Heavy equipment and truck movements and blasting are the known major sources of the noise associated with highway construction. The project description for Sahtu Settlement Area estimates that the noise levels associated with dump trucks and haul trucks are typically within 78 dBA to 82 dBA range at 15-meter distance from the trucks. The project description for Sahtu Settlement Area does not estimate the noise levels associated with the highway traffic volumes.

5.4 Provincial Noise Guidelines

Comparable noise guidelines from other provinces include the Alberta Energy Regulator Directive 038: Noise Control (AER, 2007), Alberta Utilities Rule 012: Noise Control (AUC, 2021) and British Columbia Oil and Gas Commission (BC OGC) Noise Control Best Practices Guideline (BC OGC, 2021).

In absence of ambient sound level measurements, these provincial guidelines recommend that the average rural ambient sound level can be assumed equal to approximately L_d of 45 dBA and L_n of 35 dBA. The daytime adjustment recognizes that daytime ambient sound levels are commonly 10 dB higher than nighttime levels. The equivalent L_{dn} value would be 45 dBA, based on the L_d of 45 dBA and L_n of 35 dBA. All three provincial guidelines indicate that the recommended ambient sound level for rural area may not apply in a pristine area. Pristine area is defined as a natural area that might have a dwelling but no industrial presence, including energy, agricultural, forestry, manufacturing, recreational or other industries that affect the noise environment.

5.5 Health Canada

Health Canada guidance recommends that the standard approach for baseline sound determinations is direct measurement (HC, 2017). However, the guidance also provides alternative approaches to estimate baseline levels in different community types. For quiet rural communities, HC noise guidance suggests the estimated baseline sound level L_{dn} to be 45 dBA or less. Quiet rural communities are described as community with dwelling units more than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers. The guidance also includes one conservative (i.e., most protective) approach which is to consider a reasonable worst-case scenario and assume L_{dn} baselines of 35 dBA for rural areas.

6 Key Results and Findings

The measured and estimated daytime and nighttime baseline sound level for period without MVWR operation are summarized in Table 6.1 for comparison.

Table 6.1 Baseline Sound Level Summary

Source	Daytime L_d (dBA)	Nighttime L_n (dBA)	Day-Night L_{dn} (dBA)
Mackenzie Gas Project and Enbridge Pipelines Project average baseline sound levels	34	31	38
Alberta and British Columbia noise guidelines	45	35	45
Health Canada noise guidance – quiet rural communities	45	35	45
Health Canada noise guidance – most protective approach	35	25	35

Most areas within the LSA and RSA are considered remote without any development. Anthropogenic sounds from human activities are present at certain segments of the LSA and RSA (near the settlements of Wrigley and Tulita and Norman Wells, and along the MVWR). The acoustic environment within most of the acoustic LSA and RSA of the MVH Project is expected to be dominated by natural sounds.

The measurement locations in the Mackenzie Gas Project and Enbridge Pipelines Project, described in Section 5.2, are representative of remote areas without any development, similar to the Project acoustic environment LSA and RSA. The baseline sound level L_{dn} for the MVH Project is assumed to be 38 dBA, based on the average measurement results from the Mackenzie Gas Project and Enbridge Pipelines Project. The MVH Project baseline noise levels are assumed to be the same along the proposed highway route as they are near the proposed quarry/borrow sources.

The HC noise guidance and provincial noise guidelines recommend the L_{dn} of 45 dBA for rural communities. However, measurement results from the Mackenzie Gas Project indicate lower baseline sound levels. HC guidance recommends measured baseline data in areas with similar acoustical environments. The Mackenzie Gas Project and Enbridge Pipelines Project measurement results are considered to be more representative than the most protective baseline sound level value of 35 dBA L_{dn}.

During the four months of MVWR operation, it was estimated that L_{24hr} levels within narrow strip around MVWR (approximately 25 m from road centerline) are 50 dBA (Dessau, 2012).

During construction phase, the noise from construction activities within the LSA will affect ambient sound levels. During the operation stage, the ambient sound levels will be affected by increased traffic volume.

7 Closure

This TDR was prepared for the sole benefit of GNWT to describe existing conditions related to acoustic environment within the Project LSA and RSA. If you have any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,

K’alo-Stantec Limited

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APPENDIX 13B

Effect Parameter Noise Maps

Figure 13B.1 Noise Map - Construction Phase – Construction Mobilization - Short-Term Community Annoyance (L_{dn})

Figure 13B.2 Noise Map - Construction Phase – Road Construction - Short-Term Community Annoyance (L_{dn}) - First Day

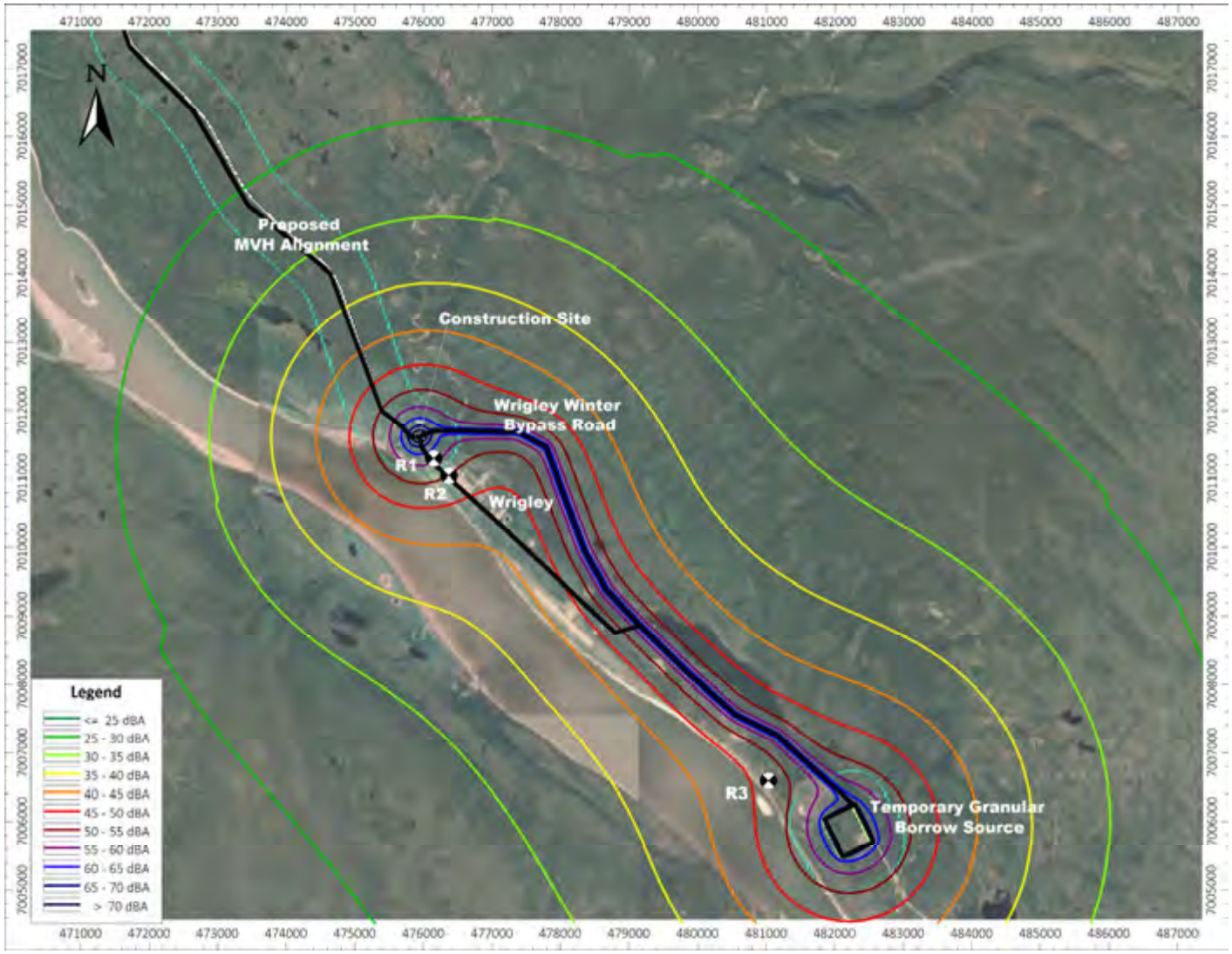

Figure 13B.3 Noise Map - Construction Phase – Road Construction - Short-Term Community Annoyance (L_{dn}) - After 11 Days

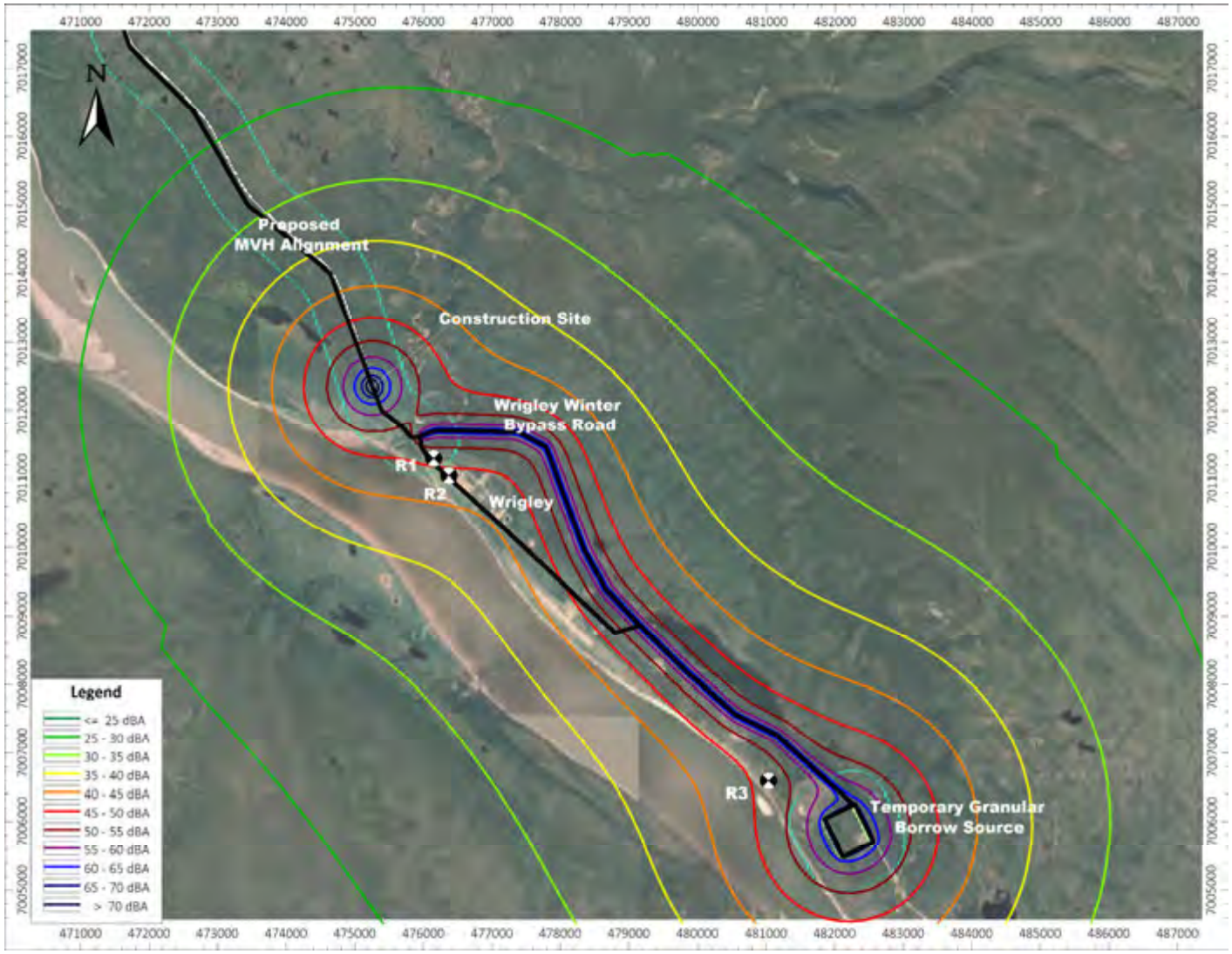

Figure 13B.4 Noise Map - Operations and Maintenance Phase - Traffic Noise ($L_{eq-24hr}$)