Government of Northwest Territories
Gouvernement des Territoires du Nord-Ouest

Via Email

Mr. Mason Mantla
Chair
Wek'èezhìı Land and Water Board
1-4905 48 STREET
YELLOWKNIFE NT X1A 3S3

JUN 12 2023

Dear Mr. Mantla:

<u>Tłįchǫ All-Season Road (Tłįchǫ Highway) – Wildlife Management and Monitoring Plan Version 6.2</u>

Following an annual review of the Wildlife Management and Monitoring Plan (WMMP) Version 5.2 for the Tłįchǫ All-Season Road (TASR), now known as the Tłįchǫ Highway, the Government of the Northwest Territories' Department of Infrastructure is pleased to submit WMMP Version 6.2 to the Wek'èezhìı Land and Water Board for their review and approval.

The WMMP Version 5.2 was reviewed and revised in accordance with Part B Condition 8 of the Tłįchǫ Highway Water Licence (W2020L8-0001), and in satisfying the requirement of Measure 10-2, Part 3 of the Mackenzie Valley Review Board's *Report of Environmental Assessment and Reasons for Decision* for the TASR Project. As part of the review process, Version 6.0 of the WMMP went through a public review process after which Version 6.1 was submitted to the Wek'èezhìı Renewable Resources Board (WRRB) in accordance with Section 12.5.1 of the Tłįchǫ Agreement. On May 26, 2023, the WRRB approved the WMMP Version 6.1 without any recommended changes. The attached document history and conformance tables provide details of the revisions made to Version 5.2.

Should you have any questions or concerns please contact me at (867) 767-9086 ext. 31117 or by email at Ziaur_Rahman@gov.nt.ca at your earliest convenience.

Sincerely,

Ziaur Rahman
Manager, Surface Design and Construction
Department of Infrastructure

Attachment
cc. Dr. Erin Kelly
Deputy Minister
Environment and Climate Change

Ms. Bertha Rabesca-Zoe, Tłįchǫ Executive Officer
Tłįchǫ Government

Table 6.0 - Wildlife Management and Monitoring Plan (Version 6.2) – Conformance Table

Reviewer	2022 Annual Review of Wildlife Management and Monitoring Plan Version 6.0 (2023-03-20)	Section	Proponents Reponses and Review Updates Revisions made in WMMP Version 6.1 (2023-04-13)
Wek'èezhìi Renewable Resources Board (WRRB)			
WRRB	**Comment:** WRRB Staff have reviewed the WMMP and have no comments at this time. The Board will formally review Version 6.0 of the WMMP after April 6 when it is submitted to the WRRB. **Recommendation:** N/A	N/A	INF would like to thank the WRRB for their collaboration and support for this project.
Wek'èezhìi Land and Water Board (WLWB)			
WLWB - 1	**Comment:** The second bullet point under section 4.1.2 states that "In the event that the operational phase requires additional gravel, quarry permits will be acquired". Board staff note that activities associated with quarrying (e.g., use of explosives, heavy vehicles, etc.) are permitted under Land Use Permits, and although GNWT-INF's Land Use Permit will expire in May 2024, Land Use Permits are not mentioned in this section of the WMMP. **Recommendation:** Please confirm that GNWT-INF will renew/apply for Land Use Permits when operational activities trigger a Land Use Permit and confirm whether this will be stated in Version 6.2 of the WMMP.	4.1.2	Yes, whenever applicable, a Land Use Permit (LUP) will be obtained prior to any operational activities that may trigger an LUP. Version 6.2 of the WMMP will be updated accordingly.
WLWB - 2	**Comment:** Various sections of the WMMP include hyperlinks that are not active. When clicked, no webpage appears, and additional information cannot be accessed (e.g., PR#7 and PR#110 on PDF pg 3, PR#238 on PDF page 87, the 2021 Annual Water Licence Report, etc.) **Recommendation:** Please confirm whether Version 6.2 of the WMMP will include active hyperlinks.	Various	Yes, Version 6.2 of the WMMP will include the applicable active hyperlinks.

Wildlife Management and Monitoring Plan

for the

Tłı̨chǫ Highway Project

Prepared for the

Wek'èezhìı Land and Water Board

And

Environment and Climate Change

W2020L8-0001 and W2016E0004

Version 6.2

June 12, 2023

Plan Maintenance and Control

The North Star Infrastructure (NSI) Environmental Manager is responsible for the overall distribution, maintenance and updating of the Wildlife Management and Monitoring Plan (WMMP) during construction and for 25 years of the operation phase; however, Government of Northwest Territories Department of Environment and Natural Resources/Climate Change (GNWT-ENR/ECC) and Government of Northwest Territories Department of Infrastructure (GNWT-INF) are responsible for updating sections of the plan where they have a leading role in the implementation of specific WMMP programs (e.g. Section 5.2). Final plan details must be approved by the GNWT-INF and GNWT-ENR and will be in accordance with conditions included in the land use permit and water licence issued by the Wek'èezhìı Land and Water Board (WLWB). Prior to approval of the WMMP by the Minister of Environment and Natural Resources/ Climate Change under s. 95(1) of the *Wildlife Act*, it will be submitted to the Wek'èezhìı Renewable Resources Board (WRRB) for review as per section 12.5.1 of the Tłı̨chǫ Agreement.

This WMMP will be reviewed and possibly revised as needed but at least annually, taking into account changes in the law, environmental factors, monitoring results, GNWT-INF and Project Co. policies, and any other pertinent site-specific changes.

Changes to this WMMP that do not affect the intent of the plan are to be made as required on a regular basis (e.g., phone numbers, names of individuals, etc.).

Wildlife Management and Monitoring Plan Document History

Revision #	Section(s) Revised	Description of Revision	Prepared by	Issue Date
1	All	Original version (in draft) to accompany permit application to Board for preliminary screening. Submitted in March 2016 (PR #7 to EA1617-01). Primary focus was mitigation associated with direct effects to wildlife resulting from construction. In August 2017, the GNWT also submitted a conceptual Wildlife Effects Monitoring Plan (WEMP) to MVEIRB, which focused on effects to wildlife extending beyond the Project footprint (PR#151).	GNWT-ENR	March 2016
2	All	Incorporate conceptual Wildlife Effects Monitoring Program. Updated Revision 1 to reflect the content of the Adequacy Statement Response and the responses to information requests and to include commitments from the technical sessions (PR #110).	GNWT-INF GNWT-ENR	September 2017
3	All	Incorporation of relevant GNWT-INF commitments from the Environmental Assessment (EA).	GNWT-INF	March 2018
3.1	All	Incorporate Measures from the Report of EA Considered the North Slave Métis Alliance (NSMA) traditional knowledge report	GNWT-INF	April 2018

Wildlife Management and Monitoring Plan Document History

Revision #	Section(s) Revised	Description of Revision	Prepared by	Issue Date
3.2	All	Incorporated review by GNWT ENR Added details for the Preferred Proponent, North Star Infrastructure Provided to WLWB for approval under W201L8-0001 and W2016E0004	GNWT-INF	January 2019
3.3	All	Includes revisions required by the WLWB in the Reasons for Decision for W201L8-0001 and W2016E0004. Includes changes requested by GNWT-ENR to GNWT-INF in a letter dated 3 June 2019. Considered the Yellowknives Dene First Nation traditional knowledge report	GNWT-INF NSI	June 2019
3.4	All	Revised to address WLWB reason for decision comments received by letter on August 23, 018 Revised to include WRRB comments received on 19 August 2019	NSI	August 26, 2019
4.0	5.2.1	Changed threshold for percent change in predicted traffic levels from those predicted in the DAR/Adequacy Statement to 100% (i.e. change from predicted traffic level of 20-40 vehicles/day to 40-80 vehicles/day); change was made to be consistent with the Thresholds section of section 5.2.1	ENR	September 07, 2020
4.0	5.2.2	Added new monitoring question and approach based on recommendation in WMMP review by Rettie (2019) to monitor the proliferation of new trails leading off of the road once it is opened for public use. Updated section on non-mandatory harvest monitoring program to reflect proposal submitted to GNWT by the Tłı̨chǫ Government.	ENR	September 07, 2020
4.0	5.2.3	Updated to reflect proposal submitted by Tłı̨chǫ Government to use traditional knowledge to monitor health of boreal caribou and the state of their habitat. Updated information on number of boreal caribou collars deployed and revisions to collar-based monitoring study area boundaries, including revised map. Added details and maps regarding the boreal caribou abundance survey conducted in Feb/Mar 2020, including a recommendation to repeat the survey towards the end of the first 5 years of operations.	ENR	September 07, 2020
4.0	5.2.4	Updated to reflect proposal submitted by Tłı̨chǫ Government to use traditional knowledge to monitor the state of barren-ground caribou (ʔekwǫ̀) winter habitat. Updated to reflect increased target for number of barren-ground caribou collared in the Bathurst herd. Added the use of weekly Core Bathurst Caribou Management Zone maps to monitor for overlap with a 10 km buffer around the Tłı̨chǫ Highway, which would trigger patrols.	ENR	September 07, 2020

Wildlife Management and Monitoring Plan Document History

Revision #	Section(s) Revised	Description of Revision	Prepared by	Issue Date
4.0	5.2.5	Added details about the 2018 moose/bison aerial survey. Based on recommendations of Rettie (2019), moose aerial surveys will be combined with the broader North Slave region moose surveys that occur about every 5 years, and bison aerial surveys will be combined with the Mackenzie bison population surveys which occur every 3-4 years.	ENR	September 07, 2020
4.0	5.2.6	Removed reference to harvest restrictions on Mackenzie bison, as there is a proposal to re-open a limited harvest now that the population exceeds 1000 individuals.	ENR	September 07, 2020
4.0	5.2.7	Added more detail to recognize limitations to monitoring predation rates of boreal caribou using collars identified in Rettie (2019). Added details about wolf abundance surveys conducted in Feb/Mar 2020, including maps, and a recommendation to repeat the survey towards the end of the first 5 years of construction.	ENR	September 07, 2020
4.0	ALL	Updated Conformance Tables 1 & 2 to address the following comments; ECCC – 16 and 17, NSMA – 20, TG-5, TG – 11, and WRRB – 18. Revised in response to WLWB's April 16, 2020 Decision Letter. Included the following Attachments: 1. Independent review of Tłı̨chǫ Highway WMMP report 2. 2019 Annual Water Licence Report 3. Migratory Bird Survey Report - Referenced in Section 2.8.2 4. Non-Intrusive Bird Nest Sweep Protocol in Section 5.1.4 (Appendix F)	NSI/GNWT-INF	September 15, 2020
4.1	All	Responded to comments from WRRB, WLWB, TG and ECCC. Relevant sections of the WMMP have been updated to reflect the responses indicated in Conformance Table 3.	NSI/-INF/ENR	November 6, 2020
4.2	2.8.2	Revised and removed the wording "and assess project effects on Species At Risk birds" as this is not part and the intent of EA Measure 10-1.	INF/ENR	January 20, 2021
5.0	2.8.1.	Updated to reflect that boreal caribou monitoring in the Wek'eezhii region indicates an increasing population trend	ENR	September 06, 2021
5.0	2.8.2	Updated Table 2 (Species At Risk Expected at the Project) and the section to reflect responses to ECCC's comments during 2019/20 annual review.	INF/ENR	September 07, 2021
5.0	3.0	Updated to capture all the Corridor Working Group Meetings held since the last annual review.	INF	September 07, 2021
5.0	4.3.1, 4.4.1	Updated description of pre-blast survey protocols to include that visual scans using both binoculars and a thermal imaging device.	NSI	September 06, 2021
5.0	5.1	Updated to reiterate GNWT's commitment to meet with TG to explore alternative method(s) of effective monitoring during the operations phase of the project	INF/ENR	September 07, 2021

Wildlife Management and Monitoring Plan Document History

Revision #	Section(s) Revised	Description of Revision	Prepared by	Issue Date
5.0	5.2.1	Added details about the location of traffic counters at the north end, middle and south end of the road.	ENR	September 06, 2021
5.0	5.2.3	Updated information about the number of boreal caribou collars deployed since the monitoring program began in March 2017	ENR	September 06, 2021
5.0	5.2.3	Updated to indicate that a more detailed assessment of the boreal caribou abundance survey report will be presented in a separate report, as it was not completed in time for inclusion in the 2020 annual Water Licence report.	ENR	September 06, 2021
5.0	5.2.6	Updated information about the status of development of an NWT Wildlife Watch app to track wildlife-vehicle collisions	ENR	September 06, 2021
5.0	6.1.1	Removed bullet requiring reporting on the implementation of the Wildlife Watch App in weekly reports during the construction phase, as the app was not ready in time for implementation during construction.	ENR	September 06, 2021
5.0	Appendix F	Pre-blast survey procedure: edited to indicate that pre-blast surveys are conducted "within a 500m the blast radius (or as determined by Blast Supervisor) prior to blasts." Added "Weather conditions/Air Temperature/Estimated Distance from the Animal" to the pre-blast survey form.	NSI	September 06, 2021
5.0	Appendix F	"Pre-Clearing Survey Procedure" changed to "Pre-clearing Large Mammal Survey Procedure".	NSI	September 06, 2021
5.0	Appendix L	Included INF's Response to ECCC's Comments on TASR 2019 Migratory Bird Baseline Study Report	INF	September 13, 2021
5.1	2.8.2	Changed the status of Short-Eared Owl under COSEWIC listings from "Special Concern" to "Threatened". Changed the status of Barn Swallow under COSEWIC listings from "Threatened" to "Special Concern". Changed the status of Red-Necked Phalarope under SARA from "No Status" to "Special Concern". Changed the status of Evening Grosbeak from "No Status" to "Special Concern".	INF	November 3, 2021
5.1	4.1.2	Updated the section with the following statement: "GNWT-INF/NSI will continue to follow the NWT forest fire prevention and suppression guidelines.	INF	November 3, 2021
5.1	5.2.6	Updated the section with the following statement: "Prior to the implementation of the Wildlife Watch Application, INF will continue using the existing wildlife-vehicle collision reporting form in collaboration with ENR. A copy of the form has been attached to Appendix F.	INF/ENR	November 3, 2021

Wildlife Management and Monitoring Plan Document History

Revision #	Section(s) Revised	Description of Revision	Prepared by	Issue Date
5.1	6.1.3	Updated the section with the following statement: "At the end of the Construction Phase, and the first 5 years of the Operations Phase, INF/NSI will submit to ENR a compiled version of all wildlife observations collected during surveys conducted by NSI. This data will be entered into ENR's Wildlife Management Information System (WMIS) which is ENR's wildlife data repository. All data from surveys and monitoring programs conducted by ENR under the TASR WMMP are also being entered into WMIS."	INF/ENR	November 3, 2021
5.1	Appendix C	Updated ECCC's contacts with current email addresses.	INF	November 3, 2021
5.1	Appendix F (Pages F-13 and F-32)	Updated ECCC's contacts with current email addresses. Also, included wildlife-vehicle collision reporting form.	INF	November 3, 2021
6.0	All	Updated with appropriate wording to reflect completion of the road.	INF/ENR/NSI	January 20, 2023
6.0	All	Where appropriate, replaced "Tłı̨chǫ ASR" with "Tłı̨chǫ Highway" to reflect the official name of the highway following construction completion as well as accepting recommendations from the CWG.	INF	January 5, 2023
6.0	2.1	Updated the section with the following statement: "The Tłı̨chǫ Highway reached substantial completion and opened to the public on November 31, 2021 per the contractual agreement"	INF	January 5, 2023
6.0	3.0	Updated to capture all the Corridor Working Group Meetings held since the last annual review.	INF	January 5, 2023
6.0	3.0	Paragraph six has been updated with the following statement: "On June 13 and December 7, 2022, the CWG held a face-to-face meeting in Whatì and Yellowknife, respectively".	INF	January 5, 2023
6.0	4.1.2	Bullet point #1 has been updated with the following statement: "In the event that the operational phase requires additional gravel, quarry permits will be acquired. These borrow pits will remain accessible only to NSI staff or subcontractors and blocked to unauthorized personnel. Protocols will follow the Quarry Operations Plan(s)".	NSI	January 6, 2023
6.0	5.1.1	Updated last paragraph with the following statement: "Maintenance of the sighting log will be discontinued during operations and be replaced with ENR's existing wildlife sightings and collisions reporting form".	INF/ENR	January 18, 2023
6.0	5.1.2	Updated with a new paragraph as follows, "During the Operations Phase, wildlife harvest monitoring (Measure 9-1) and incorporation of TK into monitoring of barren-ground caribou (Measure 7-1) will be undertaken by TG in collaboration with GNWT-ENR and support from GNWT-INF"	INF	January 18, 2023

Wildlife Management and Monitoring Plan Document History

Revision #	Section(s) Revised	Description of Revision	Prepared by	Issue Date
6.0	5.2.3	Updated the section to include all collar deployments until 2022 and the number of active collars at the end of 2022.	ENR	January 17, 2023
6.0	5.2.7	Updated the section to reflect the current survey data and results.	ENR	January 17, 2023
6.0	6.2	Updated with the following statement: "See the 2021 Water Licence Annual Report here"	INF/ENR	January 5, 2023
6.0	6.2.1	Updated to reflect the current status of the Project with the following statement: "This section applies to both construction and operation phases of the project. As with the construction phase, the operation phase will continue the adaptive management concept….."	INF/ENR	January 5, 2023
6.0	6.3.1	Updated last paragraph with the following statement: "TG and ENR undertake monitoring of wildlife and related activities along the highway following opening of the road".	INF/NSI	January 9, 2023
6.0	Appendix M	Added an Appendix M for ENR's Wildlife Collisions and Sightings Reporting Forms	INF	January 19, 2023
6.1	4.1.2	Bullet point #1 has been updated with the following statement: In the event that the operational phase requires additional gravel, quarry permits will be acquired. A valid LUP will also be in place for this operation, if required. These borrow pits will remain accessible only to NSI staff or subcontractors and blocked to unauthorized personnel. Protocols will follow the Quarry Operations Plan(s).	INF/NSI	April 13, 2023
6.1	ALL	The applicable hyperlinks have been updated and found to be active.	INF/NSI	April 13, 2023

Additional copies of the WMMP can be obtained from the NSI Environmental Manager and/or the GNWT representative responsible for the Tłı̨chǫ Highway, formerly known as the Tłı̨chǫ All Season Road (Tłı̨chǫ ASR).

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Definitions and Acronyms

Adaptive management	Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. The term is commonly thought of as "learning by doing". Active adaptive management typically involves active experimentation to simultaneously test a range of alternative management actions, whereas passive adaptive management may involve selecting only the "best" management option and evaluating the results to see if further adjustments are needed.
Construction Areas	Areas where there is active construction at that time.
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
Danger Zone	Areas determined by blast supervisor.
DNA	Deoxyribonucleic acid
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
Environmental Monitor	Individuals who observe Project activities in relation to permit conditions, and report observations to the NSI Environmental Manager so that mitigation actions can be taken if necessary.
GNWT	Government of the Northwest Territories
GNWT-ENR/ECC	Department of Environment and Natural Resources/Climate Change, GNWT
GNWT-INF	Department of Infrastructure, GNWT
GNWT-Lands	Department of Lands, GNWT
GPS	Global Positioning System
Habitat	The area or type of site where a species or an individual of a species of wildlife naturally occurs or on which it depends, directly or indirectly, to carry out its life processes (NWT *Wildlife Act*).
MBCA	*Migratory Birds Convention Act*
Mitigation	Measures taken to eliminate or reduce a potential Project effect.
Monitoring	The process of observing and documenting Project activities. This document distinguishes between "mitigation monitoring" which is undertaken to identify the need to apply or modify mitigations for the protection of wildlife and wildlife habitat at the project site, and "effects monitoring" which consists of the design and implementation of monitoring studies for quantifying project-related effects both within the project footprint and region.
MVEIRB	Mackenzie Valley Environmental Impact Review Board
NSI	North Star Infrastructure (Design-Build-Finance-Operate-Maintain Contractor)
NT1	The Northwest Territories Range for boreal caribou, used for critical habitat identification in the Recovery Strategy for the Woodland Caribou, Boreal population in Canada.
NWT	Northwest Territories
Project	The Tłı̨cho All Season Road

Project Co.	The company that was engaged to construct and operate the Tłı̨chǫ Highway.
Project site	The area encompassed by the Tłı̨chǫ Highway right of way, borrow pits, borrow pit access roads, and all equipment and infrastructure within this area.
SARA	*Species at Risk Act*
SARC	Species at Risk Committee
Tłı̨chǫ Highway	Tłı̨chǫ All Season Road
WEMP	Wildlife Effects Monitoring Plan
Wildlife	"wildlife" means (a) all species of vertebrates and invertebrates found wild in nature in the Northwest Territories, and individuals of those species, except (i) fish as defined in section 2 of the *Fisheries Act* (Canada), and (ii) other prescribed species and subspecies, (b) species of wildlife referred to in paragraph (a) that are domesticated or held in captivity, and individuals of those species, and (c) prescribed species or subspecies of vertebrates and invertebrates, and individuals of those species or subspecies. (NWT *Wildlife Act*).
WLWB	Wek'èezhìı Land and Water Board
Worker	A person employed by the Developer or the Contractor to work on the Project.
WRRB	Wek'èezhìı Renewable Resources Board
WMMP	Wildlife Management and Monitoring Plan

1.0 INTRODUCTION

The Government of the Northwest Territories (GNWT) constructed an all-season road from Highway 3 to the community of Whatì, called the Tłı̨chǫ Highway, formerly known as the Tłı̨chǫ All Season Road (or Tłı̨chǫ ASR/the Project). The route follows an old winter road route known as the 'Old Airport Road', that continues to be used for hunting, trapping and recreation (NSMA 2018, YKDFN 2018, Tłı̨chǫ Government 2014). Within the GNWT, this Project is led by the Department of Infrastructure (GNWT-INF). The Department of Environment and Natural Resources/Climate Change (GNWT-ENR/ECC) provided technical expertise on how potential highway impacts on wildlife and wildlife habitat could be mitigated and monitored.

The construction and operation of the Tłı̨chǫ Highway can impact wildlife and wildlife habitat in a number of ways, including direct habitat loss, habitat degradation, and functional habitat loss due to noise or other sensory disturbances, dust, accidental spills of toxic or hazardous substances, injury or mortality due to vehicle collisions, increased mortality associated with improved access for harvesters or wildlife-human interactions, increased mortality from facilitated predator movements, and wildlife attraction to construction camps. Particular concern over impacts to caribou from increased harvesting pressure, increased predation resulting from new access, increased road-induced mortality, and barrier effects, in addition to uncertainty regarding the effectiveness of mitigation measures were cited by the Mackenzie Valley Environmental Impact Review Board (MVEIRB) as reasons for referring the Project to environmental assessment (EA; MVEIRB 2016).

This Wildlife Management and Monitoring Plan (WMMP) outlines mitigation measures that are being implemented to reduce Project impacts on wildlife and wildlife habitat, and the monitoring actions proposed to understand the impacts of the Tłı̨chǫ Highway on wildlife, test the predictions made during the EA, and inform adaptive management. This document is intended to meet the requirements of s.95(2) of the *Wildlife Act* and other relevant legislation (see Appendix A), and to meet various measures and commitments in the Report of Environmental Assessment (PR #286; MVEIRB 2018), including the overarching guidance for WMMP updates and annual review described in Measure 10-2.

This document includes elements that are specific to the Project, and some that are extensions of existing GNWT-ENR programs. In general, the monitoring described in Section 5.1 is Project-specific, while the monitoring described in Section 5.2 contains programs that will fit into or expand upon existing GNWT-ENR programs and operations, as well as Project-specific elements, which will be implemented regardless of this WMMP.

This WMMP describes mitigation and monitoring that applies to both road construction and operation phases of the Project. In some cases, mitigation is phase-specific, whereas other mitigation applies to both phases, as indicated.

This document refers to documents by their public registry number (i.e., the first version of the WMMP was PR#7) to facilitate cross-referencing with the Project Description Report and other relevant documents already submitted to the MVEIRB public registry for EA1617-01.

2.0 BACKGROUND

2.1 Project Description

The Tłı̨chǫ Highway is an all-season two-lane gravel road (Appendix B). The Project footprint is comprised of the preferred route and is approximately 94 kilometres (km) in length with a 60 metre (m) right of way. A further 3 km of upgrades are required within Community Government of Whatì lands, bringing the total Project footprint to 97 km. The footprint also includes laydown areas, construction camps, and borrow sites with associated access roads with a 30 m right-of-way. A total of 14 borrow sites/quarries were developed either withing the existing RoW or via doglegged access roads Almost all access roads were planned to overlap with the preferred route right-of-way and borrow sites where applicable, and one borrow site was accessed from the existing community access road from Whatì. Thus, access roads to borrow sites did not create additional direct physical disturbance to the landscape. The cleared driving surface of the Tłı̨chǫ Highway is approximately 7 m wide. The Project follows a pre-existing overland winter road route, where possible, to minimize new disturbance to the landscape. The Project includes water crossings that utilize culverts and four bridge structures. Some blasting was undertaken, the majority of which was confined to the quarries as well as localized ditch and road cuts. The road has a posted speed limit of 70 kilometres per hour (km/h) during operations and will allow for year-round use by commercial and private vehicles. Traffic levels are estimated at 20 to 40 vehicles per day, including potential traffic from a proposed mine northeast of Whatì. Upon receiving approval from the WLWB and GNWT, construction commenced on the Tłı̨chǫ Highway on September 3, 2019. Favourable weather conditions in the fall and early winter of 2019 supported road construction/access pioneering, which ultimately led to accessing and installing temporary bridges at all water crossings along the alignment. Once access to the LaMartre River was gained, an ice crossing was prepared facilitating winter pile installation on both north and south sides of the river. Subsequently, the milestone for girder placement for the LaMartre River bridge structure was achieved on March 18, 2020. The Tłı̨chǫ Highway reached substantial completion and opened to the public on November 31, 2021 per the contractual agreement. Further Project description details are provided in the updated Project Description Report.

2.2 Objectives

The objectives of this WMMP include the following:

- Document and mitigate effects to wildlife from Tłı̨chǫ Highway construction and operation.

- Describe how adaptive management will be applied to wildlife mitigation and monitoring.
- Constitute part of the engagement with communities, regulatory agencies, and interested parties in wildlife effects mitigation and monitoring.
- Describe how the GNWT will meet relevant guidelines and regulatory requirements.
- Describe how wildlife monitoring for the Project will integrate with existing GNWT-ENR programs and initiatives, and with other wildlife monitoring in the area.

2.3 Statutory Requirements and Guidelines

Several federal and territorial acts and regulations apply to wildlife and wildlife habitat in relation to the Project, summarized in Table 1. Specific sections of the relevant acts are provided in Appendix A. The contents of this WMMP follow the requirements of Section 95(2) of the *Wildlife Act*.

Table 1: Regulatory Requirements for Wildlife and Wildlife Habitat Protection

Regulator	Regulatory Guidelines	Applicability to Wildlife Management and Monitoring Plan
Environment and Climate Change Canada (ECCC)	*Species at Risk Act* (SARA)	Under SARA, it is forbidden to kill, injure, harass, destroy the residence of, critical habitat of, capture or take an individual designated as extirpated, endangered, or threatened (Sections 32 and 33), or territorial lands (Section 34 [1]). An order by the Governor in Council may, based on the recommendation of the Minister of Environment, apply Sections 32 and/or 33 on territorial lands if the territorial laws do not effectively protect the species or its residences in question (Section 34 [2] and [3]).
ECCC	*Migratory Birds Convention Act* (MBCA) and Migratory Birds Regulations	The MBCA protects migratory birds and their nests throughout Canada. Migratory birds covered under the act include: waterfowl, waterbirds, shorebirds, and songbirds. The MBCA is the enabling statute for the *Migratory Birds Regulations*, 1994. These regulations state that without authorization of a permit, the disturbance or destruction of a nest or eggs of a migratory bird is prohibited. See Appendix A for relevant excerpts of the MBCA.

Table 1: Regulatory Requirements for Wildlife and Wildlife Habitat Protection

Regulator	Regulatory Guidelines	Applicability to Wildlife Management and Monitoring Plan
GNWT-ENR	*Wildlife Act*	The Northwest Territories (NWT) *Wildlife Act* pertains to all wildlife harvesting and management within the NWT. The Act states that a Wildlife Management and Monitoring Plan is required for projects that may cause significant disturbance to big game, substantially alter, damage or destroy habitat, pose a threat of serious harm or contribute to cumulative effects. The Act also states that no person shall, without a permit, chase, disturb, or harass wildlife. It prohibits the destruction, disturbance, or taking of the eggs or nests of birds, and the damage or destruction of a den, beaver dam or lodge, muskrat push-up or hibernaculum. Permits to haze wildlife or engage in an activity that may result in disturbance to an animal or destroy/damage a den, dam, or lodge, or eggs or nests of birds not listed under the MBCA may be issued by GNWT-ENR under the Act. The Act also states that a person is permitted to kill wildlife in defense of human life or property. See Appendix A for relevant excerpts of the NWT *Wildlife Act.*
GNWT-ENR	*Species at Risk (NWT) Act*	The *Species at Risk (NWT) Act* applies to both public and private lands throughout the NWT and includes private lands owned under land claims agreements. The Act applies to any wild animal, plant, or other species managed by the Government of Northwest Territories (GNWT). The Act is intended to be complementary to the federal *Species at Risk Act* and addresses concerns at the territorial level.
Wek'èezhìı Land and Water Board	Mackenzie Valley Land Use Regulations	Land use permits may include provisions for the protection of wildlife habitat. GNWT – Lands has compliance and enforcement responsibilities related to land use permits.

Other guidelines and documents that were considered in the preparation of this document include the following:

- Wildlife Management and Monitoring Plan (WMMP): Process and Content Guidelines
- Fortune Minerals NICO Project Wildlife and Wildlife Habitat Protection Plan (Draft)
- Fortune Minerals NICO Project Wildlife Effects Monitoring Plan (Draft)
- Guidelines for Dust Suppression
- Northern Land Use Guidelines: Camp and Support Facilities
- Northern Land Use Guidelines: Pits and Quarries
- Northern Land Use Guidelines: Access Roads and Trails
- Forest Fire Prevention and Suppression Guidelines for Industrial Activities

- Tłı̨chǫ Government Traditional Knowledge Study for the Proposed All-Season Road to Whatì
- North Slave Métis Alliance Report of Traditional Knowledge Study for the Proposed Tłı̨chǫ All-Season Road
- Yellowknives Dene First Nation Traditional Knowledge Report Summary for the Tłı̨chǫ All-Season Road
- Various documents prepared by the GNWT for the Tłı̨chǫ ASR Project EA, including the Project Description Report (PR #7), Adequacy Statement Response (PR #110), Information Request responses, Technical Report responses and Closing Arguments (PR #285), available on the Mackenzie Valley Review Board public registry for EA1617-01.
- Report of Environmental Assessment and Reasons for Decision (PR #286; MVEIRB 2018), Tłı̨chǫ Highway Project, Mackenzie Valley Review Board EA1617-01

2.4 Relevant Environmental Management Plans and Operating Procedures

Other environmental management plans or operating procedures that have some relevance to wildlife or wildlife habitat include the following:

- GNWT Erosion and Sediment Control Manual
- Tłı̨chǫ Highway (Tłı̨chǫ ASR) Erosion and Sediment Control Plan
- Tłı̨chǫ Highway Water Monitoring Plan
- Tłı̨chǫ Highway Fish and Fish Habitat Protection Plan
- Tłı̨chǫ Highway Waste Management Plan
- Tłı̨chǫ Highway Spill Contingency Plan
- Tłı̨chǫ Highway Quarry Operations Plan
- Tłı̨chǫ Highway Adaptive Management Framework
- Highway Operations Manual – Beaver Dam Removal

2.5 Lessons from other NWT Highways

The GNWT has mitigation and monitoring in place to reduce the impacts of existing NWT highways on wildlife during construction, maintenance, and operations. This section summarizes some of the relevant practices and experiences.

2.5.1 Bird Nesting

The GNWT has recent experience with managing birds nesting on infrastructure. For example, swallows routinely nest on the sides and underside of bridges, particularly when there is a platform (such as at the bridge drains). While this does not present a concern during normal use and inspections, there may be a hazard to the nests when conducting maintenance. To prevent swallow nesting on the underside of the Buffalo River Bridge prior to major rehabilitation in 2016 and 2017, the underside of the bridge was enclosed by netting in the spring prior to the work to prevent bird access. As a result, swallows were not observed in the area and no nesting occurred on the bridge.

Conversely, spikes were tried with less success. To deter ravens from nesting in the overhead steel trusses of the Buffalo River Bridge, bird spikes were installed prior to nesting season. The ravens successfully built their nest regardless of the spikes, as the spikes appeared to provide a better foothold for their nest. Work on the bridge had to be delayed until the chicks were fledged.

Typically, no effort is made to stop birds from nesting on operational structures such as bridges when there is no immediate hazard to the nest. However, unoccupied nest material may be removed during bridge cleaning operations.

With regards to the potential for bank and barn swallows nesting in highway aggregate stockpiles, GNWT-INF follows Environment and Climate Change Canada (ECCC) guidance to manage stockpile slopes. Slopes are maintained at less than 70 degrees to prevent nesting (ECCC 2017a). Additionally, vegetation clearing is conducted as part of highway maintenance along right of ways, outside of the migratory bird nesting season.

Physical deterrents, if required, was supposed to apply after the nesting period and prior to the arrival of birds in the Spring.

2.5.2 Bison Interactions

Based on experience on other Northwest Territories (NWT) highways, the majority of bison-vehicle collisions occur in the months of August to November, with a peak in October. This may be due to shorter daylight hours, meaning that more vehicle collisions occur in low light conditions, and lack of snow on the ground that makes it very difficult to see bison on the road (snow provides contrast). As driving conditions are generally still good at this time of year (no ice or snow), drivers may be driving faster than during the winter season. Bison tend to graze along the cleared right of way adjacent to roads and may do so more at this time of year than in mid-winter. Most collisions occur on straight and level sections of the road. Bison will travel on roads in winter, especially in years of deep snow.

In some winters, bison appear reluctant to leave the road, perhaps to avoid walking through deep snow. Plowing travel lanes for bison parallel to the road has been successful in reducing the number of animals on roads. In most cases, however, analyses of data available to the GNWT have not provided a clear explanation for why bison use roads or enter communities, how much time bison spend in places that result in conflicts, or how to prevent those incursions (Mackenzie Bison Working Group 2016).

Interactions with bison and highway operations occur during both construction and operation. During the four years of construction at the Deh Cho Bridge, bison were regularly present at open areas on the north approach. It was suspected that they selected these areas for the wind and associated shelter from insects. The bison did not seem to be disturbed by the construction activity, and often bedded within construction laydown areas. On rare occasions, bison got between an operator and the vehicle. In these instances, the operator would typically wait until the bison moved. During an anthrax outbreak, a bison monitor was hired to deter bison from the work area due to the human safety concerns. Significant efforts were also made to prevent bison from gaining access to the bridge during construction, and Texas Gates were added to the bridge to prevent access during operations.

With respect to highway operations, collisions with bison continue to be a significant concern. Bison collisions and mortalities were documented by the Mackenzie Bison Working Group (2016), reporting 270 bison-vehicle collisions on Highway 3 between 1989 and 2015. Although a full analysis of the available data has not been completed, the number of collisions varies year-to-year for unknown reasons and there appears to have been a general increase over time (Mackenzie Bison Working Group 2016).

To manage this risk, the GNWT includes wildlife-vehicle collisions in the “Drive Alive” Program, with a focus on bison. This program includes public messaging and campaigns to reduce the number of bison collisions. The following advice is provided through the program to educate drivers:

- Check road bulletins before departing
- Drive at speeds appropriate for the conditions, particularly at dusk and dawn, and don’t overdrive headlights
- Avoid distractions
- If you see wildlife, flash your hazard lights to warn drivers behind you
- Do not swerve suddenly, rather stop and wait for bison to leave the road
- Remember that most bison travel in herds

- Use your high beams whenever possible
- Wear your seatbelt
- Do not approach an injured animal

Also included in the Program is signage reminding drivers of the presence of bison and current updates.

In addition to the above steps in the "Drive Alive" Program, and to be consistent with the Mackenzie Bison Management Plan (Mackenzie Bison Working Group 2018), the following actions will be taken to document and minimize bison-vehicle collisions on Tłı̨chǫ Highway:

- Improve consistency of reporting of bison hit or killed in collisions (see Section 5.2.6) and document bison incursion into the community of Whatì.
- If bison incursion into the community of Whatì occurs, engage the community to find ways (including Traditional Knowledge) to reduce bison incursions.
- Improve public awareness and knowledge on what actions to take when bison are found in the community.
- Use both electronic and static signs to caution drivers about the presence of bison.
- Explore the use of alternatives to salt that do not attract bison.
- Post reduced speed signs in sections of the road with high frequency of bison presence.
- When hunting is re-opened, hunting near the road will be encouraged in an adaptive management approach to assess its effect on collision reduction.

2.6 Roles and Responsibilities

The implementation of the wildlife effects monitoring programs (Section 5.2) will be led by GNWT-ENR, GNWT-INF, or North Star Infrastructure (NSI), the company that was engaged to construct and operate (for 25 years) the Tłı̨chǫ Highway. Mitigation monitoring activities are led by NSI and conducted as required to fulfill the terms and conditions set out in regulatory approvals, licences and permits, to meet GNWT commitments. GNWT-ENR will assist NSI in the monitoring of the effectiveness of mitigation measures in avoiding or minimizing potential effects. Ultimately, GNWT-INF, in collaboration with NSI is responsible for the Tłı̨chǫ Highway, and to ensure that commitments in the WMMP are met and for monitoring the implementation of wildlife and wildlife habitat mitigation measures. The respective individuals reporting hierarchy and contact information is provided in Appendix C subject to change due to staffing changes and transitioning from construction to operations phase.

2.7 Spatial and Temporal Scales

2.7.1 Spatial Boundaries

The WMMP uses different spatial boundaries, depending on the objective and the species. The spatial boundaries include:

- The Project footprint (i.e., the road, right of way, and quarries) was used for questions related to direct effects (such as habitat loss, vehicle collisions, disturbance to nests, and traffic levels).
- Study areas extending beyond the Project footprint were used for questions related to indirect effects and are defined for each monitoring program described.

2.7.2 Temporal Boundaries

The Project is planned to occur during two phases:

- Construction phase: the period from the start of construction (September 2019) to the start of operation (substantially completed on Nov. 30, 2021)
- Operation phase: encompasses operation and maintenance activities throughout the life of the Project, which is anticipated to be indefinite.

For the purposes of the WMMP, wildlife effects monitoring is proposed to continue for at least five years following the completion of construction.

2.8 Focal Wildlife Species

The WMMP focuses on mitigating and monitoring the impacts to caribou, species at risk, as well as big game species and prescribed species identified in the *Wildlife Act* General Regulations for which impacts were identified in the Adequacy Statement Response (PR #110; e.g., moose and bison), and for which human safety concerns tend to arise (e.g., black bear). The WMMP does not exclude any wildlife from monitoring and addresses a broader range of species for which general prohibitions under the *Wildlife Act*, *Species at Risk Act,* and *Migratory Birds Convention Act* and associated regulations apply. Mitigation and monitoring measures are meant to address impacts to individuals of these species and their habitat. Species descriptions can generally be found in the Adequacy Statement Response (PR #110), but relevant additional clarifications are included below.

2.8.1 Caribou

The Project may interact with both boreal and barren-ground caribou (Tłı̨chǫ Government 2014, NSMA 2018, YKDFN 2019; Tłı̨chǫ ASR EA PR#189 & 190). As these two ecotypes of caribou may be difficult to distinguish, the mitigation and monitoring described in this document applies equally to both, unless otherwise stated. A brief description of boreal and barren-ground caribou is provided. Further details on caribou habitat availability, habitat distribution, survival, and reproduction are provided in the Adequacy Statement Response (PR #110).

Boreal caribou are distributed across the forested regions of Canada, reaching the northern limit of their range in the NWT. Both traditional knowledge (Tłı̨chǫ Government 2014, NSMA 2018, YKDFN 2019; Tłı̨chǫ ASR EA PR#178 & 179) and science based studies of boreal caribou in Wek'èezhìı suggest that boreal caribou have used areas along the proposed Project corridor, including some areas identified as traditional harvest sites and important habitat for boreal caribou (Tłı̨chǫ Government 2014). The Tłı̨chǫ Highway alignment is completely within the NT1 boreal caribou range as delineated in the national recovery strategy (EC 2012). Traditional knowledge indicates that the boreal caribou range includes parts of the proposed Tłı̨chǫ Highway route; however, the Elders indicated that the main habitat is to the west of the proposed corridor (Tłı̨chǫ Government 2014). The current population trend in the North Slave Region and Wek'èezhìı region is increasing (GNWT 2021; GNWT-INF, Kiewit and NSI 2021) and other areas, except in southern NWT, are believed to be stable or increasing (SARC 2012). A recovery strategy is in place to guide the protection and recovery of boreal caribou in the NWT (Conference of Management Authorities 2017). The amount of undisturbed habitat in the region is currently close to the 65% undisturbed habitat management threshold identified in the national recovery strategy. GNWT has completed a Framework for boreal caribou range planning which will guide what factors regional Range Plans will consider, how disturbance will be managed, what kinds of actions are recommended for different levels of disturbance, and how those actions will be implemented (GNWT 2019). It is anticipated that the drafting and implementation of range plans will include regular reassessment of boreal caribou habitat. Boreal caribou prefer mature to old conifer forests since these habitats contain lichen, which is the boreal caribou's primary winter food source, and are present throughout the year (EC 2012).

Barren-ground caribou migrate from boreal habitats in winter, to calving grounds north of the treeline in summer. While the Project is nearest to the Bathurst and Bluenose East herd ranges, the Project likely occurs outside of the core seasonal range boundaries described by barren-ground collared caribou cows and regular interaction with the Project is not expected. However, traditional knowledge indicates that barren-ground caribou have in the past been present in areas near the north end of the Project during winter (Tłı̨chǫ Government 2014, YKDFN 2018), likely during periods of high abundance (Tłı̨chǫ ASR EA PR#189 & 190). Due to the current low population of the Bathurst herd, harvest controls have been in place since 2010, currently limiting harvest of Bathurst caribou to zero, and a Bathurst Caribou Range Plan has been prepared (GNWT-ENR 2019).

2.8.2 Species at Risk

The intent of the *Species at Risk Act*, and the *Species at Risk (NWT) Act* is to protect species at risk from becoming extirpated or extinct as a result of human activity. While the former was enacted by the Government of Canada, the latter was enacted by the GNWT and applies only to wild animals and plants managed by the GNWT. For example, species managed by the *Migratory Bird Convention Act* and Regulations are not covered by the *Species at Risk (NWT) Act*. For the purposes of this WMMP (and as recommended by ECCC 2017b), species may be considered to be of concern as a result of either their national, territorial or Committee on the Status of Endangered Wildlife in Canada (COSEWIC) status (notwithstanding that COSEWIC does not provide legal protection). The list of species of concern that may be affected by the Tłı̨chǫ Highway Project is provided in Table 2. This table may be updated in the future to reflect the latest species assessments by the NWT Species at Risk Committee (SARC) and COSEWIC.

Table 2: Species At Risk Expected at the Project

Species	NWT SARC Assessment[(a)]	NWT List of Species at Risk	COSEWIC Listing[(b)]	SARA Listing[(c)]
Boreal caribou	Threatened	Threatened	Threatened	Threatened
Barren-ground caribou	Threatened	Threatened	Threatened	Threatened
Wood bison	Threatened	Threatened	Special Concern	Threatened
Wolverine	Not at Risk	No status	Special Concern	Special Concern
Little brown myotis	Special Concern	Special Concern	Endangered	Endangered
Peregrine falcon	Not assessed	No status	Not at Risk	Special Concern
Short-eared owl	Not assessed	No status	Threatened	Special Concern
Bank swallow	Not applicable	Not applicable	Threatened	Threatened
Barn swallow	Not applicable	Not applicable	Special Concern	Threatened
Common nighthawk	Not applicable	Not applicable	Special Concern	Threatened
Olive-sided flycatcher	Not applicable	Not applicable	Special Concern	Threatened

Table 2: Species At Risk Expected at the Project

Species	NWT SARC Assessment[a]	NWT List of Species at Risk	COSEWIC Listing[b]	SARA Listing[c]
Horned grebe (Western population)	Not applicable	Not applicable	Special Concern	Special Concern
Red-necked phalarope	Not applicable	Not applicable	Special Concern	Special Concern
Rusty blackbird	Not assessed	No status	Special Concern	Special Concern
Yellow rail	Not applicable	Not applicable	Special Concern	Special Concern
Evening Grosbeak	Not applicable	Not applicable	Special Concern	Special Concern
Harris's Sparrow	Not applicable	Not applicable	Special Concern	No Status
Gypsy cuckoo bumble bee	Data Deficient in the NWT	No status	Endangered	Endangered
Yellow-banded bumble bee	Not at Risk in the NWT	No status	Special Concern	Special Concern
Lesser Yellowlegs	Not applicable	Not applicable	Threatened	Under Consideration
Suckley's Cuckoo Bumble Bee	Not assessed	No status	Threatened	Under Consideration
Transverse Lady Beetle	Not assessed	No status	Special Concern	Special Concern

All listings sourced from NWT Species at Risk (2021)

a) Northwest Territories Species at Risk Committee. Note that species included in the Migratory Bird Convention Act are not covered by the Species at Risk (NWT) Act and are labelled 'Not applicable'.

b) Committee on the Status of Endangered Wildlife in Canada

c) Species at Risk Act.

In 2019, a Migratory Bird Survey was completed near the Tłįchǫ Highway alignment as a baseline survey in an attempt to confirm the occurrence or otherwise of Species At Risk birds, which may determine if additional mitigation measures are required. A copy of the report has been attached as Appendix G. The analysis completed to date did not identify any additional Species At Risk birds. Hence, no additional mitigation measures are being recommended at this time. GNWT-INF is working with ECCC to assess if further analyses are required, and if necessary, future versions of the WMMP will be updated accordingly following further analyses. GNWT-INF provided a detailed and formal response (Appendix L) to ECCC's comment during the 2019/20 annual review. Additionally, GNWT-INF submitted a copy of the survey's raw field data to ECCC in May 2021 at their request.

The WMMP is intended to be consistent with the proposed Recovery Strategy for the Wood Bison in Canada (ECCC 2018a) by including mitigation to reduce vehicle collisions and including a mechanism for documenting and reporting bison observations along the Tłı̨chǫ Highway. The WMMP does not conflict with any existing recovery strategy for species listed federally or territorially, which may be found in the Project Area.

2.9 Sensitive Periods for Wildlife:

Known sensitive periods for wildlife are listed in Table 3. Sensitive periods are not meant to imply that all construction activities needed to be suspended at these times; however, different types of pre-construction surveys and additional mitigation measures would have been required during these times to minimize sensory disturbance and/or risk of wildlife injury or mortality.

Table 3: Sensitive Periods for Wildlife and Rationale

Wildlife	Period	Rationale
Boreal Caribou Moose Bison	Calving/Post-Calving: 05 April to 15 July (caribou) 15 May to 15 July (moose) 1 March to 15 July (bison)	Timing window captures parturition (birth) and the first month of life for offspring. Female ungulates entering the parturition period are usually in poorer physical condition from the harsher climatic conditions and limited food availability throughout the winter period. After parturition, females are subject to additional energy demands from lactation, and generally attain their lowest body condition post-calving. Disturbance during the calving/fawning period can induce fleeing, increased movement of young and increased nutritional demands, and higher susceptibility to predation.
Boreal Caribou	Late-winter: 16 March to 04 April	Boreal caribou are exhibiting their shortest daily movements at this time of year, likely reflecting the increased energetic costs of travelling through deep snow at this time of year, or limited areas that provide easier access for foraging on ground. As boreal caribou are depleting their stores of fat throughout the winter, and movement through deep snow or displacement from good foraging habitat could have high energetic costs, disturbance events at this time of year could have negative impacts on female body condition and subsequently have negative impacts on calving and calf survival.
Birds	Nesting season: 01 May to August 15	Prohibition against damage or destruction of nests or eggs of migratory birds under Migratory Birds Regulations and the *Wildlife Act*. This sensitive period should cover the majority of species, but it should be noted that some raptor species may initiate nests as early as late March, and may remain at the nest until mid-September. (Shank and Poole 2016)
Black Bear	Denning season: September 30 to March 30	Prohibition under the *Wildlife Act* against damage or destruction of a den. Disturbance of denning bears could jeopardize survival of both adults and young born in the den.

Appendix D provides further details on how construction activities were modified based on sensitive periods and boreal caribou collar data.

3.0 POTENTIAL IMPACTS

The construction and operation of the Tłı̨chǫ Highway can impact wildlife and wildlife habitat in a number of ways, including direct habitat loss, habitat degradation and functional habitat loss due to noise, dust, spills of toxic or hazardous substances or other sensory disturbances, injury or mortality due to vehicle collisions, increased mortality associated with improved access for harvesters or wildlife-human interactions, increased mortality from facilitated predator movements, and wildlife attraction.

Follow-up monitoring under the *Mackenzie Valley Resource Management Act* is intended to evaluate the soundness of the EA. Potential impacts from the Project on wildlife are described in detail the Project Description Report (GNWT 2016) and the Adequacy Statement Response (PR #110), or are derived from traditional knowledge (Tłı̨chǫ Government 2014, NSMA 2018). Details of the proposed monitoring are provided in Section 5.0. To indicate the linkages between the EA and the proposed monitoring, Table 4 contains the Effects Pathways identified for wildlife in the Adequacy Statement Response (PR #110), and the associated monitoring that will address each identified pathway.

The Effects Pathways are based primarily on the MVEIRB Terms of Reference, which includes but does not specify when issues derive from science or traditional knowledge. Effects Pathways were also developed using the available traditional knowledge reports, and these instances are cited in the Adequacy Statement Response.

Section 4 of the WMMP cites instances where traditional knowledge was used to develop mitigation. Section 5 specifies instances where traditional knowledge, if necessary, will be used in monitoring programs. Section 6.1.2 requires that the WMMP Annual Report contain a summary of all traditional knowledge reports that became available over the previous year, and any traditional knowledge provided by the Tłı̨chǫ Government. Section 6.2.1 describes how new mitigation will be documented through the adaptive management audit. Section 6.2.3 specifies that the WMMP will be updated with the findings of the program that uses Tłı̨chǫ harvesters' traditional knowledge and methods to monitor the state of barren-ground caribou.

As and when new or additional traditional knowledge is provided by Indigenous interested parties through the Corridor Working Group, it will be incorporated into future WMMPs for adaptive management. An objective of the Corridor Working Group (CWG) Terms of Reference is to provide advice to the GNWT-INF on Tłı̨chǫ

Highway monitoring and mitigation results that may contribute to adaptive management.

The CWG group held a face-to-face meeting on June 24, 2019 and December 11, 2019 in Whatì and Behchokǫ̀, respectively. Due to COVID-19 restrictions, subsequent meetings were held virtually on July 7, 2020, December 1, 2020, June 16, 2021, and December 15, 2021, respectively. On June 13 and December 7, 2022, the CWG held a face-to-face meeting in Whatì and Yellowknife, respectively. There were no direct suggestions to incorporate any Traditional Knowledge (TK) into the WMMP. If TK is suggested at the subsequent CWG meetings, it will be incorporated into future versions of the WMMPs where appropriate.

Further, Table 5 indicates the monitoring proposed for each species at risk. Monitoring specific to bison, moose, black bear and wolves is described in Sections 5.2.5, 5.1.6 and 5.2.7.

Table 4: Project Effects Pathways to Wildlife and Applicable Monitoring

Adequacy Statement Response Effects Pathway	Pathway Category (Measurement Indicators)	Phase (Construction or Operation)	Pathway Assessment	Applicable Monitoring
Site preparation, construction and operation activities can result in the loss or alteration of vegetation and topography that may change habitat availability, use, and connectivity and influence wildlife abundance and distribution	Direct habitat loss (habitat availability, habitat distribution)	Construction Operation	Primary	• Spatial data for the footprint of the Project will be collected and reported when construction is complete to provide a precise record of direct habitat loss. • Boreal Caribou Collaring • Barren-ground Caribou Collaring • Moose and Bison Population Monitoring
Site preparation and construction may result in the destruction of roosting or hibernating bats (incidental take)	Direct habitat loss (habitat availability, survival and reproduction)	Construction	Primary	• Pre-clearing Bird Nest surveys (applies to roosting bats) • Wildlife Surveillance
Site preparation and construction may result in the destruction or disturbance of bear dens	Direct habitat loss (habitat availability) Sensory Disturbance (habitat availability, habitat distribution)	Construction	Primary	• Pre-clearing Large Mammal/ Bird / Bat Surveys • Wildlife surveillance monitoring at active construction areas
Site preparation and construction may result in the destruction of nests, eggs, and individuals of migratory birds (incidental take)	Direct habitat loss (habitat availability, survival and reproduction)	Construction	Primary	• Pre-clearing Large Mammal,/ Bird / Bat Surveys • Consult with ECCC • Wildlife Surveillance
Dust and air emissions, and subsequent deposition can change soil quality and vegetation, which can affect wildlife habitat availability and distribution	Indirect habitat loss or alteration (habitat availability, habitat distribution)	Construction Operation	Secondary	• Boreal Caribou Collaring • Barren-ground Caribou Collaring
Surface water runoff from the Project area can alter surface water, soil, vegetation, which can change the availability and distribution of wildlife habitat	Indirect habitat loss or alteration (habitat availability, habitat distribution)	Construction	Secondary	• Boreal Caribou Collaring • Barren-ground Caribou Collaring • Water Analysis Plan • Erosion and Sediment Control Plan

Table 4: Project Effects Pathways to Wildlife and Applicable Monitoring

Adequacy Statement Response Effects Pathway	Pathway Category (Measurement Indicators)	Phase (Construction or Operation)	Pathway Assessment	Applicable Monitoring
Changes to hydrology may alter drainage patterns and increase/decrease drainage flows and surface water levels that can cause changes to soils and vegetation, which can affect wildlife habitat availability and distribution	Indirect habitat loss or alteration (habitat availability, habitat distribution)	Construction Operation	Secondary	• Boreal Caribou Collaring • Barren-ground Caribou Collaring • Water Analysis Plan • Erosion and Sediment Control Plan
Sensory disturbance (lights, smells, noise, dust, human activity, viewscape) can change wildlife habitat availability, use and connectivity (movement and behaviour), which can lead to changes in wildlife abundance and distribution	Sensory disturbance (habitat availability, habitat distribution)	Construction Operation	Primary	• Road Surveys • Pre-blast Surveys • Traffic Monitoring • Boreal Caribou Collaring • Barren-ground Caribou Collaring • Moose and Bison Population Monitoring
Physical hazards on the Project site, and collisions with construction vehicles can cause injury or mortality to individual wildlife, leading to decreases in survival and reproduction	Direct mortality (survival and reproduction)	Construction Operation	Secondary	• Wildlife Sightings Log • Pre-blast Surveys • Road Surveys • Wildlife Surveillance • Traffic Monitoring • Wildlife Sightings and Collisions
Spills on the Project site can alter surface water quality, soils, vegetation, which can change the availability and distribution of wildlife habitat	Indirect habitat loss or alteration (habitat availability, habitat distribution)	Construction Operation	No Linkage	• Water Analysis Plan
Increase in public access could affect wildlife survival and reproduction through vehicle strikes, and/or legal and illegal hunting	Access and harvesting (survival and reproduction)	Operation	Primary	• Traffic Monitoring • Access and Harvest Monitoring

Table 4: Project Effects Pathways to Wildlife and Applicable Monitoring

Adequacy Statement Response Effects Pathway	Pathway Category (Measurement Indicators)	Phase (Construction or Operation)	Pathway Assessment	Applicable Monitoring
Use of linear corridors and converted habitat (i.e., younger, more productive forest) by prey and predators leading to decreases in survival and reproduction of prey	Indirect habitat loss or alteration (survival and reproduction)	Operation	Secondary	• Boreal Caribou Collaring • Barren-ground Caribou Collaring • Moose and Bison Population Monitoring • Wildlife Sightings and Collisions • Wildlife sighting and collision reporting system
Use of linear corridors by bison may lead to range expansion and affect moose and caribou habitat	Indirect habitat loss or alteration (habitat distribution)	Operation	Primary	• Moose and Bison Population Monitoring • Wildlife Sightings and Collisions
Loss of functional habitat due to competition with other wildlife species (in particular bison)	Indirect habitat loss or alteration (habitat availability, habitat distribution)	Operation	Primary	• Boreal Caribou Collaring • Barren-ground Caribou Collaring • Moose and Bison Population Monitoring
Altered movement patterns, including any changes to interactions with other caribou herds	Indirect habitat loss or alteration (habitat availability, habitat distribution)	Operation	Primary	• Boreal Caribou Collaring • Barren-ground Caribou Collaring • Moose and Bison Population Monitoring
Reduced habitat availability and distribution due to any increases in fires resulting from use of the road.	Indirect habitat loss or alteration (habitat availability, habitat distribution)	Operation	Secondary	• Boreal Caribou Collaring • Barren-ground Caribou Collaring • Moose and Bison Population Monitoring • Access and Harvest Monitoring
Attraction of wildlife to the Project (e.g., food waste, petroleum based products, salt) during construction may increase human wildlife interactions and change predator-prey relationships, which can affect wildlife survival and reproduction	Direct mortality (survival and reproduction)	Construction Operation	Secondary	• Wildlife Sightings Log • Road Surveys • Pre-blast Surveys • Wildlife Surveillance
Introduction and spread of noxious and invasive plant species can affect plant community composition, which can affect wildlife habitat availability and distribution	Indirect habitat loss or alteration (habitat availability)	Operation	Secondary	• Herbaceous plant surveys

Table 5: Applicability of Monitoring to Species at Risk

Species	Bird Nesting and Bat Roosting	Wildlife Surveillance	Pre-Clearing Large Mammal / and Bird Nesting Surveys	Boreal Caribou Collaring	Moose and Bison Population	Road Surveys	Pre-blast Surveys	Wildlife Sightings and Collisions	Wildlife Incidents	Access and Harvest Monitoring	Wildlife Sightings Log
Boreal caribou			✓	✓		✓	✓	✓		✓	✓
Barren-ground caribou			✓	✓		✓	✓	✓		✓	✓
Wood bison			✓		✓	✓	✓	✓		✓	✓
Wolverine		✓						✓	✓	✓	✓
Little brown myotis	✓	✓									✓
Peregrine falcon	✓	✓									✓
Short-eared owl	✓	✓									✓
Bank swallow	✓	✓									✓
Barn swallow	✓	✓									✓
Common nighthawk	✓	✓									✓
Olive-sided flycatcher	✓	✓									✓
Horned grebe	✓	✓									✓
Red-necked phalarope	✓	✓									✓
Rusty blackbird	✓	✓									✓
Yellow rail	✓	✓									✓
Evening Grosbeak	✓	✓	✓								✓
Harris's Sparrow	✓	✓	✓								✓

4.0 MITIGATION

Mitigation for each of the Pathway Categories (Table 4) is described in the section below. Mitigation is derived from current standard practices on other NWT roads and highways, best practices or guidelines listed in Section 2.3, through recommendations provided to the developer through the EA process, through Measures from the Report of Environmental Assessment (MVEIRB 2018) or from suggestions emanating from traditional knowledge studies (Tłı̨chǫ Government 2014, NSMA 2018).

4.1 Mitigation for Direct Habitat Loss

4.1.1 Construction

- The current layout of the Project footprint minimized the amount of new disturbance by following the existing Old Airport Road route to Whatì and intersecting areas previously burned where feasible.
- Limited the cleared Tłı̨chǫ Highway corridor to 60 m wide (not including the borrow sites and access corridors).
- Borrow source areas were minimized and located close to the Tłı̨chǫ Highway right of way so that access roads were short. Most of the borrow sources also overlap with the Tłı̨chǫ Highway alignment so additional disturbance to access these areas was limited.
- As borrow pits and quarries are no longer required during the operations phase, reclamation was completed in consideration of the Northern Land Use Guidelines for Pits and Quarries. Once reclamation activities were completed, access to the quarries and borrow sources that are no longer required area blocked.
- Avoided disturbance or destruction of bird nests and eggs by clearing land outside of the bird nesting and fledging season (May to mid-August); however, if vegetation clearing was required within this time, non-intrusive pre-clearing nest surveys was completed, and no-work zones was observed where there was evidence of nesting. Through consultation with GNWT-ENR and ECCC, bird nests were protected by a buffer that protects the nest while allowing construction to continue with monitoring. Details of nests identified, and the mitigation measures were included in the weekly wildlife monitoring reports.
- Birds were deterred from nesting on infrastructure by placing covers/screens on vents, holes, and crevices where birds could potentially nest, and if necessary, through active (but non-lethal) disturbance of birds to discourage them from establishing a nest on a construction site. Physical deterrents were not applied during the nesting season. If bird nesting occurred, the nest was not disturbed until

after the birds left the area, while clearance was discussed in consultation with GNWT-ENR and ECCC.

- Although not found during construction, plans were in place to avoid destruction of bat roosts by managing, to the extent possible, the incremental removal of vegetation so that it occurs outside of spring through fall. If vegetation clearing was required within this time, pre-clearing nest surveys and ‘no work zones’ for identified active maternity roost sites would have been implemented to avoid disturbance.
- Avoided disturbance of hibernating bats by surveying for sites of hibernacula potential (i.e., abandoned buildings and mines and caves) within 200 m of the right of way during the Bear Den Aerial Survey.
- If any reclamation activities were planned for the terrestrial portions of the existing Tłı̨chǫ winter road, it was managed and addressed jointly by the Tłı̨chǫ Government and the GNWT by way of a bilateral agreement.
- Operating machinery on highly saturated soil (primarily during freshet) outside of the highway alignment, borrow sources and borrow source access roads was avoided, where practicable. When unavoidable, suitable ground equipment was used to prevent unnecessary soil damage through rutting.
- Herbaceous plant surveys of the Project footprint were completed in August 2018 by a qualified botanist and a Tłı̨chǫ assistant (Golder 2019). Further surveys will be completed at one year, five years and ten years following completion of construction. If rare plants and/or invasive species are found, GNWT-ENR will be consulted to determine next steps.
- Rare and exotic plant survey has been completed (Golder 2019) and the results posted on the WLWB’s public registry.
- Management and control plan for rare and exotic plant species will be prepared in consultation with ENR prior to the next scheduled surveys; one year after construction and five years thereafter.
- Any required reseeding will be done so with an approved native, non-invasive, seed mix to avoid the introduction of noxious and invasive plants.

4.1.2 Operations

- Signs indicating the daily wildfire risk will be posted at the Tłı̨chǫ Highway junctions at Highway 3 and the existing Whatì community access road by the GNWT to minimize the risk of accidental fires. GNWT-INF/NSI will continue to follow the NWT forest fire prevention and suppression guidelines.

- In the event that the operational phase requires additional gravel, quarry permits will be acquired. A valid LUP will also be in place for this operation, if required. These borrow pits will remain accessible only to NSI staff or subcontractors and blocked to unauthorized personnel. Protocols will follow the Quarry Operations Plan(s).

4.2 Mitigation for Indirect Habitat Loss or Alteration

4.2.1 Construction

- Dust suppression techniques (as per the GNWT Guideline for Dust Suppression and the GNWT-INF Erosion and Sediment Control Manual) were utilized as required and feasible to reduce dust emissions onto vegetation outside of the right of way.
    - Visual cues (e.g. low visibility during driving, observed dust on vegetation at limits of work areas) were the primary trigger for dust suppression
    - During dry summer conditions, visual observations were conducted in areas of heavy traffic (heavy hauls and material placement). When localized dust levels were deemed visibly high or obviously migrating beyond the ROW, dust suppression measures were implemented and maintained until dust levels were visibly reduced and repeated as necessary. This approach to dust suppression was continued during the summer of 2021.
    - Dust suppression involved the application of water and/or Inspector approved chemical products such as calcium chloride using tanker trucks.
    - Trucks applied water and/or products as needed to active work areas. Only water was used within 100 m of a water body. During the operation phase of the project, calcium chloride will be applied once per year.
    - Use of gravel construction entrances/exits where construction access meets public highways to avoid tracking material onto paved surfaces.
- Layout and location of quarries considered the Northern Land Use Guidelines for Pits and Quarries.
- Reduced speed limits (50 km/h) during construction reduced dust production.
- Cleaned and inspected Project vehicles and equipment prior to entering the NWT to avoid introducing noxious and invasive plants.
- Re-cleaning Project vehicles and equipment if an area of weed infestation was encountered, prior to advancing to a weed-free area to minimize the spread of noxious and invasive plants.

- Locating and managing cleaning locations on the Project site to avoid the spread of noxious and invasive plants (see the pamphlet "Invaders in the Northwest Territories" for more information on invasive plants in the NWT).
- Domestic and recyclable waste and dangerous goods were stored on site in appropriate containers, as per the Waste Management Plan, to avoid exposure until they were shipped off site to an approved facility, and to prevent spills or leakage into the surrounding environment that would have caused habitat degradation.
- Hazardous materials and fuel were stored according to regulatory requirements to avoid contamination to the environment and workers.
- Individuals working on-site and handling hazardous materials were trained in the Workplace Hazardous Materials Information System and the Transportation of Dangerous Goods to avoid accidental spills.
- An approved Spill Contingency Plan was followed by Project staff to prevent spills and if spills occurred as a result of an accident, they were controlled and remediated to minimize the area impacted.
- Emergency spill kits were available wherever toxic materials or fuel were stored and transferred during construction to minimize effects to vegetation and wildlife habitat.
- Spill response and containment was completed expeditiously in accordance with the approved site-specific Spill Contingency Plan to reduce the area impacted. Spills were reported in a timely manner.
- Construction equipment, machinery, and vehicles were regularly maintained to avoid accidental spills.
- Fuel storage areas were equipped with spill kits, and were located at least 100 m away from water bodies. Large fuel storage tanks (2,000 to less than 80,000 litres) were double walled as per the regulations.
- Construction and maintenance vehicles were equipped with spill kits and fuelled at least 30 m away from water bodies.
- The GNWT-INF Erosion and Sediment Control Manual, in conjunction with a suitable road design, was utilized for erosion and sediment control and slope stabilization, which minimized damage to riparian, stream, wetland, and lake habitat from altered hydrology.
- Workers did not travel off the Project site unless there is a specific requirement.
- Riparian areas were maintained whenever possible to minimize erosion, with vegetation removal limited to the width of the right of way. At watercourse

crossings, a riparian buffer was maintained along the width of the right of way except at the actual crossing location.

- Removed vegetation/debris were removed from site to prevent them entering the watercourse.
- Impacts to riparian vegetation at temporary crossings were minimized by using structures such as snow fills and single-span bridges instead of fording, especially where banks were susceptible to erosion.
- Disturbed areas along the stream banks were stabilized upon completion of work to minimize erosion.
- Culverts were embedded as appropriate to maintain species and habitat present, and were installed parallel to the existing channel to minimize changes to channel morphology.

4.2.2 Operation

- Dust suppression techniques (as per the GNWT Guideline for Dust Suppression and the GNWT-INF Erosion and Sediment Control Manual) will be utilized as required, to reduce dust emissions onto vegetation outside of the right of way.
- Signs indicating the daily wildfire risk will be posted by GNWT at the Tłı̨chǫ Highway junctions at Highway 3 and the existing Whatì community access road to minimize the risk of accidental fires.
- Use of culverts and other design features will minimize changes to local flows and drainage patterns and drainage areas. Regular maintenance will occur along the Tłı̨chǫ Highway to ensure culverts are clear of debris (including ice during spring thaw).
- Culverts will be embedded as appropriate to maintain species and habitat present, and will be installed parallel to the existing channel to minimize changes to channel morphology.
- Disturbed areas along the stream banks will be stabilized upon completion of work to minimize erosion.

4.3 Mitigation for Sensory Disturbance

4.3.1 Construction

- Project staff were provided with awareness training prior to working on the site as outlined in Section 4.7.1. This training included the various procedures and protocols that are included in this section.

- Harassment, feeding or approaching wildlife by Project staff were prohibited.
- Project staff communicated, via radio, relevant observations of wildlife to the NSI Environmental Manager or designate. The NSI Environmental Manager then relayed this information to Site Supervisors and equipment operators working in the area. Any such observations were included in the Wildlife Sightings Log during the construction phase.
- Construction was temporarily suspended by the NSI Environmental Manager, or speed limits on the road temporarily reduced, when moose, caribou, bison, or any other wildlife that might be at imminent risk of injury or mortality, were known to be near the active construction site. An Incident Report was prepared for each such occurrence.
- Blasting only proceeded if no large mammals (e.g., caribou, moose, and bison) are detected in the 500m blast radius or immediate blast zone (as determined by the Blast Supervisor). As outlined in Appendix F Pre-Blast Survey Procedure two environmental monitors completed a 1-hour survey, within a 500m radius of the blast zone perimeter (or as defined by the Blast Supervisor). The survey was conducted by foot or truck and was also included that surveying within the immediate blast zone area to the extent that it was safe to do so. The Environmental Monitors conducted a visual scan of the blast radius using both binoculars and thermal imaging device prior to blasting to ensure no large mammals were present. All blasting was preceded by air horn signals, which further deterred wildlife from the area. Specific mitigation measures that apply to blasting during the late-winter and calving season for collared boreal caribou are included in Appendix D.
- Construction activities considered sensitive periods. For example, vegetation clearing was planned to occur outside of the nesting season for migratory birds.
- Boreal caribou collar locations were used to notify construction crews of their proximity to active construction areas during the late-winter and calving season, and increased mitigation measures will be triggered as described in Appendix D.
- If any big game species were observed within the cleared right of way adjacent to active construction areas, speed limits were reduced to 30 km/h within 1 km on either side of the sighting. If bison were present on roads, Environmental Monitors were contacted. Environmental Monitors should be aware that groups of bison with more than 5 individuals are likely to be nursery groups containing calves and juveniles. Any such observations were included in the Wildlife Sightings Log during construction
- The NSI Environmental Manager communicated, via radio, the requirements for a reduced speed limit to Supervisors and equipment operators working in the area.

The Manager monitored equipment operations to ensure the reduced speed limit was followed.

- In the event that an active mammal den, bird nest (active or inactive) or young were discovered during construction, disruptive construction activities were halted and GNWT-ENR and ECCC (for migratory birds) were consulted to determine an appropriate strategy to avoid or minimize disturbance. Appendix C provides the appropriate contact information for ECCC personnel.
- Pre-clearing surveys were meant to detect the presence of large mammals prior to vegetation clearing
- Observations of caribou, moose, bison, and other big game and species at risk were reported to Environmental Monitors. Observations of species at risk were be reported to GNWT-ENR through weekly reports.
- Where feasible, road embankments were gently sloped and used fine-grain materials (YKDFN 2018)

4.3.2 Operation

- Project staff will be provided with awareness training prior to working on the site as outlined in Section 4.7.1. This training will include the various procedures and protocols that are included in this section.
- Harassment, feeding or approaching wildlife by Project staff will be prohibited.
- Dust suppression techniques (as per the GNWT Guideline for Dust Suppression and the GNWT-INF Erosion and Sediment Control Manual) will be utilized as required and feasible to reduce dust emissions onto vegetation outside of the right of way.

4.4 Mitigation for Direct Wildlife Mortality

4.4.1 Construction

- Project staff were provided with awareness training prior to start of work on the site as outlined in Section 4.7.1. This training included the various procedures and protocols that are included in this section.
- Quarry stockpiles, overburden, or exposed soil banks were maintained with slopes of less than 70 degrees to prevent bank swallow nesting, following ECCC (2017a) guidance. Regular activity in the quarries also helped to deter nesting (ECCC 2017a). If a nesting colony was found, a buffer zone of at least 50 m was established, and excavation of the nest area did not continue (ECCC 2017a).
- Awareness training provided to personnel, as outlined in Section 4.7.1, included information on yielding the right of way to wildlife during construction. If wildlife

were crossing or attempting to cross a road or active construction area, traffic and mobile equipment stopped and waited for the animal to cross unless they were posing a risk to personnel or themselves as noted in the following bullet point. The presence of large mammals (e.g., caribou, moose, and bison) and other wildlife was communicated to construction workers, which minimized risks of physical hazards through site-wide awareness.

- During construction, Project staff communicated, via radio, relevant observations of wildlife to the NSI Environmental Manager or designate. The NSI Environmental Manager then relayed this information to Site Supervisors and equipment operators working in the area.
- If bison, caribou or moose were observed in areas where there were hazards, operations at that particular work site was temporarily suspended by the NSI Environmental Manager to allow wildlife to move away from the area of their own accord. If they did not leave the area within 15 minutes, they were gently encouraged to move away from construction activities. This involved the slow approach of Environmental Monitors by vehicle towards the caribou/moose/bison or making their presence known by calling out and waving their arms to encourage them to move. This was done from behind a vehicle or piece of equipment to prevent personnel from going too close to the animal. An Incident Report was completed for all deterrent actions, if they occurred. It is possible that females may be unwilling to leave the area if they have a calf hiding nearby (see Table 3). In these cases, operations in the area were suspended by the NSI Environmental Manager.
- Bear-banger type deterrents were only used if there was an immediate need to mitigate risk to personnel or wildlife safety.
- Speed limits for construction vehicles were limited to 50 km/h.
- If any big game species were observed within the cleared right of way adjacent to active construction areas, speed limits were reduced to 30 km/h within 1 km on either side of the sighting. The NSI Environmental Manager communicated, via radio, the requirements for a reduced speed limit to Supervisors and equipment operators working in the area. The Manager monitored equipment operations to ensure the reduced speed limit is followed.
- Blasting only proceeded if no large mammals (e.g., caribou, moose, and bison) were detected in the 500m blast radius or immediate blast zone. As outlined in Appendix F Pre-Blast Survey Procedure, two environmental monitors completed a 1-hour survey, within a 500m radius of the blast zone perimeter (or radius as defined by the Blast Supervisor and Blast Plan). The survey was conducted by foot or truck and also included surveying within the immediate blast zone area to the extent that it was safe to do so. The Environmental Monitors conducted a visual scan of the

blast radius using binoculars and thermal imaging device prior to blasting to ensure no large mammals were present. All blasting was preceded by air horn blasts, which deterred wildlife from the area. Specific mitigation measures that apply to blasting during the late-winter and calving season for collared boreal caribou are included in Appendix D.

- Pre-clearing den surveys were completed. In the event that an active mammal den was identified during pre-clearing surveys, or during construction activities, GNWT-ENR was consulted to determine next steps. If applicable, operations near the den were temporarily suspended by the NSI Environmental Manager, and GNWT-ENR was be consulted.
- Project staff were provided with environmental awareness training.
- An appropriately designated supervisor provided field workers with Bear Aware training (see Appendix E) and general wildlife awareness.
- Environmental Monitors documented wildlife and managed and minimized risks to wildlife and workers.
- Harassment, feeding or approaching wildlife by Project staff was prohibited.
- No hunting or fishing by Project staff was permitted.
- To avoid wildlife harvest, firearms were not allowed on-site during construction except for firearms in the possession and control of authorized Environmental Monitors or law enforcement officers.
- Camps and buildings were designed to prevent wildlife interactions, including appropriate storage of non-waste wildlife attractants (e.g., food and petroleum products) and use of adequate lighting were installed in areas where it was essential to detect bears that might have been in the vicinity.
- Development and implementation of a Waste Management Plan to avoid access to food waste by wildlife. This included:
    - Waste products were stored in secured containers and transported to approved facilities to avoid access by wildlife.
    - Food waste was collected in bear proof containers that minimize attraction or impact to wildlife.
    - Littering and feeding of wildlife were prohibited to avoid wildlife attraction to the site.
    - All workers and visitors were educated on waste management practices for the Project site to avoid wildlife attraction.

- Exposure of wildlife to contaminants was avoided by use of appropriate deterrents (e.g., temporary fencing and noise makers) to discourage wildlife from entering an affected area.
- In case of wildlife exposure to contaminants, territorial (GNWT-ENR) or federal (ECCC) authorities were contacted immediately to determine appropriate course of action, including capturing, relocating, or treating contaminated wildlife.

4.4.2 Operation

- Speed limits will be established, posted, and enforced to reduce the risk of vehicle-wildlife collisions (NSMA 2018).
- GNWT has the ability to install temporary portable signage and temporarily lower speed limits on parts of the Tłı̨chǫ Highway if a localized wildlife collision hazard is present. This mitigation will be applicable to areas where groups of bison, caribou, or moose are seen or reported along the right of way, in areas where wildlife-vehicle collisions repeatedly occur, or where caribou are known to be nearby based on collar data.
- GNWT's "Drive Alive!" Program includes information on avoiding wildlife collisions (see Section 2.5.2). Information on this program will be disseminated at appropriate locations in the communities of Whatì and Behchokǫ̀.
- Quarry stockpiles, overburden, and exposed soil banks will be maintained with slopes of less than 70 degrees to prevent bank swallow nesting, following ECCC (2017a) guidance. Regular activity in the quarries will also help to deter nesting (ECCC 2017a). If a nesting colony is found, a buffer zone of at least 50 metres will be established, and excavation of the nest area will not continue (ECCC 2017a).

4.5 Mitigation for Access and Harvesting

4.5.1 Construction

- Firearms were not allowed on-site except for firearms in the possession and control of authorized Environmental Monitors or law enforcement officers.
- No hunting or fishing by Project staff was permitted.

4.5.2 Operation

- GNWT-ENR will enforce the NWT's hunting regulations which are in place to ensure that wildlife is conserved for future generations and that hunting is done safely.
- The Tłı̨chǫ Government will investigate the need for regulations and policies to manage the construction of cabins and design of hunting, trapping, and fishing in

the area, in order to minimize impacts on local animal populations. Tłı̨chǫ Government will work to provide clear guidance on this topic (Mitigation 10 of PR#96, Tłı̨chǫ Government 2014).

- Discuss use of windrows to limit access to spur trails with the Tłı̨chǫ Highway Corridor Working Group (Tłı̨chǫ Government 2014, YKDFN 2018).
- Further mitigation and monitoring measures to address Access and Monitoring are described in Wildlife Effects Monitoring (Section 5.2 of this document).

4.6 Caribou Mitigation

In addition to the mitigation described in Sections 4.1 to 4.5, specific mitigation is required for boreal and barren-ground caribou during the Construction phase.

Barren-ground caribou show a distinct seasonal migration and tend to travel in groups. While the Tłı̨chǫ Highway is beyond the recent range of barren-ground caribou, traditional knowledge indicates that they are occasionally present in the area during winter. Further, they are considered a species at risk and require particular attention. As it can be difficult for inexperienced observers to distinguish barren-ground and boreal caribou, the same mitigation is applied to both if they are known to be in the Tłı̨chǫ Highway area, as described in Table 6. Protocols for the use of collared caribou locations to mitigate impacts from construction are provided in Appendix D.

Table 6: Construction Phase Mitigation and Monitoring for Boreal and Barren-ground Caribou

Threshold	Caribou-specific Mitigation	Caribou-specific Monitoring
Collared Barren-Ground caribou are present within 10 km of the Tłı̨chǫ Highway	• GNWT-ENR will advise the NSI Environmental Manager if a collared caribou is within 10 km of the Project, and provide updates based on collar data as required. • GNWT-ENR will also notify GNWT-INF, Tłı̨chǫ Government, Wek'èezhìı Renewable Resource Board (WRRB) NSI Environmental Manager to notify all Project staff working in the area	• Wildlife Road Surveys along the Tłı̨chǫ Highway by Environmental Monitors or patrols by GNWT-ENR wildlife officers to document caribou presence near the road and group size

Table 6: Construction Phase Mitigation and Monitoring for Boreal and Barren-ground Caribou

Threshold	Caribou-specific Mitigation	Caribou-specific Monitoring
Caribou (barren-ground or boreal) observed on or adjacent to the Tłı̨chǫ Highway right of way	• Caribou have the right of way on the road • Communicate location of caribou sightings to other Project staff working in the area via radio • Notify GNWT-ENR of the location and number of individuals • Decrease speed limits within 1 km on either side of the area to 30 km/h • NSI Environmental Manager may temporarily suspend construction traffic and other activities if caribou are on the road or within an active construction area (e.g. borrow source)	• Environmental Monitors will be informed of general location and time of caribou sighting and will initiate active monitoring of the area. • Continue monitoring the road within 1 km on either side of where caribou were sighted for 30 minutes after they leave the right of way, before increasing speed limits to 50 km/h again.
Collared boreal caribou within 0.5-3 km of the Tłı̨chǫ Highway right of way, borrow sources or borrow source access roads	• See Appendix D for detailed mitigation measures	• Boreal caribou collar-based monitoring; maps of collar locations will be provided on a more frequent basis if caribou occur within cautionary zones during late-winter and calving periods; see Appendix D for further details.

Tłı̨chǫ Highway = Tłı̨chǫ All Season Road; GNWT-ENR/ECC = Government of the Northwest Territories Department of Environment and Natural Resources/Climate Change; GNWT-INF = Government of the Northwest Territories Department of Infrastructure; NSI = North Star Infrastructure; km = kilometres; km/h = kilometres per hour.

4.7 Education and Training

4.7.1 Education and Training for Project Workers

Contractor(s) hired for road construction, and maintenance activities during the operational phase of the road, will be responsible for educating and training Project staff on applicable practices contained within the WMMP. All training will be documented and recorded in the WMMP Annual Report. Information provided to contract employees during training and prior to starting work will include the following:

- Review of the WMMP.
- An understanding of wildlife response protocols including reporting requirements and procedures related to wildlife observations, wildlife incidents, and wildlife-related accidents. Posters on display in camps illustrating species that require real-time reporting will reinforce the training information.
- During construction, Project staff must report wildlife observations using the Wildlife Sightings Log, and to report any incidents or concerns immediately to the Environmental Monitors.

- Understanding of confidentiality of observations made during work.
- Instructions not to disturb any birds or nests of observed birds and to immediately report discovered or observed nests to the NSI Environmental Manager.
- Requirements of the *Migratory Birds Convention Act*.
- Reporting procedures for all wildlife observations.
- Instructions regarding Project mitigation and operating protocols (e.g., wildlife right of way and speed limits).
- An understanding of Species at Risk, including identification (posters in camps) and reporting procedures.
- Wildlife legal requirements and policies (i.e., no feeding, no harassment, no hunting, and no trapping).
- Instructions on waste and wildlife attractant management including the implications of wildlife human-habituation, food conditioning, and unsecured wildlife attractants.
- An understanding of working safely in wildlife areas and avoiding wildlife encounters through familiarization with the ecology of potentially dangerous predators, including bears, wolves and wolverines. This will include education on the identification, behaviour, seasonal movements, and habitat preferences of these species, as well as specific bear awareness and safety training, referencing regulations, permit conditions, industry standards, and Project commitments/policies, and information on managing non-natural attractants. Appropriate videos/DVD's such as "Staying Safe in Bear Country" and "Working in Bear Country", as well as the GNWT Bear Safety Brochure (see Appendix E) will be provided as part of the bear awareness and safety training. Workers will be educated on proper procedures for exiting vehicles or buildings in bear areas, where high risk bear-human interaction areas are likely to occur (i.e., areas where vegetation or terrain limit visibility and might hide a bear, and locations where sounds may mask the sound of an approaching bear), and to watch for bear signs and avoid potential denning and feeding areas, if possible.
- Instructions regarding worker safety precaution protocols for working in remote areas. These include, working in pairs or larger groups, packing out waste for proper disposal, having adequate communication with supervisors and Environmental Monitors (i.e., though radios, cell phones, and/or satellite phones), and regular check-in times.
- Instructions for the Environmental Monitors and other designated/trained staff on how to use non-lethal deterrent materials (e.g., bear spray and bear bangers) and the requirement to complete a Wildlife Incident Report as described in Appendix F

if a deterrent is used. These individuals will be given access to non-lethal deterrent materials while working and living on construction sites

4.7.2 Public Awareness

Public awareness will also reduce environmental impacts of the Tłı̨chǫ Highway. The GNWT conducts continual public education and information campaigns, including the "Drive Alive!" Program (Section 2.5.2), and information on preventing and reducing the risk of forest fires through the "FireSmart" Program. These campaigns will continue to be communicated through the GNWT website, social media, radio, newspapers, road checkpoints, and roadside signs. The public was restricted from accessing the active construction areas, unless authorized and accompanied by NSI representatives.

5.0 MONITORING

5.1 Mitigation Monitoring

This section describes the monitoring that will take place to ensure that the wildlife and wildlife habitat protection measures identified for the Tłįchǫ Highway are being implemented and functioning as intended, provide advance warning of wildlife issues that may require mitigation, and identify opportunities to improve mitigation through adaptive management. The GNWT and Tłįchǫ Government commit to continuing to explore alternative study designs. GNWT met with TG/their consultant and discussed their wildlife monitoring proposal to meet applicable EA Measures during operations. Detailed procedures and data sheets for the construction phase are provided in Appendix F.

5.1.1 Wildlife Sightings Log

Wildlife sighting logs provide a simple means for all Project staff to contribute to tracking wildlife activity at the Project. The value of the data is limited as it is not systematically collected and contains repeated observations, but it can provide an indication of the potential for wildlife incidents or problem wildlife and areas of concern at the Project.

During the Operations Phase of the project, incidental observations of wildlife made by maintenance staff on the Tłįchǫ Highway will be recorded. Maintenance of the sighting log will be discontinued during operations and be replaced with ENR's existing wildlife sightings and collisions reporting form.

5.1.2 Road Surveys

Road surveys were conducted by NSI staff during the Construction Phase of the project. Environmental Monitors drove the Project site regularly. Documenting wildlife observations along the road was conducted to help identify wildlife risks and communicate them to Project staff in the area, or to identify areas with higher presence of wildlife.

Observations of wildlife on project roads (includes all spur roads such as quarry and water source roads) within the cleared right of way adjacent to the road, or within borrow pits were documented by Environmental Monitors. Unlike the Wildlife Sightings Monitoring, this task was only completed by the Environmental Monitors.

During the Operations Phase, wildlife harvest monitoring (Measure 9-1) and incorporation of TK into monitoring of barren-ground caribou (Measure 7-1) will be undertaken by TG in collaboration with GNWT-ENR and support from GNWT-INF.

5.1.3 Wildlife Surveillance During Construction

Wildlife surveillance monitoring was intended to provide systematic and current information of wildlife activity at the Project construction camps, and was to provide direct feedback regarding the effectiveness of wildlife mitigation. Examples of wildlife activities was supposed to be documented through the Wildlife Surveillance monitoring include presence of wildlife within camp areas, any instances where food or wastes was improperly stored, and use of buildings by wildlife for shelter or nesting. Through systematically and actively searching for and documenting the presence of all wildlife within and around the Project footprint, Environmental Monitors remained appraised of prevailing and emerging issues, and was able to manage issues as they arose.

Environment Monitors were undertaking systematic tours of the Project construction camps to record all wildlife observations or recent wildlife sign (e.g., tracks and scat). Environmental Monitors recorded the area surveyed, and the nature and location of all observations. The surveillance monitoring survey included areas of the Project where there is risk of wildlife attractants or risk of wildlife finding shelter, denning or availability of food. This includes camps, construction areas, and waste management areas.

If a camp is maintained as part of the operations phase of the project, wildlife surveillance will be conducted by maintenance staff (weekly) when camps are operational.

5.1.4 Bird Nesting and Bat Roosting During Construction

In addition to the Wildlife Surveillance monitoring described above, specific monitoring was proposed to detect bird nesting or bat roosting activity and mitigate impacts to active nests, bat roosting sites with particular emphasis on birds protected by the *Wildlife Act*, *Migratory Bird Convention Act* and the *Species at Risk Act* (Table 2). Early identification of birds showing nesting activity could help to avoid conflict, and nests that are found on Project infrastructure or in hazardous areas should be identified and monitored. Environmental monitors, in consultation with ECCC planned to establish buffer zones around nests to ensure they are adequately protected from disturbance on a case-by-case basis as advised by ECCC and the Guidelines to Reduce Risk to Migratory Birds (ECCC 2018b). If an inactive raptor nest was discovered during construction that intersects with an active work area and avoidance was not possible, NSI would have applied to ENR for a permit to destroy the nest(s). Appendix C provides the appropriate contact information for ECCC personnel.

Clearing of vegetation was scheduled to occur outside of the migratory bird breeding season. However, there may be instances where vegetation removal is required during this period due to schedule changes or unforeseen circumstances. In these cases, non-intrusive bird nest sweeps are required; please see Appendix F for the detailed protocol. This includes:

- Qualified biologists taking into consideration the type of habitat and species that are likely to be present during the specific time period.
- Searching for evidence of nesting by the presence of birds through observation of singing birds, alarm calls and distraction displays.
- Use of "point counts" to locate singing territorial males in the case of songbirds.

Plans were supposed to be developed on case-by-case basis in consultation with ECCC and ENR, following the Guidelines (ECCC 2018b). The information collected would have been relevant to Measure 10-1 of the Report of Environmental Assessment (MVEIRB 2018). Appendix C provides the appropriate contact information for ECCC personnel.

Any nest found was supposed be protected with a buffer zone determined by a setback distance appropriate to the species, the level of the disturbance and the landscape context, until the young have permanently left the vicinity of the nest.

Though not anticipated, if vegetation clearing is required within the breeding bird season during the operational phase of the project, Bird Nesting and Bat Roosting surveys will be conducted following the protocol provided in Appendix F.

5.1.5 Pre-blast Surveys

Blasting only proceeded if no large mammals (e.g., caribou, moose, and bison) were detected in the 500m blast radius or immediate blast zone. As outlined in Appendix F Pre-Blast Survey Procedure, two environmental monitors completed a 1-hour survey, within a 500m radius of the blast zone perimeter (or as defined by the Blast Supervisor and Blast Plan). The survey was conducted by foot or truck and also included surveying within the immediate blast zone area to the extent that it was safe to do so."

Scans for large mammals within the blast radius were completed prior to all blasts, regardless of blast size. No large mammals were observed during pre-blast surveys.

5.1.6 Pre-Clearing Large Mammal and Bird Nesting Surveys

Clearing of vegetation was required, primarily to widen the right of way. Limited clearing was required at the quarries, and at any quarry access roads. Clearing was scheduled to occur between September and April in 2019/2020, and 2020/2021. While clearing was timed to avoid the migratory bird season, other wildlife could be present and active. Two surveys were required:

- Pre-Clearing Survey to detect large mammals ahead of clearing activities, completed during clearing operations
- Bear Den Aerial Surveys, completed in the fall to detect possible bear denning locations before denning is initiated

Black bears in northern Alberta were documented to initiate denning over a four to five week span beginning in early October. Dens were located in mixed forest or mature spruce stands and were generally excavated underground or beneath root masses of fallen trees but avoided muskeg (Tietje and Ruff 1980). When disturbed, denning black bears will abandon dens. Linnell et al. (2000) found that black bears will select dens within 2 km of human activity, but some abandoned dens when there was activity within 1 km of the den, particularly within 200 metres.

Pre-clearing surveys were conducted as outlined in Appendix F – Monitoring Protocols and Data Sheets (Pre-clearing Survey Procedure and form) were only be completed during the construction phase, ahead of the two fall and winter clearing seasons. The Pre-Clearing Large Mammal Survey consisted of a ground-based survey no more than 48 hours prior to clearing. If a caribou was observed within 500 meters of clearing activities, clearing was temporarily suspended as per the Pre-Clearing Large Mammal Survey. For 2019 winter season, ENR completed a Bear Den Aerial Survey along the Tłı̨chǫ Highway alignment under Wildlife Research Permit #WL500763. The result of the survey is attached as Appendix H. Timing of the surveys should be flexible to select suitable weather and snow conditions, and to account for the construction schedule.

5.1.7 Wildlife Incidents

Wildlife incidents refer to a range of possible occurrences at the Project. Examples of wildlife incidents include:

- Human-wildlife interactions that present a risk to either people or animals
- Wildlife-caused damage to property or delay in operations
- Wildlife deterrent actions
- Wildlife injury or mortality (including vehicle collisions), or situations likely to cause injury or mortality
- Wildlife in hazardous areas or hazardous situations
- Incidents related to migratory birds, which includes damage or disturbance to nest or eggs, bird mortalities.

Wildlife incidents during the operational phase of the road are addressed in the Wildlife Effects Monitoring section (Section 5.2).

Bear encounter response guidelines can be found in Appendix E.

5.2 Wildlife Effects Monitoring

The proposed monitoring of effects of the Tłı̨chǫ Highway on wildlife and wildlife habitat focuses on boreal caribou, barren-ground caribou, moose, and bison. Specifically, effects monitoring addressed concerns raised during the environmental assessment that the Tłı̨chǫ Highway might lead to direct and indirect loss of wildlife habitat, potential range expansion of bison, and increased wildlife mortality due to increased harvest pressure and traffic-related mortality along the highway.

The primary objectives of wildlife effects monitoring activities are to:

a) Determine if improved year-round access created by the Tłı̨chǫ Highway results in a level of harvest mortality or harvest patterns of any wildlife that would suggest a conservation concern.

b) Determine the distribution, habitat use, and movements of boreal woodland caribou in the Tłı̨chǫ Highway study area and adjacent areas before, during and after road construction.

c) Measure direct habitat loss at completion of construction.

d) Monitor and measure changes in distribution and abundance of moose, bison, and boreal caribou as borrow site activities and Tłı̨chǫ Highway right of way construction progresses.

e) Monitor and measure changes in distribution and abundance of moose, bison, and caribou for up to five years after construction of the highway is completed, and possibly longer if traffic levels increase substantially beyond predicted levels.

f) Determine the amount and seasonality of wildlife injuries and mortality from vehicle collisions.

g) Determine spatial and temporal distribution of wildlife movements, sightings, and collisions along the road to inform targeted mitigation actions.

h) Use the information from monitoring to mitigate and manage highway impacts where possible.

i) Use information from monitoring to inform best practices associated with future highway development and wildlife management in the NWT.

5.2.1 Traffic Monitoring

Rationale

Many of the predictions in the EA are contingent on the Tłı̨chǫ Highway having relatively low traffic volumes. Traffic levels for the proposed Tłı̨chǫ Highway have been estimated at 20 to 40 vehicles/day. This number was extrapolated both qualitatively and quantitatively by relying on the Tłı̨chǫ Winter Road Project Officer’s numerous years of experience, Tłı̨chǫ winter road traffic counters, Tłı̨chǫ winter road community resupply details, and the estimated traffic volumes of a metals mine north of Whatì. Monitoring traffic levels is important for operational considerations related to road maintenance as well as for gauging the effects of the road. As roads tend to open up other areas for new development, the potential exists for traffic levels to increase in future, along with associated risks to people and wildlife.

Monitoring Question

- Are daily traffic levels averaged over a three-year period staying within 100 percent (%) of the maximum annual average daily traffic levels predicted for the Tłı̨chǫ Highway (i.e., within 40-80 vehicles/day)?
- What are average and maximum daily traffic levels during sensitive seasonal periods for boreal caribou, moose and bison, or during periods of higher known collision risk?

Proposed Approach

The NWT highway network consists of 2,200 km of all-weather roads and 1,620 km of winter roads. To monitor traffic using the highway system, the Department of Infrastructure operates a series of permanent and seasonal mechanical traffic counters and conducts periodic visual counts and surveys. Where counters are located, the stations provide hourly information on traffic for the full year, or selected portions of the year for counters located on winter roads or other seasonal access roads. These stations are positioned to capture the general flow of traffic on the highway network.

GNWT-INF has installed a permanent traffic counting station along the Tłı̨chǫ Highway at KM 50, as well as two temporary traffic counters (TRAFX Research Ltd), one at the south end of the road at KM 18 and one towards the north end of the road at KM 60, and will develop a regular schedule of visual counts and surveys to verify the accuracy of units. In October 2022 GNWT-INF installed an additional three TRAFX Research Ltd. traffic counters provided by ENR at KM 4, KM 39 and KM 91. These counters need to be retrieved to download captured data on a regular schedule.

Temporal scope

Traffic monitoring will occur indefinitely through the operations phase at the permanent traffic counter location, and for up to 5 years at the five temporary traffic counter locations, and GNWT-INF will report to GNWT-ENR annually.

Thresholds

Part of adaptive management is identifying the need for increased monitoring or mitigation when conditions change, therefore, when traffic levels averaged over a three-year period indicate a 100% increase (40-80 vehicles/day) in traffic levels above the predicted annual average daily traffic levels (20-40 vehicles/day), or maximum daily traffic levels during sensitive periods exceed 200 vehicles/day, the need for extending or reinstating programs in this WMMP beyond the first five years of the operational phase of the road will be considered. Although literature reviews of effects of different traffic levels (see PR#214 and Appendix G to the draft WMMP Revision 2, PR#192) suggests thresholds of 300 to 500 vehicles/day as levels associated with adverse impacts to carnivores and ungulates, respectively, a trigger of 200 vehicles/day is chosen both to be precautionary and to reflect the design criteria for the road. The monthly traffic data can be used as a covariate in analyses for other programs under this WMMP.

5.2.2 Access and Harvest Monitoring

Rationale

One of the key concerns associated with the Tłı̨chǫ Highway is increased wildlife mortality associated with a) hunting along the road; b) greater hunter access from the road into previously difficult-to-access harvesting areas and c) extended seasonal access into winter harvesting areas for barren-ground caribou beyond the Tłı̨chǫ Highway study area. There is concern that this increased access will change patterns of legal harvest in the region and increase illegal harvest such that harvested wildlife populations will experience higher total mortality. A comprehensive approach will be required, employing both greater collaboration between GNWT and the Tłı̨chǫ Government at the community level to support community-based programs (as per Measure 9-1 of the Report of Environmental Assessment [MVEIRB 2018]), as well as enhanced compliance monitoring by GNWT-ENR. Similarly, efforts will be made to align the monitoring with the Access Monitoring proposed for the NICO Project (Fortune Minerals 2013). The information collected will be used in assessing whether harvest levels are sustainable as per Measure 6-1 and 9-1 of the Report of Environmental Assessment (MVEIRB 2018).

Monitoring Questions

- Determine if the highway is resulting in a pattern or level of harvest mortality for moose and caribou that would suggest a conservation concern or need for additional harvest management actions.
- Identify who is using the road to access harvest opportunities.
- Determine the sex and age structure of the harvested population of moose in the North Slave Region.
- Determine if and where moose are being harvested near the Tłı̨chǫ Highway.
- Determine if improved year-round access from the Tłı̨chǫ Highway results in the proliferation of new trails leading off of the Tłı̨chǫ Highway right of way.

Proposed Approach and Temporal Scope

i) Create a new GNWT-ENR Renewable Resource Officer position in Whatì. The GNWT-ENR Officer position in the community of Whatì will help to conduct and/or facilitate several of the recommended actions in the WMMP and address concerns related to harvest and access associated with the Tłı̨chǫ Highway. This position would also help to monitor for additional impacts to wildlife habitat associated with the road such as fire monitoring, spill response etc. (*Temporal scope*: This is proposed to be a permanent position, starting in the 2021-22 fiscal year.)

ii) Once the Tłı̨chǫ Highway is operational, establish regular patrols along the Tłı̨chǫ Highway throughout the year, particularly during fall resident moose harvest seasons and fall/winter caribou harvest seasons. Currently GNWT-ENR regularly sends patrols out along the existing winter road for the duration of the winter road season; however, there will need to be patrols year-round with increased activity in peak harvesting seasons (i.e., fall moose hunt, fall/winter boreal caribou season, winter barren-ground caribou hunt, etc.). GNWT-ENR patrols contribute to harvest and access monitoring as well as enforcement of hunting regulations, and promoting the "Report a Poacher" toll-free line. (*Temporal scope*: ongoing once the road is operational, with the frequency of patrols to be determined and modified in response to results of monitoring, availability of resources, or identified concerns).

iii) Increase the length of the winter monitoring season. Once the Tłı̨chǫ Highway is operational, GNWT will establish a checkpoint station during the barren-ground caribou winter harvest season on the Tłı̨chǫ Highway south of Whatì and extend the period the checkpoint is open by one month on either end of the current winter road season, if there is evidence that barren-ground caribou are wintering in the region north of Whatì and if there is evidence that hunters are using the Tłı̨chǫ Highway to reach barren-ground caribou in that area. (*Temporal scope:* Ongoing, as needed, until harvest restrictions on barren-ground caribou are lifted, at minimum).

iv) GNWT-ENR will work together with the Tłı̨chǫ Government and Wek'èezhìı Renewable Resources Board (WRRB) to develop and implement a non-mandatory Aboriginal harvest monitoring and reporting program, with a target to implement for the opening of the Tłı̨chǫ Highway. The Tłı̨chǫ Government developed a proposal for a monitoring program to address Measures 7-1 and 9-1 of the Report of EA. In August 2020, GNWT-INF committed funds to support the Tłı̨chǫ Government to undertake this program. The information from this program will provide information that will also support implementation of Measures 6-2 and 7-2, as well as inclusion of traditional knowledge as required by Measures 9-3 and 10-2. Future versions of the WMMPs will be updated with any recommendations from the study. Further details on this program are provided in Appendix I. (*Temporal scope*: fiscal years 2020-21 to 2022-23; continuation subject to renewal of funding thereafter)

As required by Measure 9-1, the harvest monitoring and reporting program will:

a. focus on boreal caribou, barren-ground caribou and moose population trends in areas accessed by winter roads and trails from the Project;

b. be community-based and involve collaboration between Tłı̨chǫ Government and the developer;

c. involve traditional knowledge holders and harvesters in monitoring wildlife harvesting trends; and,

d. report on wildlife harvesting numbers and trends from monitoring checkpoints and/or other harvest monitoring methods annually to the Tłı̨chǫ Government, WRRB, GNWT-ENR and other wildlife co-management partners.

v) Increased number of aerial surveys to monitor harvesting activities on either end of the winter barren-ground caribou harvest season. (*Temporal scope*: Ongoing until harvest restrictions on barren-ground caribou are lifted, at minimum).

vi) Map the pre-construction trail network leading off of the existing Lac La Martre winter road using satellite imagery and update annually starting at the end of the construction phase, and for the first five years of operation of the road. GNWT-ENR will use the map of trail networks identified prior to construction of the road developed for the boreal caribou habitat offset plan as the baseline against which to assess proliferation of new trails once the road opens to the public. *(Temporal scope:* Once prior to construction, once at the end of construction, and annually during the first 5 years of operations; *Spatial scope:* all trails identified within 500 m on either side of the Tłı̨chǫ Highway)

vii) Continue GNWT-ENR North Slave Region's moose jaw collection program. The GNWT-ENR North Slave Region has been running a voluntary moose jaw collection program since 2013/2014 whereby moose hunters in the North Slave Region are provided an incentive of $50 plus a ball cap to supply GNWT-ENR with the lower jaws of harvested moose and general location of harvest on a 10 km by 10 km grid. Hunter information, specific locations, and personal details are kept confidential and results are saved to the GNWT-ENR Wildlife Management Information System. The program is run year-long. The information is used to generate the sex and age structure of moose harvested in the North Slave Region, identify areas of higher harvest pressure, and generate an interest in moose management among the public. This program can provide general indicators on patterns of harvest in the North Slave Region. For instance, the age structure of the harvested moose population can provide one broad indicator of the overall sustainability of the harvest. If, over time, there is a change in the age structure of the population (such as a shift to a younger average age of harvested moose) to suggest the harvest is no longer sustainable, increased monitoring and harvest management actions can be considered in areas of concern within the North Slave Region. Locations of harvests can provide a sense of the extent to which additional harvest areas are being targeted near the road during construction and operation. (*Temporal scope*: Ongoing, subject to funding).

Thresholds

The proposed approach in conjunction with other programs for monitoring species population trend (boreal and barren-ground caribou) and/or distribution (moose, bison) is expected to provide several lines of evidence to inform GNWT and the Tłı̨chǫ Government if there would be a need to consider management actions.

GNWT-ENR, in collaboration with the Tłı̨chǫ Government and WRRB, will consider wildlife management actions and mitigations based on the results of the monitoring above and the information collected by the GNWT's existing Resident Hunting Reporting Program, to help ensure sustainable Aboriginal harvesting of wildlife. The Tłı̨chǫ Government will be given the opportunity to be involved in the pre-selection for a potential hunter to harvest bear(s).

Given the paucity of baseline data and current absence of identified triggers defined by species–level management plans, setting quantitative thresholds is difficult at this time. However, as required by Measure 6-2 of the Report of Environmental Assessment (MVEIRB 2018), the GNWT-ENR, in collaboration with Aboriginal groups and in accordance with the requirements of the Tłı̨cho Agreement, will determine sustainable harvest levels for boreal caribou in the North Slave portion of the NT1 range prior to the road being opened to the public. In that same period, if current harvest levels are determined to exceed sustainable levels, management action will be undertaken in conjunction with the Tłı̨cho Government.

If harvest levels are observed to increase towards unsustainable levels once the road is opened to the public, GNWT-ENR and the Tłı̨cho Government will submit a wildlife management proposal under section 12.5.1 of the Tłı̨cho Agreement to the WRRB for the timely implementation of any measures necessary to ensure boreal caribou harvest in the region is kept within sustainable levels. Such measures may include the establishment of a no-hunting corridor along the Project route.

5.2.3 Boreal Caribou

Rationale

Boreal caribou are a culturally and ecologically important species in the NWT. They are listed as "Threatened" under the federal *Species at Risk Act* and as "Threatened" under the *Species at Risk (NWT) Act*. While the population in the continuous range in the NWT (NT1) identified in the federal Boreal Caribou Recovery Strategy is considered to be "likely self-sustaining" based on habitat conditions, population trends likely vary among NWT regions. For example, there is evidence of population declines in the southern NWT, yet it is unclear to what extent this applies across the rest of the range (SARC 2012). While GNWT-ENR has conducted boreal caribou population monitoring in the South Slave, Deh Cho and Inuvik regions, boreal caribou were only once formally surveyed in the North Slave Region in 2005, and no long-term population monitoring has ever been conducted in this region. Implementation of a collar-based boreal caribou program in the North Slave Region has become imperative with the Tłı̨chǫ Highway and with the "threatened" status of boreal caribou in the NWT. In other jurisdictions, linear features including roads have been shown to contribute to the loss of functional habitat for boreal caribou and to population declines associated with increased predation by wolves that use those features (EC 2012). Although the Tłı̨chǫ Highway is not predicted to change the self-sustaining status of boreal caribou at the range-wide scale (NT1), the impact of the road on population trend of boreal caribou within the North Slave (Wek'èezhìı) portion of the range is less certain given that the amount of undisturbed habitat in the region is currently close to the 65% undisturbed habitat management threshold identified in the national recovery strategy. A collar-based program was initiated in March 2017, prior to construction of the road, to provide some baseline data on boreal caribou distribution, population trend, movements and body condition in the Tłı̨chǫ HighwayProject area against which potential impacts of the road can be monitored. Collars are also necessary to complement aerial surveys to provide sightability metrics necessary for calculation of abundance when population surveys are undertaken by the GNWT (as required by Measure 6-1, Part 2 of the Report of Environmental Assessment). Information on habitat selection and areas where collared caribou frequently cross the Tłı̨chǫ Highway alignment can be used to target mitigations for preventing collisions.

To complement the collaring program, GNWT will support the Tłı̨chǫ Government in the design and implementation of a program that uses Tłı̨chǫ harvesters' traditional knowledge and methods to monitor the health of boreal caribou (tǫdzı) and the state of their habitat, during and after the completion of the Tłı̨chǫ Highway Project (Tłı̨chǫ Government 2014, YKDFN 2018). The details of this program, which will be implemented by the Tłı̨chǫ Government, including monitoring objectives and approach, are described in Appendix I, and will be further developed through discussion with Tłı̨chǫ elders and knowledge holders. The expertise and advice of the WRRB will also be sought in the design of the program. The information collected will have relevance to Measure 6-1 of the Report of Environmental Assessment (MVEIRB 2018) and will be incorporated into the WMMP where appropriate.

Monitoring Questions

Information from a collaring program may help determine:

- Where collared boreal caribou are located in relation to construction activities
- If boreal caribou avoid the road during and after construction
- If and where boreal caribou cross the road
- If the rate of boreal caribou movements changes in proximity to the road and, if sample sizes allow, the potential zone of influence of the road on boreal caribou habitat use
- If rates of caribou mortality increase within the study area during and after highway construction
- The population trend of boreal caribou in the regional Tłı̨chǫ Highway study area

Approach

Collar-based monitoring

Global Positioning System (GPS) collars (Telonics TGW-4577-4 Iridium) will be deployed on up to 30 adult female caribou to monitor the movements, habitat use, survival, and responses of these caribou to disturbance (see Figure 1 for the current study area). Between 20 and 30 collars are required to monitor adult female survival rates and cow to calf ratios in order to provide sufficient statistical power to detect population trends over a minimum five-year period (Rettie 2017).

A total of 20 collars were deployed in the boreal caribou study area in March 2017. Additional collars were deployed in subsequent years to replace collars scheduled to drop off, any mortalities, any premature collar releases, and to bring the target sample size up to 30 collars. Five additional collars were deployed in March 2018, seven were deployed in March 2019, there were no deployments in 2020, and 23 were deployed in March 2021. The 2021 deployment was larger than typical because the collars deployed in 2017 were scheduled to drop off in March 2021. Ten collars were deployed in February 2022. In 2018, the North Slave (Tłı̨chǫ Highway) population monitoring study area was revised to exclude the area southeast of HWY 3, and the area southeast of HWY 3 that occurs within the North Slave region was added on to the Mackenzie boreal caribou study area (see Figure 1) which was initiated in 2015. This change was made due to the low number of occurrences of collared caribou crossing HWY 3, suggesting it might make sense to treat groups of caribou on either side of HWY 3 as separate for the purpose of population trend monitoring. Two collars that were deployed southeast of HWY 3 that were initially considered part of the Tłı̨chǫ Highway program were re-assigned to the Mackenzie study area. The boreal caribou monitoring program in the Mackenzie study area is led by the South Slave ENR office, and all other collar deployments within that study area have occurred in the South Slave region except for 2 new collars deployed in the North Slave portion of the study area in 2021. Some collared caribou in the Mackenzie study area move back and forth between the North Slave and South Slave regions on an annual basis.

There are currently 36 active collars (as of December 2022) in the Tłı̨chǫ Highway study area (with 6 collars scheduled to drop in the 2022-23 monitoring year). GNWT-ENR intends to maintain the number of collared females within the North Slave (Tłı̨chǫ Highway) study area at 30 individuals annually during the construction phase, and for at least 5 years during the operational period of the road, to obtain more precise estimates of female survival. GNWT-ENR will attempt to ensure that at least 10 collars are deployed on females with home ranges in the vicinity of the road, to monitor effects of construction and operation of the road on individuals that are likely to interact with the road. To measure population trend, spring aerial recruitment surveys will be required annually to determine cow to calf ratios. When possible, collars will be promptly retrieved from cows that have died to determine the cause of mortality.

The collars used in this study are equipped with a "geofencing" function that allows increased frequency of locations to be collected within a previously defined area programmed into the collar. In this study, collars are programmed to generate six locations per day, but this increases to hourly locations within a buffer of 10 km from the Tłı̨chǫ Highway alignment. This will allow for a finer scale assessment of the behavioural response of boreal caribou to the construction and operation of the Tłı̨chǫ Highway, and to traffic along the existing HWY 3.

During construction of the Tłı̨chǫ Highway, information on the location of collared boreal and barren-ground caribou was provided to the NSI Environmental Manager to alert of the potential need to apply mitigations, such as temporary suspension of construction activities or the need for additional mitigations to avoid disturbing known animals (see Appendix D for further details).

Data collected during collar deployment will include pregnancy and body condition, diseases and parasites, and deoxyribonucleic acid (DNA).

Calf production will be determined by assessing pregnancy rates collected from blood serum during the capture of cows each year of the study and by assessing the movement rates of GPS-collared cows.

Ten-month calf recruitment will be determined from aerial surveys conducted each March by counting and classifying the number of calves and adults associated with collared caribou and other caribou observed during the survey. Animals will be classified as calves or adults (greater than or equal to 12 months) on the basis of body size. Females will be identified by the presence of a black vulva patch and males by lack thereof. Recruitment will be expressed as the ratio of calves per 100 adult cows.

Pollock et al's (1989) staggered-entry modification of Kaplan and Meier's (1958) survivorship model and collared cow data will be used to estimate adult cow survival. For each year, the finite rate of population increase will be estimated from annual recruitment of females (assuming a 50:50 sex ratio in calf production and equal survival of sexes to time of census) and annual adult female survival using the formula outlined by Hatter and Bergerud (1991). The finite rate of population increase (λ) will be determined using a stochastic version of Hatter and Bergerud's (1991) equation (λ =adult female survival/[1-female calf recruitment]) following Latham et al. (2010). The stochastic version of λ is the mean of 10,000 iterations calculating λ.

To assess the impacts of construction and operation of the Tłı̨chǫ Highway on distribution and movement behaviour of boreal caribou, resource selection function (Manly et al. 2010) or step selection function (Fortin et al. 2005) models will likely be developed for boreal caribou using covariates such as vegetation type, proximity to the Tłı̨chǫ Highway and Highway 3, proximity of other linear features, traffic levels, and taking into account seasonality. Other potential approaches include comparing movement rates in proximity and far away from to the Tłı̨chǫ Highway, comparing crossing rates of the Tłı̨chǫ Highway to crossing rates of random roads or crossing rates of random caribou trajectories, comparing percent overlap of home ranges with the Tłı̨chǫ Highway before, during and after construction (e.g., Leblond et al. 2012; Eftestøl et al. 2014), barrier behaviour analysis (e.g., Xu et al. 2020), or piecewise regression methods (e.g., Boulanger et al. 2021). Depending on the data, other potential analyses include the use of multi-state models to test whether the construction of the highway influences the probability of caribou movement across the road and if proximity to the highway affects survival rates.

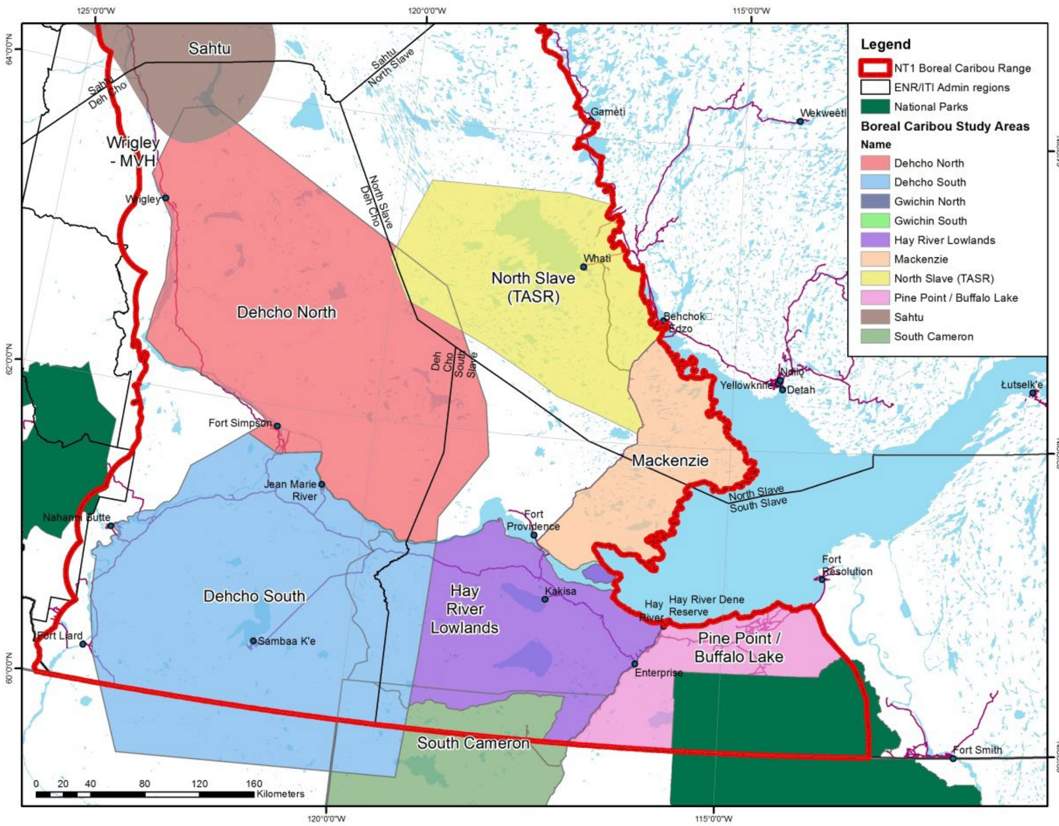

Figure 1: Boreal Caribou North Slave (Tłįchǫ Highway) Study Area, and other adjacent boreal caribou study areas in the southern NWT[1].

Monitoring to determine boreal caribou abundance

Measure 6-1, Part 2 of the Report of Environmental Assessment (MVEIRB 2018) requires GNWT to conduct monitoring to determine the abundance of boreal caribou in the North Slave portion of the NT1 range. GNWT-ENR conducted a two-phase aerial survey to estimate population abundance of boreal caribou within the North Slave – Tłįchǫ Highway Study area between February 19 and March 2, 2020 (Wildlife Research Permit # WL500813), following methods developed in Québec by Courtois et al. 2003. The objective of Phase 1 of the survey was to locate and GPS mark caribou track networks, visual sightings of caribou, and unidentified ungulate tracks along equally spaced transects. The locations of the recorded observations were then revisited during Phase 2 and associated caribou were located, counted, and classified. Observations of other ungulates (moose and bison), and carnivores (wolf, fox, lynx, wolverine) were recorded and locations marked during both phases of the survey. Other wildlife observations were also noted. The proportion of collared boreal caribou that were visually detected during

[1] Note that the South Cameron [aka Cameron Hills] study area is no longer active.

the Phase 2 surveys will be used to estimate a detection correction factor for the overall abundance estimate.

Originally, the planned study area for the abundance survey was 26,300 km^2 and included 13,000 km of transects. The study area was divided into five survey blocks to facilitate the Phase 1 survey using two fixed-wing planes and to reduce observer fatigue by dividing long transects up between the two aircraft (Figure 2). Due to an incident with one of the aircraft, poor weather conditions in parts of the study area, and time constraints, a survey of approximately 21,071 km^2 (Figure 3) of the study area was completed. Survey lines were spaced 2 km apart. The Phase 1 survey was flown with a BushHawk and DHC-2 Beaver (when available) at altitudes ranging from 97 to 172 m and a speed of approximately 90 knots (167 km/hr; ranging from 124 to 212 km/hr). Each survey crew consisted of 2 community observers, an ENR navigator, and a pilot. Observers included Tłı̨chǫ community members from Whatì and Behchokǫ̀, and members of the Yellowknives Dene First Nations, and North Slave Métis Alliance. Each day, following the Phase 1 surveys, the locations of tracks and sightings of boreal caribou and unidentified ungulates made by the Phase 1 survey crews were investigated by helicopter (A-Star-350 B2). The Phase 2 helicopter survey crew consisted of 2 ENR staff (1 caribou spotter/classifier/navigator and 1 radio telemetry operator/caribou spotter/data recorder), 1 Tłı̨chǫ Government staff members (caribou spotter/data recorder) and the pilot. When groups of boreal caribou were located by helicopter, they were classified into adult females (cows), adult males (bulls), and calves in order to estimate cow:calf ratios and bull:cow ratios. The caribou classifier also looked for the presence of GPS collars on adult females in each group. The proportion of collared adult females visually located by the classifier will be used to estimate a detection correction factor. The telemetry operator had prior knowledge of the location of collared adult female caribou, but did not share the locations with the other crew members in the helicopter. The telemetry operator used the telemetry gear to scan for the VHF signals of collared caribou throughout the survey. When collared female caribou were not visually located by the classifier, the telemetry operator instructed the helicopter to circle back to locate the group by telemetry by honing in on the VHF signal. While searching for groups containing one or more collared caribou, other groups of boreal caribou were incidentally located that would otherwise have been missed by the first pass Phase 2 visual survey.

During the Phase 2 surveys, a total of 414 boreal caribou (218 cows, 122 bulls, and 66 calves) in 73 different groups were recorded visually by flying to the location of boreal caribou sightings and tracks recorded by the Phase 1 survey crew and intensively searching the area. Eight collared boreal caribou were located visually within these groups without the aid of telemetry. An additional 163 boreal caribou (97 cows, 37 bulls, and 26 calves) were counted inside the study area by locating groups with collared boreal caribou (n=26) by telemetry that would have otherwise been missed by the visual surveys. The total number of boreal caribou counted within the study area was 577, resulting in a minimum density estimate of 2.74 caribou/100 km^2. A more detailed assessment of boreal caribou abundance and density accounting for detectability will be presented in a separate report.

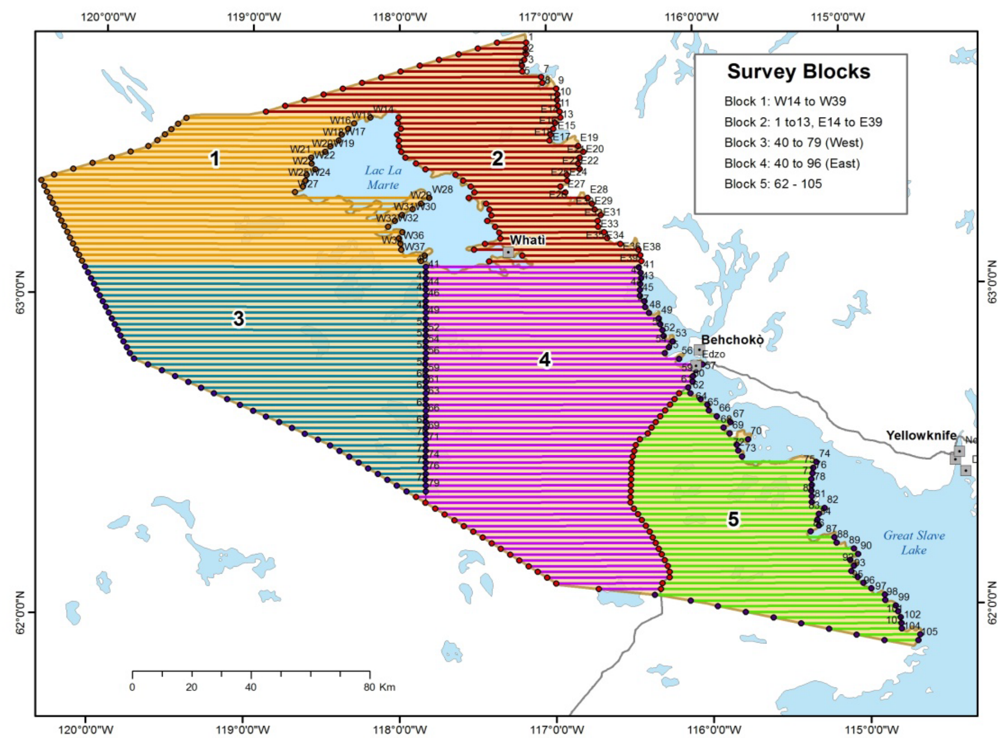

Figure 2: Original North Slave – Tłįchǫ Highway study area with survey blocks 1-5.

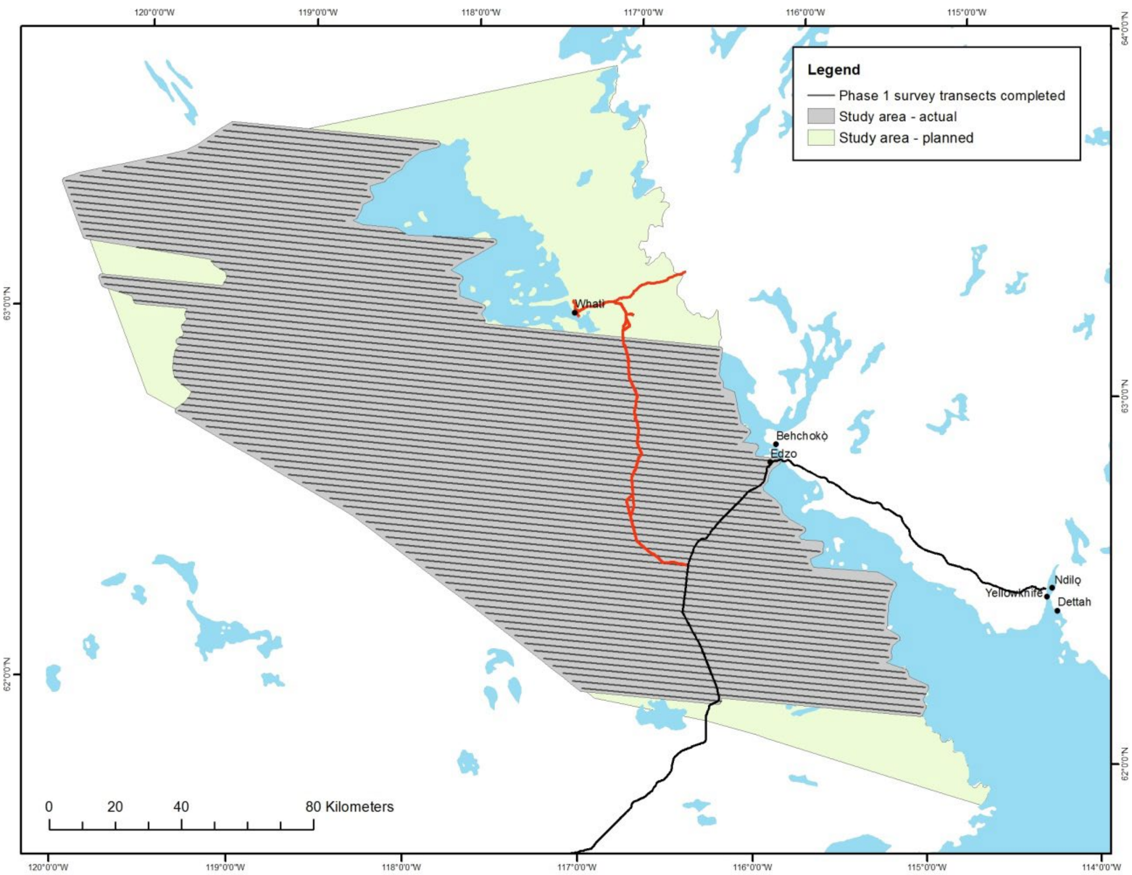

Figure 3: Actual study area (grey polygon) and transects (lines) surveyed between Feb. 19-28, 2020 by two fixed-wing aircraft for sightings and tracks of boreal caribou, other ungulate and carnivore species.

The population estimate from the 2020 abundance survey could be used to estimate changes in the number of boreal caribou in the region over time based on measures of annual rate of population change obtained from the collaring program. It is recommended that the abundance survey be repeated towards the end of the first 5 years of operations of the road.

Annual reporting and summaries of results of the boreal caribou monitoring program will be distributed to co-management partners such as Tłı̨chǫ Government and the WRRB through the wildlife research permitting process, the Tłı̨chǫ Highway corridor working group, and annual WMMP reports; whereas more formal comprehensive analysis and reporting will occur: a) at the end of construction; and, b) after five years of operations.

Temporal Scope

The collaring program is proposed for the duration of construction plus five years of operations. The need for continued monitoring will be re-evaluated at that time. A boreal caribou abundance survey took place during the construction phase, and an additional abundance survey is recommended towards the end of the first 5 years of operations.

Thresholds

During construction, monitoring of collared animals will help to determine the proximity of some animals to the Tłı̨chǫ Highway for construction. In addition to visual on-the-ground monitoring conducted by Environmental Monitors to identify approaching wildlife, GNWT-ENR will provide location maps of collared boreal caribou to the NSI Environmental Manager to monitor the movements of collared caribou, and to trigger mitigation measures to reduce sensory disturbance and risk of caribou mortality or injury. Specific distance thresholds of collared caribou to the Tłı̨chǫ Highway alignment and to areas where blasting will occur that will trigger mitigations are defined for different seasons in Appendix D. Maps of collar locations will be provided more frequently during the late-winter and calving seasons as per the standard operating procedure (Appendix D).

During the operational phase of the road, the results of this monitoring program will be used to identify where mitigation actions (such as reduced speed limits or signage at crossing locations or in sensitive seasons) should be applied. Formal analyses of resource selection and movement patterns related to the road can help to quantify the impact of the road and provide information for future resource planning in the NWT. Estimates of population trend and related statistics will support regional scale efforts such as range planning and help to identify larger issues with productivity and survival that may lead to consideration of management interventions among co-management partners.

5.2.4 Barren-Ground Caribou Collaring

Rationale

Barren-ground caribou are a highly valued species in the NWT. Barren-ground caribou have been assessed as "threatened" by the NWT list of species at risk. Several herds in the NWT have experienced substantial population declines. While barren-ground caribou have not been detected in the vicinity of the Tłı̨chǫ Highway in recent years of low population levels, the historical annual range of the Bathurst herd as determined by traditional knowledge, aerial survey data and collaring data has overlapped the northern section of the Tłı̨chǫ Highway corridor. It is possible that barren-ground caribou may re-occupy the area of the Tłı̨chǫ Highway corridor in the future, likely in winter. The current barren-ground caribou collaring program will help GNWT-ENR to detect whether barren-ground caribou are approaching the Tłı̨chǫ Highway corridor. Given that the Tłı̨chǫ Highway will occur on the very edge of the range, the risk of the road acting as a substantial movement barrier to barren-ground caribou is low, however, collar data may be used over time to evaluate the impacts of the road on barren-ground caribou movements if they move into the area.

To complement the collaring program, and as required by Measure 7-1, GNWT will support the Tłı̨chǫ Government in the design and implementation of a program that uses Tłı̨chǫ harvesters' traditional knowledge and methods to monitor the state of barren-ground caribou (ʔekwǫ̀) winter habitat, during and after the construction of the Tłı̨chǫ Highway Project. The details of this program, which will be implemented by the Tłı̨chǫ Government, including monitoring objectives and approach, are described in Appendix I, and will be further developed through discussion with Tłı̨chǫ elders and knowledge holders. The findings of the program will be incorporated into the WMMP while it is in place. The expertise and advice of the WRRB will also be sought in the design of the program.

Monitoring Question

Data from the existing barren-ground caribou collaring program may be used to determine whether barren-ground caribou are approaching the area of the Tłı̨chǫ Highway corridor.

Approach

GNWT-ENR attempts to maintain 70 GPS collars annually on the Bathurst caribou herd, 50 on cows and 20 on bulls. Some of these collars could be equipped with a "geofencing" function that allows increased frequency of locations to be collected within a previously defined area programmed into the collar, and the goal is to have all collars equipped with this capability over time with redeployments. Collars are generally programmed to generate three locations per day, but newly deployed collars can be programmed to generate hourly locations within a buffer of 10 km from the proposed Tłı̨chǫ Highway if caribou begin to spend more time in the region of the road. This will allow for a finer scale assessment of the behavioural response of barren-ground caribou to the construction and operation of the Tłı̨chǫ Highway, and to traffic along the existing highway if caribou do re-enter the area. Data are typically downloaded every four days. Given the slower and more limited movements of barren-ground caribou in the winter, current programming of three times daily is sufficient to detect their approach into the area and to initiate patrols to look out for them and determine how many individuals may be in the area. GNWT-ENR will use the Core Bathurst Caribou Management Zone maps (aka "Mobile Zone" maps), which are generated weekly every winter since 2015, to evaluate overlap of the Mobile Zone with a 10 km buffer around the Tłı̨chǫ Highway alignment. Any overlap between the two polygons will be used as a trigger to initiate patrols.

Temporal Scope

Indefinitely, as this is a well-established, on-going program.

Thresholds

If collar data and Core Bathurst Caribou Management Zone maps indicate that barren-ground caribou are approaching within 10 km of the Tłı̨chǫ Highway road, GNWT-ENR and GNWT-INF staff traveling the road will be notified to monitor for groups of caribou. In the event that GNWT staff either see or receive reports of groups of caribou on or adjacent to the road, GNWT-ENR will contact GNWT-INF to discuss the need or potential for temporary signage, speed reductions or road closures.

5.2.5 Moose and Bison Population Monitoring

Rationale

Moose are an important big game species in the North Slave Region, comprising a substantial portion of the Tłı̨chǫ subsistence harvest and supporting a resident fall harvest. While GNWT-ENR conducts moose population surveys approximately every five years throughout the North Slave Region, these studies have not historically focussed on the Tłı̨chǫ Highway regional study area and are not designed to detect changes in a small-targeted area. Moose occur in low densities throughout the NWT, and a population survey in the North Slave Region conducted in 2012 identified densities of roughly 2.9 moose/100 square kilometres (km^2) in the Taiga Plains (Cluff 2013). A North Slave Region moose survey took place in 2016, but the area of the Tłı̨chǫ Highway could not be surveyed due to poor weather (Cluff 2018). The most recent North Slave Region moose survey took place in 2020/21. There are several factors affecting moose in the Tłı̨chǫ Highway study region that, in addition to the road itself, warrant tracking moose populations. Given harvest restrictions on barren-ground caribou, moose may be targeted more frequently by hunters, which will be further facilitated by the road. This could lead to the potential for localized over-hunting. In addition, community members have expressed concerns that the potential expansion of the Mackenzie bison northward towards Whatì will negatively impact moose and caribou in areas where they overlap. While the extensive recent burns in the vicinity of the Tłı̨chǫ Highway might be expected to increase moose habitat over time, the interaction of these factors introduces sufficient uncertainty to warrant more targeted regional monitoring. Having an understanding of how the population is changing in the regional study area is essential to placing the information generated by harvest and collision monitoring into context for making decisions about the need for management actions.

Wood bison, assessed as Threatened by the NWT Species at Risk Committee and listed as Threatened under the federal *Species at Risk Act* and *Species at Risk (NWT) Act*, are a species of management concern in the NWT. With construction of the Tłı̨chǫ Highway, it is possible that the Mackenzie bison herd will use the road corridor to expand its range northward, possibly entering the community of Whatì. This has raised the concern among community members that bison may begin to exclude moose and caribou in the region.

Hunting of the Mackenzie bison population is currently closed following an anthrax outbreak in 2012, but a new road will increase hunters' access into bison habitat and may increase hunting pressure when hunting is reinstated. The last Mackenzie bison population estimate (2019) exceeded 1000 individuals, and the Mackenzie Bison Working Group has recommended that a limited harvest of the herd be re-opened. Traffic on a new road will also increase the number of bison-vehicle collisions, which is already a substantial cause of mortality on Highway 3. Collisions are a risk to human safety and a cause of bison mortality. Aerial surveys designed to monitor moose relative abundance and trend in the Tłı̨chǫ Highway study region can also be used to monitor bison occurrence in the area, track any northward expansion, and inform the need for more targeted mitigation to minimize bison-vehicle collisions.

Monitoring Questions

Data obtained from population monitoring conducted in the regional Tłı̨chǫ Highway study area will help to determine:

- If the relative abundance of moose in the Tłı̨chǫ Highway regional study area changes over time. This will help to identify potential conservation concerns related to the road and hunter access.
- Whether changes in the abundance of moose in the Tłı̨chǫ Highway regional study area are qualitatively similar to what is observed in North Slave Regional surveys.
- If and at what rate bison expand their range northward along the road corridor.
- If the relative abundance of bison in the Tłı̨chǫ Highway regional study area changes over time.

Proposed Approach

GNWT-ENR originally proposed late winter aerial surveys every three years for moose and bison to generate density estimates in the Tłı̨chǫ Highway regional study area, and to look for impacts of the road, with at least two rounds of surveys occurring once the operation of the road begins. The first aerial survey occurred in February 2018, before road construction, to get a baseline estimate of moose and bison density (Wildlife Research Permit #WL5005580). This survey was conducted within a ~10,000 km^2 study area centered on the proposed Tłı̨chǫ Highway alignment (Figure 4), with survey transects spaced 2 km apart. A distance-based sampling method (Buckland et al. 2001) was used to estimate moose and bison densities within the study area. The distribution of the number of observations made at different distances to survey transects is used to estimate a detection function to model how the probability of recording observations decreases as a function of distance from the line. The detection function is then used to estimate the density of moose or bison in the study area while accounting for decreasing likelihood of recording animals that are farther from the transect. The February 2018 survey recorded 27 observations of bison (group sizes ranging from 1-54 bison), and 34 observations of moose (group sizes ranged from 1-3 animals). The number of bison and moose observations from this survey alone were insufficient to estimate a detection function, as Buckland et al. (2001, p. 240) recommend at least 60 to 80 independent observations of a species in order to estimate a reliable detection function. In order obtain a sufficient sample size to estimate a detection function for moose, the 2018 Tłı̨chǫ Highway data was experimentally combined with data from a 2016 North Slave moose survey that also used distance sampling. This resulted in an estimate of 125 moose in the 10,000 km^2 (or 1.25 moose/100 km^2) study area with a Coefficient of Variation (CV) of 24%. Boulanger et al. (2015) recommended a target CV of 15% for monitoring bison populations, which would provide 80% power to detect a decline of a population to ~54% of its initial value (Rettie 2019). A similar target CV of 15% for moose population estimates would also be necessary to achieve similar power to detect changes of this magnitude.

As recommended by Rettie (2019), future aerial surveys for moose and bison for the Tłı̨chǫ Highway will be combined with the larger regional North Slave moose aerial survey, and the Mackenzie bison population surveys, both of which use a distance-based sampling approach. Combining the Tłı̨chǫ Highway survey with the broader regional surveys should provide the necessary number of observations to reliably estimate detection functions, and to generate population estimates with an acceptable level of precision for both species. The Tłı̨chǫ Highway study area will be treated as a strata within the broader regional survey areas in order to estimate moose and bison densities specific to this area.

The most recent North Slave region moose survey occurred in fall 2020 and spring 2021. A moose composition survey was conducted in November 2020 to estimate sex ratios prior to bull moose shedding their antlers, followed by the moose abundance survey in March 2021. The north Slave region moose abundance survey also uses a distance-based sampling approach, with survey transects spaced 8 km apart (Cluff 2018), and covers a much larger area (~44,000 km^2) which fully encompasses the Tłı̨chǫ Highway area surveyed in 2018 (Figure 5). Transect spacing may be decreased to 4 km within the Tłı̨chǫ Highway area to obtain a more precise density estimate.

The last Mackenzie bison survey took place in 2019, and recorded an average density of 6.1 bison per 100 km^2, and a population estimate of 1468 bison (95% C.I. 914-2359 animals). The next Mackenzie bison survey will take place in 2023. Although the Mackenzie bison survey area only covers the southern half of the Tłı̨chǫ Highway (Figure 5), no bison observations recorded in previous surveys (including the 2018 moose-bison survey, and the 2020 boreal caribou abundance survey) have occurred north of that survey area to date. The Mackenzie bison survey area boundary should therefore be appropriate for estimating the bison population but may not answer the question of whether bison are moving further north along the Tłįchǫ Highway right of way. GNWT-ENR is confident that other ongoing programs such as regular road surveys and wildlife sightings recorded by NSI project staff, as well as annual boreal caribou spring composition surveys, will continue to provide sufficient bison sightings data to detect northward expansion of bison along the Tłįchǫ Highway right of way if it occurs.

Abundance estimates for both the moose and bison surveys will be generated using the program Distance (distancesampling.org). The moose and bison aerial surveys will also record boreal caribou and other incidental wildlife sightings. Although these incidental sighting records would not be enough to provide reliable population estimates or trend information for these species, they can still provide information on boreal caribou occupancy throughout the study area. For the moose and bison aerial survey programs, a summary report will be included in the annual WMMP report after every survey year, and in the comprehensive reports.

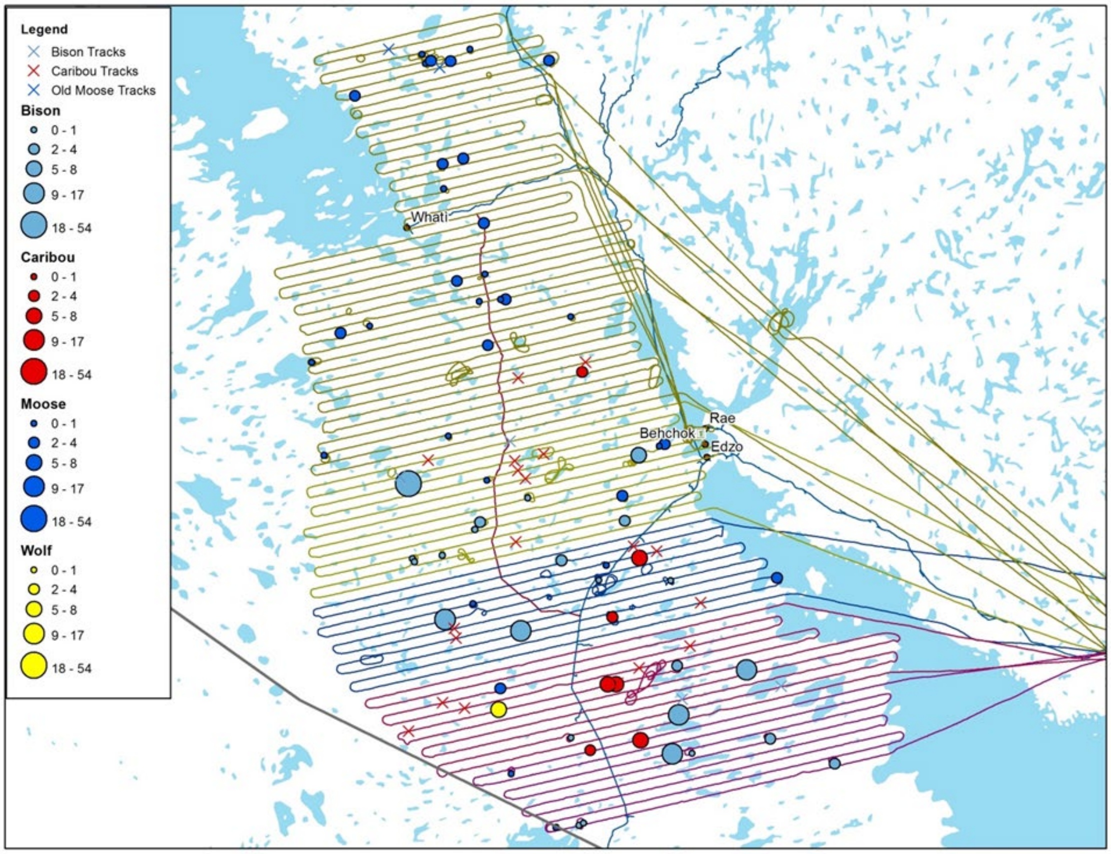

Figure 4: Wildlife Observations Recorded During a 2018 Aerial Moose/Bison Survey[2]

[2] Note: Symbol sizes for each observation are proportional to the number of individuals in each group. Coloured lines represent the aerial survey transects flown, starting in the northern end of the study area working south.

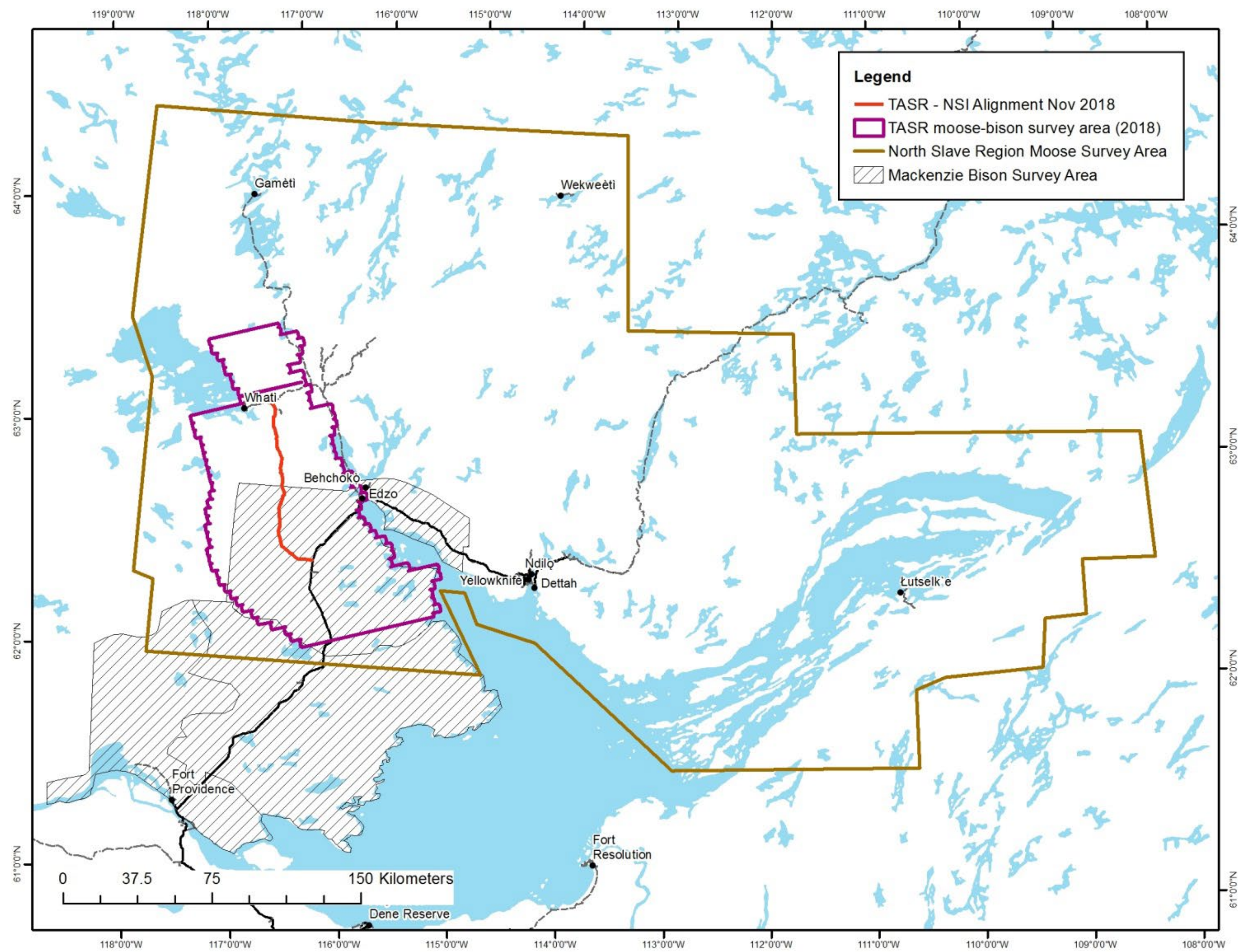

Figure 5: Survey area boundaries for Mackenzie bison surveys and North Slave moose surveys which will be used to estimate abundance of moose and caribou in the Tłı̨chǫ Highway area in future surveys. The 2018 moose-bison survey area that was conducted specifically as part of the Tłı̨chǫ Highway WMMP is shown to illustrate overlap with the future bison and moose survey areas.

Temporal Scope

One baseline survey for moose and bison was conducted in Winter 2018. One additional moose aerial survey was conducted during the construction phase (2020/21). Additional surveys for moose will occur on five year intervals (2025/26 and onwards). The next aerial survey for Mackenzie bison is planned to occur in 2023. The frequency of bison population surveys depends on the herd size (Mackenzie Bison Working Group 2018). Currently the Mackenzie bison population is estimated at >1000 individuals and surveys are proposed to occur every 3-4 years when the population is between 1000-1500 individuals (Mackenzie Bison Working Group 2018).

Annual reporting and summaries of results of the moose and bison surveys will be distributed to co-management partners such as Tłı̨chǫ Government and the WRRB through the wildlife research permitting process, the Tłı̨chǫ Highway corridor working group, and annual WMMP reports; whereas more formal comprehensive analysis and reporting will occur: a) at the end of construction; and, b) after five years of operations.

Thresholds

Moose and bison density estimates and distribution information within the Tłı̨chǫ Highway study area can help to detect changes in the region over time that may identify harvesting or collision issues and inform the need for management decisions to be considered with co-management partners. For example, if harvest monitoring indicates notable increases in moose mortality in the regional study area, the need to consider conservation actions would be informed by whether population level monitoring shows decreasing, stable or increasing populations. Specific management thresholds may be identified once baseline moose density and harvest levels have been determined.

5.2.6 Wildlife Sighting and Collisions

Rationale

Increased risk of wildlife injury and mortality due to vehicle collisions is one of the main concerns with the Tłı̨chǫ Highway. One difficulty in predicting the extent and the seriousness of harm to wildlife from vehicle collisions associated with a new road is that currently GNWT does not have a single source of baseline data on wildlife mortalities. GNWT-INF and GNWT-ENR have different processes and keep separate records of animal–vehicle collisions which makes assessing the true costs to humans and wildlife difficult. This particular impact pathway potentially affects all wildlife but was a particular source of uncertainty in the EA for Mackenzie bison which are more susceptible to collisions given their frequent use of roadways. Bison mortalities due to vehicle collisions along the new Tłı̨chǫ Highway will need to be carefully monitored in the context of sustainable management of the herd. Currently, there is no consistent, accurate, geo-referenced system in place for tracking wildlife-vehicle collisions or wildlife observations along the road to determine where potential hotspots may be that warrant dedicated mitigation efforts such as increased signage or heightened speed limit enforcement. Having a consistent method for reporting wildlife-vehicle collisions and wildlife observations will also provide information on potential range expansion of Mackenzie bison along the Tłı̨chǫ Highway, which addresses one of the questions of the EA.

Monitoring Question

- How many wildlife-vehicle collisions are occurring along NWT highways, and how will the Tłı̨chǫ Highway contribute to that?

- Where are wildlife-vehicle collisions occurring most frequently along the Tłı̨chǫ Highway, if they occur, and other NWT highways?
- Where is wildlife being observed most frequently along the Tłı̨chǫ Highway?
- Are the Mackenzie bison expanding their range further north along the road?
- Is snow cleared from the Tłı̨chǫ Highway making it difficult for wildlife to cross the right of way?

Monitoring Approach

GNWT will establish an inter-departmental working group co-chaired by GNWT-INF and GNWT-ENR to investigate, design and launch a wildlife collision and sighting reporting system for GNWT employees based on the Alberta Wildlife Watch Program (Alberta 2016). Alberta has designed a smartphone app for use by employees and contractors who travel the roads frequently to easily and accurately record wildlife sightings, carcasses and collisions in order to better understand the costs associated with collisions, impacts to wildlife, where mitigation is required and the effectiveness of mitigation. Alberta is making the platform available to other jurisdictions to tailor to their needs. GNWT has obtained access to the platform through a Software Licence Agreement with the Alberta Government, and is currently evaluating which aspects of the mobile and web applications will need to be modified for use in the NWT. GNWT hopes to conduct pilot tests of an NWT version of the app during the first year of operation of the Tłı̨chǫ Highway. The app will include a mechanism for reporting instances of wildlife that show signs of having difficulty moving alongside the road due to snow removal. GNWT will encourage Fortune Minerals to align their monitoring of wildlife use of roads proposed for the NICO Project (Fortune Minerals 2013) with the GNWT's proposed methodology. Prior to the implementation of the Wildlife Watch Application, INF will continue using the existing wildlife-vehicle collision reporting form in collaboration with ENR. A copy of the form has been attached to Appendix F.

Temporal Scope

The timeline and appropriate review cycles necessary to generate the appropriate amount of data to support mitigation for the operations phase of the Tłı̨chǫ Highway would be determined by the working group based on periodic review of results. Wildlife-vehicle collision monitoring and wildlife sightings reporting along the Tłı̨chǫ Highway will be ongoing once the Tłı̨chǫ Highway is operational.

Thresholds

Depending on the rate of data acquisition, the program will identify regular intervals for analysis that will provide sufficient data to identify potential hot-spots along the road.

When these are identified, GNWT-INF can implement mitigations such as lowered speed limits or temporary and permanent signage.

5.2.7 Predator Monitoring

As required by Measure 6-1, Part 2, GNWT will undertake monitoring to assess predator population densities, movements and predation rates. Predation rates on boreal caribou will be assessed by investigating mortalities of collared boreal caribou to determine cause of death. Although the sample size of annual mortalities and known cause of death of collared boreal caribou from the Tłı̨chǫ Highway study area is likely to be too low to analyze statistically on its own (Rettie 2019), mortality data from this program will be pooled with that from other NWT boreal caribou study areas in order to contribute to a broad-scale long-term data set that can be used to assess mortality patterns (e.g. Kelly 2020).

To assess the abundance of wolves in the Tłı̨chǫ Highway study area, aerial wolf population surveys were conducted in two 5000 km^2 blocks in February and March 2020. One survey block was centered along the Tłı̨chǫ All-Season Road alignment (conducted under Wildlife Research Permit # WL500813), and a second reference block was placed within the Mackenzie boreal caribou monitoring study area southeast of HWY 3 (conducted under Wildlife Research Permit # WL500772). Survey methods followed those used in previous wolf surveys conducted in the South Slave and Dehcho regions (Serrouya et al. 2016). The survey was flown using a fixed-wing aircraft (Scout), and a crew consisting of the pilot and professional tracker. Survey transects were spaced 3 km apart, and when wolf tracks were encountered, they were followed to locate the wolf pack and determine pack size. Where packs could not be located, numbers were estimated based on track characteristics (e.g., amount of activity, track splitting, individual tracks). Observations of other large ungulates and carnivores were also recorded by GPS.

The Mackenzie block was surveyed from February 7-12, 2020, with no flights on February 10-11 due to poor weather conditions. One pack estimated at 3-4 wolves based on tracks was recorded on February 7, and a second pack estimated at 5-6 wolves based on tracks was recorded on February 8 (Figure 6). Wolf density was estimated to be 1.6-2.0 wolves per 1000 km^2.

The Tłı̨chǫ Highway survey block was flown on March 9-10, 2020. One pack of 5 wolves was observed on March 09, 2020 as well as 2 wolves on a bison kill (Figure 6). Wolf density was estimated to be 1.4 wolves per 1000 km^2.

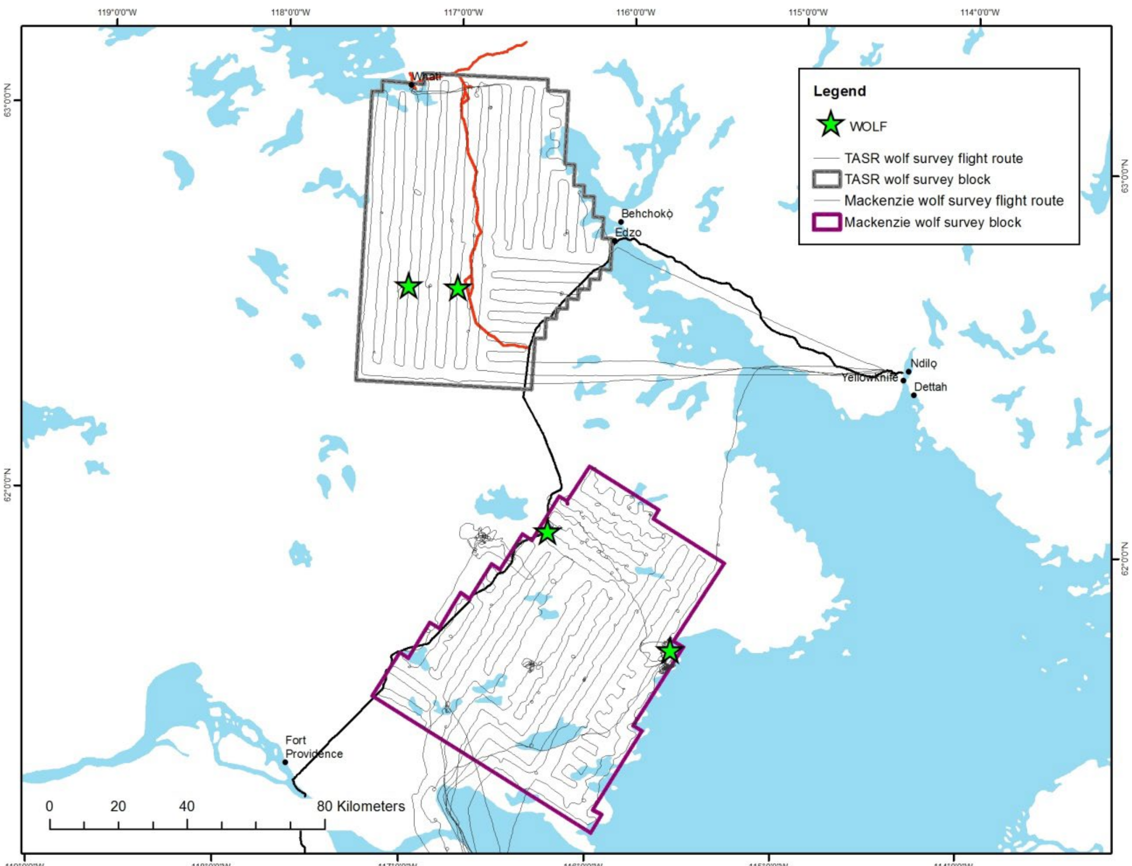

Figure 6. Observations of wolves or wolf track networks recorded during aerial wolf abundance surveys conducted within two ~5000 km² blocks in February/March 2020.

Aerial wolf population surveys were conducted again in 2022 under Wildlife Research Permit # WL501017. Survey methods were consistent with the 2020 wolf surveys. One survey repeated the Tłı̨chǫ All-Season Road alignment block surveyed in 2020 and was surveyed from February 26 to March 1, 2022. Wolf density was estimated to be 2.0 – 2.8 wolves/ 1000 km^2 .

A 5000 km^2 reference block was placed within the north end of the Mackenzie boreal caribou monitoring study area east of HWY 3. It was was surveyed Feb 21-26, 2022 with no flights on Feb 22nd. Wolf density was estimated to be 1.4 wolves per 1000 km^2.

In 2022 GPS collars were used to begin monitoring wolves to assess predator movements. Four collars (Telonics model TGW-4577-4) were deployed onto wolves in boreal caribou range of the North Slave area. GPS collars will allow for monitoring the movements, distribution and habitat selection of wolves, including their use or avoidance of the Tłı̨chǫ Highway and other linear features. A male and female wolf were collared east of HWY 3 on February 24 and 25, 2022, respectively. On each of March 1 and 3, 2022, a male wolf was collared west of HWY 3. Wolf collars are programmed to release approximately 1.5 years after deployment.

Temporal Scope

It is recommended that the wolf abundance surveys be repeated once more towards the end of the first 5 years of operations of the road. It is recommended that wolf collaring continue to target 1-2 collars per pack across the study area, to better understand movements and habitat selection of an important predator of boreal caribou [for the first 5 years of operations of the road?].

5.3 Refinement of the Study Design

GNWT-ENR commissioned an independent review of the wildlife effects monitoring programs (Section 5.2) outlined in the WMMP. The main objectives of the review were to 1) determine whether the various wildlife effects monitoring programs were appropriately designed to meet the monitoring objectives and answer specific monitoring questions, 2) assess whether the programs would have enough statistical power to detect changes within the different parameters measured for each program. A copy of the WMMP review by Rettie (2019) has been provided (Appendix J) to assist with the first annual review of the WMMP, and was considered in the updates made to wildlife effects monitoring programs in version 4.0 of the WMMP.

6.0 REPORTING AND ADAPTIVE MANAGEMENT

6.1 Reporting

Three levels of reporting will be completed; weekly, annual, and cyclical comprehensive reports. The monitoring described here is exclusive of any immediate reports that may be required in the event of a wildlife emergency or required to fulfill research permit requirements. Weekly and monthly meetings also occurred during the construction phase.

6.1.1 Weekly Reports

During the construction phase, weekly reports were prepared. The weekly reports were submitted to the GNWT, the NSI Environmental Manager, the Tłı̨chǫ Government, the WLWB, ECCC, WRRB and other interested parties. The weekly reporting included, but not be limited to the following content:

- Mitigation triggered or new mitigation implemented
- Wildlife incidents
- Wildlife collisions and mortalities
- Bird nests observed (and any mitigations implemented)
- Any bat hibernacula discovered (and mitigations implemented)
- Copies of the wildlife sightings logs, with particular reference to any observations of Species at Risk (and any mitigations implemented)
- Waste management concerns
- Project staff behaviour concerns
- Any other issues that may be pertinent to the protection of wildlife or the relevant legislation and regulations protecting wildlife
- Any reviews of or changes to WMMP mitigation.
- Anticipated construction and monitoring activities for the upcoming week.
- Dust suppression methods and activities
- Maps of collared caribou movements (although distribution may be limited to protect sensitive information)

6.1.2 Annual Reports

The GNWT and NSI will report on the progress and implementation of the WMMP. The annual WMMP report will be submitted as a component of the Water Licence Annual Report. See the 2021 Water Licence Annual Report here This will ensure maximized efficiency for all review parties. The Water Licence Annual Report will document the previous year's activities and will include, but not be limited to, the WMMP following information:

- A summary of all data collected
- Related to boreal caribou:
  - Annual adult female survival rates, calf recruitment rates, and population trend estimates (lambda)
  - A summary of the number of times collared boreal caribou crossed the Tłı̨chǫ Highway alignment by season and year
  - The number of times collared boreal caribou occurred within the 4-6 km buffers around the road alignment in weekly or 2-day reporting intervals outlined in Appendix D, and the number of times such instances triggered additional mitigation measures.
  - Information on any collared caribou mortalities, collar releases or malfunctions.
- Occurrences of human-wildlife interactions, and incidents, accidents, injuries, or mortalities involving wildlife
- Records of disturbances to wildlife habitat that were not predicted
- Observations of recreational, traditional, or non-traditional activities near the Project
- A discussion of the effectiveness of the mitigation outlined in the WMMP, based on the mitigation audit
- A summary of annual reviewer comments on the WMMP
- Any reviews of or changes to WMMP mitigation
- Report on relevant scientific or traditional knowledge reports for the Tłı̨chǫ Highway area that became available in the previous year
- Traditional knowledge provided by the Tłı̨chǫ Government.
- Report on monitoring results and management actions, as required by Measure 10-1, Part 2 of the Report of Environmental Assessment.

- Results of the Thermal Imaging Device Pilot Study
- Traffic monitoring results

The GNWT-ENR will require an annual public review of the Tłı̨chǫ Highway WMMP, as required by Measure 10-2, Part 3 of the Report of Environmental Assessment (MVEIRB 2018). Recommendations received during the WMMP public review from parties, responses on how recommendations were incorporated and reasons for recommendations which were not incorporated will be made public.

6.1.3 Comprehensive Reports

Two comprehensive reports that compile and synthesize information from all previous years and monitoring programs will be prepared, the first following the final year of construction, and the second five years after monitoring during operations starts. The comprehensive report will consider analysis of the following, in addition to any other relevant issues:

- The efficacy of mitigation
- Road-related mortalities
- Available information on changes in wildlife distribution, trend and abundance
- Answers to the specific wildlife effects monitoring questions posed in section 5.2
- Wildlife conservation concerns related to the Tłı̨chǫ Highway
- Suggested mitigation for any unacceptable effects observed
- Description total direct habitat loss
- Relevant scientific or traditional knowledge reports for the Tłı̨chǫ Highway area

At the end of the Construction Phase, and after the first 5 years of the Operations Phase, INF/NSI/ENR/TG will submit to ENR a compiled version of all wildlife observations collected during surveys conducted by NSI. TG and ENR undertake monitoring of wildlife and related activities along the highway following opening of the road. This data will be entered into ENR's Wildlife Management Information System (WMIS) which is ENR's wildlife data repository. All data from surveys and monitoring programs conducted by ENR under the Tłı̨chǫ Highway WMMP are also being entered into WMIS.

The second comprehensive report will include recommendations for the termination of the WMMP or continuation of aspects of the WMMP.

6.2 Adaptive Management and Response Framework

The Tłı̨chǫ Highway Adaptive Management Framework outlines approaches to adaptive management, and the components of a Response Framework. Adaptive management is defined by the Adaptive Management Framework as a formal process for continually improving management policies and practices by learning from their outcomes. The Adaptive Management Framework further identifies four categories of adaptive management; Active, Passive, Impromptu and Adaptive Co-Management. Of these strategies, all are applied in the WMMP with the exception of Active Adaptive Management.

A response framework is a system of pre-determined thresholds, which trigger actions when exceeded. A response framework can be used in passive adaptive management, as it involves applying one mitigation action at a time, and proposes specific and pre-defined solutions before monitoring begins.

This section outlines how adaptive management is applied to the WMMP, in accordance with Suggestion 14-1 of the Report of Environmental Assessment (MVEIRB 2018).

6.2.1 Adaptive Management

This section applies to both construction and operation phases of the Project. As with the construction phase, the operation phase will continue the adaptive management concept, primarily using the Adaptive Co-Management approach, based on annual reports. The reports will be circulated to regulatory agencies, Tłı̨chǫ Highway Corridor Working Group members, and other interested parties. Through these reports, all incidents, relevant wildlife observations and concerns regarding the environmental management of the Project will be documented, and the WMMP mitigation triggered, or any new mitigation implemented will be described. Through the Adaptive Co-Management process, stakeholders will collaborate to find consensus on a solution. Information provided through Adaptive Co-Management should include both scientific and traditional knowledge.

Passive adaptive management will be applied through the application of best management practices, and the response framework actions listed in Section 6.2.2.

Where appropriate, Impromptu Adaptive Management will also be implemented. This approach is suitable in situations where risk is low, and solutions maybe implemented on an impromptu basis by experienced environmental staff. Examples include implementing additional waste management procedures at a location where scavenging wildlife are observed or closing access to an area where sensitive wildlife are present. These occasions will also be reported in the weekly and annual reports.

During the construction phase, a mitigation audit was planned annually, specific to the mitigation listed as part of the WMMP Annual Report, to document instances of Impromptu Adaptive Management, and the success of the proposed mitigation. The mitigation audit was intended to investigate:

- If all mitigation has been implemented
- Which mitigation was perceived to be or shown to be successful
- If new mitigation has been implemented in response to new issues
- If some mitigation is redundant

No mitigation audits were completed because no Adaptive Management actions were triggered by wildlife monitoring activities.

6.2.2 Response Framework

The phase response framework identifies the thresholds and actions listed below. In each case, exceeding a threshold will also lead to an incident report, and will trigger an immediate review of the WMMP mitigation.

Thresholds and actions during the **construction phase** include:

- One caribou, moose or bison killed or injured as a result of construction operations.
- Destruction or disturbance of one bird nest, one bat roost site or hibernaculum, or one mammal den. Disturbance includes any activity that causes wildlife to abandon or defend their nest, eggs, den or young other that those authorized by a regulatory agency.
- One bear or other carnivore killed in defense of life and property as a result of attraction to camp facilities or other work areas.
- Initiate more frequent Bird Nesting surveys if nests or nesting activity is observed.
- Boreal caribou harvest levels that exceed sustainable levels was meant to initiate management actions to reduce harvest levels in conjunction with Tłı̨chǫ Government.

Thresholds and actions during the **operations phase** include:

- If monitoring indicates that there are recurring areas, times of year or times of day associated with wildlife-vehicle collisions, GNWT will evaluate the implementation of temporary/permanent signage, reduction of speed limits in high risk zones or at high risk times.

- If there is evidence of specific sections of the road that are repeatedly crossed by big game species, based on monitoring of collared boreal and barren-ground caribou or reporting of sightings of big game species, GNWT will install signage to warn of collision risk in these areas.
- If collared barren-ground caribou are within 10 km of the Tłı̨chǫ Highway, or there are reports of sightings of barren-ground caribou along the Tłı̨chǫ Highway, GNWT will initiate patrols along the road, to determine the number of individual caribou involved. GNWT-ENR will contact GNWT-INF to discuss any required mitigations.
- When traffic levels averaged over a three-year period indicate a 100% increase in traffic levels above the predicted annual average daily traffic levels (of 20-40 vehicles/day), or maximum daily traffic levels during sensitive wildlife periods exceed 200 vehicles/day, the need for extending or reinstating programs in this WMMP beyond the first 5 years of the operational phase of the road initial operations timelines will be considered.
- Snow will be managed as it is on Highway 3, to maintain a slope on the side of the road (to maintain permafrost and reduce snowdrifts on the road). If there is evidence that the snow removal practices are causing difficulty for wildlife, snow removal procedures will be reviewed (see also the GNWT Response to Technical Reports from the environmental assessment PR#238)
- If there is evidence that boreal caribou harvest levels are increasing towards or exceeding unsustainable levels, GNWT-ENR and the Tłı̨cho Government will submit a wildlife management proposal under section 12.5.1 of the Tłı̨cho Agreement to the WRRB for the timely implementation of any measures necessary to ensure boreal caribou harvest in the region is kept within sustainable levels. Such measures may include the establishment of a no-hunting corridor along the Project route.
- If there are concerns about unsustainable levels of harvest of other wildlife species along the Tłı̨chǫ Highway corridor, GNWT will initiate discussions with Tłı̨chǫ Government, WRRB, North Slave Métis Alliance (NSMA), YKDFN and other relevant Indigenous government organizations to determine an appropriate response, using an Adaptive Co-Management Response.
- Changes observed that require implementation of wildlife management actions will occur through formal Adaptive Co-management processes with the WRRB.

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Appendix A: Statutory Requirements Relevant to Wildlife and Wildlife Habitat

NWT *Wildlife Act*		
Topic	**Section of NWT *Wildlife Act***	**Notes**
Birds and nests	**51.** (1) Subject to section 17, no person shall, unless authorized by a licence or permit to do so, destroy, disturb or take (a) an egg of a bird; (b) the nest of a bird when the nest is occupied by a bird or its egg; or (c) the nest of a prescribed bird.	Prescribed birds for the purpose of paragraph 51(1)(c) and 52 of the *Wildlife Act* are birds of prey (raptors) as set out in Schedule B of the Wildlife General Regulations Bullet (c) protects unoccupied raptor nests •
Wildlife abodes	**51.**(2) Subject to section 17, no person shall, unless authorized by a licence or permit to do so, break into, destroy or damage a den, beaver dam or lodge, muskrat push-up or hibernaculum.	Subject to sub-section 5.3.(1) of the Wildlife General Regulations, no person shall damage, destroy, disturb, or otherwise adversely affect the summer abode of a bat (also referred to as a summer maternity roost), unless authorized by a licence or permit to do so.
Disturbance and harassment	**52.** Subject to section 17, no person shall, unless authorized by a licence or permit to do so, (a) engage in an activity that is likely to result in a significant disturbance to big game or other prescribed wildlife; or (b) unnecessarily chase, fatigue, disturb, torment or otherwise harass game or other prescribed wildlife.	Prescribed birds for the purpose of paragraph 51(1)(c) and 52 of the Wildlife Act are birds of prey (raptors) as set out in Schedule B of the Wildlife General Regulations "big game" means species of wildlife prescribed as big game, or an individual of a species of big game;
Chasing Wildlife	**55.** Notwithstanding any other provision of this Act or the regulations, a person may chase wildlife away from a dwelling place, camp, work site, municipality or unincorporated community, or its immediate vicinity, if doing so is necessary to prevent injury or death to a person or damage to property.	"wildlife" means (a) all species of vertebrates and invertebrates found wild in nature in the Northwest Territories, and individuals of those species, except (i) fish as defined in section 2 of the *Fisheries Act* (Canada), and (ii) other prescribed species and subspecies, (b) species of wildlife referred to in paragraph (a) that are domesticated or held in captivity, and individuals of those species, and (c) prescribed species or subspecies of vertebrates and invertebrates, and individuals of those species or subspecies.

Defence of life and property	**56.** (1) Notwithstanding any other provision of this Act or the regulations but subject to subsection (4), a person may harvest and consume wildlife or take and consume the eggs of birds if it is necessary to prevent starvation of a person. (2) Notwithstanding any other provision of this Act or the regulations but subject to subsection (4), a person may kill wildlife if it is necessary to prevent injury or death to a person. (3) Notwithstanding any other provision of this Act or the regulations but subject to subsection (4) and any regulations specified as applying in respect of this section, a person may kill wildlife if it is necessary to prevent damage to property. (4) Subsections (1), (2) and (3) do not provide a defence to a contravention of this Act or the regulations for a person who resorts to harvesting or killing wildlife as a result of his or her mismanagement.	
Reporting	**57.** Subject to the regulations, a person shall, as soon as is practicable, report the harvest or kill of big game or other prescribed wildlife to an officer, if (a) under section 56, the person harvested big game or other prescribed wildlife to prevent starvation, or killed big game or other prescribed wildlife to prevent injury or death to a person or damage to property; and (b) the harvest or kill would, but for subsection 56(1), (2) or (3), be a contravention of this Act or the regulations.	Section 7 of the Wildlife General Regulations indicates the information that must be included in the report.
Accidental kill or wounding	**58.** A person who, with a motorized vehicle, accidentally kills or seriously wounds big game or other prescribed wildlife on a highway as defined in section 1 of the *Motor Vehicles Act*, shall report the event to an officer within the time fixed in the regulations.	Sub-section 8(1) of the Wildlife General Regulations requires that any person who accidentally kills or seriously wounds big game with a motorized vehicle on a highway must report the event to an officer within 24 hours after the incident. Sub-section 8(2) of the Wildlife General Regulations indicates the information that must be included in the report.

Feeding wildlife	**65.** (1) Subject to subsection (2), no person shall intentionally feed big game, fur-bearers or other prescribed wildlife. (2) Subsection (1) does not apply in respect of a person feeding wildlife lawfully kept in captivity or in circumstances permitted by the regulations.	
Wildlife Attractants	**66.** (1) No person shall deposit, place or leave in, on or about land or premises food, food waste or another substance if there is a reasonable likelihood that it could attract big game or other prescribed wildlife to the land or premises and endanger a person, a domestic animal or wildlife. (2) Subsection (1) does not apply in respect of (a) the drying or caching of meat, pelts or hides, except in a manner contrary to regulations respecting the treatment, caching and identification of wildlife and parts of wildlife left temporarily on the land; (b) a person lawfully harvesting fur-bearers with bait; or (c) other persons and circumstances exempted by the regulations.	
Damage to habitat	**93.** (1) No person shall substantially alter, damage or destroy habitat. (2) A person who establishes that he or she acted with legal justification in altering, damaging or destroying habitat shall not be convicted of an offence under subsection (1).	"habitat" means the area or type of site where a species or an individual of a species of wildlife naturally occurs or on which it depends, directly or indirectly, to carry out its life processes;
Requirement for Wildlife Management and Monitoring Plan	**95.** (1) A developer or other person or body may be required, in accordance with the regulations, to prepare a wildlife management and monitoring plan for approval by the Minister, and to adhere to the approved plan, if the Minister is satisfied that a development, proposed development, or other activity is likely to (a) result in a significant disturbance to big game or other prescribed wildlife; (b) substantially alter, damage or destroy habitat; (c) pose a threat of serious harm to wildlife or habitat; or (d) significantly contribute to cumulative impacts on a large number of big game or other prescribed wildlife, or on habitat	

Contents of the Wildlife Management and Monitoring Plan	**95**. (2) A wildlife management and monitoring plan must include (a) a description of potential disturbance to big game and other prescribed wildlife, potential harm to wildlife and potential impacts on habitat; (b) a description of measures to be implemented for the mitigation of potential impacts; (c) the process for monitoring impacts and assessing whether mitigative measures are effective; and (d) other prescribed requirements.	
Species at Risk (NWT) Act		
Topic	**Section of the Act or Regulations**	**Notes**
Designated Habitat	**80.** No person shall destroy any part of designated habitat.	
Species conservation	**151.** (1) The Commissioner, on the recommendation of the Minister, may make regulations respecting the conservation of pre-listed species or listed species, including but not limited to (a) requiring the doing of things that may conserve the species; (b) prohibiting activities that may adversely affect the species; (d) imposing prohibitions against (i) killing, harming, harassing, capturing or taking an individual of a species,	For up-to-date information on Regulations and Permits issued under the Act go to http://nwtspeciesatrisk.ca/en/Regulations
Habitat conservation	**152.** The Commissioner, on the recommendation of the Minister, may make regulations respecting the conservation of habitat of pre-listed species or listed species or the area in which the habitat is located or the surrounding area, including but not limited to (a) requiring the doing of things that may conserve the habitat or area; (b) prohibiting activities that may adversely affect the habitat or area; (c) imposing prohibitions against damaging or destroying the habitat or area; (d) controlling, restricting or prohibiting any use of, access to, or activity in the habitat or area; and (e) controlling, restricting or prohibiting the release of any substances in or into the habitat or area.	For up-to-date information on Regulations and Permits issued under the Act go to http://nwtspeciesatrisk.ca/en/Regulations

Designating habitat	**153.** (1) The Commissioner, on the recommendation of the Minister, may, by regulation, designate habitat, or a component or combination of components of habitat, of a pre-listed species or a listed species.	For up-to-date information on Regulations and Permits issued under the Act go to http://nwtspeciesatrisk.ca/en/Regulations
Designated habitat	**154.** The Commissioner, on the recommendation of the Minister, may make regulations respecting the conservation of designated habitat or the area in which designated habitat is located or the surrounding area, including but not limited to (a) requiring the doing of things that may conserve the designated habitat or area; (b) prohibiting activities that may adversely affect the designated habitat or area; (c) imposing prohibitions against damaging the designated habitat or area; (d) controlling, restricting or prohibiting any use of, access to, or activity in the designated habitat or area; and (e) controlling, restricting or prohibiting the release of any substances in or into the designated habitat or area.	For up-to-date information on Regulations and Permits issued under the Act go to http://nwtspeciesatrisk.ca/en/Regulations
Migratory Birds Convention Act		
Topic	**Section of the Act or Regulations**	**Notes**
Deposit of harmful substances	5.1 (1) No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area.	

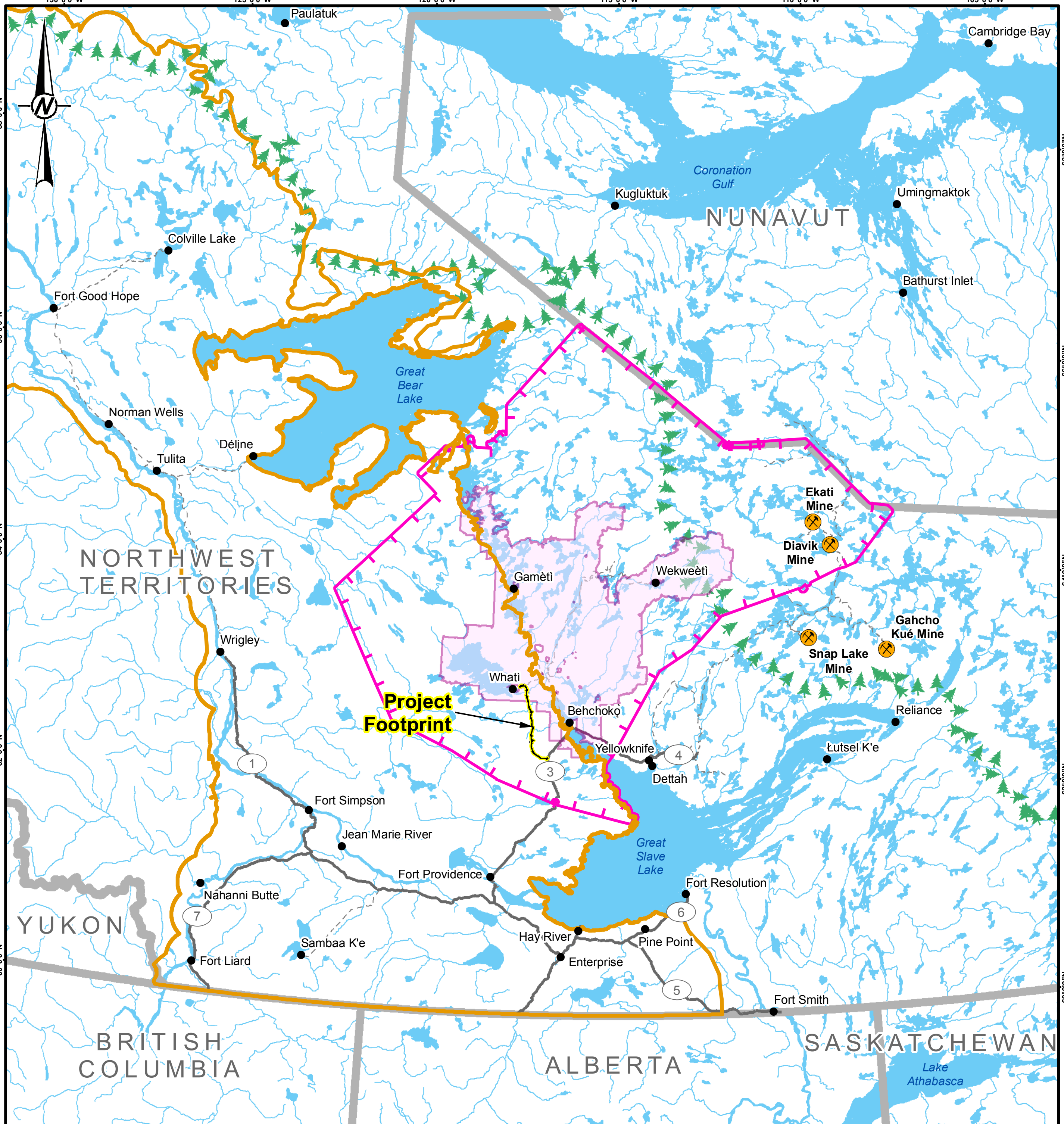
Migratory Birds Regulations (federal) enabled under the *Migratory Birds Convention Act*		
Topic	**Section of the Act or Regulations**	**Notes**
Disturbance and/or destruction of migratory birds, their nests and eggs	5(1) of the Migratory Bird Regulations states that no person shall hunt a migratory bird except under authority of a permit. 6. Subject to subsection 5(9), no person shall (a) disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird, or	"Hunt" means to chase, pursue, worry, follow after or on the trail of, lie in wait for, or attempt in any manner to capture, kill, injure or harass a migratory bird, whether or not the migratory bird is captured, killed or injured. Currently, the regulations do not provide for authorizations or permits for the inadvertent harming or killing of migratory birds and the disturbance or destruction of their nests and eggs (a.k.a. "incidental take") in the course of industrial or other activities. For further advice on how to avoid incidental take or reduce risks to migratory birds and their nests and eggs, refer to the avoidance guidelines and frequently asked questions related to the protection of migratory bird nests and eggs as well as the fact sheet "Planning Ahead to Reduce Risks to Migratory Bird Nests" at: http://www.ec.gc.ca/paom-itmb/

Species at Risk Act (federal)		
Topic	**Section of the Act or Regulations**	**Notes**
Killing, harming, etc., listed wildlife species	**32.** (1) No person shall kill, harm, harass, capture or take an individual of a wildlife species that is listed as an extirpated species, an endangered species or a threatened species.	"individual" means an individual of a wildlife species, whether living or dead, at any developmental stage and includes larvae, embryos, eggs, sperm, seeds, pollen, spores and asexual propagules.
Damage or destruction of residence	**33.** No person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed as an endangered species or a threatened species, or that is listed as an extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada.	"residence" means a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating.
Prohibitions	**35** a) in respect of individuals of aquatic species and their habitat or species of birds that are migratory birds protected by the Migratory Birds Convention Act, 1994; or (b) on land under the authority of the Minister or the Parks Canada Agency.	These prohibitions apply everywhere, regardless of land tenure.

Destruction of critical habitat	**58.** (1) Subject to this section, no person shall destroy any part of the critical habitat of any listed endangered species or of any listed threatened species — or of any listed extirpated species if a recovery strategy has recommended the reintroduction of the species into the wild in Canada — if (a) the critical habitat is on federal land, in the exclusive economic zone of Canada or on the continental shelf of Canada; (b) the listed species is an aquatic species; or (c) the listed species is a species of migratory birds protected by the Migratory Birds Convention Act, 1994.	"critical habitat" means the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species.
Destruction of critical habitat	**61.** (1) No person shall destroy any part of the critical habitat of a listed endangered species or a listed threatened species that is in a province or territory and that is not part of federal lands. (1.1) Subsection (1) does not apply in respect of (a) an aquatic species; or (b) the critical habitat of a species of bird that is a migratory bird protected by the *Migratory Birds Convention Act, 1994* that is habitat referred to in subsection 58(5.1). (2) Subsection (1) applies only to the portions of the critical habitat that the Governor in Council may, on the recommendation of the Minister, by order, specify.	

Agreements and Permits	**73.** (1) The competent minister may enter into an agreement with a person, or issue a permit to a person, authorizing the person to engage in an activity affecting a listed wildlife species, any part of its critical habitat or the residences of its individuals. 2) The agreement may be entered into, or the permit issued, only if the competent minister is of the opinion that (a) the activity is scientific research relating to the conservation of the species and conducted by qualified persons; (b) the activity benefits the species or is required to enhance its chance of survival in the wild; or (c) affecting the species is incidental to the carrying out of the activity. (3) The agreement may be entered into, or the permit issued, only if the competent minister is of the opinion that (a) all reasonable alternatives to the activity that would reduce the impact on the species have been considered and the best solution has been adopted; (b) all feasible measures will be taken to minimize the impact of the activity on the species or its critical habitat or the residences of its individuals; and (c) the activity will not jeopardize the survival or recovery of the species.	

Appendix B: Tłı̨chǫ ASR Project Maps



LEGEND

- EXISTING MINE
- POPULATED PLACE
- ALL-SEASON ROAD
- WINTER ROAD
- TREELINE
- WATERCOURSE
- PROVINCIAL/TERRITORIAL BOUNDARY
- TŁĮCHǪ LAND
- WATER BODY
- PROJECT FOOTPRINT
- BOREAL CARIBOU NT1 RANGE
- WEK'ÈEZHÌI RESOURCE MANAGEMENT AREA

0 120 240

1:6,000,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: CANADA LAMBERT CONFORMAL CONIC

CLIENT

GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT

TŁĮCHǪ ALL-SEASON ROAD
WILDLIFE MANAGEMENT AND MONITORING PLAN

TITLE

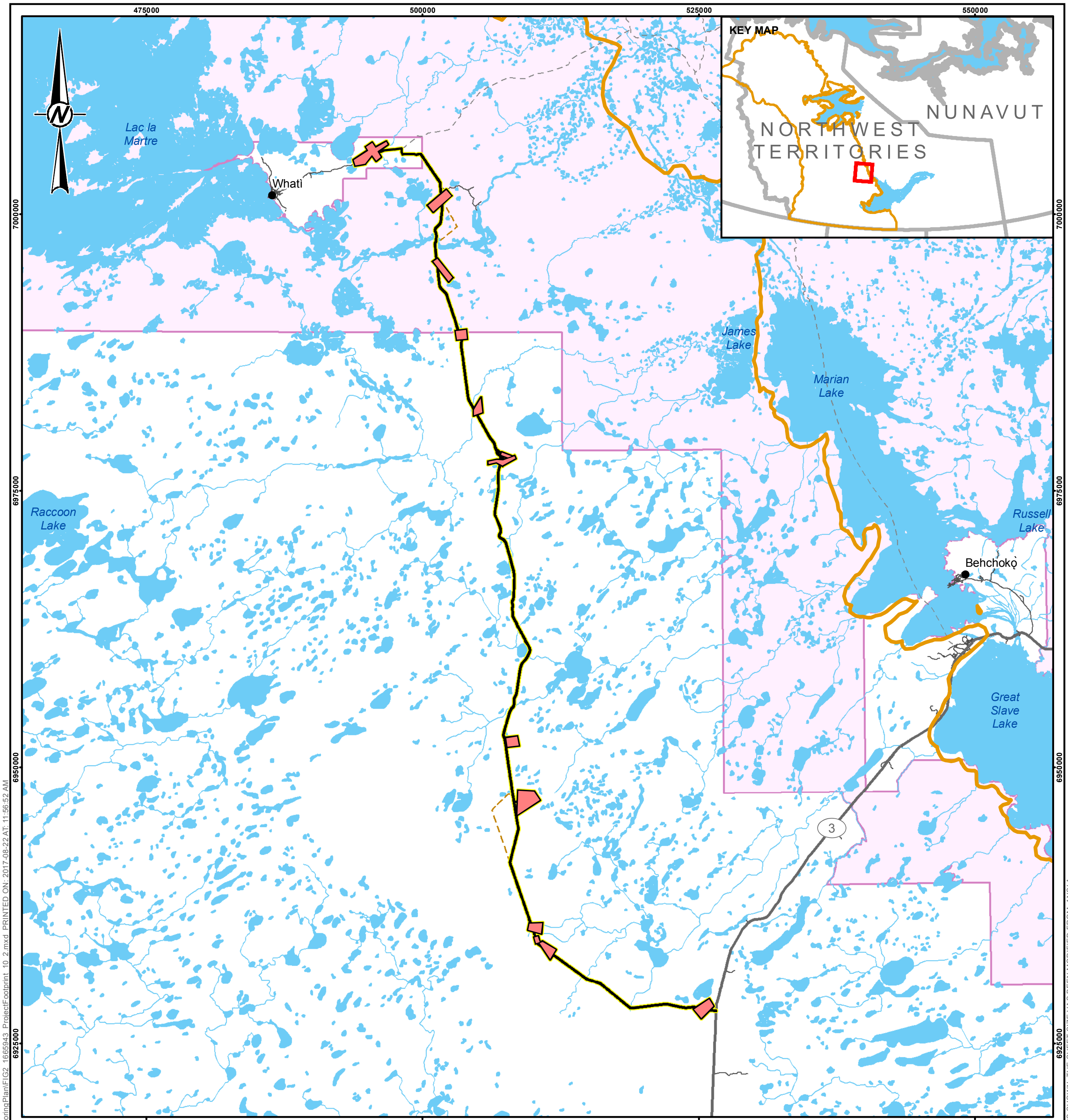
LOCATION OF THE TŁĮCHǪ ALL-SEASON ROAD PROJECT

CONSULTANT

Golder Associates

YYYY-MM-DD	2017-08-22
DESIGNED	DC
PREPARED	LMS
REVIEWED	DP
APPROVED	DP

PROJECT NO.	REV.	FIGURE
1665943	0	1



LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- LOCAL ROAD
- WINTER ROAD
- OLD AIRPORT ROAD
- WATERCOURSE
- TŁĮCHǪ LAND
- WATER BODY
- PROJECT FOOTPRINT - BORROW SOURCE
- PROJECT FOOTPRINT - ROAD
- BOREAL CARIBOU NT1 RANGE

0 10 20
1:500,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 11 DATUM: NAD83

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD
WILDLIFE MANAGEMENT AND MONITORING PLAN

TITLE
PROPOSED TŁĮCHǪ ALL-SEASON ROAD PROJECT FOOTPRINT

CONSULTANT
Golder Associates

YYYY-MM-DD	2017-08-22
DESIGNED	DP
PREPARED	LMS
REVIEWED	DP
APPROVED	DP

PROJECT NO.	REV.	FIGURE
1665943	0	2

Appendix C: Responsibility Hierarchy and Contact Information

Table C-1. Responsibility Hierarchy for the Tłı̨chǫ Highway

Agency	Role	Position	Reports to	Roles	Name	Contact
GNWT-INF	Developer	Project Sponsor	GNWT-INF Deputy Minister	Overall Project Lead	Ziaur Rahman	Ziaur_Rahman@gov.nt.ca (867) 767-9086 ext. 31117
NSI	Private Partner	Project Manager	GNWT Project Sponsor	Overall Project delivery for NSI	Robert Cornell	(514) 609-9965
NSI	Private Partner	Environmental Manager	NSI Project Lead	Oversee the implementation of the relevant WMMP mitigation Oversee construction and operations in relation to Land Use Permit conditions Implement WMMP monitoring in Section 5.1 Contact GNWT Project Manager and ENR Renewable Resource Officer as required	Dave Green	Dave.Green1@kiewit.com (416) 738 - 7869
NSI	Private Partner	Environmental Monitors	NSI Environmental Manager	Implement the relevant WMMP mitigation Implement WMMP monitoring in Section 5.1 Contact GNWT Project Manager and ENR Renewable Resource Officer as required	TBD	TBD
Associated Engineering	Owners' Engineer	Project Manager	GNWT Project Sponsor	Ensure that all Owner requirements have been met by NSI Provide technical advice to regarding Project modifications Direct audits of construction activities	Leslie Mihalik	mihalikl@ae.ca (604) 293-1411 Ext. 391

Table C-2. Regulatory Agencies with Jurisdiction over Wildlife

Agency	**Position**	**Roles**	**Name**	**Contact**
GNWT-ENR	Renewable Resource Officer	Enforce the Wildlife Act	GNWT-ENR	Regulator/ Support
GNWT-ENR	Wildlife Biologist	Implement WMMP monitoring in Section 5.2	James Hodson	James_Hodson@gov.nt.ca and Kathy_Unger@gov.nt.ca
GNWT-ENR	N/A	In the event accidently kill or seriously injure / wound big game (e.g mouse, bison , caribou)	As required	Big Game Vehicle Collision 1-866-762-2437
Environment Canada Climate Change (ECCC) - Canadian Wildlife Services (CWS)		Provide advice to NSI Environmental Manager on mitigatory birds and nesting, including mortality notifications		cwsnorth-scfnord@ec.gc.ca
ECCC Wildlife Enforcement Division		Enforce the *Migratory Bird Convention Act*		dalfnord-wednorth@ec.gc.ca.
ECCC Environmental Protection Division/Canadian Wildlife Service		Environmental protection and all other matters, including WMMP reviews and regulatory requirements		eanorthnwt@ec.gc.ca

Appendix D: Operating Procedure for Use of Boreal Caribou Collar Data to Mitigate Impacts from Construction

OPERATING PROCEDURE

Use of Boreal Caribou Collar Data To Mitigate Impacts From The Construction Of The Tłı̨chǫ All-Season Road

August 2019

Purpose

This protocol outlines the procedure for communication between the Government of Northwest Territories (GNWT) Department of Infrastructure (INF), Department of Environment and Natural Resources (ENR), and Project Co. regarding the location of collared boreal caribou near the proposed Tłı̨chǫ All Season Road (Tłı̨chǫ ASR) during road construction carried activities carried out under land use permit W2016E0004.

The objective of this protocol is to alert Project Co. and INF when collared caribou approach construction activities within pre-defined distances, or "cautionary zones", so that mitigation measures can be implemented to:

- Reduce sensory disturbance and unnecessary energy expenditure by caribou during the most sensitive periods – late-winter and calving
- Avoid sensory disturbance that would reduce the likelihood of calf survival during the calving period
- Avoid injury or mortality of caribou, or risk of personal injury

These protocols are to be implemented in addition to all monitoring and mitigation described in the WMMP.

This protocol is intended to address the following construction activities:

- Vegetation clearing along the Tłı̨chǫ ASR right of way, at borrow sources, and borrow source access roads in advance of road bed construction and borrow source operations
- Blasting at borrow sources, quarries and, if required, along the right of way
- Other construction activities along the cleared right of way, and at borrow sources/quarries such as hauling granular materials to construct the road embankment and driving surfaces, extraction of granular materials at borrow sources/quarries, any grading, cutting or filling necessary to construct the road embankment, preparation of the driving surface, construction of water crossing and bridges, etc.

Limitations of using the collar data to trigger mitigation measures:

- ENR will attempt to increase the number of collared female caribou in proximity to the Tłı̨chǫ ASR alignment in winters 2018 and 2019, but it must be recognized that only a small portion of the boreal caribou population will be collared. Therefore, an absence of collar locations in proximity to Tłı̨chǫ ASR construction activities cannot be considered to indicate an absence of boreal caribou near construction activities. Collar data needs to be supplemented by visual surveys conducted by environmental monitors in and around active construction areas to verify that no boreal caribou are present.
- ENR receives updated collar data every 24 hours, and when the updated collar data is received it is already 24 hours old. If ENR provides INF and Project Co. with updated maps of collar locations every 48 hours during the most sensitive periods, the collar locations will already be 48-72 hours out of date. Therefore collar data indicates where boreal caribou were 2-3 days ago, not where they are presently located. Again, the use of collar data must be supplemented by real-time visual surveys of active construction areas by environmental monitors to confirm presence or absence of boreal caribou.
- If updated maps of collar locations cannot be provided within the time intervals specified in Table 1, and, if one or more caribou were observed within the cautionary zone at the time the last map was provided, the associated mitigation will be observed until a new map is provided that indicates the caribou have left the cautionary zone.

Assumptions:

- Given the low density of boreal caribou within the Regional Study Area for the Tłı̨chǫ ASR, interactions with boreal caribou will be infrequent and unlikely.
- Boreal caribou are expected to avoid active construction areas during most times of the year due to the noise associated with these activities. However, exceptions may occur during times of the year where boreal caribou exhibit restricted daily movements, i.e. the late-winter period (mid-March to early April) and the calving period (early April to mid-Julye), and construction activities advance upon areas where boreal caribou are residing or if caribou choose to use an area where there is currently little to no construction activity and activities subsequently start up in that area.
- Boreal caribou tend to aggregate in small groups during the winter season, thus the use of location data from collared individuals to trigger mitigation measures should help to protect more than just those collared individuals.
- Prior to calving (pre-calving period), females increase their movement rates to locate suitable calving areas.

- During calving season, female boreal caribou spread out to calve individually; therefore the use of collar data to trigger mitigation measures will only protect the collared females and their calves.
- Most vegetation clearing will take place between September and April to avoid the migratory bird nesting season, and therefore most vegetation clearing required for the project will occur outside of the calving season for boreal caribou.

Sensitive periods:

Although boreal caribou may be sensitive to disturbance from construction activities throughout the year, ENR considers there to be two key periods when boreal caribou should receive additional protection from sensory disturbance to increase the likelihood of successful calving and thus recruitment of new individuals into the population. The following sensitive periods are based on the seasonal activity periods reported in Table 6 in the status report for boreal caribou in the NWT (Species at Risk Committee 2012), but some year-to-year variation should be expected based on snow and weather conditions:

- Late-winter (16 Mar – 4 April): Boreal caribou are exhibiting their shortest daily movements at this time of year, likely reflecting the increased energetic costs of travelling through deep snow at this time of year, or limited areas that provide easier access for foraging on ground lichens (wind swept areas and closed canopy forests with shallow snow). As boreal caribou are depleting their stores of fat throughout the winter, and movement through deep snow or displacement from good foraging habitat could have high energetic costs, disturbance events at this time of year could have negative impacts on female body condition and subsequently have negative impacts on calving and calf survival.
- Calving (05 April – 15 July): Female boreal caribou spread out during the pre-calving period (05-30 April) and increase daily movements to find suitable calving locations. Females spread out during calving as an anti-predator strategy to make themselves and their calves rare in the midst of other prey species and predators. Once a calving location is selected, daily movement rates drop considerably during calving (30 Apr – 6 June). During the calving period, sensory disturbances that may cause energetic stress to the calving female, or cause the calving female to flee and leave her calf temporarily may reduce the odds of calf survival. There are high energetic demands on females while they are lactating and raising their calves. Caribou tend to avoid suitable calving locations that are close to sensory disturbance from development (Carr *et al.*. 2007; Schaefer and Mahoney 2007; Vors *et al.*. 2007; Vistnes and Nellemann 2008 *cited in* OMNR 2014), so they may avoid calving in close proximity to active Tłı̨chǫ ASR construction areas. However, in instances where construction activities may advance upon or be in close proximity to an area where a female has chosen to calve, displacement of the female from that area could have negative impacts on calf survival.

Calves appear to be most vulnerable to predation during the first six weeks after birth (Pinard et al. 2012), therefore the calving season includes the period up to July 15 (i.e. to address the case that calves are born as late as May 30).

Boreal caribou are considered to be less sensitive to sensory disturbance at other times of the year, as they are moving greater distances on a daily basis and will likely avoid active construction areas or move away from them quickly if and when they encounter them.

Protocols for sharing information:

- Project Co. will provide ENR and INF with weekly updates of where construction activities will take place (i.e., which sections of the alignment will be active, which borrow sources/quarries will be active), and the type of activities taking place (e.g. vegetation clearing, blasting, embankment construction, etc.). Specifications in regards to how information will flow, to be determined.
- ENR will provide INF and Project Co. with maps of collar locations according the schedule outlined in Table 1 for different periods of the year. Project Co. will provide the maps to its Environmental Monitors and any other relevant designated staff and sub-contractors. Project Co. will inform ENR of who the maps are being shared with.
- The maps will illustrate the location of collared caribou in proximity to the Tłı̨chǫ ASR alignment, borrow sources and Whatì access road and the date of the collar location information.
- Implementation of mitigation measures will be determined by the proximity of collared caribou, the time of year, and the type of construction activity taking place as outlined in Table 1.
- INF and Project Co. will provide ENR with weekly records of the timing and location of all planned blasting events.
- The data provided by ENR is to be used only for the purpose of assisting Project Co. and INF in conducting construction work as provided for under land use permit W2016E0004.
- Collar data should be considered sensitive information. INF and Project Co. will not share the data provided by ENR with anyone other than the Site Supervisor.
- INF and Project Co. acknowledge that collared caribou represent only a portion of the caribou in the North Slave Region. INF and Project Co. recognize that the lack of collared caribou in an area does not mean that caribou are not present and will make an effort to visually confirm that caribou are not present when undertaking construction work in a new area, and will remain vigilant for the presence of caribou that choose to move into or across an active construction area.

- A project management team will host monthly and weekly meetings.
- The Tlicho All-Season Road Corridor Working Group will receive regular updates from the project management team.

Construction Activity	Season		
	Summer, Fall, Early to Mid-winter **(16 July – 15 Mar)**	**Late-winter** **(16 Mar – 4 Apr)**	**Calving** **(05 April – 15 July)**
Vegetation clearing of the right of way	Cautionary Zone: 4 km Maps will be provided once a week to evaluate presence of collared caribou within 4 km of the Tłı̨chǫ ASR alignment and borrow sources. Mitigation: • See WMMP Section 4.3.1 for mitigation related to clearing activities • Implement the Pre-Clearing Survey for Large Mammals and follow the additional mitigation required	Cautionary Zone: 4 km Maps will be provided every 2 days to evaluate presence of collared caribou within 4 km of the Tłı̨chǫ ASR alignment and borrow sources. Mitigation: • See WMMP Section 4.3.1 for mitigation related to clearing activities • Implement the Pre-Clearing Survey for Large Mammals and follow the additional mitigation required	Cautionary Zone: 6 km Maps will be provided every 2 days to evaluate presence of collared caribou within 6 km around the Tłı̨chǫ ASR alignment and borrow sources. Mitigation: • See WMMP Section 4.3.1 for mitigation related to clearing activities • Complete the Pre-Clearing Survey for Large Mammals and follow the additional mitigation provided • If collared caribou are within 6 km of an area that will be cleared within the next 48 hours, suspend vegetation clearing in the active construction area. ENR will re-evaluate the collar locations every 24 hours and will notify INF and Project Co. when the collared caribou moves out of the 6 km cautionary zone. At this point, vegetation clearing can resume.

Construction Activity	**Season**		
	Summer, Fall, Early to Mid-winter **(16 July – 15 Mar)**	**Late-winter** **(16 Mar – 4 Apr)**	**Calving** **(05 April – 15 July)**
Blasting	Cautionary Zone: 4 km Collar data maps will be provided once a week to evaluate the presence of collared caribou within 4 km around areas where blasting will take place in the next week. Mitigation: • See WMMP 4.3.1 and 4.4.1 for mitigation related to blasting • Implement the Pre-Blast Survey and follow any additional mitigation required	Cautionary Zone: 4 km Collar data maps will be provided every 2 days to evaluate the presence of collared caribou within 4 km around areas where blasting will take place in the next week. Mitigation: • See WMMP 4.3.1 and 4.4.1 for mitigation related to blasting • Implement the Pre-Blast Survey and follow any additional mitigation required	Cautionary Zone: 6 km Collar data maps will be provided every 2 days to evaluate the presence of collared caribou within 6 km around areas where blasting will take place in the next week. Mitigation • See WMMP 4.3.1 and 4.4.1 for mitigation related to blasting • Implement the Pre-Blast Survey and follow any additional mitigation required • If collared-caribou are within 1 km of blast site, delay blasting for 48 hours to determine if caribou is calving (relatively stationary, e.g. hourly locations <1 km apart). • If the caribou is calving, suspend blasting until an ENR biologist indicates that calving is completed. • If the caribou is moving more than 1 km/day, suspend blasting and re-evaluate every 48 hours until the caribou moves out of the area or it is confirmed that the caribou is calving within the 1 km buffer, in which case suspend blasting until an ENR biologist indicates that calving is completed.

Construction Activity	**Season**		
	Summer, Fall, Early to Mid-winter **(16 July – 15 Mar)**	**Late-winter** **(16 Mar – 4 Apr)**	**Calving** **(05 April – 15 July)**
Other construction activity along the cleared right of way and borrow sources and quarries Applies to activities taking place within areas that have already been cleared of vegetation	Cautionary Zone: 4 km Collar data maps will be provided once a week to evaluate presence of collared caribou within 4 km around the Tłı̨chǫ ASR alignment and borrow sources. Mitigation: • See WMMP Sections 4.3.1 and 4.4.1 for general mitigation • Implement the Road Surveys and follow any additional mitigation required • If collared caribou are within 4 km of sections of the road that have regular vehicle traffic (e.g. trucks travelling to and from borrow pits to lay down the road embankment), speed limits along the road within 2 km on either side of the collar locations shall be reduced to 30 km/h to reduce the likelihood of wildlife-vehicle collisions should collared caribou cross the right of way.	Cautionary Zone: 4 km Collar data maps will be provided every 2 days to evaluate presence of collared caribou within 4 km around the Tłı̨chǫ ASR alignment and borrow sources. Mitigation: • See WMMP Sections 4.3.1 and 4.4.1 for general mitigation • Implement the Road Surveys and follow any additional mitigation required • If collared caribou are within 4 km of sections of the road that have regular vehicle traffic (e.g. trucks travelling to and from borrow pits to lay down the road embankment), speed limits along the road within 2 km on either side of the collar locations shall be reduced to 30 km/h to reduce the likelihood of wildlife-vehicle collisions should collared caribou cross the right of way.	Cautionary Zone: 6 km Collar data maps will be provided every 2 days to evaluate presence of collared caribou within 6 km around the Tłı̨chǫ ASR alignment and borrow sources. Mitigation: • See WMMP Sections 4.3.1 and 4.4.1 for general mitigation • Implement the Road Surveys and follow any additional mitigation required • If a collared caribou chooses to calve within 6 km of an already active construction area, then activities other than blasting can continue as it assumed that noise from construction is not bothering them since they chose to calve there. • If a situation arises where a caribou chooses to calve within 500 m of an active construction area, there may be a risk to calving success. Construction activities will be suspended, and collar locations re-evaluated every 24 hours, until the ENR biologist confirms that the individual has moved >500 m away. • If a collared caribou is calving within 6 km of a cleared construction area, that is not presently active but is planned to become active within the next 48 hours, collar locations will be re-evaluated every 24 hours, and construction in that area shall be delayed until the caribou moves out of the 3 km cautionary zone.
Aircraft	Follow GNWT "Flying low? Think Again…" guidelines.	Follow GNWT "Flying low? Think Again…" guidelines.	Cautionary zone: 6 km Collar data maps will be provided every 2 days to evaluate location of collared caribou within Tłı̨chǫ ASR Regional Study Area. No low-level flights (<1000 FT) within 6 km of known calving sites based on collar data.

Contacts

Environment and Natural Resources contacts
James Hodson, Wildlife Biologist, Environmental Assessment/Habitat • (867) 767-9237 Ext. 53227 • James_hodson@gov.nt.ca
Andrea Patenaude, Wildlife Biologist, Environmental Assessment/Habitat • 767-9237 Ext. 53228 • Andrea_patenaude@gov.nt.ca
Adrian Lizotte, ENR North Slave Region, Manager, Wildlife and Environment • (867) 767-9238 ext. 53248 • Adrian_Lizotte@gov.nt.ca
Department of Infrastructure contacts
Ziaur Rahman , GNWT-INF Project Lead • (867) 767-9086 ext. 31117 • Ziaur_Rahman@gov.nt.ca
Project Co. contacts
Dave Green , North Star Infrastructure (NSI) Environnemental Manager • Phone 416 – 738 - 7869 Email: Dave.Green1@kieiwt.com Robert Cornell, North Star Infrastructure (NSI), Project Manager • Phone 514-609-9965 Email: Robert.cornell@kiewit.com

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Vistnes, I. and C. Nellemann. 2008. The matter of spatial and temporal scales: a review of reindeer and caribou response to human activity. Polar Biology 31(4):399-407.

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Appendix E: Bear Safety and Reporting

APPENDIX E: Bear Occurrence Procedures Manual

2014

Bear Occurrence Procedures Manual

Photo by Dean Cluff/ENR

Environment & Natural Resources

Northwest Territories Environment and Natural Resources

Bear Occurrence Procedures Manual

Implementation of these procedures will allow ENR a greater ability to provide advice and assistance in preventing harm to humans, bear(s) or property. In addition, it will provide guidance on safely deterring bears that find themselves in areas of development, tourism camps or cabins with the aim of preventing habituation and unnecessary destruction.

Report any incidents such as sightings, encounters, injuries and/or mortalities to the ENR. The GNWT Phone Directory can be found at http://rdirectory.gov.nt.ca/rDirectory.aspx Regional contacts are listed below:

North Slave Region

Wildlife Emergency	(867) 873 - 9238 (24 Hours)
Yellowknife	(867) 873 - 9238
Fax:	(867) 873 - 6230

South Slave Region

Wildlife Emergency	(867) 872 - 0400 (24 Hours)
Fort Smith	(867) 872 - 6400
Fax:	(867) 872 - 4250

Inuvik Region

Wildlife Emergency	(867) 678 - 0289 (24 Hours)
Inuvik	(867) 678 - 6650
Fax:	(867) 678 - 6659

Sahtu Region

Wildlife Emergency	(867) 587 - 2422 (24 Hours)
Norman Wells	(867) 587 - 3500
Fax:	(867) 587 - 3516

Deh Cho Region

Wildlife Emergency	(867) 695 - 7433 (24 Hours)
Fort Simpson	(867) 695 - 7450
Fax:	(867) 695 - 2381

BEAR AWARENESS TRAINING

ENR supports the NWT Mine Health and Safety Regulations (s.15.05), which requires that all field personnel involved in mineral exploration undertake bear-safety training. However, human/wildlife incident prevention is a key component to the training.

Training of personnel in preventing and responding to wildlife incidents can reduce the likelihood of injury to personnel and wildlife. Therefore, all field personnel working on the project must receive bear awareness training, preferably from a professional trainer.

The training should include:

1. Recognizing the causes of human/wildlife conflicts;
2. How to prevent and respond to bear incidents;
3. Proper storage, transfer and disposal of camp waste; and
4. Proper use and safe application of deterrents.

INCIDENT PREVENTION

Refer to the ***Camp Waste and Wildlife Attraction Guideline.*** This resource provides guidance on how to minimize or prevent attraction from bears to your camp, cabin or work site.

OCCURRENCE RESPONSE

Small scale exploration and tourism camps should develop and implement Bear Incident Standard Operating Procedures (SOPs) that can be used in the field. The SOPs will allow all members on site to have knowledge of how to minimize or prevent any loss of life or property if there is a bear within the vicinity of your camp area or work site. SOPs may include such things as:

a) Response team
b) Equipment
c) Action level
d) Emergencies
e) Reporting Requirement

1. SIGHTING - Bear in the general vicinity (>1km)

1. If it is within sight of your camp/cabin and it is safe to do so, use a ***Wildlife Sightings Log*** to record and report information regarding your observations.
2. Continue to monitor, if necessary.

2. ENCOUNTER - Bear In Camp (<1km)

1. If safe to do so; take a quick note of the location, direction of travel and general behaviour of the bear(s).
2. Sound the bear alarm.
3. If necessary, phone the ENR Regional contacts listed above for guidance on necessary next steps to ensure human/wildlife safety and protection of property.
4. If necessary, stay indoors or in your vehicle. **DO NOT APPROACH THE BEAR.**
5. Keep all doors and windows closed.

6. If necessary and safe to do so; continue to monitor the behaviour and movement until either the bear leaves on its own, deterrence is successful or response personnel arrive.
7. If possible, start deterrence procedures.
8. Report status of bear encounter to the ENR Regional contacts listed above when safe to do so.

3. Injury

1. Any injuries a bear may have obtained from direct or indirect contact with the camp or persons must be reported to the appropriate ENR Regional contact listed above.

4. Mortality

1. A bear may be destroyed if human life is in danger or destruction of property is imminent.
2. Under the NWT Wildlife Act, mortalities must be reported to the appropriate ENR Regional contact listed as soon as is practicable. In some cases, the responsible party may be asked to:

   a) Skin the bear leaving the claws and head attached.
   b) Preserve the hide by freezing and/or salting it and store it in a cool place. Turn in the hide, the skull, evidence of sex and any other biological samples requested when filing the report to the nearest ENR Regional office or to an ENR Renewable Resource Officer.

If or when possible, the attached ***Bear Occurrence Checklist*** should be completed prior to calling ENR. It is critical that as much information as possible be provided in order for ENR to provide appropriate advice and guidance.

DENNING BEARS

A. For exploration camps, if a bear is located in, at or near a den site, work in the area must halt. All employees should safely retreat from the area and report the incident to the Site Supervisor and/or Wildlife Monitor and the appropriate ENR Regional contact listed above for further advice and assistance.

B. For cabin owners, if a bear is located in, at or near a den site, safely retreat from the area and report the incident to the appropriate ENR Regional contact listed above for further advice and assistance.

C. Staff from ENR will be required to assess the den site and may implement measures to ensure both human safety and that the bear(s) remain undisturbed. This may include the establishment of a buffer zone of at least 300 meters around the den.

D. Work inside the buffer zone may not be permitted until after den emergence.

Office Use Only
File#:

Environment & Natural Resources (ENR)
Bear Occurrence Checklist

- Fill out or check all that apply

1. **Complainant Details:**	
Name, job title and affiliation:	
Contact information:	
Location of complainant: *(coordinates, lake or property name)*	
Other on-site contact information: *(wildlife monitors/site supervisors)*	

2. **Bear Occurrence Details:**				
Date/Time:		**Location:** *(coordinates, lake or property name)*		
Type of bear occurrence:	☐ sighting	☐ encounter	☐ injury	☐ mortality *Ear tag/tattoo #*
	☐ Other, explain:			
Number of bears:		**# of cubs**		
Type:	☐ black	☐ grizzly	☐ unknown	
Sex :	☐ male	☐ female	☐ unknown	
Age Class:	☐ cub (<1)	☐ juvenile	☐ adult	☐ unknown
Behaviour:	☐ fearful	☐ not fearful	☐ aggressive	☐ other
General Observations	☐ moving toward site	☐ moving away from site	☐ at site	
Other observations: *(i.e. walking, resting, eating, mortality, injury, den site, number of cubs, etc.)*				
Has bear(s) been involved in a previous incident:	☐ No ☐ Yes	**If yes, explain:**		
Did the bear obtain a reward	☐ No ☐ Yes	**If yes, explain:**		
Any property damage or loss of life:	☐ No ☐ Yes	**If yes, explain:**		

3. **Detection/Deterrent:**				
Detection system on site:	□ Alarm	□ Dog	□ Motion detector	□ Other:
Deterrence on site:	□ Bear boards	□ Auditory *(Yelling/Flares/Alarm/Horn/Bell/ Whistle/Cracker shells)*	□ Projectile *(Rubber Bullets/Firearms)*	
	□ Electric Fence	□ Chased *(Dog, vehicle)*	□ Other:	
Was deterrence used:	□ No □ Yes	**Explain:**		
Was the deterrence successful:	□ No □ Yes	**Explain:**		
Present status of bear with dates:	□ at large	□ captured	□ deterred	□ other

4. Additional Comments	

Appendix F: Monitoring Protocols and Data Sheets

Tłįchǫ Highway Project

Wildlife Management and Monitoring Plan

Appendix F: Monitoring Protocols and Data Sheets

September 9, 2021

WILDLIFE SIGHTINGS PROCEDURE

PURPOSE

The purpose of this procedure is to describe the management of the Wildlife Sightings that are observed during the construction phase of the Project.

RESPONSIBILITY

All staff are responsible for reporting wildlife sightings. The Environmental Monitors are responsible for collecting the log sheets weekly, entering them into a database. Environmental Monitors are also responsible for entering wildlife observations reported by radio into the log sheets.

PROCEDURE

1. Wildlife sighting logs will be posted on various bulletin boards in camps and work areas for Project staff to record observations of wildlife.

2. Project staff will be made aware of which species are a priority to report.

3. All Project staff will be encouraged to add observations to the log, including the species, number, location, and date of the observation.

4. Environmental Monitors will check the logs weekly for evidence of problem wildlife or problem areas that may pose a risk to wildlife.

5. Observations of wildlife may be called in by radio and entered into the Wildlife Sightings Log by the Environmental Monitors.

EQUIPMENT REQUIREMENTS

None. Data sheets to be posted for all Project staff use.

REPORTING

Observations relevant to human or wildlife safety, such as observations of bears, caribou, moose, bison, species at risk or nesting birds, will be included in the Weekly Report. Copies of all Wildlife Sightings Logs will be provided in the Weekly Report. All information including surveys and monitoring will be summarized in the Annual Report.

Tłı̨chǫ ASR Wildlife Sightings Log

Date	Time	Species	Number	Location (km marker, or coordinates)	Notes (any behavioural response or reactions?)	Name	Company

WILDLIFE ROAD SURVEY PROCEDURE

PURPOSE

The purpose of this procedure is to describe the management of the Wildlife Road Survey. This procedure will be used during the construction phase only.

RESPONSIBILITY

The Environmental Monitors are responsible for completing wildlife road surveys and entering them into a database.

PROCEDURE

1. The Wildlife Road Survey is to be completed each time Environmental Monitors drive a section of road.
2. Observations of wildlife on the roads, within the cleared right of way adjacent to the road, or within borrow pits will also be documented by Environmental Monitors. This survey may be completed as a stand-alone survey, or while driving the road for other purposes. To provide sufficient survey effort, a minimum distance of 10 km is suggested when completing a stand-alone survey and the entire drivable length of road should be covered at least twice per week.
3. At the start of a survey, the date, start time, start location and observers will be document on the Wildlife Road Survey data sheet provided.
4. All observations of wildlife or wildlife sign along the road will be documented, including the species, number of individuals, location (UTM or kilometre) and photo if relevant.
5. Where possible, comparisons between thermal imaging device and binoculars observations should be drawn when caribou, moose or bison are observed during the road surveys. Comparisons between devices will not be made where bison are resting, grazing or travelling within the cleared RoW.
6. Speed should be limited to 50 km/h, the maximum driving speed for Project vehicles. Any notes on mitigation actions taken or suggested follow up will also be reported.
7. Observations of large mammals on the road will be reported to other drivers in the area, to reduce risk of collision.
8. At the completion of the survey, document the end time and the end location. File the original hard copy in the Environmental Office and update the Wildlife Sightings Form database.

EQUIPMENT REQUIREMENTS

- Truck
- Binoculars
- Data Sheet
- Field guide to birds
- GPS
- Project map
- Digital camera

REPORTING

Observations relevant to human or wildlife safety, such as observations of bears, caribou, species at risk or nesting birds, will be included in the Weekly Report. All information including surveys and monitoring will be also summarized in the Annual Report.

Wildlife Road Survey

Date: Start time: End time: Observer(s):

Survey start at (km marker, GPS location or other landmark):

Survey completed at:

Time	**Species**	**Number**	**Age/sex**	**Location** (general feature describe)	**Location** / UTM or Km Marker	**Photo ID**	**Notes** (any behavioural response or reactions?)

Additional notes (e.g. details on wildlife interactions, behavioural responses, or response to mitigation):

WILDLIFE SURVEILLANCE MONITORING PROCEDURE

PURPOSE

To prevent wildlife incidents through systematically documenting wildlife activity. This procedure will be used during the construction phase only.

RESPONSIBILITY

The Environmental Monitors are responsible for completing surveys of all camps and construction areas for evidence of wildlife presence and entering them into a database.

PROCEDURES

Environment Monitors will undertake systematic tours of the Project construction camps to record all wildlife observations or recent wildlife sign (e.g., tracks and scat). Surveys of will be completed at least once per week. Observers will travel to defined Project location, and record the following at each location:

1. Time upon arrival at location / monitoring site
2. Location or monitoring site
3. Presence of wildlife or wildlife sign (Yes or No)
4. Species or sign observed
5. Number of individuals
6. Wildlife Activity
7. Photo number (if photo taken)
8. Record any relevant comments about the observation, or relevant information from people working at the location.
9. Observations of any birds nesting or mammals denning adjacent to the cleared right of way, access roads or borrow sources will also be recorded.
10. Record any relevant comments about improper storage or segregation of wastes or other wildlife attractants, any evidence of wildlife gaining access to wastes or attractants, and any reports of dangerous wildlife interactions from people working at the location.
11. Report wildlife sign (such as tracks or scat) or observations of wildlife from Project staff working in the area shall be recorded on the data sheets in the additional comments section on the reverse side of the data sheet. Photos of sign and wildlife should be taken where possible to help in identification of species after completion of the survey.

12. Record the photo number on the data sheet and download and file the photos by date.
13. If no wildlife is observed, no sign seen and no reports of wildlife from staff, then an "N" should be recorded on the data sheet and in the database for that monitoring site or location.

LOCATIONS FOR SYSTEMATIC MONITORING

The following areas / sites should be visited at least once a week:

- Accommodations camps (entire perimeter)
- Waste transfer areas (entire perimeter)
- Quarries

EQUIPMENT REQUIREMENTS

- Truck
- Binoculars
- Data Sheet
- Field guide to birds
- GPS
- Project map
- Digital camera

REPORTING

Any wildlife concerns that come to light during the survey should immediately be brought to the attention of the Project Supervisor so that appropriate action can be taken. Any wildlife incidents observed or reported during this survey should be reported in the Wildlife Incident Report Form (see separate form). Observations relevant to human or wildlife safety, such as observations of bears, caribou, moose, species at risk or nesting birds, will be included in the Weekly Report. All information including surveys and monitoring will be summarized in the Annual Report.

Wildlife Surveillance Monitoring Form

Observers: Date: Page: of:

Wildlife Observed or Wildlife Sign

Time	Location	Wildlife Present? (Y/N)	Species Or Sign	Number	Activity	Photo #	Observations from people working at the location / other comments

Record any additional comments on reverse page

Additional comments or notes:

Reviewed by:

Date:

Follow up:

BIRD NESTING ACTIVITY PROCEDURE

PURPOSE

To purpose of this procedure is to detect and mitigate impacts to active nests and bat roosting sites. This procedure will be used during the construction phase only, except for quarries which will be monitored during operations as well.

Clearing of vegetation is scheduled to occur outside of migratory bird breeding season (1 May to 15 August). However, there may be instances where vegetation removal is required during this period due to schedule changes or unforeseen circumstances. In these cases non-intrusive pre-clearing surveys are required, to be developed on a case-by-case basis.

RESPONSIBILITY

The Environmental Monitors are responsible for completing the surveys and entering them into a database.

PROCEDURE

Environment Monitors will undertake systematic monitoring of the Project site to detect bird nesting activity, bird nests on the Project infrastructure. Environment Monitors will document all avian nests and nesting behaviour in the areas surveyed, as well as for little brown myotis maternal roosting sites. The surveillance monitoring survey will include areas of the Project where there is risk of birds or bats nesting or finding shelter. This will include buildings, stockpiles of supplies, mobile and stationary equipment.

The surveys will occur at least twice per week prior to and during the migratory bird nesting season (April to mid-July) and more frequently in particular areas if nests are found or nesting activity is observed.

LOCATIONS FOR SYSTEMATIC MONITORING

The following areas / sites should be visited at least once a week:

- Accommodations camps (entire perimeter and buildings)
- Waste transfer areas (entire perimeter and buildings)
- Heavy equipment that has been stationary for more than two days
- Waterbodies within 100 m of camps
- Stream crossing locations
- Quarries
- Borrow sources

Observers will travel to defined Project locations, and record the following at each location:

1. Time upon arrival at location / monitoring site
2. Location or monitoring site
3. Presence of bird nesting behaviour, active bird nests or bat roosting sites
4. Number of individuals
5. Photo number (if photo taken)
6. Any relevant comments about the observation, or relevant information from people working at the location.
7. Any reports of sign or observations of species from Project staff working in the area shall be recorded on the data sheets in the additional comments section on the reverse side of the data sheet.
8. If no nests, nesting behaviour or roosting sites are observed, no sign seen and no reports of wildlife from staff, then an "N" should be recorded on the data sheet and in the database for that monitoring site / location.
9. Quarries in particular should be checked for signs of swallow and nighthawk nesting. Quarry pile slopes should be less than 70 degrees to discourage swallow nesting (Refer to the ECCC pamphlet Bank Swallow in Sandpits and Quarries).
10. Monitoring will initiate in April and continue at least until mid-July (or until all identified nests are inactive), and focus on areas where scheduled construction activities are expected during the migratory bird nesting season.
11. Incidental observations of avian species at risk in particular should be documented. These include:
    - Peregrine falcon
    - Short-eared owl
    - Bank swallow
    - Barn swallow
    - Common nighthawk
    - Olive-sided flycatcher
    - Horned grebe
    - Red-necked phalarope
    - Rusty blackbird

- Yellow rail

EQUIPMENT REQUIREMENTS

- Truck
- Binoculars
- Data Sheet
- Field guide to birds
- GPS
- Project map
- Digital camera

Reporting

Any bird nesting observed during the survey should immediately be brought to the attention of the Project Supervisor. The Project Supervisor will email ECCC at ec.dalfnort-wednorth.ec@canada.ca to determine an appropriate course of action. Through consultation with GNWT-ENR and ECCC, bird nests will be protected by a buffer that protects the nest while allowing construction to continue, and will be monitored. Details of nests identified and the mitigation will be included in the weekly wildlife monitoring reports.

All observations of nesting activity or risk of nesting on Project infrastructure should be included in the Weekly Report. All information including surveys and monitoring will be summarized in the Annual Report.

Bird Nesting / Bat Roosting Activity Monitoring Form

Observers: Date: Page: of:

Location:

Wildlife Observed or Wildlife Sign

Time	Location	Species Observed	Photo #	Nesting behaviour observed	Nests Roost observed (describe)

Record any additional comments on reverse page

Additional comments or notes:

Reviewed by:

Date:

Follow up:

PRE-BLAST SURVEYS PROCEDURE

PURPOSE

This procedure is to search for and document large mammals (specifically caribou, moose, bison and bears) within a 500m radius (or as determined by Blast Supervisor) prior to blasts. Refer also to the relevant Blast Plan for each blasting operation for any additional site-specific procedures.

RESPONSIBILITY

The Environmental Monitors are responsible for completing the survey and entering the results into the database.

PROCEDURES

1. The Environmental Monitor will ensure that blasting does not conflict with the Operating Procedure for Use of Boreal Caribou Collar Data to Mitigate Impacts from Construction of the Tłı̨chǫ ASR (Appendix D).
2. Refer to the relevant Blast Plan for any additional blast-specific direction.
3. Two Environmental Monitors will complete a 1 hour survey, within a 500m radius of the blast zone perimeter (or as defined by the Blast Supervisor). The survey will be conducted by foot or truck, and will also include surveying within the immediate blast zone area to the extent that it is safe to do so.
4. Both binoculars and thermal imaging device will be used to survey the blast zone buffer and perimeter. The intent is to determine if the thermal imaging device improves the detectability of wildlife.
5. All large mammals observed will be documented, and it will be noted on the data sheet whether the detection was made with the thermal imaging device. Information will also include estimated distance from animal and weather conditions including air temperature.
6. If large mammals are detected in the 500m blast radius or blast zone they will be given at least 15 minutes to move away from the blast area before deterrent procedures will be considered. Deterrents will only be used if there is a risk to human or wildlife safety.
7. Once the blast zone and perimeter is cleared of large mammals, the blast should occur as soon as possible to avoid other large mammals from entering the blast zone.
8. Using the form provided, the Environmental Monitors or the Blast Supervisor will document efforts to detect wildlife, document any wildlife observed and document any deterrent actions taken.

The following will be recorded for during each survey:

- Date, time and location of blast
- Magnitude of the blast
- Time spent on wildlife survey
- Area of blast radius that cannot be surveyed due to vegetation
- Photo number (if photo taken)
- Wildlife observed and efforts to deter the wildlife

Equipment Requirements

- Truck
- Binoculars
- Thermal Imaging Device
- Data Sheet
- GPS
- Digital camera

Reporting

All relevant observations for each blast will be documented in the Weekly Report. A summary of all surveys completed will be included in the Annual Report.

Pre-blast Survey Form

Observer: Date: Page: of:

Location: Blast Plan Reference Number:

Estimated area of blast radius: Start and end time of Survey:

Time of blast:

Weather conditions/Air Temperature:

Wildlife Observed:

Notes on wildlife detection using binoculars versus thermal imaging device (Were any large mammals observed using one technique and not the other? Please describe including distance to animal .):

Deterrent Actions Required and Wildlife Response:

PRE-CLEARING LARGE MAMMAL SURVEY PROCEDURE

PURPOSE

The purpose of this procedure is to detect large mammals ahead of the clearing activities, as well as to detect any possible denning locations. This procedure will be used during the construction phase of the Project.

RESPONSIBILITY

The Environmental Monitors are responsible for completing the surveys and entering them into a database. Surveys will be overseen by the NSI Environmental Supervisor.

PROCEDURE

PRE-CLEARING LARGE MAMMAL SURVEY

1. Environmental Monitors will travel (by foot, ATV or snow machine) the length of the right of way that will be cleared, ahead of the clearing activities.
2. The Monitors will travel at no more than 10 km per hour along the road alignment, one person on each side of the alignment, and looking into the forest on either side of the alignment for wildlife or fresh wildlife sign.
3. Any large mammals (caribou, moose, bison, bears, wolves) or sign observed in the forest to either side of the alignment will be documented and reported to the NSI Environmental Manager. The Environmental Monitors should aim to survey areas to be cleared no more than 48 hours prior to the vegetation clearing.
4. For each day of surveys, the following information will be recorded using the datasheet provided: the start and finish coordinates, the observer names and any observations. Communications with the NSI Environmental Manager and any follow up actions will also be documented.
5. If a caribou is seen within 500 m ahead of clearing operations, operations will be temporarily suspended by the Project Supervisor to allow wildlife to move away from the area of their own. If they do not leave the area within 15 minutes, they will be gently encouraged to move away from construction activities, and an incident report will be completed. This will involve the slow approach of Environmental Monitors towards the caribou to encourage them to move. If a caribou is reluctant to leave the area, this could be a sign that it is a female that is hiding a calf in close proximity. If this is the case, operations will be suspended, and regional ENR biologist contacted for advice.

BEAR DEN AERIAL SURVEYS

Helicopter-based bear den surveys will be completed surveys by GNWT-ENR. Detailed methods will be prepared prior to the survey, but will include the following elements:

1. The survey will be conducted by one ENR biologist and two environmental monitors in the fall of 2019 and 2020, during den initiation, targeting all areas where vegetation clearing is planned for that winter season, plus an 800 m buffer around those areas.
2. Flights lines will be flown between 200-300m apart
3. A rotary wing aircraft will be used to allow for low and slow flying opportunities for the observers
4. If any wildlife dens are observed, the pilot will slow down and circle the area to obtain photographs and GPS waypoints of the den location. In some cases, where it is safe to do so, the helicopter may need to land so that observers can verify the presence of a suspected den on the ground. Surveyors will be equipped with bear deterrents and firearms in the event there is an active bear in the area.
5. Mineral licks, raptor nests and landscape features that might provide suitable habitat for bat hibernacula will also be documented.
6. Any other wildlife sightings during the survey will also be recorded.

Mitigation options in the event that a denning bear is detected:

If a bear is located in, at or near a den site that is within 800 m of an area that will be cleared of vegetation during the winter, the following mitigation options will be evaluated by ENR and NSI (in decreasing order of preference):

- If feasible, adjust the road alignment, access road alignment, borrow source boundaries or camp location to avoid the bear den by 800 m.
- Do not use all or a portion of a borrow source for that winter of construction in order to avoid the den by 800 m.
- Reduce the size of the exclusion zone and proceed but implement continual monitoring of the den to ensure the denning bear is not disturbed by activities.
- If a den is located directly on the ROW for the road, and no other mitigations can be applied, contact the Tłįchǫ Government to preselect a potential hunter(s) from the closest Tłįchǫ community to harvest the bear(s) in a den.

Mitigation options in the event that a mineral lick is detected:

If a mineral lick is documented during the aerial bear den survey that is within 250 m of an area that will be cleared of vegetation during winter, the following mitigation options will be evaluated by ENR and NSI (in decreasing order of preference):

- If feasible, adjust the road alignment, access road alignment, borrow source boundaries or camp location to avoid the mineral lick by 250 m.
- Do not use all or a portion of a borrow source to avoid the mineral lick by 250 m.
- Reduce the size of the exclusion zone but maintain a vegetated buffer between the mineral lick and the cleared area, maintain connectivity of the vegetated buffer to adjacent forested areas, and avoid disruptions to drainage and groundwater near the mineral lick.

Mitigation options in the event that a raptor nest(s) is detected:

If an unoccupied raptor nest is documented during the aerial bear den survey that is within 500 m of an area that will be cleared of vegetation during winter, the following mitigation options will be evaluated by ENR and NSI (in decreasing order of preference):

- If feasible, adjust the road alignment, access road alignment, borrow source boundaries or camp location to avoid the raptor nest by 500 m.
- Do not use all or a portion of a borrow source to avoid the raptor nest by 500 m.
- Reduce the size of the exclusion zone but maintain a vegetated buffer around the raptor nest. Leave the tree(s) supporting the raptor nest(s) standing if safety permits.
- If the tree(s) supporting the nest(s) is directly within an area that must be cleared, and the mitigations listed above are not feasible, obtain a permit from ENR to destroy the raptor nest.

Equipment Requirements

- Data Sheet
- GPS
- Project map
- Transect lines
- Digital camera
- Rotary Wing Aircraft

Reporting

Observations of large mammals or fresh sign will be reported immediately to the NSI Environmental Manager. Survey effort and a summary of results will be included in the

Weekly Report. All information including surveys and monitoring will be summarized in the Annual Report.

Pre-Clearing Wildlife Survey

Date: Start time: End time:

Observer(s):

Survey Type (circle): Pre-Clearing Wildlife Survey Bear Den Survey

Feature (circle one): Quarry Quarry access road Road right of way

Start location (UTM): End location:

Wildlife and Wildlife Sign Observations

Time	Species	Observation (observed, tracks, other sign)	Location (UTM)	Comments

Document follow-up actions resulting from any wildlife observations

THERMAL IMAGING DEVICE PILOT STUDY PROCEDURE

PURPOSE

This procedure will provide evidence to determine if thermal imaging devices are a useful tool for detecting wildlife. If the tests are successful, the devices may be integrated into the WMMP monitoring.

The procedure will be initiated when large mammals have been observed as part of the Pre-blast Wildlife Survey and where possible Road Surveys. Once observed, the Environmental Monitors will use both the thermal imaging device and traditional binoculars to estimate if detectability is improved.

RESPONSIBILITY

The Environmental Monitors are responsible for completing the survey. The Environmental Monitors are responsible for entering the results into the database. Guidance will be provided by the Environmental Supervisor.

PROCEDURES

1. The Environmental Monitors will initiate this survey opportunistically when a large mammal is observed, and no other immediate actions are required to manage hazards to the wildlife. Large mammals include moose, bison, caribou and wolves.
2. Upon observation of a large mammal, the data sheet will be initiated to document details of the wildlife (such as species and group size) and the environmental setting (such as daylight, season, temperature, habitat).
3. Initiate monitoring by watching the individual until it is no longer visible with either binoculars or the thermal imaging device. Do not follow the wildlife.
4. Collect photos, preferably while the large mammal is still visible.
5. When the wildlife is no longer visible with either binoculars or the thermal imaging device, complete the data sheet and continue with the original task.

The following will be recorded for during each survey:

- Date, time and location
- Large mammal details (species, group size)
- Environmental setting details (time of day, light conditions, weather, forest density)
- Time spent on the task
- Photo number
- Environmental Monitor observations on the effectiveness of the thermal imaging device for detecting and tracking large mammals

Equipment Requirements

- Binoculars
- Thermal Imaging Device
- Data Sheet
- GPS
- Digital camera

Reporting

A summary of all surveys completed will be included in the Annual Report, with a recommendation for the continued use of thermal imaging devices.

Thermal Imaging Device Pilot Study Form

Observer: Date:

Location: Photo numbers:

Start and end time of Survey: Large mammal species and group size:

Sky (% overcast): Precipitation (rain or snow): Daylight (day, night, twilight):

Binoculars make and model:
Thermal imaging device make and model:

How was the large mammal originally detected?

Approximately how far away was it when last observable?

Please check the appropriate box:	Binoculars	Thermal Imaging Device	Naked Eye
What was the best way to first detect the large mammal?			
What was the best way to track the large mammal?			
Which were you using when you last saw it?			
Overall, what was the best way to observe the large mammal?			

Please record any other useful information, and your suggestions for use of the thermal imaging device:

WILDLIFE INCIDENT REPORTING PROCEDURE

Purpose

The following procedure is intended as a guideline to identify wildlife that requires immediate reporting and sampling (if necessary). ENR encourages all those conducting activities on the land or residents to record and report all instances of injury or possibility of disease in wildlife. The Project will document all such incidents to prevent future incidents or escalation of problems, and report to GNWT-ENR and ECCC if migratory birds are involved.

RESPONSIBILITY

All project personnel are responsibility for providing recording wildlife incident to the on the Project site.

As per Section 57 of the *Wildlife Act,* any defense of life and property kills must be reported without delay to ENR. All reasonable efforts must be made to ensure the hide and other valuable parts do not spoil and that these are turned over to an ENR Officer to avoid any wastage.

As per Section 58 of the *Wildlife Act*, and sub-section 8(1) of the Wildlife General Regulations, any person who accidentally kills or seriously wounds big game or other prescribed wildlife with a motorized vehicle on a highway must report the event to an officer within 24 hours after the incident.

PROCEDURES

Report wildlife incidents when:

- wildlife is determined to be injured.
- wildlife is suspected of being diseased.
- wildlife is found dead.
- there is the potential for human/wildlife conflict such as an occupied bird nest or wolf or bear den.
- wildlife was deterred from camp or other work area.
- there is a defensive kill.
- property is destroyed by wildlife.
- wildlife is injured or killed due to collision with a vehicle.

Complete the Wildlife Incident Record Form, providing information such as:

- Behaviour and movements
- Loss of life or property
- Reason for attraction to area
- Estimation of how long the animal was dead
- Any other animals seen in the area

Collect photographs:

- Add photo name/label
- Show general area
- In case of mortality, photograph the animal (one from each side, head, and tail), including anything unusual and any obvious injuries or marks

REPORTING

Environmental Monitors should report all incidents immediately to the NSI Environmental Manager. When the Wildlife Incident Report is complete, the NSI Environmental Manager is to contact:

- GNWT-ENR North Slave Emergency number at (867) 873 - 7181 (24 Hours), Fax: (867) 873 – 6230.
- Environment and Climate Change Canada at ec.dalfnort-wednorth.ec@canada.ca

All Incident Reports will be included in the Weekly Reports.

Occurrence Date/Time:

Date Reported:

Wildlife Incident Record

<table>
<tr><td colspan="5">MAIN CONTACT INFORMATION</td></tr>
<tr><td colspan="5">NAME:
ADDRESS:
PHONE NUMBER:</td></tr>
<tr><td colspan="5">Location of Complaint:
(coordinates, km marker, lake, camp)</td></tr>
<tr><td colspan="5">Details Taken by:</td></tr>
<tr><td colspan="5">Location of Incident
(coordinates, km marker, lake, camp):</td></tr>
<tr><td>Type of Incident:</td><td colspan="4">☐ Encounter ☐ Nuisance ☐ Wildlife Mortality ☐ Wildlife Injured ☐ Defensive ☐ Other:</td></tr>
<tr><td>Species:</td><td colspan="4">☐ Black Bear ☐ Bison ☐ Fox ☐ Wolverine ☐ Wolf ☐ Caribou ☐ Moose ☐ Bird ☐ Other:</td></tr>
<tr><td rowspan="4">Sex:</td><td>☐ Male</td><td rowspan="4">AGE CLASS:</td><td colspan="2">☐ Adult</td></tr>
<tr><td>☐ Female</td><td colspan="2">☐ Juvenile</td></tr>
<tr><td>☐ Unknown</td><td colspan="2">☐ Cub</td></tr>
<tr><td></td><td colspan="2">☐ Unknown</td></tr>
</table>

Details of Incident: (movement, behaviour, reason for attraction, property damage, vehicle collision, etc.)

Details of Action Taken: (reporting, deterrence type, disposal, removal of attractant, etc.)	
DATE: mm/dd/yy	

Was the incident resolved?	☐ Yes	☐ No
Has Environment & Natural Resources been contacted? **Contact Name:** **Date/Time Reported:**	☐ Yes	☐ No

Appendix G: Migratory Bird Survey Report

Government of Northwest Territories Gouvernement des Territoires du Nord-Ouest

SEP 30 2019

DR. JOE DRAGON
DEPUTY MINISTER
ENVIRONMENT AND NATURAL RESOURCES

Submission of the Bird Survey Report for the Tłı̨chǫ All Season Road

The Government of the Northwest Territories Department of Infrastructure (GNWT-INF) respectfully submits to the Government of the Northwest Territories Department of Environment and Natural Resources the attached Bird Survey Report. The Bird Survey Report is being provided in accordance with Measure 10-1 of the Environmental Assessment. Please see the attached report for further details.

Should you have any questions or concerns please contact me at (867) 767-9049 ext. 31186 or by email at Cameron_Wilson@gov.nt.ca at your earliest convenience.

Sincerely,

C. Wilson

Cameron Wilson
Regional Superintendent
Infrastructure

Attachment

c. Ms. Laurie McGregor
Environmental Assessment Analyst
Environment and Natural Resources

Ms. Loretta Ransom
Manager, Environmental Impact Assessment and Monitoring
Environment and Natural Resources

TECHNICAL MEMORANDUM

DATE September 10, 2019 **Project No.** 1790290-5000-5007

TO Stu Nivens, Manager – Environmental Affairs Design & Technical Services, Department of Infrastructure, Government of the Northwest Territories

CC Damian Panayi, Paula Bentham

FROM Lynnette Dagenais, Connor Charchuk **EMAIL** lynnette_dagenais@golder.com

TŁĮCHQ̨ ALL-SEASON ROAD 2019 MIGRATORY BIRD BASELINE STUDY

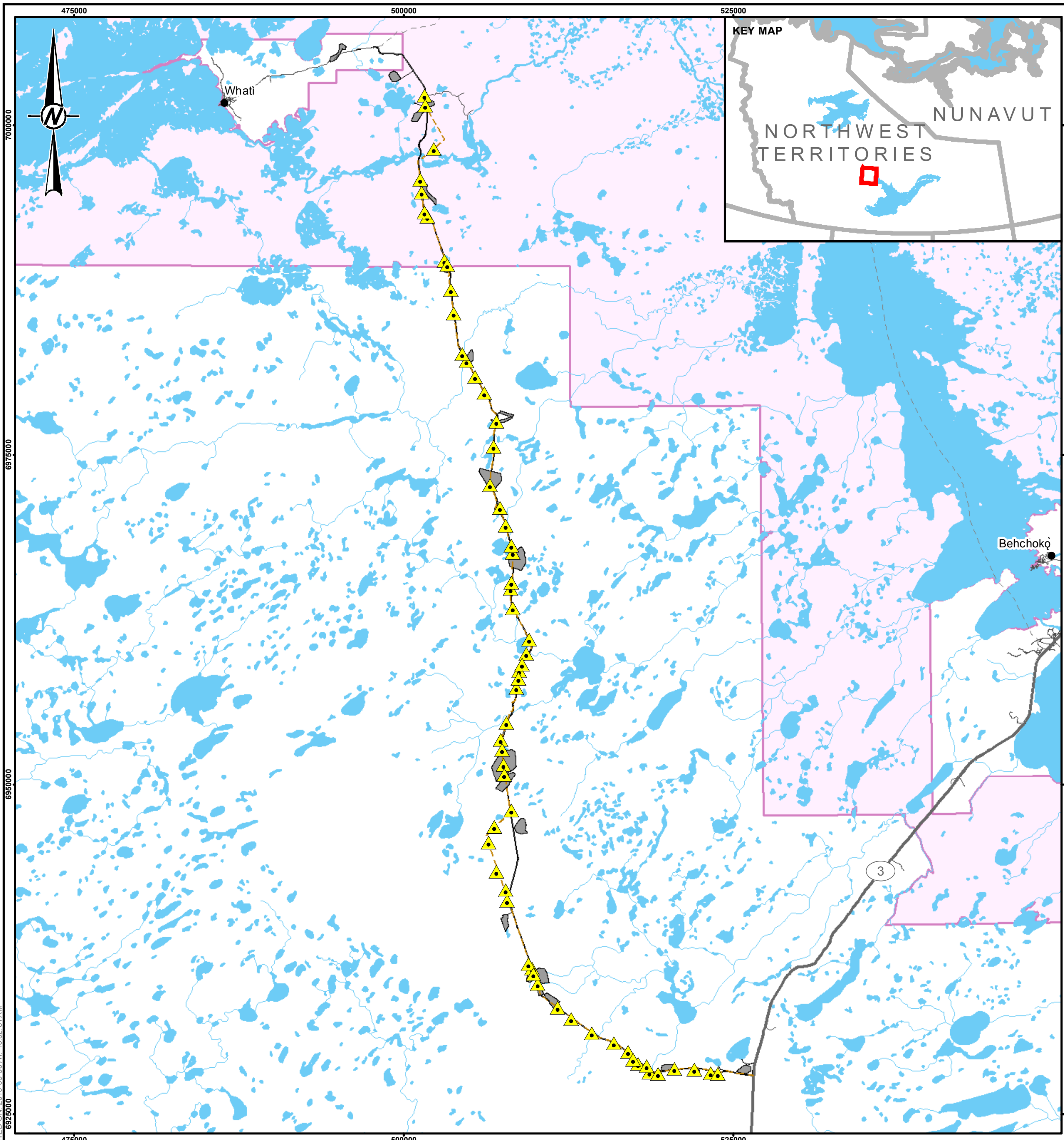
1.0 INTRODUCTION

The Government of the Northwest Territories, Department of Infrastructure (INF) has applied to construct and develop the Tłı̨chǫ All-Season Road (the Project), which will be an all-season road from Kilometre 196 of Highway 3 to the Community Government of Whatì boundary. The Project generally follows the Old Airport Road, a historic winter road route connecting Whatì to Highway 3 (Figures 1 to 3) that is still in frequent use for hunting and firewood collection, and by recreational off-road vehicles. The Project triggered an environmental assessment by the Mackenzie Valley Environmental Impact Review Board (MVEIRB; EA1617-01). In the Report of Environmental Assessment and Reasons for Decision, the MVEIRB prescribed Measure 10-1 to mitigate effects on bird species at risk (SAR) and migratory birds (MVEIRB 2018). Part 1 of Measure 10-1 states:

> "The developer will conduct pre-construction field surveys of bird species at risk and migratory birds prior to disturbing potential habitat, including any clearing of the right-of-way, quarry sites, camps, access routes, or other project infrastructure. The developer will consult with Environment and Climate Change Canada (ECCC), and GNWT-ENR about methods and timing for a field survey(s). The developer will conduct the survey using methods derived from peer-reviewed scientific literature and best practices."

Consultations between INF and ECCC and Government of the Northwest Territories, Department of Environment and Natural Resources (ENR) took place on April 18, May 11, and May 28, 2018 (Golder 2018a). Following the last meeting, INF agreed to implement a study for migratory and SAR birds within 200 metres (m) of the Project centreline (i.e., 400 m corridor; bird baseline regional study area [RSA]) in 2019. The baseline monitoring study design that reflects all engagement recommendations from ECCC and ENR is Version 3.2 of the Tłı̨chǫ All-Season Road 2019 Migratory Bird Baseline Study Plan (Golder 2018b) and is described in the sections below.

This report summarizes the results of 2019 baseline monitoring for the Project following the Tłı̨chǫ All-Season Road 2019 Migratory Bird Baseline Study Plan (Golder 2018b). The objective of the 2019 bird baseline studies is to comply with Part 1 of Measure 10-1 (MVEIRB 2018).



LEGEND

- POPULATED PLACE
- ALL-SEASON ROAD
- LOCAL ROAD
- WINTER ROAD
- WATERCOURSE
- TŁ̨ICHǪ LAND
- WATERBODY
- 2019 ARU LOCATION
- OLD AIRPORT ROAD
- PROJECT FOOTPRINT

0 8 16

1:425,000 KILOMETRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 11 DATUM: NAD83

CLIENT

GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT

TŁ̨ICHǪ ALL-SEASON ROAD

TITLE

LOCATION OF AUTONOMOUS RECORDING UNITS ALONG THE PROJECT ALIGNMENT, 2019

CONSULTANT

GOLDER

YYYY-MM-DD	2019-08-30
DESIGNED	DC
PREPARED	LMS
REVIEWED	LD
APPROVED	LD

PROJECT NO.	REV.	FIGURE
1790290	0	1

PATH: I:\2017\1790290\Mapping\MXD\Wildlife\1790290_Actual2019BirdSurvey_Rev0.mxd PRINTED ON: 2019-08-30 AT: 10:32:51 AM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

25mm

0

Figure 2: Existing Conditions on the Old Airport Road

Figure 3: Existing Conditions on the Old Airport Road

2.0 METHODS

The intent of the baseline surveys was to meet the following objectives:

- identify the presence, habitat associations, and relative abundance of migratory birds, with focus on bird SAR; and
- determine if migratory bird abundances are different within and outside of the Project right-of-way (ROW; 60 m from the Old Airport Road centreline [120 m corridor]).

The Project follows the Old Airport Road for most of the alignment. Although there is some deviation of the Project alignment from the Old Airport Road (Figure 1), the ROW and RSA were defined based on the Old Airport Road because of access limitations during ARU deployment, and because the Project route was still under development.

For this report, species at risk are species that are federally listed as endangered, threatened, or of special concern (SARA 2019; COSEWIC 2019).

Autonomous recording units (ARUs) were used for the 2019 baseline surveys and followed the draft guidelines for the use of ARUs in impact assessment studies (ECCC 2018), which were provided to Golder by the ECCC in March 2019. The 2019 baseline surveys were completed under Wildlife Research Permit WL500689 and covered the entire ROW (Figure 1).

2.1 Sampling Design

Land cover types described by Systeme Pour l'Observation de la Terre (SPOT) 4/5 data were used in the Environmental Assessment (EA) for the Project as the basis for describing available bird habitat at baseline. The ECCC recommended that SPOT 4/5 land cover types be combined into broad-scale habitats (Golder 2018a; Table 1, Figure 4). SPOT 4/5 data does not explicitly delineate wildfire burns but combines burns with anthropogenic disturbance into the “recently disturbed” land cover type.

A total of 60 ARUs were deployed within the RSA in 2019 (Table 1; Golder 2018b). The ARUs were deployed in five broad-scale habitat types (Table 1, Figure 4). As per ENR and ECCC recommendations, the broad-scale habitat types excluded NWT wildfire data (Golder 2018a). Prior to site selection, available sites in the RSA were restricted to those separated by a minimum of 500 m in a Geographic Information System (GIS) platform as per ECCC (2018). These were then intersected with habitat polygons. Each location was assigned a habitat type based on the dominant habitat type within 50 m. This scale was chosen to maximize the number of potential sites given the low abundance of several habitat types in the RSA. A 50 m scale is also consistent with breeding bird survey standards for point-counts (Ralph et al. 1995; Matsuoka et al. 2014).

Locations for ARUs in each of the broad-scale habitat types, except wetlands, were selected through generalized random tessellation stratified (GRTS) sampling via the ‘spsurvey’ package in R (Kincade and Olsen 2016; RCDT 2015) to maximize spatial variation in each habitat type. The GRTS sampling also selected three additional alternate sites, where possible, to provide spatially balanced sampling coverage in case some of the main survey locations could not be accessed due to safety or logistical concerns.

For wetlands, there was insufficient habitat area available to deploy 10 ARUs with 500 m spacing. As such, the number of sites selected was set to the number available and additional sites were allocated to other more abundant habitats to achieve deployment of 60 ARUs.

Table A-1 (Appendix A) outlines vegetation data at each ARU location, as identified in the field.

Table 1: SPOT 4/5 Reclassification into Broad-scale Habitat Types, Area and Percent Cover in the Regional Study Area, and Number of Autonomous Recording Units Deployed in Broad-scale Habitat Types Inside and Outside of the Project Right-of-way.

Broad-scale Habitat Type	SPOT 4/5 Grid Codes	SPOT 4/5 Land Cover Class	Area within the RSA (ha)	Proportion of the RSA (%)	Number of ARU Units Deployed within the Project ROW[c]	Number of ARU Units Deployed within the RSA[d]
Dense conifer	1, 2	Evergreen conifer forest (high density) Evergreen conifer forest (medium density)	1,006	26.9	2	13
Sparse conifer	3, 13	Evergreen conifer (low density/non-forest) Sparse conifer lichen	1,513	40.4	10	12
Deciduous	4, 5, 6	Mixed forest Deciduous forest Young forest	570	15.2	3	6
Open	9, 10, 11, 12	Erect shrub Herbaceous Bryoid Barren	375	10.0	2	6
Wetlands	14, 16	Herbaceous wetlands Water	100	2.7	0	5
Recently disturbed[e]	7	Anthropogenic Wildfire burns Cut blocks	6	0.2	0	1[e]
Total	**N/A**	**N/A**	**3,570[a]**	**95.4[b]**	**17**	**43**

Note: Spatial and temporal wildfire data was removed to preserve the original SPOT land cover data for site selection. The disturbance land cover type in SPOT 4/5 data includes burns and anthropogenic disturbance.
(a) Area does not equal RSA size (3,741 ha) because not all land cover types available were assigned to broader habitat types
(b) Percent total does not equal 100% because not all land cover types available were assigned to broader habitat types.
(c) ROW = 0 to 60 m from the Old Airport Road centreline (120 m wide corridor)
(d) RSA = 61 to 200 m from the Old Airport Road centreline (400 m wide corridor)
(e) Due to small sample size, the one ARU deployed in recently disturbed habitat was grouped with open habitat for analysis.
ARU = autonomous recording until; ha = hectare; m = metres; N/A = not applicable; SPOT = Systeme Pour l'Observation de la Terre dataset; ROW = right-of-way; RSA = regional study area.

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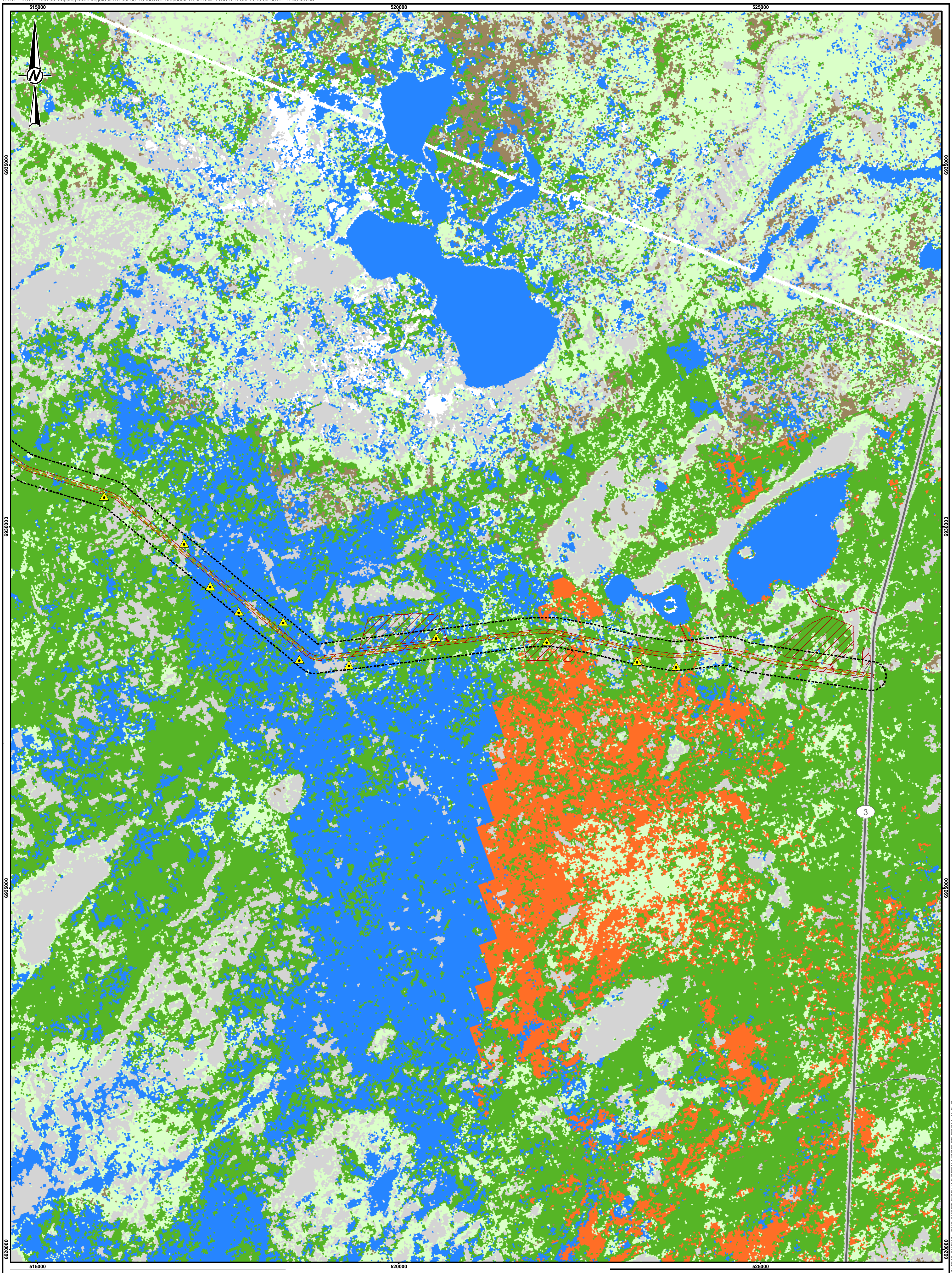

LEGEND

	ALL-SEASON ROAD		2019 ARU LOCATION
	LOCAL ROAD		PROJECT FOOTPRINT
	OLD AIRPORT ROAD		STUDY AREA

LAND COVER

- DENSE CONIFER
- SPARSE CONIFER
- DECIDUOUS
- OPEN
- WETLANDS
- RECENTLY DISTURBED

DRAFT

0 1,000 2,000

1:50,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. MEDIUM RESOLUTION LAND COVER MAPPING OF CANADA FROM SPOT 4/5 DATA; GEOMATICS CANADA, OPEN FILE 4, 37 P., DOI:10.4095/295751.

PROJECTION: UTM ZONE 11 DATUM: NAD83

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHǪ ALL-SEASON ROAD

TITLE
BROAD-SCALE HABITAT TYPES AND ARU LOCATIONS WITHIN THE BIRD BASELINE REGIONAL STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2019-09-05
DESIGNED	LD
PREPARED	LMS
REVIEWED	-
APPROVED	-

PROJECT NO.	PHASE	REV.	FIGURE
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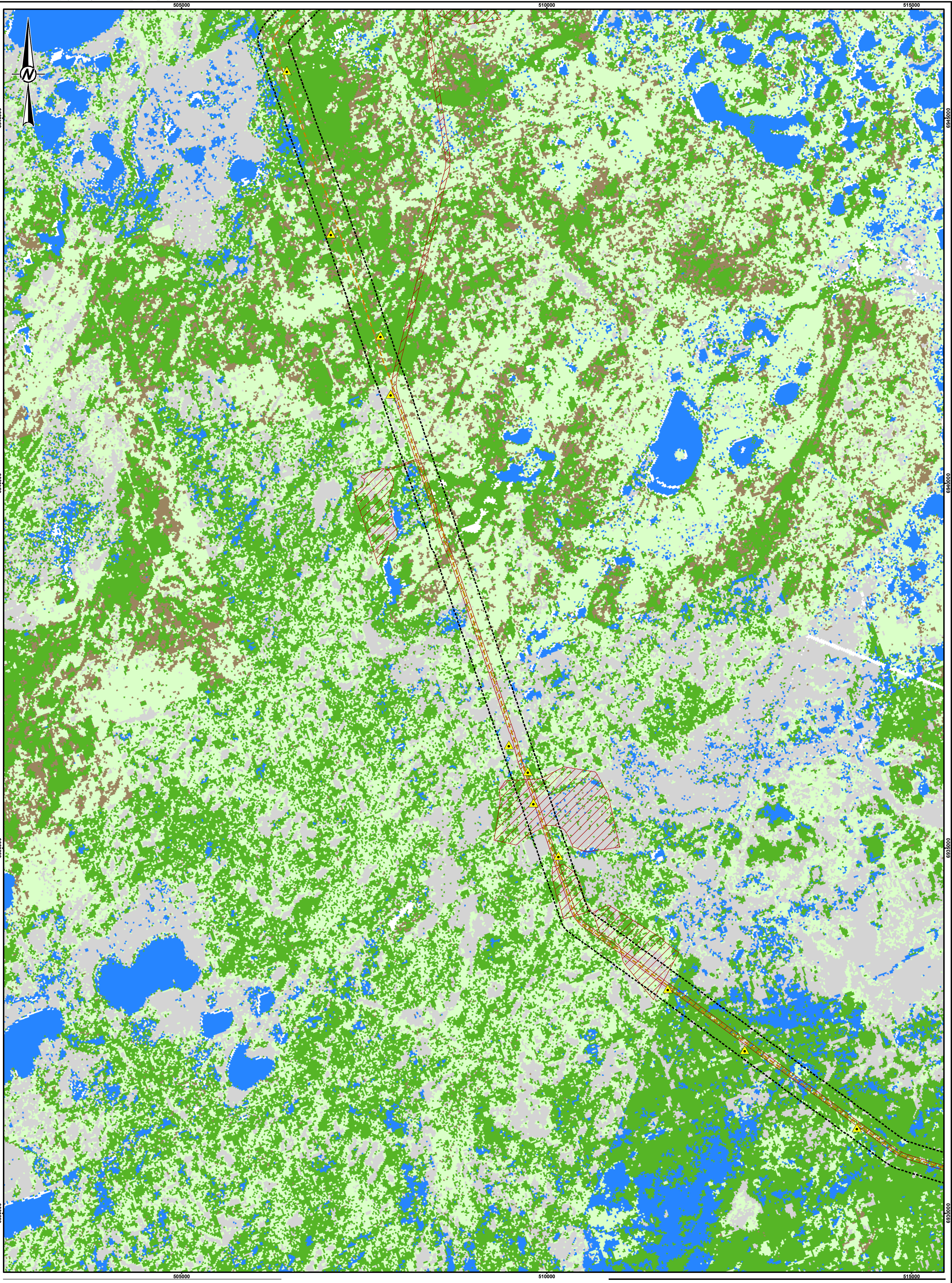

LEGEND

- OLD AIRPORT ROAD
- 2019 ARU LOCATION
- PROJECT FOOTPRINT
- STUDY AREA

LAND COVER

- DENSE CONIFER
- SPARSE CONIFER
- DECIDUOUS
- OPEN
- WETLANDS

DRAFT

0 1,000 2,000

1:50,000 METRES

REFERENCE(S)

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2. MEDIUM RESOLUTION LAND COVER MAPPING OF CANADA FROM SPOT 4/5 DATA; GEOMATICS CANADA, OPEN FILE 4, 37 P., DOI:10.4095/295751.

PROJECTION: UTM ZONE 11 DATUM: NAD83

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHQ ALL-SEASON ROAD

TITLE
BROAD-SCALE HABITAT TYPES AND ARU LOCATIONS WITHIN THE BIRD BASELINE REGIONAL STUDY AREA

CONSULTANT
GOLDER

YYYY-MM-DD	2019-09-05
DESIGNED	LD
PREPARED	LMS
REVIEWED	-
APPROVED	-

PROJECT NO.	PHASE	REV.	FIGURE
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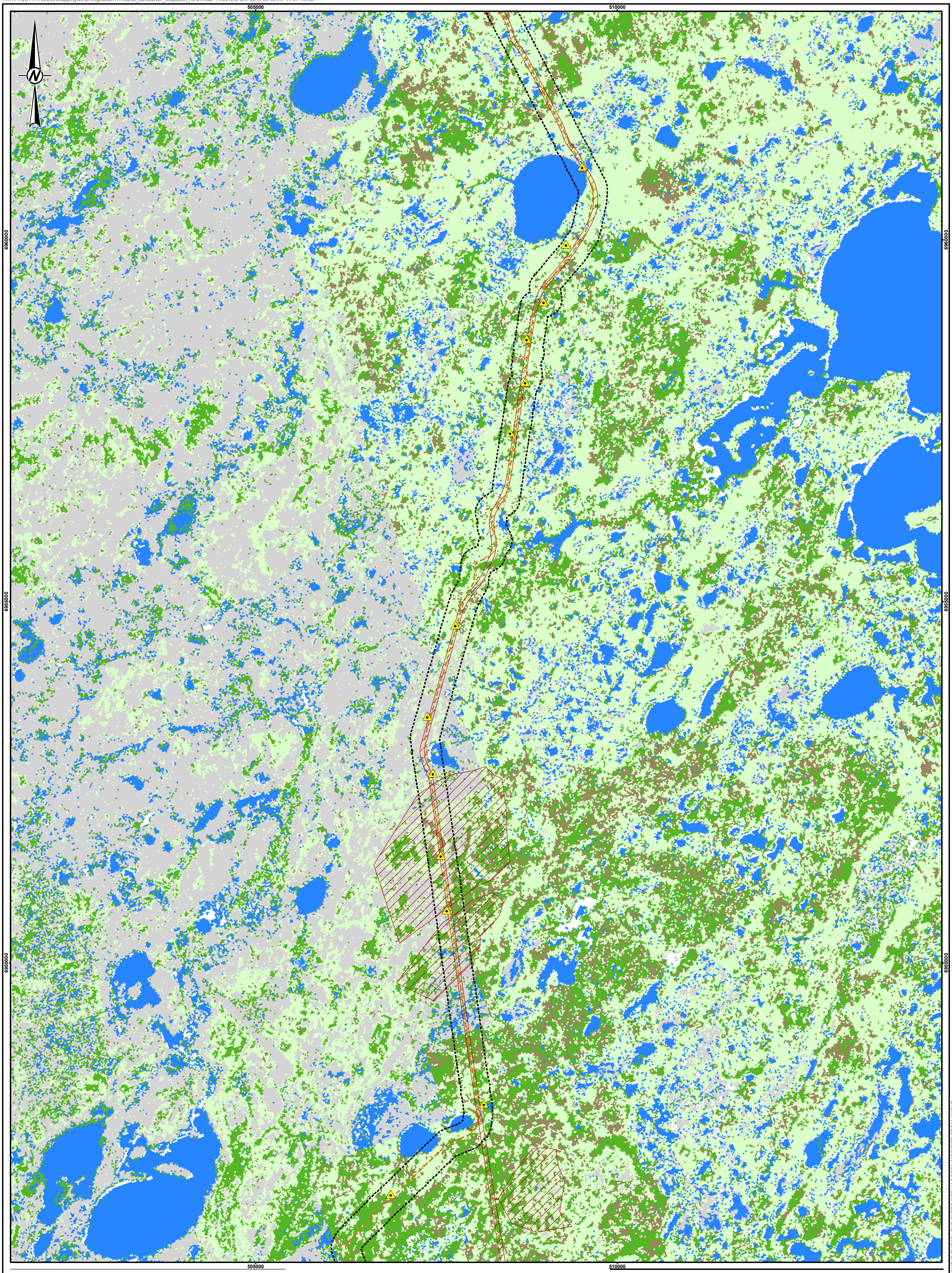

LEGEND

- OLD AIRPORT ROAD
- 2019 ARU LOCATION
- PROJECT FOOTPRINT
- STUDY AREA

LAND COVER

- DENSE CONIFER
- SPARSE CONIFER
- DECIDUOUS
- OPEN
- WETLANDS

DRAFT

0 1,000 2,000

1:50,000 METRES

REFERENCE(S)

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PROJECTION: UTM ZONE 11 DATUM: NAD83

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BROAD-SCALE HABITAT TYPES AND ARU LOCATIONS WITHIN THE BIRD BASELINE REGIONAL STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2019-09-05
DESIGNED	LD
PREPARED	LMS
REVIEWED	-
APPROVED	-

PROJECT NO.	PHASE	REV.	FIGURE
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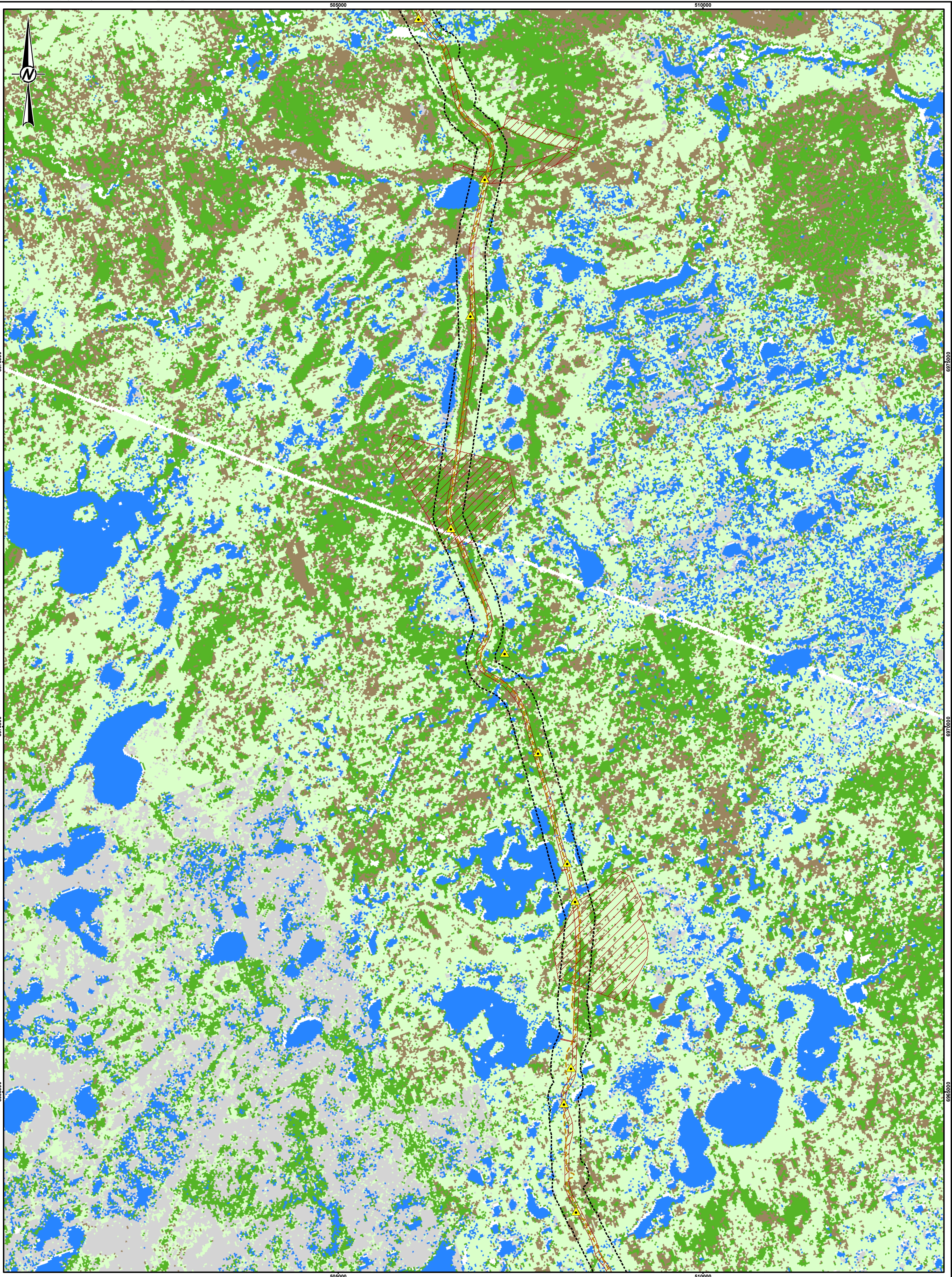

LEGEND

- OLD AIRPORT ROAD
- 2019 ARU LOCATION
- PROJECT FOOTPRINT
- STUDY AREA

LAND COVER

- DENSE CONIFER
- SPARSE CONIFER
- DECIDUOUS
- OPEN
- WETLANDS

DRAFT

0 1,000 2,000

1:50,000 METRES

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PROJECTION: UTM ZONE 11 DATUM: NAD83

CLIENT
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TŁĮCHǪ ALL-SEASON ROAD

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BROAD-SCALE HABITAT TYPES AND ARU LOCATIONS WITHIN THE BIRD BASELINE REGIONAL STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2019-09-05
DESIGNED	LD
PREPARED	LMS
REVIEWED	-
APPROVED	-

PROJECT NO.	PHASE	REV.	FIGURE
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LEGEND

- OLD AIRPORT ROAD
- 2019 ARU LOCATION
- PROJECT FOOTPRINT
- STUDY AREA

LAND COVER

- DENSE CONIFER
- SPARSE CONIFER
- DECIDUOUS
- OPEN
- WETLANDS
- RECENTLY DISTURBED

DRAFT

0 1,000 2,000

1:50,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. MEDIUM RESOLUTION LAND COVER MAPPING OF CANADA FROM SPOT 4/5 DATA; GEOMATICS CANADA, OPEN FILE 4, 37 P., DOI:10.4095/295751.

PROJECTION: UTM ZONE 11 DATUM: NAD83

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHỌ ALL-SEASON ROAD

TITLE
BROAD-SCALE HABITAT TYPES AND ARU LOCATIONS WITHIN THE BIRD BASELINE REGIONAL STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2019-09-05
DESIGNED	LD
PREPARED	LMS
REVIEWED	-
APPROVED	-

PROJECT NO.	PHASE	REV.	FIGURE
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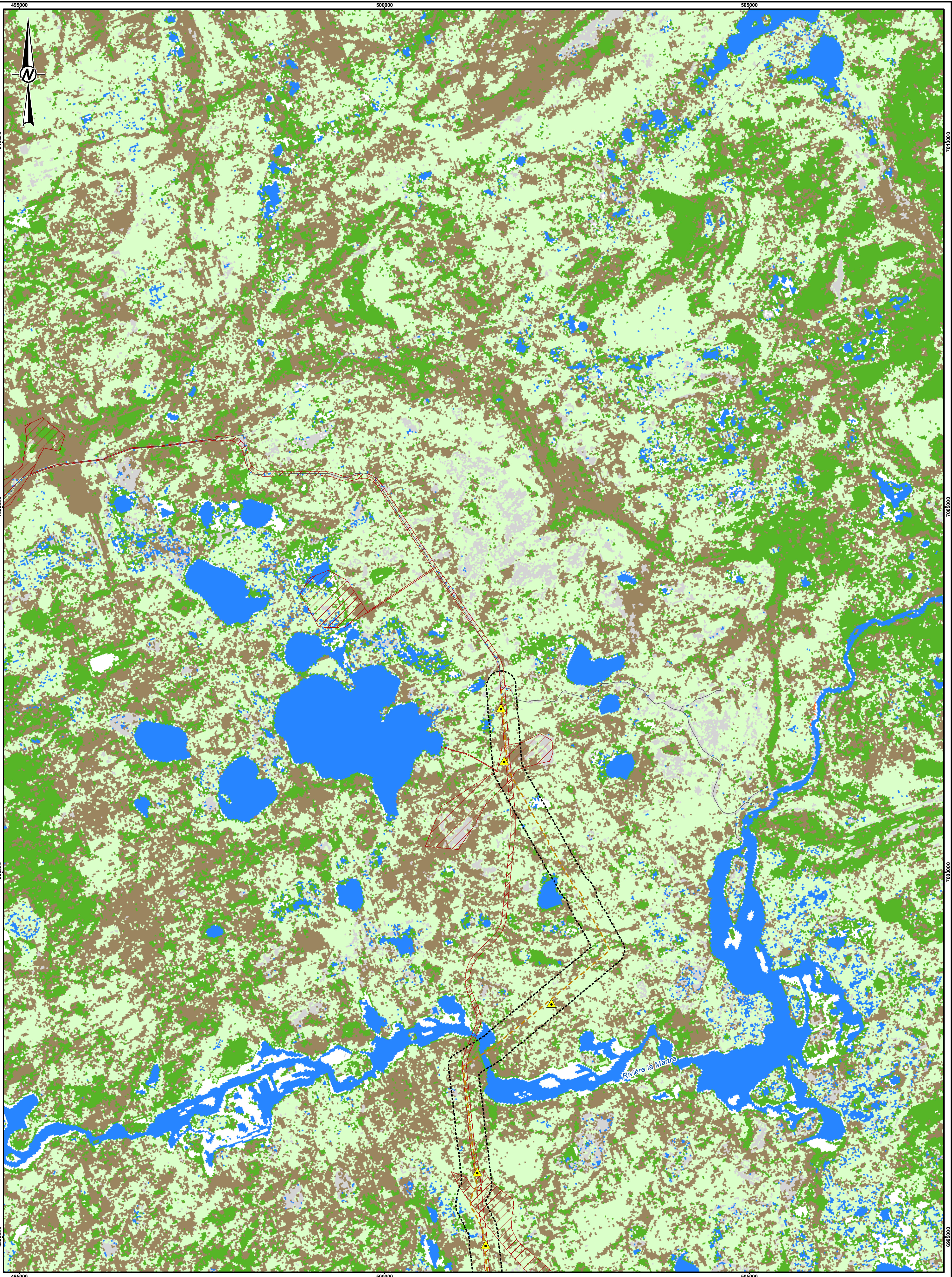

LEGEND

- LOCAL ROAD
- WINTER ROAD
- OLD AIRPORT ROAD
- 2019 ARU LOCATION
- PROJECT FOOTPRINT
- STUDY AREA

LAND COVER

- DENSE CONIFER
- SPARSE CONIFER
- DECIDUOUS
- OPEN
- WETLANDS
- RECENTLY DISTURBED

DRAFT

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1:50,000 METRES

REFERENCE(S)

1. BASE DATA OBTAINED FROM GEOGRATIS, © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
2. MEDIUM RESOLUTION LAND COVER MAPPING OF CANADA FROM SPOT 4/5 DATA; GEOMATICS CANADA, OPEN FILE 4, 37 P., DOI:10.4095/295751.

PROJECTION: UTM ZONE 11 DATUM: NAD83

CLIENT
GOVERNMENT OF NORTHWEST TERRITORIES

PROJECT
TŁĮCHQ ALL-SEASON ROAD

TITLE
BROAD-SCALE HABITAT TYPES AND ARU LOCATIONS WITHIN THE BIRD BASELINE REGIONAL STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2019-09-05
DESIGNED	LD
PREPARED	LMS
REVIEWED	-
APPROVED	-

PROJECT NO.	PHASE	REV.	FIGURE
1790290	2000	A	4F

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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To determine if bird abundances are different within and outside of the Project ROW, 17 ARUs were placed within 0 to 60 m from the Old Airport Road centreline (i.e., within the Project ROW [120 m corridor]) and 43 ARUs were placed between 61 to 200 m from the Old Airport Road centreline (i.e., within the RSA [400 m corridor]). The ARUs were deployed on March 27 to 30, 2019 and were retrieved on July 3 to 6 and July 11 and 12, 2019.

There are unequal numbers of ARUs within and outside of the ROW as the bird baseline study design was prepared and approved (Golder 2018b) prior to receiving ECCC's recommendations on ARU data analysis (ECCC 2018). Also, comparing bird density and presence within and outside of the ROW was not discussed during engagement meetings with ECCC and ENR (Golder 2018a,b).

2.2 Recording Schedule

The ARUs (Wildlife Acoustics Song Meter SM4) were programmed to record 10 minutes at the beginning of each hour starting one hour before sunset until five hours after sunrise (i.e., "recalibrating" at one hour before sunrise to five hours after sunrise). An additional 10 minutes was recorded at 12:00 and 15:00. This schedule occurred daily from June 1 to 30, 2019. The ARUs were programmed to record at a sampling rate of 24,000 Hertz (Hz) in a 'w4v' format. The 'w4v' format is a file format developed by Wildlife Acoustics Inc and is a "WAV file compression developed specifically for minimizing loss of useful information in bioacoustics audio recordings while maximizing compression to save on valuable card space" (Wildlife Acoustics 2018).

2.3 ARU Data Interpretation

A total of 15, three-minute recordings were analysed from 59 of the 60 ARUs, as per below. At one location (a deciduous stratum plot outside of the ROW), only six recordings were transcribed due to failure of the recording unit during the survey period.

- Recordings were randomly selected from the total number of recordings within three "breeding periods" (i.e., June 1-9 [period 1], June 10-19 [period 2], June 20-29 [period 3]; total of three days). The resulting dates selected were June 6, June 18, and June 21.
- Three-minute "morning point counts" were completed at the beginning of the hour one hour before sunrise, at sunrise, and two hours after sunrise.
- For the first two breeding periods, three-minute "night surveys" were conducted one hour before sunset, at sunset, and two hours after sunset.
- Alternate recordings were randomly selected within the breeding period if original recordings exceeded weather guidelines (i.e., heavy wind or rain).

The resulting 891 recordings were assigned to two experienced avian biologists for interpretation and transcription. High quality circumaural headphones (i.e., Sennheiser HD380 Pro or equivalent) were used to transcribe ARU recordings. Audacity software (Version 2.2.2) was used to display a stereo spectrogram and listen to ARU recordings to identify all bird species and individuals present. Audacity settings were modified based on recommendations by the Bioacoustic Unit (2017) with the goal to set the frequency, time, and spectral resolution settings to have the most detailed image of a birdsong without comprising the efficiency of interpreting and annotating a recording. Automated species recognition algorithms were not used for data interpretation.

All detected bird vocalizations were identified to species and the time of first detection was recorded. Once an individual was detected, it was "removed" from further detection in a recording. If multiple individuals of the same species were detected during a recording (based on directionality inferred from stereo channels, timing of song, and other cues), a letter was assigned to each individual (alphabetically in order of detection), to differentiate between individuals. Vocalization types were grouped into two categories: song (i.e., the primary territorial vocalization of male passerines, or equivalent territorial sound display in non-passerines [e.g., woodpecker drumming]) and call (any call unrelated to territorial display). A qualitative confidence level was assigned for each individual heard based on confidence in species identification (i.e., low, medium, and high). Vocalizations that could not be identified to species were recorded using unknown codes (e.g., UNPA for unknown passerine). Metadata recorded for each recording included ambient noise (e.g., industrial noise, traffic) and weather conditions (e.g., light to heavy wind and rain).

2.4 ARU Data Interpretation Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) of interpreted ARU data was performed by two experienced avian biologists. The first minute (33% of each recording) of 429 randomly selected recordings (48% of total recordings) was reviewed by a biologist who did not complete the original data transcription (total 16% QA/QC of all recordings). The transcription QA/QC was completed to confirm the number of species detections and to review low and medium confidence ratings. All low and medium confidence detections were reviewed by a second observer. Only detections that were identified with high confidence were used in further analysis.

2.5 Data Analysis

As only one ARU was deployed in recently disturbed habitat, data from this ARU was combined with data from ARUs deployed in open habitats (Table 1).

2.5.1 Species Density and Species Richness

Species detections tabulated following interpretation (Section 2.3) were analysed to estimate the mean abundance (± 95% confidence interval [CI]) of bird species (ECCC 2018). Also reported are the mean number (± 95% CI) of individuals of each species observed by broad-scale habitat type, as well as mean number of individuals recorded within and outside of the Project ROW. Mean (± 95% CI) species richness (i.e., the number of different species) was estimated for each broad-scale habitat type within and outside of the ROW.

2.5.2 Species Density Models

Two modelling approaches were used to determine the factors that affect bird density in the RSA. The type of modelling approach chosen was based on sample size for individual bird species (i.e., number of recordings in which a species was detected). The preferred modelling approach was the QPAD approach (Solymos 2016), followed by occupancy models (Mackenzie et al. 2002). Each of these approaches is described in more detail below. The candidate models that were compared using either modelling approach are presented in Table 2. Null models were only considered for species that had small sample size to determine if data were sufficient for covariate estimation.

Depending on sample size, either Akaike's Information Criterion (AIC), Bayesian Information Criterion (BIC), or AIC adjusted for small sample size (AICc) were used to assess the best fit among the models developed. Either BIC or AICc was used for species with small sample size. All predictor variables contained in the top model were considered statistically significant.

Analyses were performed using R version 3.5.1 (The R Foundation for Statistical Computing 2018).

Table 2: Candidate Models that were Analysed using the QPAD Method or Occupancy Models

Model Parameters	Model Description
Null	Intercept only
Location	Location (within or outside ROW) as fixed effect
Habitat	Broad-scale habitat type as fixed effect
Habitat + Location	Habitat and location as fixed effects
Habitat * Location	Interaction between habitat and location
Latitude	Latitude as fixed effect
Habitat * Latitude * Location	Interaction between habitat, latitude and location
Habitat + Latitude	Habitat and latitude as fixed effects
Latitude * Location	Interaction between latitude and location
Habitat * Latitude	Interaction between habitat and latitude

ROW = right-of-way

2.5.2.1 QPAD Approach

The QPAD approach (Sólymos et al. 2013) is a harmonized approach developed for point count surveys where temporal and environmental effects on detectability cannot be controlled for directly. A species' singing rate (sra) and effective detection radius (edr) are modelled as a function of potential covariates to generate statistical offsets for each point count survey. Existing model coefficients for sra and edr are available for many species (Solymos et al. 2013). For example, time since sunrise and Julian date are important predictors for sra and forest density is commonly used as a predictor for edr (i.e., edr decreases with increasing forest density). These existing model coefficients were used to generate statistical offsets for each point count. These offsets are then used in a modelling framework to estimate predicted density (birds per hectare [ha]) in response to treatment variables while controlling for variation in detectability between point counts caused by factors such as time of day, day of year, or habitat.

Time since sunrise and Julian date were used as model coefficients. However, forest density data was not collected during this ARU program; therefore, edr was assumed to be constant across all ARUs. The best model for fitting sra and edr was determined by the availability of covariates in our dataset, and previously compared models in the Solymos et al. (2013) dataset. Models used for estimating sra are contained in Appendix B.

All data from both "morning point count" and "night" survey periods were used in the QPAD analysis. The analysis was run in R version 3.5.1 (R Core Team 2018) using the 'detect' package (Solymos et al. 2018). A Poisson distribution was used in a generalized linear model to run each candidate model. AIC or BIC model selection was used to select the best model. Predicted density values from the best model were then visually compared between inside the ROW and outside the ROW.

2.5.2.2 Occupancy Models

Occupancy models estimate the probability of occurrence of a species at a site while accounting for imperfect detection of the species during surveys (MacKenzie et al. 2002). The occupancy approach allows modelling variation in occupancy and detection, simultaneously, while also accounting for site-specific covariates. Occupancy modelling requires a detection history of detected and non-detected observations from repeated surveys at the same location. To improve sample size for species that were rarely detected on ARUs, survey date was used as the level of visit to aggregate data between recordings (e.g., if a bird was detected in any of the recordings on June 6, it was considered detected in visit 1). Because nocturnal surveys were only completed for visits 1 and 2, only dawn recordings were analysed to maintain equal sample size across each of the three visits.

Occupancy models were run in R version 3.5.1 (R Core Team 2018) using the ‘unmarked’ package (Fiske and Chandler 2011) and the ‘occu’ function. The ‘occu’ function runs the original occupancy models developed by MacKenzie et al. (2002) to estimate probability of occupancy (psi) and probability of detection (p) simultaneously, with potential covariate effects on both. Because data were aggregated across recordings where covariates influencing p varied, it was assumed that detectability is constant across plots. In other words, detectability was controlled through the *a priori* study design rather than through estimating offsets and was assumed constant across ARUs. However, detectability was still imperfect and had to be accounted for when estimating psi. AICc model selection was used to determine the best model, which was then used to calculate predicted probability of occupancy for each plot. Predicted probability of occupancy values from the best model were then visually compared between inside the ROW and outside the ROW.

3.0 RESULTS

3.1.1 Species Density and Species Richness

A total of 69 species, including 4 SAR, were recorded on ARUs in 2019 Table 3). Average species richness was highest in open habitat and lowest in dense conifer habitat within the Project ROW (Table 3). Outside of the Project ROW, average richness was highest in open habitat and lowest in deciduous habitat (Table 3). Table C-1 (Appendix C) lists the species and average number of individuals per ARU detected within the Project ROW and outside of the ROW. Table C-2 lists the average number of individuals detected per ARU for each species by habitat type.

3.1.1.1 Species at Risk

There were four SAR recorded on ARUs within the ROW: common nighthawk (*Chordeiles minor*), evening grosbeak (*Coccothraustes vespertinus*), olive-sided flycatcher (*Contopus cooperi*), and rusty blackbird (*Euphagus carolinus*) (Table 3). Common nighthawk and olive-sided flycatcher were also observed outside of the ROW (Table 3).

3.1.2 QPAD Approach

Sample size was sufficient to run complex density models using the QPAD method (Solymos et al. 2013; Section 2.5.2.1) for 11 species: alder flycatcher (*Empidonax alnorum*), American robin (*Turdus migratorius*), chipping sparrow (*Spizella passerina*), hermit thrush (*Catharus guttatus*), Lincoln’s sparrow (*Melospiza lincolnii*), palm warbler (*Setophaga palmarum*), Swainson’s thrush (*Catharus ustulatus*), Wilson’s snipe (*Gallinago gallinago*), white-throated sparrow (*Zonotrichia albicollis*), and yellow-rumped warbler (*Setophaga coronata*); statistical offsets were available for these species. Model selection was based on AIC (Table 5), with the exception of models for alder flycatcher and palm warbler, which used BIC due to small sample size (Table 6).

An interaction between habitat type and latitude was the top-ranked model for explaining American robin and hermit thrush densities, while an interaction between habitat and location (inside versus outside of the ROW) was the top-ranked model for chipping sparrow, Lincoln’s sparrow, and yellow-rumped warbler (Table 5). Dark-eyed junco and Swainson’s thrush densities were best explained by interactions among habitat, latitude, and location (Table 5). Interaction between latitude and location was the top-ranked model for alder flycatcher and white-throated sparrow density (Table 5, Table 6). Wilson’s snipe density was best explained by habitat alone (Table 5) and palm warbler density was best explained only by latitude (Table 6).

Dark-eyed junco, alder flycatcher, chipping sparrow, hermit thrush, Lincoln’s sparrow, and white-throated sparrow densities were significantly higher outside of the ROW than inside the ROW (Figure 2, Table 6). Lincoln’s sparrow densities were significantly higher outside of the ROW in dense conifer and significantly higher in open habitats within the ROW (Table 6). Chipping sparrow and dark-eyed junco densities were significantly higher in the ROW for open and sparse conifer habitats (Table 6). Swainson's thrush densities were significantly higher outside the ROW in open habitats (Table 6).

As latitude increased, dark-eyed juncos were at significantly higher densities inside the ROW (Table 6). The opposite relationship was observed for alder flycatcher, Swainson's thrush, hermit thrush, and white-throated sparrow; the densities of these species were significantly higher outside the ROW at higher latitudes (Table 6).

Effects plots were developed to visualize final model effects for all species (Appendix D; Figures D-1 to D-10). Box plots were used to visualize categorical effects (i.e., habitat) while regression plots were used to visualize continuous variables (i.e., latitude) as a function of predicted density (birds per hectare).

Table 3: Species, Federal and Provincial Status, Total Number of Individuals Detected in the Regional Study Area, and Indication if the Species Detected within the Project Right-of-way on Autonomous Recording Units in 2019

Common Name	Scientific Name	Number of Individuals	Detected in the Project ROW[(a)] in 2019 (Y/N)	COSEWIC Ranking[(b)]	SARA Ranking[(c)]	NWT Ranking[(d)]
alder flycatcher	*Empidonax alnorum*	35	Y	No Status	No Status	Secure
American bittern	*Botaurus lentiginosus*	15	Y	No Status	No Status	Sensitive
American robin	*Turdus migratorius*	78	Y	No Status	No Status	Secure
American three-toed woodpecker	*Picoides dorsalis*	4	N	No Status	No Status	Secure
black-backed woodpecker	*Picoides arcticus*	10	N	No Status	No Status	Secure
blackpoll warbler	*Setophaga striata*	1	N	No Status	No Status	Secure
blue-headed vireo	*Vireo solitarius*	6	Y	No Status	No Status	Secure
bohemian waxwing	*Bombycilla garrulus*	5	N	No Status	No Status	Secure
boreal chickadee	*Poecile hudsonicus*	3	Y	No Status	No Status	Secure
boreal owl	*Aegolius funereus*	1	N	Not at Risk	No Status	Secure
Canada goose	*Branta canadensis*	23	Y	No Status	No Status	Secure
Canada jay	*Perisoreus canadensis*	36	Y	No Status	No Status	Secure
chipping sparrow	*Spizella passerina*	78	Y	No Status	No Status	Secure
clay-colored sparrow	*Spizella pallida*	4	N	No Status	No Status	Secure
common loon	*Gavia immer*	14	Y	Not at Risk	No Status	Secure
common nighthawk	***Chordeiles minor***	**97**	**Y**	**Special Concern**	**Threatened**	**At Risk**
common raven	*Corvus corax*	9	N	No Status	No Status	Secure
common redpoll	*Acanthis flammea*	1	N	No Status	No Status	Secure
dark-eyed junco	*Junco hyemalis*	122	Y	No Status	No Status	Secure
evening grosbeak	***Coccothraustes vespertinus***	**1**	**Y**	**Special Concern**	**No Status**	**Secure**

Table 3: Species, Federal and Provincial Status, Total Number of Individuals Detected in the Regional Study Area, and Indication if the Species Detected within the Project Right-of-way on Autonomous Recording Units in 2019

Common Name	Scientific Name	Number of Individuals	Detected in the Project ROW[(a)] in 2019 (Y/N)	COSEWIC Ranking[(b)]	SARA Ranking[(c)]	NWT Ranking[(d)]
fox sparrow	*Passerella iliaca*	5	Y	No Status	No Status	Secure
gadwall	*Mareca strepera*	1	N	No Status	No Status	Undetermined
gray-cheeked thrush	*Catharus minimus*	1	N	No Status	No Status	Secure
great horned owl	*Bubo virginianus*	1	Y	No Status	No Status	Secure
hairy woodpecker	*Dryobates villosus*	3	N	No Status	No Status	Secure
hermit thrush	*Catharus guttatus*	128	Y	No Status	No Status	Secure
least flycatcher	*Empidonax minimus*	3	N	No Status	No Status	Secure
LeConte's sparrow	*Ammospiza leconteii*	3	Y	No Status	No Status	Secure
lesser scaup	*Aythya affinis*	1	N	No Status	No Status	Sensitive
lesser yellowlegs	*Tringa flavipes*	38	Y	No Status	No Status	Sensitive
Lincoln's sparrow	*Melospiza lincolnii*	68	Y	No Status	No Status	Secure
mountain bluebird	*Sialia currucoides*	2	N	No Status	No Status	Undetermined
Nashville warbler	*Leiothlypis ruficapilla*	1	Y	No Status	No Status	Undocumented
northern flicker	*Colaptes auratus*	5	Y	No Status	No Status	Secure
northern goshawk	*Accipiter gentilis*	1	N	Not at Risk	No Status	Secure
northern shoveler	*Spatula clypeata*	1	N	No Status	No Status	Secure
northern waterthrush	*Parkesia noveboracensis*	2	N	No Status	No Status	Secure
olive-sided flycatcher	***Contopus cooperi***	**22**	**Y**	**Special Concern**	**Threatened**	**At Risk**
orange-crowned warbler	*Leiothlypis celata*	25	Y	No Status	No Status	Secure
pacific loon	*Gavia pacifica*	15	Y	No Status	No Status	Secure

Table 3: Species, Federal and Provincial Status, Total Number of Individuals Detected in the Regional Study Area, and Indication if the Species Detected within the Project Right-of-way on Autonomous Recording Units in 2019

Common Name	Scientific Name	Number of Individuals	Detected in the Project ROW[a] in 2019 (Y/N)	COSEWIC Ranking[b]	SARA Ranking[c]	NWT Ranking[d]
palm warbler	*Setophaga palmarum*	40	Y	No Status	No Status	Secure
pied-billed grebe	*Podilymbus podiceps*	5	N	No Status	No Status	Undetermined
pileated woodpecker	*Dryocopus pileatus*	1	N	No Status	No Status	Secure
pine grosbeak	*Pinicola enucleator*	1	N	No Status	No Status	Secure
red crossbill	*Loxia curvirostra*	4	Y	No Status	No Status	Secure
red-breasted nuthatch	*Sitta canadensis*	1	Y	No Status	No Status	Secure
ruby-crowned kinglet	*Regulus calendula*	29	Y	No Status	No Status	Secure
rusty blackbird	***Euphagus carolinus***	**1**	**Y**	**Special Concern**	**Special Concern**	**Sensitive**
sandhill crane	*Antigone canadensis*	34	Y	No Status	No Status	Secure
Savannah sparrow	*Passerculus sandwichensis*	1	N	No Status	No Status	Secure
sharp-tailed grouse	*Tympanuchus phasianellus*	3	N	No Status	No Status	Secure
short-billed dowitcher	*Limnodromus griseus*	2	Y	No Status	No Status	Undetermined
solitary sandpiper	*Tringa solitaria*	10	Y	No Status	No Status	Secure
sora	*Porzana carolina*	62	Y	No Status	No Status	Secure
spotted sandpiper	*Actitis macularius*	1	N	No Status	No Status	Secure
spruce grouse	*Falcipennis canadensis*	1	N	No Status	No Status	Secure
Swainson's thrush	*Catharus ustulatus*	116	Y	No Status	No Status	Secure
swamp sparrow	*Melospiza georgiana*	3	N	No Status	No Status	Secure
Tennessee warbler	*Leiothlypis peregrina*	24	Y	No Status	No Status	Secure
tree swallow	*Tachycineta bicolor*	4	N	No Status	No Status	Secure

Table 3: Species, Federal and Provincial Status, Total Number of Individuals Detected in the Regional Study Area, and Indication if the Species Detected within the Project Right-of-way on Autonomous Recording Units in 2019

Common Name	Scientific Name	Number of Individuals	Detected in the Project ROW[(a)] in 2019 (Y/N)	COSEWIC Ranking[(b)]	SARA Ranking[(c)]	NWT Ranking[(d)]
warbling vireo	*Vireo gilvus*	1	N	No Status	No Status	Secure
western wood-pewee	*Contopus sordidulus*	9	N	No Status	No Status	Secure
white-crowned sparrow	*Zonotrichia leucophrys*	21	N	No Status	No Status	Secure
white-throated sparrow	*Zonotrichia albicollis*	116	Y	No Status	No Status	Secure
white-winged crossbill	*Loxia leucoptera*	12	Y	No Status	No Status	Secure
Wilson's snipe	*Gallinago delicata*	59	Y	No Status	No Status	Secure
Wilson's warbler	*Cardellina pusilla*	4	Y	No Status	No Status	Secure
yellow-bellied flycatcher	*Empidonax flaviventris*	5	Y	No Status	No Status	Secure
yellow-rumped warbler	*Setophaga coronata*	53	Y	No Status	No Status	Secure

COSEWIC = Committee on the Status of Endangered Wildlife in Canada; m = metres; N = no; NWT = Northwest Territories; ROW = right-of-way; SARA = *Species at Risk Act*; Y = yes
Note: **Bolded** species are species at risk
(a) ROW = 0 to 60 m from the Old Airport Road centreline (120 m wide corridor).
(b) COSEWIC (2019)
(c) SARA (2019)
(d) *Species at Risk (NWT) Act* (2019)

Table 4: Average Number of Species Detected in each Habitat Type within and outside of the Project Right-of-way.

Stratum	Number of Locations Within ROW[(a)]	Mean Richness (± 95% CI) Within ROW[(a)]	Number of Locations Outside ROW[(b)]	Mean Richness (± 95% CI) Outside ROW[(b)]
Deciduous	3	11.0 ± 11.4	6	12.8 ± 2.3
Dense conifer	2	10.0 ± 12.7	13	16.8 ± 1.9
Open	1	19.0[(c)]	5	19.2 ± 3.4
Recently disturbed[(d)]	0	NA	1	15.0[(c)]
Sparse conifer	11	15.8 ± 1.8	13	15.5 ± 2.2
Wetlands	0	NA	5	19.0 ± 3.6

CI = confidence interval; ROW = right-of-way; m = metres; NA = not applicable
(a) Within 0 to 60 m from the Old Airport Road centreline (120 m corridor)
(b) Within 61 to 200 m from the Old Airport Road centreline (400 m corridor)
(c) Only mean presented as sample size was insufficient to calculate 95% confidence interval.
(d) Recent disturbance did not include additional forest fire data per recommendations by ECCC and ENR (Golder 2018a).

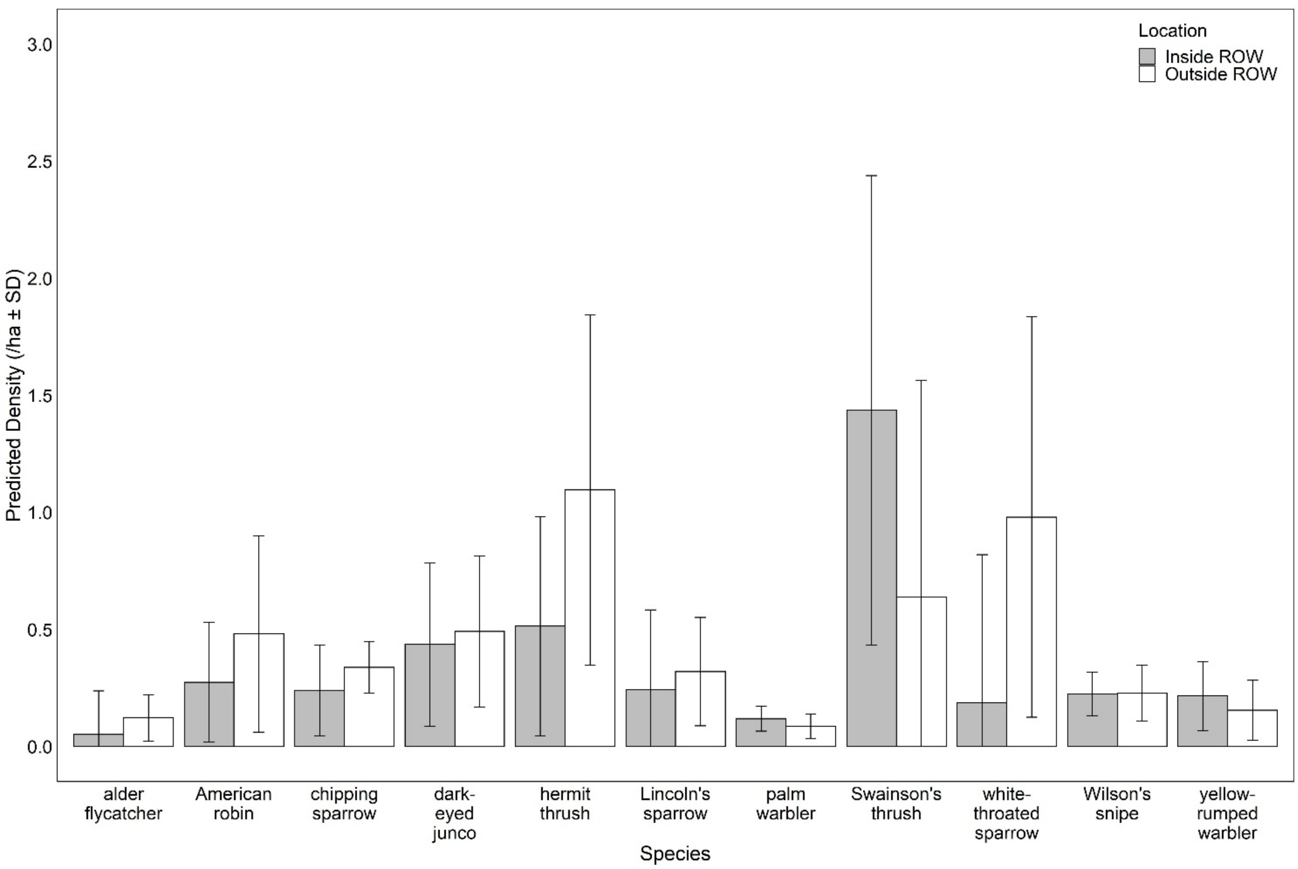

Figure 2: Predicted Densities (± Standard Deviation) of Bird Species in and out of the Project right-of-way for Species with Adequate Data to Complete QPAD Models.

Table 5: Candidate Models and Akaike's Information Criteria Scores for QPAD Models.

Species	Model Parameters	AIC[(a)]	Δ AIC[(b)]
American robin	**Habitat * Latitude**	**1,383.65**	**0.00**
	Habitat * Latitude * Location	1,383.98	0.34
	Latitude * Location	1,403.88	20.23
	Habitat + Latitude	1,404.05	20.40
	Latitude	1,406.51	22.87
	Habitat * Location	1,436.86	53.22
	Habitat + Latitude	1,437.45	53.81
	Habitat	1,444.90	61.26
	Location	1,487.03	103.38
chipping sparrow	**Habitat * Location**	**1,248.29**	**0.00**
	Habitat * Latitude	1,252.54	4.25
	Latitude	1,252.84	4.55
	Habitat + Latitude	1,253.13	4.84
	Latitude * Location	1,255.41	7.12
	Habitat	1,268.68	20.39
	Habitat + Location	1,270.08	21.79
	Location	1,296.71	48.42
	Habitat * Latitude * Location	1,238.99	NA[(c)]
dark-eyed junco	**Habitat * Latitude * Location**	**1,480.14**	**0.00**
	Habitat * Latitude	1,482.05	1.91
	Habitat + Latitude	1,485.98	5.84
	Habitat * Location	1,488.09	7.95
	Latitude * Location	1,489.24	9.10
	Latitude	1,489.50	9.36
	Location	1,492.80	12.66
	Habitat + Location	1,496.22	16.08
	Habitat	1,497.07	16.93

Table 5: Candidate Models and Akaike's Information Criteria Scores for QPAD Models.

Species	Model Parameters	AIC[a]	Δ AIC[b]
hermit thrush	**Latitude * Location**	**3,849.20**	**0.00**
	Habitat * Latitude	3,852.48	3.28
	Habitat + Latitude	3,863.53	14.33
	Latitude	3,874.47	25.27
	Habitat * Location	3,939.30	90.10
	Location	3,943.94	94.74
	Habitat + Location	3,944.19	94.99
	Habitat	3,998.93	149.73
	Habitat * Latitude * Location	3,762.99	NA[c]
Lincoln's sparrow	**Habitat * Location**	**1,200.97**	**0.00**
	Habitat * Latitude	1,205.69	4.72
	Habitat + Location	1,237.54	36.57
	Habitat	1,237.80	36.83
	Habitat + Latitude	1,237.85	36.88
	Location	1,254.77	53.80
	Latitude * Location	1,257.81	56.84
	Latitude	1,258.40	57.43
	Habitat * Latitude * Location	1,155.16	NA[c]
Swainson's thrush	**Habitat * Latitude * Location**	**4,293.24**	**0.00**
	Habitat * Latitude	4,328.57	35.33
	Habitat + Latitude	4,406.10	112.86
	Latitude * Location	4,419.76	126.52
	Latitude	4,478.14	184.90
	Habitat * Location	4,570.01	276.77
	Habitat + Location	4,587.76	294.52
	Habitat	4,613.79	320.55
	Location	4,805.21	511.97

Table 5: Candidate Models and Akaike's Information Criteria Scores for QPAD Models.

Species	Model Parameters	AIC[a]	Δ AIC[b]
Wilson's snipe	**Habitat**	**1,036.55**	**0.00**
	Habitat + Latitude	1,037.19	0.65
	Habitat + Location	1,037.83	1.28
	Habitat * Location	1,038.01	1.47
	Habitat * Latitude	1,039.40	2.86
	Latitude * Location	1,054.15	17.60
	Latitude	1,063.39	26.85
	Location	1,069.11	32.57
	Habitat * Latitude * Location	1,033.92	NA[c]
White-throated sparrow	**Latitude * Location**	**1,487.78**	**0.00**
	Habitat * Latitude	1,573.89	86.11
	Latitude	1,594.30	106.52
	Habitat + Latitude	1,598.70	110.92
	Habitat * Location	1,725.31	237.53
	Habitat + Location	1,767.67	279.89
	Habitat	1,863.95	376.17
	Location	1,878.48	390.70
	Habitat * Latitude * Location	1,455.91	NA[c]
Yellow-rumped warbler	**Habitat * Latitude**	**783.86**	**0.00**
	Habitat + Latitude	790.73	6.87
	Habitat * Location	791.63	7.77
	Latitude * Location	793.89	10.02
	Location	795.12	11.26
	Habitat + Location	795.87	12.00
	Latitude	797.75	13.89
	Habitat	807.05	23.19
	Habitat * Latitude * Location	777.29	NA[c]

(a) Akaike's Information Criterion.
(b) Change in AIC between the given model and the first model listed per response variable.
(c) Not applicable because the model did not converge

Table 6: Candidate Models and Bayesian Information Criteria Scores for QPAD Models.

Species	Model Parameters	BIC[(a)]	Δ BIC[(b)]
alder flycatcher	**Latitude * Location**	**549.58**	**0.00**
	Habitat * Latitude	561.37	11.80
	Latitude	566.35	16.78
	Habitat + Latitude	567.89	18.32
	Habitat	589.84	40.26
	Habitat * Latitude * Location	590.22	40.65
	Habitat + Location	593.49	43.92
	Habitat * Location	598.67	49.10
	Location	607.78	58.20
	Null	611.33	61.75
palm warbler	**Latitude**	**541.60**	**0.00**
	Null	550.13	8.53
	Latitude * Location	552.24	10.63
	Location	556.82	15.21
	Habitat	557.74	16.13
	Habitat + Latitude	558.78	17.18
	Habitat + Location	561.43	19.82
	Habitat * Latitude	572.96	31.36
	Habitat * Location	578.02	36.42
	Habitat * Latitude * Location	602.63	61.03

(a) Bayesian Information Criterion.
(b) Change in BIC between the given model and the first model listed per response variable.

Table 7: Coefficients for Top-Ranked Models for Species with Adequate Data to Complete QPAD Models

Species	Model Coefficients																			
	Intercept	Dense Conifer[a]	Open[a]	Sparse Conifer[a]	Wetlands[a]	Location[b]	Latitude	Dense Conifer * Location [a,b]	Open * Location [a,b]	Sparse Conifer * Location [a,b]	Wetlands * Location [a,b]	Latitude * Location[b]	Dense Conifer * Latitude[a]	Open * Latitude[a]	Sparse Conifer * Latitude[a]	Wetlands * Latitude[a]	Dense Conifer * Latitude * Location [a,b]	Open * Latitude * Location [a,b]	Sparse Conifer * Latitude * Location [a,b]	Wetlands * Latitude * Location [a,b]
alder flycatcher	**-3.63**					1.20	**-4.46**					**3.83**								
American robin	**-1.48**	0.43	0.95**	0.46	**2.05**		**-0.89**						0.43	0.6764*	0.1303	**1.82**				
chipping sparrow	**-3.73**	0.41	**3.66**	2.53*	**1.10**	2.02		0.49	-2.80**	-2.15*	NA									
dark-eyed junco	-4.56*	2.43	3.34	4.35*	-0.18*	4.57*	3.11*	-3.00	-3.74*	-4.38*	NA	-3.43*	-3.11	0.01	-2.88	0.36	2.95	NA	3.01*	NA
hermit thrush	0.31**					0.26*	**-0.84**					**0.52**								
Lincoln's sparrow	**-1.37**	-1.67	**1.96**	0.15	-0.59	0.20		2.41*	-1.72**	0.26	NA									
palm warbler	**-1.72**						**0.42**													
Swainson's thrush	-0.44	0.06	-0.27	1.03	0.35	-0.64	0.83	0.30	3.31**	0.28	NA	0.50	0.06	**4.02**	-0.43	0.54	0.05	NA	-0.42	NA
Wilson's snipe	**3.41**	0.7368*	**1.63**	0.9461**	0.35															
white-throated sparrow	**-2.25**					**1.55**	**-3.91**					**3.14**								
yellow-rumped warbler	**-2.12**	0.88	1.17	1.17	1.19		0.74						0.39	-0.48	-0.56	0.95				

Note: p-values: "**bolded text**" = p<0.001, "**" = p<0.01, "*" = p<0.05

[a] Habitat is a categorical variable that includes five categories. The coefficient is comparing dense conifer, open, sparse conifer, and wetland habitats to the reference condition deciduous forest

[b] Location is a categorical variable that includes two categories. The coefficient is comparing "outside the ROW" (i.e., within 61 to 200 m from the Old Airport Road centreline) to the reference condition "within the ROW" (i.e., within 0 to 60 m from the Old Airport Road centreline)

3.1.3 Occupancy Models

Sample size was sufficient to run occupancy models (Section 2.5.2.2) for eight species: Canada jay (*Perisoreus canadensis*), common nighthawk, orange-crowed warbler (*Leiothlypis celata*), olive-sided flycatcher, ruby-crowned kinglet (*Regulus calendula*), sora (*Porzana carolina*), Tennessee warbler (*Leiothlypis peregrina*), and white-crowned sparrow (*Zonotrichia leucophrys*).

Common nighthawk and olive-sided flycatcher occupancy was best explained by the model containing only latitude; the probability of occupancy for both species declined as latitude increased (Table 8, Table 9). The probability of Canada jay and Tennessee warbler occupancy was also best explained by the model containing latitude but probability of occupancy increased for these species with increasing latitude (Table 8, Table 9). The ruby-crowned kinglet model revealed a quadratic relationship with latitude, indicating a peak occupancy at an intermediate latitude (Table 8, Table 9). White-crowned sparrow occupancy was best explained by location (in or out of the ROW); the probability of occupancy was higher outside the ROW (Figure 3, Table 8, Table 9). The probability of orange-crowned warbler occupancy was best explained by an interaction between latitude and location (Table 8). Orange-crowned warbler occupancy was higher within the ROW and also at lower latitudes; however, there is a positive relationship between probability of occupancy and the interaction between latitude and location (Table 9). Variables considered in the occupancy models did not explain sora density; the null model was the highest ranked model for this species (Table 8).

Effects plots were made to visualize covariate effects in the final occupancy models (Figures B11-B14). Regression plots were used to visualize the effect of latitude on predicted probability of occupancy.

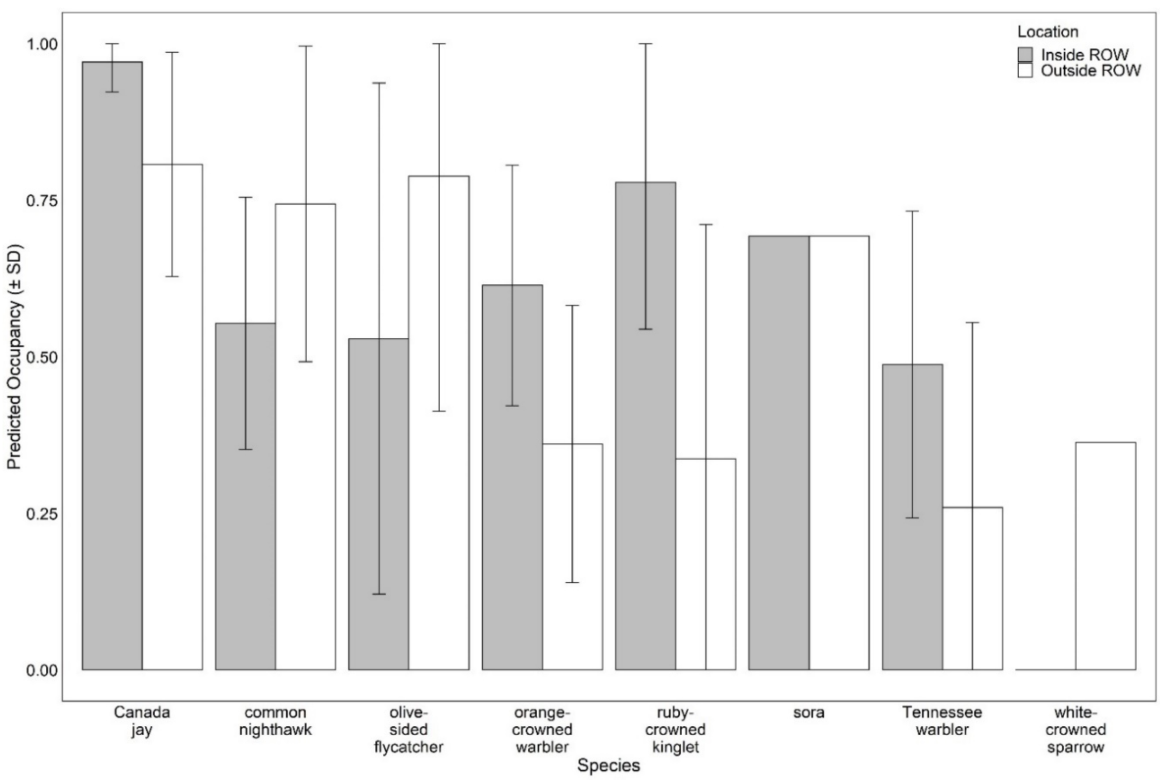

Figure 3: Predicted Occupancy (± Standard Deviation) of Bird Species in and out of the Project right-of-way for Species with Adequate Data to Complete Occupancy Models.

Table 8: Candidate Models and Akaike's Information Criteria Scores for Occupancy Models

Species	Model Parameters	AIC[a]	ΔAIC[b]	AIC Weight[c]
Canada Jay	Psi(Latitude),p(.)	207.28	0.00	0.19
	Psi(Latitude * Location),p(.)	208.46	1.18	0.11
	Psi(.),p(.)	208.59	1.31	0.10
	Psi(Habitat),p(.)	209.05	1.77	0.08
	Psi(Latitude + Latitude2),p(.)	209.35	2.07	0.07
	Psi(Location),p(.)	210.59	3.31	0.04
	Psi(Habitat + Location),p(.)	210.73	3.45	0.03
	Psi(Habitat * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat * Latitude * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat + Latitude),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat * Latitude),p(.)	NA[d]	NA[d]	NA[d]
common nighthawk	Psi(Latitude),p(.)	219.25	0.00	0.54
	Psi(Latitude * Location),p(.)	219.81	0.56	0.41
	Psi(Habitat * Latitude),p(.)	225.44	6.19	0.03
	Psi(Habitat + Latitude),p(.)	225.82	6.57	0.02
	Psi(.),p(.)	233.41	14.16	<0.01
	Psi(Location),p(.)	233.92	14.67	<0.01
	Psi(Habitat),p(.)	235.35	16.10	<0.01
	Psi(Habitat + Location),p(.)	236.98	17.73	<0.01
	Psi(Habitat * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat * Latitude * Location),p(.)	NA[d]	NA[d]	NA[d]

Table 8: Candidate Models and Akaike's Information Criteria Scores for Occupancy Models

Species	Model Parameters	AIC[a]	ΔAIC[b]	AIC Weight[c]
olive-sided flycatcher	Psi(Latitude),p(.)	144.20	0.00	0.42
	Psi(Habitat),p(.)	151.81	7.61	0.01
	Psi(Habitat + Location),p(.)	153.79	9.59	<0.01
	Psi(.),p(.)	154.24	10.04	0.00
	Psi(Location),p(.)	156.24	12.04	<0.01
	Psi(Habitat * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat * Latitude * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat + Latitude),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Latitude * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat * Latitude),p(.)	NA[d]	NA[d]	NA[d]
orange-crowned warbler	Psi(Latitude * Location),p(.)	162.04	0.00	0.69
	Psi(Latitude),p(.)	164.71	2.67	0.18
	Psi(Location),p(.)	167.13	5.09	0.05
	Psi(.),p(.)	167.77	5.73	0.04
	Psi(Habitat + Latitude),p(.)	169.82	7.78	0.01
	Psi(Habitat),p(.)	170.10	8.06	0.01
	Psi(Habitat + Location),p(.)	171.23	9.19	0.01
	Psi(Habitat * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat * Latitude * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat * Latitude),p(.)	NA[d]	NA[d]	NA[d]

Table 8: Candidate Models and Akaike's Information Criteria Scores for Occupancy Models

Species	Model Parameters	AIC[(a)]	ΔAIC[(b)]	AIC Weight[(c)]
ruby-crowned kinglet	Psi(Latitude + Latitude2),p(.)	148.55	0.00	0.76
	Psi(Latitude),p(.)	151.53	2.98	0.17
	Psi(Latitude * Location),p(.)	153.83	5.28	0.05
	Psi(Habitat + Latitude),p(.)	156.34	7.79	0.02
	Psi(Habitat + Location),p(.)	174.43	25.88	<0.01
	Psi(Habitat),p(.)	176.04	27.49	<0.01
	Psi(Location),p(.)	176.49	27.94	<0.01
	Psi(.),p(.)	182.69	34.14	<0.01
	Psi(Habitat * Location),p(.)	NA[(d)]	NA[(d)]	NA[(d)]
	Psi(Habitat * Latitude * Location),p(.)	NA[(d)]	NA[(d)]	NA[(d)]
	Psi(Habitat * Latitude),p(.)	NA[(d)]	NA[(d)]	NA[(d)]
sora	Psi(.),p(.)	227.74	0.00	0.40
	Psi(Location),p(.)	228.99	1.25	0.21
	Psi(Latitude * Location),p(.)	229.30	1.56	0.18
	Psi(Latitude),p(.)	229.41	1.67	0.17
	Psi(Habitat),p(.)	233.89	6.15	0.02
	Psi(Habitat + Location),p(.)	235.71	7.97	0.01
	Psi(Habitat + Latitude),p(.)	235.81	8.07	0.01
	Psi(Habitat * Latitude),p(.)	237.55	9.81	<0.01
	Psi(Habitat * Location),p(.)	NA[(d)]	NA[(d)]	NA[(d)]
	Psi(Habitat * Latitude * Location),p(.)	NA[(d)]	NA[(d)]	NA[(d)]

Table 8: Candidate Models and Akaike's Information Criteria Scores for Occupancy Models

Species	Model Parameters	AIC[a]	ΔAIC[b]	AIC Weight[c]
Tennessee warbler	Psi(Latitude),p(.)	118.91	0.00	0.39
	Psi(Habitat + Latitude),p(.)	118.98	0.07	0.37
	Psi(Latitude + Latitude2),p(.)	120.60	1.69	0.17
	Psi(Latitude * Location),p(.)	122.33	3.42	0.07
	Psi(Location),p(.)	132.83	13.92	<0.01
	Psi(.),p(.)	135.59	16.68	<0.01
	Psi(Habitat + Location),p(.)	138.60	19.69	<0.01
	Psi(Habitat),p(.)	140.50	21.59	<0.01
	Psi(Habitat * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat * Latitude * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat * Latitude),p(.)	NA[d]	NA[d]	NA[d]
white-crowned sparrow	Psi(Location),p(.)	109.03	0.00	0.53
	Psi(Latitude * Location),p(.)	111.15	2.12	0.18
	Psi(Habitat + Location),p(.)	111.16	2.13	0.18
	Psi(Latitude),p(.)	113.56	4.53	0.06
	Psi(Habitat),p(.)	115.88	6.85	0.02
	Psi(.),p(.)	117.05	8.02	0.01
	Psi(Habitat * Latitude),p(.)	117.47	8.44	0.01
	Psi(Habitat + Latitude),p(.)	117.48	8.45	0.01
	Psi(Habitat * Location),p(.)	NA[d]	NA[d]	NA[d]
	Psi(Habitat * Latitude * Location),p(.)	NA[d]	NA[d]	NA[d]

Note: Psi indicates variables tested in relation to occupancy, p indicates variables tested in relation to detection probability. Psi(.) indicates the null model for occupancy and p(.) indicates the null model for detection probability.

(a) Akaike's Information Criterion.
(b) Change in AIC between the given model and the first model listed per response variable.
(c) The probability that the given model is best suited to the data relative to all candidate models
(d) Not applicable because the model did not converge

Table 9: Coefficients and Probability of Detection Estimates for Top-Ranked Occupancy Models

Species	Detection Estimate[(a)]	Intercept	Location[(b)]	Latitude	Latitude^{2}[(c)]	Latitude * Location
Canada jay	0.30	3.10		2.32		
common nighthawk	0.55	1.10**		-1.39		
orange-crowned warbler	0.45	1.40	-1.81	-1.39		2.41*
olive-sided flycatcher	0.21	3.45		-4.94*		
ruby-crowned kinglet	0.53	1.28		4.08**	-2.88**	
sora	0.52	0.81*				
Tennessee warbler	0.45	-1.16*		1.78**		
white-crowned sparrow	0.45	-9.65	9.09			

Note: P-values: "**" = p<0.01, "*" = p<0.05

(a) Detection estimate is the probability that a species will be detected if the species is present at a location.

(b) Location is a categorical variable that includes two categories. The coefficient is comparing "outside the ROW" (i.e., within 61 to 200 m from the Old Airport Road centreline) to the reference condition "within the ROW" (i.e., within 0 to 60 m from the Old Airport Road centreline)

(c) Latitude as a quadratic term

4.0 DISCUSSION

Overall, sample size was a limiting factor for using the QPAD approach, which is the modelling approach suggested by ECCC (2018). The Project is located at the northern range limit for many bird species and so species are expected to occur at relatively low densities in this region. This effect was shown by the occupancy models for common nighthawk and olive-sided flycatcher, which had lower probability of occupancy at higher latitudes. These results are consistent with range maps available for both common nighthawk (Brigham et al. 2011) and olive-sided flycatcher (Altman and Sallabanks 2012).

The 11 species that had sufficient sample sizes for the QPAD approach are common species and most of these species are habitat generalists. Of the 11 species for which density models could be estimated, seven contained the ROW variable in the final model. Density estimates inside the ROW were only higher for Swainson's thrush, and it is interactive with latitude and habitat. These results suggest that overall, even common species are avoiding the ROW, although that effect may be buffered or intensified by latitude or habitat. Avoidance of existing disturbance (i.e., the Old Airport Road; Figures 2 and 3) may explain why birds tend to have higher densities outside of the ROW than inside the ROW.

One constraint with the use of ARUs to conduct point counts is an inability to estimate sampling area for each species at each ARU, thus inhibiting direct estimation of density. The QPAD approach allows for studies to model the edr for each species as a function of forest density to account for differences in detection distance caused by vegetation. Investing additional effort to collect forest density data within 50 m of each ARU could allow the assumption of equal detection area at each sampling location to be relaxed. By using this assumption, differences in bird density may be masked by differences in detectability across survey locations.

The occupancy models revealed latitude to be a strong driver of probability of occupancy for six out of eight species tested. In most cases, increasing latitude was associated with a decreasing probability of occupancy. However, for the Tennessee warbler and Canada jay, the probability of occupancy increased with latitude. This result might be driven by detectability rather than occupancy, as northern populations likely have later nesting periods and may remain vocally active later in the season than southern populations (Ralph et al. 1993). High densities of Tennessee warbler at the higher latitudes in this study could also be indicative of a northern range expansion for this species.

Of the SAR detected in 2019, rusty blackbird, olive-sided flycatcher, and common nighthawk were assessed as valued components in the EA for the Project. As it was listed following the preparation of the EA, the evening grosbeak was not explicitly assessed in the EA. While evening grosbeak was detected inside the ROW, ARUs may not be appropriate for identifying habitat use. Evening grosbeaks do not sing, and most vocalizations are delivered in flight (Gillihan and Byers 2001); therefore, detection at an ARU station does not constitute habitat use as it does with other passerines. Furthermore, evening grosbeak uses similar habitats to olive-sided flycatcher.

Of the bird species that were assessed as valued components in the EA, bank swallow (*Riparia riparia*), barn swallow (*Hirundo rustica*), horned grebe (*Podiceps auritus*), yellow rail (*Coturnicops noveboracensis*), red-necked phalarope (*Phalaropus lobatus*), peregrine falcon (*Falco peregrinus*), and short-eared owl (*Asio flammeus*) were not recorded on the ARUs in 2019. Although these species were not detected on ARUs in 2019, these species were assumed to be present in and around the Project ROW and were assessed as such in the EA for the Project. Using ARUs is not an adequate survey method for red-necked phalarope, peregrine falcon, and short-eared owl and so not detecting these species on the ARUs is not surprising. Horned grebe and yellow rail have potential to be detected using ARUs and other wetland species (e.g., American bittern) were detected on ARUs in 2019 (Table 3).

Aligning the Project along the existing Old Airport Road, as much as possible, is expected to limit residual effects to bird SAR and migratory birds. Mitigation presented in the EA for the Project is anticipated to be sufficient to limit effects on bird SAR and migratory birds; no additional mitigation is suggested based on the results of the 2019 baseline study.

5.0 CLOSURE

We trust the information contained in this technical memorandum is sufficient for your present needs. If you require any further information, please do not hesitate to contact us.

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APPENDIX A

ARU Deployment Location and Vegetation Data

Table A-1: TASR ARU Deployment Location and Vegetation Data

ARU ID	UTM Coordinates (NAD 83)		Deployment Date	Retrieval Date	Landcover Classification	Observed Habitat	Canopy Coverage %	Dominant Tree Species		Burn Present?
	Easting	Northing						Tree	Shrub	
TR-02-01	501598	7002253	30/03/2019	12/07/2019	Deciduous	Sparse conifer/Deciduous	20%	Tamarack/Spruce	Alder	No
TR-02-02	501640	7001529	30/03/2019	12/07/2019	Sparse conifer	Dense conifer	30%	Pine	Soap berry	Yes/New growth
TR-02-04	502286	6998211	30/03/2019	12/07/2019	Deciduous	Sparse conifer	50%	Pine	Willow	Yes
TR-02-05	501269	6995899	30/03/2019	06/07/2019	Deciduous	Deciduous/Sparse conifer	10%	Tamarack/Spruce	Alder	No
TR-02-06	501384	6994903	30/03/2019	06/07/2019	Sparse conifer	Deciduous/Sparse conifer	95%	Tamarack/Spruce	Alder	No
TR-02-08	501556	6993387	30/03/2019	06/07/2019	Deciduous	Deciduous/Sparse conifer	5%	Tamarack/Spruce	Alder	No
TR-02-09	501802	6993097	30/03/2019	06/07/2019	Deciduous	Deciduous/Sparse conifer	20%	Tamarack/Spruce	Alder	No
TR-02-11	503075	6989714	29/03/2019	06/07/2019	Deciduous	Deciduous/Sparse conifer	60%	Pine/Aspen	Soap berry/ willow	No
TR-02-12	503321	6989412	29/03/2019	06/07/2019	Deciduous	Dense conifer	60%	Pine	Alder	No
TR-02-13	503588	6987514	29/03/2019	06/07/2019	Sparse conifer	Sparse conifer	30%	Pine	Alder	No
TR-02-14	503780	6985755	29/03/2019	06/07/2019	Sparse conifer	Deciduous	95%	Aspen/Spruce	Willow	No
TR-02-16	504444	6982675	29/03/2019	05/07/2019	Dense conifer	Sparse Conifer	100%	Tamarack/Spruce	Alder	No
TR-02-17	504767	6982121	29/03/2019	05/07/2019	Deciduous	Dense/Sparse conifer	5%	Pine	n/a	Yes/New growth
TR-02-18	505420	6980952	29/03/2019	05/07/2019	Sparse conifer	Sparse conifer	40%	Pine/Spruce	Alder	No
TR-02-19	506098	6979712	29/03/2019	05/07/2019	Deciduous	Dense conifer	70%	Pine/Spruce	Alder	No
TR-02-20	507010	6977516	29/03/2019	05/07/2019	Deciduous	Sparse conifer	70%	Pine	Alder	No
TR-02-21	506811	6975642	29/03/2019	05/07/2019	Sparse conifer	Dense conifer	60%	Pine/Spruce	Alder	n/a
TR-02-24	506548	6972728	29/03/2019	05/07/2019	Dense conifer	Dense conifer	50%	Spruce/Pine	Willow	No
TR-02-25	507282	6971020	29/03/2019	05/07/2019	Dense conifer	Dense conifer	50%	Spruce/Pine	n/a	No
TR-02-26	507741	6969656	29/03/2019	05/07/2019	Sparse conifer	Sparse conifer	70%	Pine/Spruce	Alder	No
TR-02-27	508141	6968146	29/03/2019	05/07/2019	Wetlands	Sparse conifer	5%	Tamarack/Spruce	Alder	n/a
TR-02-28	508245	6967622	29/03/2019	05/07/2019	Sparse conifer	Sparse conifer	30%	Spruce/Pine	Alder	No
TR-02-29	508187	6965337	29/03/2019	05/07/2019	Sparse conifer	Sparse conifer	5%	Spruce/Pine	Alder	No
TR-02-30	508262	6963368	29/03/2019	05/07/2019	Sparse conifer	Sparse conifer	5%	Pine/Spruce	n/a	No
TR-02-31	509511	6961012	29/03/2019	05/07/2019	Wetlands	Wetland	5%	Spruce	n/a	No
TR-02-32	509292	6959943	29/03/2019	05/07/2019	Sparse conifer	Sparse conifer	5%	Spruce/Tamarack	n/a	No
TR-02-33	508981	6959154	28/03/2019	05/07/2019	Wetlands	Sparse conifer/Wetland	n/a	Spruce/Pine	n/a	No
TR-02-34	508748	6958636	28/03/2019	05/07/2019	Dense conifer	Dense Conifer	30%	Spruce	Spruce	No
TR-02-35	508725	6958038	28/03/2019	05/07/2019	Sparse conifer	Sparse conifer/Wetland	10%	Spruce/Tamarack	Spruce	No
TR-02-36	508514	6957342	28/03/2019	05/07/2019	Dense conifer	Dense conifer	20%	Spruce	Birch	No
TR-02-37	507759	6954680	28/03/2019	05/07/2019	Sparse conifer	Dense conifer	40%	Spruce	Willow	No
TR-02-38	507372	6953416	28/03/2019	05/07/2019	Open	Sparse conifer	5%	Pine/Aspen	Spruce	New growth
TR-02-39	507448	6952632	28/03/2019	04/07/2019	Open	Open	5%	Spruce/Tamarack	Alder	No
TR-02-40	507556	6951494	28/03/2019	04/07/2019	Sparse conifer	Dense conifer	5%	Pine	Soap Berry	New growth
TR-02-41	507643	6950738	28/03/2019	04/07/2019	Open	Open	n/a	Pine	Aspen	Yes
TR-02-43	508157	6948060	28/03/2019	04/07/2019	Dense conifer	Wetland	<5%	Spruce/Tamarack	Alder	No
TR-02-44	506866	6946810	28/03/2019	04/07/2019	Sparse conifer	Sparse conifer	30%	Pine/Spruce	Aspen	No
TR-02-45	506442	6945653	28/03/2019	04/07/2019	Dense conifer	Dense conifer	40%	Pine/Aspen	Aspen	Yes
TR-02-46	507043	6943418	28/03/2019	04/07/2019	Dense conifer	Open	10%	Pine	Soap Berry	Yes
TR-02-47	507727	6942026	28/03/2019	04/07/2019	Dense conifer	Wetland/Open	30%	Pine	Aspen	Yes
TR-02-48	507861	6941223	28/03/2019	04/07/2019	Open	Sparse Conifer	10%	Pine	Aspen	Yes
TR-02-49	501598	7002253	28/03/2019	04/07/2019	Sparse conifer	Dense Conifer	20%	Pine	n/a	Yes
TR-02-51	501640	7001529	28/03/2019	04/07/2019	Open	Open	0%	Pine	Alder/ Aspen	Yes
TR-02-52	502286	6998211	28/03/2019	04/07/2019	Dense conifer	Dense Conifer	10%	Pine/Aspen	Aspen	Yes
TR-02-53	501269	6995899	28/03/2019	04/07/2019	Open	Open	10%	Pine	n/a	Yes
TR-02-54	501384	6994903	28/03/2019	04/07/2019	Sparse conifer	Wetland	10%	Pine	Aspen	Yes
TR-02-56	501556	6993387	28/03/2019	04/07/2019	Dense conifer	Wetland	5%	Aspen/Pine	Willow/ Aspen	Yes
TR-02-57	501802	6993097	28/03/2019	04/07/2019	Dense conifer	Dense conifer	<5%	Pine	Willow/ Aspen	Yes
TR-02-58	503075	6989714	28/03/2019	04/07/2019	Sparse conifer	Dense conifer	50%	Pine/Aspen	Aspen	Yes
TR-02-60	503321	6989412	28/03/2019	03/07/2019	Dense conifer	Dense conifer	10%	Pine	n/a	Yes
TR-02-61	503588	6987514	28/03/2019	03/07/2019	Open	Open	5%	Pine	n/a	Yes
TR-02-62	503780	6985755	27/03/2019	04/07/2019	Wetlands	Wetland	10%	Pepper/Spruce	Aspen	No
TR-02-63	504444	6982675	27/03/2019	03/07/2019	Wetlands	Dense conifer	60%	Spruce/Pine	n/a	No
TR-02-64	504767	6982121	27/03/2019	03/07/2019	Wetlands	Dense conifer	50%	Pine/Birch	Aspen	Yes
TR-02-65	505420	6980952	27/03/2019	03/07/2019	Wetlands	Sparse Conifer	15%	Pine	Aspen	Yes
TR-02-66	506098	6979712	27/03/2019	03/07/2019	Open	Open	10%	Pine	Pine	Yes
TR-02-67	507010	6977516	27/03/2019	03/07/2019	Dense conifer	Open	30%	Pine	Aspen	Yes
TR-02-68	506811	6975642	27/03/2019	03/07/2019	Dense conifer	Open	30%	Pine	Alder	Yes
TR-02-69	506548	6972728	27/03/2019	03/07/2019	Open	Sparse Conifer	30%	Pine	Aspen	Yes
TR-02-70	507282	6971020	27/03/2019	03/07/2019	Open	Sparse Conifer	20%	Pine	Aspen	Yes

APPENDIX B

Modals Used for Estimating Singing Rate in QPAD Models

Table B-1: Models Used for Estimating Singing Rate in QPAD Models

Species	Singing rate (sra) model
chipping sparrow	JDAY + TSSR + TSSR2
dark-eyed junco	JDAY + JDAY2 + TSSR + TSSR2
hermit thrush	TSSR + TSSR2
Lincoln's sparrow	JDAY + TSSR + TSSR2
Swainson's thrush	TSSR + TSSR2
Wilson's snipe	JDAY + JDAY2 + TSSR
white-throated sparrow	JDAY + JDAY2 + TSSR + TSSR2
yellow-rumped warbler	JDAY + TSSR + TSSR2
alder flycatcher	JDAY + JDAY2 + TSSR + TSSR2
palm warbler	JDAY + TSSR + TSSR2

JDAY = Julian date; JDAY2 = Julian date^2; TSSR = Time since sunrise; TSSR2 = Time since sunrise^2

APPENDIX C

2019 ARU Results

Table C-1. Mean Number of Individuals Detected and 95% Confidence Intervals Within and Outside of Project Right-of-way.

Common Name	Scientific Name	Mean Number of Individuals (± 95% CI) Within ROW[(a)]	Mean Number of Individuals (± 95% CI) Outside ROW[(b)]
alder flycatcher	*Empidonax alnorum*	0.24 ± 0.39	0.72 ± 0.30
American bittern	*Botaurus lentiginosus*	0.35 ± 0.25	0.21 ± 0.13
American robin	*Turdus migratorius*	0.82 ± 0.33	1.49 ± 0.21
American three-toed woodpecker	*Picoides dorsalis*	-	0.09 ± 0.11
black-backed woodpecker	*Picoides arcticus*	-	0.23 ± 0.15
blue-headed vireo	*Vireo solitarius*	0.18 ± 0.20	0.07 ± 0.08
blackpoll warbler	*Setophaga striata*	-	0.02 ± 0.05
boreal chickadee	*Poecile hudsonicus*	0.12 ± 0.17	0.02 ± 0.05
boreal owl	*Aegolius funereus*	-	0.02 ± 0.05
bohemian waxwing	*Bombycilla garrulus*	-	0.12 ± 0.12
Canada jay	*Perisoreus canadensis*	0.65 ± 0.31	0.58 ± 0.15
Canada goose	*Branta canadensis*	0.35 ± 0.25	0.40 ± 0.15
clay-coloured sparrow	*Spizella pallida*	-	0.09 ± 0.09
chipping sparrow	*Spizella passerina*	1.18 ± 0.55	1.35 ± 0.25
common loon	*Gavia immer*	0.18 ± 0.20	0.26 ± 0.15
common nighthawk	***Chordeiles minor***	**1.00 ± 0.48**	**1.86 ± 0.47**
common raven	*Corvus corax*	-	0.21 ± 0.13
common redpoll	*Acanthis flammea*	-	0.02 ± 0.05
dark-eyed junco	*Junco hyemalis*	2.06 ± 0.56	2.02 ± 0.21
evening grosbeak	***Coccothraustes vespertinus***	**0.06 ± 0.12**	**-**
fox sparrow	*Passerella iliaca*	0.18 ± 0.20	0.05 ± 0.07
gadwall	*Mareca strepera*	-	0.02 ± 0.05
gray-cheeked thrush	*Catharus minimus*	-	0.02 ± 0.05
great horned owl	*Bubo virginianus*	0.06 ± 0.12	-

Table C-1. Mean Number of Individuals Detected and 95% Confidence Intervals Within and Outside of Project Right-of-way.

Common Name	Scientific Name	Mean Number of Individuals (± 95% CI) Within ROW[(a)]	Mean Number of Individuals (± 95% CI) Outside ROW[(b)]
hairy woodpecker	*Dryobates villosus*	-	0.07 ± 0.08
hermit thrush	*Catharus guttatus*	1.53 ± 0.52	2.37 ± 0.32
Le Conte's sparrow	*Ammospiza leconteii*	0.06 ± 0.12	0.05 ± 0.09
least flycatcher	*Empidonax minimus*	-	0.07 ± 0.14
lesser scaup	*Aythya affinis*	-	0.02 ± 0.05
lesser yellowlegs	*Tringa flavipes*	0.41 ± 0.37	0.72 ± 0.18
Lincoln's sparrow	*Melospiza lincolnii*	1.00 ± 0.63	1.19 ± 0.42
mountain bluebird	*Sialia currucoides*	-	0.05 ± 0.09
Nashville warbler	*Leiothlypis ruficapilla*	0.06 ± 0.12	-
northern flicker	*Colaptes auratus*	0.12 ± 0.17	0.07 ± 0.08
northern goshawk	*Accipiter gentilis*	-	0.02 ± 0.05
northern waterthrush	*Parkesia noveboracensis*	-	0.05 ± 0.07
northern shoveler	*Spatula clypeata*	-	0.02 ± 0.05
orange-crowned warbler	*Leiothlypis celata*	0.53 ± 0.26	0.37 ± 0.20
olive-sided flycatcher	***Contopus cooperi***	**0.35 ± 0.25**	**0.37 ± 0.16**
pacific loon	*Gavia pacifica*	0.35 ± 0.25	0.21 ± 0.14
palm warbler	*Setophaga palmarum*	0.65 ± 0.44	0.67 ± 0.23
pied-billed grebe	*Podilymbus podiceps*	-	0.12 ± 0.10
pine grosbeak	*Pinicola enucleator*	-	0.02 ± 0.05
pileated woodpecker	*Dryocopus pileatus*	-	0.02 ± 0.05
red-breasted nuthatch	*Sitta canadensis*	0.06 ± 0.12	-
ruby-crowned kinglet	*Regulus calendula*	0.94 ± 0.38	0.30 ± 0.14
red crossbill	*Loxia curvirostra*	0.12 ± 0.25	0.05 ± 0.09

Table C-1. Mean Number of Individuals Detected and 95% Confidence Intervals Within and Outside of Project Right-of-way.

Common Name	Scientific Name	Mean Number of Individuals (± 95% CI) Within ROW[(a)]	Mean Number of Individuals (± 95% CI) Outside ROW[(b)]
rusty blackbird	***Euphagus carolinus***	**0.06 ± 0.12**	**-**
sandhill crane	*Antigone canadensis*	0.35 ± 0.25	0.65 ± 0.18
Savannah sparrow	*Passerculus sandwichensis*	-	0.02 ± 0.05
short-billed dowitcher	*Limnodromus griseus*	0.06 ± 0.12	0.02 ± 0.05
sora	*Porzana carolina*	0.65 ± 0.36	1.19 ± 0.33
solitary sandpiper	*Tringa solitaria*	0.24 ± 0.22	0.14 ± 0.11
spruce grouse	*Falcipennis canadensis*	-	0.02 ± 0.05
spotted sandpiper	*Actitis macularius*	-	0.02 ± 0.05
sharp-tailed grouse	*Tympanuchus phasianellus*	-	0.07 ± 0.08
swamp sparrow	*Melospiza georgiana*	-	0.07 ± 0.10
Swainson's thrush	*Catharus ustulatus*	3.06 ± 0.62	1.49 ± 0.49
Tennessee warbler	*Leiothlypis peregrina*	0.65 ± 0.40	0.30 ± 0.21
tree swallow	*Tachycineta bicolor*	-	0.09 ± 0.11
warbling vireo	*Vireo gilvus*	-	0.02 ± 0.05
white-crowned sparrow	*Zonotrichia leucophrys*	-	0.49 ± 0.26
western wood-pewee	*Contopus sordidulus*	-	0.21 ± 0.17
Wilson's snipe	*Gallinago delicata*	0.94 ± 0.38	1.00 ± 0.16
Wilson's warbler	*Cardellina pusilla*	0.06 ± 0.12	0.07 ± 0.08
white-throated sparrow	*Zonotrichia albicollis*	0.47 ± 0.66	2.51 ± 0.54
white-winged crossbill	*Loxia leucoptera*	0.18 ± 0.20	0.21 ± 0.16
yellow-bellied flycatcher	*Empidonax flaviventris*	0.06 ± 0.12	0.09 ± 0.09
yellow-rumped warbler	*Setophaga coronata*	1.06 ± 0.29	0.81 ± 0.22

[(a)] ROW = 0 to 60 m from the Old Airport Road centreline (120 m wide corridor)
[(b)] RSA = 61 to 200 m from the Old Airport Road centreline (400 m wide corridor)
Note: averages could not be calculated where abundance was too low.
Note: **bolded** species are species at risk

Table C-2. Mean number of individuals detected per ARU and 95% confidence intervals for each habitat stratum.

Common Name	Scientific Name	Mean Number of Individuals (± 95% CI) Deciduous	Mean Number of Individuals (± 95% CI) Dense Conifer	Mean Number of Individuals (± 95% CI) Open	Mean Number of Individuals (± 95% CI) Recently Disturbed	Mean Number of Individuals (± 95% CI) Sparse Conifer	Mean Number of Individuals (± 95% CI) Wetlands
alder flycatcher	*Empidonax alnorum*	0.11 ± 0.26	1.13 ± 0.69	0.67 ± 0.86	0	0.42 ± 0.35	0.60 ± 0.68
American bittern	*Botaurus lentiginosus*	0.11 ± 0.26	0.40 ± 0.28	0.33 ± 0.54	0	0.25 ± 0.19	0
American robin	*Turdus migratorius*	0.89 ± 0.60	1.53 ± 0.35	1.67 ± 0.54	-	1.08 ± 0.30	1.80 ± 0.56
three-toed woodpecker	*Picoides dorsalis*	0.22 ± 0.51	0	0.17 ± 0.43	0	0	0.20 ± 0.56
black-backed woodpecker	*Picoides arcticus*	0	0.13 ± 0.19	0.33 ± 0.54	-	0.04 ± 0.09	0.80 ± 1.04
blue-headed vireo	*Vireo solitarius*	0.22 ± 0.34	0	0.17 ± 0.43	0	0.13 ± 0.14	0
blackpoll warbler	*Setophaga striata*	0	0	0	0	0.04 ± 0.09	0
boreal chickadee	*Poecile hudsonicus*	0	0	0	0	0.13 ± 0.14	0
boreal owl	*Aegolius funereus*	0	0	0	0	0	0.20 ± 0.56
bohemian waxwing	*Bombycilla garrulus*	0	0	0.50 ± 0.88	-	0.04 ± 0.09	0
Canada jay	*Perisoreus canadensis*	0.33 ± 0.38	0.40 ± 0.28	0.50 ± 0.57	0	0.79 ± 0.21	-
Canada goose	*Branta canadensis*	0.33 ± 0.38	0.47 ± 0.29	0.50 ± 0.57	0	0.33 ± 0.20	0.40 ± 0.68
clay-coloured sparrow	*Spizella pallida*	0	0.20 ± 0.23	0.17 ± 0.43	0	0	0
chipping sparrow	*Spizella passerina*	0.78 ± 0.51	1.33 ± 0.34	1.67 ± 1.08	-	1.25 ± 0.42	1.80 ± 1.36
common loon	*Gavia immer*	0.11 ± 0.26	0.13 ± 0.19	0.17 ± 0.43	-	0.33 ± 0.24	0.20 ± 0.56
common nighthawk	*Chordeiles minor*	0.89 ± 0.90	1.87 ± 0.62	2.67 ± 2.36	-	1.04 ± 0.40	3.00 ± 1.24
common raven	*Corvus corax*	0.11 ± 0.26	0.13 ± 0.19	0	-	0.04 ± 0.09	0.80 ± 0.56
common redpoll	*Acanthis flammea*	0	0	0.17 ± 0.43	0	0	0
dark-eyed junco	*Junco hyemalis*	1.78 ± 0.75	1.87 ± 0.46	2.00 ± 0.94	-	2.25 ± 0.34	-
evening grosbeak	*Coccothraustes vespertinus*	0	0	0	0	0.04 ± 0.09	0
fox sparrow	*Passerella iliaca*	0	0	0.17 ± 0.43	0	0.17 ± 0.16	0
gadwall	*Mareca strepera*	0	0.07 ± 0.14	0	0	0	0
gray-cheeked thrush	*Catharus minimus*	0	0.07 ± 0.14	0	0	0	0
great horned owl	*Bubo virginianus*	0	0	0	0	0.04 ± 0.09	0
hairy woodpecker	*Dryobates villosus*	0	0	0.17 ± 0.43	-	0.04 ± 0.09	0
hermit thrush	*Catharus guttatus*	1.67 ± 0.86	2.27 ± 0.61	2.33 ± 0.86	-	2.13 ± 0.49	2.20 ± 1.36
LeConte's sparrow	*Ammospiza leconteii*	0.11 ± 0.26	0	0	0	0.08 ± 0.17	0
least flycatcher	*Empidonax minimus*	0	0	0.50 ± 1.29	0	0	0
lesser scaup	*Aythya affinis*	0	0.07 ± 0.14	0	0	0	0
lesser yellowlegs	*Tringa flavipes*	0.56 ± 0.56	0.67 ± 0.34	1.17 ± 0.43	0	0.50 ± 0.28	0.80 ± 0.56
Lincoln's sparrow	*Melospiza lincolnii*	0.89 ± 1.05	1.47 ± 0.69	1.33 ± 1.84	0	1.13 ± 0.57	0.60 ± 0.68
mountain bluebird	*Sialia currucoides*	0	0	0.33 ± 0.86	0	0	0
Nashville warbler	*Leiothlypis ruficapilla*	0	0	0	0	0.04 ± 0.09	0
northern flicker	*Colaptes auratus*	0	0.13 ± 0.19	0	0	0.13 ± 0.14	0
northern goshawk	*Accipiter gentilis*	0.11 ± 0.26	0	0	0	0	0

Table C-2. Mean number of individuals detected per ARU and 95% confidence intervals for each habitat stratum.

Common Name	Scientific Name	Mean Number of Individuals (± 95% CI) Deciduous	Mean Number of Individuals (± 95% CI) Dense Conifer	Mean Number of Individuals (± 95% CI) Open	Mean Number of Individuals (± 95% CI) Recently Disturbed	Mean Number of Individuals (± 95% CI) Sparse Conifer	Mean Number of Individuals (± 95% CI) Wetlands
northern waterthrush	*Parkesia noveboracensis*	0.11 ± 0.26	0	0	0	0.04 ± 0.09	0
northern shoveler	*Spatula clypeata*	0	0	0.17 ± 0.43	0	0	0
orange-crowned warbler	*Leiothlypis celata*	0.44 ± 0.41	0.47 ± 0.51	0.50 ± 0.57	0	0.46 ± 0.21	0
olive-sided flycatcher	*Contopus cooperi*	0	0.33 ± 0.27	0.33 ± 0.54	0	0.42 ± 0.21	1.00 ± 0.88
pacific loon	*Gavia pacifica*	0	0.20 ± 0.23	0.33 ± 0.54	0	0.38 ± 0.24	0.20 ± 0.56
palm warbler	*Setophaga palmarum*	0.44 ± 0.56	0.60 ± 0.41	0.67 ± 0.54	0	0.92 ± 0.37	0.20 ± 0.56
pied-billed grebe	*Podilymbus podiceps*	0	0.13 ± 0.19	0.17 ± 0.43	-	0	0.20 ± 0.56
pine grosbeak	*Pinicola enucleator*	0	0	0	0	0.04 ± 0.09	0
pileated woodpecker	*Dryocopus pileatus*	0	0.07 ± 0.14	0	0	0	0
red-breasted nuthatch	*Sitta canadensis*	0.11 ± 0.26	0	0	0	0	0
ruby-crowned kinglet	*Regulus calendula*	0.33 ± 0.38	0.33 ± 0.27	0.17 ± 0.43	0	0.83 ± 0.30	0
red crossbill	*Loxia curvirostra*	0	0	0	0	0.08 ± 0.17	0.40 ± 1.11
rusty blackbird	*Euphagus carolinus*	0	0	0	0	0.04 ± 0.09	0
sandhill crane	*Antigone canadensis*	0.44 ± 0.56	0.60 ± 0.28	0.67 ± 0.54	0	0.50 ± 0.22	1.00 ± 0.88
Savannah sparrow	*Passerculus sandwichensis*	0	0	0.17 ± 0.43	0	0	0
short-billed dowitcher	*Limnodromus griseus*	0	0	0	0	0.08 ± 0.12	0
sora	*Porzana carolina*	1.11 ± 0.98	0.93 ± 0.39	1.83 ± 1.39	-	0.96 ± 0.42	0.40 ± 0.68
solitary sandpiper	*Tringa solitaria*	0	0.20 ± 0.23	0	0	0.25 ± 0.19	0.20 ± 0.56
spruce grouse	*Falcipennis canadensis*	0	0.07 ± 0.14	0	0	0	0
spotted sandpiper	*Actitis macularius*	0	0.07 ± 0.14	0	0	0	0
sharp-tailed grouse	*Tympanuchus phasianellus*	0	0.07 ± 0.14	0.33 ± 0.54	0	0	0
swamp sparrow	*Melospiza georgiana*	0	0.07 ± 0.14	0	0	0.08 ± 0.17	0
Swainson's thrush	*Catharus ustulatus*	2.67 ± 1.33	1.13 ± 0.69	1.00 ± 1.33	0	2.71 ± 0.68	0.80 ± 1.04
Tennessee warbler	*Leiothlypis peregrina*	0.78 ± 0.75	0.27 ± 0.39	0.50 ± 0.88	0	0.33 ± 0.24	0.40 ± 1.11
tree swallow	*Tachycineta bicolor*	0	0	0.50 ± 0.88	0	0	0.20 ± 0.56
warbling vireo	*Vireo gilvus*	0	0	0	0	0	0.20 ± 0.56
white-crowned sparrow	*Zonotrichia leucophrys*	0	0.40 ± 0.35	0.83 ± 1.68	0	0.17 ± 0.20	1.20 ± 1.04
western wood-pewee	*Contopus sordidulus*	0	0.13 ± 0.19	0.33 ± 0.86	0	0.04 ± 0.09	0.80 ± 1.36
Wilson's snipe	*Gallinago delicata*	0.56 ± 0.41	1.00 ± 0.30	1.33 ± 0.54	-	1.04 ± 0.29	-
Wilson's warbler	*Cardellina pusilla*	0	0.07 ± 0.14	0.17 ± 0.43	0	0.08 ± 0.12	0
white-throated sparrow	*Zonotrichia albicollis*	1.00 ± 0.94	2.40 ± 1.06	3.50 ± 1.96	-	1.17 ± 0.71	3.80 ± 1.04
white-winged crossbill	*Loxia leucoptera*	0.33 ± 0.54	0.13 ± 0.19	0.33 ± 0.86	0	0.13 ± 0.14	0.40 ± 0.68
yellow-bellied flycatcher	*Empidonax flaviventris*	0.11 ± 0.26	0	0.17 ± 0.43	0	0.08 ± 0.12	0.20 ± 0.56
yellow-rumped warbler	*Setophaga coronata*	1.11 ± 0.46	0.67 ± 0.34	0.83 ± 0.43	-	0.96 ± 0.34	0.80 ± 0.56

"-" = means could not be calculated because of small sample size.

APPENDIX D

Effects Plots for Final Model Effects

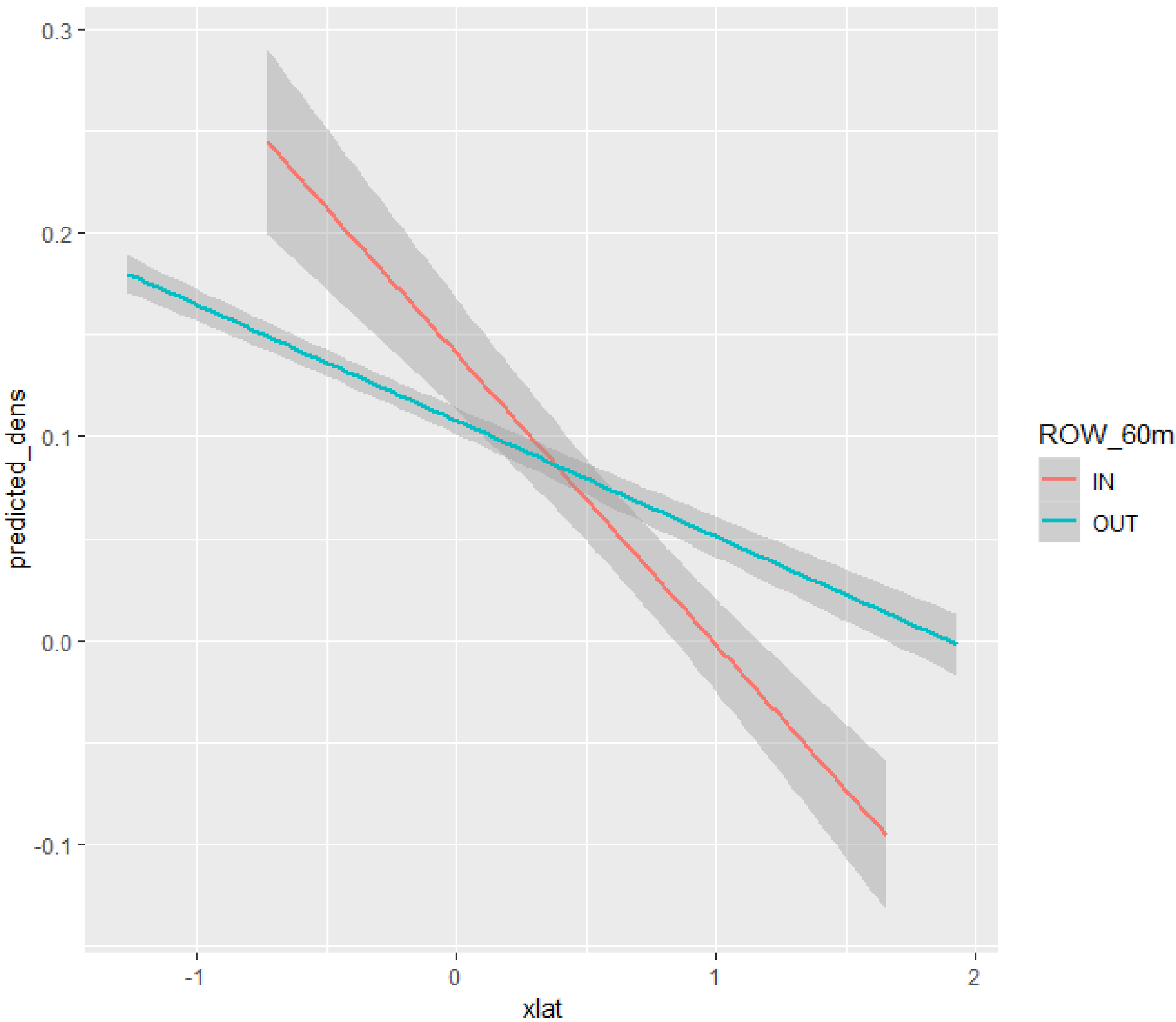

Figure D-1: Alder Flycatcher Predicted Density in Response to Latitude (xlat) by Location (ROW).

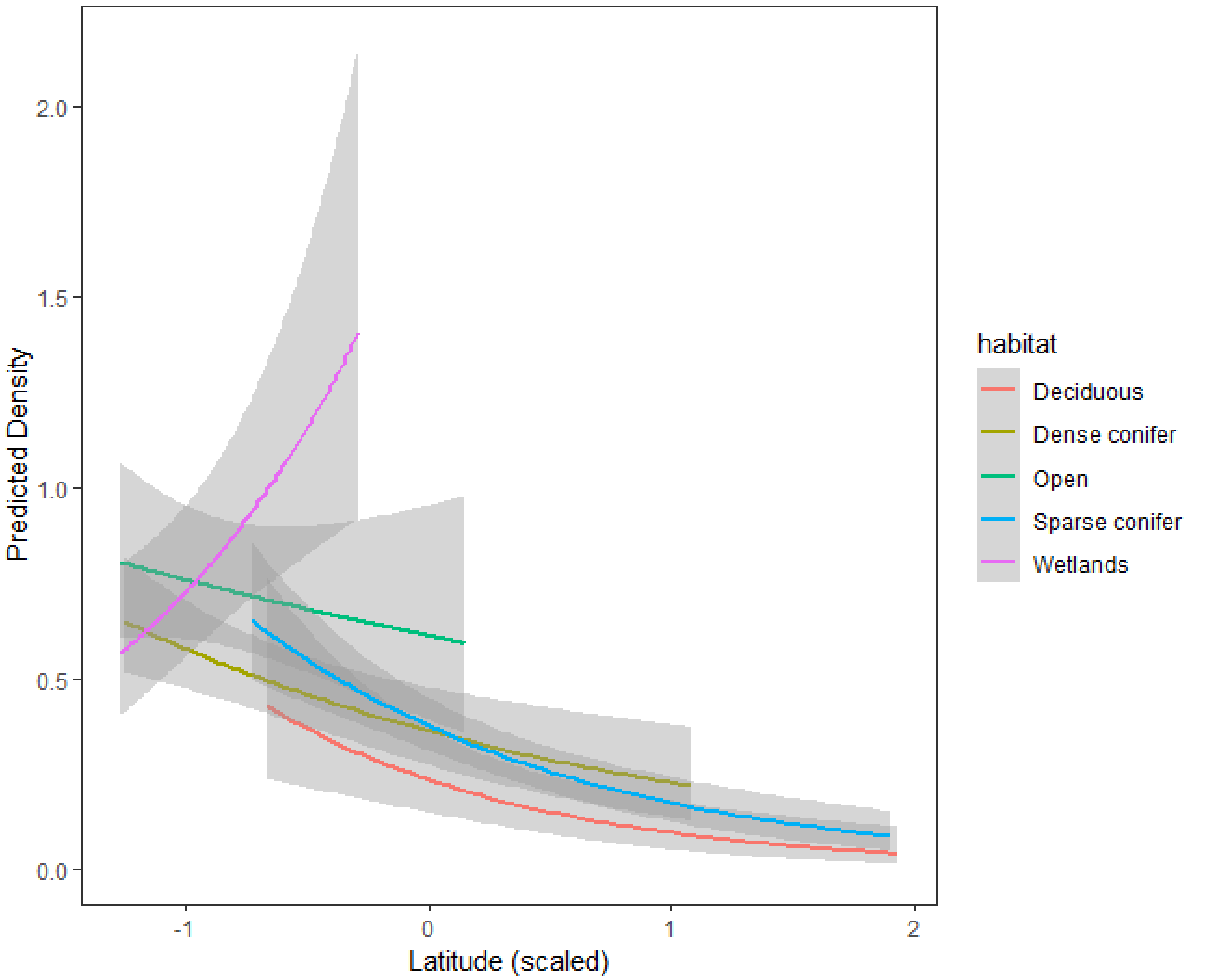

Figure D-2: American Robin Predicted Density in Response to Latitude by Habitat Type.

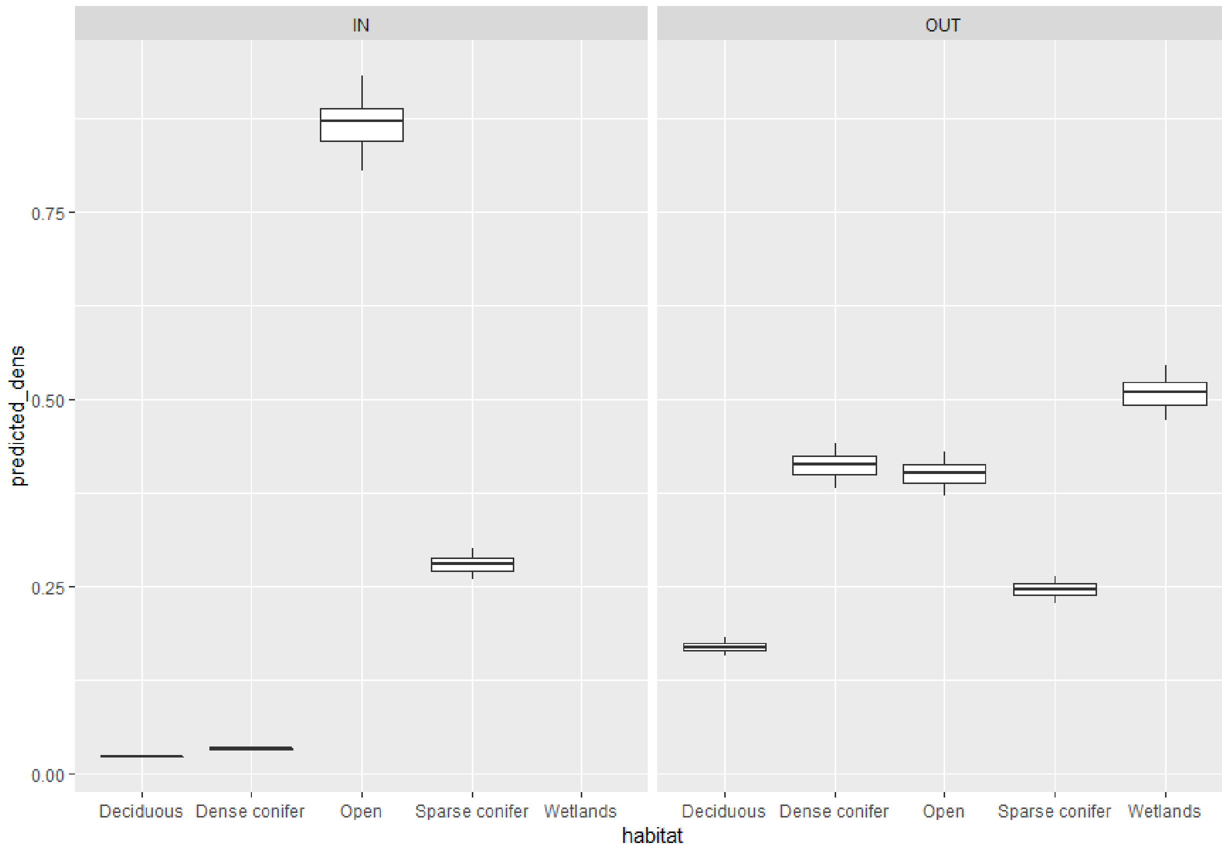

Figure D-3: Chipping Sparrow Predicted Density in Response to Habitat Type by Location (IN/OUT).

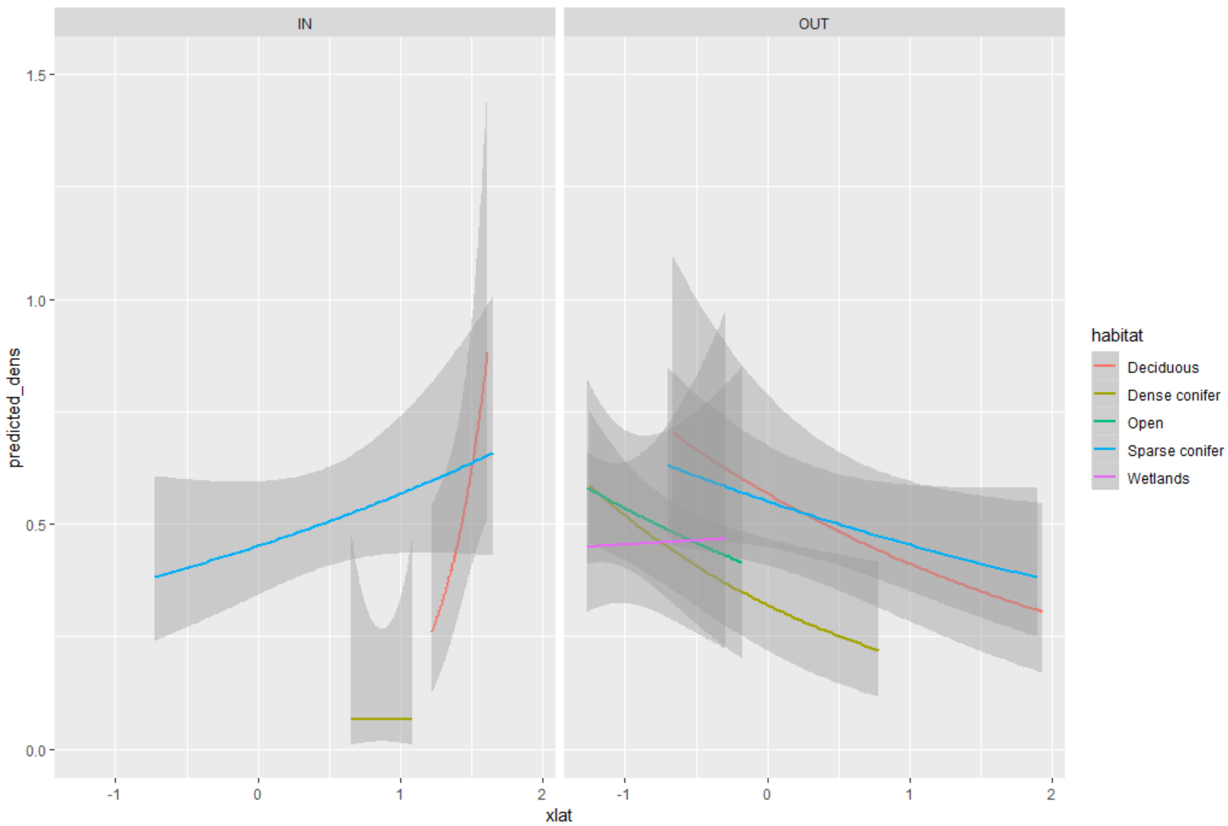

Figure D-4: Dark-eyed Junco Predicted Density in Response to Latitude (xlat) by Location (IN/OUT) and Habitat Type.

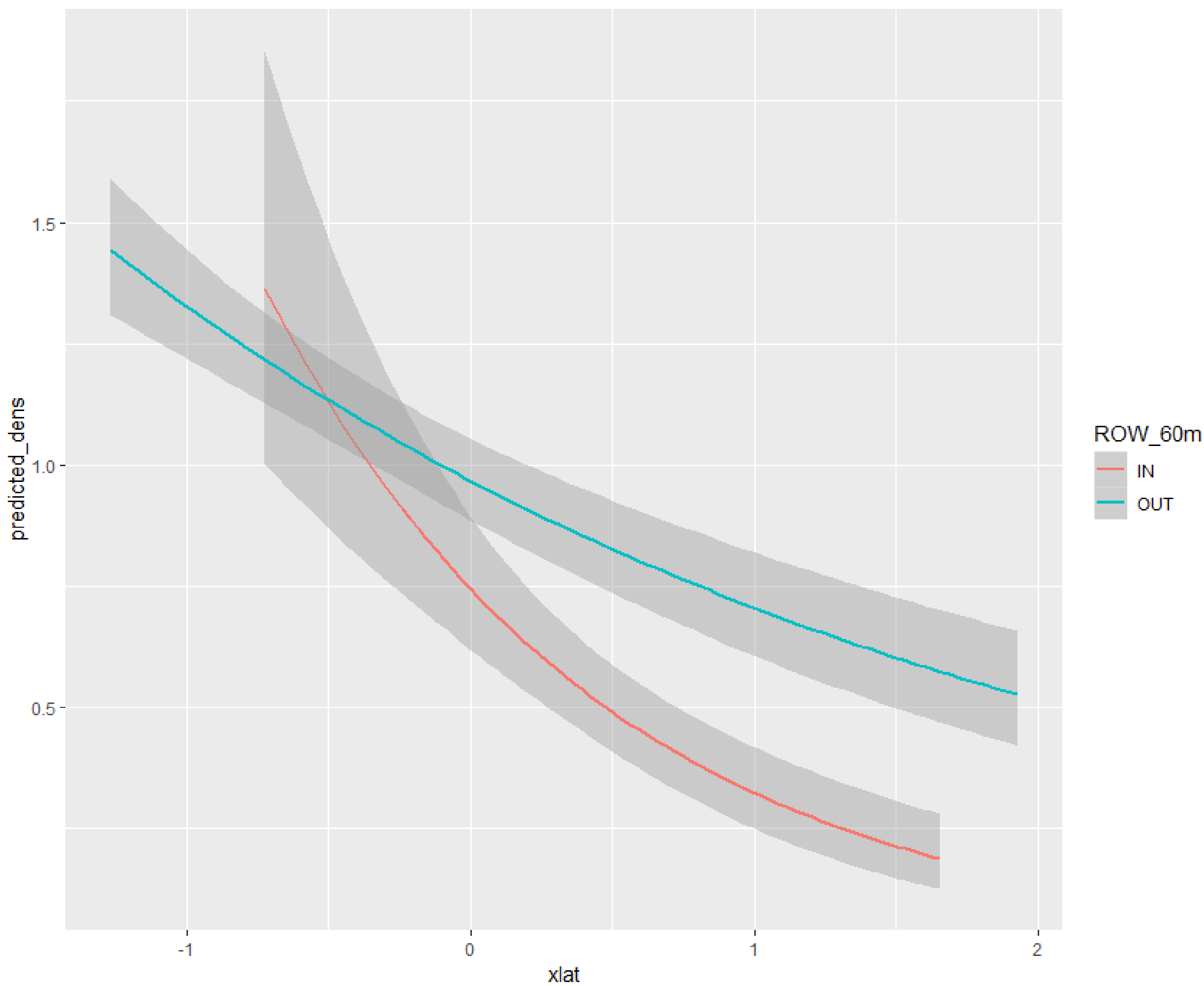

Figure D-5: Hermit Thrush Predicted Density in Response to Latitude (xlat) by Location (ROW).

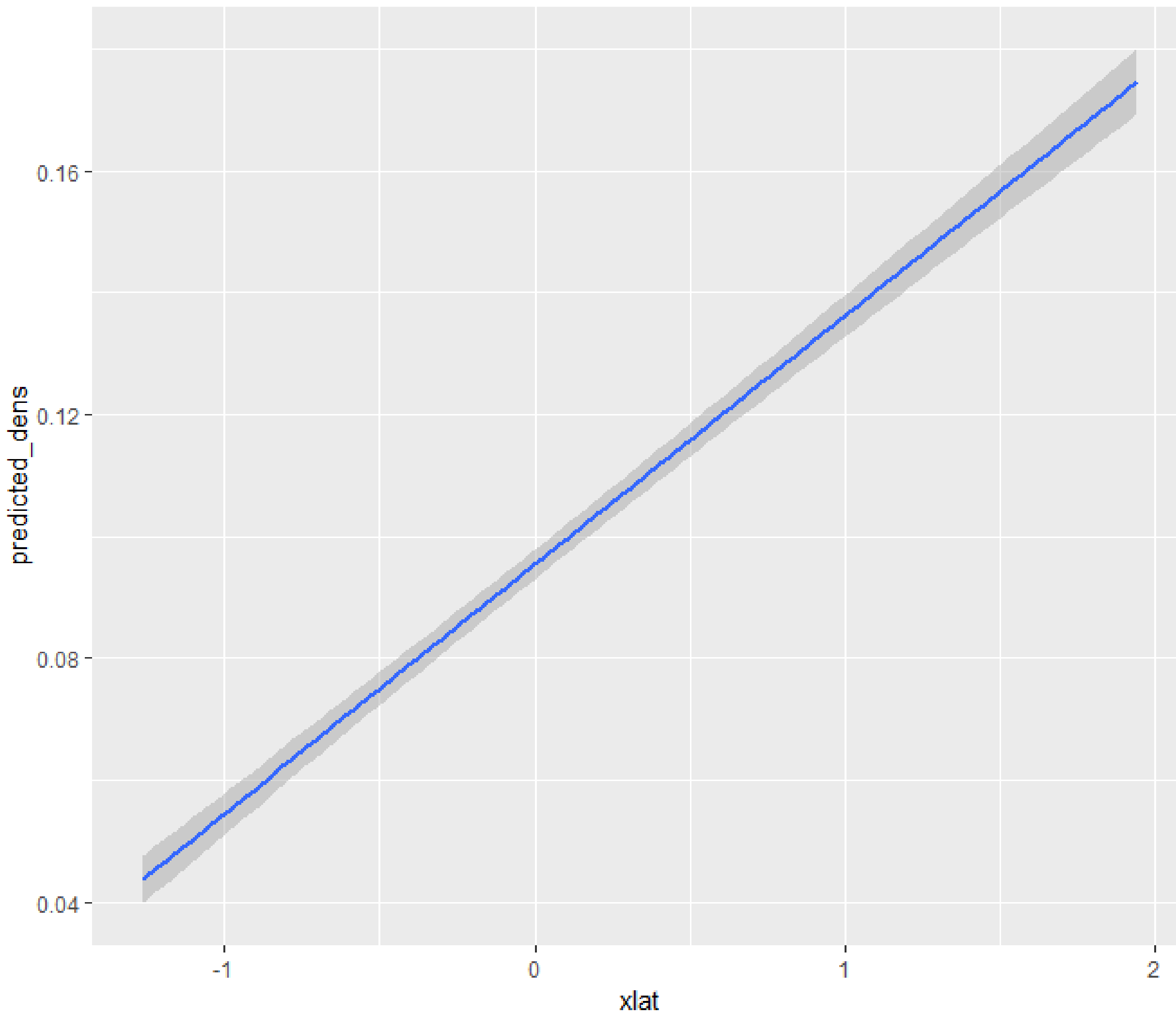

Figure D-6: Palm Warbler Predicted Density in Response to Latitude (xlat).

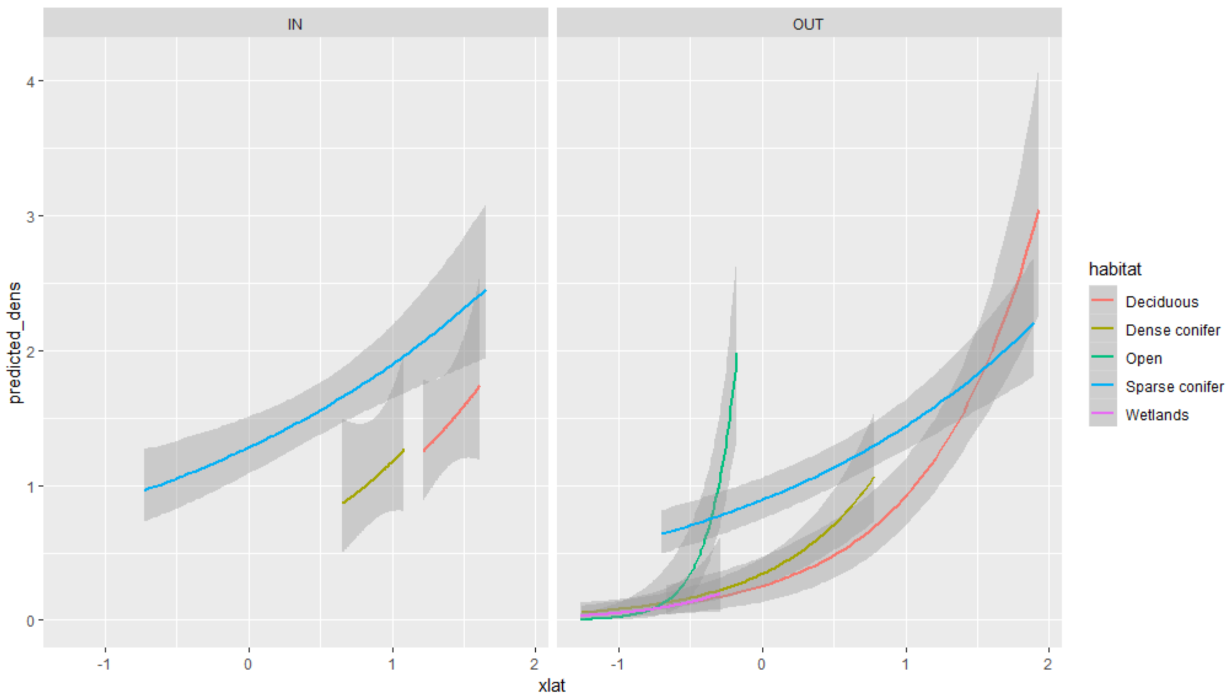

Figure D-7: Swainson's Thrush Predicted Density in Response to Latitude (xlat) by Location (IN/OUT) and Habitat Type.

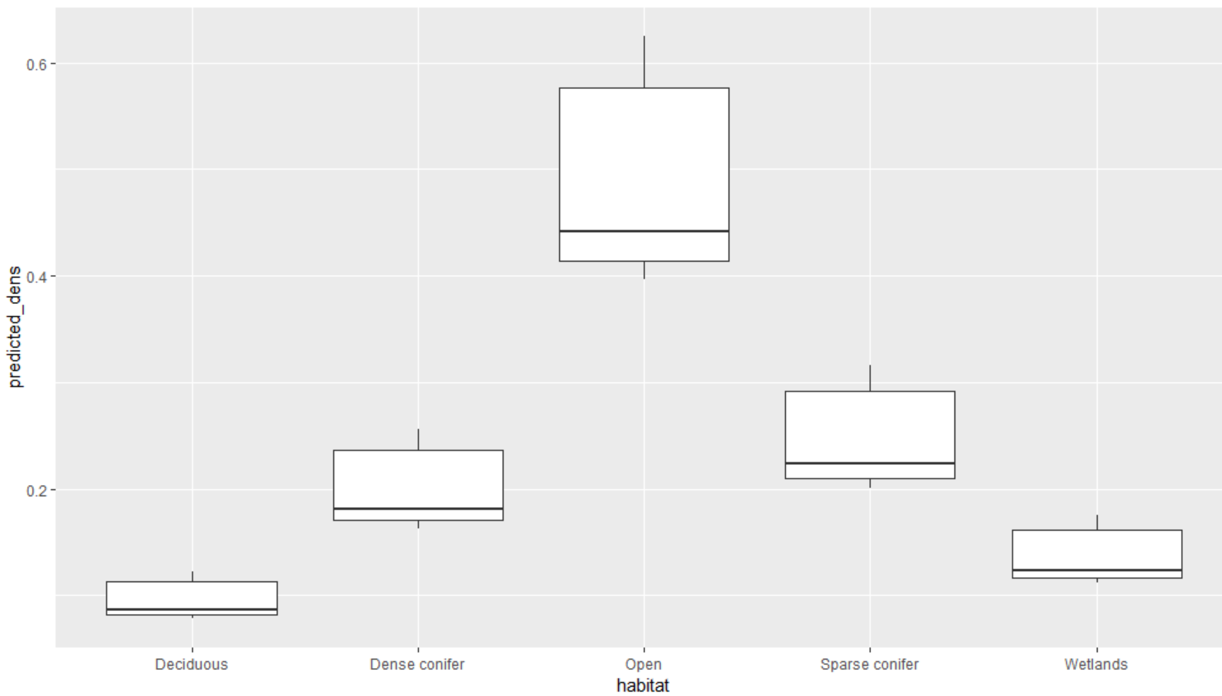

Figure D-8: Wilson's Snipe Predicted Density in Response to Habitat Type.

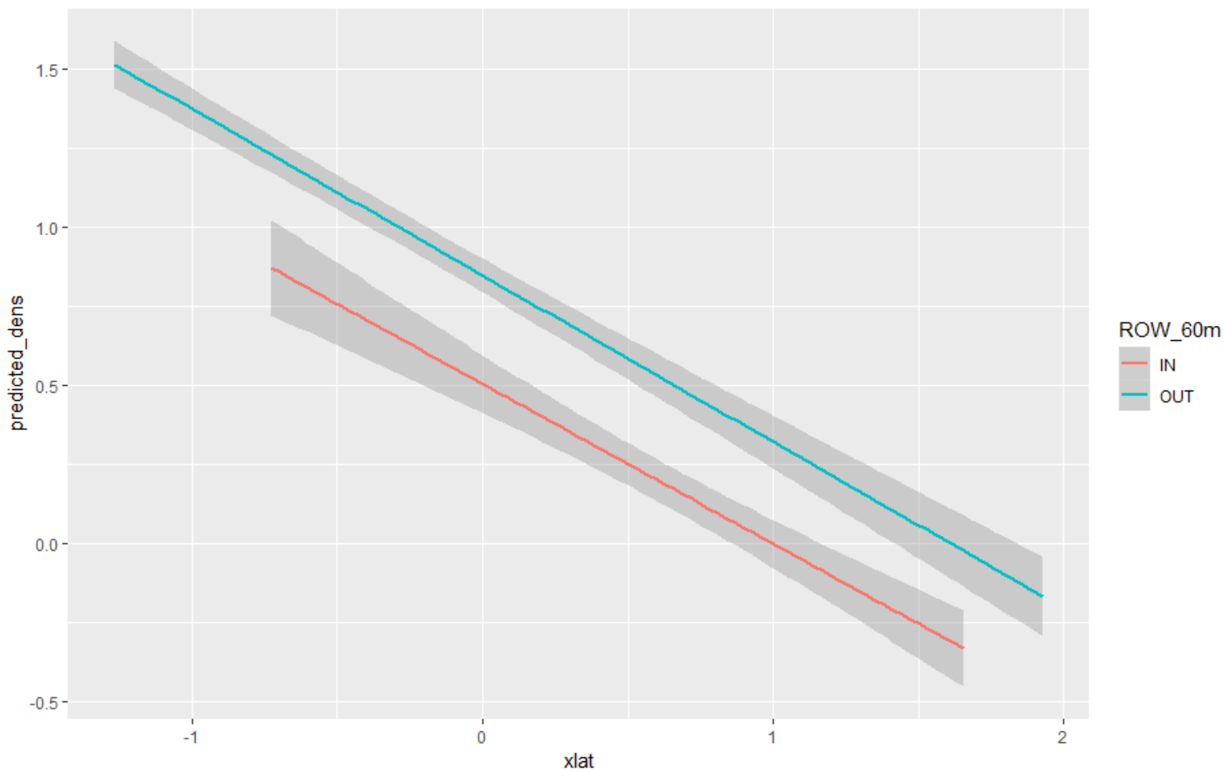

Figure D-9: White-throated Sparrow Predicted Density in Response to Latitude (xlat) by Location (ROW).

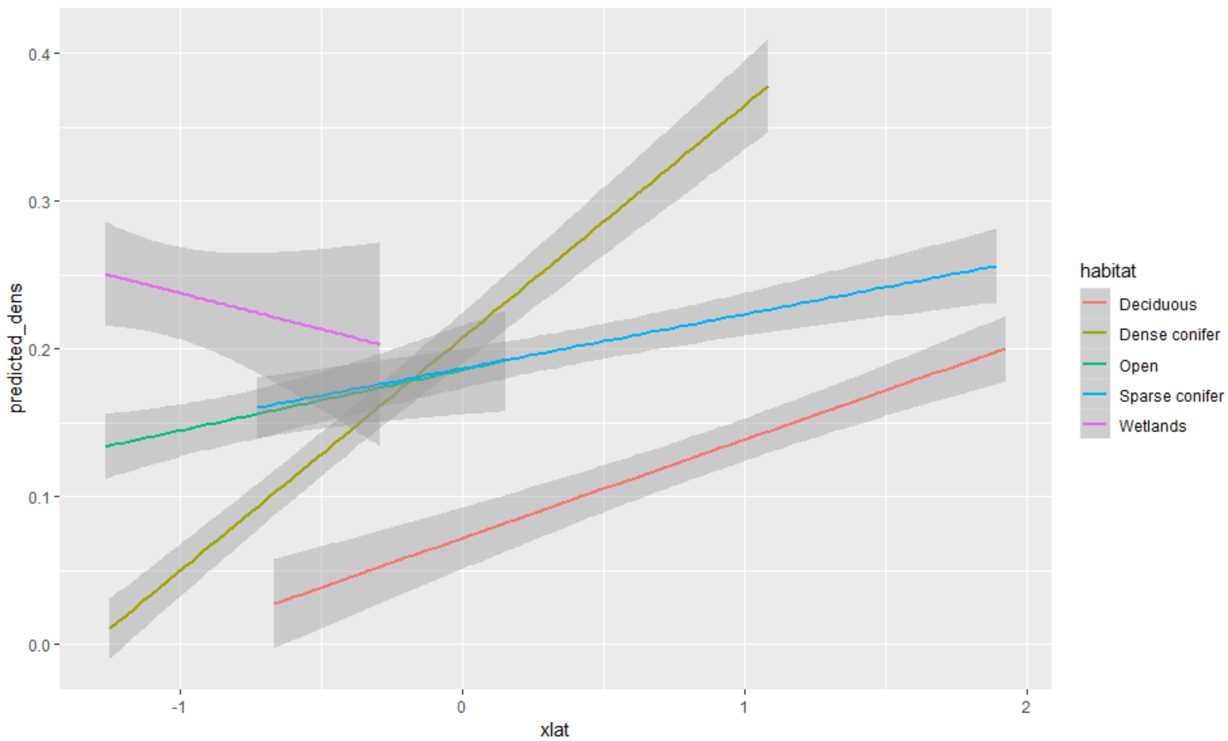

Figure D-10: Yellow-rumped Warbler Predicted Density in Response to Latitude (xlat) by Habitat Type.

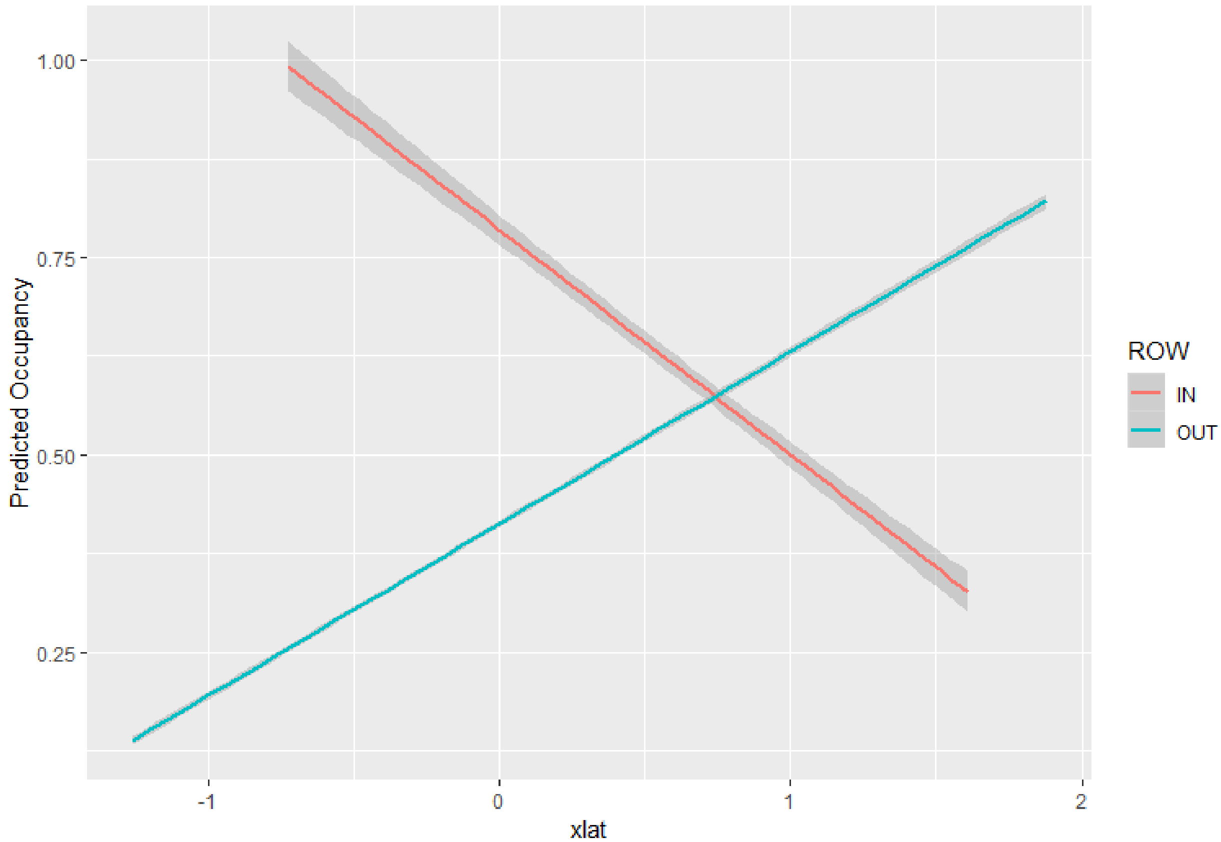

Figure D-11: Orange-crowned Warbler Predicted Occupancy in Response to Latitude (xlat) by Location (ROW).

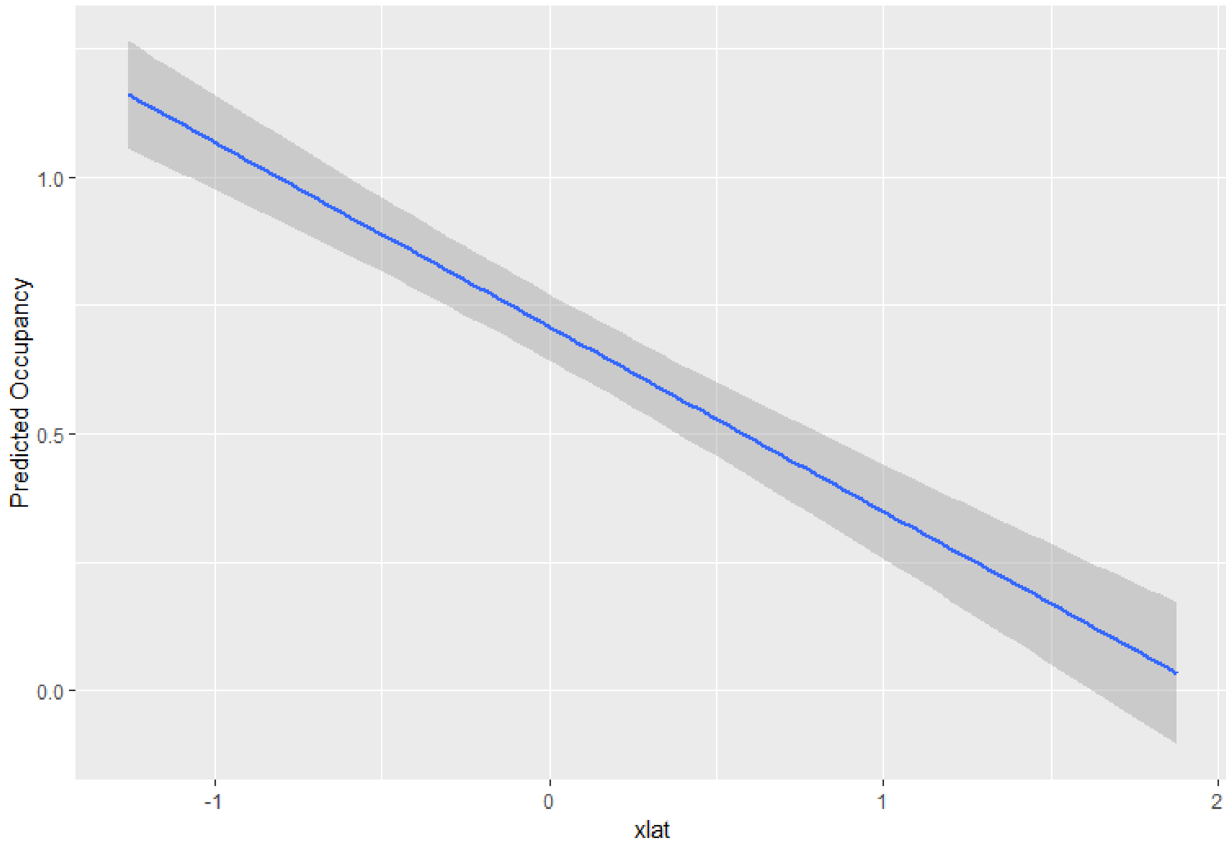

Figure D-12: Olive-sided Flycatcher Predicted Occupancy in Response to Latitude (xlat).

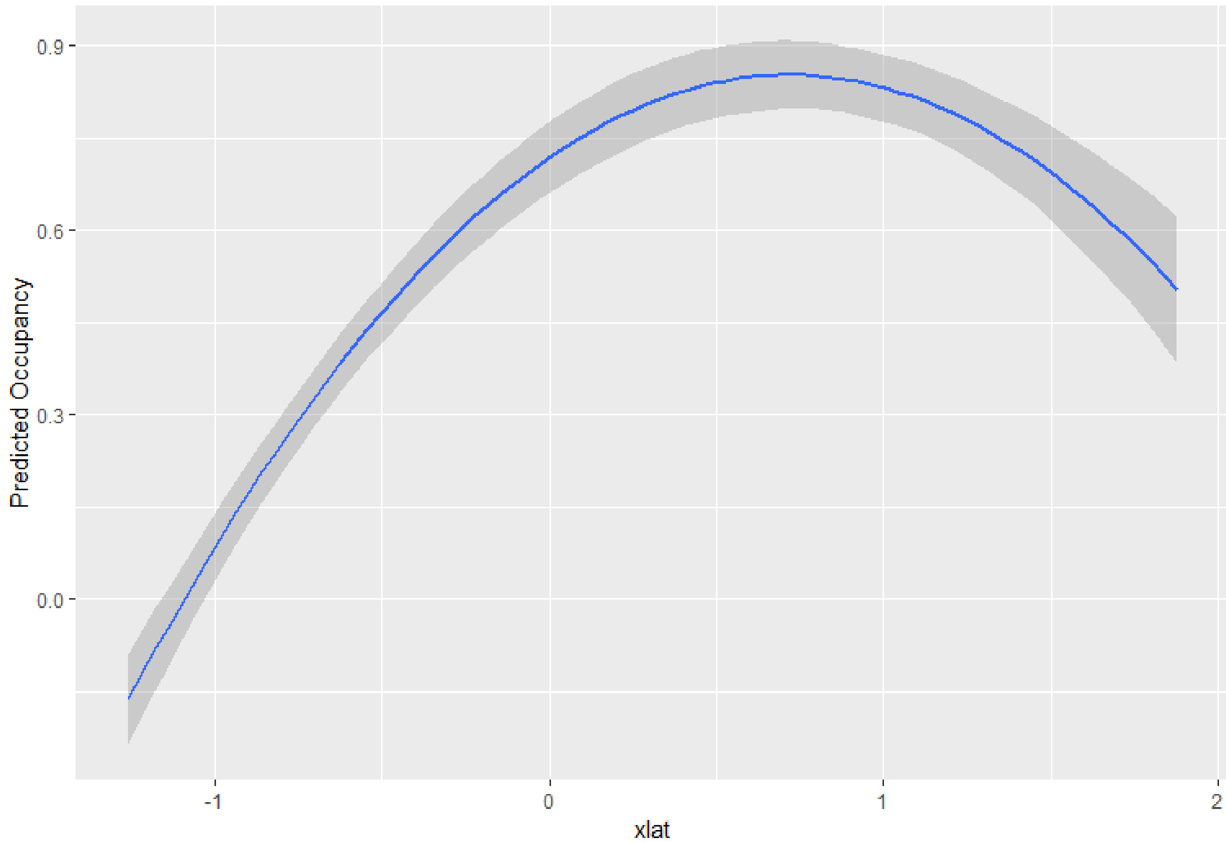

Figure D-13: Ruby-crowned Kinglet Predicted Occupancy in Response to Latitude (xlat).

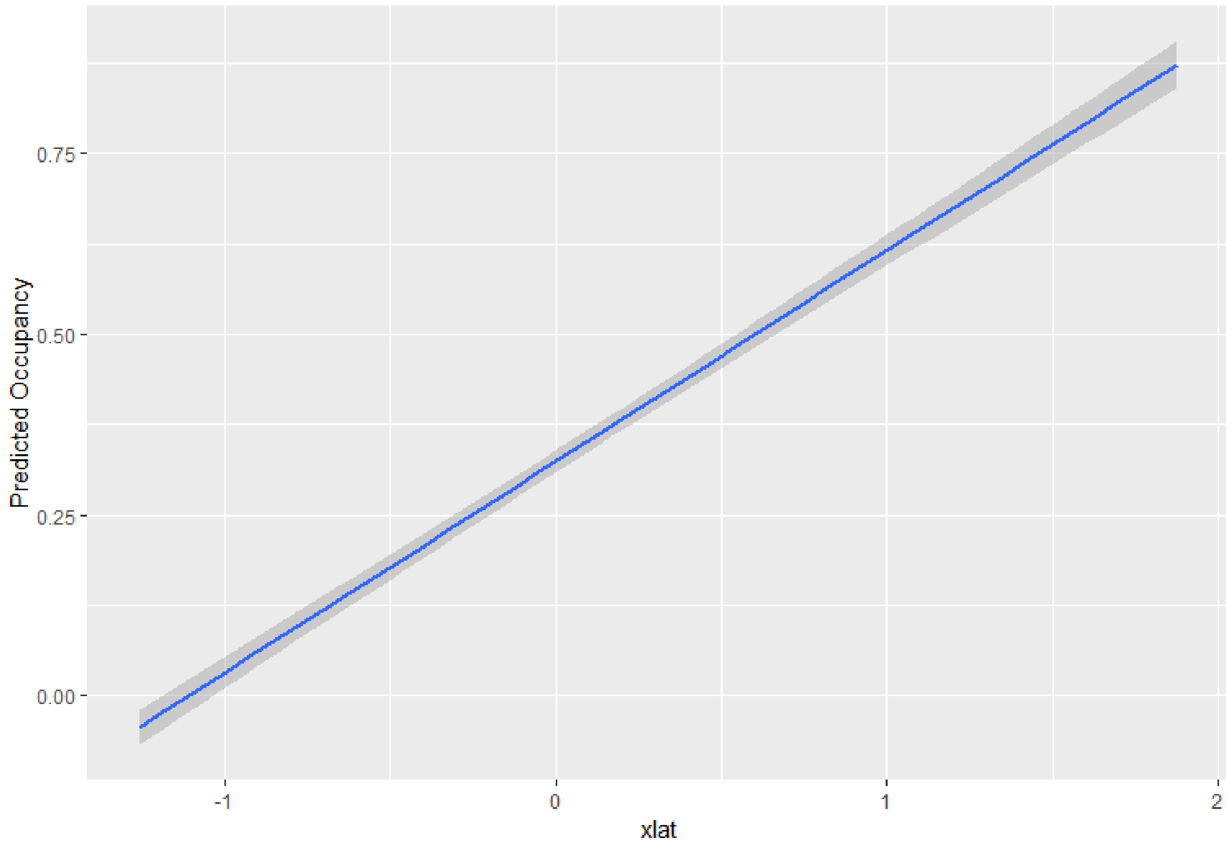

Figure D-14: Tennessee Warbler Predicted Occupancy in Response to Latitude (xlat).

Appendix H: Bear Den Aerial Survey Report

Government of Northwest Territories Gouvernement des Territoires du Nord-Ouest

Tłı̨chǫ All-Season Road Project Aerial Bear Den Survey Results

Wildlife Research Permit #WL500763

James Hodson
11/26/2019

Department of Environment and Natural Resources, Wildlife Division

Government of the Northwest Territories

Tłı̨chǫ All-Season Road Project Aerial Bear Den Survey Results – Wildlife Research Permit #WL500763

Purpose

As per the Wildlife Management and Monitoring Plan for the Tłı̨chǫ All-Season Road Project (TASR), the purpose of this survey was to document potential or active bear dens within 800 m of the Tłı̨chǫ All-Season Road alignment, borrow sources and borrow source access roads, and, in the event that an active den was detected, trigger mitigation and monitoring measures outlined in Appendix F (pages F-20 – F-21) of the WWMP. The aerial surveys were also used to document any conspicuous wildlife features such as mineral licks, raptor nests, or potential habitat for bat hibernacula (e.g. caves) within the survey area that may require mitigation to protect them from disturbance from construction activities.

This aerial survey complements the ground-based pre-clearing and pre-blast surveys that are being conducted on an ongoing basis by North Star Infrastructure (NSI) as clearing and construction of the Tłı̨chǫ All-Season Road proceeds.

Methods

The study area for the aerial bear den survey was defined by an 800 m buffer around the proposed 60 m wide Tłı̨chǫ All-Season Road right of way, as well as any proposed borrow sources and borrow source access roads.

Aerial surveys were conducted by helicopter along survey transects spaced 250 m apart within the 800 m buffer around the project footprint, with the central transect following the alignment of the Tłı̨chǫ All-Season Road (Figure 1).

Surveys were conducted using an A-Star helicopter hired from Great Slave Helicopters Ltd. piloted by T.Firth. The survey crew consisted of an ENR wildlife technician (S.Goodman) who served as observer, navigator and data recorder, and two observers from the community of Behchokǫ̀ (H.Mantla and L.Ekendia). The helicopter was flown an altitude of roughly 100-200 feet and speed of 60 km/hr. Suspected den sites, wildlife observations and other wildlife habitat features of note were recorded with GPS waypoints and photos were taken where possible.

The survey took place over a 3-day period from October 23-25, 2019. For aerial bear den surveys to be effective it is important that they be conducted after a recent snowfall in order to more easily detect bear tracks and signs of den excavation. At the time of the survey there was roughly ~90% snow cover within the study area, and the most recent snowfall was on October 21 (Kiewit-NSI Weekly Environmental Report for October 20-26, 2019). Conditions were overcast with fog patches and ~2.5 miles visibility on the first day, followed by overcast conditions in the mornings of the 2nd and 3rd day with skies clearing in the afternoons. Temperatures varied from -2°C on the first day, 2°C on the second day, and -7°C on the third day.

At the time of the surveys, clearing of the right of was advancing between kilometers 28.5 to 31.3, two camps were active at kilometer 0 and 19, and quarrying operations were occurring at Pit #2B and #13C (Kiewit-NSI Weekly Environmental Report for October 20-26, 2019).

Results

Wildlife sightings, tracks and notable wildlife habitat features recorded during the survey are summarized in Table 1.

No active bear dens were detected during the aerial survey, but two potential den sites were recorded (waypoint 7; Figure 2,6,7 & waypoint 15; Figures 5,8,9). The potential den site at waypoint #7 was located roughly 800 m away from the road alignment, whereas the potential den site at waypoint #15 is located within the 60 m right of way for the road alignment between km 65-70. The crew landed at waypoint 7 to investigate the potential den site on foot (Figure 9).

There were no old or fresh bear tracks seen around the two potential den sites; however, old bear tracks were detected in 3 locations within the study area (waypoints 1, 2, and 5; Figures 2,4), and one set of fresh bear tracks was observed just south of km 65 (waypoint 16; Figures 5, 10).

There were 3 moose sightings, two of which were in the survey area (waypoints 6 and 20; Figures 2, 5, 11) and one moose that was spotted off-transect during a transit flight (waypoint 18; Figure 2). Bison were sighted on two occasions within the survey area (waypoints 11 and 19; Figures 2, 3, 12), and once off transect (waypoint 17; Figure 3). The only other direct wildlife sighting recorded was a porcupine (waypoint 9; Figure 3).

The survey crew recorded 6 locations (waypoints 3, 4, 8, 10, 12, and 13; Figures 2-4;) that had caves or sink holes that could potentially provide bat hibernacula habitat, but none of them were within the road right of way or potential footprint of any borrow sources. Example photos of these features are provided in Figures 13 and 14.

No raptor nests were recorded during the survey.

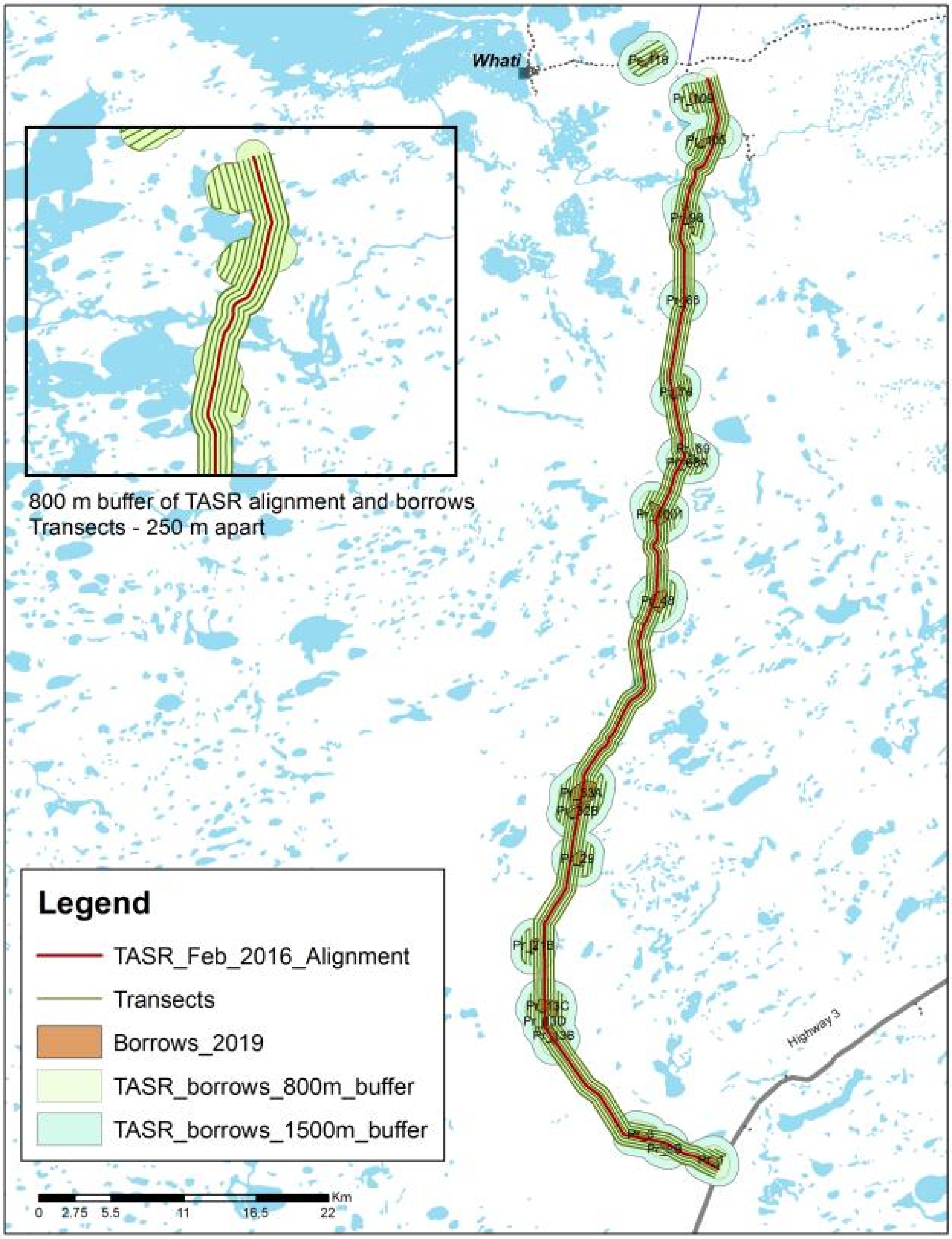

Figure 1. Aerial bear den study area defined by an 800 m buffer around the Tłı̨chǫ All-Season Road right of way, borrow sources and borrow source access roads.

Table 1. Wildlife sightings, tracks and notable wildlife habitat features recorded during the aerial bear den survey conducted along the Tłı̨chǫ All-Season Road alignment between October 23-25, 2019.

Waypoint	Date	Observation	Group Size	Comments	latitude	longitude
1	10/23/2019	bear track		old track, snow in track	62.53611398	-116.762878
2	10/23/2019	bear track		old track, snow in track	62.55135102	-116.780624
3	10/23/2019	cave		Bat habitat?	62.62277196	-116.820513
4	10/23/2019	sink hole			62.87048402	-116.840865
5	10/23/2019	bear tracks		old track, snow in track	62.75131599	-116.820341
6	10/23/2019	moose	2		62.50846703	-116.687158
7	10/24/2019	potential den		Potential bear den	*	*
8	10/24/2019	sink hole			62.57996902	-116.857571
9	10/24/2019	porcupine	1		62.68804201	-116.863665
10	10/24/2019	cave		karst landscape, lots of caves and sinkholes	62.86244201	-116.873043
11	10/24/2019	bison	6	6 bison (2 cows, 1 bull, 2 yearling, 1 unknown)	62.67264303	-116.854482
12	10/24/2019	cave		sink hole cave, no tracks	62.51901699	-116.760039
13	10/24/2019	sink hole		multiple sink holes	62.49811697	-116.687192
15	10/25/2019	potential den		potential den right beside right of way, no tracks near den/hole. This den should be investigated further.	*	*
16	10/25/2019	bear track		fresh bear track along road/trail cutline, headed N	62.92807499	-116.861076
17	10/25/2019	bison	5	Incidental sighting of 5 bison	62.69168403	-116.735539
18	10/25/2019	moose	3	incidental: 3 moose (cow with 2 yearling, one yearling had small antlers)	62.59630401	-116.642866

19	10/25/2019	bison	9	> 9 bison, headed NE	62.58415796	-116.827455
20	10/25/2019	moose	1	1 moose, cow	63.09134298	-116.953856

* Coordinates of potential den sites have been omitted to protect these locations from non-project related disturbance in the event the dens are active. The coordinates of the potential den sites have been shared with NSI.

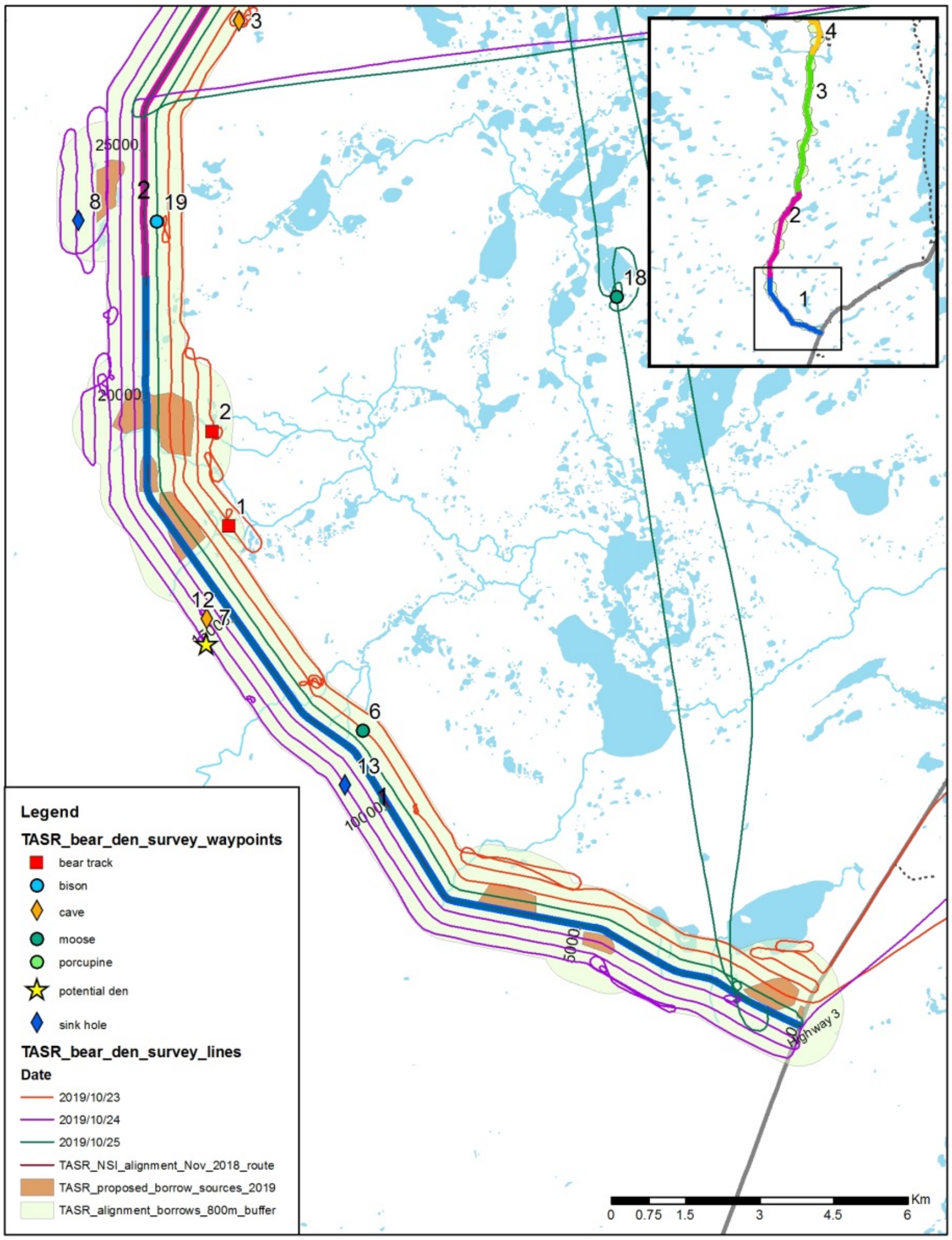

Figure 2. Aerial bear den survey wildlife and wildlife habitat sightings along the first 25 km of the TASR alignment.

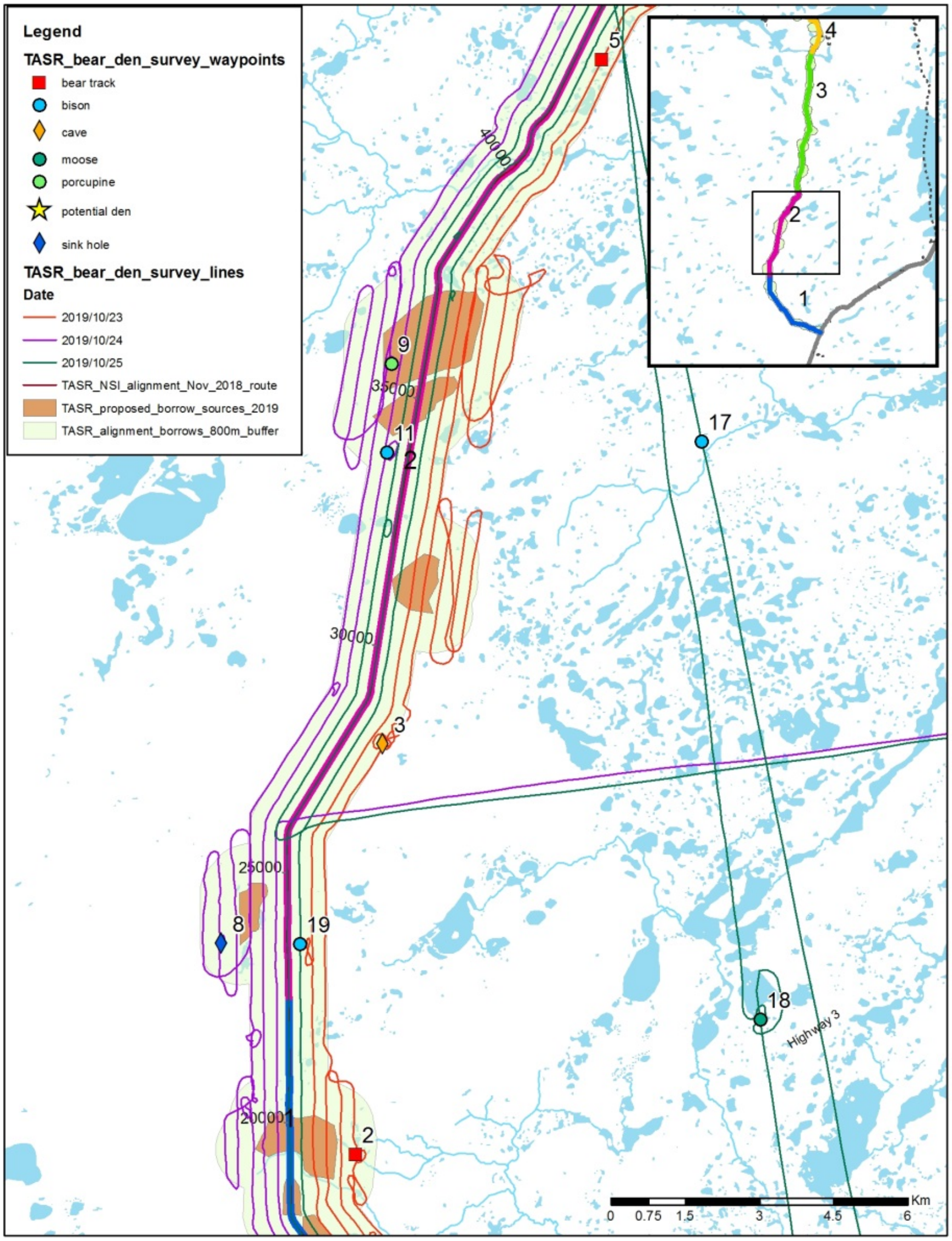

Figure 3. Aerial bear den survey wildlife and wildlife habitat sightings from kilometer 25 to kilometer 40 along the TŁĮCHQ ALL-SEASON ROAD alignment.

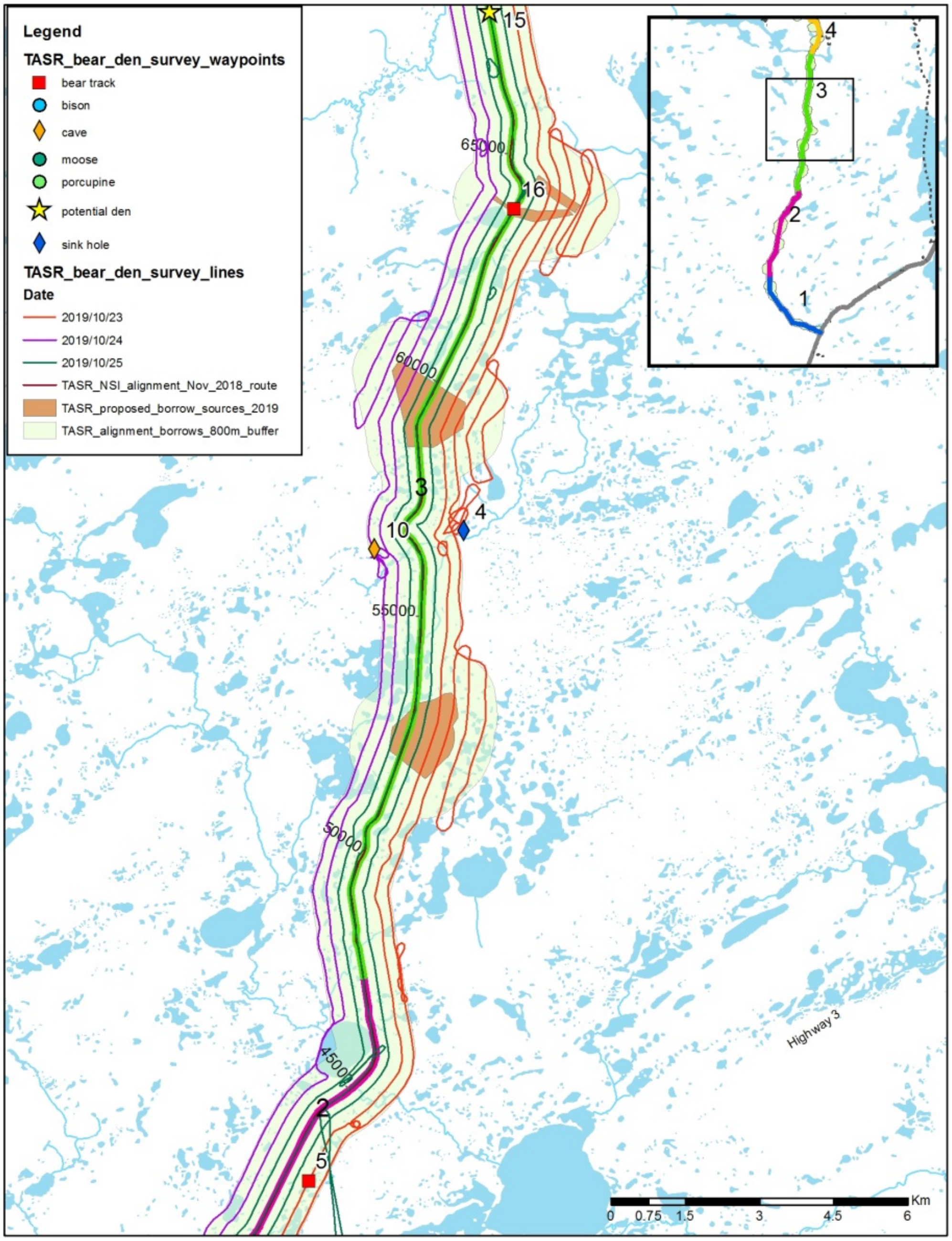

Figure 4. Aerial bear den survey wildlife and wildlife habitat sightings from kilometer 40 to kilometer 65 along the TŁĮCHǪ ALL-SEASON ROAD alignment.

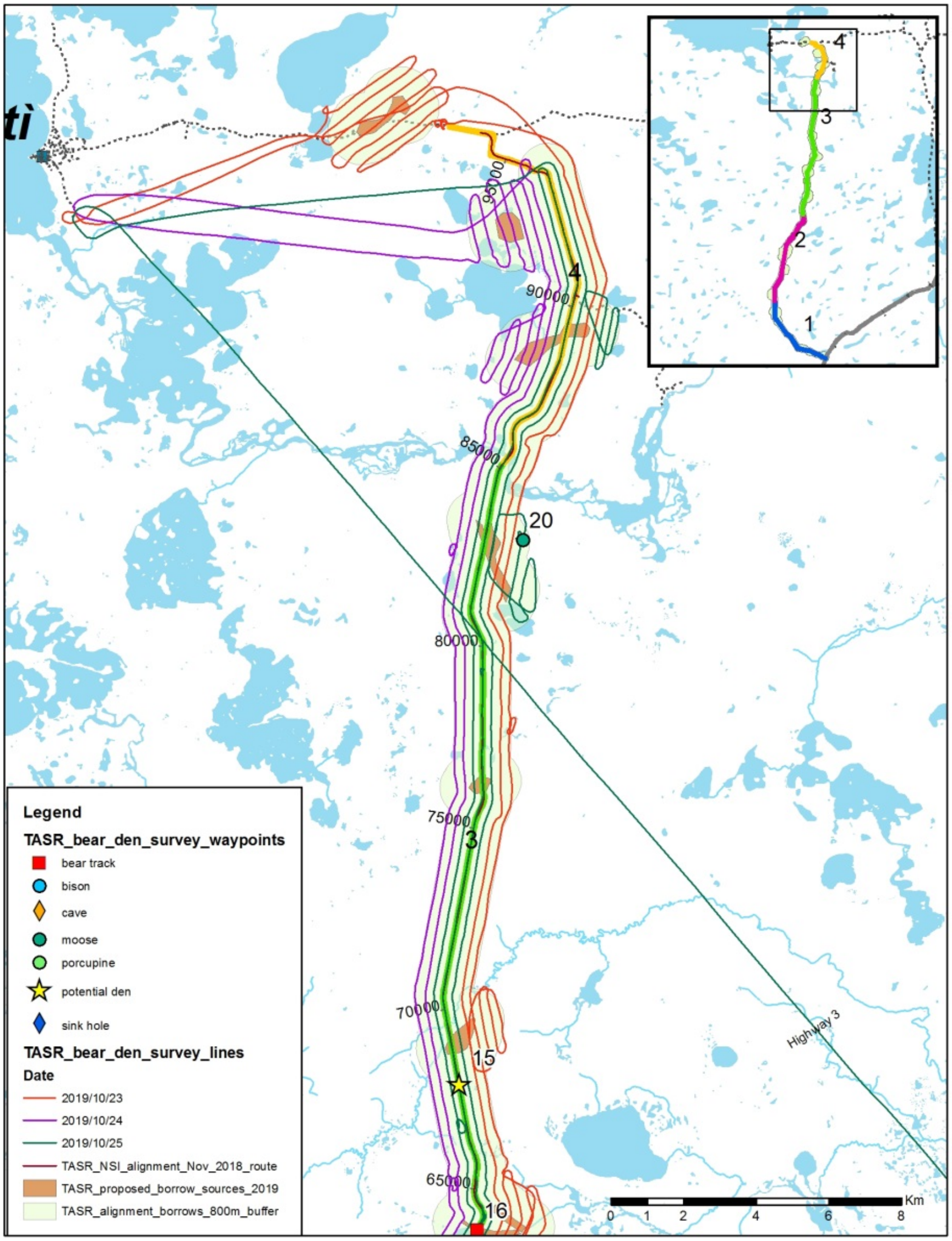

Figure 5. Aerial bear den survey wildlife and wildlife habitat sightings from kilometer 65 to kilometer 97 along the TŁĮCHQ ALL-SEASON ROAD alignment.

Figure 6. Potential den site at waypoint 15.

Figure 7. Potential den site at waypoint 15.

Figure 8. Potential den site at waypoint 7

Figure 9. Potential den site at waypoint 7

Figure 10. Fresh bear tracks recorded at waypoint 16

Figure 11. Two moose sighted at waypoint 6

Figure 12. Six bison recorded at waypoint 11.

Figure 13. Sinkhole at waypoint 4.

Figure 14. Cave at waypoint 12.

Conclusions and Recommendations

Although there was sufficient snow cover in the study area to conduct the survey, warm temperatures around the time of the survey degraded some of the wildlife tracks and may have made it more difficult to detect and discern fresh bear tracks. The survey crew nonetheless observed old and fresh bear tracks and two potential den sites which may have been utilized in previous years. Given that a grizzly bear sighting was reported by NSI on November 01, 2019

(Kiewit-NSI Weekly Environmental Report for October 27-November 02, 2019), it is possible that bears had not yet started denning at the time of the aerial surveys.

ENR recommends the following:

1) NSI continue to carry out with pre-clearing and pre-blast surveys to look for dens and signs of wildlife presence as per Appendix F of the approved Tłįchǫ All-Season Road Wildlife Management and Monitoring Plan.
2) NSI investigate the potential den site that was identified within the right of way between kilometers 65-70 prior to any clearing activities at that location. As outlined in Appendix F of the Wildlife Management and Monitoring Plan, thermal imaging devices were to be trialed by NSI as a tool to detect wildlife. The thermal imaging device should be used to help determine if the den is occupied.
3) If it is determined or suspected that the den is occupied, NSI should contact ENR to discuss mitigation options.
4) A trail camera should be installed near the potential den site to be able to record if a bear emerges from that den during winter construction activities or in the spring.
5) If clearing along the entire length of the right of way and proposed borrow sources is not completed this winter, the aerial bear den survey should be carried out again in fall 2020 for any areas that remain uncleared, and within 800 m of any areas where blasting will occur during the winter 2020-21 season.

Acknowledgments

ENR would like to thank the two monitors from Behchokǫ̀ that participated in the survey, and would also like to thank NSI for allowing ENR to store fuel for the survey within one of their staging areas.

Appendix I: Tłı̨chǫ Government Proposal for TASR Caribou Monitoring Program

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Prepared By:	Tłı̨chǫ Government
Submitted To:	GNWT Environment and Natural Resources; Wek'èezhìi Renewable Resources Board
Date:	July 24, 2020
Subject:	Tłı̨chǫ Government Proposal for TASR Caribou Monitoring Program

1. INTRODUCTION

This proposal summarizes the purpose and proposed approach for the Tłı̨chǫ All-Season Road (TASR) Caribou Monitoring Program, being developed by the Tłı̨chǫ Government. The monitoring program will provide data to be used by the Tłı̨chǫ Government in considering and negotiating mitigations related to the TASR. The proposal includes an overview of the measures relating to this program, the objectives of the program, the proposed monitoring framework, data analysis and reporting, the timeline for developing the program, as well as the human and resource needs.

2. MACKENZIE VALLEY REVIEW BOARD RELEVANT MEASURES

The TASR Caribou Monitoring Program has been developed in accordance with Measures 6-2, 7-1, 7-2 and 9-1 in the Report on Environmental Assessment (REA) issued by the Mackenzie Valley Review Board. Those measures from the REA are as follows:

TASR REA measures related to boreal and barren-ground caribou monitoring program		
Measure 6-2	Determine sustainable harvest levels for boreal caribou (tǫdzı) and implement measures to ensure harvest is sustainable if required	*To mitigate significant adverse impacts from the project on boreal caribou (tǫdzı), the GNWT-ENR, in collaboration with Aboriginal groups and in accordance with the requirements of the Tłı̨chǫ Agreement, will determine sustainable harvest levels for boreal caribou in the North Slave portion of the NT1 range prior to the road being opened to the public.* *In that same period, if current harvest levels are determined to exceed sustainable levels, management action will be undertaken in conjunction with the Tłı̨chǫ Government.* *If harvest levels are observed to increase towards unsustainable levels once the road is opened to the public, GNWT-ENR and Tłı̨chǫ Government will submit a wildlife management proposal under section 12.5.1 of the Tłı̨chǫ Agreement to the Wek'èezhìı Renewable Resources Board for the timely implementation of any measures necessary to ensure boreal caribou harvest in the region is kept within sustainable levels. Such measures may include the establishment of a no- hunting corridor along the Project route.*
Measure 7-1	Incorporate Traditional Knowledge into monitoring of barren-ground caribou (hozìı ɂekwǫ̀)	*To improve and inform mitigation of significant adverse impacts to barren-ground caribou (hozìı ɂekwǫ̀) resulting from increased access due to the Project, the developer will include Traditional Knowledge in barren-ground caribou (hozìı ɂekwǫ̀) monitoring and management. Prior to operations, the developer will:* *a) support the Tłı̨chǫ Government in the design and implementation of a program that uses Tłı̨chǫ harvesters' traditional knowledge and methods to monitor the state of barren-ground caribou (hozìı ɂekwǫ̀) winter habitat, during and after the construction of the Project;* *b) fund the implementation of the program in paragraph a); and,*

		c) incorporate the findings of the program in paragraph a) into the Wildlife Management and Monitoring Plan while it is in place, and into any other barren-ground caribou (hozìı ʔekwǫ̀) management if the Wildlife Management and Monitoring Plan is not extended.
Measure 7-2	Barren-ground caribou mitigation and policy changes	*To manage significant adverse impacts to barren-ground caribou (hozìı ʔekwǫ̀) resulting from the Project, GNWT-ENR and Tłı̨chǫ Government, along with their co-management partners in the Wek'èezhìı area, will:* *a) complete the Bathurst Caribou Range Plan as soon as possible and prior to the expiry of the Wildlife Management and Monitoring Plan; and,* *b) consider protecting barren-ground caribou (hozìı ʔekwǫ̀) historic winter habitat from fires when determining where and when fires are fought, to offset effective habitat loss from the Project.*
Measure 9-1	Monitoring harvest and managing wildlife to maintain successful harvest Part 1 Aboriginal harvest monitoring and reporting program Part 2 Use monitoring to Inform management	*9-1, Part 1: Aboriginal harvest monitoring and reporting program* *To mitigate impacts on Aboriginal harvesters and to effectively inform management of wildlife populations in the area of the Project, GNWT-ENR will work together with the Tłı̨chǫ Government and Wek'èezhìı Renewable Resources Board to develop and implement a non-mandatory Aboriginal harvest monitoring and reporting program.* *The harvest monitoring and reporting program will:* *a) focus on boreal caribou, barren-ground caribou and moose population trends in areas accessed by winter roads and trails from the Project;* *b) be community-based and involve collaboration between Tłı̨chǫ Government and the developer;* *c) involve Traditional Knowledge holders and harvesters in monitoring wildlife harvesting trends; and,* *d) report on wildlife harvesting numbers and trends from monitoring checkpoints and/or other harvest monitoring methods annually to the Tłı̨chǫ Government, Wek'èezhìı Renewable Resources Board, GNWT-ENR and other wildlife co-management partners.* *The developer will fund this harvest monitoring and reporting related to the project. The harvest monitoring will meet the requirements of Appendix C.* *9-1, Part 2: Use monitoring to inform management* *GNWT-ENR, in collaboration with the Tłı̨chǫ Government and Wek'èezhìı Renewable Resources Board, will consider wildlife management actions and mitigations based on the results of the monitoring above and the information collected by the GNWT's existing Resident Hunting Reporting Program, to help ensure sustainable Aboriginal harvesting of wildlife and report on monitoring results and management actions in the annual reviews of the Wildlife Management and Monitoring Plan.*

In addition to direct support of the measures listed above, the data generated by the TASR Caribou Monitoring Program will also play a role in supporting TG decision-making in relation to measures dealing with habitat offsetting (e.g. 6-1, 6-3) and the inclusion of traditional knowledge (e.g. 9-3, 10-2).

3. OBJECTIVES OF THE MONITORING PROGRAM

Based on Measures 6-2, 7-1, 7-2 and 9-1 above, as well as the information provided in the key documents, the following objectives have been identified for the monitoring program:

1. Determine changes in tǫdzı harvesting pressure following construction of the road:

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- Determine sustainable levels of harvest for boreal caribou in the North Slave area before the road is built;
- Monitor harvesting pressure on boreal caribou and moose after the road is built to determine if it is too high.

2. Determine effects of the road on hozìı ɂekwǫ̀ winter habitat:

- Determine impacts to winter habitat from the road based on Tłįchǫ traditional knowledge;
- Use this information to enact measures to protect winter habitat near the road.

3. Develop an Aboriginal harvest monitoring and reporting program for hozìı ɂekwǫ̀ (barren ground caribou) and tǫdzı (woodland caribou) and moose.

Given the sensitive nature of this type of program, we will explore the feasibility of a pilot program to identify protocols for Aboriginal harvest levels along the TASR. Results of this program will be confidential to the Tłįchǫ Government and will be used to inform discussions with the GNWT about measures to reduce harvesting pressure along the TASR, if necessary.

4. MONITORING PROGRAM FRAMEWORK

To meet these objectives, the monitoring program will include the following components:

1. Establish a Harvest Advisors Committee – (K'àgòò Tįlıì Deè Committee), reporting to DCLP

This group, composed of elders and knowledge holders, will provide advice and guidance to the monitoring program, managed by the DCLP. They would contribute both as advisors to the design of the program and as interview participants. They will assist in interpreting results and making recommendations about additional mitigations to implement along the TASR, based on the results of the monitoring programs. The Committee will be struck at the outset of the study, and engaged on an as-needed basis.

2. Work with the K'àgòò Tįlıì Deè Committee and key informants to establish baseline conditions for tǫdzı and hozìı ekwǫ̀ along the TASR.

This work will include using qualitative interviews and/or focus groups to identify the current state of hozìı ɂekwǫ̀ winter habitat, and the state of hozìı ɂekwǫ̀, tǫdzı and moose harvesting levels and their relative sustainability. The K'àgòò Tįlıì Deè Committee will assist with identifying the types of questions to ask and who should be interviewed. Participants will include members of the K'àgòò Tįlıì Deè Committee as well as other key informants they identify. As part of this task, Tłįchǫ monitors will be trained to assess the state of winter habitat and assist with monitoring harvesting pressure along the TASR.

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3. Develop a voluntary harvester report program.

Tłı̨chǫ harvesters who regularly interact with the TASR area will be asked to carry log books and/or a digital app to record their kills and observations, and will submit these log books and/or their recorded data to the Lands office. Combined with effort (i.e., an estimate of how much time people are spending on the land), these data can be used to help inform population estimates and changes over time.

4. Conduct yearly interviews with people who are actively on the land in the vicinity of the TASR.

This work will use follow up interviews to identify changes to the state of winter habitat and changes to the state of hozìı ʔekwǫ̀, tǫdzı and moose populations in the vicinity of the TASR over time. Interviews will be administered to a similar group of people who helped inform the baseline condition, using the same questions to provide consistency over time. Depending on advice from the K'àgòò Tı̨lıì Deè Committee, trained Tłı̨chǫ monitors will also be involved in aspects of this monitoring work.

5. Explore approaches to establish a Tłı̨chǫ-staffed checkpoint along the TASR during the winter hunting season to collect harvest data and observations from returning harvesters.

Tłı̨chǫ operating this checkpoint will be provided with appropriate training to safely conduct interviews and vehicle checks with harvesters using the TASR. The location, timing and duration of operation for this checkpoint will be informed by the K'àgòò Tı̨lıì Deè Committee. Data will be used to report out on harvesting pressure along the TASR and may help inform the need to impose limits on the use of the road for harvesting.

6. Explore approaches for tracking Aboriginal harvesting protocols and levels along the TASR.

Explore the feasibility of conducting a pilot study on hunting protocols and success levels with a group of Tłı̨chǫ harvesters. Harvesters who participate in this program will be asked to provide their input on protocols that are used to manage hunting levels, as well as possible survey approaches or methods based on traditional knowledge that could be used to track Tłı̨chǫ harvesting levels in the future. All results from this pilot project will be kept confidential within the Tłı̨chǫ Government, and will be used to inform measures that should be taken to reduce harvesting pressure along the TASR if necessary.

5. DATA ANALYSIS AND REPORTING

Data will be analysed and reported as follows:

- To establish the baseline condition of hozìı ʔekwǫ̀ winter habitat, and the state hozìı ʔekwǫ̀, tǫdzı and moose harvesting levels in the vicinity of the TASR, data from focus groups and interviews will be summarized in a baseline condition report.

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- These data will be updated using a consistent format each year to identify changes in the condition of hozìı ʔekwǫ̀ winter habitat and hozìı ʔekwǫ̀, tǫdzı and moose harvesting levels.
- Data from the voluntary harvester report program will be used to track changes in population numbers and health over time.
- Data from the Tłı̨chǫ-staffed checkpoint will be used to track changes in harvesting pressure over time and identify situations that may warrant road closures, or other mitigation measures.
- The Tłı̨chǫ Government will retain full confidentiality and ownership of the initial work to explore hunting protocols and guidance for understanding and managing the Aboriginal harvest along the road, and will use this study to determine how best to manage Aboriginal harvesting along the TASR in the future.
- All non-confidential data will be reported out in an annual report to wildlife management partners and incorporated into the Wildlife Management and Monitoring Plan where appropriate.
- All data will be reported to the K'àgòò Tı̨lıì Deè Committee each year, who will provide advice on changes to the monitoring programs and adaptive management.

6. TIMELINE FOR PROGRAM DEVELOPMENT

The table below provides an initial timeline for developing the monitoring program. All dates are proposed and will be finalized with input from Tłı̨chǫ Government staff.

Month	Task	Roles
July 2020	Virtual meetings with ENR and WRRB to consider approach and review timelines. DCLP to submit budget and arrange funding with GNWT. Meetings to consider: approach, budget, mitigation measures, and appropriate threshold points for applying mitigation measures	DLCP, Firelight, WRRB and ENR
August 2020	Establish the K'àgòò Tı̨lıì Deè Committee, including purpose, terms of reference, roles	DCLP
Sept-Oct 2020	Hold meeting of Committee to identify focus group and interviewees and develop focus group questions	DCLP and Firelight
Oct 2020	Hold virtual focus group(s) and interviews with the K'àgòò Tı̨lıì Deè Committee and key informants	DCLP with Firelight support
Nov 2020	Compile results into initial baseline condition report of hozìı ʔekwǫ̀ winter habitat, and the state of both hozìı ʔekwǫ̀, moose and tǫdzı harvesting levels	Firelight with Tłı̨chǫ Government lead
Nov-Dec 2020	Ongoing work with the K'àgòò Tı̨lıì Deè Committee to develop voluntary harvest reporting program (log books or app); develop parameters of checkpoint; develop approach for exploring aboriginal harvest protocols and management approaches	DCLP with Firelight
Jan 2021	Working with harvesters to implement an initial approach to	Firelight with DCLP

	understanding aboriginal harvest levels along the TASR	
Feb 2021	Analyse results and consider future steps	Firelight to analyse results; report to be provided to DCLP
March 2021	Conduct follow-up interviews after hunting season to reassess baseline conditions of hozìı ɂekwǫ̀ winter habitat, and the state of both hozìı ɂekwǫ̀, moose and tǫdzı harvesting levels	DCLP with Firelight support
March 2021	Compile results into baseline condition report	Firelight with DCLP
	End of Fiscal Year 2020-21	
April-June 2021	Develop training and data collection for voluntary harvester reporting program	Firelight with DCLP
June-Sept 2021	Hiring and training for Tłı̨chǫ harvest checkpoint staff	DCLP
June-Sept 2021	Identify and train regular users of TASR area in reporting of observations and hunting effort.	Firelight with DCLP
Sept 2021 – Feb 2022	Data collection during TASR construction to begin this winter. Tłı̨chǫ harvest checkpoint staff to initially provide monitoring during road construction.	Trained staff, DCLP lead. Firelight to provide support as needed.
Sept-March 2021	Data collection for voluntary harvester report program	DCLP lead, Tłı̨chǫ trained harvest checkpoint staff, Firelight support
January 2022	Review and if necessary revise data collection strategy; finalize reporting methods and templates for voluntary harvester report program	Firelight with DCLP
March 2022	Conduct follow-up interviews after hunting season to reassess baseline conditions of hozìı ɂekwǫ̀ winter habitat, and the state of hozìı ɂekwǫ̀, moose and tǫdzı harvesting levels	
March 2022	Compile results of 2021-22 monitoring into draft report	Tłı̨chǫ Government lead with Firelight support
April 2022	Meet with Committee to get advice on revisions and adaptive management	Tłı̨chǫ Government lead
	End of Fiscal Year 2021-22	
May 2022	Finalize all aspects of monitoring program, including data collection, monitoring, reporting, and decision-making	Firelight with DCLP
May 2022 – ongoing	Monitoring program operations based on final program framework. *Note: funding for ongoing operations of monitoring program to be determined based on program development from July 2020 – May 2022.	DCLP staff, Tłı̨chǫ trained monitors, K'àgòò Tı̨lıì Deè Committee

7. HUMAN AND INFRASTRUCTURE RESOURCE NEEDS TŁĮCHǪ GOVERNMENT

The Tłı̨chǫ Government runs a number of other monitoring programs that are relevant to this proposed work. Based on the existing programs, the following potential synergies and human resource needs have been identified:

- The Tłı̨chǫ Government currently runs the Ekwǫ̀ Nàxoède Kè (Boots on the Ground) program monitoring summer habitat of the Bathurst Caribou through the DCLP. Data monitoring approaches, indicators, and approaches will be shared between the programs. Training and coordination, as well as data management techniques will also be shared between the programs.

- The Tłı̨chǫ Government will rely on the existing trained monitors and continue to train further monitors – which will require a range of types of training (e.g., BEAHR monitors, among others).
- The Tłı̨chǫ Government will require a new staff member to manage this program, along with the support of a consulting firm. The Firelight Group has assisted in the design of the proposal and will assist with program design, data collection, and analysis.

8. CLOSURE

The Tłı̨chǫ Government looks forward to working closely with all parties on the development and implementation of this work over the coming years.

Should you have any questions about this proposal, please contact me at 1-867-447-4704.

In Tłı̨chǫ Unity,

Tyanna Steinwand

Manager, Research Operations and Training

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APPENDIX: SUPPORTING DOCUMENTS AND PROGRAMS

The table below lists key relevant documents for the proposed monitoring program.

Document	Link or location
Tłıchǫ All-Season Road Wildlife Management And Monitoring Plan (Version 3.4; 2019)	http://registry.mvlwb.ca/Documents/W2016E0004/W2016E0004%20-%20TASR%20-%20Wildlife%20Management%20and%20Monitoring%20Plan%20-%20Version%203.4%20-%20Aug%2030_19.pdf
K'àgòò tıl̨ı Deè: Traditional Knowledge Study for the Proposed All-Season Road to Whatì (2014)	https://research.Tłı̨chǫ.ca/sites/default/files/tk_report_whati_road_.pdf
Summary of the capture and collaring of boreal caribou along the proposed Tłıchǫ All-Season Road to Whati, NT, March 2017	Provided via email by Michael Birlea May 1 2020
Summary of winter 2018 field work carried out under Wildlife Research Permit WL500580 (Hodson and Patenaude 2018)	Provided via email by Michael Birlea May 1 2020
Summary of winter 2019 field work carried out under Wildlife Research Permit WL500580 (Hodson 2019)	Provided via email by Michael Birlea May 1 2020
Tłıchǫ All-Season Road Caribou (tǫdzı) Draft Habitat Offset Plan	*Not barren-ground caribou (hozìı ʔekwǫ̀) related but a potential resource for habitat offset materials.*
Concordance Tables 1 and 2 on the First Draft (delivered June 17, 2019) of the Boreal Caribou Habitat Offset Plan for the Tłı̨chǫ All Season Road.	
Tłıchǫ Traditional Knowledge Study for Winter Trip on TASR (2020)	*Link to be provided*

Identified Recent ENR Work relevant to TASR

- March 2017 – Deployment of 20 boreal caribou collars
- Feb 2018 – Deployment of 5 more boreal caribou collars; Moose/Bison aerial abundance survey
- Mar 2018 – Boreal caribou composition survey
- Mar 2019 – Deployment of 7 more boreal caribou collars; Boreal caribou composition survey
- Oct 2019 – Aerial bear den survey
- Feb/Mar 2020 – Boreal caribou abundance/composition survey; Wolf Abundance Survey

Note: additional documents and references will be compiled as part of the kick-off phase of this project.

Appendix J: Review of wildlife effects monitoring programs in the Wildlife Management and Monitoring Plan for the Tłı̨chǫ All-Season Road

Review of wildlife effects monitoring programs in the Wildlife Management and Monitoring Plan for the Tłı̨chǫ All-Season Road.

Government of the Northwest Territories Environment and Natural Resources contract

2019

W.J. Rettie

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EXECUTIVE SUMMARY

This report is a technical review of the wildlife effects monitoring program components of the Wildlife Management and Monitoring Plan (WMMP) for the Tłı̨chǫ All-Season Road (GNWT-INF 2019).

The wildlife effects monitoring portion of the WMMP outlines two basic categories of monitoring programs: monitoring focused on wildlife and monitoring focused on the road. The road-focused monitoring includes: monitoring traffic levels; monitoring human use of the road for access to off-road areas; monitoring hunter harvest of moose and caribou; and monitoring wildlife activity on and near the road including wildlife-vehicle collisions. The methods outlined for road-focused monitoring appear able to deliver the key information for which they are designed and provide opportunities to add information and analyses that can enhance the ability to predict the relationships between wildlife and the road. The addition of a new Renewable Resources Officer in Whatì will be instrumental in delivering these monitoring programs as will collaborative relationships between the Department of Environment and Natural Resources and the Tłı̨chǫ Government, the Wek'èezhìı Land and Water Board, and the Department of Infrastructure.

The monitoring programs focused on wildlife include population surveys for moose, bison, boreal caribou, and wolves. It is unlikely that aerial surveys for boreal caribou will be effective at detecting population change. Aerial surveys will likely be limited to detecting large changes in bison and moose populations, changes that may arise from moderate annual changes that accumulate over many years. Bison survey data will also be used to track changes in the occupied bison range.

The wildlife monitoring programs also include tracking of radio-collared boreal caribou, use of radio-collar data from barren-ground caribou, and the possible tracking of radio-collared wolves. In each study with radio-collared animals the resulting data will provide the necessary information to monitor moderate changes in survival rates, recruitment rates, and population growth rates (generally using several years of data together). They will also provide the data to create resource selection functions and other associated wildlife-habitat relationships (e.g., step-selection functions) that will explain and predict wildlife behaviour, including the effect of the road and traffic on each species.

Beyond harvest and population dynamics, radio-collared caribou will provide some notice of animals approaching the road, though detection of animals with this method will be inadequate to predict most encounters of caribou with the road. However, in combination with resource selection analyses using radio-collar data and wildlife observations, predictive occurrence models and effective mitigation strategies should be possible.

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ABBREVIATIONS AND ACRONYMS

Term	Definition
CEA	Cumulative effects assessment
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CV	Coefficient of variation. A standardized measure of the precision of an estimate. Equal to the standard error divided by the mean.
CWS	Canadian Wildlife Service
DAR	Developer's Assessment Report. For the TASR, the DAR consists of the Adequacy Statement Response plus the Project Description Report
DNA	Deoxyribonucleic acid
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
GNWT	Government of the Northwest Territories
GNWT-DOT	Department of Transportation, GNWT
GNWT-ENR	Department of Environment and Natural Resources, GNWT
GNWT-INF	Department of Infrastructure, GNWT
GNWT-Lands	Department of Lands, GNWT
GPS	Global Positioning System
MVEIRB	Mackenzie Valley Environmental Impact Review Board
NWT	Northwest Territories
Project	The Tłı̨cho All Season Road
SARA	Species at Risk Act
SARC	Species at Risk Committee (NWT)
SE	Standard error (of an estimate)
TASR	Tłı̨chǫ All Season Road
TG	Tłı̨chǫ Government
UD	Utilization Distribution
WLWB	Wek'èezhìı Land and Water Board
WMMP	Wildlife Management and Monitoring Plan for the Tłı̨chǫ All Season Road
WRRB	Wek'èezhìı Renewable Resources Board
WVC	Wildlife Vehicle Collision

1.0 INTRODUCTION

1.1 Tłı̨chǫ All-Season Road (TASR) Project Background

In March 2016 the Government of the Northwest Territories Department of Transportation (GNWT-DOT) prepared a Project Description Report (GNWT-DOT 2016) for the proposed Tłı̨chǫ All-season Road (TASR). The Project Description Report accompanied applications to the Wek'èezhìı Land and Water Board (WLWB) for a Type A Land Use Permit and a Type B Water Licence. Following various stages of review, comment, materials submission, and information requests the Mackenzie Valley Environmental Impact Review Board (MVEIRB) issued an Adequacy Statement to GNWT-DOT in October 2016. The Adequacy Statement detailed the outstanding information required to satisfy MVEIRB's terms of reference. In April 2017 the Government of the Northwest Territories Department of Infrastructure (GNWT-INF) submitted an Adequacy Statement Response (GNWT-INF 2017) to MVEIRB. Together, the Project Description Report and the Adequacy Statement Response constitute the Developer's Assessment Report (DAR) for the TASR.

1.1.1 TASR Description

The TASR will be a 94 km all-season road connecting Highway 3 to the community of Whatì (Figure 1). The TASR will be a two lane gravel highway (60 m wide right-of-way) with a designed speed of 80 km/hr and a posted speed of 70 km/hr (GNWT-DOT 2016). Of the 94 km, 17 km is located on Tłı̨chǫ land and the remainder on NWT land (GNWT-DOT 2016). Traffic estimates are for between 20 and 40 vehicles per day including traffic associated with a proposed mine northeast of Whatì. The four-year construction schedule runs from November 2018 to November 2022, with the project opening by the end of November 2022 (GNWT-INF 2017).

1.1.2 TASR Wildlife Management and Monitoring Plan (WMMP)

The original version of the TASR Wildlife Management and Monitoring Plan (WMMP) accompanied the permit application in 2016. The GNWT-INF submitted version 3.3 of the TASR WMMP on June 14, 2019. Version 3.3 of the WMMP (GNWT-INF 2019) incorporated revisions arising from: reviews by communities and First Nations; traditional knowledge reports; reviews by the Government of the Northwest Territories Department of Environment and Natural Resources (GNWT-ENR) and WLWB; the Adequacy Statement and the Adequacy Statement Response; and subsequent commitments made by GNWT-INF during the permitting process.

The WMMP conforms with the recent Process and Content Guidelines (GNWT-ENR 2019). Under the guidelines, the WMMP is required for developments if the activities are likely to:

"*(a) result in a significant disturbance to big game or other prescribed wildlife;*

(b) substantially alter, damage or destroy habitat;

(c) pose a threat of serious harm to wildlife or habitat; or

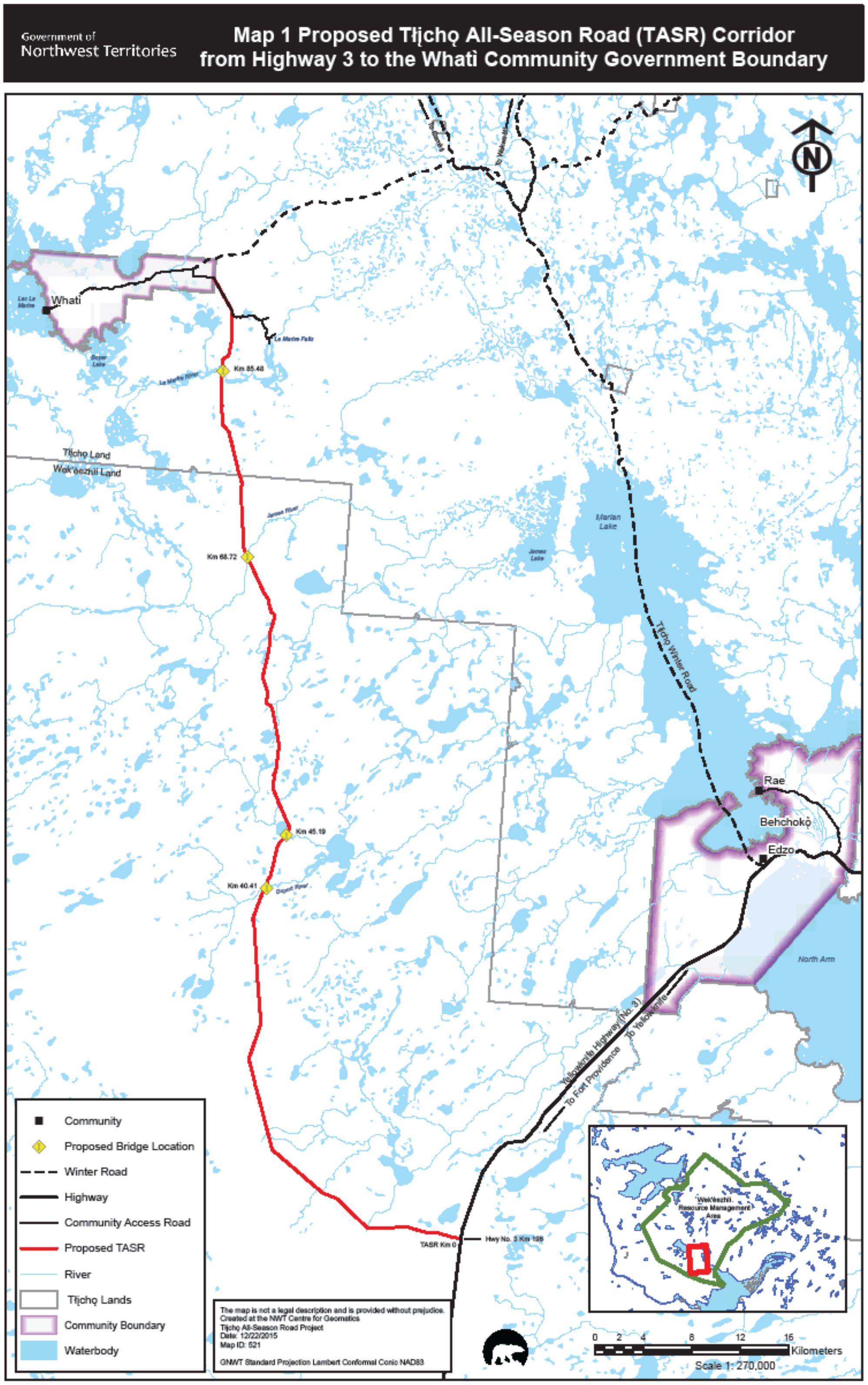

Figure 1: Map of the Proposed Tłįchǫ All-season Road. (From GNWT 2016: Proposed Tłįchǫ All-season Road Project Description Report)

(d) significantly contribute to cumulative impacts on a large number of big game or other prescribed wildlife, or on habitat."

(GNWT-INF 2019, p. 11)

The WMMP guidelines (GNWT-ENR 2019, pp. 37-38) distinguish among three different types of monitoring:

- Mitigation monitoring (regular inspections to verify the application of approved designs, procedures, and equipment);
- Wildlife effects monitoring (systematic tracking of indicators to quantify project-related effects on wildlife and wildlife habitat); and
- Regional scale wildlife monitoring (typically participation in, or contribution to, regional scale monitoring of cumulative effects consistent with any predicted project-related regional effects).

1.2 Report focus: Wildlife Effects Monitoring

This report is a technical review of the wildlife effects monitoring program components of the WMMP for the TASR (GNWT-INF 2019). The focal wildlife species identified in the WMMP for wildlife effects monitoring are:

- boreal caribou;
- barren-ground caribou;
- moose;
- bison; and
- wolves, by virtue of their role as a predator common to the other four species.

The wildlife effects monitoring program was designed to address the direct and indirect effects of the TASR on the habitat and distribution and abundance of these species, including mortality from predation, hunting, and accidents. The list of primary objectives of the wildlife effects monitoring activities are listed in Section 5.2 of the WMMP (GNWT-INF 2019, pp. 5-37 and 5-38).

1.3 Report objectives

The report objectives are to:

1) Evaluate specific wildlife effects monitoring programs described in Sections 5.2.1 to 5.2.7 of the TASR WMMP to:
    a. Determine whether the study design and methods described for each monitoring program are appropriate to meet the monitoring objectives and to answer the specific monitoring questions listed,

b. Determine if the sample size, sampling frequency and spatial scale of each monitoring program will provide enough statistical power to detect changes in the parameters of interest and triggers for adaptive management within the time frame specified for the monitoring program. This may require some statistical power analysis using data previously collected for the TASR WMMP or from similar surveys previously conducted by GNWT-ENR;

2) Make recommendations on the methods and design of surveys to estimate abundance of boreal caribou, predators (wolves and black bears), moose, and bison;

3) Make recommendations on the statistical methods that can be used to analyze the monitoring data to answer the specific monitoring questions outlined in Sections 5.2.1 to 5.2.7 of the WMMP; and

4) Make recommendations on quantifiable triggers for adaptive management based on the results of monitoring programs in the sections of the WMMP described above (see Section 6.0 of the WMMP).

1.4 Report structure

In Section 2, a broad overview of the structure of effective monitoring programs is presented. It is followed by a description of sampling power and its importance in environmental monitoring, particularly in the context of adaptive management.

In Section 3, each element of the wildlife effects monitoring program in the WMMP is summarized including its stated monitoring objective and a description of methods. It is followed by an evaluation of the method and its strengths and weaknesses. A discussion of alternative methods is provided with an assessment of the method.

2.0 ESTABLISHING QUANTITATIVE MONITORING OBJECTIVES

To monitor the effects of a Project and to use the results of monitoring activities to evaluate and adjust mitigation actions (i.e., to adaptively manage) requires that the environmental variables being monitored are quantifiable and have an expected relationship to the effects of the Project. The necessary precision to identify important change in each metric (a measurable environmental variable or indicator) relates to the effect size requiring detection, the variance in the data to be collected, and the confidence and power desired. The precision in turn dictates sample size and distribution.

Consideration should also be given to the available management or monitoring response if the value of a metric crosses a threshold or reveals an effect size determined to be of concern.

2.1 Necessary elements for establishing quantitative objectives

The selection of metrics (indicators) for monitoring is guided by several related factors:

- The existence of an identified important threshold or important effect size for each metric;

- That the metrics be quantifiable;
- That variance can be reasonably estimated; and
- That the required precision of measurement is attainable with available methods, and affordable with the given budget.

2.2 Selection of statistical test, sampling power, confidence

In establishing a formal monitoring program it is important to consider the desired power and confidence of the program in advance, as they are integral to establishing effective monitoring methods for any performance indicator. Confidence, the probability of avoiding a Type I statistical error[1], provides a level of certainty that differences detected and reported through monitoring are true differences and not errors in measurement. Power, the probability of avoiding a Type II statistical error[2], is a measure of certainty that when important changes occur they will be detected (e.g., detecting if a population size has fallen below a pre-determined threshold or if a population growth rate has changed by more than a pre-determined important amount). Determining the ecologically important effect size (the value of a threshold that the indicator may cross, or the level of change in the indicator's value); the amount of change that you want to be able to detect, is an important step in power analysis.

The selection of power and confidence levels is largely a matter of convention. Research studies have routinely adopted confidence levels of 95% or 90% (alpha = 0.05 or 0.10 respectively). More recently, the convention for monitoring programs is to seek a power of 80% when designing studies. Ultimately, the power and confidence adopted must relate to the levels of acceptable risk, the likelihood of success, and the associated costs. These will vary in each case and are important considerations prior to initiating a monitoring program. Prospective power analysis will prepare those involved for the likely results, their strengths and weaknesses, and the associated costs.

Both power and confidence can be improved with reductions in the variance of data collected, with longer studies, with larger sample sizes, and with management actions likely to have larger effects on the performance indicators. An evaluation against a fixed value (i.e., a threshold) has an advantage over the comparisons of two or more estimates. A fixed threshold value has no error in the threshold measurement; hence the measured value of the performance indicator and its variance will influence the

[1] Type I statistical error. In the context of ecological monitoring over time, a Type I error occurs when a parameter (e.g., survival rate or population size) is determined to have changed through time when it has not, i.e., a false detection of change. Setting a higher confidence level for a monitoring program reduces the probability of making a Type I error.

[2] Type II statistical error. In the context of ecological monitoring over time, a Type II error occurs when a parameter (e.g., survival rate or population size) is determined not to have changed through time when it really has changed. The power is the probability that meaningful changes in the parameter of interest will be detected through the monitoring program (i.e., increasing power reduces the probability of a Type II error).

ability of a monitoring program to determine the value of the performance indicator relative to the threshold.

If monitoring a performance indicator value is through measurement between two (or more) periods, there is variance in each measurement of the performance indicator that influences the ability of monitoring to detect change. Accounting for the uncertainty in the performance indicator estimates requires either a larger effect to have occurred, improved precision (requiring larger samples, longer monitoring), or accepting a lower confidence that a change has occurred. When using an absolute threshold for comparison (e.g., determining if a population growth rate is consistent with a stable population), the uncertainty resides entirely within the performance indicator measurement at one point in time.

3.0 TASR EFFECTS MONITORING PROGRAMS

3.1 Traffic monitoring (WMMP 5.2.1)

The objective of the traffic monitoring program is to provide long-term averages of daily traffic levels for comparison with predictions in the DAR. The DAR included a cumulative effects assessment (CEA) that accounted for use of the TASR for access to the community and for cumulative effects including three reasonably foreseeable developments: the Fortune Minerals Ltd. Nico mine; the Nailii Hydroelectric Project at La Martre River Falls; and Tłı̨chǫ/Whatì Park Area at La Martre Falls (GNWT-INF 2017). While there were other factors considered in the CEA, none of them were factors that would affect traffic levels on the TASR or that anticipated the construction of other roads connected to the TASR.

The proposed approach for traffic monitoring is to operate a series of both permanent and seasonal mechanical traffic counters and to conduct visual counts and surveys periodically on a regular schedule to verify automated counts (GNWT-INF 2019, p. 5-39). The traffic monitoring program presented in the WMMP will be highly effective in meeting its objectives as it will count vehicles as they pass and will be validated for accuracy.

The traffic monitoring data that will be collected as described in the WMMP will meet or exceed the traffic data required for comparison with predicted traffic volumes. The availability of hourly traffic information throughout the year will equal or exceed the availability of all wildlife effects monitoring program data making detailed traffic data available as a covariate for other analyses. Traffic data will be a strong component of wildlife effects monitoring. The location of traffic counters can enhance both analyses of the effects of the TASR on wildlife and mitigation of the effects of the road. Similarly, locations for monitoring of seasonal access roads may enhance other monitoring programs. Consideration of needs related to other monitoring programs should be used to inform the locations for traffic data acquisition.

3.2 Access and harvest monitoring (WMMP 5.2.2)

The broad objectives of the access and harvest monitoring program are to monitor hunting along the TASR, hunting in newly accessible areas near the TASR, and the extension of seasonal access through use of the TASR. Both legal and illegal wildlife harvest are of concern. When harvest estimates are available, the sustainability of those harvests will be assessed. Collaborative wildlife monitoring and management between GNWT and the Tłı̨chǫ Government is proposed, as is collaborative access monitoring with Fortune Minerals. The specific questions for the program are to:

- determine if the highway is resulting in a pattern or level of harvest mortality for moose and caribou that would suggest a conservation concern or need for additional harvest management actions;
- identify who is using the road to access harvest opportunities;
- determine the sex and age structure of the harvested population of moose in the North Slave Region; and
- determine if and where moose are being harvested near the TASR.

3.2.1 Renewable Resource Officer in Whatì

As a result of TASR construction, a new GNWT-ENR Renewable Resource Officer (RRO) position will be created in Whatì. Scheduled patrols (e.g., weekly or semi-weekly throughout the year, more frequently during harvest seasons) by the RRO should be highly effective in documenting:

- points of access from the TASR (e.g., locations of newly established trails, access points to open areas or existing trails for snowmachines or all-terrain vehicles);
- a count of observed hunting groups and their vehicles;
- observations of, or evidence of, successful harvests based on loading points along the TASR;
- information from direct interactions with harvesters; and
- wildlife sightings and collisions (Section 3.6).

A GNWT checkpoint on the TASR is planned during the winter barren-ground caribou season if there is evidence that hunters are using the TASR to access barren-ground caribou.

3.2.2 Collaboration of GNWT-ENR with Tłı̨chǫ Government and Wek'èezhìı Renewable Resources Board

The ability to build relationships between GNWT-ENR and Tłı̨chǫ Government (TG) and the Wek'èezhìı Renewable Resources Board (WRRB) will be important for effective harvest management in the TASR study area. Moose and boreal caribou are not abundant in the area and will have limited ability to sustain harvest. Currently, the GNWT-ENR only has information on licensed resident harvest. Knowledge of indigenous harvest will be an important component in making appropriate decisions about licensed harvest in the area. The proposed approach of having community members collect information has been successful in other jurisdictions, such as with the Porcupine Caribou Management Board.

3.2.3 Aerial surveys to monitor harvesting activities

The use of aerial surveys to monitor barren-ground caribou harvesting activities should be effective in confirming hunting activity and identifying access points from the TASR. Coupled with RRO road patrols, access points should be well documented.

In addition to locating and monitoring access points, the effects of the TASR on the distribution of all ungulate species would benefit from knowledge of the spatial extent of hunting activity from the various access points along the TASR. The access trail network branching out from the TASR can be mapped in its current state from existing maps, aerial photographs, satellite imagery, and GIS layers of linear features. Coupled with patrols along the TASR that can identify access points, aerial surveys could be used to plot trail networks, signs of active hunting, and possibly harvest sites. Remotely sensed imagery and aerial photographs may also contribute to such a dataset. Any expansion of trail systems across years may coincide with changes in prey distribution and harvest mortality rates. Knowledge of the areas used by hunters and its relationship to wildlife distribution and abundance will be important in assessing the effects of the TASR and in designing effective mitigation strategies. Though not currently part of the WMMP, mapping the pre-construction trail network branching out from access points would provide baseline data for comparison should the interest and funding become available for future monitoring.

3.2.4 North Slave Region moose jaw collection

The jaw collection program currently operating in the North Slave Region provides an opportunity to collect additional information about number and locations of harvested moose and add sex and age structure to the population estimates for the region. All of these data are valuable:

- for population modelling and harvest management (age, sex, number of harvested moose); and
- for TASR road mitigation.

Additionally, direct interactions with hunters are an opportunity to acquire additional information and share harvest management information and objectives.

3.2.5 Population modelling and management

The information collected from hunters combined with ungulate population monitoring programs (Sections 3.3, 3.4, 3.5) provides the input data for population and harvest modelling. Population modelling can be useful in guiding management decisions, identifying potential harvest thresholds, and identifying information needs.

The GNWT-ENR is currently undertaking a boreal caribou modelling exercise to aid in determining sustainable harvest levels throughout the southern NWT.

3.3 Boreal caribou (WMMP 5.2.3)

The deployment of radio-collars is indicated as a centerpiece of North Slave Regional boreal caribou monitoring. The monitoring objectives described in the WMMP are to help determine:

- *"Where collared boreal caribou are located in relation to construction activities;*

- *If boreal caribou avoid the road during and after construction;*
- *If and where boreal caribou cross the road;*
- *If the rate of boreal caribou movements changes in proximity to the road and, if sample sizes allow, the potential zone of influence of the road on boreal caribou habitat use;*
- *If rates of caribou mortality increase within the study area during and after highway construction; and*
- *The population trend of boreal caribou in the regional Tłı̨chǫ ASR study area"* (GNWT-INF 2019, p. 5-44)

The objectives fall into three broad categories addressed in Subsections 3.3.1 to 3.3.3:

3.3.1 Using collared animal locations to mitigate construction activities

The deployment of radio-collars and the subsequent behaviour of collared animals will give each adult animal in the population an equal probability of having a radio-collar, this may vary if a different proportion of each sex is collared and if gregarious behaviour is sex-specific, but for illustrative purposes I have chosen to consider all animals as equally likely to be collared. Mathematically:

$$p = \frac{i}{N}$$

Where *p* is the probability of a randomly selected animal in the population having a radio-collar, *i* is the number of radio-collars deployed, and *N* is the caribou population size. Conversely, the probability of a randomly selected animal to be without a radio-collar can be represented as:

$$q = 1 - p$$

If we assume that a group will be detected if it contains at least one collared animal, then the monitoring concern is the failure to detect a group because it contains zero collared animals. If we assume that collared animals are distributed at random among all the groups in the population then the probability of a group containing a collared animal will be related to group size. As group size increases it will be more likely that it will contain at least one collared animal. The collective probability of all animals in a group of size *g* being without radio-collars is:

$$q^g$$

and the probability of group containing at least one radio-collared animal is:

$$1 - q^g$$

Rettie (2019) summarized areas of interest for GNWT-ENR boreal caribou population monitoring, modelling, and harvest management. Included was a North Slave study area of 22,204 km^2, an area that includes most of the TASR study area for boreal caribou. If a minimum population density of 1 caribou per 100 km^2 is assumed for North Slave (TASR) study area, the population estimate is 222 caribou (*N* =222). The TASR WMMP commitment for monitoring is for 30 boreal caribou to be radio-collared at all times (*i* = 30). From the equations above the probability of a randomly selected caribou having a radio-collar is:

$$p = \frac{30}{222} = 0.135$$

and the probability of it not having a radio-collar is:

$$q = 1 - 0.135 = 0.865$$

Figure 2 shows a range of group sizes plotted against the probability of a group of that size containing at least one radio-collared individual. The North Slave (TASR) study area probabilities are based on 13.5% of animals being collared and three additional levels of collaring intensity (10%, 20%, and 25%) are plotted for reference. The probability of a group containing at least one radio-collared individual effectively represents the probability of detection of groups of various sizes when using telemetry data to locate groups.

Assuming 30 radio-collars in a population of 222 caribou, to have a 50% chance of detecting a group of boreal caribou in the North Slave (TASR) study area through its inclusion of at least one radio-collared individual, the group would need to have a minimum of 5 animals (Figure 2, red dashed lines). Average group sizes observed during GNWT-ENR winter classification surveys conducted in the TASR study area were 6.1 (Hodson and Patenaude 2018) and 5.1 (Hodson 2019); groups whose sizes make their likelihood of detection between 52% and 58% when 13.5% of the caribou in the North Slave (TASR) study area are radio-collared. The largest group observed during the two years of winter surveys was 16 caribou.

If the North Slave (TASR) study area population is larger than 222 caribou, the probability of each individual being without a radio-collar would increase and the probability of a group of a given size to contain at least one collared animal would decline; the effect would be to lower the solid black line plotted in Figure 2. Conversely, if the proportion of animals in the vicinity of the TASR with radio-collars is above the 13.5% calculated for the North Slave (TASR) study area then groups of each size will have a higher probability of being detected. Based on 2018 and 2019 survey results (Hodson and Patenaude 2018, Hodson 2019), and considering only animals likely to interact with the TASR (GNWT-ENR personal communication) yields a percentage of animals collared of between 22% and 25%; consistent with >50% detection of groups of ≥3 caribou (Figure 2).

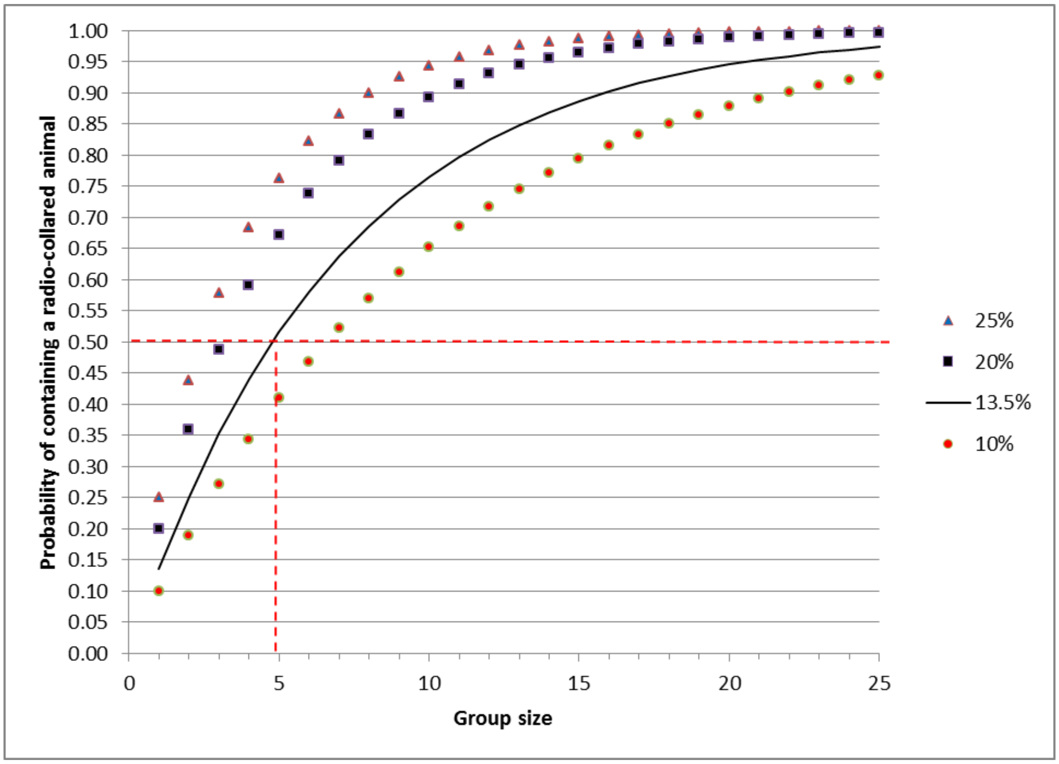

Figure 2: Probability of detection of different sized groups of boreal caribou (equal to the probability that the group contains one or more radio-collared caribou). The four sets of data indicate the percentages of all caribou in the area that are radio-collared (black line, 13.5% [North Slave (TASR) study area caribou currently collared]) and other potential percentages of animals collared (10%, 20%, 25%) Based on the 2019 aerial survey minimum population count, up to 25% of caribou likely to interact with the TASR are currently collared. Horizontal red dashed line shows 50% probability of detection.

The use of telemetry data to attempt to mitigate the effects of construction (or operations) activities in real-time is unlikely to be completely effective as:

- the majority of groups of ≤ 3 caribou will not contain a radio-collared individual. This is of particular importance during calving , post-calving, and summer periods when female boreal caribou are with a single calf or are solitary (i.e., a group size of 1 or 2);
- many larger groups will also not contain radio-collared individuals; and
- there is a time lag of up to two days between telemetry data acquisition by the radio-collar and data acquisition by GNWT-ENR.

It is important to use the telemetry data that are available as they will accurately track individuals and identify some groups close to the road; however the absence of telemetry locations close to the road will not indicate the absence of caribou in the area at any given time.

3.3.2 Resource selection by caribou relative to the TASR and other environmental factors

Three of the monitoring objectives can be grouped together as relating to determination of resource selection including the TASR as an environmental covariate. The commitment to deploy radio-collars on a minimum of ten animals in the vicinity of the road; to maintain data collection for a minimum of five years during TASR operation; and to increase the rate of data acquisition when collared animals are within 10 km of the road will generate a data set sufficient to allow resource selection functions to be determined for caribou in the region and to determine the effect of the road on caribou behaviour. The collection of hourly traffic flows will further enhance the analyses of caribou behaviour and the role not only of the presence of the road but the contributing role of traffic volume to any observed barrier effect. Effects on speed of travel, probability of crossing, and the relationships of these behaviours with other habitat covariates should all be possible under the data collection proposed. The fine spatial and temporal scales of the location and covariate data sets will lend themselves to step-selection analyses to identify key corridors, environmental covariates, and traffic patterns (e.g., Beyer et al. 2016; Prokopenko et al. 2017) and lead to the implementation of effective mitigation strategies.

The use of telemetry data to identify the effects of the Project on caribou behaviour and the relationships between behaviour and environmental covariates (including the TASR) has a high potential to contribute to effective long-term mitigation.

3.3.3 Caribou population and mortality monitoring

Population trend monitoring

The vital rate of greatest interest is Lambda (λ), the population growth rate (GNWT-INF 2019, Section 5.2.3). Lambda can be calculated in a number of ways, but combining adult female survival estimates from radio-collared animals with recruitment estimates from late winter composition aerial surveys (Hatter and Bergerud 1991; Hervieux et al. 2013) is the most common method used for boreal caribou in Canada (Rettie 2017). Estimates of adult female survival and recruitment are conducted annually by GNWT-ENR and combined to estimate λ. As noted in Section 3.3.1 above, the North Slave (TASR) study area for boreal caribou is largely within the North Slave study area monitored by GNWT-ENR, though the North Slave (TASR) study area also includes part of the Mackenzie boreal caribou study area (Figure 3). In a recent population and harvest modelling report (Rettie 2019), the boreal caribou vital rate data for the North Slave study area were combined with data from the Dehcho North and Mackenzie study areas for the period from 2008 to 2018 to represent vital rates in NWT Wildlife Management Zone R (Zone R). Combining the data from the three study areas was considered to:

1. provide a better representation of the variation in vital rates for the region;
2. compensate for there being only 1 year of vital rate data in the North Slave study area at the time; and
3. recognise that individuals from all three areas occasionally move across study areas.

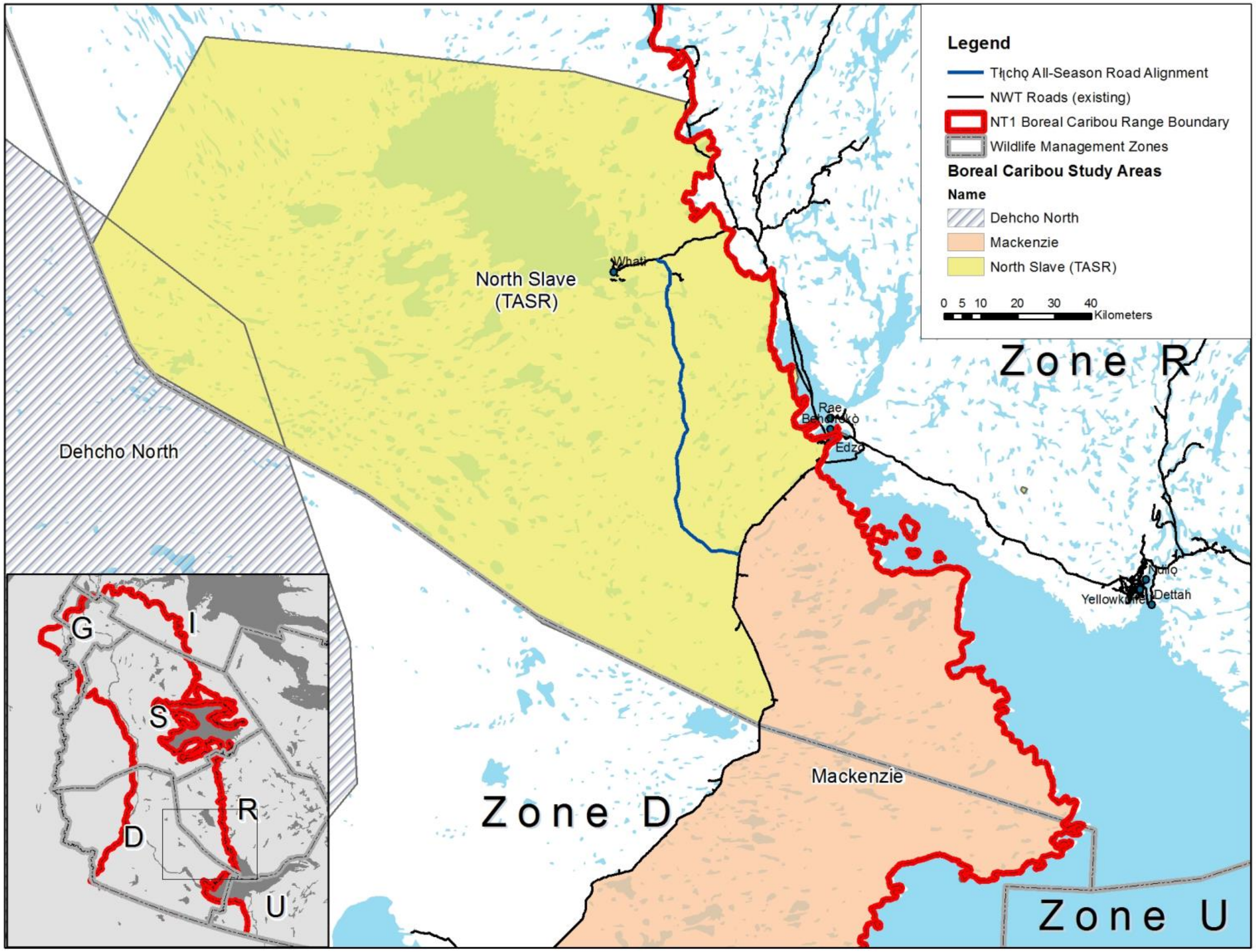

Figure 3: The North Slave (TASR) study area for boreal caribou.(GNWT-ENR).

The power of the proposed TASR monitoring to detect changes in λ was assessed through simulations using existing data presented in Rettie (2019). To assess the relationship between data from TASR study area radio-collared caribou survival and aerial composition surveys and the precision of survival, recruitment, and population trend estimates, a Monte Carlo modelling exercise was undertaken in R version 3.3.3 (R Core Team 2017). Empirical survival and recruitment data from 2008 to 2018 were pooled and as described above and used to provide input values for the simulations for Zone R. The simulations followed those used by Rettie (2017) to determine the likely variation in key vital rates when a sample of 30 radio-collars is maintained on a boreal caribou population (in March 2019 the TASR study area contained 30 radio-collared boreal caribou [Hodson 2019]). Knowledge of variation in survival, recruitment, and population growth rates over monitoring periods of different lengths determines the power of the monitoring program to detect changes in those parameters. The coefficients of variation (CV) for survival, recruitment, and λ were calculated for each simulation and are presented in Figure 4.

Figure 4a presents the CVs of annual adult female survival based on simulation of three- to nine-year monitoring programs with 30 radio-collared caribou. The results show that three-year monitoring programs are likely to include considerable variation in annual survival estimates; that the precision of those estimates improves for five- and seven-year programs; and that nine-year programs produce stable results with a CV of approximately 3%. Recruitment estimates (Figure 4b) have higher CVs for all monitoring time periods than those observed for annual survival, revealing that recruitment is more highly variable year-to-year than is survival. There is a reduction in recruitment CV with longer term monitoring and the CV for nine-year monitoring is approximately 10%. With Zone R recruitment values of between 0.20 and 0.45 calves per cow annually (Rettie 2019), a 10% CV represents a 95% confidence interval of between 0.04 to 0.09 calves per cow. For the purposes of WMMP objectives, λ is the most important parameter for evaluation. From simulations based on pooled data to represent Zone R data there is a decrease in the CV of mean λ from 5.4% to 3.2% between 3-year and 9-year studies (Figure 4c).

The geometric mean population growth rate of boreal caribou in Zone R (based on pooled data) between 2008 and 2018 was λ=1.038 (Rettie 2019). Figure 5 shows the power to detect change between λ=1.038 and a range of potential future λ values (determined in the computer program PASS with confidence set at 0.80 [Hintze 2008]). The power of detection is determined by the degree of change in λ and the CV of λ. Figure 4 presents precision in terms of CV of each parameter; while Figure 5 uses standard deviation; when the mean value is 1.00 the standard deviation and the CV are equal. For the purposes of comparisons presented here, all of which hold λ near 1.00, the CV and sample standard deviation have been considered equivalent. The standard deviations plotted in Figure 5 cover the range observed for three- to nine-year simulations. Figure 5 shows that a nine-year monitoring program (standard deviation=0.032) has 50% power to detect a decline to λ = 1.00 and 80% power to detect a reduction if λ declines to 0.975. With a five- or seven-year monitoring program (where simulated λ CVs are approximately 0.043), the power to detect a reduction of λ to 1.00 is approximately 38% and λ would need to decline to approximately 0.93 before there was an 80% chance of it being detected.

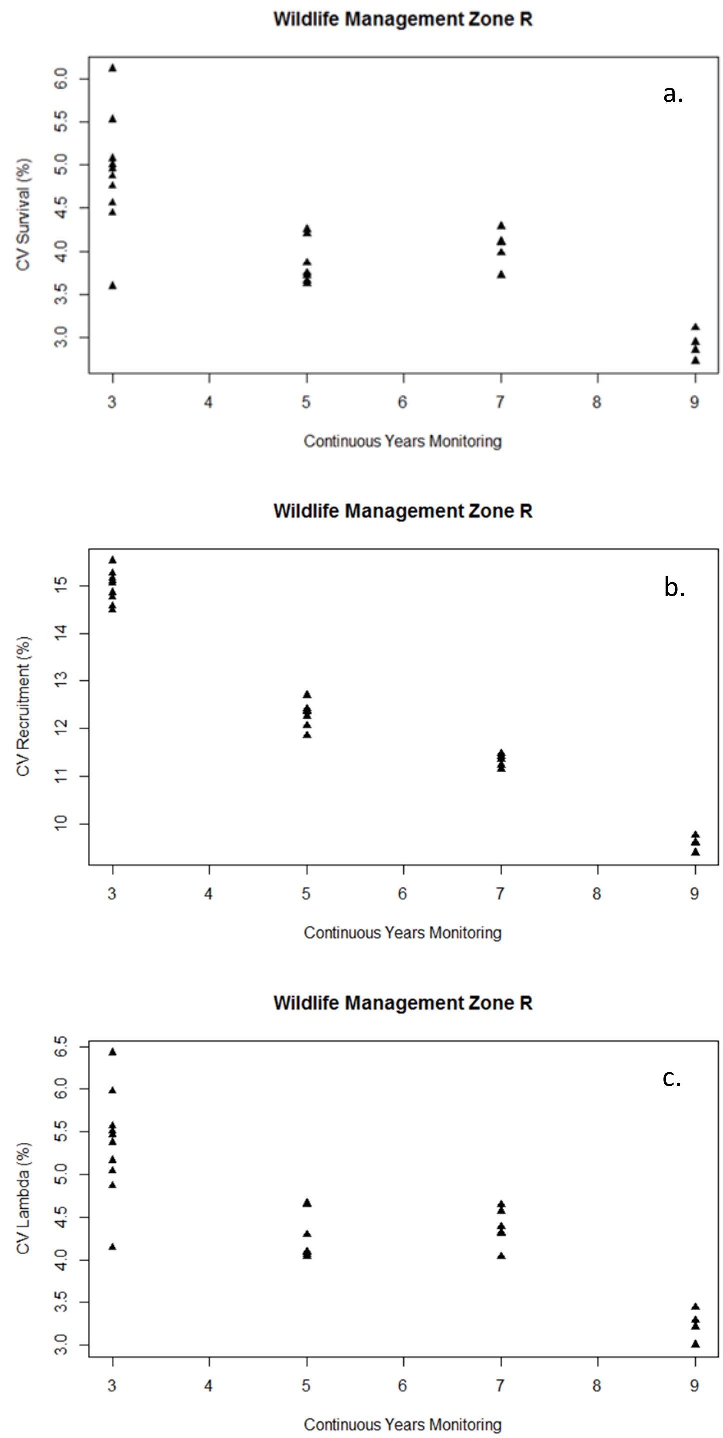

Figure 4: Coefficients of Variation for vital rates calculated through 3-, 5-, 7-, and 9-year simulations of data from a study with 30 radio-collars. Based on boreal caribou data from Dehcho North, Mackenzie and North Slave (TASR) study areas pooled to represent Wildlife Management Zone R; (a) adult female survival rate, (b) recruitment rate, and (c) population growth rate [Lambda].

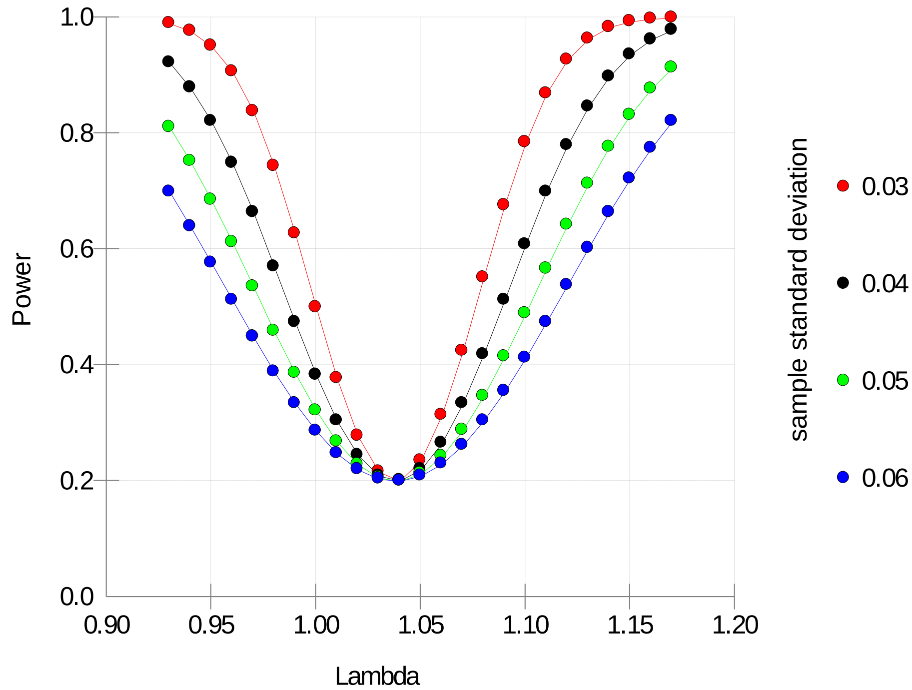

Figure 5: Power to detect change from 2008 to 2018 Wildlife Management Zone R Lambda of 1.038 relative to the sample standard deviation of Lambda from radio-collared caribou survival and aerial survey recruitment rates. Alpha is set to 0.20 (80% confidence).

The methods identified in the WMMP to calculate survival, recruitment rate, and λ are all appropriate and supported by the literature and standard practices for determining boreal caribou demographic parameters (Rettie 2017). Ongoing population trend monitoring using radio-collared adult female survival and annual recruitment surveys can be reasonably effective in detecting a decline of boreal caribou below a self-sustaining level within wildlife management Zone R. Any changes to survival, recruitment, and λ determined through these methods will be most representative of the changes in the areas containing radio-collared animals and monitoring may not reflect population changes in Zone R as a whole; the results should be interpreted carefully. Several scenarios are possible:

- Currently the radio-collared caribou in Zone R are in the southern half of the Zone, within the North Slave (TASR) study area. Other animals in the northern part of the study area are less likely to be affected by the TASR and are not included within the portion of the population being monitored. Consequently, the demographic parameters derived from monitored individuals will better represent the effects within the North Slave (TASR) study area rather than the effects within Zone R as a whole; collectively, Zone R caribou will be less affected by the TASR than monitoring results will suggest;

- At a finer scale, the North Slave (TASR) study area (Figure 3) is large enough that only some animals may interact with the TASR. Changes in survival and reproduction within the North Slave (TASR) study area may vary relative to proximity to the TASR at this scale, though inferences to the entire North Slave (TASR) study area may be appropriate;
- Overall, the effects on caribou in the region are likely to be localized in the parts of the North Slave (TASR) study area closest to the TASR where caribou density may be expected to decline and where behavioural changes are more likely to be observed. The distribution of radio-collared animals and recruitment survey effort will affect calculations of demographic parameters and the area about which inferences should be made.

In the future, if the affected portion of the Zone R population resident in the North Slave (TASR) study area contains few radio-collared animals, then there will not be sufficient power to confidently detect a localized population decline with these methods. Finally, if some limiting factors are biased in radio-collared caribou then the population trend will misrepresent population growth. Of particular concern is the potential for hunter harvest to be underestimated if hunters avoid shooting radio-collared animals, as has been observed for other species (Jacques et al. 2011). Harvest monitoring (Section 3.2) will provide information that may be useful to adjust survival estimates from radio-collared animals.

Population surveys

Methods are under consideration for population surveys including aerial surveys and genetic-based methods using DNA obtained from fecal pellets surveys (GNWT-INF 2019, Section 5.2.3). For all population survey methods, including fecal pellet surveys, a key factor is that sightability of less than 100% adds uncertainty to all wildlife survey estimates, including the estimates that would result from the methods being considered for TASR boreal caribou.

Two-stage population surveys (Courtois et al. 2003) have been widely employed in Quebéc. These consist of first stage survey with fixed-wing aircraft to assess population size, followed by helicopter surveys to determine composition. In their original survey work Courtois et al. (2003) had 20 radio-collared caribou in their survey area and determined sightability from observations of radio-collared animals in each stage of the survey. Overall, they determined sightability at 85% (SE = 8%) for all caribou, a value that has been applied as a correction factor for some other caribou population survey estimates in Quebéc. Fieberg and Giudice (2008) cautioned against applying a common sightability correction factor outside survey units with similar covariate values. As factors that influence sightability vary among surveys, this caution should be extended to avoid use of common correction factors for different survey years. The application of a standard correction factor will not correct the uncertainty associated with imperfect sightability as multiple survey-specific factors affect sightability including vegetation cover, animal behaviour, group size, snow cover, sunlight, topography, and observer experience (e.g., DeMars and Boutin 2013; Zabransky et al. 2016). Additionally, the application of the same correction factor to data from every survey will not alter the ability to detect change in the population as each population estimate will simply be scaled up by the same value. Consequently, a sightability correction factor should be determined for each population survey. Though not detailed in the WMMP, the calculation of survey-specific correction factors is planned by GNWT-ENR (personnel communication).

Despite the high sightability results of Courtois et al. (2003), it is not uncommon for fewer than half the animals in an area to be seen by observers in aerial ungulate surveys (e.g., elk, Vander Wal et al. 2011; moose, Peters et al. 2014; mule deer, Zabransky et al. 2016) and sightability can vary substantially from survey to survey. Serrouya et al. (2017) reported high winter sightability for some local population units of the Southern Mountain population of woodland caribou; the survey conditions in their study area differed from those for boreal woodland caribou populations in the study area.

There are several methods to determine sightability using mark-and-resight methods (e.g., Mahoney et al. 1998; Courtois et al. 2003, Adams and Roffler 2005, 2007; Hegel et al. 2016). Adams and Roffler (2005, 2007) worked with populations with 98 and 138 radio-collared caribou (in 2005 and 2007 respectively) providing them with a large number of potential sightings in blind surveys. They determined sightability in each of the two surveys relative to group size: for single animals sightability was 45% and 47%; and sightability increased with increasing group size to 96% when group size was ≥20 caribou. The CVs of their final population estimates were 4.5% and 7% for the two years. In each survey year there was extensive survey effort and a population where between 14% and 18% of the population (98 and 138 animals) were radio-collared.

The current deployment of 30 radio-collars in the TASR with additional collared animals in the adjacent Mackenzie study area provides a reasonable sample size (approximately 40 radio-collared caribou) for building a sightability correction factor for boreal caribou in the TASR study area. However, even repeated, relatively precise surveys (e.g., Adams and Roffler 2005, 2007) have low power to detect changes in a population over time. To demonstrate the power to detect relative differences between two consecutive population estimates, a simulation was completed with standard errors (SEs) of between 5% and 20% of the initial population mean. A hypothetical estimate of 1.00 was adopted and compared with a range of values between 0.50 and 1.50 (equivalent to between 50% population reduction and 50% population increase). A two-sample t-test (Hintze 2008) was used to compare the ratio between two values, each value with SEs between 0.05 and 0.20 (note that the SEs are absolute values; they are equal to CVs of 0.05 to 0.20 for the initial population level of 1.00, but the CV range increases to 0.10 to 0.40 when the population has declined to 0.50 and the CV range declines to 0.03 to 0.13 when the population has increased to 1.50). With alpha = 0.20, and an SE = 0.20 (Figure 6, blue line) there is 69% chance (i.e., power = 0.69) of detecting a 50% change in the population (i.e., a decline to 50% of the initial estimate or increase to 150% of the initial estimate). With an SE in each estimate of 0.10 (Figure 6, black line) the power of the monitoring program improves but would still require a population increase or decrease of approximately 30% to have 80% power. Even with precise population estimates with SEs near 5% as obtained by Adams and Roffler (2005, 2007), the ability to detect population change through the comparison of separate population estimates has little probability of detecting population changes unless they are approaching 20%. Further, the simulated range of SEs (0.05 to 0.20 [5% to 20% of the initial population value]) is precise compared to empirical results for forest ungulates where population survey results may yield SEs in excess of 50% (e.g., DeMars and Boutin

2013), though Courtois et al. (2003) report an SE of 9.4%; SEs > 20% reduce the power to detect differences between two population survey estimates below those plotted in Figure 6.

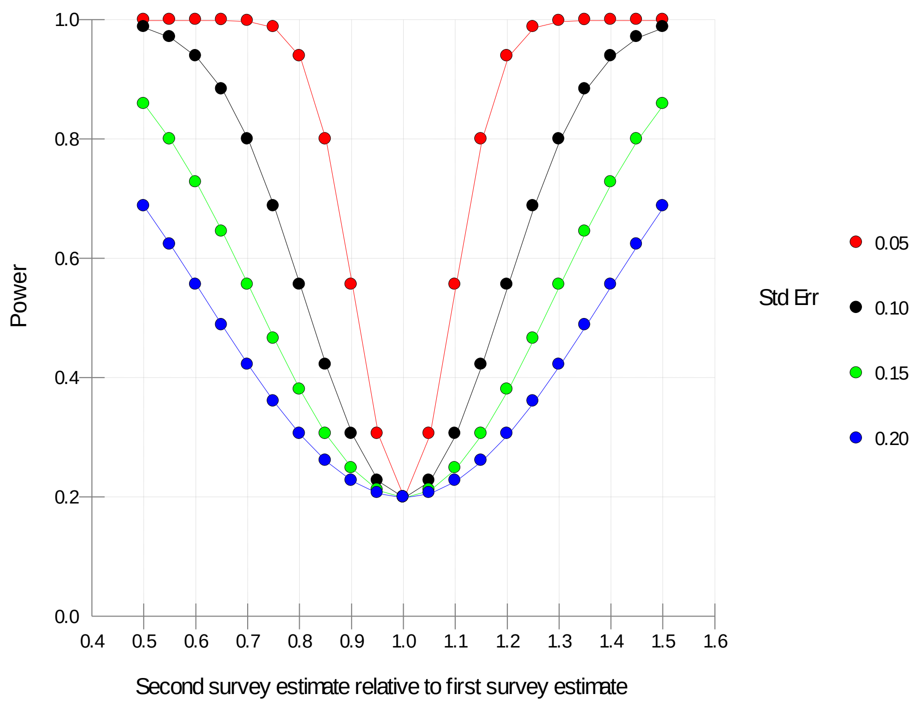

Figure 6: Power to detect a change in population size between two independent population survey estimates relative to the standard error of the population estimates. The estimates are scaled against each other such that the first estimate is assumed to be 1.00 and the second estimate reflects proportional increase or decrease. Alpha was set to 0.20 (80% confidence).

Overall, imprecision of population estimates for boreal caribou makes comparison of population estimates an inefficient method of detecting population changes over time except when the population changes are extremely large.

The 40 radio-collared caribou in and near the TASR study area will likely provide adequate data from which to construct a reasonable sightability estimates to assist in correcting for missed observations. Though repeated surveys are likely to lack power to detect population changes of less than 30%, an initial population estimate corrected for sightability will assist in assessing the potential effects of actual or proposed levels of harvest in the study area. It will also serve as a pilot study for the method in the NWT. Should more precise population estimates be desired, DeMars et al. (2015) proposed a pilot study to investigate sightability from multiple source of information (including occupancy estimation, double observer aerial surveys, detection probability from pellet surveys, and mark-resight surveys of radio-collared caribou) to provide improved precision in boreal caribou population estimates. The results of such a project may lead to improvements in survey precision.

Mortality surveys and investigations

The use of GPS radio-collars with same-day satellite data delivery will provide timely acquisition of mortality event and location information. The pooled data used to represent Zone R adult female boreal caribou had an annual mortality rate of 12% from 2008 to 2018 (Rettie 2019). At the same mortality rate, with 30 radio-collars deployed in TASR study area there would be an average of three or four mortalities of collared caribou per year, to an estimated total of 18 caribou in a five year period. A commitment to daily monitoring of mortality status and rapid response of staff to investigate each mortality site might yield cause of death for each of these animals, but any delays in site investigations and the varying circumstances of each mortality will reduce the number of mortalities where cause of death is certain; the number of mortalities from known causes is the sample size. Between 2004 and 2017 there were 44 recorded mortalities of radio-collared caribou in the pooled data representing Zone R (GNWT-ENR unpublished data); cause of death was determined for 34 animals, of which 21 (approximately 60%) were attributed to wolf predation. Power analysis to determine the ability of the monitoring program to identify changes in the proportion of mortality from any one cause was run using an inequality test for two proportions (Hintze 2008); the baseline mortality rate for the cause of death was set at 60%. The results are presented in Figure 7.

Power analysis suggests that, with modest sample sizes, a large change in the numbers of mortalities attributed to a single cause would need to occur to have reasonable probability of being detected. E.g., with 25 mortalities in each group (Figure 7, black line), 80% power of detection is achieved only when an initial proportional cause of mortality of 0.60 falls to 0.30 or rises above 0.85. With 30 radio-collared boreal caribou and an annual mortality rate from all causes of 0.12, the small sample sizes that might be attributed to each cause of death make it unlikely that the effects of TASR on changes in the percentage of mortalities from each source will be possible to determine.

Radio-collaring of caribou in the TASR study area began in March 2017. To December 2019 there had only been two mortalities of collared animals (GNWT-ENR unpublished data).

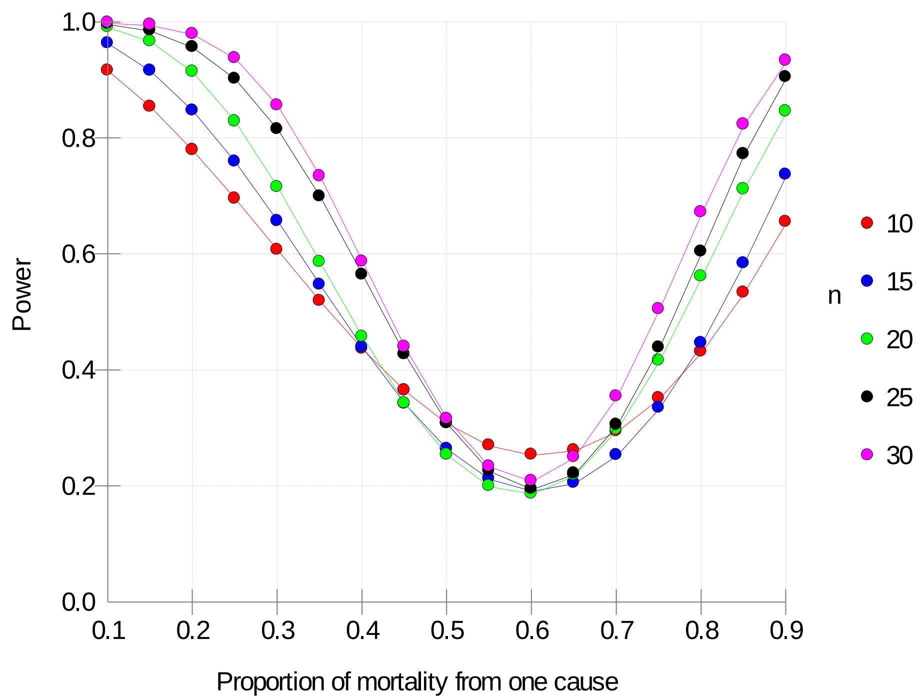

Figure 7: Power to detect a difference between the proportion of animals dying from a single specific cause of mortality in two separate samples (e.g., mortalities before and after an event, or mortalities from two different locations). The sample size is identical for both groups. In the reference population the cause of mortality (e.g., wolf predation) is assumed responsible for 60% of all deaths of animals in the sample. The proportion dying from the same cause was varied from 0.10 to 0.90 in the second group. Sample sizes (*n*) of between 10 and 30 in each sample were modelled and are represented by different coloured symbols and lines. Alpha was set to 0.20 (80% confidence).

3.4 Barren-ground caribou collaring (WMMP 5.2.4)

3.4.1 Use of individual radio-collared animals to monitor proximity to TASR

As with boreal caribou, the use of radio-collared caribou to detect animals and provide warning of animals near the road is dependent on the herd population size, the number of radio-collars deployed, and the group size. See Section 3.3.1 above for the details on the general efficacy of using radio-collared animals to detect group proximity to the TASR. Table 1 shows the relevant data for both the Bluenose East and Bathurst herds while Figures 8 and 9 show the relationship between group size and its detection probability within each herd.

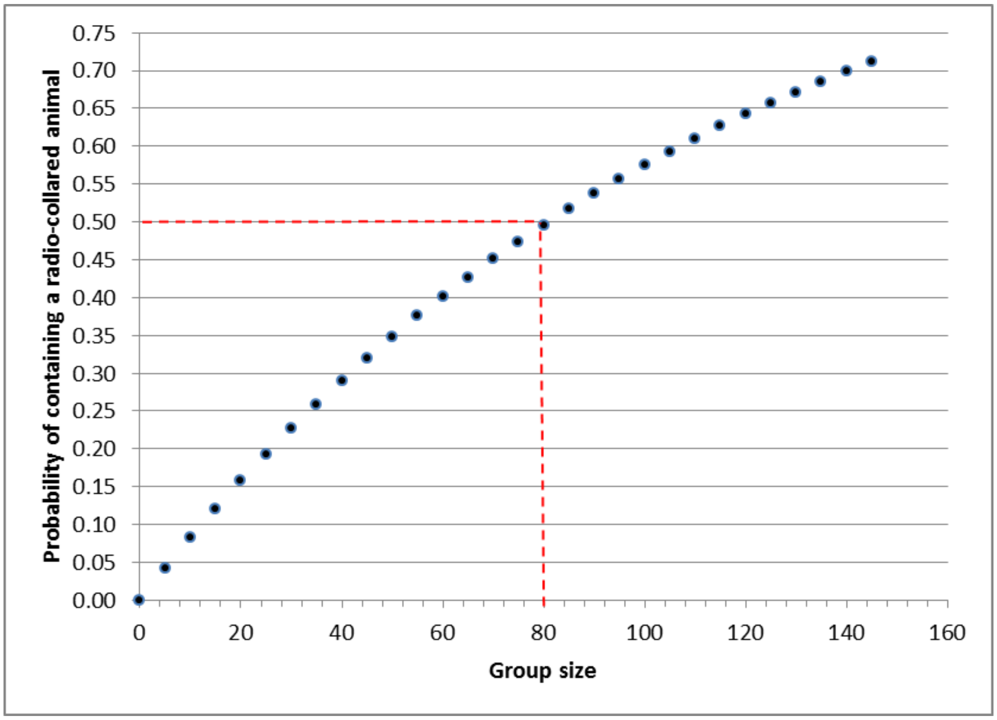

Figure 8: Probability of detection of a group of Bathurst caribou based on its inclusion of at least one radio-collared animal.

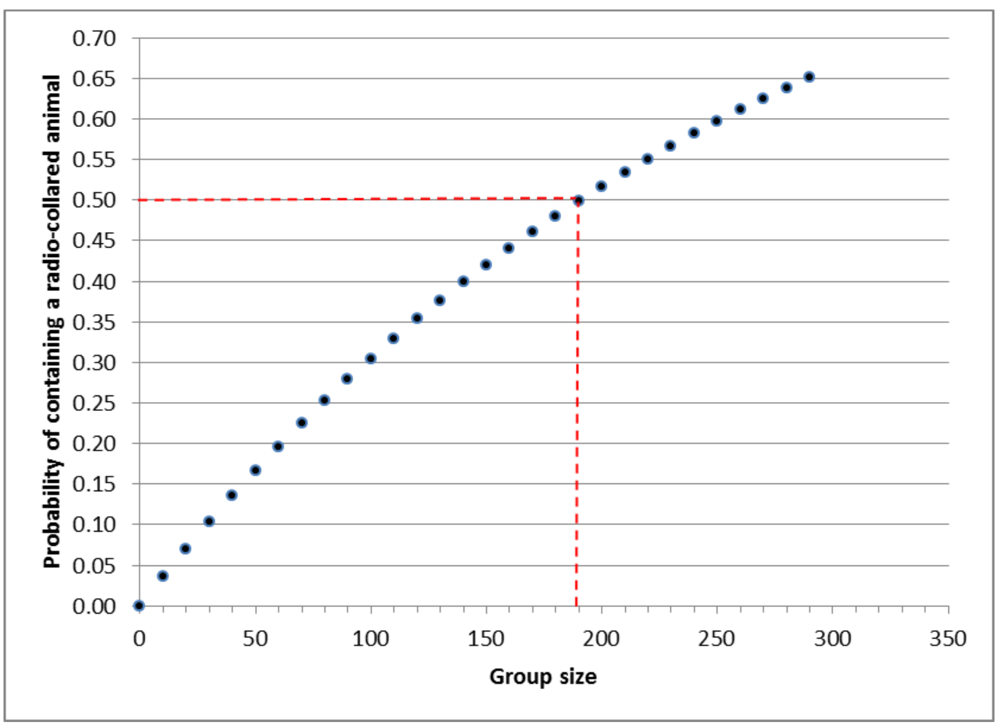

Figure 9: Probability of detection of a group of Bluenose East caribou based on its inclusion of at least one radio-collared animal.

Table 1: Radio-collaring probabilities for Bluenose East and Bathurst caribou herds

Parameter	Bathurst herd	Bluenose East herd
Population size[1]	8207	19,294
Number of collars recommended[1]	70	70
Probability of being collared	0.009	0.004
Probability of not being collared	0.991	0.996

[1] Bathurst herd data from Adamczewski et al. 2019. Bluenose East data from Boulanger et al. 2019.

As observed for boreal caribou, the group sizes required to have a 50% probability of detection are quite large; 80 animals for the Bathurst herd and 190 animals for the Bluenose East herd. Depending on telemetry locations to attempt to mitigate the effects of TASR construction or operations activities in real-time is unlikely to be effective as it is unlikely that any given group of animals will contain a radio-collared individual.

Aerial surveys of the Bluenose East and Bathurst caribou herds were conducted by GNWT-ENR in November 2019 and provide recent evidence of group sizes for the two herds. The Bathurst herd survey result was 2009 individual caribou in 43 groups of between 6 and 290 animals (GNWT-ENR unpublished data). The Bluenose East herd survey result was 3436 caribou in 144 groups of between 2 and 209 caribou (GNWT-ENR unpublished data). From the November 2019 survey observations, 7 of the 43 groups (16%) observed in the Bathurst herd had more than 80 animals, each group with ≥50% chance of having a radio-collared animal in them and being detected through radiotelemetry; the 7 groups contained 1127 caribou (56% of all animals observed). From the Bluenose East survey observations, 2 of the 144 groups had more than 190 animals, each group with ≥50% chance of having a radio-collared animal in them and being detected with radiotelemetry; the 2 groups contained 401 caribou (1.3% of all animals observed). These results illustrate the limitations of relying on radio-collared animals to detect caribou groups and mitigate effects of the TASR.

Alternatively, an effective use of barren-ground caribou location data to identify times and locations of concern for caribou interactions with TASR might be a process similar to that used to define the Mobile Core Bathurst Caribou Management Zone. The set of current location data (e.g., daily or weekly) from each of the two herds could be used to create herd-specific polygons or utilization distributions (UDs) that could be compared with the 10 km threshold established for the TASR (GNWT-INF 2019, Section 5.2.4). When either an individual radio-collared animal or a herd-specific polygon comes within 10 km of the TASR, the mitigation action of patrols to monitor caribou along the road could be initiated.

3.4.2 Other uses of barren-ground caribou telemetry data for mitigation

The Bluenose East and Bathurst caribou herds have distinct seasonal ranges that may shift among years. The proximity of caribou from both herds to the TASR is highly seasonal. Seasonal ranges for the Bluenose East herd do not overlap with the Project area (GNWT-ENR, 2008 to 2017 unpublished data); coming south to the northern tip of Lac La Martre in winter and during spring migration. The seasonal

90% UDs for the Bathurst herd have never overlapped the Project area (data collection began in 1996) and have not come within 100 km of the Project area since at least 2008 (GNWT-ENR unpublished data). As for the Bluenose East herd, Bathurst animals have historically been closest to the Project area in winter and spring migration seasons.

Calculating seasonal UDs for each season for each year for each of the Bathurst and Bluenose East herds will provide information necessary to track long-term shifts in range distribution for each herd. Concerns of interactions between barren-ground caribou and the TASR can be reserved until a time when a pattern of seasonal range shifts indicates movement towards the TASR. The current sample sizes of radio-collared animals in both the Bluenose East and Bathurst herds and the frequency of location acquisition will be effective to yield the necessary telemetry data to track long-term changes in seasonal range UDs for the Bathurst and Bluenose East herds.

3.5 Moose and bison population monitoring (WMMP 5.2.5)

Under the WMMP, aerial surveys to estimate populations of both wood bison and moose are scheduled for the TASR study area every three years.

"Data obtained from population monitoring conducted in the regional Tłįchǫ ASR study area will help to determine:

- *If the relative abundance of moose in the Tłįchǫ ASR regional study area changes over time. This will help to identify potential conservation concerns related to the road and hunter access.*
- *Whether changes in the abundance of moose in the Tłįchǫ ASR regional study area are qualitatively similar to what is observed in North Slave Regional surveys.*
- *If and at what rate bison expand their range northward along the road corridor.*
- *If the relative abundance of bison in the Tłįchǫ ASR regional study area changes over time."* (GNWT-INF 2019, p. 5-52)

3.5.1 Aerial population surveys

Recent aerial surveys for bison and moose in the NWT have used distance sampling to correct for imperfect detection of animals, including the 2016 North Slave moose survey and the 2019 Mackenzie wood bison survey (GNWT-ENR unpublished data).

In February and March 2018 the GNWT-ENR completed a multi-species (moose, bison, wolf, and boreal caribou) survey within a 10,000 km^2 study area centred on the TARS alignment and within the broader TASR study area for boreal caribou (Hodson and Patenaude 2018). The fixed-wing survey had 2-km transect spacing and required 47 hours of survey time. There were 27 observations of bison (groups sizes ranged from 1 to 54 bison) in the southern half of the study area. Moose were observed in 34 groups of 1 to 3 animals, distributed throughout the study area. Buckland et al. (2001, p. 240) recommend at least 60 to 80 independent observations of a species in order to estimate a reliable detection function; hence, sample sizes were inadequate to estimate a detection function for either species.

In their review of applicable methods for NWT bison monitoring, Boulanger et al. (2015) supported distance sampling as the best approach for population surveys of NWT bison and noted the opportunity to pool data across years to create a detection function. In the same study area, with the same covariates, this may be an option for the TASR study area. Another option is to include the TASR study area with bison and moose surveys being conducted in adjacent areas. The TASR study area is adjacent to the Mackenzie bison population range and could be integrated into Mackenzie range surveys with a common detection function calculated for bison. The TASR study area is also within the broader area of previous North Slave region moose surveys and an integration of moose surveys between the two areas would produce the sample sizes required to estimate reliable detection functions for moose in both areas. Though not surveyed in the same year, the 2018 TASR data and the 2016 North Slave moose data were combined experimentally to provide a sufficient number of moose observations to estimate a detection function (GNWT-ENR unpublished data); the result was an estimate of 125 moose within the TASR survey area with a CV of 24%.

3.5.2 Wood bison monitoring

Boulanger et al. (2015) conducted power analysis on the ability to detect change in the Mackenzie bison population from successive distance sampling estimates. They looked at both regression analyses across multiple survey years and using t-tests for two surveys in different years. The modelling conducted by Boulanger et al. (2015, p. 56-57) for paired sample t-test comparisons of estimates, while presented differently, is essentially the same as the analyses presented in Section 3.3.3 for boreal caribou: adopting Boulanger et al.'s (2015) target CV of 15%, 80% power is attained when the population declines to approximately 54% of its initial value (Figure 6). A persistent annual decline of 19% would lead to a three year overall population decline of 47%. If that is an acceptable detectable effect, and if a population estimate CV of 15% is attainable, then distance sampling appears adequate to monitor wood bison in the TASR study area.

Rather than a more intensive occupancy survey to determine range expansion, simple plotting of survey observations may be adequate to provide change through time, augmented by local observations and observations made during other surveys. A more precise estimate of range expansion could be obtained through occupancy estimation. One option is restricted spatial regression occupancy estimation (Johnson et al. 2013), an approach that accounts for spatial autocorrelation where the probability of occupancy of a sampling unit is based on observations made in that unit, sample unit covariates, the detection covariate, and observations and covariates of nearby units. If conducted within a reasonable time after population surveys, the population survey data might serve to establish the survey area near the limit of distribution and provide an initial set of observations in the occupancy cells.

3.5.3 Moose monitoring

Combining the North Slave and TASR moose surveys would serve at least two purposes:

- To increase the sample size of observations for calculating detection functions;

- To provide comparable data (i.e., same survey crews, same sampling year, same survey conditions) for comparison of the North Slave and TASR study area populations.

As with boreal caribou and wood bison, the ability to detect changes through time is dependent on the magnitude of change and the precision of the survey estimates. Figure 6 shows the power to detect proportional changes in a population with a range of SEs of the estimates (as the reference value in the figure is a population of 1.0, the SE is the same as the CV for the reference population). The experimental combination of 2016 North Slave moose survey data with 2018 TASR moose survey data produced an estimate of 125 moose (SE = 30 moose, CV = 0.24 or 24% [GNWT-ENR unpublished data]). It may be possible to reduce the CV if future surveys are combined intentionally. The WMMP does not specify an effect size (i.e., degree of population change) for detection, but the relationships among SE, degree of population change, and power presented in Figure 6 hold for any species surveyed in two separate periods.

Another alternative might be to consider a stratified random block survey (Gasaway 1986) or a geospatial population estimate (Kellie and DeLong 2006, DeLong 2006, Davison and Callaghan 2019) for moose as it might reduce and focus the survey area. A desktop exercise to stratify the area and estimate survey costs might be a good investment of time. In this way, the moose survey could be run independently of the bison survey and the bison survey could be added to the Mackenzie bison survey.

3.6 Wildlife Sighting and Collisions (WMMP 5.2.6)

Wildlife-vehicle collisions present a risk both to wildlife and to people driving on the TASR. Presently GNWT-INF and GNWT-ENR do not pool their data and there is not a single, reliable database with geographically referenced records of wildlife records and wildlife observations. The proposed monitoring approach (GNWT-INF 2019, p. 5-55) is to construct a wildlife collision and sighting reporting system smartphone app for employees and contractors who are on the road frequently, designed after a program in Alberta. The objectives for monitoring wildlife sightings and collisions are to:

- quantify wildlife-vehicle collisions (WVCs) on the TASR relative to other NWT highways;
- identify areas with frequent WVCs;
- identify areas with frequent sightings of wildlife (to provide a leading indicator of potential risk areas);
- identify any changes in wildlife distribution, especially of Mackenzie bison; and
- identify areas where wildlife crossing is hindered by snow cleared from the TASR.

The proposed approach to acquire sighting and collision information from frequent road users will provide useful information. While the acquisition of data from frequent road users will aid in monitoring the distribution of wildlife and WVCs, there is a risk that familiarity of observations will lead to a reduction in reporting after an initial period of diligence. Scheduled patrols by the RRO or other GNWT-ENR employees to systematically search for and record wildlife, WVC sites, and wildlife tracks adjacent to the road will create a comprehensive record of wildlife activity on a fixed interval.

The data from a GNWT-ENR patrol will differ from voluntary reporting. For example, if a driver chooses not to report a WVC it may go unreported as the injured animal may retreat into the bush (Snow et al. 2015). Regular patrols by GNWT-ENR staff can be used to survey the road and roadsides for evidence of wildlife activity and signs of WVCs in a manner that other employees asked to provide observations cannot. If snow is a potential barrier, identified by tracks that approach but do cross snowbanks, then snowbank monitoring at those locations can provide information on barrier effects. Mitigation by snow clearing crews at safe crossing locations can reduce the barrier effect as well as increase visibility of wildlife.

In a test of concerns about underreporting of WVCs, Snow et al. (2015) showed that predictive ability of models created from reports from as few as 25% of WVCs in an area still enabled them to identify hotspots for collisions. Wildlife and WVCs are non-randomly distributed, and databases with only a fraction of available data can still generate valuable predictive models from habitat covariates.

A combination of WVC data, volunteer monitor reporting, reporting by road maintenance contractors and INF patrols, and GNWT-ENR road patrol observations in a common database can be used as inputs for resource selection modelling to identify hotspots for mitigation actions (e.g., reduced speed limits, increased snow clearing, signage). Trained GNWT-ENR employees can identify wildlife sign by species, and records from scheduled patrol activities can be effective at recording the distribution of bison and other species along the road and throughout the year.

3.7 Predator Monitoring (WMMP 5.2.7)

Under the WMMP, the GNWT has committed to monitor predator population densities, movements, and predation rates. The only prey species mentioned explicitly is boreal caribou and the only predators mentioned explicitly for wildlife effects monitoring are wolves.

3.7.1 Mortality investigations

The investigation of radio-collared boreal caribou mortality sites is discussed in Section 3.3.3 above. To summarize that discussion: the number of mortalities that can be expected is small (perhaps three or four caribou per year based on the recent mortality rate in the region) and it will not be possible to determine cause of death in each case. The sample sizes for analysis will be small and the SEs of the estimates will be high, suggesting that monitoring will have low power to detect changes in cause-specific mortality rates (Figure 7). Monitoring radio-collar data for mortality and conducting mortality site investigations should be included in the WMMP program; spatial distribution of mortalities and mortality site habitat characteristics and relationship to the TASR may reveal patterns over time but adequate data will require years to acquire, perhaps as much as a decade.

3.7.2 Aerial population surveys

The wolf survey methods developed and tested by Serrouya et al. (2016) are a proposed approach for evaluating distribution and abundance of wolf densities in the TASR study area. Serrouya et al. (2016) are clear that ideal survey conditions with respect to snow cover, recent snow and wind events, and light are necessary for consistent survey results.

The TASR study area surveyed in 2018 for moose and bison (Hodson and Patenaude 2018) was approximately 10,000 km^2 and was surveyed using a DHC-2 Beaver at 167 km/hr. Serrouya et al., using smaller aircraft, took 16 hours of survey time to survey the 5571 km^2 Hay River Lowlands wolf survey unit (350 km^2 / hr) and had survey intensities below 300 km^2 / hr for most of their wolf survey units. For a 10,000 km^2 survey area, this suggests 30 to 35 hours of survey time. A challenge in implementing this method may be to find sufficient survey days that meet the survey condition standards. An additional challenge within government, where surveys occur near the end of the fiscal year, is to resist the temptation to conduct surveys under sub-optimal conditions when there is a fear of losing funds at the end of the fiscal year. Adherence to standards for survey conditions will be an important factor in producing survey results that are at least relative among years.

This is a promising approach, especially if there is an opportunity to periodically validate sightability with radio-collared wolves in the study area. The surveys will also serve to document wolf distribution in the study area.

3.7.3 Movement rates and predation rates

Predator movement rates and predation rates are listed as objectives in WMMP Section 5.2.7. Determining movement rates will require radio-collared animals. If wolves in the TASR study area are radio-collared then a number of objectives may be possible to address. These include:

- Movement rates as required under the WMMP. These can also be employed to determine the effects of the road on wolf behaviour and resource selection;
- Assessment of sightability estimates for aerial surveys (e.g., Serrouya et al. 2016);
- Distribution of wolves relative to distribution of ungulate prey (e.g., Klaczek et al. 2016);
- Predation rates (as required under the WMMP) from radio-collar location distribution and backtracking radio-collared wolves (e.g., Woodruff and Jimenez 2019); and
- Wolf vital rates.

4.0 SUMMARY AND RECOMMENDATIONS

The following is a summary of recommendations and observations for each wildlife effects monitoring item in the WMMP:

Traffic Monitoring

- A complete census of information will be acquired with the planned approach to traffic monitoring.
- Consideration of traffic data needs related to other monitoring programs should be used to inform the locations for traffic data acquisition.

- The availability of hourly traffic information throughout the year will equal or exceed the availability of all wildlife effects monitoring program data, making detailed traffic data available as a covariate for all other analyses.

Access and Harvest Monitoring

- Consider creating an explicit list of monitoring objectives for RRO patrols on the TASR and providing a data sheet with mandatory fields. In this way a standardized set of data will be collected through time.
- Annual mapping of trails detected through aerial surveys or via remotely sensed data will provide a measure of the rate of incursion into the surrounding area from the TASR.
- Link RRO patrols with wildlife sightings and collisions data collection.

Boreal Caribou

- The use of radio-collars to provide information on the proximity of boreal caribou to the TASR will generally not be effective. When detected near roads, the data will be accurate, but probability of any specific group of animals containing a radio-collared animal makes it unlikely that most groups and most animals will be detected with this method. No alternatives are suggested. This is one element in detection of animals. Other information will come from observations made along the road (and habitat based resource selection modelling in future).
- Determination of resource selection will be possible with the quantity of data being selected. Step-selection functions are recommended to address movement near the TASR. Traffic data will also be available to use as a covariate. These analyses will be valuable in developing effective mitigation.
- Survival and recruitment rates will be appropriately used to detect population change. The current rate of population growth in the TASR area (λ=1.038) would need to decline to approximately 0.93 to have an 80% chance of detection based on a five- to seven-year pooled data set.
- Aerial surveys are unlikely to be effective in evaluating population change over time.
- An initial aerial survey including calculation of a sightability correction factor will provide an initial estimate to guide harvest management decisions.
- Mortality site investigations are highly unlikely to detect a statistical change in the cause of death over time. The sample size (the number of mortalities with an assigned cause of death) will be small (e.g., 10 to 20 animals in a five year period). Site investigations will require a commitment to rapid deployment of staff and may be expensive when they require helicopter access. I do not believe the results will be worth the expense. If such a study is initiated a quantitative threshold or effect size should be established at the outset and the data should be revisited annually to determine the power to detect the desired effect.

Barren-ground Caribou Collaring

- As for boreal caribou, the use of radio-collars to provide information on the proximity of barren-ground caribou to the TASR will generally not be effective. When detected near roads, the data will be accurate, but probability of any specific group of animals containing a radio-collared animal makes it unlikely that most groups and most animals will be detected with this method.

  An effective alternative might be to use barren-ground caribou location data in a process similar to that used to define the Mobile Core Bathurst Caribou Management Zone; the creation of a minimum convex polygon or short-term (e.g., 1 week) UD for each of the Bluenose East and Bathurst herds. Over the longer term, calculation of seasonal UDs for each herd and monitoring their change among years may provide an advance indication of seasonal range shift towards the TASR.

Moose and Bison Population Monitoring

Bison

- Aerial population surveys will require a large effect to have sufficient power to detect a change in bison populations. Pairing the TASR bison survey data with data from the Mackenzie bison surveys should produce a better detection function for distance analyses. Ideally the two surveys would be run in the same year with the same survey crews.
- Bison range expansion analyses is not addressed in the WMMP. Consideration should be given to evaluating range expansion either with: a) basic survey data plus anecdotal data; or b) formal occupancy estimation near the range limit.

Moose

- Aerial population surveys will require a large effect to have sufficient power to detect a change in moose populations. Pairing the TASR moose survey data with data from the North Slave moose survey should produce a better detection function for distance analyses. Ideally the two surveys would be run in the same year with the same survey crews.
- Another alternative is a stratified random block survey or geospatial population estimate. A desktop exercise to stratify the area and estimate survey costs is recommended.

Overall

- For effective coverage of the TASR study area, moose and bison are presently scheduled to be surveyed in the same flights. Consideration should be given to surveying TASR bison with Mackenzie bison. The TASR moose survey could be combined with the North Slave moose survey or run as an independent stratified random block survey.

Wildlife Sighting and Collisions

- The proposed metrics and data acquisition are fine. Adding RRO patrols for WVCs and wildlife sightings will improve the available data as it will provide a consistent effort and consistent record. Including animal tracks relative to snowbank heights in the RRO patrol will assist in determining barrier effects in winter. The use of RSF analyses with WVC and wildlife sighting data will allow the creation of predictive models of wildlife-road interactions.

Predator Monitoring

- As noted above regarding boreal caribou, mortality site investigations are highly unlikely to detect a statistical change in the cause of death over time.
- The planned aerial wolf surveys appear to be a promising approach to monitoring wolf distribution and abundance.
- Consideration should be given to radio-collaring wolves. The desired movement and predation rate data will be possible to acquire if wolves are radio-collared. If wolves are collared, then determining wolf vital rates, distance to collared caribou, and RSFs in the TASR study area are possible.

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Appendix K: ENR Response to Summary and Recommendations of Rettie, J. 2019. Review of Wildlife Effects Monitoring Programs in the Wildlife Management and Monitoring Plan for the Tłı̨chǫ All-Season Road

ENR response to Summary and Recommendations in Section 4.0 of Rettie, J. 2019. Review of wildlife effects monitoring programs in the Wildlife Management and Monitoring Plan for the Tłı̨chǫ All-Season Road

Summary and Recommendations	ENR Response
Traffic Monitoring	
A complete census of information will be acquired with the planned approach to traffic monitoring.	No response required.
Consideration of traffic data needs related to other monitoring programs should be used to inform the locations for traffic data acquisition.	ENR will follow up with INF to ensure that traffic counters are placed at both the southern and northern ends of the TASR. This would ensure that vehicles departing from either the southern or northern end of the road that do not travel the full length of the road are captured in measures of traffic volume.
The availability of hourly traffic information throughout the year will equal or exceed the availability of all wildlife effects monitoring program data, making detailed traffic data available as a covariate for all other analyses.	No response required.
Access and Harvest Monitoring	
Consider creating an explicit list of monitoring objectives for RRO patrols on the TASR and providing a data sheet with mandatory fields. In this way a standardized set of data will be collected through time.	Once an RRO has been hired for Whati, ENR staff will work with them to define the list of monitoring objectives and develop data sheets for patrols of the road. ENR expects the RRO position will be filled before March 31, 2021.
Annual mapping of trails detected through aerial surveys or via remotely sensed data will provide a measure of the rate of incursion into the surrounding area from the TASR.	This recommendation was added to Section 5.2.2 in version 4.0 of the WMMP.
Link RRO patrols with wildlife sightings and collisions data collection.	The wildlife collision and sighting reporting system proposed in Section 5.2.6 of the WMMP is intended to be used by RROs on their patrols of the road, as well as by other GNWT-INF staff or contractors involved in maintenance of the road once it opens.

Boreal Caribou	
The use of radio-collars to provide information on the proximity of boreal caribou to the TASR will generally not be effective. When detected near roads, the data will be accurate, but probability of any specific group of animals containing a radio-collared animal makes it unlikely that most groups and most animals will be detected with this method. No alternatives are suggested. This is one element in detection of animals. Other information will come from observations made along the road (and habitat based resource selection modelling in future).	No response required.
Determination of resource selection will be possible with the quantity of data being selected. Step-selection functions are recommended to address movement near the TASR. Traffic data will also be available to use as a covariate. These analyses will be valuable in developing effective mitigation.	Resource selection functions and step-selection functions were already proposed in Section 5.2.3. of the WMMP as potential methods to assess the impacts of construction and operation of the Tłı̨chǫ ASR on distribution and movement behaviour of boreal caribou. Other potential analytical approaches were also outlined in that section of the WMMP. The most appropriate method of data analysis to address the monitoring questions outlined in Section 5.2.3 will be determined for the first comprehensive WMMP report after the construction phase is completed.
Survival and recruitment rates will be appropriately used to detect population change. The current rate of population growth in the TASR area (λ=1.038) would need to decline to approximately 0.93 to have an 80% chance of detection based on a five- to seven-year pooled data set.	No response required. The collaring program is proposed to continue for at least the first 5 years of the operations phase of the road, providing a total of 9 years of data since the program was started in 2017.
Aerial surveys are unlikely to be effective in evaluating population change over time.	ENR acknowledges this limitation of aerial surveys; however, ENR was required by Measure 6-1, Part 2 of the Report of EA to assess boreal caribou abundance. The collar-based monitoring program will provide estimates of population change over time, and as stated in the recommendation that follows, the abundance survey will provide an initial population estimate, and annual lambda estimates from the collaring program will indicate how the population size might be changing from that initial estimate over time.
An initial aerial survey including calculation of a sightability correction factor will provide an initial estimate to guide harvest management decisions.	ENR agrees. The population estimate from the 2020 abundance survey can be used to estimate changes in the number of boreal caribou in the region over time based on measures of

	annual rate of population change obtained from the collaring program. ENR has recommended that the abundance survey be repeated towards the end of the first 5 years of operations of the road.
Mortality site investigations are highly unlikely to detect a statistical change in the cause of death over time. The sample size (the number of mortalities with an assigned cause of death) will be small (e.g., 10 to 20 animals in a five year period). Site investigations will require a commitment to rapid deployment of staff and may be expensive when they require helicopter access. I do not believe the results will be worth the expense. If such a study is initiated a quantitative threshold or effect size should be established at the outset and the data should be revisited annually to determine the power to detect the desired effect.	In Section 5.2.7 of the WMMP, ENR has acknowledged the limitation of mortality site investigations for detecting changes in boreal caribou mortality that might be attributable to the TASR. However, ENR believes that mortality data collected from boreal caribou collared for the TASR monitoring program can be pooled with mortality data from other NWT boreal caribou study areas in order to contribute to a broad-scale and long-term data set that can be used to assess seasonal mortality patterns and causes of death (e.g. Kelly 2020; see full citation in the WMMP). Furthermore, collars recovered from mortality events can be refurbished and re-deployed offsetting some of the costs of new collar purchase.
Barren-ground Caribou Collaring	
As for boreal caribou, the use of radio-collars to provide information on the proximity of barren-ground caribou to the TASR will generally not be effective. When detected near roads, the data will be accurate, but probability of any specific group of animals containing a radio-collared animal makes it unlikely that most groups and most animals will be detected with this method. An effective alternative might be to use barren-ground caribou location data in a process similar to that used to define the Mobile Core Bathurst Caribou Management Zone; the creation of a minimum convex polygon or short-term (e.g., 1 week) UD for each of the Bluenose East and Bathurst herds. Over the longer term, calculation of seasonal UDs for each herd and monitoring their change among years may provide an advance indication of seasonal range shift towards the TASR.	ENR has incorporated this recommendation into Section 5.2.4 of the WMMP: “GNWT-ENR will use the Core Bathurst Caribou Management Zone maps (aka “Mobile Zone” maps), which are generated weekly every winter since 2015, to evaluate overlap of the Mobile Zone with a 10 km buffer around the Tłı̨chǫ ASR alignment. Any overlap between the two polygons will be used as a trigger to initiate patrols.”
Moose and Bison Population Monitoring	
Bison	
Aerial population surveys will require a large effect	ENR has incorporated this recommendation in Section 5.2.5 of the WMMP. The next bison

to have sufficient power to detect a change in bison populations. Pairing the TASR bison survey data with data from the Mackenzie bison surveys should produce a better detection function for distance analyses. Ideally the two surveys would be run in the same year with the same survey crews.	survey will be combined with the Mackenzie bison population survey in 2023.
Bison range expansion analyses is not addressed in the WMMP. Consideration should be given to evaluating range expansion either with: a) basic survey data plus anecdotal data; or b) formal occupancy estimation near the range limit.	As stated in Section 5.2.5 of the WMMP, ENR is confident that survey data from the bison population surveys, coupled with bison sighting data from annual boreal caribou spring composition surveys, and bison sightings recorded as part of regular road surveys and incidental sightings made by project staff will be sufficient to detect and document any northward range expansion of bison.
Moose	
Aerial population surveys will require a large effect to have sufficient power to detect a change in moose populations. Pairing the TASR moose survey data with data from the North Slave moose survey should produce a better detection function for distance analyses. Ideally the two surveys would be run in the same year with the same survey crews.	In Section 5.2.5 of the WMMP, ENR has incorporated the recommendation to combine the TASR moose aerial surveys with the broader regional North Slave moose aerial surveys to provide sufficient observations for estimating detection functions for distance analyses. The next North Slave region moose survey will occur in winter 2020/21.
Another alternative is a stratified random block survey or geospatial population estimate. A desktop exercise to stratify the area and estimate survey costs is recommended.	ENR has chosen to continue with a distance-based survey design, but as stated above will combine the TASR survey with the North Slave region survey.
Overall	
For effective coverage of the TASR study area, moose and bison are presently scheduled to be surveyed in the same flights. Consideration should be given to surveying TASR bison with Mackenzie bison. The TASR moose survey could be combined with the North Slave moose survey or run as an independent stratified random block survey.	This recommendation has been adopted in Section 5.2.5 of the WMMP.
Wildlife Sighting and Collisions	
The proposed metrics and data acquisition are fine. Adding RRO patrols for WVCs and wildlife sightings will improve the available data as it will	ENR intends to use the proposed wildlife vehicle collision and sightings recording system (based on Alberta Wildlife Watch App) in RRO patrols. ENR

provide a consistent effort and consistent record. Including animal tracks relative to snowbank heights in the RRO patrol will assist in determining barrier effects in winter. The use of RSF analyses with WVC and wildlife sighting data will allow the creation of predictive models of wildlife-road interactions.	will consider including recording information on snowbank heights associated with animal tracks that cross the road in winter as part of the app. ENR will consider the use of RSF analyses to generate predictive models of areas with greater potential for wildlife-vehicle collisions if and when there is sufficient data to support the use of this approach.
Predator Monitoring	
As noted above regarding boreal caribou, mortality site investigations are highly unlikely to detect a statistical change in the cause of death over time.	Acknowledged above.
The planned aerial wolf surveys appear to be a promising approach to monitoring wolf distribution and abundance.	No response required.
Consideration should be given to radio-collaring wolves. The desired movement and predation rate data will be possible to acquire if wolves are radio-collared. If wolves are collared, then determining wolf vital rates, distance to collared caribou, and RSFs in the TASR study area are possible.	ENR will consider the deployment of collars on wolves, if there is interest and support from wildlife co-management partners to do so and if ENR can find additional funding to support a wolf collaring program.

Appendix L: INF's Response to ECCC's Comments on TASR 2019 Migratory Bird Baseline Study Report

Via Email

Mr. Jean-François Dufour
Environmental Assessment Officer
Canadian Wildlife Service (Northern Region)
Environment and Climate Change Canada
Government of Canada

DEC 09 2020

Dear Mr. Dufour:

Tłı̨chǫ Highway – Submission of Reponses to Technical Comments from Environment and Climate Change Canada on the 2019 Migratory Bird Baseline Survey Report

The Government of the Northwest Territories' Department of Infrastructure (GNWT-INF) is pleased to submit the attached Technical Memo to the Environment and Climate Change Canada (ECCC). This Memo provides responses to ECCC's technical comments on the 2019 Migratory Bird Baseline Survey Report for the Tłı̨chǫ Highway, formerly known as the Tłı̨chǫ All-Season Road.

The ECCC submitted their comments to the GNWT-INF on October 1, 2020, and to the Wek'èezhìı Land and Water Board as part of the Wildlife Management and Monitoring Plan 4.0 annual review process. The GNWT-INF sought the support of Golder, the Consultant responsible for the baseline survey and the report, to provide responses to ECCC's comments. In addition to the attached Technical Memo, Golder has also provided the attached meeting notes and emails showing how they collaborated with ECCC and Environment and Natural Resources during the planning and completion of the survey.

As construction of the Tłı̨chǫ Highway progresses steadily and smoothly without any environmental compliance issues, GNWT-INF would like to thank ECCC for their collaboration and expert advice on the baseline bird survey. Should you have any questions or concerns please don't hesitate to contact me at (867) 767-9083 Ext. 31058 or by email at Benjamin_Bey@gov.nt.ca at your earliest convenience.

Sincerely,

Benjamin Bey, Ph.D.
Environmental Analyst
Design & Technical Services
Department of Infrastructure

GOLDER

TECHNICAL MEMORANDUM

DATE November 30, 2020 **Project No.** 20351333

TO Benjamin Bey
Department of Infrastructure, Government of the Northwest Territories

CC Damian Panayi

FROM Connor Charchuk, Dan Coulton, John Virgl **EMAIL Connor_Charchuk@golder.com**

RESPONSES TO ECCC COMMENTS ON TASR 2019 MIGRATORY BIRD BASELINE STUDY REPORT

Environment and Climate Change Canada (ECCC) uploaded comments to the Wek'èezhìı Land and Water Board on the Tlicho All-season Road Wildlife Management and Monitoring Plan, Version 4 on October 1, 2020 (ECCC 2020). On October 14, 2020, the Department of Infrastructure, Government of the Northwest Territories (INF) requested support from Golder Associates Ltd. (Golder) in preparing responses to ECCC's comments. The comments by ECCC and Golder's responses are provided in Table 1.

Golder Associates Ltd.

Original has been Signed **Original has been Signed**

Connor Charchuk, M.Sc., PBio.)
Terrestrial Biologist

John Virgl, Ph.D.
Principal, Senior Ecologist

DWC/CC/JAV/al

https://golderassociates.sharepoint.com/sites/134404/project files/5 technical work/eccc comments on wmmp/response to eccc comments on aru report.docx

Table 1: Comments by ECCC and Response

ECCC Comment	Response
In the analysis, the selection of Project ROW at 60 m, and the RSA from 60-200 m, as the distance thresholds for spatial comparisons presents many challenges. For example, the 60m Project ROW from the Old Airport Road centerline does not include the entire footprint of the proposed TASR project and does not encompass all potential project effects on migratory birds and species at risk birds. Only two spatial scales were defined in the Adequacy Statement Response (ASR) - the footprint and the RSA (a 2.5 km buffer). However, the ASR also acknowledges the Benitez-Lopez et al. (2010) metaanalysis, which indicated infrastructure effects on bird populations extending to distances up to 1 km. In ECCC's opinion, a 1 km buffer of the proposed TASR footprint is a scale more appropriate for determining project effects to migratory birds and species at risk birds. The 1 km buffer model predictions should be compared to model predictions at a larger regional scale. The selected RSA in the report is also too small for meaningful comparisons. ECCC recommends that spatial comparisons of model predictions be redone using 1 km from the proposed TASR footprint (representing all potential project effects to birds), and 15 km to represent a more suitable regional scale.	The Wildlife Management and Monitoring Plan (WMMP; GWNT 2020) incorrectly reported that the Tlicho All-season Road 2019 Migratory Bird Baseline Study (Golder 2019a) was to attempt to assess effects of the Project on bird species at risk. Effects assessment on bird species at risk was completed in the Adequacy Statement Response (ASR) for the Tlicho All-season Road Project (Golder 2017). The purpose of the baseline study (Golder 2019a) was to meet compliance with Measure 10-1, as was stated in the report. Measure 10-1 of the Report of Environmental Assessment and Reasons for Decision by the Mackenzie Valley Environmental Impact Review Board (MVEIRB 2017): *The developer will conduct pre-construction field surveys of bird species at risk and migratory birds including any clearing of the right-of-way, quarry sites, access routes or other potential infrastructure. The developer will consult with Environment and Climate Change Canada and GNWT-ENR about methods and timing for a field survey(s). The developer will conduct the survey using methods derived from the peer-reviewed scientific literature and best practices.* A secondary objective was to identify additional mitigation to apply based on the results of the baseline study (Golder 2019b) to meet conditions of Measure 10-2. No additional mitigation based on the results was identified through this process (Golder 2019b). The GNWT prepared a study plan (Golder 2018) that reflected the recommendations from two rounds of engagement with Environment and Climate Change Canada (ECCC) (and the GNWT-ENR) and ECCC guidelines (ECCC 2018a). The study plan identified that autonomous recording units (ARU) would be placed within 200 m of the Project centreline and included a map of the locations for deployment. ECCC approved the study plan prior to the deployment of ARUs (ECCC2018b). ECCC (2018a) also recommends deployment of ARUs within 200 m of Project infrastructure and methods for interpretation and analysis. Golder (2019a) demonstrates that the recommendations and guidelines by ECCC were followed. Golder (2019a) demonstrates compliance with the criteria of Measure 10-1. Additional pre-construction surveys are outlined in the WMMP (GNWT 2020) to also mitigate effects to bird species at risk and migratory birds during construction. Monitoring bird species at risk or migratory birds during operation of the Project to test effects predictions from the ASR is not within the scope of the WMMP (GNWT 2020). The wildlife study areas in the ASR (Golder 2017) were selected to be large enough to capture the cumulative effects of other developments with the potential to interact with the Project and small enough to maximize the incremental effects of the Project in order to provide a precautionary assessment of effects by the Project. The 2.5 km buffer around the Project alignment accomplishes this and provides a conservative assessment appropriate for the analysis of effects on assessment endpoints (self-sustaining and ecologically effective populations). In landscapes with little to no human

ECCC Comment	Response
	disturbance, such as where the Project occurs, assessment of a larger study area will only dilute incremental effects on measurement indicators such as habitat availability. Analysis of a larger study area is unlikely to change the conclusions of the ASR because the effects predicted in the ASR would be of greater magnitude (Golder 2017). The 1 km and 15 km study strata proposed by ECCC are 5 times and 75 times larger in extent than the 200 m of measured data previously approved by ECCC (ECCC 2018b) and would require the assumption that measured and unmeasured conditions within and beyond 200 m are the same. This adds uncertainty to conclusions about the comparisons proposed by ECCC at these larger extents without any means of validating that the conditions are the same. Additionally, this approach may not account for the fact that the Old Airport Road was an existing alignment that already had human activity prior to construction of the Tlicho All-Season Road, including for recreation, travel to Whati, hunting and commercial and personal firewood harvesting. Therefore, in order to properly estimate landscape scale effects of the Project, the effects of the existing alignment must be taken into account. The 2.5 km study area used in the ASR (Golder 2017) is 1.5 times larger than the 1 km zone of influence reported by Benitez-Lopez et al. (2010) for birds from roads so the 2.5 km study area is large enough to capture indirect effects of this extent. Golder (2019a) also reflects the baseline condition, which includes activity from human use of the existing disturbance but would not include cars and truck traffic consistent with analysis of existing roads by Benitez-Lopez et al. (2010). According to the conclusions of Benitez-Lopez et al. (2010) traffic intensity did not influence reductions in bird populations. In accordance with Measure 10-2, Golder (2019a) is to inform on whether additional mitigation actions to apply to the Project and the report concludes that no additional mitigation is required (Golder 2019a,b). Before undertaking the additional analyses proposed by ECCC, ECCC should clarify how the proposed analyses will identify additional mitigation and what those mitigation measures would be that are not included in the WMMP (GNWT 2020).

ECCC Comment	Response
The location of the sampling station was used as a model parameter ("location") and defined as within and outside the project ROW (i.e. 60 m from the Old Airport Road centerline). The use of this parameter is not meaningful and reduces the precision and accuracy of model predictions as it splits an already relatively small sample size of 60 sampling stations. Model predictions of species-specific density or occupancy estimates should have been generated irrespective of the sampling station location. ECCC is of the opinion that models including "location" interactions (and their corresponding interpretation) should therefore be excluded from the analysis and reporting.	The purpose of including location as a model parameter is to satisfy one of three metrics required by ECCC for ARU baseline analysis (ECCC 2018a): "[the] information should be summarized for both the proposed project footprint and RSA". The inclusion of location as a candidate parameter during the model selection procedure serves as a test for the effect of the existing disturbance on bird densities. Subsequently, this information provides a metric of density relative to nearby habitat outside of the Right-of-Way (ROW) for each species; this information allows for a meaningful determination of the effects of additional effects expected within the ROW for each bird species analyzed. It is worth clarifying that the location variable contains just two levels: within ROW and outside ROW, and thus has a minor effect on available degrees of freedom to test for other parameters. Location was not treated as a random effect in this analysis because this condition was not specified in ECCC (2018a), as is often done with spatial analyses. Therefore, density estimates are expected to be robust for the extent of the Project, and account for the effect of the existing airport road where it is relevant, rather than leaving this landscape-scale feature as a source of noise in the density estimates. As an example, the hermit thrush was shown to have significantly higher density off the ROW than within the ROW. Had the analysis not accounted for this variable, regional density estimates would likely underestimate actual density, particularly in undisturbed areas. Conversely, the Swainson's thrush had significantly lower density estimates off the ROW than within the ROW, and regional density estimates would overestimate actual density in undisturbed areas. The inclusion of the existing disturbance as an explanatory variable is imperative to generating ecologically relevant density estimates in this analysis and should be included when extrapolating these estimates to a broader spatial scale.

ECCC Comment	Response
Automated species recognition algorithms were not used to confirm the presence or absence of species at risk in the project area (Section 2.3). This is an important component of ECCC's recommendations on data interpretation (ECCC 2018a) as it adds more confidence to the presence or absence determination and provides a more comprehensive understanding of species at risk habitat use in the project area. ECCC recommends that available recognizers be used on all the recordings to confirm the presence or absence of species at risk in the project area.	Automated species recognition algorithms represent a promising method for reducing detectability error. However, detectability error was sufficiently accounted for in other aspects of the analysis. The use of the QPAD approach (Solymos et al. 2013) and occupancy modelling (MacKenzie et al. 2002) are statistical methods that account for imperfect detection. In addition, nine dawn visits and six night visits were examined for each ARU, which represents a substantially greater sample size than many other ARU studies (e.g., Alquezar & Machado 2015; Charchuk & Bayne 2018; Wilson & Bayne 2019). Therefore, these analyses are unlikely to suffer from these detectability concerns due to the statistical methods and conservative approach with respect to numbers of recordings interpreted. Automated recognizers are not anticipated to provide much additional value in determining species presence/absence but would require additional time to use and verify detections. The time and cost to process and validate multiple recognizers through a dataset as large as this one are often underappreciated. Automated recognizers can provide the opportunity to improve the precision of habitat association metrics for each species by collecting more detailed information on the relative degree of use of each ARU. However, the analysis in this technical memo assesses only three potential habitat parameters, which reduces the burden of data for each species. Furthermore, the established statistical methods in the literature utilize presence/absence or count data, and the methods for analyzing automated recognizer data are still in their infancy (Knight et al. 2017). The ARU recordings have been provided to ECCC to use with recognizer algorithms. The role of INF would be to review a sample of recordings where recognizers identified new detected species at risk for confirmation. INF would then prepare a subsequent assessment of effects by the Project for any confirmed new bird species at risk that were not assessed in the ASR (Golder 2017). To trigger this assessment, the results must indicate potential for population interaction with the Project and not a one-off detection. Threshold level of observations to constitute population interaction will be determined in consultation with ECCC should the situation arise. In accordance with Measure 10-2, the baseline study (Golder 2019a) is to inform on whether additional mitigation actions to apply to the Project and the report concludes that no additional mitigation is required (Golder 2019a,b). Before undertaking the additional analyses proposed by ECCC, ECCC should clarify how the proposed analyses will identify additional mitigation and what those mitigation measures would be that are not included in the WMMP (GNWT 2020).

ECCC Comment	Response
Section 2.5.2.2 indicates that "survey date was used as the level of visit to aggregate data between recordings". The sampling unit for all analyses should be the survey or visit, and not the sampling location. Mixed-effect models are needed to account for the non-independence in the sampling units (i.e. visits nested within the sampling location). Alternatively, a rationale should be provided to explain the different approach.	The occupancy model has difficulty converging when the number of detections in a dataset is too small, and this can create issues with overinflation of the occupancy estimates by overcorrecting for poor detectability. To minimize this error, visits were amalgamated to improve the intrinsic detectability of each visit and produce more robust estimates of occupancy and detectability. The sampling units in this context are defined as the date of survey, and multiple visits within that survey date are not pseudo-replicated but rather amalgamated into a single data point. As described in Section 2.5.2.2 of the report, this procedure was only done in cases where the occupancy model could not converge with visit-level data due to a lack of detections. The visit remains the sampling unit, not the sampling location, in these instances. However, the temporal scale of the visit shifts from a 3-minute recording to a day with three, 3-minute recordings (9-minutes total). The temporal scale of a visit should account for the vocalizing behaviour and daily activity cycles of the species being modelled. Therefore, it is customary to select different temporal scales for different species, as was done in the analysis. For example, appropriate choices may include the minute-by-minute singing behaviour of a red-eyed vireo given their high singing rate, and may also incorporate the hourly singing behaviour of a Connecticut warbler due to their high movement rate and low singing rate. Analysis of a minute-by-minute singing rate of a Connecticut warbler would lead to excess zeros, a detection rate estimate that is artificially low and an overinflated occupancy rate. The use of different temporal scales does not result in pseudo-replication, but does create variable sample sizes in the detectability parameter. The occupancy parameter is estimated with the number of sample locations, which remains unchanged.
ECCC recommends that a power analysis be conducted to determine: 1) the level of risk that type II statistical errors might have occurred; and 2) what would have been an adequate sample size to detect statistically significant effects i.e. disproportionate higher or lower densities for a given species predicted within 1 km (recommended LSA) and 15 km (recommended RSA) (ECCC 2018a).	The WMMP (GNWT 2020) incorrectly reported that the Tlicho All-season Road 2019 Migratory Bird Baseline Study (Golder 2019) was to assess effects of the Project. Additional pre-construction surveys are outlined in the WMMP (GNWT 2020) to also mitigate effects to bird species at risk and migratory birds during construction. Monitoring bird species at risk or migratory birds during operation of the Project to test effects predictions from the ASR is not within the scope of the WMMP (GNWT 2020). Golder (2019b) is to inform on whether additional mitigations to apply to the Project and the report concludes that no additional mitigation is required. Before undertaking the additional analyses proposed by ECCC, ECCC should clarify how the proposed analyses will identify additional mitigation and what those mitigation measures would be beyond those included in the WMMP (GNWT 2020).

ECCC Comment	Response
ECCC also identified the following sections which require further clarification. ■ What criteria was used in the determination of referenced small sample sizes? ECCC notes that sample size (number of sampling units) does not change across species, what changes is the number of detections per species. ■ Section 2.5.2.2: It's unclear in the methods why it was decided to only analyze the dawn recordings to maintain equal sample sizes across the 3 visits. ECCC requests an explanation of the rationale for this approach. ■ Section 2.5.2.2: Please clarify what is meant by "because data were aggregated across recordings where covariates influencing p varied". ■ Which vocalizations were used in the analysis for Common Nighthawk? Peent, boom or both vocalizations? This information is important to determine if inferences should be made for overlapping home ranges or breeding territories for this species.	■ Akaike Information Criterion (AIC) model selection was used in the QPAD approach, while AIC corrected for small sample sizes (AICc) was used in the occupancy approach. The only exception was for alder flycatcher and palm warbler, which had sufficient data to model using QPAD, but the AIC selection chose complex models that did not converge properly. Subsequently, Bayesian Information Criterion (BIC) was used instead for these two species to select the most parsimonious model (Solymos et al. 2013). Sample size in this context refers to the data requirements of the modelling approach, which depends on the number of detections per species, not the number of sampling locations. ■ Visit 1 and Visit 2 had both dawn and nocturnal recordings analyzed, while Visit 3 had only dawn recordings analyzed. To include all three visits in the occupancy analysis, it was determined that the best way to account for this discrepancy was to only analyze the dawn recordings, which resulted in an equal sampling method for each visit. Two nocturnal species that might be implicated by this are the common nighthawk and sora; however, detectability rates were sufficient to model parameter effects on site occupancy and additional data are not expected to have mitigation implications. IFC would appreciate any advice from ECCC regarding the approach to handling these data. ■ By amalgamating data across recordings, the ability to assess recording-level variables for their influence on detectability was lost, such as temperature, wind, and time of day. One could analyze site-level variables for their effect on detectability, for example most commonly forest structure, but such data were not collected at each sampling location. Therefore, it was assumed that detectability was equal at each sampling location for each species analyzed. ■ Both the peent and boom vocalizations were included for the common nighthawk. It is agreed that this information is pivotal for differentiating between home range and breeding territory habitat use by common nighthawk. It is also recognized that this needs to be paired with information on how loud the call was to determine if the bird was actually at the sampling site where it was detected, given that these signals can be detected from several hundred metres away (Knight et al. 2019; Yip et al. 2019).

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TECHNICAL MEMORANDUM

DATE June 4, 2018 **Project No.** 1790290

TO Sam Hache, Environment and Climate Change Canada; James Hodson, Department of Environment and Natural Resources, GNWT

CC Stu Niven, Damian Panayi

FROM Dan Coulton **EMAIL** **daniel_coulton@golder.com**

MIGRATORY BIRD STUDY DESIGN, VERSION 2, FOLLOW-UP MEETING

On Monday, May 28, 2018, a meeting with Environment and Climate Change Canada (ECCC) and the Department of Environment and Natural Resources (ENR) biologists was held via conference call to discuss alternate sampling designs for bird studies that could be supported by ECCC. An alternate design may be necessary as insufficient habitat is available within the study area (Golder 2018) to satisfy ECCC's autonomous recording unit (ARU) guidelines of ~10 sampling stations per habitat (ECCC 2018a) and minimum distance between stations (ECCC 2018b). For review, ECCC recommended seven habitat types based on the availability of land cover types provided in Table 1 of ECCC 2018b. The meeting was attended by Sam Hache (ECCC), James Hodson (ENR) and Dan Coulton (Golder). The discussion points and recommendations that followed are listed in Table 1, and these recommendations will be incorporated into Version 3 of the Migratory Bird Study Design.

Note that during the meeting it was incorrectly stated by Golder that the Department of Infrastructure (INF) did not intend to monitor the beyond the first 50 km of the Project. A decision about monitoring the remaining area of the Project had not been made by INF at that time.

Table 1: Discussion Points and Recommendations

Discussion Points	Recommendations
Reviewed that 78.5 ha of habitat per ARU would be required to meet 500 m spacing. There is insufficient habitat within the proposed bird monitoring study area or the entire length of the road to for 10 sites to meet the 500 m spacing.	ECCC indicated that field staff could place ARUs in residual unburned habitats to maximize bird detection within burned areas including edge and wetlands. In specific habitat types (if available) considered rare in the sampling area (200m buffer along the road, e.g. deciduous stands and wetlands) and to maximize spatial representation of habitat types along the sampling area. ENR recommended using the original land cover without burn data may also increase the selection of important bird habitat (e.g., unburned wetlands).

Discussion Points	Recommendations
	ECCC agreed with this approach. Original land cover without burn should be used instead of all "old burns" and be used to inform potential residual unburned habitat types instead of "young burns".
Generalized random tessellation stratified (GRTS) sampling of 10 sites per habitat type violated 500 m spacing recommendation.	ECCC recommend that spacing of selected sites could be coerced by using a subset of available sites that are at least 500 m apart before GRTS sampling. ECCC recommended that additional pooling of habitats (land cover types) may be required to achieve 10 sites per habitat type. The number of habitat types (and ultimately the number of sites per habitat type) might change depending on new values (land cover types) that should be provided (200 m buffer along the entire road). For rare habitat types, it would also be reasonable for the design to only have 7 to 8 sites (not ideal, but better than not sampling these habitat types at all). ENR Also recommend recording a basic description of the habitat around the sampling stations once in the field. Google earth could help to distinguish unburned residuals and wetland habitat along the alignment as the imagery is fairly high resolution in that area and dates from 2016.
ECCC indicated that they recommended 60 ARU sites would be adequate baseline monitoring of the entire Project length, and therefore, 30 ARU sites would be adequate for monitoring the lower 53% in 2018. Use of 60 sites exceeds the 30 sites recommended by ECCC.	ECCC and ENR indicated that monitoring of the entire length of the Project would be necessary unless it could be demonstrated that habitat availability in the first 50 km and remaining unmonitored road were similar. Even if they would be similar, it is unclear whether species-specific habitat association and densities could be considered equivalent in both ecoregions.
ARUs are scheduled to be deployed on May 29, 2018 so they will record on June 1 and maximize recording during the three bird breeding period available for interpretation.	ECCC indicated that if more time was required for the program schedule that the duration of recoding could be adjusted accordingly. For example, if the ARUs could only be deployed in time to begin recording June 2, then an additional day could be added to the

Discussion Points	Recommendations
	recording schedule to preserve a total of 30 consecutive recorded days for interpretation. Alternatively, a few days to the recording schedule could be removed. The proposed periods will likely be comprised of ~ 10 days given the three deployment sessions required to have data from 60 sites. If it is the case, 5-7 days of recording would be considered appropriate to randomly select days for data interpretation (see ECCC guideline details for data interpretation/analyses). The importance of having an appropriate sampling design to provide baseline data for the length of the road outweigh the value of a few more days of recordings.

References

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Golder (Golder Associates Ltd.) 2018. Migratory bird baseline monitoring Design, Version 2. Prepared for the Government of the Northwest Territories, Department of Infrastructure. May 25, 2018, Yellowknife, Canada.

From:	Summerfield, Bradley (EC)
To:	Stu Niven; James Hodson; Katie Rozestraten; Williston, Georgina (EC); Michael Conway; Panayi, Damian; Melissa Pink; Loretta Ransom; Paradis, Adrian (CANNOR); Johnston, Vicky (EC); Mark Cronk; Dufour2, Jean-François (EC); Laurie McGregor; Pankratz, Rhiannon (EC)
Cc:	Panayi, Damian; Katie Rozestraten; Joyce Gourlay
Subject:	RE: Measure 10-1 migratory bird baseline study v3
Date:	Wednesday, June 27, 2018 8:55:12 AM
Attachments:	image001.jpg image002.jpg

Hi Stu,

ECCC has reviewed the updated proposed study design for measure 10-1 and has no further comments or recommendations to add at this time. We appreciate the commitment below stating that construction is not expected to begin until August 31, 2019 or later assuming all commitments and conditions have been satisfied such as measure 10-1.

ECCC is open to having ongoing discussions with INF and ENR throughout the fall and winter regarding the possible lending of some ARUs as well as to discuss further how data collected will be analyzed, communicated and used. ECCC also notes that our recommendations regarding the recording schedule and interpretation of recordings might change prior to deployment based on results from ongoing optimization studies looking into these questions (see also our disclaimer in *ECCC. 2018b. Recommendations on the use of autonomous recording units (ARUs) technology to meet baseline data requirements in environmental assessments in the Northwest Territories. May 16, 2018, Yellowknife, Canada*).

Please let me know if you have any further questions,

Thanks

Bradley Summerfield

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From: Stu Niven [mailto:Stu_Niven@gov.nt.ca]
Sent: June 18, 2018 10:32 AM
To: James Hodson; Katie Rozestraten; Williston, Georgina (EC); Michael Conway; Damian_Panayi@golder.com; Melissa Pink; Loretta Ransom; Paradis, Adrian (CANNOR); Johnston, Vicky

(EC); Mark Cronk; Dufour2, Jean-François (EC); Laurie McGregor; Summerfield, Bradley (EC)
Cc: Damian_Panayi@golder.com; Katie Rozestraten; Joyce Gourlay
Subject: FW: Measure 10-1 migratory bird baseline study v3

Good morning,

Attached is the latest and greatest bird survey plan for the TASR to meet Condition 10-1. , Part 1 as a result of consulting with ECCC and ENR about methods and timing for a field survey. Please provide feedback as soon as possible and by June 28th at the latest.

We are hoping we can borrow 60 ARU's for this field work from ECCC late next winter into summer. Not sure what that process is to request this equipment so any help on that is appreciated.

Any issues at all, please call me.

| Mársı | Kinanāskomitin | Thank you | Merci | Hąį' | Quana | ᖁᔭᓐᓇᒦᒃ | Quyanainni | Máhsı | Máhsı | Mahsì |

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From: Panayi, Damian [mailto:Damian_Panayi@golder.com]
Sent: June 15, 2018 5:56 PM
To: Katie Rozestraten; Stu Niven
Cc: Coulton, Daniel
Subject: Measure 10-1 migratory bird baseline study v3

Attached is Version 3 of the baseline study plan for migratory birds on the TASR route. We have updated the study design and ARU placement based on the last meeting with ECCC and ENR, and added details related to Katie's comments where we had information to include. We'll fine-tune the budget and logistics for deployment once we get approval of this study design.

Thanks everyone for your patience with this. Hopefully we are getting near the end of this process!

Damian

Damian Panayi (BSc)
Associate, Project Manager/Wildlife Biologist

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Work Safe, Home Safe

From:	Dufour2, Jean-François (EC)
To:	Panayi, Damian
Cc:	Benjamin Bey; Hache, Samuel (EC)
Subject:	RE: Tlicho Road 2019 bird study report
Date:	Wednesday, August 14, 2019 10:23:06 AM
Attachments:	image002.jpg

Hi Damian,

Thanks for reaching out. If Dan feels comfortable, no need. I'd encourage him to contact Sam Haché with any questions, although he's away until Aug 30. There's a fair amount of modelling involved in the analysis – see attached. Is Dan building SAR species-specific distribution models and a community level model for all mig birds?

Thanks!
JF

Jean-Francois Dufour

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From: Panayi, Damian <Damian_Panayi@golder.com>
Sent: August 9, 2019 1:42 PM
To: Dufour2, Jean-François (EC) <jean-francois.dufour2@canada.ca>
Cc: Benjamin Bey <Benjamin_Bey@gov.nt.ca>
Subject: Tlicho Road 2019 bird study report

Hi JF,

We are through the analysis of the Tlicho Road ARU recordings, and Dan Coulton is preparing to complete the report. I don't have an exact date yet, but we are on track to complete the report by end of August as was committed.

Dan tells me that he is comfortable with the direction provided in the Bird Study Plan, and that he doesn't currently need anything from ECCC to complete the report. However we wanted to check with you also to see if you feel ECCC would like to discuss before we start the reporting.

Let me know, and I can arrange a call.

Thanks,

Damian

Damian Panayi (BSc)
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From:	Laurie McGregor
To:	Stu Niven; Katie Rozestraten; Michael Conway; Panayi, Damian; Mark Cronk
Cc:	Summerfield, Bradley (EC) (bradley.summerfield@canada.ca); James Hodson; georgina.williston@canada.ca; Melissa Pink; Loretta Ransom; adrian.paradis@canada.ca; jean-francois.dufour2@canada.ca; Johnston, Vicky (EC); Pankratz, Rhiannon (EC)
Subject:	ENR comments on Measure 10-1 migratory bird baseline study v3
Date:	Thursday, June 28, 2018 8:18:02 AM
Attachments:	image001.jpg image003.jpg

Hi Stu,

ENR has reviewed version 3 of the TASR migratory bird baseline study design for measure 10-1 and has the following recommendations:

- INF should provide an estimate of when the 2018 ARU data will be analyzed and the results shared with ENR and ECCC;
- INF should provide an estimate of when the 2019 ARU data will be analyzed and the results shared with ENR and ECCC;
- ENR recommends that the survey results address Measure 10-1, Part 2, bullet h, which states that the developer will "implement additional mitigations to eliminate or reduce impacts, if warranted based on surveys". The report on the ARU survey results should clearly state if the results from the surveys will result in any changes to the project or changes to/implementation of mitigations measures.

Similar to ECCC, ENR is open to having ongoing discussions with INF and ECCC on how data collected will be analyzed, communicated and used.

ENR notes and appreciates INF's June 25, 2018 update regarding the anticipated August 31, 2019 start date for construction, subject to conditions and commitments.

Laurie McGregor
Environmental Assessment Analyst
Conservation, Assessment and Monitoring
Department of Environment and Natural Resources
Government of the Northwest Territories

5th floor, Scotia Center
P.O. Box 1320
Yellowknife, NT X1A 2L9
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Hours: Monday-Friday 8:00 am – noon, 12:30-4:00 pm

From: Summerfield, Bradley (EC) [mailto:bradley.summerfield@canada.ca]
Sent: Monday, June 25, 2018 1:15 PM
To: Stu Niven
Cc: Williston, Georgina (EC); Damian_Panayi@golder.com; Katie Rozestraten; Laurie McGregor; James Hodson
Subject: RE: Measure 10-1 migratory bird baseline study v3

Ok noted, thanks Stu.

Brad

From: Stu Niven [mailto:Stu_Niven@gov.nt.ca]
Sent: June 25, 2018 1:00 PM
To: Summerfield, Bradley (EC)
Cc: Williston, Georgina (EC); Damian_Panayi@golder.com; Katie Rozestraten
Subject: RE: Measure 10-1 migratory bird baseline study v3

Hi Brad,

Everything is a moving target as the permitting process may take a variety of paths. The expected timeline though is to have Authority construction permits and approvals (WL/LUP/WMMP/DFO review) allowing construction to start August 31, 2019, subject to Commitments and Conditions.

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Stu Niven
Manager – Environmental Affairs
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Government of Northwest Territories
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5015 - 49th Street, Yellowknife X1A 2L9
Email: Stu_Niven@gov.nt.ca

From: Summerfield, Bradley (EC) [mailto:bradley.summerfield@canada.ca]
Sent: June 25, 2018 11:30 AM
To: Stu Niven; Katie Rozestraten
Cc: Williston, Georgina (EC)
Subject: RE: Measure 10-1 migratory bird baseline study v3

Hi Stu,

Working on drafting a formal response from ECCC for this and just wondering if you could confirm that construction will not be starting until October 2019. This would help take care of any concerns regarding the completion of the pre-construction surveys prior to disturbing habitat as per the wording of measure 10-1.

Thanks

Brad

From: Stu Niven [mailto:Stu_Niven@gov.nt.ca]
Sent: June 18, 2018 10:32 AM
To: James Hodson; Katie Rozestraten; Williston, Georgina (EC); Michael Conway; Damian_Panayi@golder.com; Melissa Pink; Loretta Ransom; Paradis, Adrian (CANNOR); Johnston, Vicky (EC); Mark Cronk; Dufour2, Jean-François (EC); Laurie McGregor; Summerfield, Bradley (EC)
Cc: Damian_Panayi@golder.com; Katie Rozestraten; Joyce Gourlay
Subject: FW: Measure 10-1 migratory bird baseline study v3

Good morning,

Attached is the latest and greatest bird survey plan for the TASR to meet Condition 10-1. , Part 1 as a result of consulting with ECCC and ENR about methods and timing for a field survey. Please provide feedback as soon as possible and by June 28th at the latest.

We are hoping we can borrow 60 ARU's for this field work from ECCC late next winter into summer. Not sure what that process is to request this equipment so any help on that is appreciated.

Any issues at all, please call me.

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From: Panayi, Damian [mailto:Damian_Panayi@golder.com]
Sent: June 15, 2018 5:56 PM
To: Katie Rozestraten; Stu Niven
Cc: Coulton, Daniel
Subject: Measure 10-1 migratory bird baseline study v3

Attached is Version 3 of the baseline study plan for migratory birds on the TASR route. We have updated the study design and ARU placement based on the last meeting with ECCC and ENR, and added details related to Katie's comments where we had information to include. We'll fine-tune the budget and logistics for deployment once we get approval of this study design.

Thanks everyone for your patience with this. Hopefully we are getting near the end of this process!

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provide a consistent effort and consistent record. Including animal tracks relative to snowbank heights in the RRO patrol will assist in determining barrier effects in winter. The use of RSF analyses with WVC and wildlife sighting data will allow the creation of predictive models of wildlife-road interactions.	will consider including recording information on snowbank heights associated with animal tracks that cross the road in winter as part of the app. ENR will consider the use of RSF analyses to generate predictive models of areas with greater potential for wildlife-vehicle collisions if and when there is sufficient data to support the use of this approach.
Predator Monitoring	
As noted above regarding boreal caribou, mortality site investigations are highly unlikely to detect a statistical change in the cause of death over time.	Acknowledged above.
The planned aerial wolf surveys appear to be a promising approach to monitoring wolf distribution and abundance.	No response required.
Consideration should be given to radio-collaring wolves. The desired movement and predation rate data will be possible to acquire if wolves are radio-collared. If wolves are collared, then determining wolf vital rates, distance to collared caribou, and RSFs in the TASR study area are possible.	ENR will consider the deployment of collars on wolves, if there is interest and support from wildlife co-management partners to do so and if ENR can find additional funding to support a wolf collaring program.

Appendix M: ENR's Wildlife Collisions and Sightings Reporting Forms

NWT Wildlife Collision Report Form

Email completed form and photos to Terry_Armstrong@gov.nt.ca or fax to 867-872-4250

E-mail form

Occurrence #:		RCMP File #:
Date of Collision:	Time of Collision (if known):	Location of Incident - Hwy:
Officer:	Complainant:	

Latitude/Longitude (Use GPS on scene):

Location: (Which highway, km marker, general location)

Wildlife

Wildlife Species:
☐ Bison ☐ Moose ☐ White-tailed Deer ☐ Black Bear ☐ Other (specify):
☐ Boreal Caribou ☐ Barren-ground Caribou ☐ Mountain Caribou

Total Number of Animals Involved:

Males:	___Calf / cub	___Yearling	___Sub-Adult	___Adult	___Unknown
Females:	___Calf / cub	___Yearling	___Sub-Adult	___Adult	___Unknown

Number Killed On Impact: | Number Destroyed by Officer: | Photos of Wildlife: ◯ Yes ◯ No

Describe injuries to wildlife:

Sample ID#: ____________

Samples collected:
☐ Blood ☐ Lymph Nodes ☐ Middle Incisors ☐ Feces ☐ Ear ☐ Tail

Hide Salvaged: ◯ Yes ◯ No | Meat Salvaged: ◯ Yes ◯ No | Skull Salvaged: ◯ Yes ◯ No

Method of Carcass Disposal:

Weather & Road Conditions

Light Conditions:
☐ Daylight ☐ Dawn ☐ Dusk ☐ Night ☐ Unknown

Weather Conditions:
☐ Raining ☐ Cloudy ☐ Clear ☐ Snowing ☐ Fog
☐ Windy ☐ Freezing Rain ☐ Unknown ☐ Other:

Road Surface Type:
☐ Asphalt ☐ Gravel ☐ Dirt

Road Description:
☐ Turn ☐ Dip ☐ Rise ☐ Straight & Level

Surface Conditions:
☐ Dry ☐ Wet ☐ Icy ☐ Loose Snow ☐ Packed Snow

Vehicle

☐ Passenger Car ☐ Van ☐ Pickup Truck ☐ Bus ☐ Heavy Duty Truck
☐ Semi-Trailer ☐ RV ☐ Unknown ☐ Other: ___________

Estimate of Damage:
☐ Minimal ☐ Extensive ☐ Totalled ☐ Unknown

Photos of Vehicle Taken? ◯ Yes ◯ No

Comments (continue comments on back of this form):

ENVR-FORM-WLF-18

Incidental Mammal Form

Date (YYYY-MM-DD)	**Species***	**No. #**	**Sex****	**Age*****	**Location (grid map location or place)**	**UTM East:**	**UTM North:**	**Distance to sighting from waypoint** (m)	**Direction to sighting from waypoint** (N, E, S, W, SE, SW, NE, NW)	**Dominant Behaviour ********	**Condition** (H=healthy; S=Sick; W=wounded ; U=unk)	**Photo Taken (Y/N)**	**Comments** (i.e. unusual observation; health of animal; reported to Team Leader)	**Was this an Incident or Accident (Y/N)**

*__Species Codes:__ WV=wolverine; WF=wolf; GB=grizzly; RF=red fox; AF=arctic fox; UF=unknown fox; MO=Moose; MX=Muskox; OT=other; UN=unknown

**__Sex Codes:__ M=male, F=female, MF=male and female, FF=female and female, U=unknown, UUU = 3 unknown

***__Age Codes:__ A=adult; C=cub; AC=adult and cub; CC=cub and cub; U=unknown; etc. X=Caribou information is filled out in the Group Composition

****__Dominant Behaviour Codes:__ B=bed; BA=bedded alert; F=feed; S=stand; SA=stand alert; W=walk; T=trot; R=run U=Unknown, H=Hunting, X=No Data

QA/QC	DOMINION DIAMOND	
DATA ENTERED INTO DATABASE	Initials:	Date:
DATA VERIFIED FOR ACCURACY	Initials:	Date:

ENVR-FORM-WLF-18

Incidental Caribou Form

Date (YYYY-MM-DD)	No. #	Caribou Group Composition					Location (grid map location or place)	UTM East:	UTM North:	Distance to sighting from waypoint (m)	Direction to sighting from waypoint (N E S W SE SW NE NW)	Dominant Behaviour*	Caribou Behaviour Survey Completed (Y/N) *If no give reason in comments	Photo Taken (Y/N)	Comments (i.e. unusual observation; health of animal; reported to WL Advisor or TL)
		Bulls	Cows	Calves	Yearling	Unknown									

***Dominant Behaviour:** B=bed; BA=bedded alert; F=feed; S=stand; SA=stand alert; W=walk; T=trot; R=run U=Unknown, H=Hunting, X=No Data

QA/QC	DOMINION DIAMOND	
DATA ENTERED INTO DATABASE	Initials:	Date:
DATA VERIFIED FOR ACCURACY	Initials:	Date:

ENVR-FORM-WLF-21											**Incidental Bird Observation Form**
Record incidental observations of birds of interest (e.g., unique sightings, waterfowl, owls, eagles) and signs of breeding (e.g., nest).											
Date (YYYY-MM-DD)	**Species**	**No.**	**Description of Location**	**Map Grid Cell**	**UTM Easting**	**UTM Northing**	**Habitat** (see below)	**Breeding Evidence** (see below)	**Behaviour** Foraging=For, Fly, Rest, Breeding=Br, Nesting=Nest, H=Hunting, Swim	**Photo** (Y/N)	**Comments**

Habitat Code: BE=Bedrock, BO=Boulders>80%, EC=Esker Complex, HT=Heath Tundra, RB=Riparian Birch, SW=Sedge Wetland, IC=Ice, SF=Spruce Forest, LA=Lake; ST=Snow Covered Tundra	**QA/QC**		
Breeding Evidence: NF=Nest Found, PA=Pair, MC= Material Carry, CO=copulation, DI=Display, TE=Territorial, DD=Distraction Display, FC=Food Carry, FL=Fledgling, N=none	DATA ENTERED INTO DATABASE	Initials:	Date:
	DATA VERIFIED FOR ACCURACY	Initials:	Date: