# Proposed Tłı̨chǫ All-season Road

## Project Description Report

Northwest Territories Transportation

March 2016

# EXECUTIVE SUMMARY

This project description report (PDR) has been written to accompany the Type A Land Use Permit and Type B Water Licence applications to the Wek'èezhìı Land and Water Board (WLWB) for development of the proposed Tłı̨chǫ All-season Road (TASR). These applications are being submitted by the Department of Transportation of the Government of the Northwest Territories (DOT – GNWT). The Tłı̨chǫ Government supports these applications. This project has been identified as a GNWT commitment under the *Proposed Mandate of the Government of the Northwest Territories 2016-2019* (GNWT 2016).

Over the years, DOT and Tłı̨chǫ Government have contemplated the possibility of improved transportation to the Wek'èezhìı area. In 2011, both governments became reengaged under the Tłı̨chǫ Roads Steering Committee (TRSC) in order to assess the feasibility, desirability and implications of realigning the Tłı̨chǫ Winter Road System to provide improved community access. As of May 2013, the vision of the TRSC has been to pursue development of an all-season road. The route would end at the boundary of the community government of Whatì and predominantly follow 'Old Airport Road,' an existing overland alignment that was utilized up until the late 1980s as an overland winter road.

The proposed TASR is defined as an all-season road approximately 94 km in length and 60 m in width with a cleared driving surface of approximately 8.5 m in width in order to accommodate a two lane gravel road with culverts and/or double lane bridges over water crossings as necessary. This road has been engineered to meet RLU 80 standards, which equates to a design speed of 80 km/h and a posted speed limit of 70 km/h. This design standard will allow for year-round use by commercial and private vehicles according to the size and weight limitations outlined in NWT regulations, such as the *Large Vehicle Control Regulations*. Traffic levels for the proposed TASR have been estimated at 20 to 40 vehicles per day. This estimate has taken into consideration any potential traffic volumes of a metals mine north of Whatì if it were to begin production and develop a road that meets the TASR.

The location of the TASR begins at KM 196 along Highway 3 and continues in a northwesterly direction to the community government boundary of Whatì. The alignment is situated within the geographic coordinates 62°28'54" to 63°10'37" N latitude and 116°29'07" to 117°00'05" W longitude. The proposed footprint is entirely contained within the Wek'èezhìı area and begins approximately 40 km southwest of Behchokǫ̀ off Highway 3. Approximately 17 km of the road is located on Tłı̨chǫ lands, while the remainder is located on Territorial lands. There are 15 tributaries along the alignment, which include 4 major bridge crossings: Duport River, an unnamed tributary near KM 45, James River, and La Martre River (Map 1).

Environmental and engineering investigations, detailed design studies with the help of LiDAR and topographic surveys, community consultations and stakeholder reviews, economic and socioeconomic reviews, a Tłı̨chǫ traditional knowledge study and ground truthing have helped in designing the proposed TASR corridor as it is presented in this PDR. Final corridor refinements are anticipated after geotechnical, geochemical and thermal analyses of the route have been completed. Due to the costs associated with the final road analyses, these items can only be completed after funding has been procured for the project. Currently, the project has been accepted for review in Round 7 under the P3 Canada Fund. The

GNWT is working directly with P3 Canada to finish its assessment. If P3 Canada does not provide funding during Round 7, conventional financing will be considered.

### *REGULATORY APPROVAL*

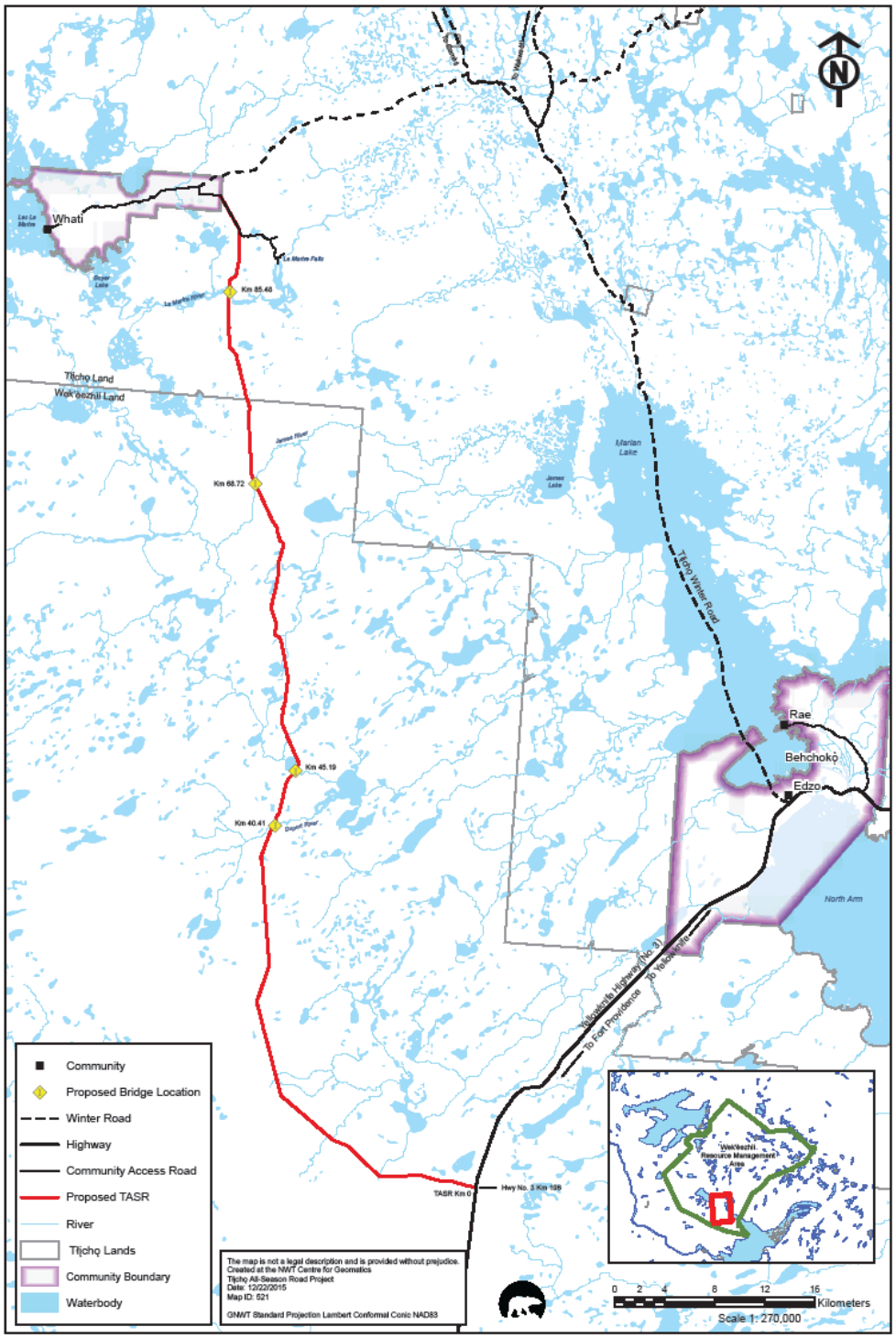
If preliminary screening results by WLWB proceed directly to the regulatory phase, the Tłı̨chǫ Government and other regulatory agencies will issue permits and licences and prepare accompanying terms and conditions. The DOT and Tłı̨chǫ Government have indicated in a letter to the WLWB (Appendix A) that they are pursuing an access agreement for the 17 km section of road located on Tłı̨chǫ lands. This letter also affirms that the Tłı̨chǫ Government will grant the necessary access agreement for any potential borrow sources and access roads located on Tłı̨chǫ lands. Quarry permits for the four to five borrow sources will be obtained from the Department of Lands. The Territorial Lands Administration (a division of Lands – GNWT) has confirmed a land reserve will not be necessary as the proposed TASR will become a designated highway once complete and because construction will occur with the use of a land use permit. Under the direction of the Prince of Wales Northern Heritage Centre, appropriate archaeological permits will be obtained and any final investigations on borrow sources will be completed. Should explosives be required for blasting within borrow sources or along the proposed corridor, blasting plans will be provided to the appropriate authorities. It is expected that the successful contractors will be responsible for obtaining the necessary permits and licences that will allow them to transport and operate explosives where required. Both community governments of Whatì and Behchokǫ̀ have provided written confirmation that construction related waste can be deposited at their respective landfills. The results of a self-assessment and associated mitigations indicate that a DFO review is not required for this project. The proposed TASR does not require a permit to construct bridges or culverts as the waterbodies within the corridor do not fall under the navigable waters listed in the schedule of the *Navigation Protection Act* though larger watercourses, in particular the La Martre River, will still be subject to common law public right of navigation. GNWT's Environment and Natural Resources (ENR) forest management staff have indicated that a timber cutting permit will not be required to clear the TASR corridor in preparation for road construction as the act of clearing a highway right-of-way is deemed to not require a permit. Most of the TASR corridor is already cleared or was involved in recent forest fires.

### *ROAD DEVELOPMENT*

The proposed TASR has been designed to meet appropriate road standards and will be primarily fill only in order to prevent permafrost degradation. Once geotechnical investigations have been completed, the potential borrow sources that have been identified to date will be further refined to the four to five sources that will be required for construction of the road. Efforts will be made to select borrow sources located on Territorial lands in areas that have been recently disturbed by forest fires in order to reduce the amount of disturbance related to road construction. Though construction specific details are difficult to determine because financing has not yet been procured and therefore the type of construction method (design-build vs. conventional) cannot be established, it is expected that construction will be year-round and is estimated to take up to four years to complete. Two to three 150-person camps will be set up within borrow sources to minimize the development footprint. It is expected that only one camp will be operated at a time.

Government of Northwest Territories

**Map 1 Proposed Tłı̨chǫ All-Season Road (TASR) Corridor from Highway 3 to the Whatì Community Government Boundary**



Water usage, including camp operation, is expected to be less than 99 $m^3$/day; however, a Type B water licence will still be required as there are water crossings larger than 5 m across. Wastewater is expected to be stored in a large watertight tank and will be trucked to Behchokǫ̀'s sewage lagoon on a daily basis. No raw sewage, treated effluent or other wastewater will be discharged on the land. Solid waste management will include incineration and temporary storage and removal to appropriate facilities in Behchokǫ̀ and Whatì. Hazardous waste will also be removed to approved facilities. Further waste details are described in the draft Waste Management Plan (Appendix N). All fuel will be stored in double-walled tanks or will have secondary containment and all personnel will adhere to the project's Spill Contingency Plan to prevent possible contamination to the environment.

Table 1 describes the bridge and culvert structures that will be required for the TASR. In addition to the structures listed, it is expected that small diameter equalization culverts will also be required every 500 m. Details and 1:2,500 maps of the current road design can be reviewed in Appendix G.

**Table 1 Required Bridges and Culverts within proposed TASR corridor**

| **Crossing ID** | **Crossing KM** | **Bridge Description; Length** |
|---|---|---|
| 8 | 40.4 | Duport River; 48 m |
| 9 | 45.2 | Unnamed tributary; 24 m |
| 14 | 68.7 | James River; 80 m |
| 15 | 85.4 | La Martre River; 100 m |
| **Crossing ID** | **Crossing KM** | **Culvert Description** |
| 1 | 2.0 and 2.4 | 1x900 CSP and 1x1200 CSP |
| 2 | 3.2 | 2x1400 CSP |
| 3 | 7.9 | 2x1400 CSP |
| 4 | 13.2 | 3x1400 CSP |
| 5 | 16.5 | 1x2430 SPCSP |
| 6 | 19.4 | 2x2430 SPCSP |
| 7 | 23.6 | 2x1400 CSP |
| 10A | 48.2 | 3660x1910 Arch Culvert |
| 10 | 48.3 | 1x1200 CSP |
| 11 | 54.5 | 2x1400 CSP |
| 12 | 56.6 | 1x1000 CSP |
| 13 | 62.7 | 3x1400 CSP |

*Note: CSP = corrugated steel pipe; SPCSP = structural plate corrugated steel pipe*

### *CONDITIONS ALONG THE PROPOSED TASR*

The proposed TASR is located within the Taiga Plains, which is located within the zone of discontinuous permafrost. The terrain is dominated by till veneers overlying bedrock, is generally well drained and mainly undulating. Soil type within the corridor is expected to be dominated by Cryosols. Twelve main vegetation communities were observed within the proposed TASR corridor during ground truthing in

2014; however, after the 2014-2015 forest fire seasons, substantial portions of the corridor were affected by the fires. Ten rare plant species have been identified as potentially occurring within or near the proposed TASR.

Approximately 140 species of mammals and avifauna, and a single amphibian are expected to occur within the area. Many wildlife species are important to the Tłı̨chǫ people for subsistence, economic and cultural purposes; these species include: caribou and moose, marten, wolf, fox, wolverine, lynx, otter, beaver, muskrat, other mustelids and snowshoe hare. Currently, 29 wildlife species potentially found within the proposed TASR corridor have been territorially ranked as 'sensitive', 'may be at risk', or 'at risk' in the General Status Ranks of Wild Species in the Northwest Territories (ENR 2014b). In addition to the NWT General Status Ranks, several of the ranked species are designated as 'endangered', 'threatened' or 'special concern' by COSEWIC and/or as federally designated as 'threatened' or 'special concern' under SARA (Canada 2012).

Water quality within the TASR corridor is expected to be pristine and as such, methods will be employed to ensure total suspended solids levels do not increase in the various watercourses as a result of construction activities. Material utilized on the road will have been screened for heavy metals and acid rock drainage potential during borrow source selection and as such sources that may be susceptible to either item will be avoided. Clear span bridges will be installed at each major water crossing and DOT's Erosion and Sediment Control Manual will be followed as a management technique to prevent any significant changes to the hydrological regime.

A total of 17 fish species have the potential to occur within the watercourses that cross through the proposed TASR though it is unlikely that any of the minor streams would provide overwintering habitat due to complete freezing. Though both Duport and James rivers had a confirmed presence of fish during field investigations, the La Martre River has the strongest fishery of all the watercourses and has the most significance to the Tłı̨chǫ people. Bridge and culvert designs have included the results of DOT's fisheries self-assessment to prevent serious harm to all fish.

An archaeological impact assessment (AIA) of the proposed TASR corridor was conducted in 2014. The AIA concluded that the overall degree of existing disturbance along the corridor was relatively high and that no new archaeological sites were identified. One indigenous historic site, previously recorded in 1986, was revisited, but will not be impacted by the proposed TASR. A subsequent archaeological overview and/or AIA may be required at a later date to address the archaeological potential amongst the chosen borrow sources, due to the typically high archaeological potential with high, well-drained, elevated features. DOT will work in conjunction with PWNHC in assessing the suitability of the proposed borrow sources.

### *ENGAGEMENT*

The DOT – GNWT and the Tłı̨chǫ Government developed an Engagement Plan (Appendix E) to meet the appropriate guidelines and policies. This plan includes a detailed engagement record (engagement summaries and logs established by all parties that could be affected by the proposed TASR). Extensive community engagement within the Tłı̨chǫ area has occurred over numerous years as discussion of an all-season road to Whatì has been documented as far back as 1983. A traditional knowledge study and in-

depth socioeconomic study were produced by the Tłı̨chǫ Government as a means to fully engage its people, with a specific focus on the community of Whatì as they would be the most affected. Whatì also undertook the formation of a Special Inter-Agency Committee whose task is to prepare the community for any potential changes as a result of an all-season road. This committee has been responsible for engaging with the different agencies that will be utilized to help with community preparations (such as engaging with ECE for training, etc.).

In January 2016, a joint (DOT & TG) community consultation tour occurred in each of the Tłı̨chǫ communities. The overall response to an all-season road was positive. Concerns identified by members included: climate change and its impact on the current Tłı̨chǫ Winter Road System; the importance of economic development in order to offset the ever increasing cost of living; and that the final road decision should be left up to the community of Whatì. An increase in social related issues (e.g. drugs and alcohol, etc.) was identified as a primary concern during the consultation tour. Whatì, the Tłı̨chǫ Government and DOT have developed a number of mitigation strategies to mitigate these concerns. During the tour, it was also identified that further discussions with the youth of Whatì would be of benefit to explain how many of their concerns had been considered in the development of mitigations for the TASR. After the tour, the TRWG provided the project material on the Tłı̨chǫ Government's website and Facebook page so that youth could have better access to the material, could review the material in detail and could then ask the TRWG additional questions. The TRWG will continue to work with the youth in Whatì so they are provided with the opportunity to continue discussions and contribute to the development of appropriate mitigations. For example, on May 4, 2016, the TRWG will participate in the third Whatì Inter-Agency Community meeting and review how programs have developed since their inception in 2014.

Under GNWT's duty to consult, additional Aboriginal organizations identified by DAAIR were also consulted. These organizations included the Acho Dene Koe First Nation, Mountain Island Métis, Dehcho First Nations and Northwest Territory Métis Nation. Three separate letters were sent to these organizations asking if they had any concerns with the project and whether they wanted to be consulted; no responses were ever received. The North Slave Métis Alliance (NSMA) was also included in the consultation process. NSMA indicated they wanted to be consulted and wanted to review the draft project material. The draft material was provided to NSMA; however, aside from a brief informal face to face meeting, NSMA had not agreed to a presentation of the proposed project or a formal meeting to discuss any possible project related concerns. DOT supplied NSMA with a letter dated January 27, 2016 pertaining to the consultation process and next steps; NSMA replied with a letter dated February 19, 2016. NSMA indicated it wished to remain engaged with the consultation process. Additional letters were sent from DOT and NSMA on March 18 and 24, respectively. DOT continues to work with NSMA through the consultation process. DOT will continue to maintain an up to date engagement log (Appendix E) with respect to NSMA consultation. Notification letters were sent to the five Aboriginal organizations on March 29, 2016 informing them that the application package was to be submitted to the WLWB on March 31, 2016.

Additional stakeholders were also provided with the opportunity to review the draft PDR in order to provide any comments or concerns associated with the proposed TASR. GNWT departments were engaged throughout the entire writing process to ensure each department's views and concerns were identified and mitigated. Northwest Territories Power Corporation, NWT Chamber of Mines, Fortune

Minerals and Wek'èezhìı Renewable Resources Board were provided with the opportunity to review the PDR in January 2016. In February 2016, a complete draft application package was reviewed internally by the GNWT while CanNor distributed the material to key federal departments. The Tłı̨chǫ Government was also included in the February 2016 review. For the review in January, only Fortune Minerals and the WRRB provided comments. DOT worked with these agencies to ensure their concerns were addressed (Appendix E). The February 2016 review revealed that socioeconomic mitigations needed to be highlighted more prominently within the PDR rather than within the appendices; sections of the PDR were then updated to improve clarity.

### *POTENTIAL EFFECTS AND MITIGATIONS*

As highlighted during the engagement process, the following items have been identified as potential concerns with respect to the proposed TASR: air quality and noise levels, increased access to hunting areas, vehicle-wildlife collisions, caribou-specific concerns and community health and wellness problems (for example, those associated with increased substance abuse). As these items were identified as concerns, their respective mitigations are briefly discussed below with further details located in Section 8.

Air quality, as a result of dust from construction activity, will be primarily mitigated by utilizing approved dust suppression techniques and ensuring slow speeds are enforced. Blast mats will also be utilized when blasting. Noise levels will be mitigated by ensuring regular maintenance of equipment and avoiding construction activities during sensitive periods. Wildlife mortality as a result of vehicle collisions are expected to be low as traffic volumes and speed limit will be low. Appropriate signage along the road will also be installed to notify drivers of potential collisions with wildlife and to discourage hunting within the proposed TASR corridor. Additional mitigations to minimize effects on wildlife will be developed through ongoing discussions with ENR and the approval of a Wildlife Management and Monitoring Plan (WMMP). It is also expected that the project will follow the recommendations from the response framework with respect to barren-ground caribou. Social concerns will primarily be addressed by the Special Inter-Agency Committee and through the implementation of programs and policies designed by the Tłı̨chǫ and Whatì Community Governments (Motion 2015-018). These include mitigations that range from addressing housing stock, the development of on the land treatment programs and revising the prohibition policy. Ongoing work with the community of Whatì will engage all the departments and agencies that deliver services.

Additional effects, such as those related to permafrost degradation, invasive vegetation species, water quality and fish and fish habitat, have also been discussed in detail within the PDR and have been mitigated accordingly; for further details see Section 8.

### *CUMULATIVE EFFECTS*

Probable future developments within the proposed TASR spatial boundary, as summarized by a preliminary cumulative effects assessment, include Fortune Minerals' NICO Mine and a hydroelectric project established at the falls on the La Martre River, which could connect into the Snare hydro system and to the community of Whatì. Though there have been active exploration projects within the same area, it is difficult to predict whether they are likely to become fully active mining projects within the temporal

boundary of 40 years. DEMCo's Bugow, Nighthawk Gold's Colomac sites and BFR Copper & Gold's Mazenod property are the three most likely projects that could possibly move forward in the future; however, each of these projects would become more likely if there were all-season roads to Gamètì and Wekweètì. Further discussion of additional projects that could contribute to cumulative effects can be found in Section 9.

The mitigation measures for the proposed TASR described in Section 8 are intended to decrease the risk of potential project effects concerning things such as air quality and noise levels, vehicle-wildlife collisions, invasive vegetation, increased erosion, water quality, fish habitat, increased hunting access, socioeconomics and various additional wildlife concerns. These mitigations are expected to be equally effective in mitigating any possible cumulative effects associated with future projects in the area. Due to the large habitat range of boreal woodland and barren-ground caribou, these species are more susceptible to cumulative effects. Measure #8 from the Review Board's Reasons for Decision for Fortune Minerals' NICO project indicated that a working group (consisting of various parties, including the GNWT and Tłı̨chǫ Government) to develop a response framework for cumulative impacts with respect to barren-ground caribou would be required for implementation with the NICO project to help manage cumulative effects. It is expected that the proposed TASR will adhere to the response framework once it is fully developed and this paired with an approved WMMP should prevent significant negative environmental effects.

### *MANAGEMENT PLANS*

Management plans are an important component of the proposed TASR. The following management plans are further described within the PDR and attached as appendices; these plans are expected to provide suitable mitigation techniques which will be employed during the construction of the proposed TASR to ensure any associated environmental impacts remain minimal.

*a. Emergency Response Plan; b. Spill Contingency Plan; c. Waste Management Plan; d. Wildlife Management and Monitoring Plan; e. Engagement Plan; f. Erosion and Sediment Control Manual; g. Quarry Operations Plan(s); h. Archaeological Site Find Protocol; i. Fish and Fish Habitat Protection Plan; j. Closure and Remediation Plan; k. In-field Water Analysis Plan*

### *CONCLUSION*

The Whatì Community Government has been working towards an all-season road for over 30 years as was noted by Grand Chief Eddie Erasmus at a June 2015 Special Inter-Agency Committee meeting (Appendix E). Both the GNWT and Tłı̨chǫ Government have been working jointly since 2011 to bring this project to fruition. Constructing the proposed Tłı̨chǫ All-season Road (TASR) will support DOT's efforts to meet its 2015-2040 strategy of providing and promoting a safe, reliable and sustainable multi-modal transportation system which strengthens connections, captures opportunities and embraces innovation (DOT 2015a). Extensive Tłı̨chǫ community engagement has indicated that there is overall support for an all-season road to Whatì as it will improve the quality of life of the residents of Whatì. Both the Community Government of Whatì and the Tłı̨chǫ Government are cognizant of the possible negative aspects (such as issues related to increased substance abuse) that an all-season road can bring to Whatì. By taking a

proactive approach and addressing the concerns head on by developing suitable mitigations (Motion 2015-018 and Special Inter-Agency Committee), these concerns can be effectively mitigated while reducing the cost of living and providing improved employment opportunities to the community. The mitigations described in this PDR will enable the development of the proposed TASR to proceed with minimal impact to the environment, while successfully connecting a remote NWT community and opening up the potential for potential future economic gains.

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# Acronyms

| | |
|---|---|
| AANDC | Aboriginal Affairs and Northern Development Canada (reverted to INAC) |
| ADKFN | Acho Dene Koe First Nation |
| AIA | Archaeological Impact Assessment |
| ARD | acid rock drainage |
| ARI | Aurora Research Institute |
| ATV | all-terrain vehicle |
| BNE | Bluenose-East herd |
| CanNor | Canadian Northern Economic Development Agency |
| CBA | cost benefit analysis |
| CCME | Canadian Council of Ministers of the Environment |
| CEC | Tłı̨chǫ Chief Executive Council |
| CIMP | Cumulative Impact Monitoring Program |
| COSEWIC | Committee on the Status of Endangered Wildlife in Canada |
| CSP | corrugated steel pipe |
| DAAIR | Department of Aboriginal Affairs and Intergovernmental Relations, GNWT |
| DCLP | Department of Culture and Lands Protection of the Tłı̨chǫ Government |
| DFO | Department of Fisheries and Oceans |
| DOT | Department of Transportation, GNWT |
| DPC | Dogrib Power Corporation |
| EAD | Environmental Affairs Division, DOT |
| EC | Environment Canada |
| ECE | Education, Culture and Employment, GNWT |
| EDO | Economic Development Officers |
| ENR | Environment and Natural Resources, GNWT |
| ERP | Emergency Response Plan |
| FFHPP | Fish and Fish Habitat Protection Plan |
| GNWT | Government of the Northwest Territories |
| HSE | Health, Safety and Environment |
| INAC | Indigenous and Northern Affairs Canada |

| | |
|---|---|
| ITH | Inuvik to Tuktoyaktuk Highway |
| ITI | Industry, Tourism and Investment, GNWT |
| Lands | Department of Lands, GNWT |
| LHO | Local Housing Organization |
| LUP | Land Use Permit |
| MACA | Municipal and Community Affairs, GNWT |
| MIM | Mountain Island Métis |
| MPF | Macroeconomic Policy Framework |
| MVEIRB | Mackenzie Valley Environmental Impact Review Board |
| MVLUR | Mackenzie Valley Land Use Regulations |
| MVLWB | Mackenzie Valley Land and Water Board |
| MVRMA | Mackenzie Valley Resource Management Act |
| NAAQO | National Ambient Air Quality Standards |
| NRCan | Natural Resources Canada |
| NSMA | North Slave Métis Alliance |
| NTPC | Northwest Territories Power Corporation |
| NWTMN | Northwest Territory Métis Nation |
| P3 | public-private partnership |
| PDR | Project Description Report |
| PWNHC | Prince of Wales Northern Heritage Centre |
| QOP | Quarry Operations Plan |
| RLU | Rural Local Undivided (Low Volume Road) |
| ROW | right-of-way |
| RSA | Regional Study Area |
| SARA | Species at Risk Act |
| SCP | Spill Contingency Plan |
| SOP | standard operation procedure |
| SPCSP | structural plate corrugated steel plate |
| TAC | Transportation Association of Canada |
| **TASR** | **Tłı̨chǫ All-season Road** |

| | |
|---|---|
| | (consisting of a 60 m right-of-way, will be approx. 94 km long and will be located entirely within the Wek'èezhìı area) |
| TC | Transport Canada |
| TG | Tłı̨chǫ Government |
| TK | traditional knowledge |
| TRSC | Tłı̨chǫ Roads Steering Committee<br>(Grand Chief, Community Chiefs, MLA for Monfwi, and Minister of Transportation) |
| TRWG | Tłı̨chǫ Roads Working Group<br>(DOT employees, Tłı̨chǫ Government, and other parties as necessary) |
| TSCA | Tłı̨chǫ Community Service Agency |
| VC | Valued Component |
| VEC | Valued Environmental Component |
| VSEC | Valued Socioeconomic Component |
| WLWB | Wek'èezhìı Land and Water Board |
| WMP | Waste Management Plan |
| WRRB | Wek'èezhìı Renewable Resources Board |
| WSC | Water Survey of Canada |
| WSCC | Workers' Safety and Compensation Commission |
| WMMP | Wildlife Management and Monitoring Plan |
| ZOI | Zone of Influence |

# 1 INTRODUCTION

The Department of Transportation of the Government of the Northwest Territories (DOT – GNWT) currently operates and maintains a winter road system in the Wek'èezhìı area, beginning at Highway 3 near Behchokǫ̀ and connecting to the communities of Whatì, Gamètì and Wekweètì (Figure 1-1). Increasingly variable climatic conditions in recent winters have often led to difficulties in constructing and maintaining the road across waterbodies and saturated soils. This has resulted in short, unpredictable winter road seasons for residents and businesses to utilize the road and to complete community re-supply. Table 1-1 illustrates the opening and closing dates for the winter road between Highway 3 and Whatì over the past 30 years. The average number of operating days for the road is 77 days, which equates to a mere 21% of yearly road access in comparison to communities with all-season roads. Though the average operating season for the road has remained fairly consistent, in order to maintain a similar length in season, it has been necessary to invest in costly new technologies and equipment over the past decade. As a comparison, in 2004, DOT paid $1,050 per kilometer to construct the Tłı̨chǫ Winter Road System, while in 2014, DOT paid $4,935 or 4.7 times the cost to construct the same road system. This increase in cost can be equated in part to utilizing specialized equipment that allows for construction to begin when the ice is not as thick. Without this equipment, the winter road season for the Tłı̨chǫ area would be greatly reduced as there would be a delay in waiting for the ice to achieve a suitable thickness for the use of less-specialized equipment.

The Tłı̨chǫ Roads Steering Committee (TRSC), comprised of the Grand Chief, the Chief of Behchokǫ̀, the Chief of Whatì, the Chief of Gamètì, the Chief of Wekweètì, as well as the MLA for Monfwi and chaired by the Minister of Transportation, with the Department of Transportation Deputy Minister as the ex-officio member sets the over-arching direction of study activities for the Tłı̨chǫ Roads Working Group (TRWG). The TRWG consists of employees from the Department of Transportation, the Tłı̨chǫ Government and other parties as needed from time to time. In 2008, the TRWG commissioned studies to examine the feasibility, desirability, and implications of realigning the winter road to provide improved community access. These studies included a *Multi-level Mapping and Route Analysis* (Kavik AXYS 2008a), which included the identification and evaluation of potential overland routes between Highway 3 and the communities of Whatì, Gamètì and Wekweètì as well as a complementary environmental and regulatory scoping study (Kavik AXYS 2008b).

Previously, DOT had conducted a *Needs/Feasibility Study* (Arthur Anderson 1999) and an environmental and regulatory scoping study (FSC 1999) for road development in the Slave Geological Province. An *Economic Analysis of All Weather Roads in the Tli Cho Region* (Nichols 2006) examined the financial costs and implications of a road realignment. The studies undertaken confirmed that realignment of the Tłı̨chǫ Winter Road to an overland alignment was both practical and viable.

In November 2013, a TRWG Tłı̨chǫ Roads Options Analysis reassessed the route options discussed in the Kavik AXYS report (2008a) and in May 2014, Nichols Applied Management was contracted again to provide an updated economic assessment of an all-season road to Whatì (2015). This updated economic report indicated it was still favourable to construct an all-season road to Whatì.

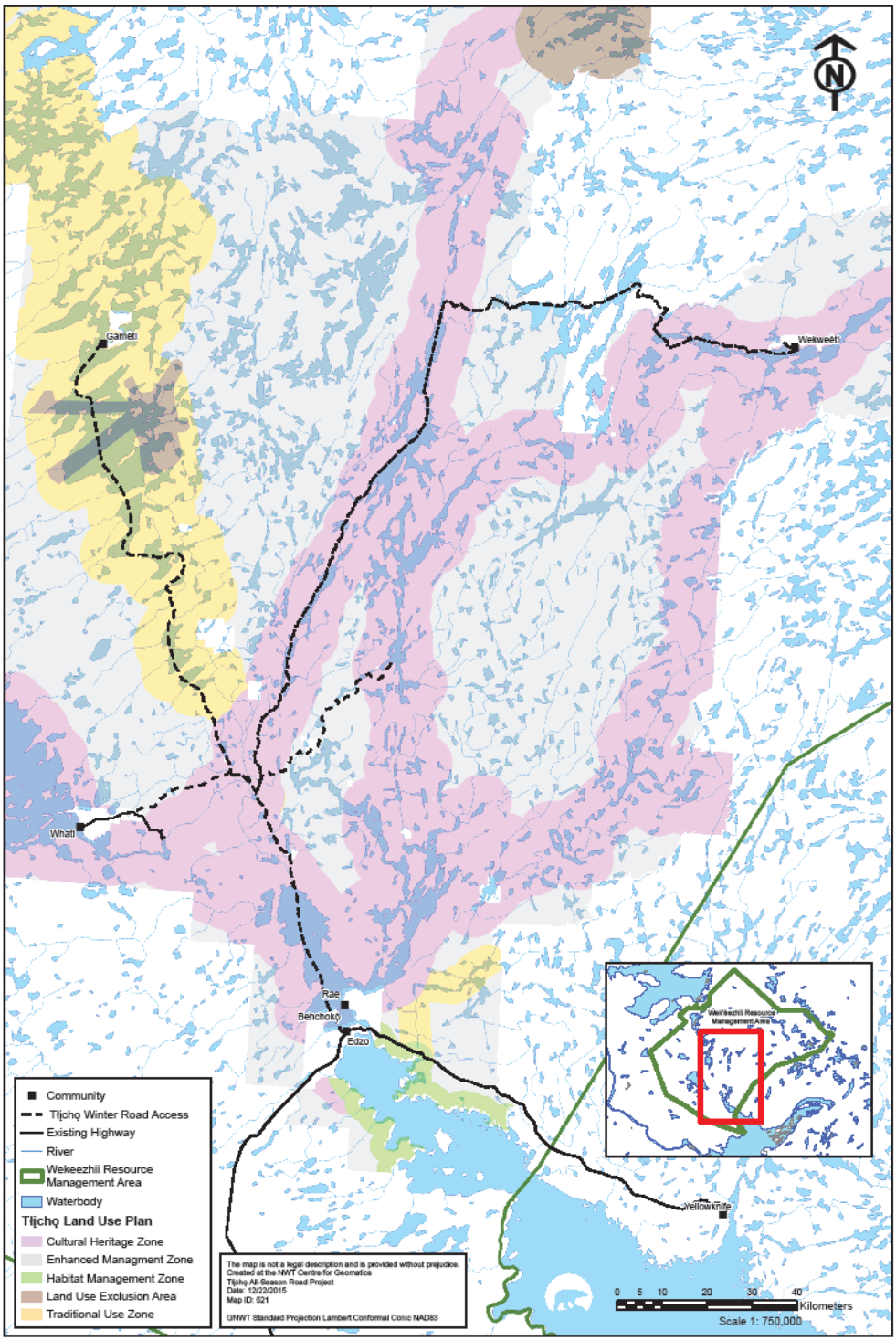
The scope of work contemplated for the current project is to change the winter road from its existing alignment between Highway 3 and Whatì to an all-season road alignment which, except for unavoidable water crossings, is entirely on land and follows as close as possible to an already disturbed route that was used as an overland winter road alignment up until the 1980s (see Section 4.3 for further discussion). The purpose of this Project Description Report (PDR) is to provide information about the proposed development, describe baseline environmental conditions, assess potential environmental effects from undertaking the realignment, and identify impact mitigations and management actions. The PDR is intended to accompany land and water use applications and provide information to support a Preliminary Screening by the Wek'èezhìı Land and Water Board under the *Mackenzie Valley Resource Management Act.*

**Table 1-1 Tłı̨chǫ Winter Road System: Highway 3 (KM 237) to Whatì Opening and Closing Dates 1986 – 2015 (average days of operation = 77)**

| Year | Opening Date | Closing Date | Days of Operation |
|---|---|---|---|
| 1986/87 | 20-Dec | 31-Mar | 101 |
| 1987/88 | 15-Jan | 5-Apr | 81 |
| 1988/89 | 23-Jan | 5-Apr | 72 |
| 1989/90 | 19-Jan | 10-Apr | 81 |
| 1990/91 | 16-Jan | 8-Apr | 82 |
| 1991/92 | 15-Jan | 7-Apr | 82 |
| 1992/93 | 27-Jan | 2-Apr | 66 |
| 1993/94 | 18-Feb | 18-Apr | 59 |
| 1994/95 | 13-Jan | 29-Mar | 75 |
| 1995/96 | 15-Jan | 20-Mar | 65 |
| 1996/97 | 20-Jan | 25-Mar | 64 |
| 1997/98 | 23-Jan | 9-Apr | 76 |
| 1998/99 | 25-Jan | 7-Apr | 72 |
| 1999/00 | 1-Feb | 20-Apr | 79 |
| 2000/01 | 20-Feb | 14-Apr | 54 |
| 2001/02 | 24-Jan | 25-Apr | 91 |
| 2002/03 | 27-Jan | 17-Apr | 80 |
| 2003/04 | 13-Feb | 22-Apr | 68 |
| 2004/05 | 14-Jan | 13-Apr | 90 |
| 2005/06 | 7-Feb | 16-Apr | 68 |
| 2006/07 | 3-Feb | 12-Apr | 68 |
| 2007/08 | 8-Feb | 11-Apr | 64 |
| 2008/09 | 23-Jan | 14-Apr | 82 |
| 2009/10 | 21-Jan | 12-Apr | 81 |
| 2010/11 | 14-Jan | 8-Apr | 85 |
| 2011/12 | 25-Jan | 19-Apr | 86 |
| 2012/13 | 22-Jan | 21-Apr | 90 |
| 2013/14 | 24-Jan | 22-Apr | 89 |

Government of Northwest Territories

**Figure 1-1 Department of Transportation Winter Road Routes for Wek'èezhìi Area**




[1] Tabloid (11x17) sized figures are available for ease of reference as a package in Appendix BB.

# 2 PROPONENT

The DOT – GNWT, in conjunction with the Tłı̨chǫ Government (TG), is applying to construct an all-season road between Highway 3 (at approximately KM 196) and the community of Whatì on the alignment identified in Section 4. Contact information for DOT – GNWT and TG are outlined in Table 2-1.

### Table 2-1 Contact Names and Addresses

| Main DOT Contact | Alternate Contact |
|---|---|
| Michael Conway<br>Regional Superintendent, North Slave<br>Department of Transportation<br>Government of the Northwest Territories<br>Box 1320 Yellowknife, NT X1A 2L9 | Rhonda Batchelor<br>Director, Environmental Affairs<br>Department of Transportation<br>Government of the Northwest Territories<br>Box 1320 Yellowknife, NT X1A 2L9 |
| Phone: (867) 767-9089 ext. 31186<br>Fax: (867) 873-0606<br>Email: michael_conway@gov.nt.ca | Phone: (867) 873-7063<br>Fax: (867) 920-2565<br>Email: rhonda_batchelor@gov.nt.ca |
| **Tłı̨chǫ Government Contact** | |
| Laura Duncan<br>Tłı̨chǫ Executive Officer<br>Tłı̨chǫ Government<br>Box 412, Behchokǫ̀, NT X0E 0Y0 | Sjoerd van der Wielen<br>Manager, Lands Section<br>Department of Culture and Lands Protection<br>Tłı̨chǫ Government |
| Phone: (867) 392-6381<br>Fax: (867) 392-6389<br>Email: lauraduncan@tlicho.com | Phone: (867) 392-6381 ext. 1351<br>Cell: (867) 447-0728<br>Fax: (867) 392-6406<br>Email: sjoerdvanderwielen@tlicho.com |

# 3 REGULATORY REVIEW AND APPROVALS

The DOT – GNWT is submitting this PDR to accompany land and water use applications and provide information to support a Preliminary Screening under the authority of the *Mackenzie Valley Resource Management Act* (*MVRMA*) and the *Waters Act*. The proposed Tłı̨chǫ All-season Road (TASR), consisting of a 60 m right-of-way (ROW), will be approximately 94 kilometres (km) long and will be located entirely within the Wek'èezhìı area. Approximately 17 km or 18% of the alignment will be located on Tłı̨chǫ lands, which are regulated and administered by the Department of Culture and Lands Protection (DCLP) of the Tłı̨chǫ Government. Approximately 77 km or 82% of the route will be located on Territorial lands, which are regulated and administered by the GNWT Department of Lands (Lands). Granular resource requirements for the road will be met using gravel and sand from selected borrow sources and possibly hauled from sources along Highway 3 and/or within the Whatì area. An effort will be made to utilize borrow sources located within the ROW of the proposed TASR; however, potential sources have been identified at a distance of up to 2 km from the ROW (discussed in Section 4.5)

In accordance with the Mackenzie Valley Land and Water Board (MVLWB) guidelines to the Land Use Permitting and Water Licence processes, this PDR includes a detailed description and schedule for the proposed development, describes community consultations, provides an environmental overview of the TASR, evaluates potential environmental effects of the proposed project and mitigation measures, and outlines the required management plans (spill contingency, waste management, engagement, WMMP, reclamation, etc.). After the Wek'èezhìı Land and Water Board (WLWB) reviews the applications, PDR, other supporting materials and comments from reviewers, the WLWB will determine if the proposed development could have a significant adverse impact on the environment or might be a cause of public concern.

Following WLWB screening, Tłı̨chǫ, territorial and federal permitting authorities will review the decision and associated recommendations from the screening and referral organizations. If the preliminary screening results for the applications proceed directly to the regulatory phase, then the Tłı̨chǫ Government and other regulatory agencies will issue permits and licences and prepare accompanying terms and conditions. For the portion of road traversing Tłı̨chǫ lands, as part of the permitting process for access and use of Tłı̨chǫ lands, an Access Agreement will be granted by the Tłı̨chǫ Government. Because potential borrow sources lie within the cultural heritage zone on Tłı̨chǫ lands, the DCLP will work closely to ensure that borrow sources are not in areas that are culturally or environmentally critical. Suitable mitigation strategies will also be utilized to ensure minimal impact on the ecological and cultural values for which the zone was established.

Other Tłı̨chǫ, territorial and federal agencies that will play a role in the regulatory approval process include, but may not be limited to: the Tłı̨chǫ Government, WLWB, Fisheries and Oceans Canada (DFO), Department of Environment and Natural Resources (ENR) of the GNWT, Department of Lands (Lands) of the GNWT, Environment Canada (EC), Transport Canada (TC), Natural Resources Canada (NRCan), Aurora Research Institute (ARI) and Prince of Wales Northern Heritage Centre (PWNHC).

Approvals or authorizations that may be required for the proposed development are listed in Table 3-1 and are further described below. The DOT – GNWT has submitted or will be submitting applications for approvals to the agencies granting authorizations identified in Table 3-1.

**Table 3-1 Anticipated Authorizations, Permits, Licences or Other Approvals Required for the Realignment and Construction of the Tłı̨chǫ All-season Road**

| Process, Authorization, Permit, Licence, Approval | Act and/or Regulation | Board, Agency or Organization |
|---|---|---|
| **Environmental Impact Assessment Process** | | |
| Preliminary Screening | *MVRMA* | Wek'èezhìı Land and Water Board (WLWB) |
| **Land** | | |
| Type A Land Use Permit | *Mackenzie Valley Land Use Regulations* | WLWB |
| Quarry Permit | *Quarrying Regulations*<br>*Northwest Territories Lands Act/Regulations*<br>*Northwest Territories Land Use Regulations* | GNWT Department of Lands (Lands) |
| Explosives Permit | *Explosives Act/Regulations 2013*<br>*Explosives Use Act/Regulations* | Natural Resources Canada (NRCan)<br>Workers' Safety and Compensation Commission (WSCC) |
| Access Authorization (borrow sources, access roads and TASR corridor during construction) | *Tłı̨chǫ Lands Protection Amendment Law*<br>*Tłı̨chǫ Land Use Plan Law* | Tłı̨chǫ Government |
| Approval to transport dangerous goods | *Transportation of Dangerous Goods Act/Regulations* | Transport Canada |
| Permit to Burn and Fire Preparedness Plan | *Forest Protection Act* | Forest Management Division, ENR |
| **Water** | | |
| Type B Water Licence | *Waters Act/Regulations*<br>*MVRMA* | WLWB |
| **Other** | | |
| Archaeology Permit | *Archaeological Sites Act/Regulations* | Prince of Wales Northern Heritage Centre (PWNHC) |
| Waste Disposal Approval | | Communities of Whatì and Behchokǫ̀ Landfills |

## 3.1 Review and Approvals Processes

### 3.1.1 Tłı̨chǫ Land Administration Authorizations

"Chapter 19 of the Tłı̨chǫ Agreement provides for certain situations where people can access Tłı̨chǫ lands without a land use permission being granted. This access is referred to as 'bare access'" (Section 5.3.1 of TG 2013). Access that is more than 'bare access' and falls outside of the category of activities exempt from the requirement for land use permissions listed in Section 5.3.2 of the Tłı̨chǫ Land Use Plan requires

permission from the Tłı̨chǫ Government; the granting of permission is started by way of an application to the DCLP.

Portions of the TASR will be located on Tłı̨chǫ lands and fall within the cultural heritage and enhanced management zones (see Section 4; Figure 4-1). Both zones allow for transportation corridors; however, only the enhanced management zone allows for quarries (TG 2013). Preliminary granular investigations indicate certain potential sources fall within the cultural heritage zone. All efforts will be made during geotechnical and geochemical analyses of sources to ensure that sources within the cultural heritage zone are not required. However, if all other sources are not viable, it may become necessary to utilize the sources available within the cultural heritage zone. Consultations with the Tłı̨chǫ Government during TRWG meetings have indicated that if it is necessary to develop a quarry and access road within the cultural heritage zone, the DCLP will engage with the GNWT with a view to granting land use and quarry permit access to the area after confirmation that selected areas are not culturally or environmentally critical. The TRWG will continue to work collaboratively to ensure the DCLP needs are met with respect to borrow sources and their applicable access roads. The TRWG anticipate securing multi-year authorizations from the DCLP to accommodate the duration of road construction. The project schedule is discussed in Section 4.

An access agreement would typically be required for construction of the 17 km TASR corridor that will be located on Tłı̨chǫ lands; however, GNWT and Tłı̨chǫ Government are prepared to negotiate an agreement whereby Territorial lands will be exchanged for the 17 km of Tłı̨chǫ lands required for the all-season road. This is anticipated under Chapter 18.1.9 and 18.1.10 of the Tłı̨chǫ Agreement and is expected to be complete prior to construction. A joint letter dated March 24, 2016 from the Tłı̨chǫ Government and GNWT affirms this intention (Appendix A). Tłı̨chǫ Government acknowledges that it intends to grant GNWT access by way of an interim access agreement to the Tłı̨chǫ lands described above for the purposes of constructing the proposed Tłı̨chǫ All-season Road to Whatì. GNWT confirms in the joint letter that it will grant access to those Territorial lands as necessary for the purposes of constructing the proposed TASR.

### 3.1.2 Wek'èezhìı Land and Water Board

According to Section 58.1 of the *MVRMA*, the Board "…shall regulate the use of land and waters and the deposit of waste so as to provide for the conservation, development and utilization of land and water resources in a manner that will provide the optimum benefit generally for all Canadians and in particular for residents of its management area."

The TRWG has reviewed the *Waters Act/Regulations* for their applicability to the proposed TASR. The proposed project was evaluated against Schedule B of the *Waters Regulations* to classify the undertaking as industrial, municipal, or miscellaneous. Based on this review, the miscellaneous classification is the most appropriate classification.

The TRWG understands that the project will require one Type B water licence to encompass the various project elements. The licence will authorize watercourse crossings that exceed five meters in width. The 'triggers' for a Type B water licence are described below with reference to the relevant regulatory thresholds:

- Water Crossings – Schedule H of the *Waters Regulations* states that no licence will be required for the "construction of a structure across a watercourse that is less than 5 metres wide at the ordinary high water mark at point of construction." The proposed TASR crosses more than one watercourse greater than five meters in width. For miscellaneous undertakings, these crossings would require a Type B water licence.
- Direct Water Use – Schedule H of the *Waters Regulations* states that no licence will be required for the direct water use of less than 100 $m^3$ per day. The estimated water use for construction and camp use is expected to be less than 99 $m^3$ per day and therefore no licence would be required. In the event that additional camps are required and/or construction activities are increased to complete the project in a shorter period of time, it is expected that a Type B water licence would be required as a result of the increase in daily water use. Please note that water requirements associated with an increase in construction activities will remain below 300 $m^3$ per day and would not trigger a Type A water licence.
- Deposit of Waste – Under Schedule H, if there is no direct or indirect deposit of waste to surface water, a water licence is not required; all other deposits of waste require a Type B water licence. It is expected that there will be no direct or indirect deposit of waste to surface water; therefore, no licence will be required.

Under Subsection 41(1) of the *Waters Act*, the Board may, if satisfied that it would be in the public interest, hold a public hearing in connection with any matter relating to the issuance of a Type B licence. In support of the Board's deliberations, the PDR provides information about the water crossings greater than five meters wide, identifies the need for crew accommodations, and provides a construction schedule and preliminary logistics plan. It also provides watercourse characteristics and proposed crossing structure designs.

As per Section 4 of the *Mackenzie Valley Land Use Regulations*, a Type A Land Use permit is required for this project due to the equipment required to construct the road, the fact that the road will exceed 1.5 m in width and 4 ha in area, temporary campsites will exceed 400 person-days and because it is expected that it may be necessary to utilize a single container for the storage of petroleum fuel that has a capacity equal to or exceeding 4,000 L.

### 3.1.3 GNWT Authorizations

#### *3.1.3.1 Department of Lands*

GNWT Department of Lands (Lands), in application of the *Northwest Territories Lands Act/Regulations*, the *Northwest Territories Land Use Regulations*, and the *Quarrying Regulations*, holds jurisdiction over territorial lands in the Northwest Territories. Applicable permit or licence application forms will be submitted, referencing the relevant sections of this PDR.

- Quarry Permit – The project will require quarry permits issued under the *Quarrying Regulations* for the extraction of borrow materials. It is understood that Lands will review quarry permit applications in the context of Lands' responsibility to manage granular

resources on territorial lands in the Northwest Territories. In keeping with this responsibility, Lands will consider requested volumes in the context of the resource requirements of other reasonably foreseeable community, industrial, and other demands for granular resources. A Quarry Operations Plan (QOP) will be submitted with applications consisting of a volume greater than 1,000 $m^3$ in order to meet application requirements.

The Territorial Lands Administration (a division of Lands – GNWT) has confirmed that long term land tenure (in the form of reserves or some other type of disposition) will not be required, as the TASR, once fully constructed, will be designated a Public Highway pursuant to the *Public Highways Act* under the administration and jurisdiction of the GNWT, Department of Transportation.

Lands completed a land use plan scoping study for public lands in the Wek'èezhìı Management Area. As of 2016, Lands advises that it is actively working on moving forward with a land use plan for the Wek'èezhìı Management Area with the Tłı̨chǫ Government, planning partners and other stakeholders. Lands continues to be committed in promoting and supporting effective land use planning for public lands in the Wek'èezhìı Management Area. At this time, there are no land use plan conditions or requirements for public land in the Wek'èezhìı Management Area that the proposed TASR would have to adhere to.

#### *3.1.3.2 Forest Management Division, ENR*

Under the *Forest Protection Act*, ENR's Forest Management Division is authorized as a Forest Supervisor and can issue directions to prevent forest fires. Under this authorization, ENR has developed *Forest Fire Prevention and Suppression Guidelines for Industrial Activities* (ENR 2001). These guidelines state that a Fire Preparedness Plan is required for industrial activities in Risk Classification A or B if the activity is to be carried out between May 1 and September 30. A Permit to Burn is also required in instances outlined under Section 21 of the same guidelines (ENR 2001). Blasting, metal cutting, grinding or welding, tree felling and trail building (using small engines) fall under Risk Classification A. Land clearing and right of way clearing, maintenance or grass mowing fall under Risk Classification B. Bridge building, drilling, quarrying, gravel processing, loading and hauling fall under Risk Classification C (ENR 2001).

During construction and operation of the proposed TASR, ENR's *Forest Fire Prevention and Suppression Guidelines for Industrial Activities* will be followed, where required. If construction activities that fall under Risk Classification A or B are expected to occur during the 'closed season' (between May 1 and September 30), a Fire Preparedness Plan will be developed and submitted to a Forest Officer prior to conducting the activities. As a concrete construction schedule has not been established because a contract has not been awarded, it is uncertain whether the mentioned high risk activities will actually occur during the closed season. As there are other regulations (such as the Migratory Bird Nesting Periods) that must be adhered to, there is the possibility that the high risk for fire activities will occur outside the forest fire closed season.

Should the chosen brush disposal method include burning (final decision can only be made once construction contract has been awarded) and occur during the closed season, a Permit to Burn will be acquired from a Forest Officer prior to commencing any burning.

#### *3.1.3.3 Prince of Wales Northern Heritage Centre*

Archaeological investigations are permitted under the *Archaeological Sites Act/Regulations*. Archaeological permits are issued by the Prince of Wales Northern Heritage Centre. These authorizations have been obtained prior to the conduct of field activities and local communities have been notified of proposed work activities. An additional archaeological permit may be required during final borrow source investigations and continued contact with PWNHC will ensure the appropriate permit is in place prior to any potential fieldwork.

### 3.1.4 Natural Resources Canada/Workers' Safety and Compensation Commission

Natural Resources Canada (NRCan) and Workers' Safety and Compensation Commission (WSCC) are the regulating bodies for the *Explosives Act* and the *Explosives Use Act*, respectively. As the proposed TASR lies on previously disturbed land, blasting is not likely to be needed to clear the route itself. However, especially during the winter season when potential borrow material is frozen together, blasting is usually done at borrow sites in order to free up material for stockpiling. Thus, explosives are expected to be utilized at select borrow sources along the alignment. As part of the pit development process, details of the means and extent of blasting is included in individual QOPs, with blasting plans being provided to appropriate authorities for review and official authorization before the use of explosives at any site commences. DOT recognizes that the WSCC must be contacted to receive a permit for all blasting within the NWT and that NRCan is to be contacted if magazine storage and/or use occurs outside of a quarry site. The successful contractors will be responsible for obtaining the necessary permits and licences that will allow them to transport and operate explosives where required.

### 3.1.5 Community Governments of Whatì and Behchokǫ̀

In order to deposit construction related waste at either the Whatì and/or Behchokǫ̀ landfills, written consent is required from the community governments. Preliminary consent has been obtained from the communities of Whatì and Behchokǫ̀ via email in anticipation that non-combustible waste produced during construction of the TASR will be directed to their respective community government landfills (Section 4.11; Appendix O). If the WLWB requires additional consent in the form of a signed letter, DOT will obtain said consent.

## 3.2 Non Applicable Authorizations

This section describes the authorizations that have been considered but have been deemed not applicable with respect to construction of the proposed TASR.

### 3.2.1 Fisheries and Oceans Canada Authorizations

Fisheries and Oceans Canada (DFO) administers the *Fisheries Act*, which includes provisions that potentially relate to aspects of the proposed Tłı̨chǫ All-season Road.

> *35(1) No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery.*

Section 35 of the *Fisheries Act* prohibits serious harm to fish which is defined in the Act as "the death of fish or any permanent alteration to, or destruction of, fish habitat".

Proponents are responsible for avoiding and mitigating serious harm to fish that are part of or support commercial, recreational or Aboriginal fisheries. When proponents are unable to completely avoid or mitigate serious harm to fish, their projects will normally require authorization under Subsection 35(2) of the *Fisheries Act* in order for the project to proceed without contravening the Act.

Following the process as outlined on the Fisheries Protection Program website (www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html), a self-assessment was conducted for the proposed TASR and appropriate mitigations have been identified in order to ensure serious harm to fish is avoided (see Sections 6.8 and 8.9 of PDR for further discussion). The results of the self-assessment and associated mitigations indicate that DFO review is not required for this project.

### 3.2.2 Transport Canada Authorization

Under the *Navigation Protection Act/Regulations*, the proposed TASR will not require a permit for construction of bridges or culverts across or over navigable waterbodies in the area as the La Martre River is not listed as one of the waterways where approval is required. It is understood that some of the larger watercourses, in particular the La Martre River, will still be subject to common law public right of navigation.

### 3.2.3 Department of Environment and Natural Resources

GNWT Environment and Natural Resources (ENR), in application of the *Forest Management Act/Regulations*, holds jurisdiction over timber cutting on Territorial lands; however, a timber cutting permit will not be required to clear the 60 m right-of-way in preparation for road construction. The act of clearing a highway right-of-way is deemed to not require a permit; which has been confirmed by ENR forest management staff.

# 4 DEVELOPMENT DESCRIPTION

## 4.1 Project Purpose

Under the newly released *Connecting Us: Northwest Territories Transportation Strategy 2015-2040* (DOT 2015a), DOT's mission, 'to provide and promote a safe, reliable and sustainable multi-modal transportation system by strengthening connections, capturing opportunities and embracing innovation,' is affirmed. *Connecting Us* states that 'there is an increasing demand for new roads or upgraded winter roads to support economic development and diversification, inter-community travel and to reduce the cost of living in communities' and that the 'expansion of the NWT transportation system will facilitate economic diversification and improve the quality of life for residents, who will gain increased access to essential services, economic opportunities, mobility and a reduced cost of living' (DOT 2015a). Under this updated strategy, the proposed TASR has been identified as a 'priority transportation corridor, which will support a lower cost of living, improved quality of life, sustainable resource development, tourism and other economic activities' (DOT 2015a). This project has also been identified as a GNWT commitment under the *Proposed Mandate of the Government of the Northwest Territories 2016-2019* (GNWT 2016).

The proposed TASR is considered an ideal project not only from the DOT's viewpoint, but also from various GNWT strategies. As summarized in *Connecting Us*, the following strategies support improved transportation:

> *Priorities of the NWT's 17th Legislative Assembly – Believing in People and Building on the Strengths of Northerners:* Improving the transportation system helps to build a strong and sustainable future for the NWT, increases employment opportunities where they are most needed and strengthens and diversifies our economy.
>
> *NWT Economic Opportunities Strategy:* Reliable, efficient and cost-effective transportation services greatly helps to strengthen and diversify the NWT economy by stimulating investment, expanding potential, enhancing communities, building sectors using regional strengths, establishing a positive entrepreneurial environment and preparing NWT residents for employment opportunities.
>
> *NWT Tourism 2020 (in progress), and NWT Energy Action Plan:* These strategies recognize the need to improve transportation infrastructure and services to promote tourism and enable energy development.
>
> Strategies supporting the social development of the North are also influenced by transportation. Transportation improvements support business and employment opportunities, help reduce the cost of living and develop local skilled workforces. The transportation system also supports access to health care, personal mobility, educational opportunities and other social needs that keep our residents healthy, productive and safe (DOT 2015a).

The proposed TASR would serve to meet some of the goals of these strategies.

In an attempt to meet its mission statement, the DOT has made the investigation of an all-season road alignment within Wek'èezhìı a priority since 2008. The DOT anticipates that the construction of the proposed TASR would provide direct benefits for Tłı̨chǫ residents through:

- improved opportunities for inter-community travel;
- improved access to services for Tłı̨chǫ residents;
- ability to diversity the local economy of Whatì, including new services such as a hotel, new stores, a restaurant, among other business opportunities that the community has identified;
- reduced re-supply costs for communities and improved re-supply options;
- enhanced employment, training, and contracting opportunities during all-season road construction and maintenance;
- improved opportunities for road-based tourism travel; and
- improved logistics, access and reduction in costs for mineral exploration, which could assist the development of producing mines (such as, Fortune Minerals' NICO Mine) in Wek'èezhìı.

Currently, winter road construction and maintenance cannot be undertaken until waterbodies and saturated areas are sufficiently frozen to allow standard equipment to operate safely. In warmer winters, as have been more frequent recently, greater operations and maintenance costs have incurred in order to deliver the same operating season for the public by utilizing costly new technology and equipment that enables construction to begin while the ice is still too thin for standard methods. Operations and maintenance costs are only expected to rise as is noted by the ten year cost difference from 2004 ($1050) to 2014 ($4935) per kilometer. In May 2011, in preparation for the construction of the Inuvik to Tuktoyaktuk Highway (ITH), the DOT released a comprehensive report, noting that "[a] warming trend in the northern high latitudes is anticipated to continue in this century. Many adverse impacts are anticipated, including the degradation of permafrost and its attendant effects" (EBA 2011). It is therefore expected that the technologies available will eventually no longer be able to extend the winter road season and the operating period will become shorter as a result of the variable climatic conditions. Such conditions can cause extreme difficulties for community and industrial re-supply. These issues have led the DOT, in conjunction with the Tłı̨chǫ Government, to propose the development of the TASR.

A 2014/2015 socioeconomic report (Appendix B) prepared by the Tłı̨chǫ Government provides further assessment of the benefits and concerns associated with the all-season road, while Nichols provides an updated economic analysis in its 2015 report, Economic Evaluation of the Tłı̨chǫ Road (Appendix C). The Tłı̨chǫ Government and the Whatì Community Government have also recently passed motion 2015-018 (Appendix D), which will implement a series of mitigation measures that were developed based on the review of the aforementioned reports. A Special Inter-Agency Committee meeting held on June 24, 2015 at the Whatì Culture Centre reiterated the necessary steps to ensure the items in motion 2015-018 are achieved. The meeting minutes and agenda can be found in Appendix E.

## 4.2 Project Scope

The proposed TASR involves changing the location of the existing DOT winter road alignment (Figure 1-1) between Highway 3 and Whatì to the overland all-season alignment illustrated on Figure 4-1. The selected alignment is intended for use as an all-season two lane gravel road with culverts and/or double lane bridges over water crossings as is necessary. The winter roads between Whatì and Gamètì and Gamètì and Wekweètì are not within the scope of this development.

The DOT is requesting access, a land use permit, water licence and other required authorizations to establish a 60 m right-of-way corridor that is approximately 94 km long and entirely within the Wek'èezhìı area. The estimated footprint of the proposed TASR corridor is 564 hectares. In addition, up to four or five borrow sources and their associated access roads will be required for construction purposes. It is also expected that two to three camps will be situated at midway points along the TASR, which will be set up within the borrow source footprints located on Territorial lands. Additional access roads may be required to reach appropriate water sources intended for camp use. A rough footprint estimate of the combined quarries and access roads is expected to be in the range of 220 hectares; however this number can only be confirmed once the final sources have been identified. The rough estimate has been provided to help understand the scope of the entire project.

Traffic for this proposed road is estimated at 20 to 40 vehicles per day. Note that this estimate, determined by DOT analysts, has also taken into consideration the traffic volumes of a metals mine north of Whatì if it were to begin production.

## 4.3 Route Selection

### 4.3.1 Background

In 2008, the TRWG commissioned studies to examine the feasibility, desirability, and implications of realigning the winter road to provide improved access to the communities of Whatì, Gamètì and Wekweètì. These studies included a *Multi-level Mapping and Route Analysis* (Kavik AXYS 2008a), which included the identification and evaluation of potential overland routes between Highway 3 and the communities of Whatì, Gamètì and Wekweètì as well as a complementary environmental and regulatory scoping study (Kavik AXYS 2008b).The *Multi-level Mapping and Route Analysis* identified four preliminary corridors between each community. Topographic maps at scales of 1:250,000 and 1:50,000 were used to identify initial corridors. These routes were subsequently refined by analyzing three dimensional digital air photo images in HD-MAPP, an integrated mapping system that allows the mapper to zoom in and view aerial photography in detail (e.g., scales as large as 1:1500). An aerial reconnaissance survey was flown over the area to confirm site conditions and evaluate any problematic terrain features. A number of potential routes were chosen for an overland winter road based on the following criteria:

- substrate type;
- moisture content of the substrate;
- avoidance of waterbodies and areas exhibiting thermokarst features;

- proximity to aggregate resources; and
- geometric parameters for road construction, such as elevation changes and minimization of the number of river crossings and curves (Kavik AXYS 2008a).

Once the preliminary routes were identified, terrain features were mapped along each by labeling various route segments with terrain attributes in a web-based database. Potential aggregate resources were mapped as polygons in the vicinity of the preliminary route options. Using this data, summary statistics were calculated for each route and other information, such as number of river crossings, was compiled. Each preliminary route was evaluated according to the criteria identified above. A full description of the routes identified, terrain conditions and evaluation can be found in the report, *Multi-level Mapping and Route Analysis*; however, Table 4-1 and Figure 4-2 provide a succinct summary and illustrate the possible routes between Behchokǫ̀ and Whatì, respectively (Kavik AXYS 2008a).

The advantages and disadvantages of the preliminary routes between Highway 3 and Whatì were discussed with Tłı̨chǫ beneficiaries and community residents in 2008 and again in June 2011. In a letter dated May 1, 2013 to the Minister of Transportation, the Tłı̨chǫ Grand Chief requested the study work be expanded to consider an all-season road rather than be restricted to an overland winter road (Appendix F). The preliminary corridor along Route A became the main focus of the TRSC as the alignment predominantly followed a pre-existing winter road corridor originally constructed by the military in the 1950s and had been in operation as a public winter road until the late 1980s. Constructing an all-season road along this alignment would therefore have a significantly smaller environmental impact, would be more cost effective and could be constructed in a shorter period of time; this route was also deemed desirable as an all-season road by DOT engineers.

During the original scope of work (investigating overland winter road routes), Kavik AXYS' route summary recommendations selected Routes C and A as the two most favourable routing options (2008a). Table 4-2 summarizes the benefits of both options as outlined by Kavik AXYS.

During the 2008 community meetings, Route C was identified as the "Elder's Route" and from a community perspective, was selected as the overall preferred option as it would be highly scenic and would attract tourism. Further community meetings and discussions with the TRWG continued over the next five years to determine which route should be selected and whether the project should move forward. As mentioned earlier, upon request of the Tłı̨chǫ Grand Chief in May 2013, a change of scope in the project prompted additional criteria to be considered in selecting a route. Further field studies (e.g. preliminary borrow source investigations) and discussions on account of this method shifted the initial preference of Route C to Route A based on its previous disturbance, few (<5) bridge crossings, good substrate drainage, its straight alignment with few curves or hills and that it most likely would not require blasting. Time constraints associated with the economic development of the Wek'èezhìı area (via Fortune Minerals Ltd. NICO Mine) and the reduced construction costs were additional contributing factors in selecting Route A for an all-season road. Table 4-3 illustrates the shift in route preference.

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**Figure 4-1 Proposed Tłı̨chǫ All-season Road (TASR) Corridor from Highway 3 to the Whatì Community Government Boundary**

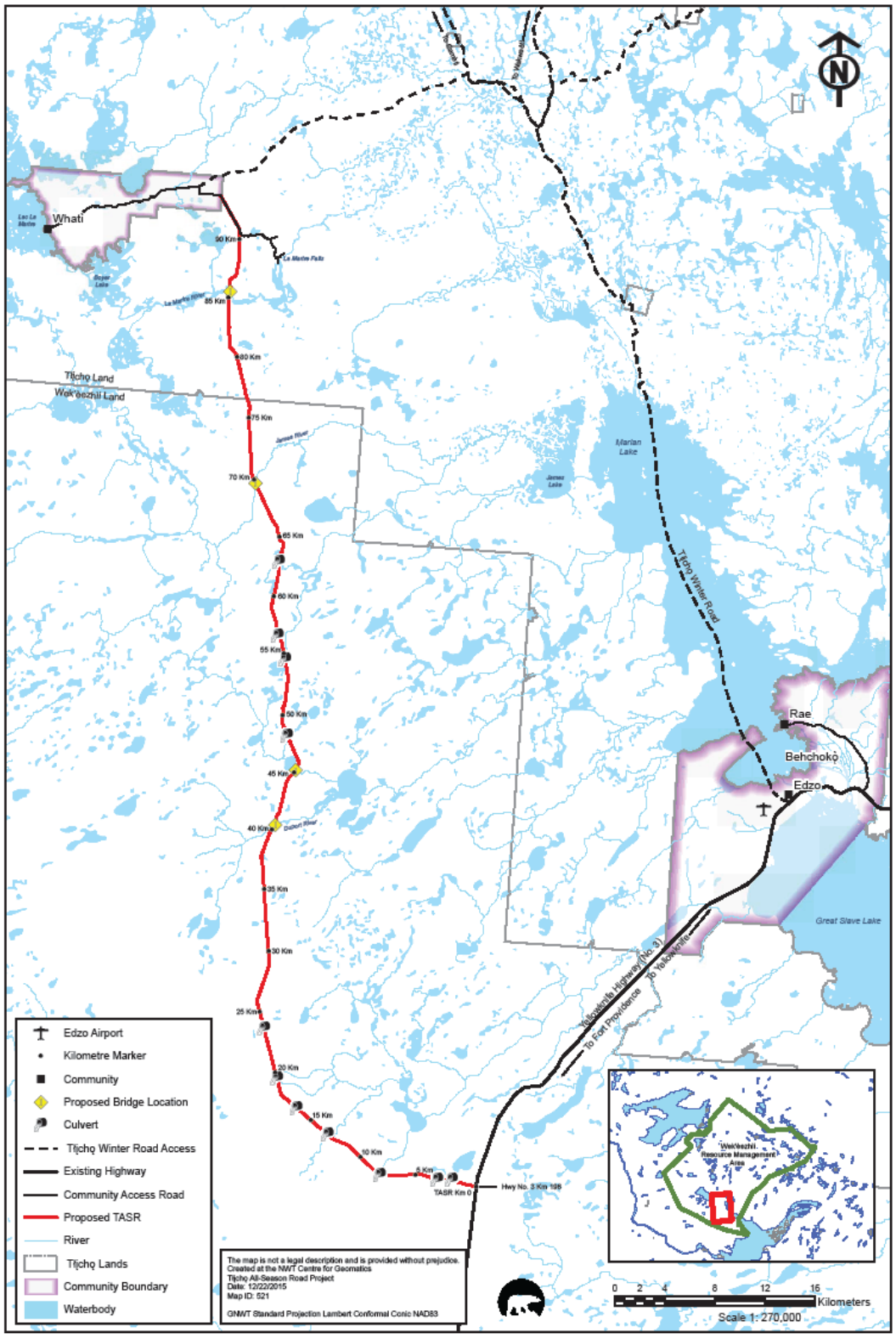

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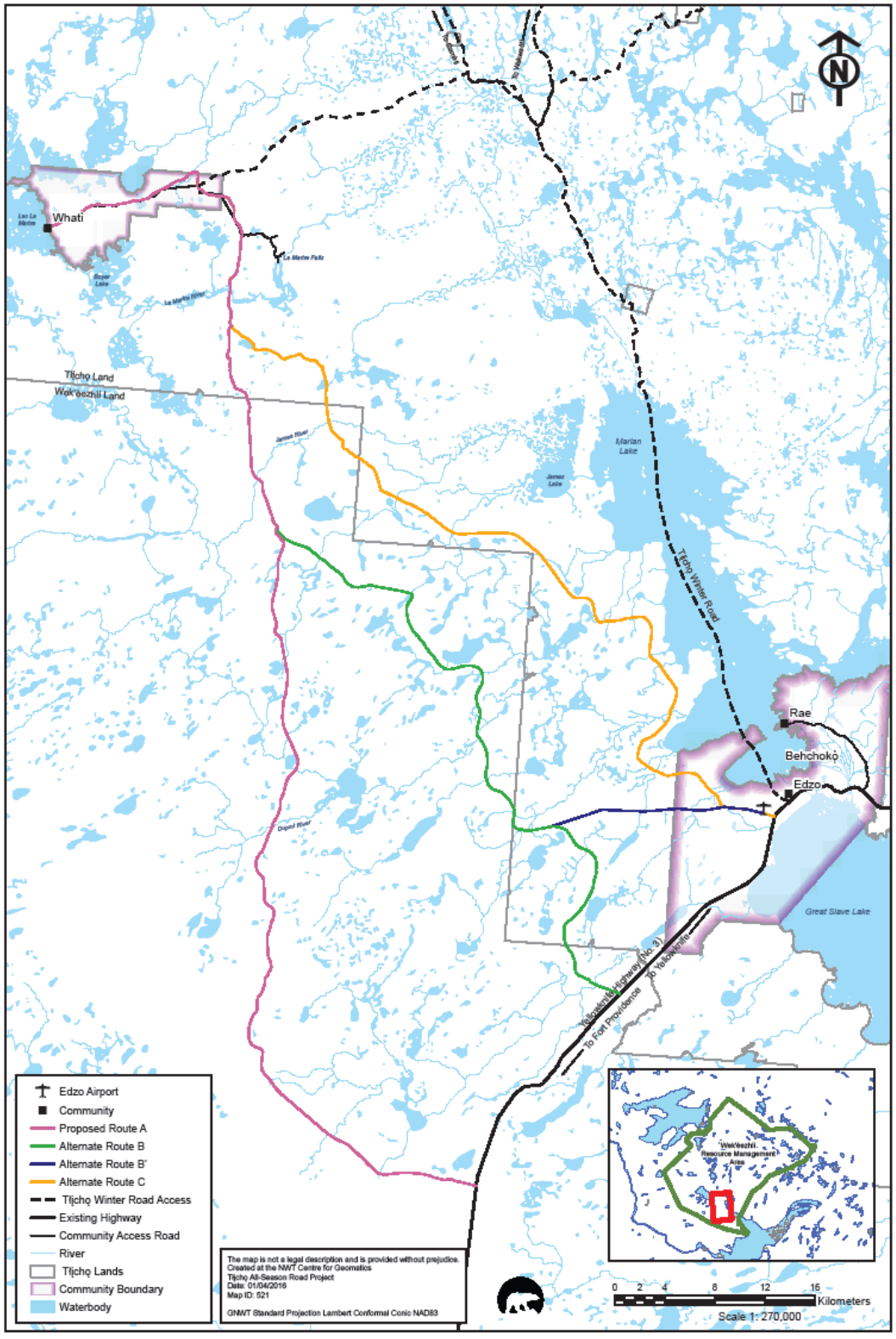
**Figure 4-2 Preliminary Behchokǫ̀ to Whatì Overland Winter Route Options Developed by Kavik AXYS 2008**



## Table 4-1 Behchokǫ̀ to Whatì – Summary of Overland Winter Route Options (Kavik AXYS 2008a)

| Criteria | Route A | Route B | Route B' | Route C |
|---|---|---|---|---|
| Distance (km) | 113.1 | 104.3 | 103.7 | 100.4 |
| Surficial materials | 39.9% till<br>24.0% raised beaches<br>22.6% glaciolacustrine<br>10.7% glaciofluvial<br>1.4% fluvial<br>1.1% organic<br>0.2% bedrock<br>0.1% water | 43.0% till<br>36.2% glaciolacustrine<br>13.1% glaciofluvial<br>5.5% raised beaches<br>1.0% fluvial<br>0.8% organic<br>0.2% bedrock<br>0.1% colluvium<br>0.1% water | 48.6% till<br>26.6% glaciolacustrine<br>14.5% glaciofluvial<br>5.8% raised beaches<br>2.0% colluvium<br>1.0% fluvial<br>0.8% organic<br>0.7% bedrock<br>0.1% water | 42.9% till<br>26.6% glaciofluvial<br>21.8% glaciolacustrine<br>5.1% raised beaches<br>1.6% fluvial<br>1.0% bedrock<br>0.7% organics<br>0.1% colluvium<br>0.1% water |
| River crossing | new crossing required at La Martre River<br>2 other minor and 1 major | new crossing required at La Martre River<br>3 other minor and 2 major | new crossing required at La Martre River<br>2 other minor and 2 major | new crossing required at La Martre River<br>2 other major crossings |
| Granular borrow sources | generally poor along route, but good potential exists near Whatì | generally poor, but good potential exists near Whatì and at the start of the route | generally poor along route, but good potential exists near Whatì | generally good |
| Drainage constraints | 1.5% rapid to very rapid<br>71% moderate to well<br>26.5% poor to imperfect<br>1.1% very poor | 0.6% rapid to very rapid<br>61.1% moderate to well<br>37.6% poor to imperfect<br>0.8% very poor | 1.2% rapid to very rapid<br>65% moderate to well<br>32.9% poor to imperfect<br>0.8% very poor | 2.5% rapid to very rapid<br>68% moderate to well<br>28.8% poor to imperfect<br>0.7% very poor |
| Slope constraints[1] | 95.5% none to slight slopes<br>4.5% moderate slopes<br>0.02% high slopes | 96.5% none to slight slopes<br>3.5% moderate slopes<br>0.01% high slopes | 95.4% none to slight slopes<br>4.6% moderate slopes<br>0.01% high slopes | 96% none to slight slopes<br>4.0% moderate slopes<br>0.02% high slopes |
| Connectivity with existing road infrastructure | Connects with the Yellowknife Highway (No.3) 40 km southwest of Behchokǫ̀ (Edzo) | Connects with the Yellowknife Highway (No.3) 20 km southwest of Behchokǫ̀ (Edzo) | Connects with the Yellowknife Highway (No.3) 3 km southwest of Behchokǫ̀ (Edzo) | Connects with the Yellowknife Highway (No.3) 3 km southwest of Behchokǫ̀ (Edzo) |

***1** none – 0-2%; slight – 3-5%; moderate – 5-15%; high – >16% slope*

## Table 4-2 Route Summary Recommendations for an Overland Winter Road

| 1st choice: Route C | 2nd choice: Route A |
|---|---|
| Shortest route | Driest route |
| Most potential aggregate resources along route | Poor aggregate resource potential |
| Highest amount of glaciofluvial materials underlying route, as well as good amounts of till and raised beach deposits, which are good road substrates | Contains good road substrate materials |
| Requires 3 major river crossings, including La Martre River | One less major river crossing than Route C |
| Second only to Route A in idealness of drainage conditions | Best drainage conditions |
| Connects most closely to the town of Behchokǫ̀ | Connection to Highway 3 is 40 km southwest of Behchokǫ̀ |

*Kavik AXYS (2008a)*

## Table 4-3 Route A and C comparison for an All-season Road from Highway 3 to the Whatì based on May 2013 change in scope

| 1st choice: Route A | 2nd choice: Route C |
|---|---|
| Significantly lower construction costs as route follows an old winter road alignment that is currently in use (snowmobiles, ATVs, dogsleds, trucks up to a certain location). | Higher construction costs as route is not pre-disturbed and blasting activities would be required to construct the majority of the road. |
| There are existing impacts from the old winter road (brownfield), which would limit the disturbance to habitat/environment. Substantial studies have already been conducted along this route so multi-year studies to develop appropriate mitigations would not be required. | Greenfield route, which would result in new disturbance to habitat/environment for entire corridor. In depth multi-year scientific studies would be required to describe the environment and to develop appropriate mitigations. |
| Fewer major water crossings requiring substantial bridges. | More major water crossings. |
| Additional borrow sources have since been identified along route; therefore, more aggregate available than originally projected in 2008. | Doubles potential harvesting impact by introducing a new road into the region (as Route A is currently used for harvesting). |
| Lower maintenance costs on Taiga Plains. Maintenance costs are determined by DOT by comparing Hwy 3 O&M between Behchokǫ̀ and YK vs. Behchokǫ̀ and Fort Providence. | Higher maintenance costs on Taiga Shield due to the proliferation of discontinuous permafrost. |
| Shorter construction period and higher chance of funding partnerships with industry, federal and territorial governments. Shorter construction period allows for potential revenue (all levels of government) as Fortune's NICO project could move forward. | Long construction period will result in lower likelihood of outside investment, which may result in Fortune's NICO project being abandoned entirely. |
| Located entirely on Crown lands aside for approximately 17 km of Tłı̨chǫ lands. Land conveyance possible. | Within Tłı̨chǫ lands aside for approx. 10 km of Crown lands. Access Agreement would be necessary (lands returned to TG upon closure of winter road would not be enough to cover the land required for a land swap with this route). |

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**Figure 4-3 2014 DOT Ground Truthed Route Following Pre-disturbed Alignment (Old Airport Road)**

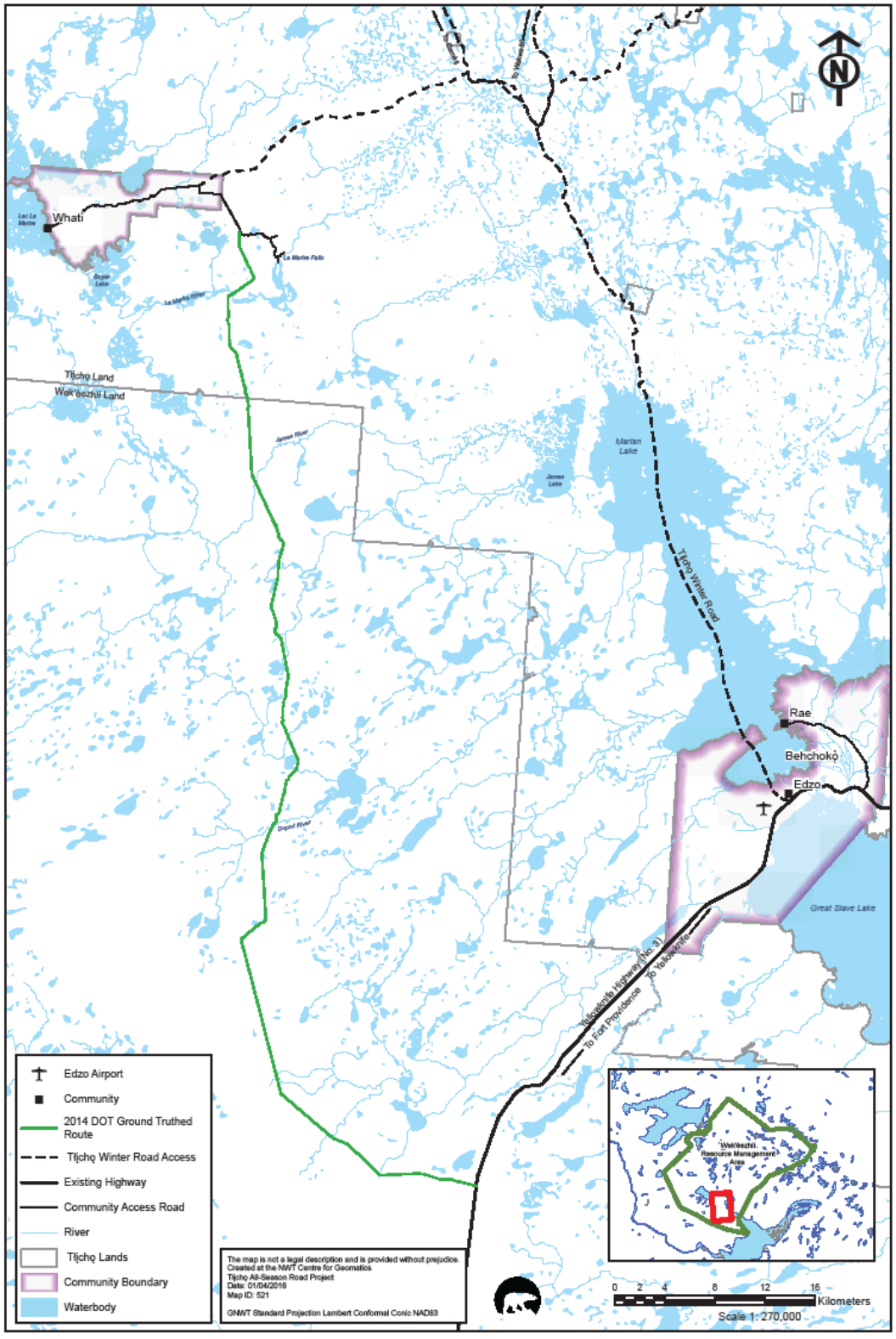

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**Figure 4-4 2008 Kavik AXYS Route A versus 2014 Ground Truthed Pre-disturbed Alignment (Old Airport Road)**

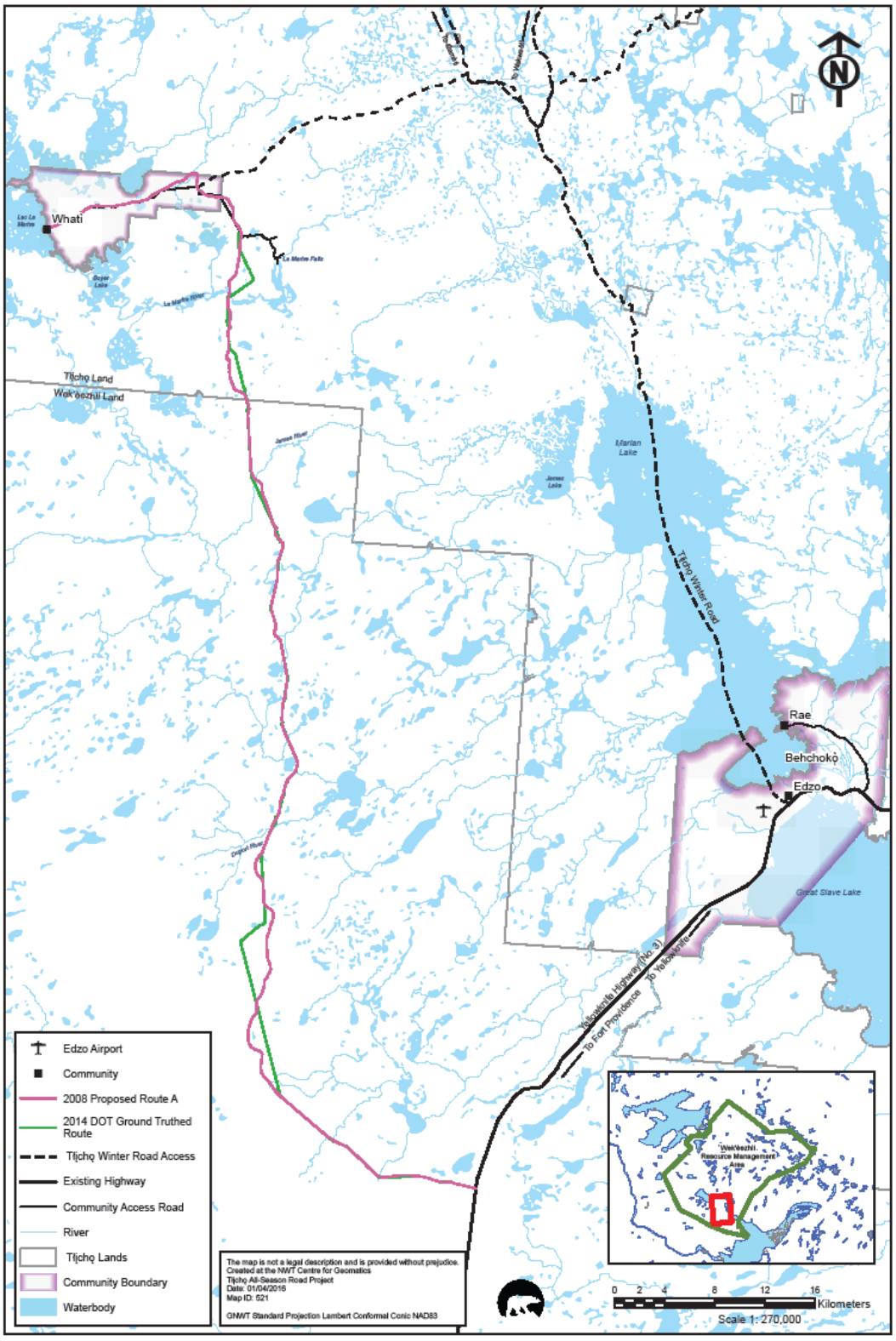

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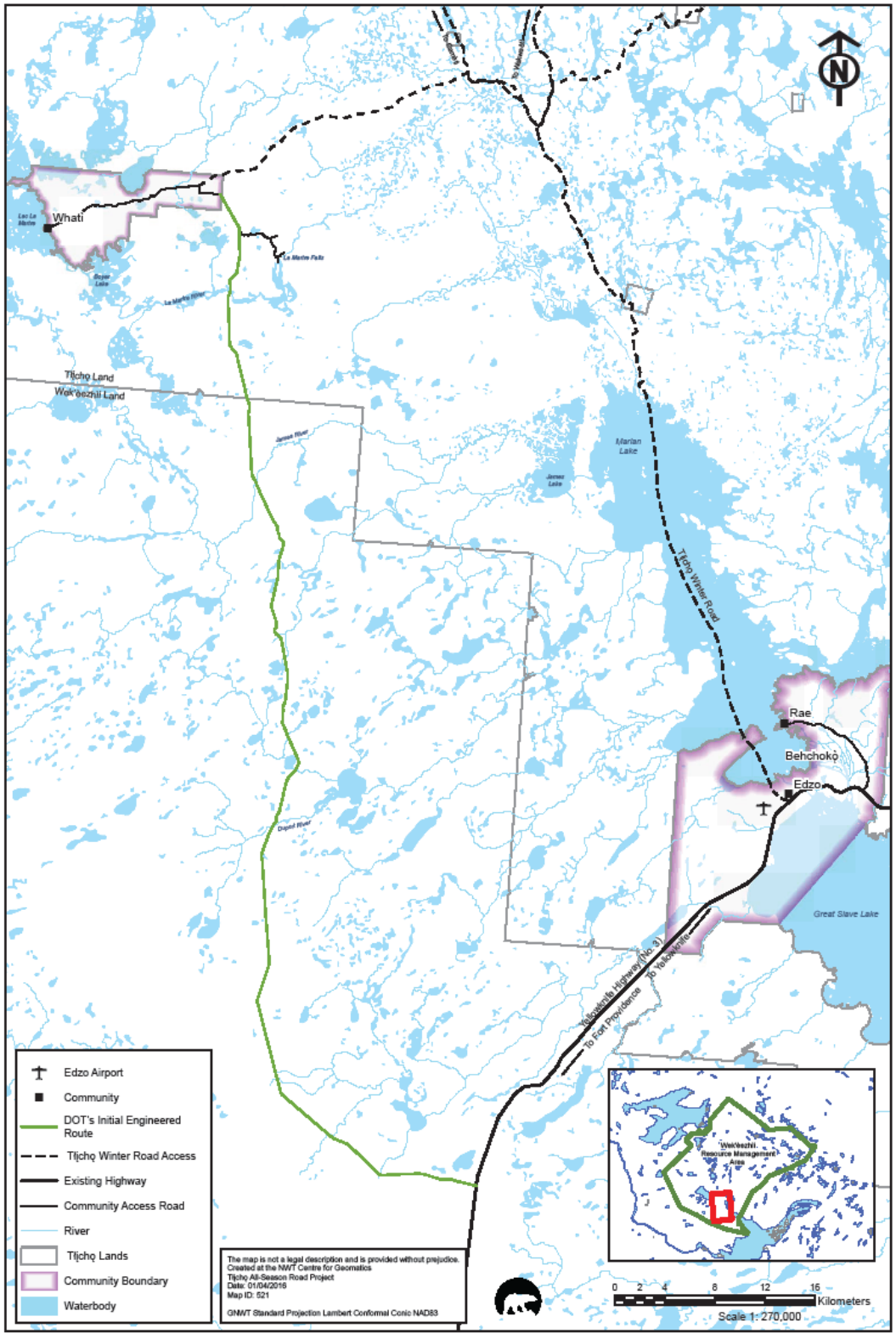
**Figure 4-5 DOT's Initial Engineered Route for Proposed TASR Corridor (2014)**



### 4.3.2 Location and Surveying

The studies, community meetings, and economic discussions conducted up until November 2013 identified preliminary Route A as the preferred alignment for an all-season road from Highway 3 to the Whatì Community Government boundary. During the spring and summer of 2014, further route analyses[2] were conducted and included flying and ground truthing an already disturbed alignment (historic military winter road, also known as 'Old Airport Road' by community members) that closely followed Route A (which had been identified by Kavik AXYS). See Figure 4-3 for ground truthed route; it is identified as the 2014 DOT Ground Truthed Route. The Kavik AXYS preliminary Route A deviated from the already disturbed alignment in areas where Kavik AXYS found it unsuitable to construct an overland winter road based on its desktop review. These deviations are limited as illustrated in Figure 4-4. Upon completion of ground truthing, review of the AIA, traditional knowledge and socioeconomics studies and a preliminary review of the data obtained from a hydrology survey conducted in July 2014, an initial DOT engineered route was selected (Figure 4-5). This proposed route predominantly followed the disturbed alignment; however, a few route realignments were identified as possibly being necessary in order to accommodate bridge construction at select crossings as noted by the preliminary hydrological analysis and general engineering requirements.

In 2015, the initial DOT engineered route underwent further refinement after the completion of a topographic field survey, review of LiDAR, review of the completed hydrotechnical report and an additional field visit to the water crossings. DOT engineers from the Structures and Design & Construction sections then proceeded to develop the proposed TASR corridor, illustrated in Figure 4-1. Design decisions took into consideration where previous disturbance was noted and incorporated this area as best as possible while maintaining engineering requirements. Though the proposed TASR corridor, identified in Figure 4-1, has already undergone substantial engineering, the corridor will be subject to final refinement prior to construction to ensure the alignment meets safety, environmental and constructability requirements. It is expected that geotechnical investigations (which will only occur after procurement of funding for the project) will contribute to the corridor refinement; however, these changes are expected to be small and should not affect the details presented in this PDR. Mitigations identified in Section 8 are expected to cover any future route refinements. For the purposes of the PDR, the alignment outlined in Figure 4-1 illustrates the most suitable corridor when accounting for engineering, environmental, archaeological and traditional knowledge factors that have been identified up until this point.

### 4.3.3 Route Selection Summary Steps

1) Four corridors identified;
2) Route A & C preferred for overland winter road;
3) Change of scope resulted in Route A being selected for all-season road;
4) Ground truthing, various 2014 studies and preliminary hydrological analysis created 2014 initial DOT engineering route;

[2] Archaeology Impact Assessment (AIA); Hydrological Assessment; Traditional Knowledge Land Use Study; Socioeconomics Study; and Aerial and Ground Truthing Studies.

5) Further studies in 2015 (topology) allowed for further refinement of route and created proposed TASR corridor; and

6) Final route refinement (e.g. geotechnical analysis) will be required prior to physical road construction.

### 4.3.4 Proposed Tłı̨chǫ All-season Road (Highway 3 to Whatì Community Government boundary)

The proposed Tłı̨chǫ All-season Road (TASR) is defined as an all-season road approximately 94 km in length and 60 m in width with a cleared driving surface of approximately 8.5 m in width. Establishing a 60 m wide right-of-way corridor for road use is standard practice as defined under the *Highway Designation and Classification Regulations*. The final ROW will be selected in order to avoid sensitive terrain (such as karst).

The location of the 94 km all-season road begins at KM 196 along Highway 3 and continues in a northwesterly direction to the community government boundary of Whatì. The alignment is situated within the geographic coordinates 62°28'54" to 63°10'37" N latitude and 116°29'07" to 117°00'05" W longitude (Figure 4-1).

The proposed footprint is entirely contained within the Wek'èezhìı area and begins approximately 40 km southwest of Behchokǫ̀ off Highway 3. Approximately 17 km of the road is located on Tłı̨chǫ lands.

There are 15 tributaries along the alignment, which include 4 major bridge crossings, which are identified in Figure 4-1. The names and locations of the main water crossings are listed in Table 4-4. A 1:2,500 map book, located in Appendix G, provides further illustrative detail.

**Table 4-4 Main water crossings within proposed TASR corridor**

| Name/Location | River Width | Approx. KM Location (Crossing #) |
|---|---|---|
| Duport River 62º43'48" N 116º50'21" W | 1.2 m + 8.3 m offline floodplain pond + 50-75 m floodplain | 40.40 (8) |
| Unnamed Tributary 62º46'13" N 116º48'51" W | 8.3 m + | 45.18 (9) |
| James River 62º58'26" N 116º54'43" W | 12.2 m + | 68.67 (14) |
| La Martre River 63º06'34" N 116º58'33" W | 26.6 m + | 85.40 (15) |

#### *4.3.4.1 Disturbance Level along ROW*

As mentioned earlier, the proposed TASR predominately follows the route of an old overland winter road established by the military in the 1950s, which is defined as a 'tractor trail[3]' by Tłı̨chǫ elders. Because this route was utilized as a public winter road for the northern Tłı̨chǫ communities up until the late 1980s and due to continued use by Tłı̨chǫ community members and other NWT residents (via snowmobiles, dog sleds, ATVs, and trucks [in certain parts]), the alignment has remained disturbed. The disturbance level

[3] Tractor trails are functional trails developed by exploration companies, or are the early winter roads for industrial purposes. These trails do not have the same cultural significance as Ancestors' trails.

along the 94 km varies based on ease of access and terrain type. For example, the first 30 km of the proposed road starting at Highway 3 can be easily accessed by truck in the summer. Depending on water levels and how dry the route is from year to year, trucks can potentially travel further north. Depending on yearly snow conditions, truck access along the route can surpass the first 30 km in winter due to increased stability of frozen ground. Snowmobiles can travel the entire alignment during winter, though are unable to cross the La Martre River due to thin ice and open water. Depending on water levels along the route in the spring and summer, ATVs can also travel the entire alignment aside for the crossing at La Martre River. Appendix H illustrates the disturbance level along the proposed TASR during the 2014 ground truthing exercise. The areas illustrated in the photos were documented prior to the 2014 and 2015 forest fires. Based on the most recent wildfire maps, it is expected that an even greater area of the proposed TASR has been disturbed by wildfires.

The proposed TASR is expected to be constructed up to the community government boundary of Whatì; however, through community access funding, over the years, the community of Whatì has been able to establish a community access road that extends out to the La Martre Falls. Approximately 3 km of the proposed TASR will follow the community access road and would only require minimal upgrading to meet the necessary DOT standards as the 3 km can currently accommodate all vehicle types (Appendix H).

Disturbance levels along the route can also be compared to Environment Canada's anthropogenic disturbance mapping across known woodland boreal caribou ranges (EC 2013). EC has created shapefiles to illustrate anthropogenic disturbances within boreal caribou ranges. By overlaying EC's 2012 updated anthropogenic disturbance shapefiles onto DOT's proposed TASR corridor, approximately 35 km of the proposed road can be identified as an anthropogenic disturbance according to EC's assessment. The 35 km consist of approximately KM 0 to KM 8, KM 68 to KM 85 and KM 88 to KM 94. This disturbance can be attributed to harvesting, travel to and from cabins, and timber harvesting.

## 4.4 Design Parameters for the Proposed TASR

The design parameters considered in the preliminary design of the proposed TASR are based on the *Geometric Design Guide of Canadian Roads* published by the Transportation Association of Canada (TAC 1999) and DOT's *Standard Specifications and Drawings for Highway Construction* (1996), which is updated internally on an as needed basis. Based on the TAC design classification system, the proposed TASR is considered as an RLU 80; this classification represents a Rural Local Undivided highway with a design speed of 80 km/h. Based on these parameters, the posted speed limit for the TASR will be 70 km/h.

The considered design parameters will allow for year-round use by commercial and private vehicles according to the size and weight limitations outlined in NWT regulations, such as the *Large Vehicle Control Regulations*. The parameters that follow in Sections 4.4.1 and 4.4.2 are based on design classification RLU 80.

### 4.4.1 Design Embankment

The proposed TASR will be designed as a two lane gravel roadway with a 8.5 m wide driving surface. To address the drainage issues, culverts will be installed where suitable. Excavation within permafrost areas

will be avoided whenever possible because cutting into surface vegetation can disturb the permafrost regime resulting in thaw and unstable ground. Design will primarily be fill out to prevent any permafrost degradation. Figure 4-6 presents the typical cross section, which will vary along the stretch of highway as per terrain and thermal analyses. Geotechnical investigations will not be carried out until financing has been procured; for this reason, final embankment thickness can only be specified at a future date. Total embankment volume is currently estimated at 3,100,000 $m^3$. As these details are only required during the final stages of design and should not create any significant changes in terms of mitigation described herein for the proposed TASR, estimated volumes are currently adequate. Based on existing design in the region with similar terrain type, a 1.5 m thick (average) embankment is considered as a design standard for a Class C estimation.[4]

### 4.4.2 Geometric Design

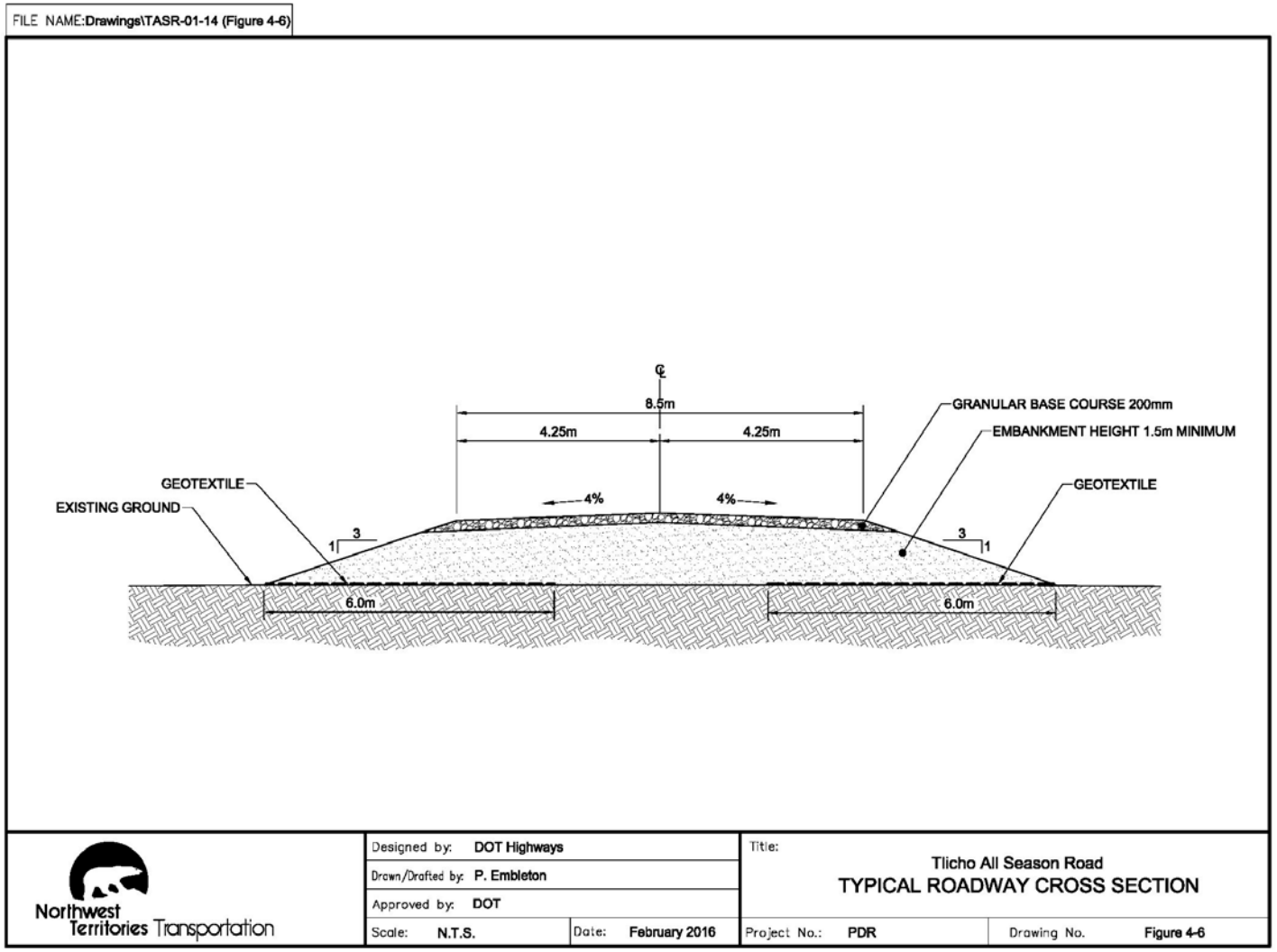
Taking into account the operational needs for the proposed TASR, minimum geometric design parameters have been developed based on the *Geometric Design Guide of Canadian Roads* published by TAC (1999) with some modifications. These parameters are presented in Table 4-5, while Figure 4-6 illustrates the design parameters in a typical highway cross section. The figure shows geotextile between the existing ground and the embankment. This is a feature that will most likely be included along the entire alignment.

### 4.4.3 Bridge and Culvert Structures along proposed TASR corridor

Along the preferred road alignment, there are fifteen water crossings. Four of these crossings will require bridge structures; two will require structural culverts and the remaining nine sites will have banks of drainage culverts smaller than 1500 mm in diameter. An additional site with a defined channel was identified by the DOT Structures section after the contracted hydrological analysis was completed. This site is located just south of crossing 10 and has been labeled 10A; it will require an arch culvert. Additional small diameter equalization drainage culverts will be required to transport water underneath the proposed TASR; the number and specific location of these culverts will be identified during the final stages of the detailed design for the development of the road and are typically only completed prior to construction. Conceptual bridge and structural culvert designs are available in Appendix I. Detailed bridge and culvert designs will be available after the geotechnical investigation is complete. Please see Photos 1 through 16 for an aerial view of each of the water crossings. Black arrows indicate where the proposed corridor will be located and identify bridge crossings. White dashed arrows indicate the direction of water flow. AC and C identify where an arch culvert or culvert will be located, respectively.

[4] Class C estimate is a cost estimate based on a comprehensive list of requirements and assumptions and is a part of the ABCD estimate classifications. It is a schematic design development estimate. Further cost estimate definitions are described by Public Works and Government Services Canada (PWGSC).

## Figure 4-6 Typical Highway Cross Section



## Table 4-5 Geometric Design Parameters for the Proposed TASR

| | | |
|---|---|---|
| **Design Parameters** | | |
| Design Designation | RLU – 80 | Rural Local Undivided (Low Volume Road) |
| Design Speed | 80 km/h | Posted speed limit = 70 km/h |
| Design Guidelines and References | | All design parameters must meet or exceed the National Standards established by applicable governing/regulatory bodies. For exemptions to any of the criteria established herein, a technical memo must be submitted to the Director of Highways and Marine Division with substantiation and rationale for the change prior to approval.<br>Following resources govern the design:<br>• *TAC Geometric Design Guidelines*<br>• *CAN/CSA-S6 Canadian Highway Bridge Design Code (current version)*<br>• *Transportation Association of Canada's Guide to Bridge Hydraulics – 2nd Edition 2001*<br>• *GNWT Transportation Regulatory Authority's requirements for Bridges & Bridge-Culverts*<br>• *To be constructed in accordance with NWT specifications* |
| **Roadway Design** | | |
| **Horizontal Alignment** | | |
| Desired Curve Radius | 500 m | This desirable is applicable for the entire length of the roadway. The minimum radius is also applicable for the entire length of the roadway; however, exceptions will be permitted on a site specific basis. The minimum radius for the horizontal alignment through site specific areas shall be 90 m. |
| Minimum Curve Radius | 250 m | |
| Passing Sight Distance (minimum) | 560 m | There is no requirement for continuous passing opportunities for the entire length of roadway; however, the designer should endeavor to allow for passing opportunities along a minimum of 30% of the roadway length. Passing opportunities should be equally spaced along the entire length of the roadway with a desirable spacing of approx. ten (10) km. |
| Minimum Sight Distance | 160 m | Horizontal sight distances are to be verified on all curves. |
| Superelevation (e max) | 0.06 m/m | |
| Minimum Spiral Parameter – "A" Value | N/A | Refer to appropriate Superelevation Tables for minimum and desirable "A" parameters for each curve radius and design speed. Spirals not required on all curves requiring superelevation. |
| **Vertical Alignment** | | |
| Minimum Passing Sight Distance | 540 m | Where the minimum stopping sight distance is used, the sight should be verified using an object height of 0.38 m and an eye height of 1.05 m. Where the minimum decision sight distance is used, the sight should be verified using an object height of 0.15 m and an eye height of 1.05 m. Where the minimum passing sight distance is used, the sight should be verified using an object height of 1.30 m and an eye height of 1.05 m. |
| Minimum Stopping Sight Distance | 140 m | |
| Minimum Decision Sight Distance | 245 m | |
| Minimum Sag K Value | 20 | Desirable "K" Value = 40. |

## Table 4-5 (Continued) Geometric Design Parameters for the Proposed TASR

| | | |
|---|---|---|
| Minimum Crest K Value | 20 | Desirable "K" Value = 50. |
| Minimum Length of Vertical Curve | 80 m | |
| Maximum Gradient | 9% | 6% desirable and 10% maximum gradient for mountainous terrain |
| Maximum Gradient at Bridge Approaches | N/A | See Structures Design below. This gradient is applicable for 100 metres in advance of the bridge apron. |
| Minimum Freeboard at Bridge Crossings | N/A | See Structures Design below. |
| **Cross-Section** | | |
| Finished Roadway Width | 8.5 m | In guardrail installation areas, an additional 1 m in width shall be added for each side that guardrail is installed. |
| Travel Lane Cross Slope | 4% | Gravel surface |
| Lane Width | 3.50 m | |
| Side Slope/Fill Slope Ratio<br>Normal<br>Minimum (with Toe of Slope in water area)<br>On fills over 4 m | <br>3.0 to 1<br>3.0 to 1<br>2.5 to 1 | <br><br>Use rock fill only in the water.<br>Final embankment heights and other recommendations/direction subject to Thermal Analysis (TBC). |
| Slope Stabilization Height | >4 m | Slope stabilization features shall be designed for fills over 4 m in height (i.e. benched embankments, etc.). Further recommendations/direction subject to the Thermal Analysis (TBC). |
| Average Embankment Height (above original ground level) | 1.5 m | Does not include base courses. Subject to Thermal Analysis. |
| Surface Gravel Thickness | 200 mm | 200 mm crushed granular base course |
| **Culverts (in accordance with latest edition of Canadian Standards Association CANS-G401)** | | |
| Drainage/Equalization Culverts (up to 1500 mm diameter) | | |
| Detailed Specifications | | Refer to:<br>1. SD-400-01-51<br>2. Standards Specifications – Division 4 Structures Section 1 – Supply and Installation of Corrugated Steel Pipe Culverts |

## Table 4-5 (Continued) Geometric Design Parameters for the Proposed TASR

| | | |
|---|---|---|
| **Guardrail** | | |
| | | Guardrail shall be designed for in areas with embankment heights of 4 m of greater and/or areas where waterbodies are close enough to the highway to be considered a hazard. The BC MOT Warrant Guide and practical safety considerations will be used for determining barrier installation locations. Type of guardrail shall be selected to minimize snow accumulation or drifting on roadway. |
| **Roadside Pullouts** | | |
| | | Roadside pullouts to be provided at approximate one half hour travel intervals. |
| **STRUCTURES DESIGN** | | |
| **Bridge-Culverts (1500 mm diameter and above) – Design Life 75 Years** | | |
| Type | Varies | Structure type, material selection and opening size to best suit specific site conditions and road geometry and to meet environmental requirements for fish passage and stream flow. |
| Minimum cover | 1.5 m | |
| Bedding Camber | | All closed bottomed bridge-culverts must be installed with camber. |
| Structural Bedding | | Top 200 mm to be un-compacted and shaped both longitudinally and transverse. |
| Structural Backfill | | Provide source and specifications of granular material/placement methods to be used must meet or exceed CHBDC requirements. |
| Ends | Required | Must be beveled as per CHBDC constraints. |
| End Treatments | Required | Must protect against hydraulic uplift, piping, undermining and ice jacking (for example using cut-off walls, impermeable barriers, sufficient load on bridge-culvert ends to prevent uplift, etc.). |
| Plate Thickness | Varies | Provide engineering rationale for selected metal thickness to meet the design life and to accommodate expected rate of section loss. |
| Corrosion Protection | | Select appropriate bridge-culvert material and coating to suit site conditions (i.e. water and soil pH, abrasion, etc.). |
| **Bridges – Design Life 75 Years** | | |
| Design Loading | CL-800 | |
| Freeboard | Min 1.5 m | This minimum is appropriate at all bridge crossings. Measurements for freeboard are between the underside of the girder and the high-high water or high-high ice levels to allow for events related to freshet, icing conditions and blockages as historical data and knowledge of stream behaviour with new road embankment and structures cannot be fully predicted. |
| Approach Slabs | Required | Required at all bridges to mitigate loss of fill at bridge/gravel road interface and to avoid grader/plow damages. |

## Table 4-5 (Continued) Geometric Design Parameters for the Proposed TASR

| | | |
|---|---|---|
| Skew | < 15 degrees | |
| Lanes | 2 | 2 lanes will provide road width consistency for travellers under various weather/visibility conditions. Safety issue. |
| Bridge width | 8.0 m clear curb to curb minimum | |
| Maximum Gradient at Bridge Approaches | 2% | This gradient is applicable for 100 metres in advance of the bridge apron. |
| **General Bridge and Bridge Culvert Considerations** | | |
| **Key Goals** | | **Safety, Durability and Functionality** |
| | | • Length, height and mass of pre-fabricated elements must be carefully planned to suit the transportation/haul constraints and launching/lifting machinery availability.<br>• Climate change.<br>• Channel movement.<br>• Lack of historical knowledge about stream activities (max flows, freshet, icing, overflow, debris, beaver activity).<br>• Maintenance requirements.<br>• Beaver activity, debris, ice/snow accumulation in bridge-culverts, overflow, freshet.<br>• Snow accumulation from plowing operations between bridge/guardrail on available roadway width and bridge/guardrail type to minimize snow accumulation.<br>• Erosion and sediment control. |
| *Special Notes and Considerations in Design of Soil-Steel Culverts in the NWT*<br>Some factors that lead to poor performance of a soil-steel culvert in the North are as follows:<br>• Use of poor quality soil, containing large quantities of clay and organic matter, in the backfill<br>• Compaction of the backfill in large layers<br>• Compaction of the backfill in very cold weather, when there are ice lenses in the soil which give rise to the false impression of an adequate degree of compaction<br>• Lack of compaction in areas where the interface radial pressures between the soil and conduit wall are particularly high<br>• Construction of the structure on very flexible foundations without strengthening as required<br>• Providing skewed bevel ends to the pipe without adequate protection in the form of strong head walls made integral with the conduit wall<br>• Lack of inlet and outlet protection when the structure carries water and is expected to be subjected to sudden and severe floods<br>*Reference: Soil Steel Bridges: Design and Construction by Abdel-Sayed, Bakht & Jaeger; McGraw-Hill Inc. 1994.* | | |

### *4.4.3.1 Bridges*

Along the preferred road alignment, four major bridge crossings have been identified. The coordinates for the major bridge crossings are identified in Table 4-4 while Table 4-6 describes the anticipated bridge structures.

Crossing 8, also known as the Duport River, will require a 48 m long bridge comprised of two equal spans. While the main defined channel is approximately one metre wide, the wide floodplain warrants a larger structure. There will be a pier centered between the main channel and the oxbow pond just north of the main channel. The centered pier will be in the floodplain but will be well away from the active main channel.

Crossing 9 is an unnamed tributary and will require one clear span 24 m long bridge.

Crossing 14 at James River is proposed as an 80 m bridge comprised of one 40 m clear span over the waterbody with a 20 m jump span on each end. The river is located in a slight valley and due to the road geometry and floodplain a larger structure could not be avoided. The piers will be located in the floodplain but will be well away from the active main channel.

The final crossing, crossing 15 at the La Martre River will require the longest bridge. A 100 m long bridge is proposed with a 40 m clear span over the river and a 30 m jump span on each end. The two piers will be adjacent to the active main channel.

The conceptual bridge designs are available in Appendix I. Final bridge designs will be available after a detailed geotechnical investigation is complete.

For information purposes, a typical construction process for a bridge might include the following:

- Mobilizing equipment, material and personnel to site
- Setting up a detour if required
- Surveying and laying out the works
- Earthworks where required to prepare the work area
- Commence pile driving. Once pile driving is complete on one end, continue piling driving at the other locations (pier/s, other abutment) while installing pile cap
- Once all piling is complete and pile caps set – install girders with deck depending on the design, complete with any bolting and grouting as required
- Complete approaches
- Install guardrail
- Install rip-rap where required to protect abutments and slope (may be necessary to complete earlier in the process)
- Install erosion and sediment control measures
- Clean up site and demobilize

- Contractor may need to return to complete seasonal deficiencies if any depending on whether the work was complete in the winter or summer season

**Table 4-6 Major Bridge Structures within proposed TASR corridor**

| Water Crossing | Station (Km) | Number of Spans | Nominal Width (m) | Total Bridge Length (m) | Total Deck Area ($m^2$) | Water Crossing Width |
|---|---|---|---|---|---|---|
| Duport | 40.40 | 2 | 8 | 48 | 288 | 1.2 m + 8.3 m offline pond +50-75 m floodplain |
| 9 | 45.18 | 1 | 8 | 24 | 144 | 8.3 m + |
| James | 68.67 | 3 | 8 | 80 | 480 | 12.2 m + |
| La Martre | 85.40 | 3 | 8 | 100 | 600 | 26.6 m + |

#### *4.4.3.2 Culverts*

In addition to the bridge structures, there will be requirements for culverts at the other 11 smaller water crossings (Table 4-7) identified by Stantec's 2014 hydrological study as well as the additional crossing DOT later identified. Stantec's detailed hydrological assessment of the original 15 watercourse crossings provided anticipated sizing requirements; however, after corridor refinements, each water crossings was reanalyzed by the DOT's Structures and Design & Construction engineering sections. The most suitable structure was selected based on site, topography, hydrology, fish passage requirements, and road geometry. Once geotechnical information is obtained and on-site studies can be completed, the culvert sizing will be finalized. Table 4-7 summarizes the necessary culverts, their respective locations and sizing, while Appendix I provides the conceptual drawings.

Crossing 5 and 6 at KM 16.5 and 19.4, respectively, will require structural plate corrugated steel pipes (SPCSP). SPCSP's are comprised of multiple plates that must be assembled and bolted together in a specific order and direction. Installing these culverts will require sub-excavation up 800 mm in order to found the culvert on a suitable foundation and allow proper compaction of material around the culvert in order to maintain the integrity of the structure. This construction is expected to occur during no flow periods or will abide by DFO fishing timing windows for the NWT. The additional channel that was identified by DOT, crossing 10A, will require a structural plate corrugated steel arch pipe culvert although limited information is available as it was not part of the hydrological study. Based on the proximity to crossing 10 and water basin maps, it is assumed 10 and 10A are actually contained within the same crossing. Conceptual designs for the two structural culverts and the arch culvert are available in Appendix I. Final culvert designs will be available after a detailed geotechnical investigation is complete.

Crossings 1, 2, 3, 4, 7, 10, 11 and 13 will also require sub-excavation and backfill to provide suitable foundations and bedding.

Beyond the 15 sites studied in the hydrology report and the additional site identified by DOT, further drainage culverts may be required. A nominal diameter of 1,200 mm and a nominal length of 30 m are the estimated dimensions for the highway drainage culverts. Smaller diameter equalization culverts will also be required; a nominal diameter of 900 mm, a nominal length of 30 m and a frequency of 500 m is estimated for the equalization culverts. Table 4-8 summarizes the necessary culverts.

The topic of fish and fish habitat discussed in Section 8.9 of this PDR addresses and mitigates bridge and culvert installation as per the Fisheries and Oceans Canada – Fisheries Protection Program website (www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html). Fish and fish habitat will continue to be considered to ensure that the appropriate water crossing structures are selected for each of the tributaries to be crossed by the proposed TASR.

### Table 4-7 Culverts at Minor Water Crossings within proposed TASR corridor

| Crossing ID | Crossing KM | N | W | Culvert Description |
|---|---|---|---|---|
| 1 | 2.03<br>2.38 | 62°29'05"<br>62°29'05" | 116°31'26"<br>116°31'50" | 2x1200 CSP |
| 2 | 3.21<br>3.22 | 62°29'06"<br>62°29'06" | 116°32'48"<br>116°32'48" | 2x1400 CSP |
| 3 | 7.84<br>7.86 | 62°29'04"<br>62°29'04" | 116°38'07"<br>116°38'09" | 2x1400 CSP |
| 4 | 13.228<br>13.233<br>13.238 | 62°30'40"<br>62°30'40"<br>62°30'40" | 116°43'16"<br>116°43'16"<br>116°43'17" | 3x1400 CSP |
| 5 | 16.53 | 62°31'43" | 116°46'22" | 1x2430 SPCSP |
| 6 | 19.427<br>19.432 | 62°32'54"<br>62°32'54" | 116°48'22"<br>116°48'22" | 2x2430 SPCSP |
| 7 | 23.58<br>23.59 | 62°35'00"<br>62°35'01" | 116°49'57"<br>116°49'57" | 2x1400 CSP |
| 10A | 48.21 | 62°47'40" | 116°49'53" | 3660x1910 Arch Culvert |
| 10 | 48.28 | 62°47'42" | 116°49'55" | 1x1200 CSP |
| 11 | 54.48<br>54.52 | 62°50'56"<br>62°50'58" | 116°50'38"<br>116°50'38" | 2x1400 CSP |
| 12 | 56.56 | 62°51'57" | 116°51'32" | 1x1000 CSP |
| 13 | 62.69<br>62.70<br>62.71 | 62°55'06"<br>62°55'06"<br>62°55'07" | 116°51'56"<br>116°51'56"<br>116°51'56" | 3x1400 CSP |

*Note: CSP = corrugated steel pipe; SPSCP = structural plate corrugated steel pipe*
*Additional specifications are available in Appendix I.*

### Table 4-8 Additional Culverts possibly required within proposed TASR corridor

| Culvert Diameter (mm) | Culvert Length (m) | Number of Culverts | Total Estimated Length (m) |
|---|---|---|---|
| 1,200 | 30 | 10 | 300 |
| 900 | 30 | 230 | 6,900 |

### *4.4.3.3 Water Crossing Structures*[5]

**Photo 1 Water Crossing #1 at KM 2 and 2.4 (ESRI 2014)**


**Photo 2 Water Crossing #2 at KM 3.2 (ESRI 2014)**


[5] Black arrows indicate proposed corridor and identify bridge crossings. White dashed arrows indicate direction of water flow at bridge crossings. AC and C identify where an arch culvert or culvert will be located, respectively.

**Photo 3** **Water Crossing #3 at KM 7.9 (July 3, 2014)**


**Photo 4** **Water Crossing #4 at KM 13.2 (July 3, 2014)**

**Photo 5** **Water Crossing #5 at KM 16.5 (July 4, 2013)**


**Photo 6** **Water Crossing #6 at KM 19.4 (July 3, 2014)**

**Photo 7 Water Crossing #7 at KM 23.6 (July 3, 2014)**


**Photo 8 Water Crossing #8 at Duport River KM 40.4 (September 9, 2015)**

**Photo 9** **Water Crossing #9 at KM 45.2 (June 3, 2014)**

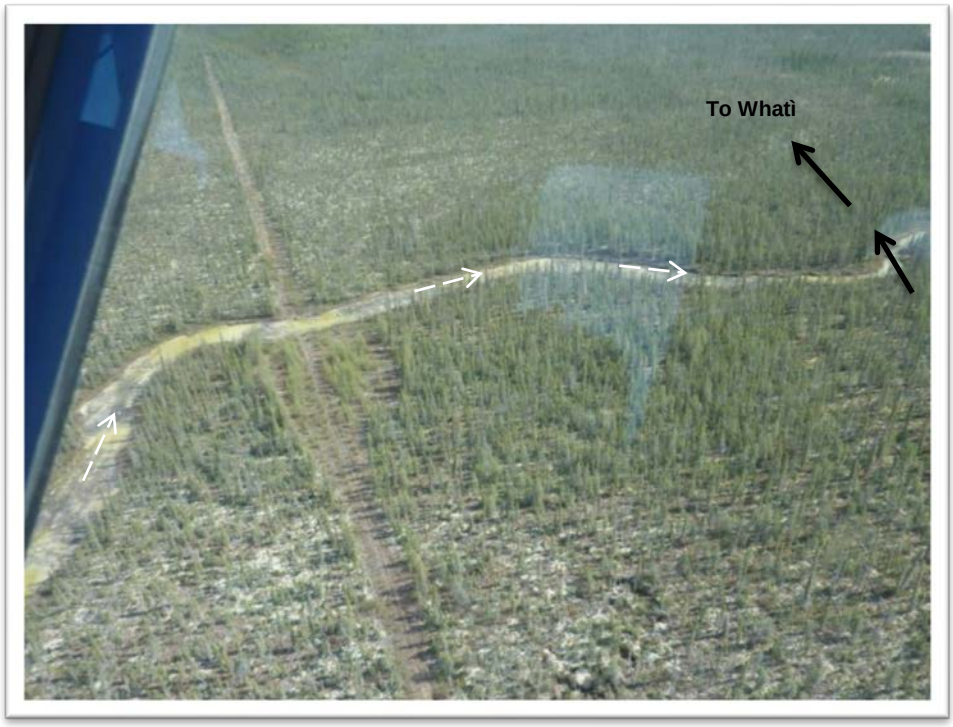



**Photo 10** **Water Crossing #10a and 10 at KM 48.2 and 48.3 (September 9, 2015)**

**Photo 11 Water Crossing #10 at KM 48.3 (View 2, September 9, 2015)**


**Photo 12 Water Crossing #11 at KM 54.5 (September 9, 2015)**

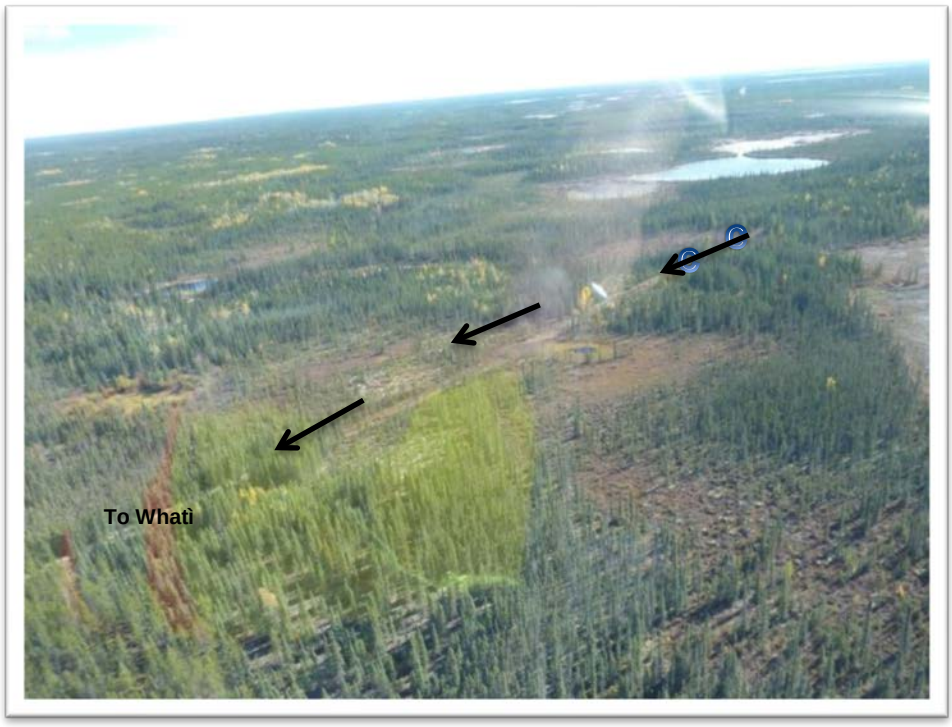


**Photo 13 Water Crossing #12 at KM 56.6 (September 9, 2015)**


**Photo 14 Water Crossing #13 at KM 62.7 (July 3, 2014)**

**Photo 15 Water Crossing #14 at James River KM 68.7 (September 9, 2015)**


**Photo 16 Water Crossing #15 at La Martre River KM 85.4 (September 9, 2015)**

## 4.5 Borrow Sources

### 4.5.1 General Information on Borrow Sources

An aerial reconnaissance and mapping study was conducted by DOT staff during early June 2014 to assess potential borrow sources within 2 km of the proposed TASR corridor.

A total of 39 granular and 21 bedrock prospects were identified along the proposed TASR corridor (Figure 4-7). The prospect land forms include raised beaches, eskers (which will be avoided if at all possible), kames and bedrock exposures along escarpment edges and at topographic highs. Refer to Appendix J for a summary listing of granular and bedrock prospects.

The existing accessible data on subsurface conditions along the route is limited to the bedrock mapping by the Geological Survey of Canada and pre-engineering testing work for the construction of the community airstrip at Whatì.

It is expected that 4 to 5 borrow sources and their respective access roads will need to be developed in order to construct the proposed TASR. The process for finalizing which borrow sources are to be used consists of (i) identification of a limited number of strategically located potential sources, (ii) analysis of geochemical and geotechnical surveys of each such source including material volume, quality and accessibility (e.g. extent of overburden, massive ice inclusions, etc.) and (iii) composing and submitting comprehensive QOPs for authorization to use the sites deemed optimal in terms of location and material. During the selection of final borrow sources, the following criteria will also considered:

- Located within human disturbance or recent fire disturbance zones vs. beaches and eskers;
- Distance from TASR corridor/length of access road;
- Located on Territorial Land vs. Tłı̨chǫ Land;
    - If on Tłı̨chǫ Land, enhanced management zone vs. cultural heritage zone

Two potential sources (116 and 118) have been located within the Whatì Community Government boundary (Figure 4-7). It is not expected that these sources will be selected for construction of the TASR. The sources identified on Figure 4-7 have only been identified as a part of a preliminary survey; no source has been affirmed for use in construction of the proposed TASR. Should there be a need to utilize a source within the Whatì community boundary for future operation and maintenance activities, DOT will obtain the necessary authorizations from Whatì and apply for a separate quarry permit and land use permit, where required.

### 4.5.2 Location of Granular and Bedrock Resources

The majority of the identified granular and bedrock prospects are within approximately two kilometres of the proposed corridor. The distribution of prospects along the corridor shows two areas with a dearth of granular materials or access to suitable bedrock resources. These areas extend from KM 37 – KM 63 and from KM 68 – KM 75 (Figure 4-7). The northern prospects that fall within the cultural heritage zone located on Tłı̨chǫ lands will be avoided if at all possible. Preliminary data suggests prospects 1, 29, 68A,

86 and 105 would be preferred borrow sources, but again, this can only be confirmed after geochemical and geotechnical analyses (Figure 4-7).

### 4.5.3 Development of Granular and Bedrock Resources

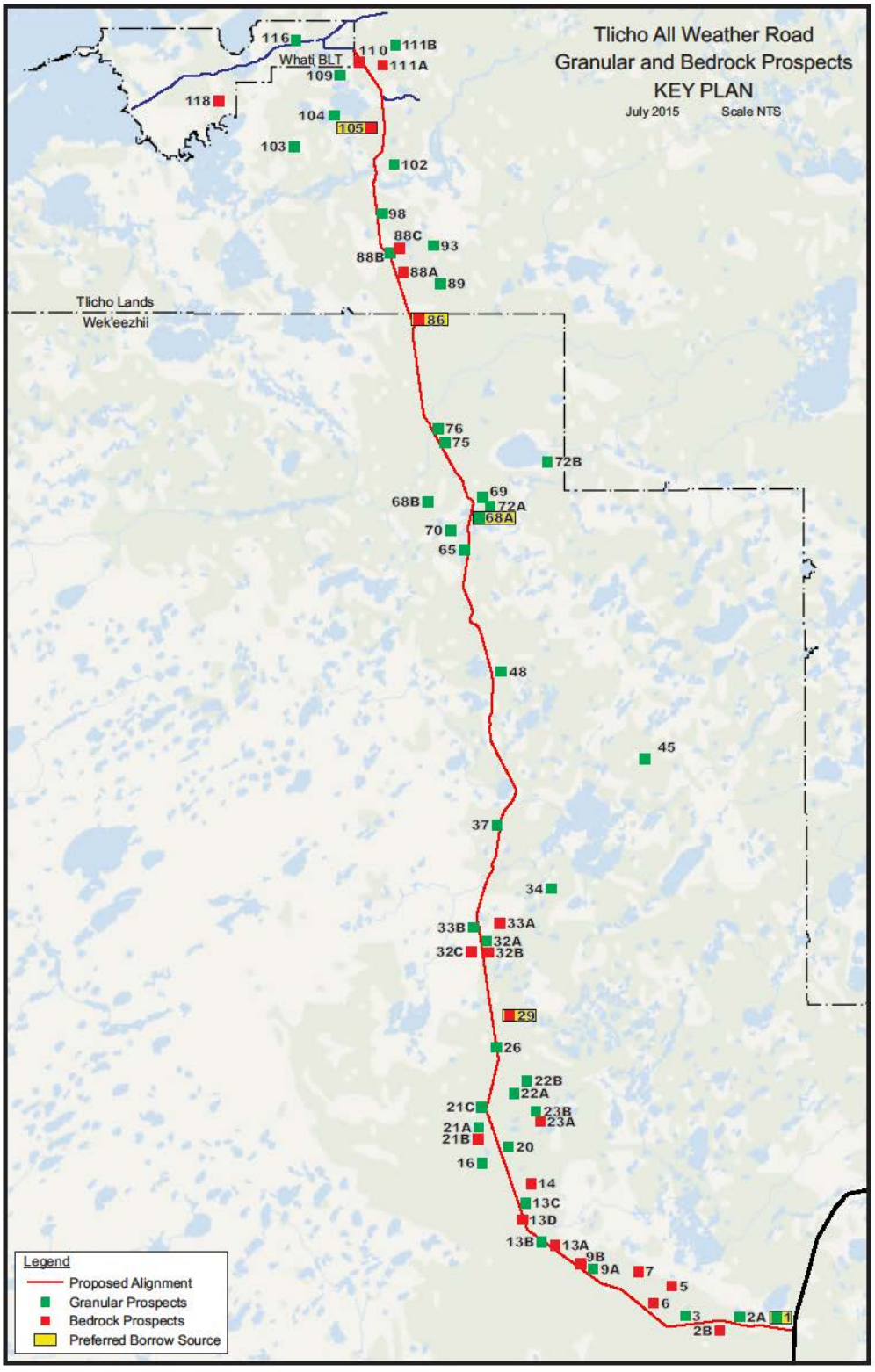
To advance the current preliminary level of information on granular and bedrock prospects, site investigations by foot reconnaissance, test pit excavation and drilling by heavy equipment are necessary to assess the quality and quantity of site materials. These geotechnical investigations will only be possible after procurement of financing for the project due to the costs associated with these investigations. Geochemical analyses of prospects will occur in conjunction with geotechnical investigations to ensure areas susceptible to acid rock drainage (ARD) and metals leaching are avoided. An effort will also be made to select borrow sources that are located within recent burn areas, which will help to reduce the disturbance level in the area as recent burn areas are already considered disturbed habitat.

The site testing of the majority of the prospects is limited to winter when access over frozen ground is available. Several of the sites are accessible during summer months over good ground near the junction of Highway 3 at KM 196 and along the existing community access road extending east from Whatì.

The construction of all-season access from the proposed TASR to the major material sources along the corridor may be economical for summer construction operations and for long term maintenance requirements of the road. For winter construction operations, the use of haul roads constructed of snow and ice may be more economical and environmentally acceptable as there is less disturbance. The shortest available route, while avoiding waterbodies, will also be a factor in establishing appropriate access roads.

Prior to selecting which granular and bedrock prospects will undergo further investigation, source locations will be ranked to ensure sensitive areas, such as eskers and the cultural heritage zone located within Tłı̨chǫ lands, are considered and avoided if at all possible. If it is necessary to investigate sources within the cultural heritage zone, joint planning with the DCLP will occur to ensure borrow sources are not in culturally or environmentally sensitive zones. At this time, prospects 1, 29, 68A, 86 and 105 have been highlighted as preferred sources (Figure 4-7); however, further investigation is required to confirm. Appropriate authorization and permits will be obtained, including any necessary archaeological assessments, prior to commencing activities.

**Figure 4-7 Granular and Bedrock Prospects Key Plan for Construction of Proposed TASR**



## 4.6 Construction

*Note: The construction and project delivery methods are contingent upon the type of financing that will be secured for the project. Financing may be either a P3[6] or conventional financing. Currently, the GNWT is being considered under Round 7 of the P3 Canada Fund. The GNWT and P3 Canada are working together to complete the assessment. If the P3 is not considered a good option, conventional financing would be considered. Because financing has not yet been procured, it is difficult to establish construction specific details for the proposed TASR. It is anticipated that year-round construction will occur; however, during the pre-construction phase (which will include geotechnical, geochemical, thermal analysis and final detailed road design), the findings will confirm which sections of the proposed TASR should be constructed during which season. DOT and/or its contractor will employ the best practices according to season and terrain location. Below is a discussion on the types of considerations that are necessary for construction during various seasons and terrain type.*

Considering the presence of discontinuous permafrost along the planned alignment, the construction techniques could vary considerably from one section to another. It is important to plan the logistics while taking into account the seasons and the results of the thermal analysis and selected geotechnical/chemical investigations. For example, if the subgrade permafrost is granular, ice-poor and thaw stable, then the preferred time to construct the embankment may be in late summer or early fall, when the active layer has thawed as much as possible. If the permafrost subgrade is thaw unstable, such as silt and clay, it is preferable to construct the first fills in winter when the ground is frozen. Nonetheless, the final pre-construction details will be evaluated by DOT and/or its contractor to determine the most appropriate and cost effective construction techniques and their scheduling, depending, among other things, will consider the following:

Construction techniques adapted to northern regions will be used for the construction of the proposed TASR. One of the most typical construction techniques used in northern regions is to build during the winter months in order to take advantage of the winter conditions. Depending on access to the roadway, some portion of the highway may also be able to be constructed in summer. The timing of construction activities will respect the sensitive nature of the management areas and conservation zones and will follow design conditions. The access roads to borrow sources will be constructed and operated as per the recommendation of the thermal analysis.

Where warranted, winter construction will be undertaken which presents the following advantages:

- Allows the placement of construction material directly onto frozen ground. This approach enables the establishment of a frozen core for the road and helps protect sensitive and ice rich terrain. Construction on frozen ground will reduce the environmental impacts on the adjacent areas;
- Minimizes potential effects on vegetation and soils adjacent to the actual roadway that might occur if working under snow-free or wet conditions;

[6] P3: Public-private partnership is a performance based contracting arrangement.

- Promotes initial stability of the road through the placement of frozen material directly onto frozen ground (with geotextile separation layer);
- The installation of certain culverts may be simplified because of the diminished flow of water in streams during the winter months; however, the timing and method for the installation of culverts will be site specific;
- The frozen surface of a lake or a river crossing may prove useful as a working platform to store construction materials;
- Winter roads can be utilized to reach points not accessible in summer, such as to allow development at the Whatì end, to more easily cross bodies either for bridge construction or to prevent a lack of crossing from hindering progress, and to require minimal construction, reclamation, and general environmental scarring of access roads to borrow sources, especially those located at some distance from the ROW; and
- The initial settlements and consolidation occurring when an embankment is placed directly on unfrozen soils can be eliminated if construction works are made in winter. The frozen ground surface can support the weight of the embankment which could not be supported in thawed conditions.

The advantages of construction during summer months are generally well known: better climatic conditions for workers and equipment, far more daylight hours, and less invasive techniques (i.e. blasting) needed to free up and stockpile borrow material. Operating costs can also be reduced due to the lower amount of fuel required for heating and start-up of camps and equipment.

Perhaps the biggest advantage of building in summer is that because compacting machinery can only be effective to a certain depth, compaction of embankment material is done in layers, and it can be extremely difficult to reach desired compaction and stability of a given layer during winter due to potential ice inclusions and the general lack of malleability of soils under winter conditions. On the other hand, it is not feasible to hold up construction of upper layers due to the inability of lower layers to be compacted properly. Thus, when embankment settlement occurs after thawing, it is possible that large deformations requiring substantial repair can occur. These issues should be considered in the development of the construction schedule and cost estimates.

Designs for bridges will include foundation requirements, backfill material specifications and slope and channel protection measures. Designs for culverts will include requirements for bedding materials, geotextiles and insulation to provide strength in the foundation and to protect the surrounding permafrost and ice-rich soils from thaw. Detailed geotechnical information will be collected during field investigations and detailed design stages will incorporate the foundation and bedding requirements for bridges and culverts.

### 4.6.1 Construction Strategy

Construction of the proposed TASR is estimated to take up to four years from approval depending on the finalized schedule and overall strategy. Due to the presence of discontinuous permafrost, the area in which the project is located should allow for year-round construction. Although preliminary estimates

assume that construction will begin at KM 196 of Highway 3 and end at the Whatì Community Government boundary, if construction is predominantly completed during winter, the presence of the winter road from Behchokǫ̀ will provide the opportunity to utilize a strategy similar to that of the ITH, where construction occurred from both ends of the highway and met in the middle. This method would be contingent upon numerous items such as whether the successful contractor could supply the additional equipment and workers required to operate from both ends. The current application assumes construction will occur from the south end; however, final details can only be established after financing has been procured and the selected contractor has indicated which construction strategy they can employ. For reference, the advantages and disadvantages of constructing the proposed TASR from both ends is highlighted below.

Advantages:

- construction time cut, possibly in half, which would reduce overall costs;
- dual access points (north and south) would allow additional crews to operate simultaneously;
- the middle of the project (which has lower borrow source prospects) could be supplied by sources on either end of it;
- it would provide the means to begin and complete the major bridge at La Martre River promptly, thereby identifying and/or minimizing potential scheduling issues as early as possible; and
- could provide economic benefits to the community of Whatì by having contractors/workers in the vicinity temporarily (potential labour, food supplier, tourism, etc.).

Disadvantages:

- requires more events to be managed, analyzed, overseen, etc., simultaneously by DOT;
- requires larger amounts of funding to be available and released over a shorter amount of time;
- potential problems due to a lack of communication between parties at either end; and
- potential problems for mobilization and/or access to resources for contractors operating from the Whatì end.

### 4.6.2 Construction Schedule

The construction schedule will hinge on a final decision of the strategy to be employed. Construction from both ends would not likely alter day-to-day and month-to-month scheduling of individual contractors, but would have a substantial effect on the timeline of the overall project in terms of planning.

Detailed geotechnical, geochemical and thermal investigations, engineering, and design are necessary in advance of construction at least up to the conceptual level, sufficient enough to anticipate the immediate construction footprint. The project delivery method will guide the design and pre-engineering activities sequencing; however, the investigation, engineering and design components need only to stay in

advance of the next segment. In other words, it is unnecessary to design the entire length of the corridor prior to commencing construction as it is possible to construct a section of road while simultaneously designing the advancing section (indicative of a design-build project delivery method). In the instance of a design-build project, the environment and mitigations described in this PDR should account for the design decisions made during pre-construction as well as if a traditional construction (designing entire corridor prior to construction) project method delivery is selected. The initial start of construction will begin in the first winter directly following approvals pending funding availability. Assuming funding is available, the first stage of design can begin in the preceding spring.

Based on past experiences with similar projects in the NWT, the project planning is described below:

- December: clearing of ROW and construction of winter highways and borrow sites;
- Jan/Feb/March: hauling and placing of embankment material on the area where summer construction is not possible;
- Apr/May/June: production and stockpiling of material (if equipment has been mobilized to the particular borrow source) and construction of embankment and related elements; and
- Jul/Aug/Sept/Oct: completion and compaction of previously constructed embankments and related elements.

### 4.6.3 Estimated Construction Costs

Project costs and pay schedule could be influenced by the construction strategy adopted, as well as by the amount of material required as a result of the selected construction methods on permafrost, the ease of access to the borrow sources and the level of maintenance required throughout the useful life of the proposed TASR. Construction costs will only be solidified when the project goes out for tender.

## 4.7 Equipment

A variety of equipment will be used in construction of the proposed TASR. Equipment and attachments listed in Table 4-9 may vary slightly as a result of available makes and models; however, this list is provided to indicate the typical equipment and size for this type of activity. An attempt has been made to capture all possible equipment in Table 4-9; however, this list may be subject to changes upon finalization of road design and project method delivery.

All maintenance and construction equipment and materials will generally be parked within the ROW and suitable spill containment units will be utilized where required; however, a compliment of equipment may also be parked within adjacent granular borrow or stockpile sites for larger project work (granular production). All materials stored within the ROW will be located a minimum of 100 m from the ordinary high water mark of all adjacent waterbodies and well outside of the tree line. Equipment use will also be subject to the details outlined in the Spill Contingency Plan (Appendix L).

## Table 4-9 Anticipated equipment list for construction of proposed TASR

| Equipment | Size | Purpose |
|---|---|---|
| Tracked Dozers | D3 through to D9 | Clearing right-of-way, drainage channels and granular borrow sites, clearing granular investigation cutlines, pushing roadway construction material on the roadway and in borrow area, pushing borrow materials and leveling stockpiles, smoothing and compacting, etc. |
| Hydraulic Excavators (wheeled & Tracked) | E70 through to 2458 | Clearing right-of-way, excavating drainage channels, excavating at culvert installation sites, excavating at bridge sites, excavating borrow sites and loading haul vehicles, making repairs to roadway embankment, granular investigations, etc. |
| Motor Graders | Various | For roadway maintenance and road repairs, grading granular surfacing, right-of-way maintenance, snow ploughing, borrow source maintenance, etc. |
| Loaders (wheeled and tracked) | Various | For loading haul trucks, moving granular materials at work areas, stockpiling granular materials, feeding crusher, etc. |
| Compaction Equipment | Various | To compact roadway surface and surfacing, compact roadway embankment, compact around culvert installations, etc. |
| Rotary Drills | Various | To carry out granular and geotechnical investigations, prepare for piling installations at bridge or ferry sites, to prepare for blasting at quarry sites, etc. |
| Gravel Crushing Plants (Cone and Jaw) | Various | To produce specified granular material. |
| Single axle, Tandem axle and Tri axle Haul Trucks | Various - water tankers, sewage tanks, rock, gravel, sanding trucks and plow trucks | For snow ploughing and road maintenance, watering on the road, hauling granular and rock materials to work site, stockpiling granular materials, gravel surfacing, sanding on the road, hauling construction materials, hauling water for work camps, sewage and waste removal. |
| Tractor Trailers | Various | To move equipment to, from and within work sites (low/high boys), etc. |
| Rock Trucks | Various | To move rock between quarry areas, to haul construction materials within work area, etc. |
| Tractor Mowing Machines | Various | To clear right-of-ways, etc. |
| Water Trucks | Various | For dust control and water supply |
| Fuel Tankers | Various to 40,000 litres | To re-supply fuel storage tanks, to refuel equipment, etc. |
| Pile Drivers | Various | For installing piles at bridge sites, etc. |
| Service Vehicles | Various - pickup trucks, utility service trucks, flat decks, snowmobiles, quads, etc. | To support and maintain all equipment required for the ongoing operation and maintenance of the public highway system, roadways, access roads, etc. |
| Tree Harvesters/Mulchers | Various | For right-of-way clearing, borrow site clearing etc. |
| Cranes | Various | For hoisting and placing bridge components, removing and installing culverts, setting up crushing plants, loading and unloading equipment, loading, unloading and placing temporary camp facilities, etc. |

**Table 4-9 (Continued) Anticipated equipment list for construction of proposed TASR**

| Equipment | Size | Purpose |
|---|---|---|
| Various small equipment (rock pickers, soil cultivators, post hole drills, post drivers, water pumps, rig maps, tampers, compressors, jack hammers, etc. | Various | To support the delivery of the ongoing operation and maintenance of the public highway system, access roads, temporary construction camps, etc. |
| Temporary Construction/Work Camp Facilities | 150 man camps | To support delivery of the ongoing operation and maintenance of the public highways system, roadways, access roads, short term construction activities, etc. |
| Generators | Various | For temporary camps, lighting units, crusher plants, to power small tools and equipment, etc. |

## 4.8 Camps

A Land Use Permit will be required for the temporary construction camps as 400 person-days will be exceeded each year. Construction camps are likely to be 150-person facilities situated in borrow sources to minimize the development footprint. Two to three camps will be placed no more than 50 km apart to ensure a maximum driving distance of 25 km for project workers. It is expected that only one camp will be operated at a time; however, if the construction schedule were shortened, two camps could operate simultaneously. If construction occurs year-round and two camps are utilized simultaneously, a conservative estimate of up to 109,500 person-days (150-person camp x 2 x 365 days) would be required annually. This number is expected to be drastically lower as 365-day construction is implausible as the project would still need to adhere to the various environmental timing windows (e.g. fish and migratory bird nests).

Erection of temporary fuel storage and camp facilities will be required. Typical temporary camp facilities will include:

- dining trailer;
- accommodation trailers for personnel;
- toilet and bathing facilities;
- waste storage facility;
- mechanic shop; and
- fuel storage facility.

Camp facilities are trailers on sleighs, which will be towed to and from the camp location during the winter months using tracked vehicles when the ground is appropriately frozen.

Camp operations will require approximately 200 L of water/person/day. A 150-person camp would therefore require approximately 30,000 L of water or 30 $m^3$/day. If two camps were in operation, water use requirements would double to 60 $m^3$/day. Power will be supplied by on-site diesel generators. Camp locations will take into consideration available fresh water sources but can only be identified after final borrow source locations have been selected (requires geotechnical and geochemical analysis). It is

expected that the two to three temporary camps will be located on Territorial lands and will not be situated on Tłı̨chǫ lands. Detailed camp siting information will be submitted to WLWB prior to construction and further details pertaining to camp set up will be available upon award of the construction contract. The selected contractor will ensure the necessary guidelines and regulations are adhered to during camp set up and operation; proper waste management and consideration of the Wildlife Management and Monitoring Plan (Appendix M) as well as adherence to the Quarry Operations Plan (Appendix K) will be ensured.

## 4.9 Fuel and Oil Storage

Fuel and oil needed for the camp facilities, aggregate borrow and road construction activities will be stored in double-walled storage tanks. All fuel and oil will be stored in accordance with CCME's *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products* (2003) and Lands' *Northern Land Use Guidelines: Camp and Support Facilities* (2014a). The *Storage Tank System for Petroleum Products and Allied Petroleum Products Regulations* will be followed to the extent applicable while on Tłı̨chǫ lands though it is not expected that storage tanks with a capacity greater than 230 L will be required in this area.

Using the ITH project as an example, it is expected that each temporary camp facility will require fuel tanks to accommodate 2,000 L of gasoline, 50,000 L of diesel for camp use, and 90,000 L of diesel at the mechanic shop. It is expected that there will be three 50,000 L double-walled diesel fuel tanks mounted on highway licensed trailers or skids and a 2,000 L double-walled gasoline fuel tank mounted on a similar system. Propane tanks with an aggregate capacity of up to 1000 lbs may also be expected at the camp facility; these tanks would range in capacity from 30 to 500 lbs. If two camps were to operate at the same time, fuel and oil storage amounts would be duplicated at the second camp.

Bulk fuel should not be stored on the ROW, but if there is a requirement for fuel storage within the corridor in order to accommodate construction plans, details and mitigation will be made available in the Spill Contingency Plan (Appendix L; to be finalized prior to construction). Heavy equipment will be fueled by mobile fuel tankers. Vehicles will be refueled on the ROW at a minimum of 100 m from the ordinary high water mark of any waterbody. All personnel handling fuel will be properly trained and spill prevention and response materials will be available.

The use of fuel and all hazardous materials will be subjected to the Spill Contingency Plan (Appendix L). All personnel will be familiar with this Plan and copies will be available at all times in the field office(s).

## 4.10 Water Usage

As mentioned under Section 4.8, each camp operation will require approximately 30,000 L of water or 30 $m^3$/day and up to 60 $m^3$/day if two camps operate at the same time. It is expected that approximately 30,000 L of water will be required per km for the entirety of the construction project (including dust suppression, water usage for temporary access roads in the winter if needed, and the construction process). Water use is therefore anticipated to be less than 5 $m^3$/day for construction. Because water is not expected to be used daily during the construction process and in order to anticipate peak phases of construction where water may be required, the total daily estimation for water, including camp operation,

would be stated as being less than 99 $m^3$/day. However, in order to accommodate the possibility of a shortened construction schedule and therefore an increase of personnel and equipment working at one time, the daily water usage requirements will be stated as being less than 300 $m^3$/day and would require a Type B water licence.

Schedule H of the *Waters Regulations* indicates that the direct use of 100 $m^3$/day and less than 300 $m^3$/day for industrial undertakings requires a Type B water licence. If only one camp is in operation at a time, a Type B water licence would not be required for camp and/or construction operations with respect to daily water use; however, as there is a chance the construction schedule could be shortened and two camps would then operate simultaneously, daily water use of less than 300 $m^3$/day will be selected on the water licence application. The DFO *Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories* (2010) will also be followed. This will include identification of suitable water withdrawal sources (lakes and stream), assessment of allowable withdrawal quantities per source, unique source identification, and water withdrawal volume tracking. These details will be made available after geotechnical investigations and after the borrow sources (and therefore camp locations) have been finalized. The *Protocol for Winter Water Withdrawal* will not apply to the possible water use for temporary winter access roads and/or winter construction as it will be ensured that less than 100 $m^3$ of water will be withdrawn over the course of one ice-covered period from any waterbody and as such the protocol will not apply. The *Protocol for Winter Water Withdrawal* is expected to be needed for winter camp operations. DFO's *Freshwater Intake End-of-Pipe Fish Screen Guideline* (1995) will also be followed.

## 4.11 Waste Management

Waste management for the proposed TASR will be managed in accordance with the *Guidelines for Developing a Waste Management Plan* (MVLWB 2011), the *Guideline for the General Management of Hazardous Waste in the NWT* (ENR 1998), and the *Northern Land Use Guidelines: Camp and Support Facilities* (Lands 2014a). A draft Waste Management Plan (WMP) is available in Appendix N. The successful contractor for the project will be responsible for submitting a final WMP prior to the commencement of operations, which will adhere to the aforementioned guidelines and will be approved by DOT.

### 4.11.1 Solid Waste Management

Source reduction and reuse or recycle of material will be a primary consideration when it comes to solid waste management during construction of the proposed TASR. As per the *Northern Land Use Guidelines*, solid waste management options will include incineration and temporary storage and removal to an appropriate facility. Combustible solid wastes will be stored in odour proof secure containers and then incinerated daily. The incinerator residue will be removed from site. Non-combustible wastes will be organized in containers with secure lids and stored on site; this material will then be progressively removed from site throughout construction operations. All waste will be removed from the site at closure. Incineration and temporary storage and removal will follow the appropriate sections of said *Northern Land Use Guidelines*. Preliminary written consent has been obtained from the communities of Whatì and Behchokǫ̀ in anticipation that non-combustible waste produced during construction of the TASR will be

directed to their respective community government landfills (Appendix O). Based on a review of the ITH construction project, it is estimated that there will be approximately 75 $m^3$ of non-combustible waste per year that will need to be diverted to the community government landfills.

### 4.11.2 Wastewater

Sewage and greywater from camps will be collected in a sewage lift station fitted with floats, switches and then transferred with a macerating pump to a larger holding tank that will be heated and insulated. The Community Government of Behchokǫ̀ has indicated that they are able to perform sewage removal services. The successful contractor will ensure that heated, insulated and bermed effluent watertight storage tanks are installed within the temporary construction camps. These tanks will be large enough to store wastewater generated by a 150-person camp for up to 5 days given the probability in the region for adverse weather conditions. This should allow for a comfortable cushion in the event that severe weather hampers the travel of mobile equipment.

Sewage will be transported offsite by means of a tandem or off road LGP vacuum truck to Behchokǫ̀'s sewage lagoon on a daily basis. Tanks on the transport vehicles will be watertight, baffled tanks and will be maintained to the manufacturer's specifications to ensure dependable performance. No raw sewage, treated effluent or other wastewater will be discharged on the land. Further details can be located in the draft Waste Management Plan (WMP).

### 4.11.3 Hazardous Waste

Hazardous waste that may be present or generated on site during construction of the proposed TASR include: sewage, waste oils, oil filters, used hydrocarbon containers and absorbents, waste antifreeze, waste solvents, used tires, explosives, animal carcasses and contaminated soils and snow. Handling and management of said wastes are described in the Spill Contingency and Waste Management plans (Appendix L and N). It is expected that all hazardous waste will be properly disposed of and transported to the appropriate facility.

### 4.11.4 Cleared Vegetation

Surface preparation along the proposed TASR corridor will follow the guidelines stipulated by Lands' *Northern Land Use Guidelines: Roads and Trails* document (2014c). These guidelines include setting aside trees larger than 12 cm in diameter for use by others and stipulate the preferred methods for brush disposal. It is expected that each of the methods described under Section 4.1.3 of the guidelines will be utilized at one point or another during the construction process (Lands 2014c).

## 4.12 Reclamation Plan

*Note: Reclamation of the current winter road alignment from approximately KM 238.5 of Highway 3 to Whatì will occur upon permanent closure of the road; however this reclamation does not fall under the current application. It is mentioned herein because this section of land helps offset the disturbance created by the proposed TASR corridor. Reclamation will only occur along the portions of the alignment*

*that are not utilized to construct the Wekweètì winter road (i.e. from approximately KM 0 to 60). The alignments selected for reclamation will follow Tłı̨chǫ Government direction. Areas of unstable terrain, exposed soils or both will be rehabilitated through contouring and revegetation with the goal of providing for long term physical stability and public safety.*

The proposed TASR is intended to be a permanent all-season road and there are no intensions to close the road anytime within the foreseeable future; therefore, no closure or reclamation is planned for the TASR itself. However, there will be a need for temporary access roads and work camp pads or platforms, potential all-season access roads and quarry/pit development in order to complete the project. A Preliminary Closure and Reclamation Plan is discussed below to address the temporary access roads and work camp pads or platforms, and any necessary all-season access roads. Closure and reclamation of borrow sources will be covered within each of the site specific Quarry Operations Plans. A draft Quarry Operations Plan is provided in Appendix K; however, final plan details will only be available after the necessary geotechnical and geochemical investigations have been completed and the 4 to 5 borrow source locations have been selected for development. If further details pertaining to reclamation are required, an updated Closure and Reclamation Plan will be submitted post permit approval.

### 4.12.1 Preliminary Closure and Reclamation Plan

Camps, borrow sources and temporary access roads will undergo progressive reclamation to ensure the areas used temporarily during the construction of the proposed TASR are returned to their original state as near as possible. The steps outlined in this Plan should provide the necessary guidance to ensure any and all areas disturbed during construction are adequately reclaimed. A final Closure and Reclamation Plan will be available once a contractor has been selected for the project and camp details have been finalized.

As previously mentioned, site specific QOPs will be developed for each borrow source. These plans will focus on the restoration of natural drainage patterns, slope grading, capping with organics/vegetation (from pre-stripping stockpiles) and revegetation with native plant species. As each QOP requires its own closure and reclamation plan, details pertaining to reclaiming quarries are therefore limited in this section. This preliminary Closure and Reclamation Plan primarily considers the details discussed in the *Northern Land Use Guidelines* (Lands 2014a, b, c) along with additional closure plans that have been approved by the Land and Water Boards.

#### *4.12.1.1 Camp Reclamation*

All temporary camp facilities will be removed from the borrow sources as soon as they are no longer needed. All material, including garbage will be removed. Waste (including hazardous waste) will be handled and managed as per the project's Waste Management Plan. The area will be visited during the summer to ensure all debris has been collected. Any areas contaminated by fuel or other hazardous waste will be properly remediated with any contaminated soil being removed for processing at a designated facility. As the project's contractor would have disposed of all overburden as instructed by an Inspector, as a condition of the Land Use Permit, at the commencement of the quarry, it is not expected that these materials will be spread over the cleared areas to encourage revegetation. The area will be

scarified and revegetated with the use of an approved native seed mix if required. Any additional erosion control measures that may be necessary will be employed under the QOP. Abandonment of active quarry faces and stockpile removal are also discussed in the QOPs.

### *4.12.1.2 Closure of Temporary Access Roads*

Temporary access roads utilized to gain access to borrow sources will be permanently decommissioned and entrances will be blocked to restrict access and discourage recreational users and/or hunters from using the roads. All waste and equipment will be removed. Appropriate erosion control measures will be employed and may consist of scarification, active revegetation by seeding or planting, ditching, contouring and creating terraces. Stockpiled organic topsoil will be replaced where available.

# 5 ENGAGEMENT AND CONSULTATION

As per the MVLWB's *Engagement and Consultation Policy* (2013) and the *Tłı̨chǫ Land Use Plan* (TG 2013), the proponent has developed an Engagement Plan (Appendix E) that follows the MVLWB *Engagement Guidelines for Applicants and Holders of Water Licences and Land Use Permits* (2014). Engagement is an ongoing process and is expected to continue until construction of the TASR is complete. The goals of engagement are to build on existing relationships; inform parties about the status, location and schedule of project activities; and engage parties to provide feedback on project activities and any proposed changes to the scope or schedule of the approved project. The pre-application engagement that has occurred to date is described below; however, please refer to the Plan to view the engagement summaries and logs in detail (Appendix E).

## 5.1 Tłı̨chǫ Traditional Knowledge

A traditional knowledge study outlining the Tłı̨chǫ *Traditional Knowledge for the Proposed All-Season Road to Whatì* (TG 2015) was prepared and funded under a Memorandum of Understanding between the Tłı̨chǫ Government and GNWT. Under the direction of the Tłı̨chǫ Research and Training Institute, a traditional knowledge study surrounding the proposed TASR was conducted between November 2013 and 2014. This study engaged the traditional knowledge of 16 male elders and harvesters in Whatì and Behchokǫ̀, each of whom had personal experience and knowledge surrounding the proposed TASR. This study will be submitted to the WLWB as an independent document by way of the Tłı̨chǫ Government and has not been included with DOT's application. The Tłı̨chǫ Government, in discussions with the WLWB, will decide whether the Traditional Knowledge (TK) report needs to be submitted under a confidential cover given that there is sensitive cultural, harvesting and traditional knowledge data contained therein. While maintaining the confidence of the TK report, below is a summary of findings and mitigation.

### 5.1.1 Harvester and Elder Reliance

The elders and harvesters that participated in this study were selected based on their intimate knowledge of the region. The TK study provides in-depth use and knowledge of the area near the proposed TASR corridor and engaged 16 male elders. In-depth community consultations and additional interviews conducted during the 2014/2015 socioeconomics study review Whatì community social and economic concerns (Appendix E and Appendix B, respectively).

### 5.1.2 Concerns and Mitigation

The main concerns of the elders outlined in the TK study include the predicted impacts of noise and dust pollution from construction and traffic; the introduction of new animal species; and the influx of outsiders and resulting increased pressure on harvesting of furbearing and ungulate animal populations that surround the proposed TASR (TG 2015). The elders predict these impacts may pose difficulties to the maintenance of the Tłı̨chǫ hunting and trapping economy and way of life (TG 2015).

In reviewing the TK study, the TRWG believes that acceptable mitigation strategies can be implemented to reduce the concerns identified by the elders. These mitigations include the following:

1) Avoid sensitive cultural sites;
2) Utilize clear span bridges where appropriate and if required, only construct in-water works within the appropriate fishery timing windows to protect fish during spawning and during incubation periods when eggs and fry are vulnerable to disturbance or sediment;
3) Maintain safe access to T'oohdeèhoteè, an important portage site at the La Martre River;
4) Install roadside pullouts and/or snowmobile crossing signs along the TASR in areas identified as a concern;
5) Utilize approved dust suppression techniques to reduce area impacted by dust during construction;
6) Ensure construction equipment is well-maintained and limit construction activities during sensitive wildlife periods;
7) Follow approved Spill Contingency Plan;
8) Offset habitat loss by reclaiming parts of current winter road alignment; and
9) Where culverts are required, ensure they are sized and positioned to allow for fish passage in support of Aboriginal, commercial and recreational fisheries.

Additional mitigation strategies will be implemented by various regulating bodies. For example:

- ENR will continue to monitor caribou and implement strategies as needed, such as, installing signage along road indicating caribou in the area or initiating temporary road closures for safe caribou passage;
- ENR's *Wood Bison Management Strategy for the Northwest Territories 2010-2020* (2010a) should provide direction in maintaining community safety;
- Under the *Tłı̨chǫ Land Use Plan*, the DCLP will manage the permitting of cabins constructed on Tłı̨chǫ lands;
- Territorial harvesting regulations and ENR's responsibility to monitor wildlife to ensure sustainable harvesting will prevent overharvesting;
- The *Northwest Territories Fishery Regulations* and DFO/ENR's responsibility to ensure the regulations are followed will prevent overfishing; and
- The Tłı̨chǫ Government and Whatì Community Government will implement motion 2015-018, which contains a series of mitigation measures that were developed on the review of the socioeconomic and TK reports.

The mitigation techniques listed above were developed based on the assessment of the TK study, which has been summarized in the sections below.

### *PROPOSED TASR/OLD MILITARY WINTER ROAD (K'ÀGÒÒ TĮLIÌ)*

As previously mentioned, the proposed TASR will predominantly follow an old military winter road. This road is described by the Tłı̨chǫ people as K'àgòò tı̨liì, which is classified as a tractor trail. A tractor trail is not built by Tłı̨chǫ elders and therefore, does not have the same cultural significance as an Ancestor Trail.

### *EWAASHÌ*

This is a culturally sensitive site that is located by the proposed TASR. The elders were reluctant to describe the nature of the place, and thought it would be best to leave the place alone and undisturbed in order to avoid upsetting any potential beings or spirits that might exist at the site. During TRWG meetings, discussions were had to ensure the proposed TASR corridor did not pass within this culturally sensitive area. No concern or additional mitigation necessary.

### *BURIAL SITES*

No burial sites were identified in immediate proximity to the proposed TASR. Graves were most often located by open waterbodies. The proposed TASR follows mostly through the forest and areas not normally chosen as burial grounds. No concern or mitigation necessary.

### *LA MARTRE RIVER CROSSING (T'OOHDEÈHOTEÈ)*

The La Martre River provides a secure source of food and resources to the Tłı̨chǫ people. Harvesting for beaver, muskrat, ducks and moose occur along the river as does fishing so it is important that construction activities and the presence of the road itself does not impact these resources.

The proposed TASR is slated to cross the La Martre River in an area approximately 240 m northwest of T'oohdeèhoteè, which is an important portage site utilized in both summer and winter by the Tłı̨chǫ people. Elders from the TK study expressed importance that the bridge and road design allow for the portage to remain intact. Bridge design should also ensure the river itself is untouched to avoid any impact on the various fish populations in the river.

In order to mitigate the fisheries concerns, a clear span bridge will be constructed. Though in-water construction of the bridge is unexpected, if it is required, it will also occur between the appropriate fishery windows to reduce the possibility of disturbance. Mitigation surrounding the portage site includes situating the clear span bridge approximately 240 m northwest of the portage site and ensuring the river remains unobstructed during construction to maintain the common law public right of transportation. Situating the bridge where it has been suggested will also ensure an indigenous cultural site located near the southern shore of the La Martre River is also avoided.

### *JAMES RIVER CROSSING*

This watercourse is used for trapping during the winter and summer, and for fishing (mainly grayling). The elders have stated that installing a bridge across would not cause any impacts on fish populations as long

as the water crossing itself is untouched. As the bridge design consists of a clear span bridge and no in-water works is expected, no further mitigation is necessary.

### *FURBEARING ANIMALS AND TRAPPING*

According to the TK study, elders and harvesters are concerned that the proposed TASR will impact trapping. They perceive the impacts surrounding the construction of the proposed TASR to be similar to those experienced during the construction of Highway 3. In their opinion, there was originally an abundance of wildlife within the area of Highway 3; however, once the road was constructed, the animal populations scattered and declined. Elders and harvesters would like to avoid a decline in furbearing populations along the proposed road.

In reviewing the traditional knowledge collected, it is the TRWG's opinion that there will be very little impact to the furbearing populations within the TASR corridor; and, in the select areas of concern, suitable mitigation will be in place to avoid negative impacts. The TRWG has assessed the potential impacts as follows:

1) Spring and summer trapping of beaver and muskrat will not be impacted by the TASR as the trails predominantly follow a north-south direction near Boyer and Mud lakes (directly southeast of Whatì). These trails are at least 3.5 km away from the TASR. Further trapping occurs along the La Martre River and follows the Màa tı̨lìì trail (snowmobile/Ancestor Trail) into James Lake. The only potential area for impact would be near the La Martre River portage site, where a clear span bridge will be installed. Because this area is already subject to frequent use, and the bridge will not impede the use of the portage route, it is unlikely trapping will be affected in this area.

2) Winter trapping of marten, lynx and wolverine mainly occurs between November and December though the season can sometimes be extended. The winter traplines identified by the TK study follow the La Martre River and the Màa tı̨lìì trail, with the only area of concern as being that of the La Martre River bridge site. Additional trapping occurs along the Campbell trail, which intersects with the TASR near James River. As the Campbell trail is a tractor trail and the elders mentioned the crossing at James River should not be a concern if the water is not impacted, no additional concern is warranted.

3) The Behchokǫ̀ elders have expressed importance in two trails towards the southern part of the TASR. One trail, starting at Marian Lake and travelling west, intersects with the TASR at approximately KM 45.2 where a bridge will be installed. This trail is important for traplines that continue west towards the Horn Plateau and Fort Providence areas. In order to mitigate potential issues between snowmobiles attempting to cross the road, during the final design phase, consideration will be taken to ensure a safe snowmobile crossing is established. The second trail is an Ancestor Trail travelling from Behchokǫ̀ to Joe Migwi's cabin (which is within the first 8 km of the proposed road) and continues westward. The terrain near Joe Migwi's cabin is very open, sandy and disturbed. The TASR crosses through this highly disturbed site and as this area is already mostly cleared, the proposed road should not impact wildlife. As will be done with the other important trails that intersect the TASR, a

suitable and safe crossing will be established at this location during the final design phase to allow for snowmobiles to continue along the Ancestor Trail.

### *BARREN-GROUND CARIBOU*

The TK study revealed that barren-ground caribou were predominantly hunted on Boyer Lake, along the La Martre River, along the Màa tı̨lìì trail towards Ts'otìtso Lake and finally onto James Lake. Barren-ground caribou were also known to pass through James River at one time. Hunting for barren-ground caribou was successful within the stated areas up until the late 1990s according to the elders. Fewer barren-ground caribou have migrated into these areas due to the development on the barren lands. The elders stated that exploration and mining in the barren-grounds have disrupted the caribou migration into the Whatì area, which has caused harvesters to travel further north towards Gamètì in order to hunt barren-ground caribou.

The elders and harvesters interviewed for the TK study are concerned that constructing the proposed TASR will further disrupt the caribou due to the associated noise, dust, smell, and pollution; however, it is the TRWG's opinion that these perceived effects will not impact barren-ground caribou because their migration patterns have changed and they are no longer located within the TASR corridor, as has been illustrated by the mapping conducted by the Bathurst Caribou Range Planning Committee which is discussed further under the wildlife mitigation Section (8.7) of this PDR. Mining and exploration within the barren lands is not expected to cease; therefore, if following the knowledge of the elders, barren-ground caribou are not expected to return to the Whatì area as long as mining continues. Under the direction of ENR, caribou patterns are and will continue to be monitored in collaboration with Aboriginal government, co-management boards (such as the Wek'èezhìı Renewable Resources Board), caribou management boards, the Government of Canada and neighbouring jurisdictions. If barren-ground caribou begin to return to the TASR corridor in the distant future, ENR may implement necessary mitigation techniques, such as, ensuring there is a safe crossing for caribou trying to travel across it.

### *WOODLAND CARIBOU*

Woodland caribou are considered to be very intelligent animals that are sensitive to noise and activities. Their small herd size and intelligence make them difficult to track; as a result, not many people kill woodland caribou. Though they are expected to travel throughout the proposed TASR corridor, their main habitat is identified by the elders as being to the west of the TASR. Tłı̨chǫ residents normally hunt woodland caribou south of Boyer Lake, Mud Lake and the smaller lakes toward Whatì.

Again, elders and harvesters are concerned about the noise and dust associated with the proposed road. However, because it is mentioned in the TK report that woodland caribou travel in small herds and prefer to inhabit areas west of the TASR, the TRWG expects very little interaction will occur between the caribou and road. Because woodland caribou, may on occasion venture towards the TASR corridor in order to reach the habitat to the east of the proposed road, the following mitigation techniques will be applied:

1) Approved dust suppression techniques will be utilized to ensure dust is controlled;

2) Construction equipment will be well-maintained and construction activities will be limited during sensitive wildlife periods to reduce noise nuisance;

3) Signage warning drivers of possible caribou crossing and/or temporary road closures may be utilized depending on the frequency of caribou within the TASR; and

4) ENR will continue to monitor and manage caribou.

### *MOOSE*

Moose can be found anywhere on the land; however, they prefer shallow water along lakes and ponds according to the elders. The TK study identified the shores along Boyer Lake and La Martre River to be key moose habitat. The area east of Mud Lake following towards James Lake was also identified as key moose habitat.

Approximately 10 kilometres of the proposed TASR intersects with moose habitat; this occurs from approximately KM76 until the proposed bridge crossing at the La Martre River. The mitigation techniques utilized for furbearing mammals and caribou should be suitable for moose as well. The reclaimed habitat along the current winter road will also offset the moose habitat lost along the TASR.

### *BISON*

There is concern that the proposed TASR will allow bison to travel further north toward Whatì, expanding their current territory. Elders are concerned that bison will become a potential nuisance and safety hazard for the community of Whatì and that the bison will ruin moose and woodland caribou habitat.

The TRWG views the expansion of the bison territory as a beneficial impact because bison would be returning to their historic territory (ENR 2010a). The potential for bison to increase in numbers would also be a beneficial impact as it would provide the Tłı̨chǫ people with a reliable source of harvestable meat where caribou have been lacking (TG-ENR 2010). In order to mitigate the potential negative impact of bison entering the community of Whatì, MACA is expected to work with communities to implement actions to reduce the number and frequency of bison within communities (ENR 2010a).

### *TRAPPING IN GENERAL*

The TK study brought forward two ideas pertaining to trapping. The first idea, that a potential road will likely increase the use of the existing trail network by harvesters and therefore pull-outs or platforms should be considered at the access points of these trails to facilitate access and avoid dangerous situations involving trucks and equipment parked alongside the road. And the second idea, that traplines will become valueless because the animals will be scared away. Unfortunately, these two ideas are contradictory in nature and the TRWG must establish which view requires mitigation. As discussed earlier in relation to trapping, it appears that traplines either occur a suitable distance away from the proposed TASR to avoid impact or the traplines intersect with the TASR in a select number of areas. These intersections should pose no long-term impact, as long as suitable crossings, pullouts and signage are installed, because the trails that intersect with the TASR are mainly transportation trails to reach traplines and hunting grounds even further away. Discussions with ENR Renewable Resource Officers confirmed

that over the past few years, individuals that could prove they have regularly trapped within the general area of the proposed TASR have already received compensation to relocate their traplines as a result of the impact from the fires. These discussions with ENR help to support the TRWG's opinion that the proposed TASR will not affect traplines as compensation has already been provided to those affected by the fires in the region, a region which happens to coincide with the proposed road.

#### *RESOURCE USE BY NON-TŁĮCHǪ RESIDENTS*

The final concern identified within the TK report would be the notion that non-Tłı̨chǫ residents would have easier access to Tłı̨chǫ resources and that this access to resources would be abused and impact the ability for Tłı̨chǫ residents to maintain their traditional way of life.

Due to the rules and restrictions outlined in the *Tłı̨chǫ Land Use Plan*, the TRWG is of the opinion that exploitation of Tłı̨chǫ resources by unauthorized users will be low. Any sort of exploration or mining development would have to abide by the land use permit (LUP) and the companies would have to apply for approval. This process provides many checks and balances and would therefore allow the Tłı̨chǫ people ample opportunity to voice their concerns. Cabins cannot be constructed along Lac La Martre without approval of the Department of Culture and Lands Protection; therefore, the Tłı̨chǫ Government has already implemented a suitable mitigation strategy with respect to cabin construction by non-Tłı̨chǫ residents. The GNWT Department of Lands is responsible for managing and administering the issuance of recreational leases for cabins on Territorial land and is currently working on the development of a Recreational Land Management Framework. Lands, working with the TG and other planning partners, completed a land use planning scoping study for public lands in the Wek'èezhìı Management Area and is now moving forward with a land use plan for the Wek'èezhìı Management Area with the TG, planning partners and other stakeholders. Harvesting of fish and other wildlife by non-Tłı̨chǫ residents must follow appropriate territorial and federal regulations, which prevent overharvesting. These regulations are reviewed periodically to ensure that wildlife harvesting remains sustainable. Restrictions can be implemented for certain species if they are identified to be at risk. It is the responsibility of ENR to monitor the sustainability of wildlife; therefore, this department will be the leading authority on whether harvesting restrictions need to be implemented in the future.

## 5.2 Aboriginal Consultation

The GNWT has a legal duty to consult and, where appropriate, accommodate an Aboriginal Government or Organization whenever it considers carrying out a government action that has the potential to adversely affect an asserted or established Aboriginal and/or Treaty right. Under this duty to consult, the Department of Aboriginal Affairs and Intergovernmental Relations (DAAIR) instructed DOT to consult with the following Aboriginal governments and organizations based on the location of the proposed TASR: Tłı̨chǫ Government, Acho Dene Koe First Nation, Mountain Island Métis, Dehcho First Nations, Northwest Territory Métis Nation, and the North Slave Métis Alliance. The details of these consultations are summarized below while additional details can be found in the Engagement Plan, which includes the engagement log and summaries (Appendix E).

### 5.2.1 Tłı̨chǫ Consultations

The 2014/2015 socioeconomic report written for the Tłı̨chǫ Government provides in-depth detail regarding the community consultations that have taken place with respect to Tłı̨chǫ residents (Appendix B). This section of the PDR provides a summary of consultation details outlined in the socioeconomic and Kavik AXYS reports (Appendix B; 2008b) as well as the consultations that have taken place since both reports were published; however, the Engagement Record, which includes the engagement logs and summaries, should be referenced for complete details (Appendix E). A further discussion pertaining to the 2014/2015 socioeconomic report can also be found in Section 7.4 of this PDR.

An all-season road to Whatì has been discussed on multiple occasions over the years by many parties including all levels of government. "In 2006, the Community Government of Whatì conducted a survey of 193 adults in which 80% of the people who filled out a survey said they wanted an all-season road" (Appendix B)[7].

In creating the *Environmental Scoping, Existing Data Collection and Regulatory Requirement Identification* report during 2008, Kavik AXYS held community meetings in all four Tłı̨chǫ communities and Yellowknife to engage Tłı̨chǫ residents and the public and gather information and input on issues or concerns regarding the winter road realignment. In advance of all 2008 community meetings, the conceptual project description (which included all corridor options at the time), produced in both Tłı̨chǫ and English languages, was provided to the community governments. Meetings consisted of a presentation to outline the proposal followed by an opportunity for participants to review project maps, ask questions, raise issues and discuss realigning the winter road. All meetings in the Tłı̨chǫ communities were conducted with the assistance of a Tłı̨chǫ language translator. Appendix E illustrates the locations and dates of meetings. Since 2008, all meetings have been jointly conducted and planned by the Tłı̨chǫ Government and the DOT.

Meetings held in the Tłı̨chǫ communities were open to all members of the public and conducted in an informal manner to facilitate discussion and input from community residents. Maps showing alternate route locations for the road realignment were displayed and used to focus discussion to determine if concerns or issues could be identified for specific routes. Detailed notes from all meetings were completed and are included in Appendix B of Kavik AXYS's report (2008b). A summary table presenting Tłı̨chǫ community input and issues were also included in Appendix D of the same report. These notes and tables are provided in Appendix E of the PDR for ease of reference.

Since 2008, there have been multiple intergovernmental meetings regarding this project with discussions on the preferred route and type of road (all-season vs. winter). In 2010 the GNWT held consultations in Whatì about the perceived benefits and risks of an all-season road. There was an additional survey conducted on behalf of the Community Government of Whatì in 2011 (Nitsiza 2011, in Appendix B). Nitsiza's survey of 81 Whatì households resulted in 105 responses with 86 people (82%) stating they would like an all-season road and 16 people (15%) stating they would not like an all-season road. The remaining three people (3%) were unsure as to whether they wanted the road (Appendix B).

[7] This survey was presented at the March 20, 2006 Community Government of Whatì Council Regular Meeting. CGRM03-06 includes a copy of the survey results (name, age, yes or no).

As of May 2013, there was renewed interest in the project, which was outlined in a letter from the Tłı̨chǫ Grand Chief Eddie Erasmus to then DOT Minister Dave Ramsay (Appendix F). This letter requested that the Tłı̨chǫ Roads Steering Committee expand the Whatì winter road study to an all-season road. Since May 2013, there have been consultation sessions in Whatì with the Tłı̨chǫ Government, including: a Special Inter-Agency Committee in June 2013; the TRWG attended a meeting in Whatì with the Chief and Council in late August 2013; TRWG attended a meeting with the community on September 4, 2013 to discuss options (70 community members attended, listened to presentations and provided options and general comments, with Route A as the most favorable); and finally, on November 28, 2013 there was a community meeting introducing the TG road studies that were being conducted. Focus groups and interviews were conducted in Whatì for the Traditional Knowledge section during the winter of 2014. Interviews and community meetings were also conducted in November-December 2013 and March 2014 for the purposes of the socioeconomic impact assessment (Appendix B). An additional Special Inter-Agency Committee meeting took place in Whatì on June 24, 2015 in order for the community to discuss how it needs to prepare for the impending changes should construction begin for the proposed TASR. The minutes and agenda for this meeting can be found in Appendix E. Through the Tłı̨chǫ Roads Working Group, members have been able to ensure that both the Tłı̨chǫ Government and Tłı̨chǫ communities remain engaged and well-informed on the project.

In addition to the engagement already mentioned, it should be noted that the Whatì Community Government has been working towards planning for an all-season road for 30 years. During the June 24, 2015 Special Inter-Agency Committee meeting, Grand Chief Eddie Erasmus explained:

> *"In 1983 the Dogrib Tribal Council started looking towards road access after the plane crash that happened in Behchokǫ̀ and Whatì Chief Johnny Nitsiza and Elder Pierre Beaverho both survived. Since that time, Whatì has been talking about the need for an all season road"* (Appendix E).

Though both the Tłı̨chǫ Government and Whatì Community Government were responsible for populating the details in the engagement log (Appendix E) to the best of their abilities, it is expected that there have been additional public sessions left unmentioned as Whatì consults on an ongoing basis about these issues and 30 years' worth of consultation is difficult to track after the fact. The engagement of the GNWT since 2008 merely marks a new level of joint governmental planning.

#### *5.2.1.1 January 18-20, 2016 Tłı̨chǫ Community Consultation Tour*

As the PDR was nearing completion in January 2016, the TRWG engaged with Tłı̨chǫ community members through a community consultation tour to touch base, provide project updates, confirm community members on a whole are in favour of the proposed TASR and to relay the proposed mitigation methods. Community consultation meetings were conducted jointly with DOT and the Tłı̨chǫ Government. Lunch or supper was offered at each of the meetings, interpreters were present and a project summary was available in both English and Tłı̨chǫ. A PowerPoint presentation was utilized to describe the project and was followed by a question and answer period. Complete details and presentation material are available as part of the engagement record (Appendix E).

Community consultation and various engagement methods will continue to be employed to ensure Tłı̨chǫ residents remain abreast of the project's progress; the engagement log will continue to document these activities.

#### *5.2.1.2 Concerns and Proposed Mitigation and Monitoring Actions*

As per the summary tables in Appendix E, community consultations in 2008 revealed concerns regarding environment and land use; safety; and socioeconomics. The 2014/2015 socioeconomic and TK reports were prepared by the Tłı̨chǫ Government to highlight and initiate the process of identifying issues raised by Whatì residents in particular; these reports mirrored concerns identified in 2008. Motion 2015-018, which was ratified by the TG and Whatì Community Government in March 2015, consists of an eleven point list of mitigations that will help to address the concerns of the Tłı̨chǫ people (Appendix D). The Community Government of Whatì also undertook the formation of a Special Inter-Agency Committee whose task is to prepare the community for any potential changes as a result of an all-season road. This committee has been responsible for engaging with the different agencies that will be utilized to help with community preparations (such as engaging with ECE for training, etc.). Some of the Special Inter-Agency Committee plans have been outlined in the June 24, 2015 meeting minutes (Appendix E). The Tłı̨chǫ Government, GNWT and the Community Government of Whatì are committed to working under the TRWG forum to develop plans, programs and policies to manage and monitor potential adverse socioeconomic and cultural impacts from the proposed TASR, and maximize benefits to Tłı̨chǫ citizens on an on-going basis through the regulatory, construction and operations phases of the road. Remaining concerns associated with the road have been addressed throughout this PDR.

During the January 18-20, 2016 Tłı̨chǫ Community Consultation Tour, concerns were identified in Gamètì and Wekweètì (e.g. can their snowmobile trails be brushed, can the road be closer to them). Though the length and location of the proposed TASR are farther than the current Tłı̨chǫ Winter Road System, an upgraded design criterion to the proposed road will now allow for a posted speed limit of 70 km/h within the TASR. It is expected that each community's drive time will remain the same, while also extending their winter road season. Both communities felt the decision of the proposed TASR should lie with the community of Whatì as they are the ones that will be directly affected by the project. Both communities indicated economic development (which will bring employment and training) was desirable and there was a recognized concern associated with the current Tłı̨chǫ Winter Road System and climate change (Appendix E). Though the Special Inter-Agency Committee is establishing steps to address the training request (e.g. June 2015 meeting), a secondary committee to fulfill the request has been initiated by DOT with its first meeting taking place March 1, 2016. This committee consists of MACA, DOT, TG, ECE and Aurora College; this committee will construct a training plan in anticipation of the future road construction positions.

During the Whatì community meeting, elders and community members spoke positively about the road. It will bring change, but it will also help in reducing the cost of living and provide the opportunity for employment. A desire for the community to work with ECE and the Mine Training Society was also discussed as these avenues will allow for training opportunities in preparation for a road. At the close of the meeting, a youth spoke up in opposition to the proposed TASR. Their concerns were with respect to the caribou in addition to a concern of increased drugs and alcohol within the community. Social concerns

will primarily be addressed by the Special Inter-Agency Committee and through the implementation of programs and policies designed by the Tłı̨chǫ and Whatì Committee Governments (Motion 2015-018). These include mitigations that range from addressing housing stock, the development of on the land treatment programs and revising the prohibition policy. Ongoing work with the community of Whatì will engage all the departments and agencies that deliver services. The TRWG's continued effort to work with ENR with respect to caribou management should also address the youth's second concern.

Overall, the community members in Behchokǫ̀ were favorable towards the proposed TASR. As was noted in the previous communities, elders supported the road and indicated the final decision should be left up to Whatì. Climate change concerns and the need for economic development were also mirrored in Behchokǫ̀. A youth of Whatì that attended the Behchokǫ̀ community meeting spoke up against the road citing numerous social issues (e.g. children with weapons; drugs) are already prevalent within the community and that an all-season road would only exacerbate the situation. It was suggested that ecotourism and an overland winter road would be a better focus. After speaking, many elders that had already spoken in favour of the road wanted to support the youth and therefore indicated concern and suggested holding a Tłı̨chǫ-wide meeting to discuss the project. Please see the '2016 Tłı̨chǫ Community Consultation Tour Summary of Issues Raised and Input Provided' located in Appendix E for further details.

As a result of the varied responses during the Behchokǫ̀ meeting, the TRWG met to review the concerns that were highlighted. Many of the concerns mentioned by youth are being considered by all three governments (Whatì, TG, GNWT) and mitigations are being established to ensure the concerns are appropriately managed. During this recent community tour, it was identified that further discussions with the youth of Whatì would be of benefit to explain how many of their concerns had been considered in the development of mitigations for the TASR. In order to rectify this gap and to ensure Whatì youth are fully engaged with the project, a TASR webpage was established on www.tlicho.ca, which provides the public with the draft project material in addition to a quick summary. This information has also been linked to the Tłı̨chǫ Government Facebook page to provide youth with easier access to the material. Questions and comments posted on both the TG Facebook page and main webpage are answered by TRWG members in a timely fashion. The TRWG will continue to work with the youth in Whatì so they are provided with the opportunity to continue discussions and contribute to the development of appropriate mitigations. For example, on May 4, 2016, the TRWG will participate in the third Whatì Inter-Agency Community meeting and review how programs have developed since their inception in 2014.

On a whole, the community of Whatì is in favour of the proposed TASR. The TRWG understands there will always be a certain amount of opposition to a project; however, the TRWG feels as if an adequate amount of engagement has occurred and mitigations have been developed to address concern, which will make the TASR a successful project that will benefit Whatì.

### 5.2.2 Acho Dene Koe First Nation

Chief Harry Deneron of the Acho Dene Koe First Nation (ADKFN) was contacted by way of letter dated May 21, 2015, which was authored by Michael Conway, Regional Superintendent of the North Slave Region with DOT. This consultation letter provided a summary of the proposed TASR, included a map

and inquired whether the ADKFN would like any additional information regarding the proposed TASR or if they had any comments or concerns. DOT received no response. A follow-up consultation letter was sent by Mr. Conway on June 12, 2015. This letter again asked if the ADKFN had any comments or concerns with respect to the proposed TASR and asked to be advised by June 26, 2015 if they would like to receive communication pertaining to the project. DOT received no response. A final consultation letter was sent on November 29, 2015 indicating that the PDR for the proposed TASR was nearing completion. This letter indicated that if the ADKFN wanted to be consulted, the Department of Transportation, in conjunction with the Tłı̨chǫ Government, would provide a presentation to assist in fully understanding the project and if ADKFN had any questions or concerns, these could be identified and addressed in the PDR prior to submission. A letter, dated March 29, 2016, was sent to ADKFN as notification that the TASR application package would be submitted to the WLWB on March 31, 2016. As of the application submission date, DOT has received no response.

### 5.2.3 Mountain Island Métis

Paul Clem, President of the Mountain Island Métis (MIM) was contacted by way of letter dated May 21, 2015, which was authored by Michael Conway, Regional Superintendent of the North Slave Region with DOT. This consultation letter provided a summary of the proposed TASR, included a map and inquired whether the MIM would like any additional information regarding the proposed TASR or if they had any comments or concerns. DOT received no response. A follow-up consultation letter was sent by Mr. Conway on June 12, 2015. This letter again asked if the MIM had any comments or concerns with respect to the proposed TASR and asked to be advised by June 26, 2015 if they would like to receive communication pertaining to the project. DOT received no response. A final consultation letter was sent on September 8, 2015 indicating that the PDR for the proposed TASR was nearing completion. This letter indicated that if the MIM wanted to be consulted, the Department of Transportation, in conjunction with the Tłı̨chǫ Government, would provide a presentation to assist in fully understanding the project and if MIM had any questions or concerns, these could be identified and addressed in the PDR prior to submission. A letter, dated March 29, 2016, was sent to MIM as notification that the TASR application package would be submitted to the WLWB on March 31, 2016. As of the application submission date, DOT has received no response.

### 5.2.4 Dehcho First Nations

Grand Chief Herb Norwegian of the Dehcho First Nations was contacted by way of letter dated May 21, 2015, which was authored by Michael Conway, Regional Superintendent of the North Slave Region with DOT. This consultation letter provided a summary of the proposed TASR, included a map and inquired whether the Dehcho First Nations would like any additional information regarding the proposed TASR or if they had any comments or concerns. DOT received no response. A follow-up consultation letter was sent by Mr. Conway on June 12, 2015. This letter again asked if the Dehcho First Nations had any comments or concerns with respect to the proposed TASR and asked to be advised by June 26, 2015 if they would like to receive communication pertaining to the project. DOT received no response. A final consultation letter was sent on September 8, 2015 indicating that the PDR for the proposed TASR was nearing completion. This letter indicated that if the Dehcho First Nations wanted to be consulted, the Department

of Transportation, in conjunction with the Tłı̨chǫ Government, would provide a presentation to assist in fully understanding the project and if the Dehcho First Nations had any questions or concerns, these could be identified and addressed in the PDR prior to submission. A letter, dated March 29, 2016, was sent to the Dehcho First Nations as notification that the TASR application package would be submitted to the WLWB on March 31, 2016. As of the application submission date, DOT has received no response.

### 5.2.5 Northwest Territory Métis Nation

Garry Bailey, President of the Northwest Territory Métis Nation (NWTMN) was contacted by way of letter dated May 21, 2015, which was authored by Michael Conway, Regional Superintendent of the North Slave Region with DOT. This consultation letter provided a summary of the proposed TASR, included a map and inquired whether the NWTMN would like any additional information regarding the proposed TASR or if they had any comments or concerns. DOT received no response. A follow-up consultation letter was sent by Mr. Conway on June 12, 2015. This letter again asked if the NWTMN had any comments or concerns with respect to the proposed TASR and asked to be advised by June 26, 2015 if they would like to receive communication pertaining to the project. DOT received no response. A final consultation letter was sent on September 8, 2015 indicating that the PDR for the proposed TASR was nearing completion. This letter indicated that if the NWTMN wanted to be consulted, the Department of Transportation, in conjunction with the Tłı̨chǫ Government, would provide a presentation to assist in fully understanding the project and if the NWTMN had any questions or concerns, these could be identified and addressed in the PDR prior to submission. A letter, dated March 29, 2016, was sent to NWTMN as notification that the TASR application package would be submitted to the WLWB on March 31, 2016. As of the application submission date, DOT has received no response.

### 5.2.6 North Slave Métis Alliance

Bill Enge, President of the North Slave Métis Alliance (NSMA) was contacted by way of letter dated May 21, 2015, which was authored by Michael Conway, Regional Superintendent of the North Slave Region with DOT. This consultation letter provided a summary of the proposed TASR, included a map and inquired whether the NSMA would like any additional information regarding the proposed TASR or if they had any comments or concerns. DOT received no response. A follow-up consultation letter was sent by Mr. Conway on June 12, 2015. This letter again asked if the NSMA had any comments or concerns with respect to the proposed TASR and asked to be advised by June 26, 2015 if they would like to receive communication pertaining to the project. On June 26, 2015, Mr. Enge sent a letter to Mr. Conway stating that the NSMA wished to be consulted and that they would like to receive all the materials pertaining to the proposed TASR. Subsequent correspondence between Mr. Enge and Mr. Conway is available in Appendix E. DOT attempted to set up a consultation meeting with the NSMA for August 5, 2015; however, the NSMA indicated that they were not available on that date and would not be available to meet until they had received and reviewed all material pertaining to the proposed TASR. On July 31, 2015, by way of letter, DOT provided the NSMA with paper copies of the draft PDR and all appendices. The following week, at the request of NSMA, DOT provided NSMA with electronic copies of the files. An informal face to face lunch meeting occurred on September 29, 2015 in order to clarify earlier NSMA correspondence pertaining to a funding request. During said meeting, NSMA continued its discussion

pertaining to consultation and funding. Due to the nature of what was discussed during the meeting, DOT requested legal counsel after the fact to help navigate the matter. After thorough review of the matter, in consultation with DAAIR and Justice, DOT supplied NSMA with a letter (January 27, 2016) pertaining to the consultation process and next steps. On February 19, 2016, NSMA provided DOT with a response letter. NSMA indicated they wished to continue with the consultation process. DOT provided a response letter on March 18, 2016 and NSMA replied once again on March 24, 2016. NSMA outlined possible next steps for consultation. DOT, in consultation with applicable GNWT departments, will draft a reply to NSMA's letter. The level of detail required to respond to NSMA's letter will require time as a result of the number of GNWT departments that will need to be consulted internally. It is expected that a response will only be available in April at the earliest. DOT continues to work with NSMA through the consultation process. DOT will continue to maintain an up to date engagement log with respect to NSMA consultation.

## 5.3 Stakeholder Engagement

In creating the Environmental Scoping, Existing Data Collection and Regulatory Requirement Identification report during 2008, Kavik AXYS circulated a conceptual project description of the Tłı̨chǫ winter road realignment to the following departments and organizations for comment:

- Wek'èezhìı Renewable Resources Board (WRRB)
- Department of Indian and Northern Affairs (INAC)
- Environment Canada (EC)
- Fisheries and Oceans Canada (DFO)
- Department of Environment and Natural Resources (ENR)
- Prince of Wales Northern Heritage Centre (PWNHC)
- NWT Chamber of Mines
- Northwest Territories Power Corporation (NTPC)

Parties were requested to consider the following specific points in their review of the proposal:

- location of current route alternatives;
- species of concern and critical habitat areas within the region;
- valued environmental and socioeconomic environmental components (VECs and VSECs) on which an assessment of potential project effects would focus;
- potential concerns resulting from the project proposal to the biophysical and socioeconomic (including cultural and archaeological resources) environment;
- information gaps: VECs and VSECs for which there may be insufficient regional information to assist with the evaluation of potential effects in the region;
- how proposed routes for the road realignment may benefit or negatively impact mining exploration and activity in the Tłı̨chǫ region;

- potential socioeconomic issues or concerns in relation to mining exploration or activities in the Tłı̨chǫ region resulting from the project proposal;
- how proposed routes for the road realignment may benefit or negatively impact Northwest Territories Power Corporation operations within the Tłı̨chǫ region; and
- any other issues or concerns with the project proposal which should be addressed during environmental assessment.

Written comments were received from INAC, ENR, PWNHC and NTPC. Issues identified by these parties are presented in Appendix E of Kavik AXYS' report (2008b) and Appendix E of this PDR. Kavik AXYS met with staff from WRRB and their comments are also included in the same Appendix. The comments and concerns from 2008 were considered in the development of the current PDR.

In January 2016, the TRWG provided the draft PDR to a similar set of stakeholders for their review and comment. Fortune Minerals, NTPC, Tłı̨chǫ Investment Corp., NWT & Nunavut Chamber of Mines and Wek'èezhìı Renewable Resources Board (WRRB) were provided with the draft project material. Fortune and WRRB replied with minor comments and their suggested changes were incorporated into the PDR.

Throughout the process of drafting the PDR, various GNWT departments were also provided with the opportunity to review and provide comments. An initial review by all GNWT departments occurred in the fall of 2014; a more concentrated review of the draft PDR by select GNWT departments took place in June 2015; and finally, the document was circulated again in February 2016 to ensure all GNWT comments and concerns had been captured. The comments and concerns identified by these departments have been incorporated into the final PDR.

As a proactive measure, during the February 25 to March 17, 2016 internal GNWT review of the draft PDR and its appendices, the same documents were also sent to the Tłı̨chǫ Government and CanNor. Comments from these agencies were incorporated into the final PDR where necessary. Individual reviewers were contacted directly if DOT required further clarification or if a discussion was required. Face-to-face meetings were also an option. The Department of Transportation and Tłı̨chǫ Government gave PowerPoint presentations to both the Federal Government and MVEIRB in order to familiarize the agencies with the proposed project. A question and answer session followed each presentation.

Throughout the process of drafting the PDR, DOT also engaged with the WLWB. The WLWB was a valuable resource in providing clarification of Board procedures and providing direction with respect to the application process.

### 5.3.1 Concerns and Mitigation

As per the 2008 summary table in Appendix E, stakeholder review revealed concerns regarding environment and land use. These concerns have been addressed in policies, programs and mitigation measures identified throughout this PDR. The more recent stakeholder review had limited concerns and the TRWG worked with the stakeholders directly to ensure their concerns were adequately addressed. The Engagement Record provides this information in detail (Appendix E). An example of the concerns included Fortune Minerals correcting a road distance and phrasing, while the WRRB provided additional information pertaining to moose and caribou and suggested including a cumulative impacts map.

The February/March 2016 draft application review on a whole highlighted that socioeconomic mitigations needed to be more prominent within the PDR. Though reviewers recognized there were numerous mitigations in place to account for potential socioeconomic concerns in Whatì, they felt that the PDR did not effectively communicate this fact. Sections of the PDR were improved to address this shortcoming. Section 5 further described the Special Inter-Agency Committee, its role and responsibility in addressing community concerns with respect to the proposed TASR. A summary of the commitments the Whatì and Tłı̨chǫ governments agreed to in Motion 2015-018 was also included in Section 8.11 so that readers would not have to flip to an appendix. Further review of the comments and concerns identified by reviewers can be located within the March 2016 compiled summary table located within the Engagement Record (Appendix E).

# 6 ENVIRONMENTAL OVERVIEW

The following sections provide a brief description of the biophysical conditions and resources existing along the proposed TASR. This background information is subsequently considered in Section 8 of this PDR to identify potential environmental effects and proposed mitigation measures to avoid or minimize negative effects.

## 6.1 Climate

Monthly air temperature data from the Whatì meteorological station (Lac la Martre, 2202678) operated by Environment Canada is available between 1996 and 2007; with occasional data gaps in 2002 (EC 2014a). Daily air temperature data from the same station is available after 2007. Precipitation, wind speed and direction and air quality have not been consistently collected from the station therefore Whatì was not included as one of the locations summarized in Environment Canada's Canadian Climate Normals 1981-2010 Station Data (EC 2014b). Behchokǫ̀ does not have a meteorological station operated by Environment Canada; therefore, the Yellowknife Airport station (2204100) is the closest meteorological station with climate normals that can be utilized to provide a climatic summary of the general surrounding area (EC 2014c).

Table 6-1 illustrates the mean monthly air temperature at the Whatì station, while Table 6-2 illustrates climate data at the Yellowknife Airport station. Both tables show similar air temperature averages, with Whatì showing slightly cooler values as a result of being 164 km northwest of Yellowknife, NT.

Based on the mean monthly air temperatures in Whatì and the climate data at the Yellowknife Airport, the proposed TASR should be characterized by cold winters followed by short summers. The lowest average daily winter temperatures generally occur in January, while the warmest month occurs in July. Rainfall generally occurs throughout June through September; while snowfall generally occurs from September through May (Table 6-2). General wind speed is relatively consistent throughout the year with maximum gusts occurring during the fall and winter. Wind direction is variable though the most frequent direction is easterly aside for the summer months (Jun-Aug) where the most frequent direction is southerly (Table 6-2).

## 6.2 Air Quality

Available air quality data for the proposed alignment is inferred from the closest ambient air quality monitoring station located in Yellowknife, NT. Results from the *Northwest Territories Air Quality Report 2012* are presented in Table 6-3 along with current NWT air quality standards (ENR 2012a). National (NAAQO) or Provincial standards that have been adopted in the NWT have been denoted with an asterisk.

A detailed summary of Yellowknife's air quality is available from the *Northwest Territories Air Quality Report 2012* (ENR 2012a); however, based on Table 6-3, aside from fine and coarse particulate, air quality levels are exceptional and should be similar along the proposed alignment. Exceedances for fine

and coarse particulate are attributed to forest fires that occur during the summer months, which can be variable depending on the number of forest fires each year. Other coarse particulate exceedances are attributed to what ENR describes as the annual "dust" event, which is typical during the month of April and is due to residual gravel on the paved roads following the spring snow thaw (ENR 2012a). The potential dust that could occur during the construction phase of the road will be mitigated by appropriate dust suppression techniques such as watering the road. It is therefore expected that construction operations should not contribute to any air quality exceedances.

**Table 6-1 Lac La Martre (Climate ID 2202678) Average Monthly Air Temperature between 1996-2007**

| Month | Daily Maximum (°C) | Daily Minimum (°C) | Daily Average (°C) | Extreme Maximum (°C) | Extreme Minimum (°C) |
|---|---|---|---|---|---|
| January | -20.93 | -29.93 | -25.46 | -6.23 | -42.98 |
| February | -16.40 | -27.06 | -21.74 | -5.08 | -40.63 |
| March | -10.59 | -25.01 | -17.83 | 4.88 | -38.72 |
| April | 1.87 | -13.22 | -5.69 | 13.12 | -29.41 |
| May | 10.50 | -1.16 | 4.70 | 22.28 | -11.81 |
| June | 19.30 | 7.15 | 13.25 | 28.56 | -1.40 |
| July | 22.38 | 10.30 | 16.35 | 30.56 | 2.15 |
| August | 18.28 | 6.81 | 12.55 | 27.74 | -1.13 |
| September | 11.32 | 2.08 | 6.72 | 21.10 | -6.21 |
| October | -0.21 | -6.53 | -3.39 | 8.40 | -18.81 |
| November | -9.96 | -17.79 | -13.86 | -0.68 | -33.78 |
| December | -17.11 | -25.81 | -21.48 | -5.54 | -39.45 |
| Annual Average | 0.70 | -10.01 | -4.66 | | |

*Note: This data has been estimated with the data available from Environment Canada (Reference: 2014a). There are data gaps; therefore, this table is for illustrative purposes only and should not be used in detailed scientific analyses.*

## 6.3 Climate Change

Changes in mean annual temperature attributed to climate change will affect permafrost, ice conditions and the amount and timing of precipitation events in the NWT (ENR 2008). General warming of the area will affect the freeze-thaw patterns and can therefore affect road construction. Mitigation techniques discussed in Section 8 will attempt to prevent further permafrost degradation and maintain road integrity.

A 2007 study conducted by Dillon Consulting Limited for the DOT produced a report titled *Climate Change and Transportation in the NWT* (Dillon 2007). This report conducted a survey on the Yellowknife-Slave area along the Highway 3 ROW. Though this area falls outside of the scope of the proposed TASR, the conclusions on climate change are expected to be similar. Table 6-4 illustrates the predicted extent of permafrost and range of ground temperatures up to 2055 (Dillon 2007), while precipitation is expected to increase based on Environment Canada's Climate Global Circulation Model (CanRCM4; EC 2014d).

## Table 6-2 1981 to 2010 Canadian Climate Normals Station Data for Yellowknife A (Climate ID 2204100)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Temperature** | | | | | | | | | | | | | |
| Daily Average (°C) | -25.6 | -22.9 | -16.8 | -5.3 | 4.6 | 13.3 | 17 | 14.2 | 7.2 | -1.7 | -13.7 | -21.8 | -4.3 |
| Standard Deviation | 4.6 | 4 | 3.5 | 2.8 | 2.7 | 1.2 | 1.3 | 1.6 | 1.7 | 2.1 | 4.3 | 4.9 | 1.5 |
| Daily Maximum (°C) | -21.6 | -18.1 | -10.8 | 0.4 | 9.7 | 18.1 | 21.3 | 18.1 | 10.4 | 0.9 | -10 | -17.8 | 0 |
| Daily Minimum (°C) | -29.5 | -27.5 | -22.7 | -11 | -0.5 | 8.5 | 12.6 | 10.2 | 4 | -4.2 | -17.5 | -25.7 | -8.6 |
| Extreme Maximum (°C) | 3.4 | 6.2 | 9.3 | 20.3 | 26.1 | 30.3 | 32.5 | 30.9 | 26.1 | 19 | 7.8 | 2.8 | |
| Extreme Minimum (°C) | -51.2 | -51.2 | -43.3 | -40.6 | -22.8 | -4.4 | 0.6 | -0.6 | -9.7 | -28.9 | -44.4 | -48.3 | |
| **Precipitation** | | | | | | | | | | | | | |
| Rainfall (mm) | 0.1 | 0 | 0.2 | 2.5 | 13.8 | 28.9 | 40.8 | 39.2 | 32.7 | 12.1 | 0.3 | 0.2 | 170.7 |
| Snowfall (cm) | 19.7 | 20 | 18.5 | 10.3 | 4.7 | 0 | 0 | 0.1 | 3.5 | 20.9 | 36.5 | 23.5 | 157.6 |
| Precipitation (mm) | 14.3 | 14.1 | 13.9 | 11.3 | 18.4 | 28.9 | 40.8 | 39.3 | 36.3 | 30.3 | 24.8 | 16.2 | 288.6 |
| Average Snow Depth (cm) | 28 | 34 | 38 | 22 | 0 | 0 | 0 | 0 | 0 | 2 | 14 | 23 | 13 |
| Median Snow Depth (cm) | 27 | 34 | 38 | 23 | 0 | 0 | 0 | 0 | 0 | 2 | 14 | 23 | 13 |
| Snow Depth at Month-end (cm) | 31 | 38 | 37 | 3 | 0 | 0 | 0 | 0 | 1 | 6 | 19 | 26 | 13 |
| Extreme Daily Rainfall (mm) | 0.8 | 0.8 | 3 | 14.4 | 34 | 33.6 | 66 | 82.8 | 29.7 | 35.6 | 7.1 | 2.2 | |
| Extreme Daily Snowfall (cm) | 16.4 | 23.7 | 16.2 | 13 | 11.2 | 3 | 0 | 1 | 15.2 | 16 | 15 | 20.2 | |
| Extreme Daily Precipitation (mm) | 14.2 | 17.5 | 12.4 | 14.4 | 34 | 33.6 | 66 | 82.8 | 29.7 | 35.6 | 12.2 | 11.4 | |
| Extreme Snow Depth (cm) | 69 | 76 | 81 | 69 | 30 | 0 | 0 | 0 | 15 | 33 | 43 | 58 | |
| **Wind** | | | | | | | | | | | | | |
| Speed (km/h) | 10.7 | 11.6 | 12.7 | 13.7 | 14.1 | 13.4 | 12.6 | 12.9 | 13.7 | 14.3 | 13.3 | 11.2 | 12.8 |
| Most Frequent Direction | E | E | E | E | E | S | S | S | E | E | E | E | E |
| Maximum Hourly Speed (km/h) | 72 | 61 | 61 | 64 | 64 | 68 | 64 | 64 | 72 | 64 | 64 | 57 | 72 |
| Direction of Maximum Hourly Speed | NW | NW | NW | NW | NE | N | N | NE | W | NW | NW | NW | NW |
| Maximum Gust Speed (km/h) | 105 | 98 | 74 | 93 | 87 | 89 | 85 | 80 | 105 | 93 | 113 | 80 | 113 |
| Direction of Maximum Gust | W | N | NW | W | NW | W | N | N | W | N | W | S | W |

*Reference: Environment Canada 2014a*

### Table 6-3 2012 Yellowknife Baseline Air Quality Report

| Species | NWT Standard (*NAAQO, **BC, ***Alberta) | | 2012 Maximum | 2012 Exceedances | |
|---|---|---|---|---|---|
| | Maximum | Avg. Period | | # Days | % Days |
| $SO_2$ | 172 ppb | 1 hour | 2.75 ppb | 0 | |
| | 57 ppb | 24 hours | 1.28 ppb | 0 | |
| | 11 ppb | Annual | >1 ppb | 0 | |
| $NO_2$ | 213 ppb | 1 hour | 36.6 ppb | 0 | |
| | 106 ppb | 24 hours | 15.8 ppb | 0 | |
| | 32 ppb | Annual | 2.2 ppb | 0 | |
| CO | 13 ppm | 1 hour | 2.909 ppm | 0 | |
| | 5 ppm | 8 hours | 1.723 ppm | 0 | |
| $PM_{2.5}$ | 30 µg/m$^3$ | 24 hours | 65.8 µg/m$^3$ | 2 | 0.5 |
| $PM_{10}$ | **50 µg/m$^3$ | 24 hours | 154.3 µg/m$^3$ | 11 | 3.0 |
| Ground Level $O_3$ | *85 ppb | 1 hour | 60.6 ppb | 0 | |
| | 65 ppb | 8 hours | 57.4 ppb | 0 | |

*Concentrations are either in parts per billion/million by volume or micrograms per cubic metre. Reference: ENR 2012a*

### Table 6-4 Predicted extent of permafrost and range of ground temperatures

| | Current (2000) | | | Mean warming to 2025 | | | Mean warming to 2055 | | |
|---|---|---|---|---|---|---|---|---|---|
| | % Frozen | Ground Temperature | | % Frozen | Ground Temperature | | % Frozen | Ground Temperature | |
| | | Min. (°C) | Max. (°C) | | Min. (°C) | Max. (°C) | | Min. (°C) | Max. (°C) |
| Yellowknife | 74.9 | -0.43 | +2.42 | 74.9 | -0.37 | +2.58 | 68.1 | -0.13 | +3.19 |

*Reference: Dillon 2007*

## 6.4 Terrain, Permafrost and Soils

### 6.4.1 Background

#### *6.4.1.1 Terrain*

The proposed TASR is situated near the western edge of the Slave Province of the Canadian Shield. An overview of the bedrock composition traversed by the proposed road is illustrated in Figure 6-1. These Devonian and Ordovician Paleozoic sedimentary rocks are covered by Holocene till, glaciolacustrine and glaciofluvial deposits.

The surficial deposits of the proposed TASR are dominated by till veneers overlying bedrock, glaciolacustrine, including raised beaches, and glaciofluvial deposits (Tables 4-1 and 6-5; Figure 6-2; and

Appendix P); these generally well-drained deposits account for between 96 to 98 percent of all materials found along the route. Till is often washed and modified by glaciolacustrine and glaciofluvial processes (Kerr and Wilson 2000). Glaciolacustrine deposits are commonly found in depressions or in joints or fractures of bedrock (Kerr and Wilson 2000). The glaciofluvial deposits found in the area are often raised landforms such as eskers, dominantly composed of gravels and sand. Organics and bedrock outcrops are not common and account for approximately one percent and less than 0.5 percent of the route, respectively (Kavik AXYS 2008a). The numerous raised beaches (which once bounded Glacial Lake McConnell) and scattered glaciofluvial deposits account for most of the aggregate potential in the area (Smith 1994).

The topography over which the proposed TASR crosses is mainly undulating. Elevations range from 180 m asl in the river valley of La Martre River to 300 m asl on the raised beach deposits of Glacial Lake McConnell, with slopes generally less than 10%. Numerous lakes such as Marian Lake and Lac La Martre and rivers such as La Martre River are also present in the surrounding environment.

LiDAR collected in 2014 and a topographic field survey in 2015 have helped in distinguishing elevation along the proposed TASR. These two surveys have been utilized to design the proposed corridor which is illustrated in detail in Appendix G.

#### *6.4.1.2 Permafrost*

All of these deposits and landforms may be affected by permafrost as the area lies within the zone of extensive discontinuous permafrost (50-90%; Heginbottom et al. 1995). While permafrost cannot be proven due to the absence of thermistor records for this region, permafrost is anticipated to be strongly correlated with finer-textured glacial and post-glacial sediments such as glaciolacustrine and lacustrine deposits as well as organic accumulations. Ice-rich deposits are expected in these areas (Heginbottom et al. 1995). Geotechnical and thermal analyses during the final design stage of the project will help to identify permafrost susceptible areas. These investigations will recommend rerouting the road accordingly or to engage various design techniques that protect permafrost.

#### *6.4.1.3 Soils*

Regional soils information was found in the Atlas of Canada, the *Environmental Scoping, Existing Data Collection and Regulatory Requirement Identification for a Transportation Corridor in the Slave Geological Province, Northwest Territories and Nunavut* (FSC 1999) and the baseline soil and terrain resources survey conducted for the proposed Fortune NICO project (Golder 2010). To date, detailed soils mapping of the proposed TASR has not been mapped; however, Figure 6-3 shows that Cryosols are likely the dominant soil type to be encountered along the route. Brunisols and Organic soils are common in the area but are limited on the proposed TASR corridor. Further soils information is not expected to be collected or necessary to complete the final road design.

Cryosols are associated with areas where permafrost exists close to the surface. Turbic, Static and Organic Cryosols could be found in this region. The distribution of Turbic and Static Cryosols can be determined by the texture of the material and age of the deposit. Turbic Cryosols are much more

prevalent on older mineral soils that have medium to fine textures and Static Cryosols are common on recently deposited materials with coarse textures (Soil Classification Working Group 1998).

Static, Turbic and Organic Cryosols are formed in either mineral or organic materials that have permafrost either within 1 m of the surface or within 2 m of the surface if the pedon has been strongly cryoturbated laterally within the active layer, as indicated by disrupted, mixed, or broken horizons. These soils have a mean annual temperature of <0°C. Differentiation of Cryosolic soils from soils of other orders involves either determining or estimating the depth to permafrost.

Brunisols can be found throughout the proposed TASR in upland areas with rapid to imperfect drainage. Brunisols are found on coarse-textured deposits. Brunisolic soils have sufficient development to exclude them from the Regosolic order, but they lack the degree or the kind of horizon development specified for soils of other orders. The central concept of the order is that of soils formed under forest cover and having brownish-colored Bm horizons, but the order also includes soils of various colors with both Ae horizons and B horizons having slight accumulations of either clay (Btj), or amorphous A1 and Fe compounds (Bfj), or both.

### 6.4.2 Terrain Conditions along Proposed TASR

Terrain conditions observed along the proposed TASR, beginning near KM 196 along Highway 3 and traveling north to the Whatì community government boundary (KM 94) are described in Table 6-5 below. Terrain details were assessed from the alignment sheets provided in Kavik AXYS' report (2008a; Appendix P). Because the proposed TASR corridor has not changed significantly from the 2008 terrain analysis, the 2008 report is still valid in describing the overall terrain trends. Further geotechnical investigations will be initiated along the proposed alignment and in potential material sources to confirm conditions of terrain and quality of material sources for construction after funds have been procured for the project. These geotechnical investigations are only necessary for the final road design and should not result in significant changes to the environment, which has been described herein. For instance, geotechnical investigations are required to establish where drilling should occur exactly to erect the clear span bridges, but this does not typically occur until construction is ready to begin. Permafrost will also be assessed at this time through thermal analysis and will help to identify if areas impacted by the 2014 forest fires have reduced permafrost layers. LiDAR and a topographic survey, necessary predesign components, were obtained in 2014/2015 and have enabled preliminary design of the proposed TASR (see Appendix G for further details).

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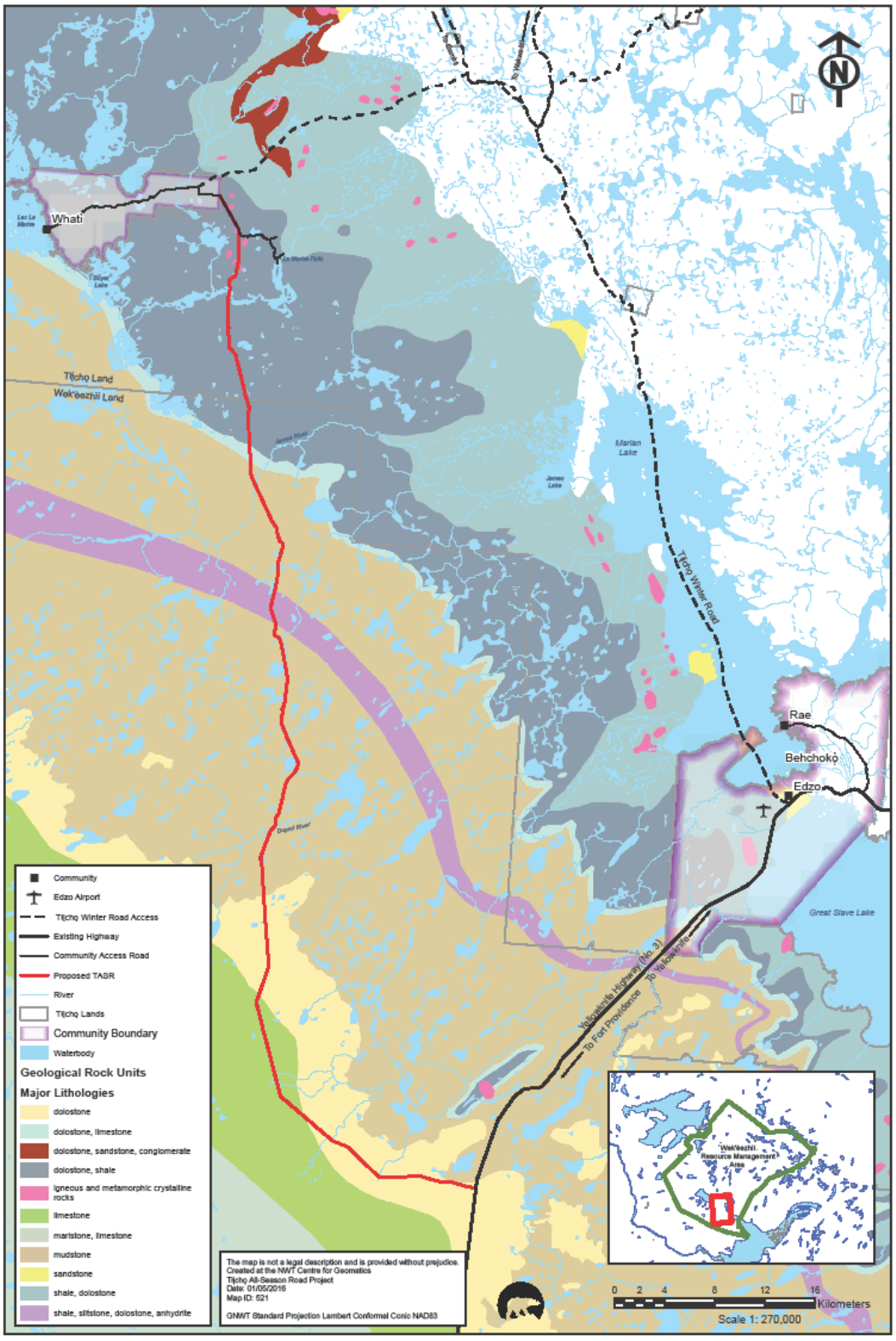
## Figure 6-1 Bedrock Composition Surrounding the Proposed TASR Corridor



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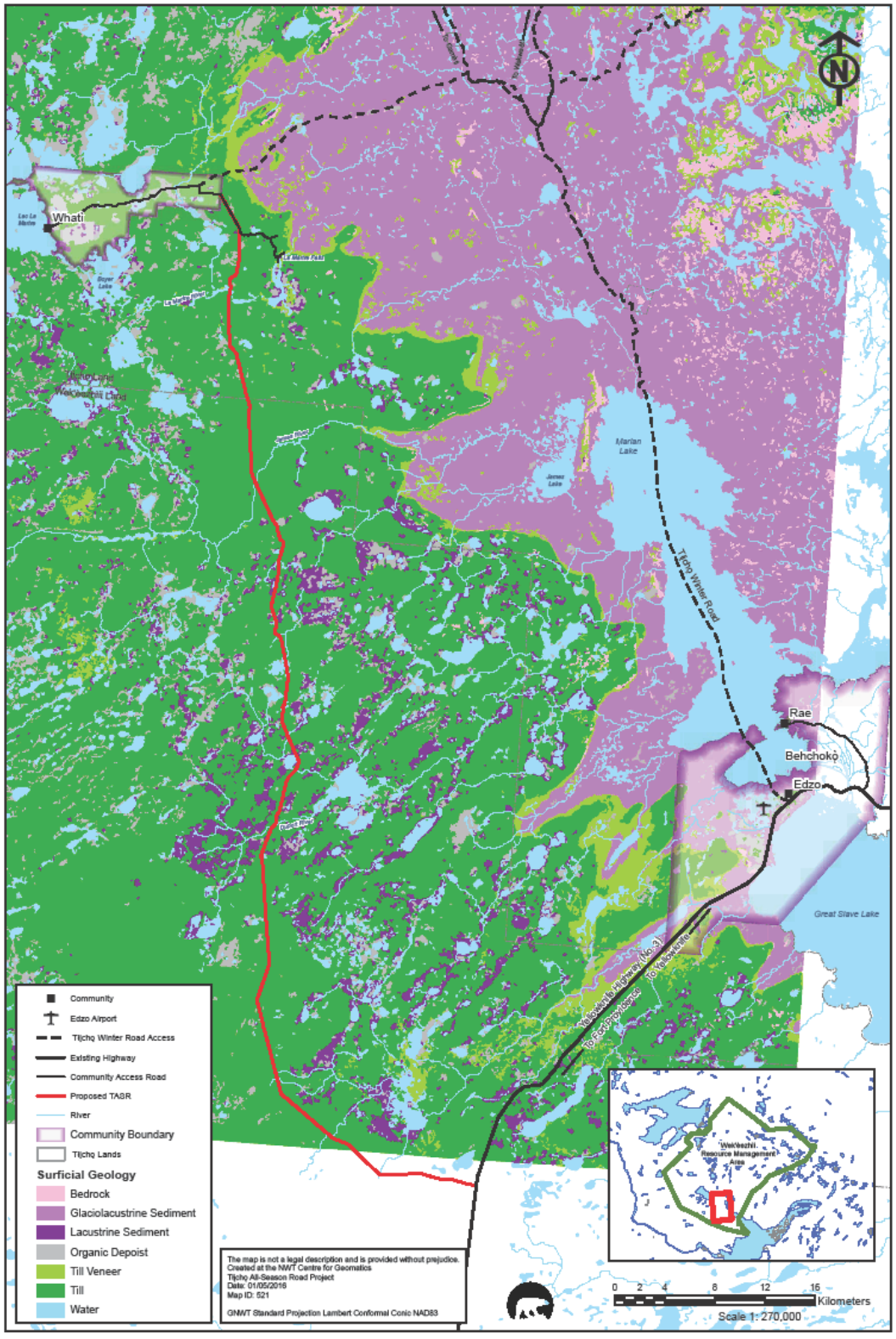
## Figure 6-2 Surficial Geology Surrounding the Proposed TASR Corridor



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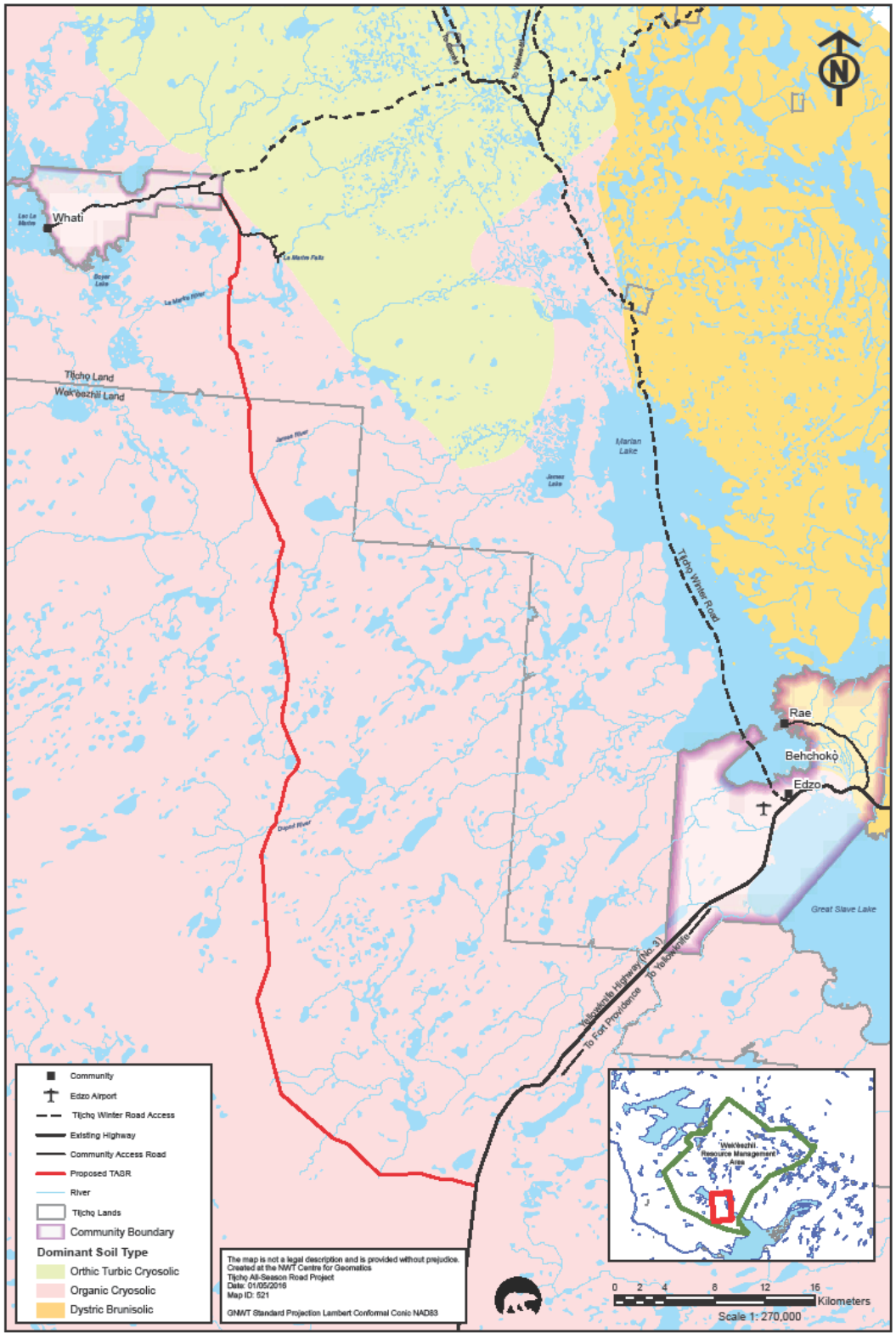
## Figure 6-3 Soils Composition Surrounding the Proposed TASR Corridor



## Table 6-5 Terrain Conditions and Vegetation Type encountered within proposed TASR, described by KM segment[1]

| Kilometre | | Description of Terrain Conditions and Vegetation Type |
|---|---|---|
| 0.00 | 7.50 | Beginning of alignment starts near KM196 off of Hwy 3 and continues west. This section consists predominantly of undulating to plain coarse glaciolacustrine material with a small percentage of fluvial veneer. There is less than a 2% slope and drainage ranges from well to moderately well with a small portion of imperfect drainage within the fluvial plain. Seasonal tributaries occur at KM2 and KM3.2.<br>Vegetation along this section consists of a mixed stand of upland tall white and black spruce with jack pine and trembling aspen and ephemeral stream crossing/swampland vegetation within the fluvial plain. The shrub layer is also highly variable with lichen and bearberry as groundcover. |
| 7.50 | 12.25 | Continuing northwest, the entire section consists of undulating coarse glaciolacustrine material mixed with limited organic veneer and a small section of fluvial veneer. There is less than a 2% slope and drainage ranges from moderately well to well with 1/3rd of the section having imperfect to very poor drainage. A seasonal tributary occurs at KM7.9.<br>Vegetation along this section includes an ephemeral stream crossing/swampland and mixed stands. |
| 12.25 | 19.50 | Continuing north-northwest, the entire section consists of coarse glaciolacustrine material that ranges between ridge, plain, blanket and undulating. There is a small percentage of fluvial veneer. The slope is less than 2% except in areas where there is blanket material and a 3-5% slope. Drainage ranges from well to moderately well with the occasional rapid or imperfect drainage sections. Seasonal tributaries occur at KM13.2 and KM16.5.<br>Vegetation along this section includes a section of regenerating jack pine forest, ephemeral stream crossing/swampland, dwarf shrub and the standard mixed stands. |
| 19.50 | 22.50 | Continuing north with a curve to the east, this section consists predominantly of coarse glaciolacustrine material that ranges between ridge, plain, blanket and undulating. There is also a portion of organic veneer. There is less than a 2% slope aside for the remaining 0.5 km which has an increasing slope of 3-5%. Drainage pattern fluctuates from well to imperfect and very poor. A seasonal tributary occurs at KM19.4.<br>Community types encountered along this section include dense jack pine, mixed stands, an ephemeral stream crossing/swampland, black spruce-tamarack, and the edges of a regenerating jack pine forest. |
| 22.50 | 32.50 | Curving back towards the west and continuing northward, this section consists mainly of undulating or plain till. There is also coarse glaciolacustrine material present. Both the till and coarse glaciolacustrine material are mostly well drained and slope less than 2%. Small portions of glaciolacustrine have a slope between 3-5%. An even smaller portion of the route consists of an organic veneer with very poor drainage. A seasonal tributary occurs at KM23.6. (Note: since final road designs, route between KM26 and KM32.5 has moved east)<br>Vegetation along this section consists of regenerating jack pine forest, shrub fen, dense jack pine, trembling aspen/balsam poplar and mixed stands. |
| 32.50 | 38.50 | Following a general northward direction with an s-curve midway, the route consists of 3/4 undulating till and 1/4 glaciolacustrine (partially coarse) material. The slope is generally less than 2% with a portion ranging from 3-9%. Drainage is moderately well to imperfect.<br>Vegetation along this section includes mixed stands, graminoid fen, and portions of a regenerating jack pine forest. |
| 38.50 | 46.50 | Continuing north-northeast, the route is 3/4 glaciolacustrine plain or undulating material ranging from imperfect to moderately well drainage and a general 2% slope. Small portions of this material have a 3-5% slope. 1/4 of the route is coarse glaciolacustrine with well to moderately well drainage and a 2% slope. Water crossings requiring bridge structures occur at KM40.4 (Duport River) and KM45.2.<br>Vegetation along this section consists of regenerating jack pine forest, riparian areas, graminoid fen, dense spruce, spruce-tamarack stands. |

## Table 6-5 (Continued) Terrain Conditions and Vegetation Type encountered within proposed TASR, described by KM segment[1]

| Kilometre | | Description of Terrain Conditions and Vegetation Type |
|---|---|---|
| 46.50 | 54.25 | Following a general northward direction with an exaggerated s-turn for the entire portion, aside for a very small portion of organic veneer, this section consists of glaciolacustrine material in plain, blanket, veneer, and undulating format. The slope is predominantly less than 2% with small sections sloping from 3-5%. Drainage is essentially imperfect with some moderately well drainage. A small dry rocky creek occurs at KM48.2.<br>Vegetation along this section consists of mixed stands, peat bog, ephemeral stream/swampland, black spruce-tamarack, and dense jack pine. |
| 54.25 | 60.00 | Continuing northward, this section consists of glaciolacustrine material that is either undulating, plain or veneer. The first 0.5 km has a 3-5% slope, while the remainder is less than 2%. Drainage is imperfect to moderately well. There is a westward bend in the road midway between KM56 and 58 to pass between two waterbodies. A seasonal tributary occurs at KM54.5 and at KM56.6.<br>Vegetation along this section consists of riparian edges, mixed stands, and shrub fen. |
| 60.00 | 67.50 | The zigzagging northward section consists of various sloping material. 50% of the material is various types of till with a general slope of less than 2% with portions ranging from 3-9%. Glaciolacustrine material has a slope less than 2% along with the glaciofluvial undulating material. Drainage is moderate to imperfect with well drainage commencing at KM66. A boggy wetland requiring a culvert structure occurs at KM62.7.<br>Vegetation along this section consists of mixed stands, black spruce-tamarack and peat bog. |
| 67.50 | 71.25 | Continuing northward, this section consists of undulating and incline till. The till ranges from well to imperfect drainage along a 0-5% slope. A portion of the incline till has a slope between 10-15%. Near KM68 there is organic plain material with little slope and very poor drainage. Near KM70 there is also a small ridge of glaciofluvial material that drains moderately well and has a 6-9% slope. KM68.7 would be James River and requires a bridge structure.<br>Vegetation along this section consists of riparian edges, mixed stands and dense jack pine. |
| 71.25 | 77 | Still continuing northward, this section consists of various types of till (undulating, incline, blanket, ridge) ranging from a 0-9% slope and has moderately well drainage. A very small portion of the route is a fluvial plain with water and glaciofluvial incline material.<br>Vegetation along this section includes graminoid fen, black spruce-tamarack, dense jack pine and mixed stands. |
| 77 | 84.75 | Following northward, the route passes the Tłı̨chǫ border at approximately KM77. This section also consists of various types of till and has a variable slope generally between 0-9%. Drainage is moderately well to imperfect. Approximately 0.5 km consists of well drained coarse glaciolacustrine material with a 3-5% slope.<br>Vegetation along this section consists of shrub fen, trembling aspen-balsam poplar, and mixed stands. |
| 84.75 | 94 | Again this northward section is dominated by various types of till with very little slope and moderately well to imperfect drainage. Just before KM85.4 would be the La Martre River crossing consisting of fluvial plain material and water. Ground truthing investigations ceased at the intersection of the Community Access Road at KM94. (Note: since final road designs, the route between KM86 to KM89.5 have moved west)<br>Vegetation includes riparian edges, mixed stands and black spruce-tamarack. |

***1** Segments and terrain details were determined by the Kavik AXYS alignment analysis (2008a). The most current proposed TASR corridor deviates in areas from both the Kavik AXYS alignment analysis and DOT's 2014 ground truthing; however, these changes have occurred as a result of engineering requirements. Brush cutting and the 2015 topo field survey followed the current proposed TASR corridor. It is not expected that terrain and vegetation details have significantly changed despite these route refinements.*

## 6.5 Vegetation

The proposed TASR is entirely located within the Taiga Plains Level II Ecoregion (Ecozone), which is located within the Taiga Level I Ecoregion (Ecoclimatic Province; ECG 2009; Figure 6-4).

### 6.5.1 Vegetation Communities

#### *TAIGA PLAINS LEVEL II ECOREGION*

The entirety of the proposed TASR is located within the Taiga Plains Level II Ecoregion, which is further subdivided into Level III and IV Ecoregions. In particular, the first 64 kilometres of the corridor crosses through the Great Slave Plain High Boreal Level IV Ecoregion (Ecoprovince), while the remaining 30 kilometres of the corridor are located within the Lac Grandin Plain Low Subarctic Level IV Ecoregion (ECG 2009). The Great Slave Plain High Boreal Ecoregion occurs at higher elevations, and characteristically consists of slow growing forests due to permafrost. Low canopy, open black spruce (*Picea mariana*), treed bogs; horizontal fens; and peat plateaus are found in wet, poorly drained areas, and mixed wood stands can be found on warmer, better drained slopes on hummocks (ECG 2009). The Lac Grandin Plain Low Subarctic Ecoregion consists of undulating areas and deeply fluted till with spruce stands; much of the area has been recently burned; and horizontal fens are common (ECG 2009).

### 6.5.2 Vegetation Communities as Described by Fieldwork

Vegetation communities were further described by assessing the photos and data collected along the proposed TASR during the 2014 fieldwork and comparing community descriptions to those outlined in the Environmental Impact Statement for the Mackenzie Valley Gas Project (MPEG 2004). Twelve main community types were observed within the proposed TASR corridor:

- dense jack pine;
- dense spruce;
- closed mixed stand;
- regenerating jack pine forest;
- dwarf shrubs;
- black spruce-tamarack;
- graminoid fen;
- shrub fen;
- peat bogs;
- ephemeral stream crossings/swampland;
- riparian edges; and
- trembling aspen/balsam poplar.

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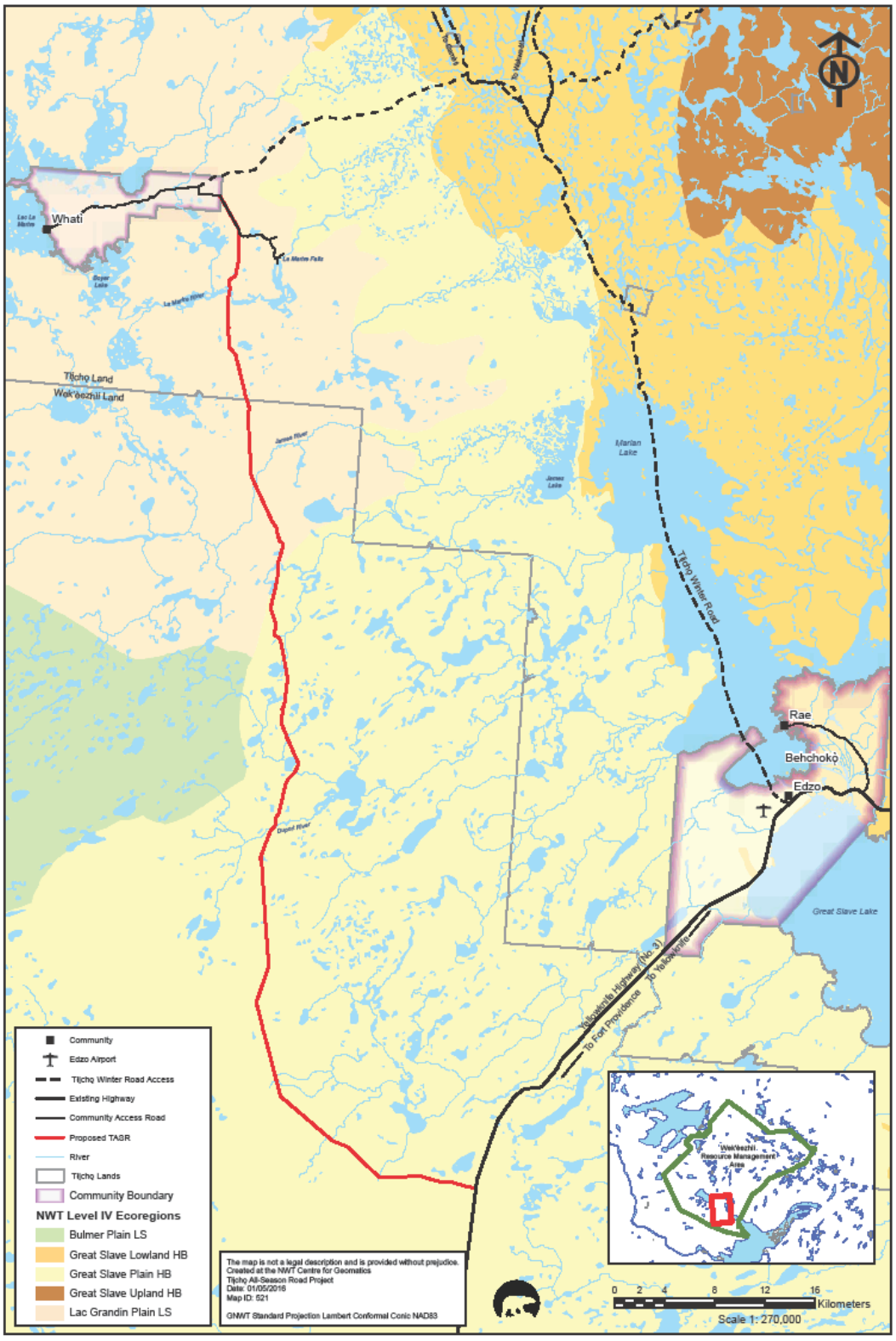
## Figure 6-4 Ecozones Surrounding the Proposed TASR Corridor



Below is a description of each community with Photos 17 to 28 illustrating each community type. Table 6-5 provides a general description of the vegetation encountered within the proposed corridor, which has been broken into kilometer segments, while Table 6-6 lists the specific vegetation that was identified during the fieldwork.

Note: The proposed TASR corridor has been refined since the 2014 ground truthing fieldwork; as a result, there are two portions of the proposed corridor that were not traversed in 2014. These sections are from approximately KM 26 to 32.5 and KM 86 to 95.5 or approximately 17% of the proposed TASR. A topographic survey was completed in July 2015; this ground survey covered the entire proposed TASR corridor as it is presented in this application. It is expected that there is little change to the vegetation described in Table 6-5 due to the overall proximity and it is therefore still valid.

### *DENSE JACK PINE*

Tall, dense upland jack pine stands in excess of 5 m in height dominate this community (Photo 17). Green alder, soapberry, prickly rose and bunchberry comprise the shrub and groundcover layers. Bryophytes and lichens are also included in groundcover. This vegetation occurs on level to moderately sloping sites that are rapidly to moderately well drained, with the parent material consisting of a primarily sandy texture.

### *DENSE SPRUCE*

Dense white and black spruce dominate this vegetation community (Photo 18). Common species in the shrub layer include prickly rose, shrubby cinquefoil, common bearberry and Labrador tea. Lichens, such as reindeer lichen, encompass the groundcover and limit other species. Terrain normally ranges from moderately well to poor drainage.

### *CLOSED MIXED STAND*

Closed mixed stands are the most common vegetation community along the proposed alignment. Jack pine, black and white spruces and trembling aspen dominate this community. Though pine, spruce and aspen have their own isolated patches along the alignment, they are more often interspersed in mixed stands. Willow, shrubby cinquefoil, prickly rose, common bearberry, common juniper, fireweed, grasses and lichen species frequent the shrub layer and forest floor (Photo 19). Towards the northern sections of the proposed TASR, white paper birch can also be found in these mixed stands though at a considerably lesser degree.

### *REGENERATING JACK PINE FORESTS*

Over the past 20 years, forest fires have affected the southern part of the proposed TASR. Prior to the 2014 forest fire seasons, three separate burn areas along the corridor were identified at different stages of regeneration, which produce fire successional jack pine stands. The initial vegetation type noted after a recent fire (i.e. KM 22-24) are standing deadfall; fireweed; various grasses; and numerous flowering plants such as Bicknell's geranium, Franklin's Phacelia, and American dragonhead (Photo 20a). After 8

years (KM 8), there are fewer standing deadfall and the grasses have been replaced by young 1-2 m jack pines. Shrubby cinquefoil and prickly rose occupy the open gravelly areas surrounding the dense pine stand (Photo 20b). Finally after 10 years (i.e. KM 36-39), the closely-spaced young jack pines reach a height between 3-4.5 m and have a sparse understory of mostly prickly rose and shrubby cinquefoil (Photo 20c). As a result of the 2014 forest fire seasons, much of the regenerating jack pine forests noted above were affected and will have returned to the beginning stages of succession.

### *DWARF SHRUBS*

Open calcareous gravel areas with short shrubs such as common bearberry, shrubby cinquefoil, prickly rose and various lichens are the dominant ground vegetation in this type of community (Photo 21).

### *BLACK SPRUCE-TAMARACK*

The black spruce-tamarack community is built upon moist soil and is found on the approach to various wetlands. The shrub layer consists of shrubby cinquefoil, dwarf birch and Labrador tea, while some mosses and various lichens are found on the forest floor (Photo 22).

### *GRAMINOID FEN*

The graminoid fen vegetation type occurs in areas of poor drainage, and is frequently associated with patches of open water/calcareous ponds. Sedges are the predominant vegetation type though smaller shrubs such as dwarf birch, willow and shrubby cinquefoil will also occupy the area (Photo 23).

### *SHRUB FEN*

The shrub fen is similar to the graminoid fen; however, rather than being sedge dominant, the community is dominated by dwarf birch and willow. Sedges are still prominent in this type of fen, while shrubby cinquefoil and tamarack can be found in patches where there is less water saturation (Photo 24).

### *PEAT BOGS*

Peat bogs are found on elevated or horizontal peat plateaus. They consist of open canopy black spruce, a shrub layer of dwarf birch, Labrador tea, cloudberry, cotton grass and then a bryophyte and lichen layer (Photo 25).

### *EPHEMERAL STREAM CROSSINGS/SWAMPLAND*

These areas succumb to seasonal flooding, which significantly dissipate during dry summers (as in 2014/2015). Standing water can remain during years of higher precipitation. Grasses and sedges are found interspersed amongst the muddy terrain directly along the alignment, while willow and dwarf birch dominate the edges. Trembling aspen can be found directly behind the shrubs (Photo 26).

#### *RIPARIAN EDGES*

The larger water crossings situated along the alignment have similar riparian environments of varying widths. Grasses and sedges dominate directly from the water's edge and then combinations of densely packed dwarf birch and/or willow follow behind. Shrubby cinquefoil can also be found spread in between the other shrubs (Photo 27). This vegetation community succumbs to frequent flooding and changes width as the channel moves. Drainage varies from moderately well to poor depending on depth to the water table, distance from channel and soil texture.

#### *TREMBLING ASPEN/BALSAM POPLAR*

The trembling aspen/balsam poplar community consists of tall dense aspen stands with a shrub layer of young balsam poplar (Photo 28). These communities tend to occur in moist areas of lower elevation (small valleys/base of hills) along the alignment. Willow, prickly rose, shrubby cinquefoil, fireweed and various grasses can also be observed.

### 6.5.3 Rare Plant Species

A rare plant is defined as a species that, because of its biological characteristics or because it occurs at the edge of its main range, exists in low numbers or in very restricted areas (Lucas and Synge 1978). McJannet *et. al.* (1995) listed approximately 206 rare plant species in the NWT. By cross-referencing McJannet *et. al.* (1995), Porsild and Cody (1980) and ENR (2000), ten rare species were identified as potentially occurring within or near the proposed TASR. These species were also cross-referenced with the Northwest Territories Species at Risk database (GNWT 2012) and the COSEWIC database of wild species (Canada 2012) to determine territorially or federally regulated species potentially present within or near the proposed TASR. Results are provided in Table 6-7 below.

Precise locations of the rare plant species identified in Table 6-7 could not be determined within the proposed corridor due to limited accuracy within source documents and the inherent lack of original and historical records. Vascular plant species on a whole are also likely under-recorded in the region due to limited vegetation surveys, both in terms of geographic scale and precise locational data. Table 6-7 indicates which species are known or expected to occur in the proposed TASR, based on nearest known location and/or habitat required.

**Photo 17 Dense Jack Pine**

**Photo 18 Dense Spruce**

**Photo 19 Closed Mixed Stand**

**Photo 20a Recent Burn**

**Photo 20b 1996 Burn**

**Photo 20c 1994 Burn**

**Photo 21 Dwarf Shrubs**

**Photo 22 Black Spruce-Tamarack**

**Photo 23 Graminoid Fen**

**Photo 24 Shrub Fen**

**Photo 25 Peat Bogs**

**Photo 26 Ephemeral Streams**

**Photo 27 Riparian Edges**

**Photo 28 Trembling Aspen**

## Table 6-6 Vegetation Identified along the Proposed TASR during 2014 Fieldwork

| Common Name | Scientific Name |
|---|---|
| Common Yarrow | *Achillea millefolium (*includes *Achillea lanulosa & Achillea nigrescens)* |
| Green Alder | *Alnus viridis (*incl *Alnus crispa)* |
| Small Round-leaved Orchis | *Amerorchis rotundifolia (Orchis rotundifolia)* |
| Cut-leaved Anemone (Hudson Bay Anemone) | *Anemone multifida* |
| Common Bearberry (Kinnikinnik) | *Arctostaphylos uva-ursi* |
| Narrowleaf Arnica | *Arnica angustifolia (Arnica alpina var. tomentosa)* |
| Alpine Milk-vetch | *Astragalus alpinus* |
| Dwarf Birch | *Betula glandulosa (Betula nana)* |
| Paper Birch (white birch) | *Betula papyrifera (Betula papyrifera var. commutata)* |
| Mosses | *Bryophytes* |
| Ruap Indian Paintbrush | *Castilleja raupii* |
| Fireweed | *Chamerion angustifolium (Epilobium angustifolium)* |
| | *Cladina spp.* |
| Boreal Pixie-cup Lichen | *Cladonia borealis* |
| | *Cladonia spp.* |
| Dwarf Dogwood (Bunchberry) | *Cornus canadensis* |
| Red Osier Dogwood | *Cornus sericea (Cornus stolonifera)* |
| Sparrow's-egg Lady's-slipper | *Cypripedium passerinum* |
| Shrubby Cinquefoil | *Dasiphora fruticosa (Potentilla fruticosa)* |
| American Dragonhead Nettle | *Dracocephalum parviflorum (Moldavica parviflora)* |
| | *Drepanocladus spp.* |
| Black Crowberry | *Empetrum nigrum* |

## Table 6-6 (Continued) Vegetation Identified along the Proposed TASR during 2014 Fieldwork

| Common Name | Scientific Name |
|---|---|
| Field Horsetail | *Equisetum arvense* |
| Cotton Grass spp | *Eriophorum triste (*See *Eriophorum angustifolium)* |
| Virginia Strawberry | *Fragaria virginiana* |
| Bicknell Geranium | *Geranium bicknellii* |
| Grasses & Sedges | |
| Alpine Sweet-vetch | *Hedysarum alpinum* |
| Boreal Sweet- vetch | *Hedysarum boreale (H. boreale ssp. Mackenziei, Hedysarum mackenziei)* |
| Common Juniper (Ground juniper) | *Juniperus communis* |
| Creeping Juniper | *Juniperus horizontalis* |
| Tamarack | *Larix laricina* |
| Common Labrador Tea | *Ledum groenlandicum* |
| Blunt-leaved Sandwort | *Moehringia lateriflora (Arenaria laterifolia)* |
| Showy Locoweed | *Oxytropis splendens* |
| Balsam Groundsel | *Packera paupercula (Senecio pauperculus)* |
| Labrador Lousewort | *Pedicularis labradorica* |
| Franklin's Phacelia | *Phacelia franklinii* |
| White Spruce | *Picea glauca* |
| Black Spruce | *Picea mariana* |
| Jack Pine | *Pinus banksiana (Pinus 6-20ivaricate)* |
| Balsam Poplar | *Populus balsamifera* |
| Trembling Aspen | *Populus tremuloides* |
| Norwegian Cinquefoil | *Potentilla norvegica* |
| Prickly Rose | *Rosa acicularis* |
| Cloudberry | *Rubus chamaemorus* |
| Willow spp | *Salix spp.* |
| Prickly Saxifrage | *Saxifraga tricuspidata* |
| Buffalo-berry | *Shepherdia canadensis* |
| | *Sphagnum spp.* |
| Boreal Aster | *Symphyotrichum boreale (Aster franklinianus,* incl *Aster junciformis)* |
| Purple-stemmed Aster | *Symphyotrichum puniceum (Aster puniceus)* |
| Sticky False Asphodel | *Triantha glutinosa (Tofieldia glutinosa,Tofieldia occidentalis)* |
| Seaside Arrowgrass | *Triglochin maritima* |
| Unidentified plants | |
| Rock Cranberry (Lingonberry) | *Vaccinium vitis-idaea* |
| Violet | *Viola ssp.* |

**Table 6-7 Rare Plant Species Known or Expected to Occur Within the proposed TASR Corridor**

| Scientific Name | Common Name | Habitat[1] | Nearest Location[2] |
|---|---|---|---|
| *Acorus americanus* | American sweet flag | Small shallow lakes and ponds, marshes | Taiga Shield |
| *Arabis holboellii var. pinetorum* | Holboell rockcress | Dry, open, sunny calcareous slopes and on shallow soils | Near Yellowknife |
| *Carex synchnocephala* | Many-headed sedge | Wet places in open woodlands, near cold springs | Near Yellowknife |
| *Deschampsia mackenziean*[3] | Mackenzie hair grass | Damp hollows along shores | East Arm of Great Slave Lake |
| *Dryopteris carthusiana* | Spinulose wood-fern | Rich woods | Northwest shore of Great Slave Lake |
| *Hudsonia tomentosa* | Woolly beach-heath | Open jack pine woods, sandy beaches, and sand blow-outs | North of Great Slave Lake |
| *Juncus vaseyi* | Vasey rush | Lowland slough margins and moist shores | Near Yellowknife |
| *Limosella aquatica* | Northern mudwort | Wet, muddy or sandy pond margins | South of McTavish Bay, Great Bear Lake |
| *Potamogeton obtusifolius* | Blunt-leaf pondweed | Small shallow lakes and ponds | North of the North Arm of Great Slave Lake |
| *Rorippa crystallina* | Yellowcress | Sedge-grass meadows and marshes | Lowland area northwest of Great Slave Lake |

***1** Habitat information from Porsild and Cody (1980)*

***2** Nearest location information from McJannet et. al. (1995) and ENR 2000*

***3** Information pertaining to Deschampsia mackenzieana obtained from GNWT 2012*

### 6.5.4 Forest Fire History

In the boreal forest, forest fires are a natural part of the cycle of regeneration and growth, affecting carbon, nutrient and water cycling, biomass accumulation, succession, and diversity (Barnes et. al. 1998). As of November 2014, the 10-year average for forest fires in the Northwest Territories was 183 fires per year; however, 385 fires were recorded during the 2014 fire season (NRCan 2014).

Data on forest fires within the proposed TASR corridor were obtained from the GNWT Centre for Geomatics database (2014). Since the early-1970s up until the end of 2013, approximately 345,300 hectares of forest have burned wholly or partially within the proposed corridor. During the 2014 fire season, 457,100 hectares of forest burned wholly or partially within the proposed TASR corridor, which impacted areas that had since completed the cycle of regeneration. Table 6-8 details all forest fires that have occurred since the early-1970s within the proposed TASR up until the end of 2014, while Figure 6-5 illustrates the locations of the forest fires in relation to the proposed TASR. A best effort is made in ensuring the accuracy of the fire perimeters; however, data gaps are known to occur. During the 2014 fieldwork, a recent forest fire (occurred within the last decade) was observed passing through the proposed corridor between KM 22 – 24 and yet it was not recorded in the GNWT Geomatics fire history database. This data gap became irrelevant following the 2014 fieldwork as fire 2014ZF-046 engulfed the area in question.

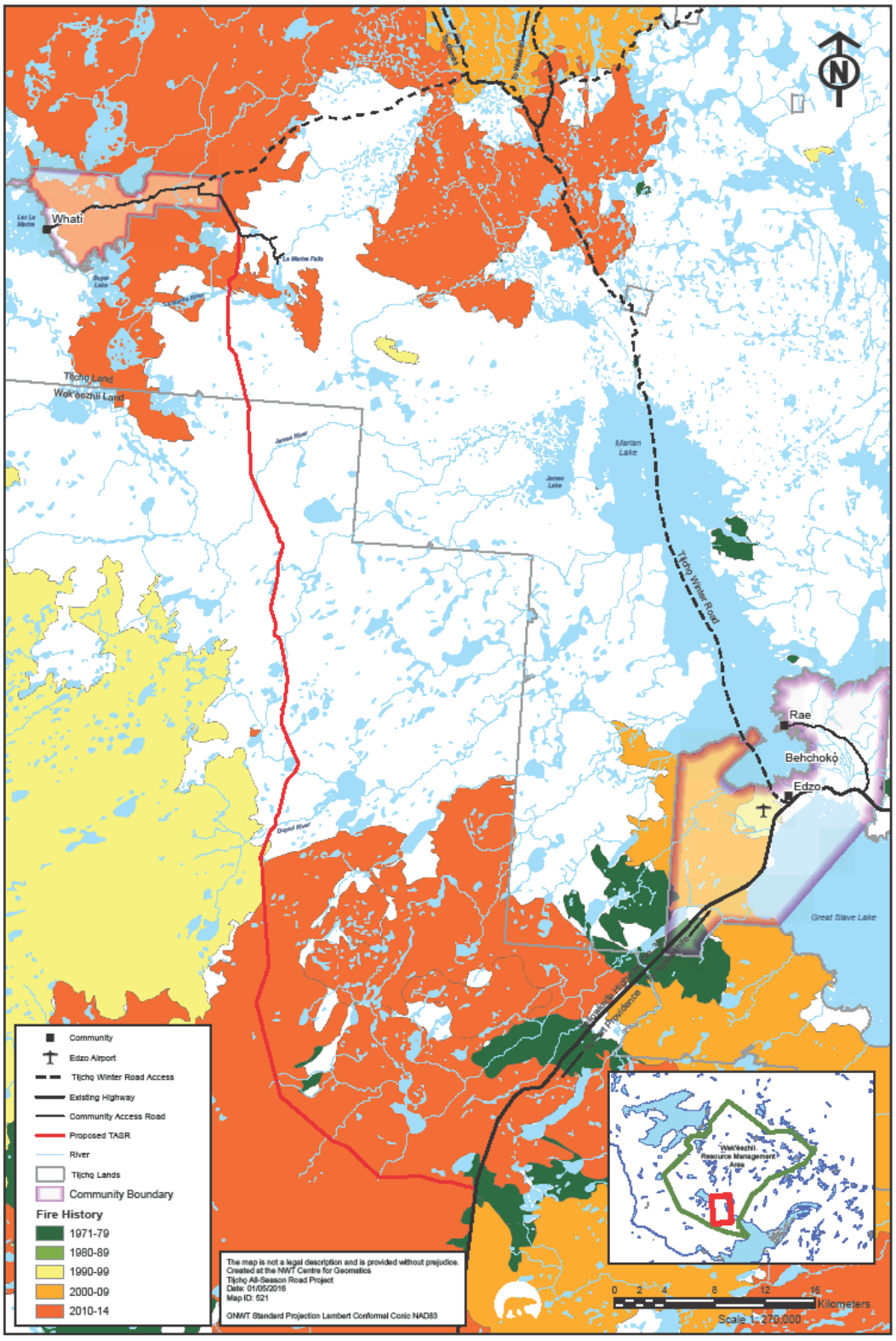
Based on the data obtained from the GNWT Geomatics database, it is expected that at least the first 38 kilometres and the last 4.5 kilometers of the proposed TASR have been impacted by fires in 2014. Preliminary information pertaining to the 2015 forest fire season indicates that wildfires once again passed through portions of the Wek'èezhìı area; however, these new fires were not in direct proximity to the proposed TASR corridor and do not show up at a 1:270,000 scale 11x17 map page (Figure 6-5). Fires from 2015 are therefore not mapped.

### Table 6-8 Forest fire occurrences along proposed TASR corridor

| Year | Identification Number | Area Burned (ha) |
|---|---|---|
| 1972 | 1971HY-018 | 3,198.36 |
| 1972 | 1972HY-030 | 51,854.19 |
| 1972 | 1972ZF-053 | 9,912.77 |
| 1994 | 1994ZF-149 | 280,342.90 |
| 1996 | 1996ZF-002 | 3.03 |
| 2014 | 2014ZF-035 | 347,087.85 |
| 2014 | 2014ZF-046 | 110,025.43 |

Government of Northwest Territories

**Figure 6-5 Forest fire Burn Areas Surrounding the Proposed TASR Corridor between 1971-2014**



## 6.6 Wildlife

Terrestrial wildlife species found within the proposed TASR are typical of those inhabiting northern boreal forests. Approximately 140 species of mammals and avifauna, and a single amphibian are expected to occur within the area. Timing is crucial in the life cycles of many species inhabiting this region as transients, migrants and residents are dependent on appropriate time and space linkages for feeding, reproduction and movement (Sly et al. 2001). As a result, there is a high degree of interdependence between and among species of wildlife and plants.

Many wildlife species are important to the Tłı̨chǫ people for subsistence, economic and cultural purposes. Species important to the Tłı̨chǫ people include caribou and moose (*Alces alces*), which are harvested for food and hides, while American marten (*Martes americanus*), gray wolf (*Canis lupus*), red fox (*Vulpes vulpes*), wolverine (*Gulo gulo*), Canada lynx *(Lynx canadensis*), northern river otter (*Lontra canadensis*), beaver (*Castor canadensis*), common muskrat (*Ondatra zibethicus*), other mustelids, and snowshoe hare (*Lepus americanus*) are trapped for fur.

A listing of the wildlife observed during the spring and summer field and ground truthing trips in 2014 along the proposed TASR is provided in Appendix Q; this listing affirms which species can be found within the proposed TASR, but is not an exhaustive listing due to the varying life cycles of many species. Subject experts from ENR along with the Tłı̨chǫ TK report have helped to summarize the wildlife described herein:

### 6.6.1 Terrestrial Mammals

Thirty-seven species of terrestrial mammals potentially occur within the proposed TASR corridor. With the exception of barren-ground caribou (*Rangifer tarandus groenlandicus*), these species are non-migratory and are considered year-round residents. Some mammals, including black bears (*Ursus americanus*), den over winter in subterranean or subnivean dens. Other mammals, including shrews, voles, and lemmings are active during the winter and utilize subnivean burrows and tunnels for foraging and cover from winter conditions. Barren-ground caribou are migratory and their historic maximum winter ranges (Bathurst and Bluenose-East herds) overlaps with the proposed TASR. Most other mammals remain active above ground in the winter, including hares, a variety of carnivores (e.g. wolverine, wolves), furbearers (e.g. marten, lynx), and ungulates (e.g. moose and bison).

#### *CARIBOU*

Caribou is inexorably tied to the Tłı̨chǫ culture and is a valued wildlife resource. Both barren-ground (Bluenose-East and Bathurst herds) and boreal woodland caribou (*Rangifer tarandus caribou)*, may be found within the proposed TASR corridor. During winter months, the woodland and barren-ground caribou may share ranges as barren-ground caribou of the Bluenose-East and Bathurst herds move south and west (Sly et. al. 2001). During pellet and winter track surveys within the regional study area for Fortune Minerals' NICO Mine project, which is adjacent to the proposed TASR, caribou presence was detected, Individuals from the Bathurst herd were also observed in this area during aerial surveys conducted from mid-winter to spring (Golder 2011).

### *BATHURST CARIBOU: BLUENOSE-EAST AND BATHURST HERDS*

The Bluenose-East and Bathurst herds are identified based on their traditional calving grounds. The Bluenose-East herd typically calves in the Rae and Richardson Rivers' area, west of Kugluktuk and moves south and east past Great Bear Lake in late summer (ACCWM 2011). This herd is most likely to overlap with the proposed TASR during winter. Data collected from collared individuals show that they primarily range between Great Bear Lake to the north and to the south around Grandin Lake; however, some satellite collared cows have been recorded as far south as Behchokǫ̀ (ACCWM 2011) and uncollared barren-ground caribou believed to be part of the Bluenose-East herd have extended to the south of Grandin Lake to Lac la Martre.

The southernmost portion of the Bathurst herd's annual range overlaps the proposed TASR corridor; however, they have not been detected within the proposed corridor in recent years during a period of population decline. These caribou typically calve in the Bathurst Inlet area and move south and west into the proposed TASR corridor in the fall, following calving (ACCWM 2011). The Bathurst herd usually winters southeast of Great Bear Lake towards Great Slave Lake, close to the communities of Wekweètì, Whatì, and Gamètì. In the past when population numbers were high, Bathurst herd caribou have been found further south into areas near Yellowknife and Lutselk'e; and even as far west as Blackwater and Keller Lakes and as far south as northern Saskatchewan (ACCWM 2011). While this herd is most likely to overlap the proposed TASR corridor in winter, collar data indicates that they have not been overwintering within the proposed TASR corridor in recent years.

Both the Bluenose-East (BNE) and the Bathurst herds have shown a decline in population numbers. ENR calving ground photo survey results showed that the BNE herd declined from more than 100,000 in 2010 to around 68,000 animals in 2013. Preliminary results of the calving ground photo survey completed in June 2015 suggest that the herd continues to decline. The Bathurst herd has been in decline since a high of over 350,000 in the mid-1990s. Although it was considered stable at low numbers from 2009-2012 at around 32,000-35,000, the photographic survey of the Bathurst calving grounds conducted in June 2015 suggests that the Bathurst herd has declined further since 2012.

While the exact reasons for the decline of the herds' population are uncertain, a large part of the declines are considered to be the result of a natural cycle that has occurred many times in the past; likely reflecting large-scale weather patterns and natural factors (Gunn 2003; Joly et al. 2011). For the Bluenose-East herd, a combination of low natural survival, reduced calf recruitment and low pregnancy rates in some years and substantial cow harvest are the most probable reasons (ENR 2014a). For the Bathurst herd, indicators showing low natural cow survival rates, reduced calf productivity and survival are consistent with a declining natural trend. Harvest may have accelerated the initial decline seen prior to 2010 (Adamczewski et al. 2009; ENR 2014a). Human activities on the annual ranges of these herds, particularly the Bathurst herd, such as mineral exploration, industrial development, the development of roads, and harvesting may contribute to cumulative impacts.

Barren-ground caribou (including both the Bluenose-East and Bathurst herds) is scheduled to be assessed by the NWT Species at Risk Committee in March 2017 and the Committee on the Status of Endangered Wildlife in Canada in November 2016.

While the proposed TASR corridor overlaps the southern limit of barren-ground distribution when the populations are high, the net impact of the TASR is not expected to be much different than the existing winter road to Whatì which will be decommissioned, particularly given that barren-ground caribou, when they do range into the area do not appear near the north end of Lac La Martre until December at the earliest.

### *Boreal Woodland Caribou*

The distribution range of the NWT boreal woodland caribou population mainly corresponds to the extent of the Taiga Plains ecozone in the NWT. It extends from the NWT-Alberta border north to the Arctic coast towards Inuvik and is bounded by the Taiga Cordillera ecozone to the west and the Taiga Shield ecozone to the east. This area includes the proposed TASR, near Whatì. Boreal woodland caribou are typically found in mature coniferous forests associated with bogs, lakes and rivers (ENR 2013c). Within forests, the boreal woodland caribou tend to live in small groups and do not migrate. Boreal woodland caribou also have low reproductive rates as cows typically do not calve until their third year. Therefore, boreal woodland caribou are sensitive to disturbance and human activities; even a small change in adult survival could result in population declines (EC 2012; SARC 2012). In the NWT, fire and anthropogenic disturbance due to timber harvesting, roads, pipelines and seismic lines have caused habitat change and loss to the boreal woodland caribou habitat and are considered the two most important factors contributing to loss of habitat availability (EC 2012; SARC 2012). Linear disturbances such as roads, seismic lines and pipeline rights-of-way can increase predation and harvest risk to boreal woodland caribou by increasing access by predators, such as wolves and grizzly bears (EC 2012; SARC 2012). The boreal woodland caribou, NWT population, is estimated at 6,000-7,000 individuals and population trends are variable in each region. Population trends are unknown within the North Slave Region where the proposed TASR will be located (SARC 2012).

The NWT boreal woodland caribou population is ranked as '*sensitive*' within the NWT General Status Ranks (WGGSNS 2011) and has also been assessed as '*threatened*' by the NWT Species at Risk Committee (SARC 2012). The Conference of Management Authorities agreed to add boreal caribou to the list of NWT List of Species at Risk and were listed in February 2014 under the *Species at Risk (NWT) Act*. The boreal caribou are also listed as '*threatened*' under Schedule 1 of the federal *Species at Risk Act* (SARA). Critical habitat for boreal caribou was identified in a federal Recovery Strategy for the species released in 2012 (EC 2012). Critical habitat is broadly defined in SARA as the "habitat that is necessary for the survival or recovery of a listed wildlife species." Specific to boreal caribou, critical habitat is defined as:

- "the area within the boundary of each boreal caribou range that provides an overall ecological condition that will allow for an ongoing recruitment and retirement cycle of habitat, which maintains a perpetual state of a minimum of 65% of the area as undisturbed habitat; and
- biophysical attributes required by boreal caribou to carry out life processes."

Undisturbed habitat is defined as areas that have not burned within the past 40 years, and areas that are further than 500 m from human disturbance footprints (e.g. roads, seismic lines, cutblocks) visible on 1:50,000 scale Landsat imagery. At the time the Recovery Strategy was released, the NWT population of

boreal caribou was considered likely to be self-sustaining based on having >65% undisturbed habitat (69% based on disturbance data current to 2009/2010). The current status of undisturbed habitat in the NWT range, and changes to undisturbed habitat as a result of construction of the road, are further described in Section 8.7.1.5.

The biophysical attributes required by boreal caribou inhabiting the Taiga Plain ecozone is broadly described as coniferous forest of jack pine (*Pinus banksiana*), spruce (*Picea sp.*) and tamarack (*Larix laricina*) exceeding 100 years with abundant lichen, sedge and moss availability but is described in detail for the five life stages of the species consisting in calving, post-calving, rutting, winter and travel habitats (Table 6-9).

**Table 6-9 Critical Habitat Biophysical Attributes for Boreal Caribou surrounding the proposed TASR corridor (adapted from EC 2012).**

| Life Stages | | | | | |
|---|---|---|---|---|---|
| **Broad scale** | **Calving** | **Post-calving** | **Rutting** | **Winter** | **Travel** |
| Mature forests (jack pine, spruce, and tamarack) of 100 years or older and open coniferous habitat.<br><br>Large areas of spruce peat land and muskeg with preference for bogs over fens and upland and lowland black spruce forests with abundant lichens, and sedge and moss availability.<br><br>Flatter areas with smaller trees and willows, hills and higher ground. | Open coniferous forests, tussock tundra, low shrub, riparian, recent burned areas, south and west aspects and hills and higher locations.<br><br>Muskegs, marshes, staying close to water sources.<br><br>Small islands of mature black spruce or mixed forests within peat lands, in old burns at the edge of wetlands, in alder thickets with abundant standing water and on lake shores. | Muskegs or areas with access to muskegs, open meadows on higher ground, close to water (lakes and rivers) and mixed bush areas.<br><br>Open coniferous forests with abundant lichens, low shrub, riparian, tussock tundra, sparsely vegetative habitat, recent burns and west aspects.<br><br>Old burns and neighbouring remnant unburned forests selected in late spring and early summer. | Open coniferous and mixed wood forests, low shrub, riparian, tussock tundra, recent burns and west aspect.<br><br>Muskegs that harbor ground lichen and sedges, mixed bush areas, areas of higher ground.<br><br>Regenerating burns and sparsely vegetated habitat. | Open coniferous forests (black spruce and pine) that provide adequate cover with abundant lichens, riparian areas.<br><br>Muskeg areas in early winter.<br><br>Spruce-lichen forests, fire regenerated, sparsely vegetated habitat, herbaceous and tall shrub habitat and sphagnum moss with scattered spruce.<br><br>As snow depth increases, they remain more often in areas of dense pine or thickly wooded black spruce, with hanging lichen and access to open, mixed vegetation for ground forage. | Females show high fidelity to calving sites among years (i.e. within 14.5 km).<br><br>Many caribou shift their pattern of use based on seasonal preferences, in large multi-habitat areas.<br><br>Rates of movement increase during the rut and are greatest in winter. |

Both traditional knowledge and science based studies of boreal caribou in Wek'èezhìı suggest that boreal caribou have used areas along the proposed TASR corridor, including some areas identified as traditional harvest sites and important habitat for boreal caribou at Tłı̨chǫ community workshops held in 2005 (Hillis and Cluff 2005; Cluff and Hillis 2006a, 2006b and 2006c cited in WRRB 2013). Aerial surveys conducted within the Taiga Plains ecoregion portion of the North Slave Region recorded densities of boreal caribou ranging from 0.17 to 3.44 animals/100 $km^2$ (Hillis and Cluff 2005). Observations of boreal caribou primarily occurred in spruce lichen forest, jack pine forest and shoreline areas (Hillis and Cluff 2005). The 2015 traditional knowledge report confirmed that the boreal caribou range includes KM 14 to KM 65 of the proposed TASR; however, the elders indicated that the main habitat is to the west of the proposed corridor (TG 2015).

### *MOOSE*

Moose are also a valued wildlife resource for the Tłı̨chǫ, making up a significant portion of the Tłı̨chǫ subsistence resource harvest. This large ungulate is a common resident of boreal wetlands and forest, feeding almost exclusively on aquatic vegetation and woody browse (Whitaker 1996). Although densities of moose are typically low through the NWT (2 to 17 moose/100$km^2$ per settlement area and region; Davidson and Callaghan 2013), the species is ranked as 'Secure' in the NWT General Status of Ranks (WGGSNS 2011).

Moose are hunted throughout their range for both food and hides, although the full extent of subsistence hunting in the North Slave Region is unknown (Cluff 2011). During the traditional knowledge study for the proposed TASR, elders and harvesters identified the shores along Boyer Lake and La Martre River as traditional hunting locations for moose. The area east of Mud Lake following towards James Lake was also identified as key moose habitat. Moose were detected within the Fortune Minerals NICO project regional study area (Golder 2011), which is directly adjacent to the northern section of the proposed TASR (at approximately KM 94).

Studies on moose have examined populations and harvest statistics throughout portions of the NWT. A baseline study completed in March 2004 in the North Slave Region examined density and bull:cow and calf:cow ratios of moose between two ecozones (RWED 2005). The survey was conducted on the west and east side of the North Arm of Great Slave Lake, within the Taiga Plains and Taiga Shield, respectively. Results from the survey provided estimates of density and, subsequently, total numbers within the surveyed areas. The density estimate for the Taiga Plains was approximately four moose per 100 $km^2$, while from the Taiga Shield was slightly lower at 2.75 moose per 100 $km^2$ (RWED 2005). The 2004 Taiga Plains survey encompassed the first 72 kilometres of the proposed TASR corridor; therefore, the density estimates provide the closest approximation of the number of moose within this area. Prior to the 2004 survey, only two moose surveys had been conducted on the Taiga Shield in the North Slave Region, in 1962 and 1989 (Cluff 2005a). Both of these surveys however support the 2004 results that moose densities on the Taiga Shield in the Yellowknife area are low (Cluff 2005a).

Two additional follow-up surveys were conducted in the North Slave Region during late 2007 and 2012. The 2004 survey results were reexamined and compared to the 2007 results. However, due to differences in sampling design (change in survey size and sampling period), an accurate comparison

could not be made and the population status between 2004 and 2007 remains unclear (Cluff 2011). Despite this uncertainty, the 2007 study estimated the Taiga Plains density as 3.2 moose/100 $km^2$ compared to 3.6 moose/100 $km^2$ in 2004 (Cluff 2011). The 2012 survey, which followed the same sampling design established in 2007, estimated the density for the Taiga Plains survey area as 2.9 moose/100 $km^2$ (Cluff 2013). Based on these surveys, it appears as if the moose population is declining in the Taiga Plains; however, further studies would be required for a more robust assessment. The next moose survey is planned for November 2016 and consideration will be given to collaring some moose to assess habitat use, movements and calf production and survival (Cluff 2013).

Increased hunting pressure on moose is expected because of restricted hunting of barren-ground caribou and the closure of the Mackenzie bison harvest due to an extensive anthrax outbreak in summer 2012 (ENR 2013b). The proposed site will most likely impact moose populations simply because of increased access for harvest throughout the year; however, the 2014 fire season should result in more moose habitat over the next 10-15 years and therefore increase moose densities. Additional concerns exist over the winter road to Contwoyto Lake, which increases public access and the potential for an associated increase in hunting pressure. Because this area was also impacted by the 2014/2015 fire seasons, moose habitat is assumed to increase along with harvesting. The longevity and low reproductive rate of moose make this species vulnerable to additive mortality pressures. While moose generally avoid human disturbance, they may be attracted to the gravel or minerals on roads and subsequently subject to vehicular accidents. Because industrial activity has and is expected to increase in the North Slave Region and greater tourism is proposed within the Taiga Plains (Cluff 2005a), vehicular traffic is expected to increase; this factor is discussed further in Section 8.

### *GRIZZLY BEAR*

Grizzly bears are found in mountain, tundra and boreal regions of the Western Canadian Arctic. The population size of grizzly bears in the NWT is estimated at 3,500 to 4,000 and each individual typically has a home range covering 1,000 to 2,000 $km^2$ (COSEWIC 2012a; ENR 2013d). The Western population of grizzly bear is listed as a species of '*special concern'* by COSEWIC and ranked as '*sensitive*' within the NWT General Status Ranks (WGGSNS 2011). The species is scheduled to be assessed by the NWT Species at Risk Committee in December 2016.

While the range of grizzly bears in the NWT is primarily confined to above treeline and mountainous regions and does not overlap the proposed TASR corridor, occasional observations of barren-ground grizzly bears have occurred within the treeline and near the proposed TASR. Reports of grizzly bears have come from Gamètì, Wekweètì and Yellowknife, the furthest reported extent of barren-ground grizzlies in the boreal forest (Cluff 2005b). Some of these extra-range occurrences are believed to be of grizzly bears following the southward movements of the Bathurst caribou herd in late fall into their winter ranges (Cluff 2005b). As any mitigation techniques that will be implemented to address impacts to black bear are expected to also be effective for grizzly bears, grizzly bear will not be considered in any greater detail herein.

### *BLACK BEAR*

Black bears are found within most forested regions of the NWT and throughout the proposed TASR corridor. Black bears prefer forested habitats, which offer seclusion and safety, mixed with open spaces, to provide shrubs, grasses and berries (ENR 2012b). Black bears will feed on the carrion of winter-killed animals and catch fish; forage for bird eggs, lemmings and mice; and can take a young moose or caribou occasionally. However, the majority of their diet consists of vegetation, with berries playing an important role. Densities of black bears are typically highest around water and where food availability is high. River valleys and shores host waterfowl nests and fish, as well as many grasses and sedges commonly consumed by black bears (ENR 2012b). Black bears can also be attracted to dumps and town sites, which can offer a high density of food. Once a black bear becomes habituated to human food or garbage, it is challenging to dissuade them from using human food sources, leading to problem bear situations (Clarkson 1993; Landriault et al. 2000; ENR 2012b).

In the NWT, black bears have documented home ranges varying between 75 to 200 $km^2$ (ENR 2010c cited in Golder 2011). Black bears tend to be secretive, making estimates of population size difficult, though the NWT population is believed to be stable and have an NWT Status Rank of '*secure*' (WGGSNS 2011). Black bears are considered a big game species and furbearer in the NWT and harvest data is considered reliable. From 1991 to 1997, the number of black bears harvested by resident hunters varied between 5 and 25 (D'Hont 2000a, b, c, d, e, f and g). The recent Tłı̨chǫ TK study has identified that black bears continue to be harvested (TG 2015).

Several black bears were observed within Fortune Minerals' NICO project regional study area during aerial and ground-based studies; a den was also identified within this area (Golder 2011). During an aerial survey of the proposed TASR in early June 2014, a large black bear was seen travelling south along the previously disturbed alignment, but no bears were directly observed during ground truthing later in the month. Evidence of black bears passing through the proposed TASR corridor were noted during ground truthing in the form of prints and bear dug holes.

As previously mentioned, establishing estimates of black bear populations is difficult due to their secretive nature, and the majority of studies regarding black bears in the NWT occur in response to problem bear situations (e.g. ENR 2011a). The black bear's keen sense of smell often attracts them to food sources, including dumps, camps and cabins, where human-bear interactions can be dangerous. Much effort is currently put into discouraging problem or nuisance bears to protect human safety and the bears.

### *WOLVERINE*

The wolverine is a large mustelid that lives in both boreal and tundra habitats throughout the NWT. The range of wolverine extends across the proposed TASR corridor, and was detected at the Fortune Minerals' NICO project site (Golder 2011). Wolverines also tend to follow migrating caribou, feeding on the remains of kills from wolves and bears (COSEWIC 2003).

While the wolverine population in the NWT is unknown, a crude population estimate is to be between 3,000 – 6,000 (SARC 2014). Wolverines typically avoid areas of human settlement and its population is thought to have decreased as development has expanded (ENR 2013d). The western population of

wolverines has been assessed as '*special concern*' by COSEWIC, due to their sensitivity to impacts from human activities or natural events; however, the western population was assessed by the NWT Species at Risk Committee in December 2014 and was determined to be not as risk (COSEWIC 2003; SARC 2014). Throughout the NWT, the wolverine is currently thought to have a stable population, though the NWT Status Rank was modified from '*secure*' to '*sensitive*' in 2006 (WGGSNS 2006). The population in the North Slave Region (Wek'èezhìı) is also thought to be stable but may be decreasing (Cardinal 2006). Intrinsic characteristics such as low reproductive rates also make them vulnerable to human threats, including nuisance kills (COSEWIC 2003).

Wolverines are currently harvested in the NWT. As they are considered a desired furbearer, the trapping of wolverine remains common throughout the NWT, occurring through commercial, resident, non-resident and subsistence harvest. ENR monitors wolverine harvest patterns based on pelt data collected under ITI's Mackenzie Valley Genuine Fur Program.

### *WOOD BISON*

Wood bison (*Bison bison athabascae*) are large, long-lived, social mammals and currently occupy the southern portion of the proposed TASR, but there are historical reports of bison as far north as Lac la Martre (Richardson 1829 in ENR 2010a). Range expansion by Mackenzie bison toward Lac la Martre would be consistent with the goals of the *Wood Bison Management Strategy for the Northwest Territories 2010-2020* (ENR 2010a). Bison use a wide variety of habitats where they primarily forage on grasses and sedges; they may eat willows and lichens at some times of the year (Larter and Gates 1991). Since bison are long-lived and social animals, once habits of travel and foraging develop they may persist.

Bison travel widely within their range and make forays into new areas. Bison readily utilize linear features such as roads and become habituated to passing vehicles. Pioneering movements may be initiated by adult males but all bison readily use roads as travel routes and foraging areas. Bison may frequently use roads as travel routes because walking there is easier than traversing wetlands. In winter, bison may be more likely to remain on the travelled surface of the roads to avoid deep snow. Management practices can influence use of roads by bison: mowing roadside vegetation in the summer may attract bison to roads in the autumn and early winter where they graze on the more palatable, re-growing vegetation; deep, unbroken stretches of packed snow in ditches inhibit bison from leaving the plowed road surface; and bison are attracted to salt used on roads in the winter. Re-vegetating the road right-of-way with palatable plants will create grazing habitat for bison and attract them to the road. Bison are also effective at dispersing plant materials including seeds of invasive alien plant species and the only means to mitigate this hazard is to eliminate introducing invasive alien plants into bison range.

The risk of collisions can be mitigated by several management actions. Most important is to avoid attracting bison to the road. This may be achieved by not re-vegetating the road right-of-way at all, and especially not using palatable plant species if the roadside is re-vegetated. Avoiding the use of salt on the road in winter will also reduce attractiveness to bison. Designing the road to have a maximum speed by vehicles of less than or equal to 70 km/h also reduces the risk of collisions.

Hunting of the Mackenzie bison population is currently suspended but a new road will increase hunters' access into bison habitat and may increase hunting pressure when hunting is reinstated. Traffic on a new

road will also increase the number of bison-vehicle collisions. Collisions are a risk to human safety and increase bison mortality.

The proposed TASR poses a risk that bison will enter the community of Whatì. Bison will enter communities but rarely remain there unless they find a supply of suitable forage. The draft Mackenzie Bison Management Plan does not include measures to address conflicts with bison in Whatì; however the *Wood Bison Management Strategy for the Northwest Territories 2010-2020* indicated one of the detailed strategies includes working with communities and the GNWT's Municipal and Community Affairs (MACA) department to implement actions to reduce the number and frequency of bison within communities along with public education material (ENR 2010a).

### *OTHER MAMMALS*

Furbearers expected to occur within the proposed TASR corridor include beaver, American marten (*Martes americanus*), mink (*Mustela vison*), short-tailed weasel/ermine (*Mustela erminea*), northern river otter, common muskrat, red fox, least weasel (*Mustela nivalis*), Canada lynx, gray wolf, and red squirrel (*Tamiasciurus hudsonicus*). Arctic fox (*Alopex lagopus*) may also be found within the proposed TASR, though their typical southern limit is the treeline (ENR 2012c). Furbearers detected within the regional study area of Fortune Minerals' NICO project (an area that borders the northern edges of the proposed TASR at KM 94) include beaver, red fox, lynx, ermine, mink, marten, muskrat, river otter and red squirrel (Golder 2011). Fisher (*Martes pennanti*) was also detected during aerial surveys, though its range was not thought to extend north of Great Slave Lake (Golder 2011). Additional range maps of furbearers within the proposed TASR are identified in the TK report (TG 2015).

Furbearers, like other species, may be subject to increased predation and harvest due to linear features (e.g. roads) in forested ecosystems. Populations of most furbearers in the NWT are thought to be stable and have NWT Status Ranks of '*secure*' (WGGSNS 2011). Though harvest data for most furbearer species are available, there is a lack of direct information regarding population health, numbers and densities. Little information exists in regards to population numbers of furbearers within Wek'èezhìı.

Wild furs from the NWT have long been regarded as among the best in the world. The American marten is the most valuable furbearer to NWT trappers and is internationally recognized as only second to Russian sable (ITI 2013). Furbearers are an important resource for community members from Whatì, Gamètì, Wekweètì and Behchokǫ̀, and for the NWT as a whole. Current management practices of furbearers include the NWT-wide collection of harvest data, studies of carcasses to determine diet and health, community monitoring, and trapper education. ENR currently plays an active role in regulating furbearer harvest and sets targets for harvest levels. Note that ENR has compensated five individuals over the past few years in order to relocate their traplines. These traplines were used occasionally and were in proximity to the proposed TASR but were impacted by fires. As these trappers have already received compensation from ENR and have had their traplines relocated, it is expected that the TASR should not affect trapping.

Other mammals that may occur in the proposed TASR corridor include North American porcupine (*Erethizon dorsatum*) and small mammals (e.g. deer mice [*Peromyscus sp*.], meadow voles [*Microtus pennsylvanicus*], heather voles [*Phenacomys sp.*], taiga voles [*Microtus xanthognathus*], northern bog

lemming [*Synaptomus borealis*], masked shrew [*Sorex cinereus*]) and bats. Hoary bats (*Lasiurus cinereus*) and little brown myotis (*Myotis lucifugus*) are thought to occur in the area. Ranges of most bat species in the NWT are poorly understood and other species may also be present within the proposed TASR corridor.

### 6.6.2 Avian Species

There are potentially over 100 species of birds occurring within the proposed TASR corridor based on geographic range with the majority of these species migrating to southern wintering areas. Few birds overwinter in the NWT, but owls, chickadees, northern goshawks, jays, redpolls, grouse, ptarmigan and ravens generally remain in their breeding range or have local migrations.

Willow ptarmigan occur year-round within the proposed TASR. The species is commonly found in areas with dense willow or birch shrubs, ranging from 0.3 to 2.0 m high, sedge-willow marshes, meadows, road and forest edges and open tundra (summarized in Hannon et al. 1998). Nest sites are commonly located in shrub habitats, including dwarf shrub heath and alder. Winter habitat is generally the same as breeding habitat, though ptarmigan are known to migrate locally from 20 km to 800 km from breeding ranges (Gruys 1993, Hannon et al. 1998). Winter habitat generally has high vegetative cover, including shrub communities, for shelter from wind and reduced snow compaction (Hannon et al. 1998, Platt 1976). Main foods include buds, twigs and catkins during the winter (Hannon et al. 1998). This species is also a prey item for a variety of carnivores, including grizzly bear, wolverine and raptors; predation is the main cause of mortality for willow ptarmigan. Their population varies from year to year in cyclic periods ranging from 8 to 11 years (Hannon et al. 1998).

Ptarmigan are a well-liked food source and subsistence hunting is the main human-caused mortality factor for this species (Hannon et al. 1998). Collisions with moving vehicles have rarely been reported, and this is likely not a major source of mortality (Hannon et al. 1998).

#### *PASSERINES*

Passerine (or songbird) species expected to occur within the proposed TASR corridor include several species of sparrow, swallow, thrush, longspur, warbler and redpoll. Most passerines that may be found in the area are migratory and spend only the summers in the area, breeding and raising young. Year-round, non-migratory songbird species include the gray jay (*Perisoreus canadensis*), boreal chickadee (*Peocile hudsonicus*), pine grosbeak (*Pinicola enucleator*), white-winged crossbill (*Loxia leucoptera*) and the common raven (*Corvus corax*). The house sparrow (*Passer domesticus*) is also a non-migratory resident of the NWT, though it is an exotic species (WGGSNS 2011).

Confirmed passerine species found adjacent to the proposed TASR are reported in upland breeding bird surveys completed by Golder (2011) at Fortune Minerals' NICO project regional study area (RSA). A total of 17 species of upland breeding birds were identified within the RSA and 13 species were identified within the mine site proper, between Lou and Burke Lakes (Golder 2011). The density of upland breeding birds within the RSA was estimated to be 1.25 birds per hectare, with the highest density observed in mid-slope to lowland habitats within treed fens and mixed wood white spruce/black spruce forests. Correspondingly, density was lowest in hilltop bedrock open coniferous/jack pine habitats (Golder 2011).

Estimates of populations are available for some passerine species within the NWT, though most population estimates are given as a North American or physiographic region total (ENR 2011b). Within the NWT General Status of Ranks, there are eight species of passerines ranked as '*sensitive*' that are known or expected to occur in the proposed TASR, including two species also listed under SARA (see Table 6-10).The olive-sided flycatcher (*Contopus copperi*) may occur in the area, and is listed as '*threatened*' under Schedule 1 of the SARA. The olive-sided flycatcher may be found in open areas of the boreal forest, near tall trees or snags, or in young regenerating forest after forest fire or clear cut (ENR 2013f). Reasons for the decline of the species outside the North are unclear and may be more applicable in its southern breeding and wintering grounds (ENR 2013e). The rusty blackbird (*Euphagus carolinus*), is territorially ranked as '*sensitive*', while it is listed under Schedule 1 of the SARA as '*special concern'*. The rusty blackbird breeds in boreal wetlands and has experienced a population decline over the last half century; due in part to conversion of its wintering habitat in the eastern and southeastern USA to agricultural lands (Greenburg and Droege 1999). This species primarily forages on insects and may nest in grass and sedge communities along wetland shorelines. Rusty blackbirds were identified during upland breeding bird surveys within the RSA for Fortune Minerals' NICO project (Golder 2011). Other species that are listed on Schedule 1 of SARA with ranges that overlap the proposed TASR include: bank swallow (*Riparia riparia*), barn swallow (*Hirundo rustica*) and common nighthawk (*Chordeiles minor*).

### *RAPTORS*

The proposed TASR corridor is home to 15 raptor species, including a variety of eagles, buteos, accipiters, falcons and owls. Similar to passerines, most raptor species only occur within the proposed TASR corridor during the breeding season. Species using the proposed TASR solely for breeding include bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*), merlin (*Falco columbarius*), northern goshawk (A*ccipiter gentilis*), northern harrier (*Circus cyaneus*), peregrine falcon, red-tailed hawk (*Buteo jamaicensis*), sharp-shinned hawk (A*ccipiter striatus*) and short-eared owl. The snowy owl (*Bubo scandiacus*) overwinters within the proposed TASR corridor, while the rough-legged hawk (*Buteo lagopus*) passes through during migration. Four owl species: boreal owl (*Aegolius funereus*), great gray owl (*Strix nebulosa*), great-horned owl (*Bubo virginianus*), northern hawk owl (*Surnia ulula*), are considered year-round resident in the proposed TASR corridor.

Four raptor species were observed within the RSA of Fortune Minerals' NICO project: bald eagle, red-tailed hawk, peregrine falcon and short-eared owl (Golder 2011). Fourteen raptor nests were identified during raptor surveys, eight belonging to unknown raptor species and the remainder belonging to bald eagles (4), red-tailed hawk and peregrine falcon.

Among the raptor groups expected to be found within the proposed TASR corridor, the short-eared owl and peregrine falcon are both currently designated as '*special concern*' under Schedule 1 of the SARA (Canada 2012). Within the NWT General Status Ranks, both the peregrine falcon and short-eared owl are listed as '*sensitive*' (WGGSNS 2011). The peregrine falcon may use portions of the proposed TASR for foraging or migratory staging, but is unlikely to nest in the area due to the lack of suitable nest habitat. The short-eared owl's range extends across the NWT and is a ground nesting species which breeds in marsh and wet meadow environments in both boreal and tundra habitat.

### *WATERFOWL*

Waterfowl, including species of ducks, geese, swans, loons and grebes, may use both wetland and riparian habitat within the proposed TASR corridor for breeding and staging. Golder (2011) reports that the most common waterfowl species encountered in the RSA of Fortune Minerals' NICO project include scaup species (*Aythya* spp.), common goldeneye (*Bucephala clangula*), American wigeon (*Anas americana*), mallard (*Anas platyrhynchos*), Pacific loon (*Gavia pacifica*) and American green-winged teal (A*nas crecca*). In total, 23 species of waterfowl were observed within the RSA and densities were estimated at 167 adult waterbirds per $km^2$ and 7.5 young waterbirds per $km^2$. During fall migration, buffleheads (*Bucephala albeola*) and scaup were observed on lakes within the RSA, while tundra swans (*Cygnus columbianus)* and Canada geese (*Branta canadensis*) were observed flying over (Golder 2011).

Additional species of waterfowl that may use habitat within the proposed TASR corridor include: snow goose (*Chen caerulescens*), northern pintail (*Anas acuta*), northern shoveler (*Anas clypeata*), canvasback (*Aythya valisineria*), long-tailed duck (*Clangula hyemalis*), white winged scoter (*Melanitta fusca*), surf scoter (*Melanitta perspicillata*), common loon (*Gavia immer*), common merganser (*Mergus merganser*), hooded merganser (*Lophodytes cucullatus*), and red-breasted merganser (*Mergus serrator*). Several of these waterfowl species are considered to be '*sensitive*' under the NWT Status Ranks, including horned grebe, northern pintail, lesser scaup, long tailed duck, white-winged scoter and surf scoter.

### *6.6.2.1 Migratory Bird Nesting Periods*

Though an effort has been made to list all avian species that may occur within the proposed TASR corridor, ensuring construction activities do not impact the nesting periods of migratory bird species is considered paramount. Environment Canada's General Nesting Periods of Migratory Birds in Canada indicates that the proposed TASR falls within the Bird Conservation Region (BCR) 6 – Boreal Taiga Plains, which corresponds to Zone B7 nesting. Under this zone, 46 species were identified as nesting in wetland habitats, 71 species nest in open habitats and 61 species nest in forest habitats. The nesting periods for species in each habitat are between: April 25-Aug 24; May 1-Aug 16; and April 25-Aug 24, respectively. The encompassing period in which no harm or disturbance can occur to the birds and their nesting habitat is therefore between April 25 and August 24 each year (EC 2014e).

**Table 6-10 Wildlife species with special conservation status with habitat surrounding the proposed TASR corridor**

| Common Name | Scientific Name | NWT General Status Rank[1] | NWT Assessment/ Legal Listing[2] | COSEWIC/SARA[3] |
|---|---|---|---|---|
| **Mammals** | | | | |
| Boreal woodland caribou | *Rangifer tarandus caribou* | Sensitive | Threatened 2012/ Threatened 2014 | Threatened 2002/ Threatened 2003 |
| Little brown myotis | *Myotis lucifugus* | May Be At Risk | Not assessed/ No status | Endangered 2013/ Endangered 2015 |
| Wolverine (Western population) | *Gulo gulo* | Sensitive | Not at risk/ No status | Special concern 2003/ Under consideration |
| Wood bison | *Bison bison athabascae* | At Risk | Not assessed/ No status | Special concern 2013/ Threatened 2003 |

**Table 6-10 (Continued) Wildlife species with special conservation status with habitat surrounding the proposed TASR corridor**

| Common Name | Scientific Name | NWT General Status Rank[1] | NWT Assessment/ Legal Listing[2] | COSEWIC/SARA[3] |
|---|---|---|---|---|
| **Birds** | | | | |
| American bittern | *Botaurus lentiginosus* | Sensitive | Not Listed | Not Listed |
| American tree sparrow | *Spizella arborea* | Sensitive | Not Listed | Not Listed |
| Bank swallow | *Riparia riparia* | Secure | Not applicable | Threatened 2013/ Under consideration |
| Barn swallow | *Hirundo rustica* | Sensitive | Not applicable | Threatened 2011/ Under consideration |
| Blackpoll warbler | *Setophaga striata* | Sensitive | Not Listed | Not Listed |
| Boreal chickadee | *Poecile hudsonicus* | Sensitive | Not Listed | Not Listed |
| Caspian tern | *Hydroprogne caspia* | Sensitive | Not at Risk | Not Listed |
| Common nighthawk | *Chordeiles minor* | At Risk | Not applicable | Threatened 2007/ Threatened 2010 |
| Harris's sparrow | *Zonotrichia querula* | Sensitive | Not Listed | Not Listed |
| Horned grebe | *Podiceps auritus* | Sensitive | Not applicable | Special concern 2009/ Under consideration |
| Least sandpiper | *Calidris minutilla* | Sensitive | Not Listed | Not Listed |
| Lesser scaup | *Aythya affinis* | Sensitive | Not Listed | Not Listed |
| Lesser yellowlegs | *Tringa flavipes* | Sensitive | Not Listed | Not Listed |
| Long-tailed duck | *Clangula hyemalis* | Sensitive | Not Listed | Not Listed |
| Northern pintail | *Anas acuta* | Sensitive | Not Listed | Not Listed |
| Olive-sided flycatcher | *Contopus cooperi* | At Risk | Not applicable | Threatened 2007/ Threatened 2010 |
| Peregrine falcon | *Falco peregrinus anatum* | Sensitive | Not assessed/ No status | Special concern 2007/ Special concern 2012 |
| Red-necked phalarope | *Phalaropus lobatus* | Sensitive | Not Listed | Special Concern 2015/ Under consideration |
| Rusty blackbird | *Euphagus carolinus* | Sensitive | Not assessed/ No status | Special concern 2006/ Special concern 2009 |
| Short-eared owl | *Asio flammeus* | Sensitive | Not assessed/ No status | Special concern 2008/ Special concern 2012 |
| Surf scoter | *Melanitta perspecillata* | Sensitive | Not Listed | Not Listed |
| White-throated sparrow | *Zonotrichia albicollis* | Sensitive | Not Listed | Not Listed |
| White-winged scoter | *Melanitta fusca* | Sensitive | Not Listed | Not Listed |
| Yellow rail | *Coturnicops noveboracensis* | May Be At Risk | Not assessed/ No status | Special concern 2009/ Special concern 2003 |
| **Insects** | | | | |
| Gypsy Cuckoo Bumble Bee | *Bombus bohemicus* | | Not assessed/No status | Endangered 2014/ Under consideration |

***1*** *NWT General Status Rank does a preliminary evaluation of each species in the NWT.*

***2*** *Species at Risk Committee assesses and assigns each species in the NWT to a category of risk. Legal listing is NWT List of Species at Risk.*

***3*** *COSEWIC, a national committee that assesses and assigns each species to a category of risk. Schedule 1 of the Species at Risk Act (SARA) provides a listing of wildlife species at risk.*

### 6.6.3 Species at Risk

The current NWT General Status Rank of species plays an important role in developing management and monitoring programs, especially for species that are traditionally and economically significant. Currently,

29 wildlife species potentially found within the proposed TASR corridor have been territorially ranked as '*sensitive*', '*may be at risk'*, or '*at risk*' in the General Status Ranks of Wild Species in the Northwest Territories (ENR 2014b). 'Sensitive' species include boreal woodland caribou, wolverine, peregrine falcon, short-eared owl, some species of waterfowl (e.g. lesser scaup, northern pintail, surf scoter), some passerines (e.g. Harris's sparrow, American tree sparrow, rusty blackbird), and other avian species (American bittern, lesser yellowlegs). One bat species (little brown myotis) is ranked as '*may be at risk*', and this species may occur within the proposed TASR corridor. The ranges of the bat species are poorly understood in the NWT, however, they are known to occur in the Taiga Plains Mid-Boreal Ecoregion and Taiga Shield High-Boreal Ecoregion (ECG 2008, 2009). The wood bison and olive-sided flycatcher are ranked territorially as '*at risk*'.

In addition to the NWT General Status Ranks, several of the ranked species are designated as '*endangered*', '*threatened*' or '*special concern*' by COSEWIC and/or as federally designated as '*threatened*' or '*special concern*' under SARA (Canada 2012). Table 6-10 provides a summary of the federally/territorially assessed and listed species at risk that may occur within the proposed TASR corridor, as well as species that have been ranked as 'sensitive', 'may be at risk' or 'at risk' under the NWT General Status Rank program.

### 6.6.4 2014 DOT Ground Truthing along Proposed TASR

Ground truthing along the proposed TASR was conducted between June 25-28, 2014 whereby three DOT employees and a TG representative traveled the entire proposed alignment by argo up until KM 94 where the alignment intersects with the community access road. Stops occurred at water crossings and selected areas of concern that were highlighted within the Tłı̨chǫ Traditional Knowledge report (e.g. trapline and cabin locations that intersect with the road; TG 2015). Where possible, incidental wildlife observations were recorded; Table 1, located in Appendix Q, summarizes these observations.

## 6.7 Hydrology and Water Quality

Water is an important resource for current and traditional uses within the proposed TASR. Lakes and rivers are used by residents for potable water supply, food provisions (e.g. fish), travel, and recreation and are a critical component for wildlife and wildlife habitat. Industrial uses of water in the area include hydro-electric power generation and the tourism industry, which also relies on water quality and quantity to sustain operations within the general area. Many factors combine to determine a hydrologic regime including geology, topography, elevation, climate, permafrost, drainage area and vegetation cover. In the NWT, the amount of available surface storage in lakes and wetlands plays a large role in characterizing hydrologic regimes (Wedel et al. 1992).

The proposed TASR traverses two primary watersheds. The majority of the area falls within the northern portion of the Great Slave sub-basin, and crosses over one secondary watershed within the Great Slave sub-basin: the Marian watershed (MRBB 2004). Major river systems flowing in these watersheds include the Marian River, emptying into Great Slave Lake (MRBB 2004). The Great Slave sub-basin stretches from the eastern Taiga Plains and into the erosion-resistant Precambrian Shield of the Western Taiga

Shield (MRBB 2004). There are hundreds of lakes within the Great Slave sub-basin; the largest of which is Lac la Martre. Other important lakes within the area include Faber, Rae and Marian Lakes.

The NWT is generally referred to as a polar desert due to the low levels of precipitation. Within the proposed TASR, precipitation generally falls half as snow and averages 200 to 400 mm annually (EMRC 1991). Though in general, average annual runoff tends to range between 100 and 199 mm (EMRC 1993), flowing primarily during the spring freshet. The open water season within the Slave Geological Province generally begins in mid to late June, shortly after ice break up occurs, and lasts until late September when lakes freeze again (Puznicki 1996). Depending on size and depth, some lakes and streams within the proposed TASR may freeze to the bottom during winter, while others will maintain some level of flow or depth and will potentially provide important over-winter habitat for aquatic species.

Regional water quality and quantity information collection for lakes and rivers within the Wek'èezhìı area is ongoing, with several monitoring stations run and sampled by various agencies. Though site-specific data pertaining to the proposed TASR can be limited, generalizations about water quality in the area can be made based on the past and current research. Generally, water quality of the major rivers and lakes throughout the region is good (Puznicki 1996, MRBB 2004). Surface waters of the Taiga Plains tend to exceed guidelines for copper and iron, and turbidity is normally greater as a result of the underlying sedimentary rock and glacial till, which is easily eroded and washed into rivers and lakes (MRBB 2004).

### 6.7.1 Surface Water

Major North Slave Area watersheds contribute to the Great Slave Lake sub basins. Large lakes in proximity to the proposed TASR include Lac la Martre and Marian Lake. Several unnamed lakes and ponds are also present. Two watersheds are traversed by the proposed TASR (NRCan 2012):

- the Great Slave Lake – North Arm – West Shore watershed includes lands from Highway 3 to the west of Marian Lake, and
- the western side of the Marian Watershed includes lands near Lac la Martre and Whatì.

Rivers and streams form important connections between area waterbodies: La Martre River drains Lac la Martre and conveys flow to the Marian River drainage; the Duport River flows to Marian Lake and an unnamed tributary (historically referred as James River) drains into James Lake. Several unnamed rivers and streams also contribute surface flow to area watersheds. A total of four major tributaries will be crossed along the proposed TASR. The locations of proposed crossing sites are summarized in Table 4-4.

While there are some water quality data available surrounding the proposed TASR, as well as information on surface drainage patterns, site-specific information throughout the area is lacking, particularly from long-term monitoring stations for water quality (SENES 2005). There are few stations reporting multiple data sets, such as climate information, stream flow and water levels (Sly et al. 2001). The NWT Discovery Portal website does however provide various links to studies and data that are available, which includes snowfall data (Centre for Geomatics 2015).

Environment Canada's Water Survey of Canada (WSC) currently operates one hydrometric station within the proposed TASR corridor, on the La Martre River in the western half of the Marian Watershed. The

station, 07TA001, is located on the La Martre River (63°6'27" N, 116°58'28" W) near the proposed bridge crossing. It has provided continuous flow monitoring since 1975, with water levels also recorded from 2002 (WSC 2012). Water temperature and level data for the La Martre station indicates the channel opens in early May and closes in late October with a 4 m water level maintained through the open water season (WSC 2012). Additional water survey gauges located within the Mackenzie River basin were utilized for the regional hydrologic analysis of each crossing to facilitate in the design and placement of bridges and culverts. This data is summarized in Stantec's *Tli Cho Road Alignment, Hydrologic and Hydraulic Study* (Appendix R).

The Wek'èezhìı Land and Water Board is currently undertaking the Tłı̨chǫ Aquatic Ecosystem Monitoring Program, which may provide additional information on surface water characteristics surrounding the proposed TASR corridor. This program was initiated by the Wek'èezhìı Land and Water Board, Tłı̨chǫ Government, GNWT's Cumulative Impact Monitoring Program (CIMP) and Wek'èezhìı Renewable Resource Board (NWTWS 2014).

### 6.7.2 Groundwater

Groundwater flow should be contained within the same water basins described in the surface water section above. Groundwater beneath the permafrost layer should have little interaction with surface flows. Groundwater contributions to watercourse flow are expected to be seasonal, with no or negligible contributions made in winter. If during geotechnical analysis, karst features are discovered; it is expected that groundwater flow in these areas could be year-round.

### 6.7.3 Hydrology and Water Quality Analysis of Fieldwork

Stantec was contracted to perform a detailed hydrological assessment of all water crossings along the proposed TASR. Fieldwork was conducted between July 1-4, 2014. Stantec's *Hydrotechnical Progress Report* is available in Appendix S, while the final *Tli Cho Road Alignment, Hydrologic and Hydraulic Study* is available in Appendix R. The final report provides a summary of each water crossing and provides the modeling detail required for bridge and culvert design. Table 6-11 summarizes the watercourse crossing descriptions from Stantec's report. Detailed water crossing summaries (e.g. bankfull width, etc.) are only provided for the major water crossings identified in the report and where the helicopter was able to land; Table 6-12 provides a summary of said data.

The design criteria utilized in Stantec's final report was for a 100-year return period rainfall event (1% flood) and a flow of 130% of the 100-year design flood was used as the check flow for scour calculations (Appendix R). A total freeboard of 1.5 m was assumed from the design water level to the low chord of the proposed bridge, which includes an icing allowance of 0.5 m (Appendix R). Please review Appendix R to gain a full understanding of the hydrologic and hydraulic details that pertain to the proposed TASR.

In-stream field measurements, such as temperature, pH, conductivity and hardness (Table 6-12), were collected. It is assumed water within the proposed TASR corridor will likely have naturally elevated background levels for elements such as copper and iron as is common in the NWT. Geochemical analysis of borrow sources prior to construction will allow for the selection of borrow materials that are not susceptible to acid rock drainage (ARD) or metal leaching. The utilization of borrow materials that have

passed geochemical analysis for road construction will permit water quality monitoring to be focused on turbidity and adaptive management.

*Note regarding Stantec report:*

*After the Design & Construction section of DOT began interpreting the LiDAR and topographic analysis, this section was able to begin designing the corridor for the proposed TASR in more detail. Once this was complete, the Structures section of DOT was able to review the corridor design and see how it compared to the crossings identified in Stantec's report. During this review, it became evident that some of the bridge locations identified by Stantec would be changing. The bridge and culvert details discussed in Section 4.4 have incorporated these necessary changes; please see this section for further information. Because Stantec's report did not consider fish passage in its assessment, the Environmental Affairs division (EAD) of DOT conducted a fish friendly water crossing assessment for the proposed TASR (further detail available in Section 6.8). This assessment followed the DFO advice of culverts embedded 10% below the invert and that:*

- *culverts less than 25 m long, velocities should not exceed 1.0 m/s at 3DQ10[8];*
- *culverts greater than 25 m long, velocities should not exceed 0.8 m/s at the 3DQ10; and*
- *culverts greater than 40 m long, velocities may be limited to 0.6 m/s at the 3DQ10.*

*The Structures section then amended the culvert designs in order to incorporate the standard DFO advice as the originally developed crossings by Stantec focused on just the hydrologic parameters.*

### Table 6-11 Stantec Watercourse Crossing Descriptions within proposed TASR corridor (from Appendix R)

| | |
|---|---|
| **Crossing 1 KM 2 and 2.4** | |
| Topography | Located within a low-lying area with a poorly defined channel and no defined floodplain. |
| Channel characteristics | Banks are vegetated with low shrubs and some trees. Stagnant water was observed approximately 200 m downstream. Surficial soil appears sandy. |
| Floodplain | At the time of assessment, the drainage was dry; however, the area of flooding during a potential rainfall event could be increased due to the flat topographic relief within the area. |
| **Crossing 2 KM 3.2** | |
| Topography | Similar to Crossing 1. Located in a low-lying area with a poorly defined channel and floodplain. |
| Channel characteristics | Banks are vegetated with thick grasses and shrubs as well as a forested area downstream. Surficial soil is sandy. |
| Floodplain | A small marsh area lies upstream which suggests that there is storage for runoff following rainfall events and as a results, a significant amount of water is expected to pond in the marsh prior to spilling at the crossing. The channel was dry but the estimated flow width is 3-5 m. |
| **Crossing 3 KM 7.9** | |
| Topography | Crossing 3 is similar to both 1 and 2 and has a poorly defined channel and floodplain. |

[8] 3DQ10: "The principle that once in 10 years, it is tolerable for fish to have to wait up to 3 days before being able to pass through the structure" (TAC 2004).

## Table 6-11 (Continued) Stantec Watercourse Crossing Descriptions within proposed TASR corridor (from Appendix R)

| | |
|---|---|
| Channel characteristics | Small shrubs and grasses are present within the channel and the banks are forested. Surficial soil appears sandy. |
| Floodplain | There is no defined floodplain; however, the area is heavily forested and vegetated in the area around the proposed crossing. |
| **Crossing 4 KM 13.2** | |
| Topography | A defined, ephemeral channel. |
| Channel characteristics | The channel is vegetated with shrubs and grasses. Channel depth is approximately 0.3 m. Surficial soil appears sandy. |
| Floodplain | An open, marsh area is located upstream of the crossing. The floodplain is forested with the same grasses and shrubs as the channel. |
| **Crossing 5 KM 16.5** | |
| Topography | A poorly defined channel. |
| Channel characteristics | The channel is vegetated with shrubs, trees, and grasses. A change in vegetation was observed downstream where flooding occurs during rainfall events. Surficial soil appears sandy. |
| Floodplain | The floodplain is forested at the crossing location and upstream. Downstream the floodplain is less forested and is open for more uninhibited channel flow. |
| **Crossing 6 KM 19.4** | |
| Topography | A poorly defined channel in a low-lying area. |
| Channel characteristics | Shrubs and grasses in the channel bed. There is a change in vegetation and forest in the area of the crossing that shows the extent of flooding during rainfall events. Surficial soil appears sandy. |
| Floodplain | A clearly defined floodplain is not present. A change in vegetation and forest in the area of the crossing shows the extent of flooding during rainfall events. |
| **Crossing 7 KM 23.6** | |
| Topography | A low-lying area where ponding occurs downstream of the road during rainfall events. |
| Channel characteristics | The channel is densely forested and vegetated. Soil appears sandy with some organics. |
| Floodplain | The floodplain is undefined but the area at the crossing is densely forested and vegetated. |
| **Duport River KM 40.4** | |
| Topography | Located within a series of well-defined and braided, meandering channels within a marsh. The area floods during high water levels. As water levels recede during dry periods low areas remain wet and small, oxbow ponds are created adjacent to the channel. |
| Channel characteristics | There is minimal vegetation in the braided channels while the floodplain is thickly grassed with some trees. The main channel is approximately 3.5-5 m wide. Bankfull depth within the main channel is 1.5 m. The channel substrate is mainly organic with some fines. The field crew sank 0.5 m into the bed of the channel at the time of the field assessment. Erosion of the braided channels is evident. |
| Floodplain | The floodplain is well-defined and is approximately 50-75 m wide. Vegetation in the floodplain is mainly grasses and shrubs. |
| **Crossing 9 KM 45.2** | |
| Topography | A major crossing and is a large, well defined, ephemeral stream. |

## Table 6-11 (Continued) Stantec Watercourse Crossing Descriptions within proposed TASR corridor (from Appendix R)

| | |
|---|---|
| Channel characteristics | The main channel is an outlet for an upstream lake which flows when the lake begins to spill. Stagnant water within the channel was observed at the time of assessment. The bankfull width and depth are 11.5 m and 0.80 m, respectively. The channel bed consists of cobbles and gravel with some silty and organic material. |
| Floodplain | There is no defined floodplain but the banks are forested. |
| **Crossing 10 KM 48.3** | |
| Topography | A low-lying area where ponding occurs. There is no defined channel. |
| Channel characteristics | The area is mainly marsh with muskeg, organics, and grass at the crossing. A second potential crossing with a small, well-defined, meandering channel was observed just south of the proposed crossing area. |
| Floodplain | The floodplain is forested and grassed. The ponding area at the crossing is approximately 15-20 m. |
| **Crossing 11 KM 54.5** | |
| Topography | Similar to 10 with a low-lying, ponding area at the crossing and no defined channel. |
| Channel characteristics | The area is mainly marsh with muskeg, organics, and grass at the crossing. The area is bounded by two lakes approximately 100-200 m upstream and downstream of the crossing. Stagnant water was observed at the time of the field visit. |
| Floodplain | The areas adjacent to the crossing are forested and grassed. |
| **Crossing 13 KM 62.7** | |
| Topography | A low-lying marsh area bounded by small lakes. Stagnant water was observed at the crossing. |
| Channel characteristics | Vegetation within the channel consists of small shrubs and grasses. Substrate appears organic. |
| Floodplain | Small shrubs and grasses bordered by forested area. |
| **James River KM 68.7** | |
| Topography | A major crossing and is a well-defined meandering channel with riffle-pool sequences. The distance between riffles is approximately 150-200 m. |
| Channel characteristics | The proposed crossing is located at a pool. The bankfull depth and width at the crossing is estimated at 2.5-3 m and 10 m, respectively. Substrate in the channel is gravel and cobbles with some fines and organic material. The channel banks are undercut and erosion is evident. A higher waterline was observed approximately 0.3 m above the measured water depth. |
| Floodplain | The floodplain is grass with forest cover. |
| **La Martre River KM 85.4** | |
| Topography | A major crossing at a set of rapids of La Martre River and originates from Lac La Martre to the west. A set of falls is located approximately 3 km downstream of the rapids. |
| Channel characteristics | The bankfull width is approximately 50-60 m while the bankfull depth is estimated at approximately 3-4 m. The river substrate consists of large boulders and cobbles with gravel. Sediment deposition is evident downstream of the rapids where streamflow velocities are much lower. |
| Floodplain | The floodplain consists of marsh areas with tall grasses immediately adjacent to the river which are bounded by thick forest. |

*Note: Crossing 10a KM 48.2 was not included in Stantec's assessment. Culvert size was determined via LiDAR and the topography survey. It is most likely that 10 and 10a are a part of the same tributary. Crossing 12 KM 56.6 from Stantec's assessment was excluded from the table as this portion of road was routed around the waterbody instead and will only require a culvert.*

## Table 6-12 Watercourse Summaries within proposed TASR corridor

| Crossing # | KM # | Bankfull width (m) | Bankfull depth (m) | Average Velocity (m/s) | Measured Flow ($m^3/s$) | Comments |
|---|---|---|---|---|---|---|
| 1 | 2 and 2.4 | | | | | No defined floodplain. Dry channel. |
| 2 | 3.2 | | | | | Poorly defined channel and floodplain. Dry channel with an estimated flow width of 3-5 m. |
| 3 | 7.9 | | | | | Poorly defined channel and no defined floodplain. |
| 4 | 13.2 | | 0.3 | | | Defined, ephemeral channel. |
| 5 | 16.5 | | | | | Poorly defined channel. |
| 6 | 19.4 | | | | | Channel and floodplain not defined. |
| 7 | 23.6 | | | | | Ponding occurs downstream. |
| Duport | 40.4 | 3.5-5 | 1.5 | 0.29 | 0.079 | Erosion of braided channels.<br>50-75m floodplain<br>temp 19°C; pH 7.56; conductivity 0.02 mS; hardness 1000 mg/L |
| 9 | 45.2 | 11.5 | 0.8 | | NF | Ephemeral stream as an outlet for upstream lake. No floodplain, defined channel. |
| 10 | 48.3 | | | | | Ponding area with no defined channel approx. 15-20 m wide. Small meandering well-defined rocky channel directly to south. |
| 11 | 49 | | | | | Ponding area with no defined channel. |
| 13 | 62.7 | | | | | Marsh area bounded by small lakes. |
| James | 68.7 | 10.0 | 2.5-3 | 0.14 | 0.385 | Well-defined meandering channel with riffle-pool sequences. Undercut channel banks.<br>temp 21°C; pH 8.11; conductivity 0.42 mS; hardness 250 mg/L |
| La Martre | 85.4 | 50-60 | 3-4 | | 32-33* | Set of falls located 3-4 km downstream of crossing.<br>temp 21°C; pH 8.04; conductivity 0.25 mS; hardness 500 mg/L |

*Note: Measured flow provided by Water Survey of Canada website (EC 2014f). NF = no flow*

## 6.8 Fish and Fish Habitat

The proposed TASR will cross ephemeral and perennial streams and come near lakes along its route. It is therefore important to develop suitable avoidance and mitigation strategies designed to protect fish populations that are ecologically important, and socially and economically valuable to northern residents. This section of the report identifies the species that may be encountered or affected by road construction and operation, based on previous studies and reconnaissance observations of existing habitat characteristics. This section also discusses the results of the *Fisheries Protection Self-Assessment Serious Harm Impacts Determination Record* for the proposed TASR (Appendix T), which was conducted by EAD staff in November 2015. This self-assessment is in accordance with DFO Fisheries Protection Program website and provides avoidance and mitigation strategies for the proposed road development so as to avoid causing harm to fish and fish habitat. Section 8.9 continues the discussion of the potential effects of the road development and a description of additional protection measures.

### 6.8.1 Fish

The proposed TASR occurs within an area that provides important fish habitat and historic and current subsistence harvest areas for the Tłı̨chǫ peoples. Although limited fish surveys have been conducted previously in streams along the proposed corridor, the *Traditional Knowledge Study* (TG 2015) provides a history of the Tłı̨chǫ fishery in proximity to the proposed TASR. A review of fish species present within the North Slave area including the La Martre River identified a total of 17 species with the potential to occur within the proposed TASR corridor (Stewart 1997; Table 6-13). General life histories of these species are provided in Table 6-14. Arctic Grayling is the valued species most likely to be affected by the road construction activities and stream crossing structures. This is because grayling utilize and are dependent upon stream habitats for spawning, juvenile rearing, and adult life stages, and require clean, well oxygenated gravel-cobble substrates to complete their life cycle (Table 6-14). As such, their productivity within a system is highly sensitive to perturbations that degrade or alter migration access or habitat quality. Actual species presence is dependent on several habitat and watershed characteristics, often including the availability and accessibility of upstream lakes that provide feeding, rearing, and/or over wintering habitats. It is unlikely that any of the minor streams (ephemeral, intermittent and/or <1.5 m deep) along the alignment would provide overwintering habitat due to complete freezing, while the larger and deeper tributaries (such as the La Martre River) would be able to provide such habitat.

## Table 6-13 List of freshwater fish species present in the North Slave Study Area (Stewart 1997; DFO 2013) with associated habitat use information (Richardson et al. 2001; Scott and Crossman 1998; Stewart 1997)

| Fish Species | Migratory Behaviour | Spawning Period | Spawning Habitat | Hatching Period | Juvenile Freshwater Habitat Preference | Adult Freshwater Habitat Preference |
|---|---|---|---|---|---|---|
| Arctic Grayling *Thynallus arcticus* | ●Can be highly migratory at all life stages or non-migratory<br>●Usually migrate to winter habitat in early fall | Spring, just as ice breaks up; mid-May to early June | ●Gravel substrate<br><20-30% fines<br>●Good flow (25-60 cm/s) | Hatch 3 weeks after spawning; 8-32 days | Fry: quiet waters near site of hatching | ●Clear small, shallow streams or medium rivers<br>●Groundwater fed springs<br>●Overwinter in lakes or lower reaches of rivers<br>●Segregate in streams by age |
| Burbot *Lota lota* | ●Migrate to lake spawning areas in winter<br>●Migrate to tributaries in late winter/early spring<br>●Migrate to deep water in summer | December to mid-January | ●Under ice in lakes or river<br>●Sand/gravel substrate<br>●Shallow (< 3 m bays or no gravel shoals) | 30 days to 3 months | ●Shallow waters<br>●Debris cover<br>●Ricky riffles<br>●Pools or deeper water in lakes | ●Mouths of creeks in fall<br>●Deep water in summer |
| Deepwater Sculpin *Myoxcephalus quadricornis thompsoni* | | Not known | | | | Deep water lakes |
| Inconnu *Stenodus leucichthys* | ●Anadromous or lake dwelling<br>●Begin upstream migrations at spring break-up<br>●Return to lakes after spawning | Late September-early October | ●1-3m depth<br>●Fast current<br>●Gravel substrate | Spring; 6 mos. after spawning | Fry washed downstream to lakes | Lakes |
| Lake Chub *Couesius plumbeus* | | Spring-Mid Summer | ●Cobble gravel substrates<br>●0.5-2m depth | Hatch 2 weeks after spawning | | Lakes and slower stretches of rivers |
| Lake Cisco *Coregonus artedii* | ●Migrate to spawning areas in fall<br>●Migrate to deep water in summer | September-November | Large groups over shallow gravel | Spring, just before ice break-up | ●Shallow waters<br>●Debris cover | Lakes |

## Table 6-13 (Continued) List of freshwater fish species present in the North Slave Study Area (Stewart 1997; DFO 2013) with associated habitat use information (Richardson et al. 2001; Scott and Crossman 1998; Stewart 1997)

| Fish Species | Migratory Behaviour | Spawning Period | Spawning Habitat | Hatching Period | Juvenile Freshwater Habitat Preference | Adult Freshwater Habitat Preference |
|---|---|---|---|---|---|---|
| Lake Trout *Salvelinus namaycush* | ●Limited migrations, usually within resident lake or large deep river<br>●Migrate to nearshore areas for spawning<br>●Move into surface waters in winter<br>●Move into deeper waters in summer | Mid to late August/Early September | ●Littoral areas of lakes<br>●Cobble boulder substrates<br>●5-40m water depth | May-June depending on water temperature | Shallow, inshore waters | ●Large deep lakes (common)<br>●Larger rivers (rare in NWT)<br>●Little movement in summer |
| Lake Whitefish *Coregonus clupeaformis* | Resident or anadromous | Late September-mid October | ●Lakes and large rivers<br>●Hard or stony substrate<br>●Water <7.5m | Late winter-early spring | ●Larvae along steep shorelines<br>●Juveniles move to deep water in summer | Deep water in lakes and large rivers |
| Longnose Sucker *Catostomus catostomus* | Migrate to shallows for spawning | June | ●Streams or lake shallows<br>●Gravel bottom<br>●15-30cm deep | ~2 weeks after spawning | ●Remain in gravel 1-2 weeks<br>●Shallows with vegetation cover | Deep water in lakes and streams |
| Ninespine Stickleback *Pungitius pungitius* | Very limited movements | Summer | Male builds nests of vegetation and debris | | Quiet, shallow waters in vegetated areas of streams | ●Freshwater lakes and streams<br>●Streams: vegetated areas in quiet waters |
| Northern Pike *Esox lucius* | ●Limited range<br>●Move from deep water winter habitat to spawning habitat in spring | Early spring, occasionally before ice melt; early May to mid-June | ●Grassy margins of lake shores<br>●Slow moving streams or sloughs | Spring, ~2 weeks after spawning | ●Stream or lake margins<br>●Slow flowing waters | ●Lakes<br>Main river channels<br>●Slack water areas in rivers |
| Round Whitefish *Prospium cylindraceum* | Limited migrations to lake shallows or upstream to rivers | October-November | Gravelly shallows of lakes or river mouths | April-May (123-140 days) | Near or beneath rocks | Moderate to deep lakes |
| Slimy Sculpin *Cottus cognatus* | Very limited movements | Spring, after breakup | Cobble in shallow water | Hatch 30 days after spawning | Gravel/cobble substrates in streams | Rocky or gravel substrates |

**Table 6-13 (Continued) List of freshwater fish species present in the North Slave Study Area (Stewart 1997; DFO 2013) with associated habitat use information (Richardson et al. 2001; Scott and Crossman 1998; Stewart 1997)**

| Fish Species | Migratory Behaviour | Spawning Period | Spawning Habitat | Hatching Period | Juvenile Freshwater Habitat Preference | Adult Freshwater Habitat Preference |
|---|---|---|---|---|---|---|
| Spottail Shiner *Notropis hudsonius* | | Spring to early summer | ●Sandy shoals and gravel<br>●0-5m deep | | | Lakes and lower drainages of tributary springs |
| Trout Perch *Percopsis omiscomaycus* | ●Move inshore at night<br>●Deep water during summer | Summer | ●Shallow streams and lake beaches<br>●<1m deep | 1 week incubation | ●Sand, gravel, mud substrate<br>●<10m deep | Deeper water of lakes and streams |
| Walleye *Stizostedion vitreum vitreum* | Migrate to deeper waters in summer | Spring to early summer; April-June | ●Gravel or rocky shoals of lakes and rivers<br>●0.3-2m deep | 4-34 days | Shallows with vegetation cover | Lakes, rivers and large streams |
| White Sucker *Catastomus commersoni* | | June | Gravel bottom streams and lake margins | ~2 weeks after spawning | ●Remain in gravel 1-2 weeks<br>●Shallows with vegetation cover | Lakes, rivers |

**Table 6-14 General life histories of freshwater fish species present within the study area (Evans et al 2002; Scott and Crossman 1998; DOT 2013a)**

| Species | History |
|---|---|
| Arctic Grayling | Arctic Grayling exist in cool boreal and foothill lakes, rivers, and streams and remain a coveted sport fish for recreational anglers. Sexual maturity occurs at the age of 4 where they move from lakes to streams to spawn in the spring and early summer in gravel or rock substrates. Juveniles can also move to streams to forage during summer months. |
| Burbot | Grow to a maximum length of approximately 120 cm. The Burbot are known to inhabit deeper lake bottoms and rivers. Preferring colder water the Burbot will not feed in temperatures over 23 degrees centigrade. Spawning occurs in the wintertime below the ice at night on gravel or sand bottom waters. Juvenile fish inhabit rocky shores or tributary streams (Evans et al. 2002) |
| Deepwater Sculpin | Although deemed not-at-risk by current COSEWIC standards, the Deepwater Sculpin's sensitivity to changing water and food source conditions make it a fish of concern when possible environmental impacts occur. Living in cold deeper lake waters, the Sculpin is distributed in habitats that can support those needs. |
| Inconnu | Young inconnu are known to remain in their rearing habitat for up to two years. Spawning occurs in autumn in tributary rivers. Inconnu are an important species for subsistent harvests. |
| Lake Chub | Lake Chub will grow to a maximum of 10-15 cm where they inhabit lakes and slower stretches of rivers. Spawning occurs in the spring and early summer where they eat aquatic insects, crustaceans, and algae. |
| Lake Cisco | Also recognized as lake herring, the Cisco travel in groups where in the fall they spawn over shallow gravel substrates. In the summer the fish migrate to deeper water and are key food for Lake Trout, Burbot, Northern Pike and Walleye. |

**Table 6-14 (Continued) General life histories of freshwater fish species present within the study area (Evans et al 2002; Scott and Crossman 1998; DOT 2013a)**

| | |
|---|---|
| Lake Trout | In the summer months, Lake Trout move to deeper water from lake shallows, rivers and streams. In the fall they spawn over rubble or boulder bottoms in the shallow of lakes (Scott and Crossman 1998). Some of the largest Lake Trout in the world inhabit the waters of Lac la Martre and remain a prominent recreational and food fish. |
| Lake Whitefish | Whitefish spawn in the fall in shallow waters after spending the warmer months in deep lakes. Preferred substrate is hard rocky bottoms or sometimes sand (Scott and Crossman 1998). Whitefish are harvested for human consumption and juveniles are a common prey to larger predatory fish. |
| Longnose Sucker | As a bottom feeder the Longnose Sucker feed on aquatic invertebrates and plankton as they are young. They spawn in late spring, early summer in streams or lake shallows and the young migrate downstream to lake habitat in the winter. |
| Ninespine Stickleback | The common forage fish for many predators, the small (6 cm) Stickleback inhabit many lakes and streams of the NWT. The male Sticklebacks build nests which they guard as females deposit eggs in the summer months. |
| Northern Pike | As a top predator, the Northern Pike is an important element to many aquatic ecosystems. Spawning in the spring in shallow weedy habitats and floodplains, the rearing areas for Pike offspring may be dry at times of the year. |
| Round Whitefish | The Round Whitefish grows to approximately 30 cm in length. The inhabitant of lakes, rivers and streams is known to spawn in the shallows of said waterways in the fall and hatch in the spring. |
| Slimy Sculpin | Ideal habitat for the Slimy Sculpin is deeper waters of lakes and streams where they spawn in the spring. The spawning habitat of these small fishes may be found in rocky stream crossings where they are susceptible to sedimentation. |
| Spottail Shiner | Spawning in the spring the Spottail Shiner finds sandy lakeside areas and lower drainages of tributary springs. Being an important food source for higher predators, the shiner itself has a diet of plankton and aquatic insect larvae. |
| Trout Perch | Trout Perch average from 7.6-10.2 cm (Scott and Crossman 1998) inhabiting deeper water of lakes and streams. Spawning occurs in the summer months. The preferred spawning areas include rocky streams and lake shallows where they feed on larvae and small fish. They are found in the Mackenzie River system, Great Bear, and Great Slave Lakes. |
| Walleye | Young Walleye remain in streams until later in the summer where they migrate to deeper waters. Distributed throughout lakes and rivers throughout the NWT, Walleye are an important recreational and subsistence fish. Walleye spawn in the spring to early summer over grave or rocky shoals of lakes and rivers. |
| White Sucker | Laying well over 100,000 eggs, the bottom feeding Sucker finds gravel bottom streams and lake margins to spawn in the spring to early summer. Younger Suckers provide food for Northern Pike, Burbot and Walleye. |

### 6.8.2 Fish Habitat

Fish habitat within the proposed TASR corridor includes freshwater streams and rivers. A literature review of published and technical reports of the area surrounding the proposed TASR revealed little detailed information on species abundance or habitat assessment for the watercourses within the proposed TASR corridor. Fish and fish habitat assessments have been completed on La Martre River for the Nailii Hydroelectric Project/La Martre Falls Hydroelectric Project (ARI 2009). Major rivers such as the La Martre River flow all year round, providing a wide variety of habitat opportunities including overwintering habitat. The proposed TASR also passes by numerous small lakes which likely provide little to no overwintering habitat but can provide feeding and rearing habitat.

### *6.8.2.1 Stream Crossing Site Investigations*

A preliminary fish habitat reconnaissance field investigation was carried out in 2014 over a 4 day period, from June 24-27, 2014. The survey initially involved low level helicopter flights over the proposed corridor to permit visual inspection of streams at stream crossing locations. The overview flights also afforded an opportunity to observe watershed conditions upstream and downstream of the crossing sites as an indication of the potential of these systems to support valued fisheries resources. Stream channels potentially possessing suitable fish habitat were further evaluated on the ground. Because the scope of the preliminary reconnaissance field investigation was limited to an overview of channel characteristics along the proposed corridor, time (and weather) constrains limited ground investigations to the specific stream crossing sites within these selected locations. At these sites, the following basic parameters were identified:

- wetted width;
- total channel width; determined from abrupt changes in elevation and from vegetation changes;
- water depth;
- substrate;
- cover (type and percent);
- flow/habitat characteristic (e.g. riffle, run, pool);
- water temperature; and,
- water velocity.

Of the fifteen identified water crossings within the proposed TASR, four major crossings were deemed as being suitable for fish habitat that support Aboriginal, recreational or commercial species of fish. These major watercourses would provide perennial migratory, spawning, rearing and feeding habitat; however, some are expected to freeze completely during the winter and therefore would not offer an overwintering habitat. La Martre River, parts of James River and possibly parts of Duport River would offer an overwintering habitat as they are of an acceptable depth. Table 6-15 summarizes the characteristics at each of the five crossings, while Photos 23-28 in Appendix Q help support the assessment.

Within the four major watercourses, rearing habitat was observed in areas of slow moving water with an abundance of over or in-stream cover including vegetation, deep pools and woody debris. Good or excellent spawning habitat was also observed within the permanent watercourses where appropriate bed material within each watercourse included a component of gravels and cobbles.

The remaining water crossings were identified as ephemeral and were mostly dry at the time of fieldwork; see Tables 6-11 and 6-12 and Section 6.7.3 for further information. Because ephemeral streams can still provide fish habitat, the Tłı̨chǫ Roads Working Group (TRWG) undertook the assumption that all crossings contain suitable fish habitat. The *Fisheries Protection Self-Assessment Serious Harm Impacts Determination Record* (Appendix T), conducted by EAD staff, continued with this assumption. Employing the avoidance and mitigation techniques described in the self-assessment ranks the development of the

proposed TASR at a low risk to fish and fish habitat; so as per the DFO self-assessment policy, any review by DFO is not warranted. Section 8.9 continues the discussion with regards to the avoidance and mitigation techniques that will be employed to manage fish and fish habitat during construction.

**Table 6-15 Habitat Characteristics at Major Water Crossings along proposed TASR**

| Crossing | Approx. Width | Cover % | Habitat Type | Substrate | Comments | Photo # in Appendix Q |
|---|---|---|---|---|---|---|
| Duport River | 3.5-5 m, floodplain 50-75 m | grasses 70% shrubs 25% conifers 5% | run/pools | silt/sand | Extensive meanders with abundant isolated and seasonally connected floodplain pools. Large woody debris, entrenched eroding banks, cyprinids under vegetation. | 23, 24 |
| @ KM45.2 | 11.5 m | grasses 2% shrubs 70% conifers 28% | run/riffle | gravel/ cobble | Limited water with very little flow, but enough to sustain cyprinids. Old algae mat covers substrate. | 25 |
| James River | 10.0 m | grasses 20% shrubs 65% conifers 15% | riffle/pool /run | cobble/ organics | Meandering river with limited undercut banks. Deep well defined channel with cobble, gravel and boulders. | 27 |
| La Martre River | 50-60 m | grasses 50% shrubs 40% conifers 10% | riffle/pool | sand/ gravel/ cobble | Extremely habitable river. Main outflow to Lac La Martre and excellent fish habitat river. Large waterfalls many kilometers downstream of bridge crossing location. | 28 |

### 6.8.3 Fish Species with Special Conservation Issues

The Committee of the Status of Endangered Wildlife in Canada (COSEWIC 2012b) lists five fish species of potential conservation concern within the NWT. The Shortjaw Cisco (*Coregonus zenithicus*, designated as 'threatened') is the only one listed as possibly existing in the Tłı̨chǫ area. Though the Shortjaw Cisco distribution map includes the Tłı̨chǫ area (ENR 2014b), its distribution is not within the proposed TASR corridor and should therefore not be a concern as Shortjaw Ciscoes are found in deeper waters of large lakes. There are no SARA listed (Schedule 1) species known to occur within the proposed TASR corridor.

# 7 HUMAN ENVIRONMENT OVERVIEW

The following sections provide a brief description of the human environment and resources existing within the proximity of the proposed TASR. This background information is subsequently considered in Section 8 of this PDR to identify potential effects and proposed mitigation measures to avoid or minimize negative effects.

## 7.1 Cultural and Heritage Resources

As defined under the *MVRMA*, heritage resources include "archaeological or historic sites, burial sites, artifacts and other objects of historical, cultural or religious significance, and historical or cultural records." Heritage resources are nonrenewable and are susceptible to alteration, damage, and destruction by construction and development activities. The value of heritage resources cannot be measured in terms of individual artifacts, rather the value of these resources lies in the integrated information which is derived from the relationship of the individual artifacts, associated features, spatial relationships (distribution), and contextual situations. As such, removal or mixing of cultural or fossil bearing sediments results in the permanent loss of information basic to the understanding of these resources. As a result, heritage resources are susceptible to destruction and depletion through disturbance. Consequently, they are protected by legislation. Unless expressly authorized by a permit or in writing by an inspector, it is illegal to disturb an archaeological site, burial or artifact, and no land use activity is permitted within 30 m of a known or suspected heritage site (*MVLUR*). An archaeological impact assessment (AIA) was conducted along the proposed TASR to verify whether any heritage resources could be impacted by the development of the road. This assessment is discussed below.

Additional, less "tangible" cultural resources such as connection to land, transfer of traditional knowledge, and continued practice of the Aboriginal way of life on the land, are also important considerations for Aboriginal people in the Wek'èezhìı area. The Tłı̨chǫ Government's *Traditional Knowledge Study* (see discussion below) examines some of the cultural benefits and risks associated with the proposed TASR with respect to the Tłı̨chǫ people (TG 2015).

### 7.1.1 Archaeological Impact Assessment (AIA)

An archaeological overview and AIA were conducted during spring/summer 2014 in order to assess the potential heritage resources along the proposed TASR. Stantec was hired to perform the necessary field work, which coincided with the DOT ground truthing trip. Stantec's full AIA is provided in Appendix U. Please note this version of the report is redacted to ensure any significant areas remain confidential. The PWNHC is in possession of the original report, as is required under the archaeological permitting process.

The AIA concluded that the overall degree of existing disturbance along the ROW was relatively high and that no new archaeological sites were identified. One indigenous historic site, previously recorded in 1986, was revisited, but will not be impacted by the proposed TASR. Discussions with TRWG Tłı̨chǫ

members confirmed that the cultural area was most likely a staging area for the installation of the hydrological station at the river, which would have been installed back in the 1970s. There is no community concern over this location; therefore, the regulated 30 m buffer zone should be adequate for this site though it is expected that the proposed TASR corridor will be more than 30 m away.

No borrow sources were included in Stantec's AIA as the specific borrow sources that will be utilized for the project have not been finalized. A subsequent archaeological overview and/or AIA may be required at a later date to address the archaeological potential amongst the chosen borrow sources, due to the typically high archaeological potential with high, well-drained, elevated features. DOT will work in conjunction with PWNHC in assessing the suitability of the proposed borrow sources.

### 7.1.2 Traditional Knowledge Study

The *Traditional Knowledge Study* that was conducted by the Tłı̨chǫ Government, under the TRSC's Memorandum of Understanding in order to outline the traditional knowledge of the area, contains a section on sacred places and places of cultural importance. Road design has taken into consideration the location of grave sites and sacred sites identified within the TK study to ensure the proposed TASR does not come in contact with these areas.

During the ground truthing field trip in 2014, cabin sites and traplines identified within the TK study were verified for accuracy. The accuracy of traplines were variable; however, as was indicated by Sean Richardson, the Tłı̨chǫ representative during the field trip, the traplines indicated in the TK study may be very old, unused and overgrown, which would demonstrate why not all could be identified on the ground. Please see Section 5.1.2 of this PDR for an additional discussion on traplines identified in the TK report.

Two cabin sites were also identified as potentially falling within the ROW as they were between 50 and 100 m away from the ground truthed route. The approximate locations of these cabins along the alignment are provided in Table 7-1. In order to avoid the cabins, the proposed TASR ROW will be situated at least 50 m away from any cabin. From discussions with ENR fire fighters and users of the area, the two cabins have since been impacted by wildfires from the 2014 season and will need to be rebuilt. It is unknown when the cabin owners will begin reconstruction; however, the proposed TASR will not encroach on these locations.

**Table 7-1 Approximate Cabin Locations adjacent to Proposed TASR corridor identified during 2014 field trip**

| KM Marker | Location | Distance from Ground Truthed Trail |
|---|---|---|
| KM 6 | 62°29'06" N 116°36'30" W | 50-100 m away |
| KM 27 | 62°37'18" N 116°51'41" W | 50-60 m away |

In addition to the erect cabins, there are two locations directly along the alignment that contain strewn remains of old camp sites. At KM 22.5 it appears to have been a possible tent frame, while at KM 78 there is a sign post labeling the area as 'Franks Camp #2'. An inquiry with the Tłı̨chǫ people via the TRWG has indicated that these sites can be cleaned up and pose no issue with respect to the proposed TASR corridor.

## 7.2 Communities

The proposed TASR is located within Mǫwhì Gogha Dè Nı̨ı̨tłèèí, the traditional territory of the Tłı̨chǫ Dene. The proposed TASR is intended to provide improved service to the Tłı̨chǫ community of Whatì, which is currently serviced by the existing winter road. This community and the regional centre, Behchokǫ̀ are illustrated on Figure 4-1 and are profiled in this section.

### 7.2.1 Behchokǫ̀

Behchokǫ̀, consisting of the settlements of Rae and Edzo, is the largest Tłı̨chǫ community. Rae is located on the shores of Marian Lake, north of Great Slave Lake. Edzo, also on Marian Lake is connected to Rae by an all-season road. A trading post was originally established in the area at Old Fort Rae on Great Slave Lake in 1852; however, settlement in Rae began in the 1900s. In 1965, the government began building the nearby community of Edzo as terrain conditions were more favourable for municipal infrastructure and growth. However, many residents did not want to move and Rae remains the larger of the two communities. Tłı̨chǫ and public government services and commerce are located in Rae, with Edzo hosting the regional high school and some residences. Rae and Edzo are accessible year round by road. An airport was recently constructed outside of Edzo.

The population of Behchokǫ̀ was 2,174 in 2012, with approximately 94% of the identified as Aboriginal (Bureau of Statistics 2013). The annual growth rate averaged 1.9% between 2001 to 2012, which was higher than the territorial average of 0.7%. In 2008, 37.5% of the population hunted and fished and 73% of households reported that country food accounted for at least half of their diet (Bureau of Statistics 2013). Nearly 90% of Aboriginal residents reported speaking an Aboriginal language in 2009. Table 7-2 summarizes the population, gender, age and education of Behchokǫ̀ residents.

**Table 7-2 Behchokǫ̀ Population, Age, and Education Data**

| | |
|---|---|
| **Total Population (2012)** | 2,174 |
| **Number of males** | 1,154 |
| **Number of females** | 1,020 |
| **Age (2012)** | |
| **% 0-14 years** | 32 |
| **% 15-24 years** | 17.5 |
| **% 25-44 years** | 30.5 |
| **% 45-59 years** | 12 |
| **% 60 years and older** | 8 |
| **% of population with High School Diploma or more (2009)** | 34 |

**Source**: GNWT Bureau of Statistics (2013)

The main sources of employment in Behchokǫ̀ are related to diamond mining and public services. There are several stores and two gas stations in Rae. A Health Centre and RCMP Detachment are also located in Rae. The regional high school is located in Edzo.

Community employment data are summarized in Table 7-3. In 2009, 515 residents aged 15 years and older participated in the labour force which equated to a participation rate of 48.5% (Bureau of Statistics

2013). The unemployment rate for Behchokǫ̀ was 22.7% in 2009, above the territorial rate of 10.3% (Bureau of Statistics 2013). The employment rate was higher for those residents who had a high school diploma or higher levels of education, than residents without (i.e., 64.6% versus 23.2%).

### Table 7-3 Behchokǫ̀ Employment Data

| | |
|---|---|
| **Number of people 15 years and older in the Labour Force (2009)** | 515 |
| **% of population that worked (2008)** | 64.3 |
| **% of population that worked more than 26 weeks (2008)** | 55.4 |
| **Potential Available Labour Supply (number of unemployed) (2009)** | 507 |
| **% That Would Do Rotational** | 77.3 |
| **% Male** | 52.3 |
| **% Aboriginal** | 99.2 |
| **Labour Force Profile (2009)** | |
| **% government, health, social services or education** | 54 |
| **% goods producing** | 29.7 |
| **% other industries** | 14.4 |
| **Average Family Income ($) (2010)** | 78,900 |

**Source:** GNWT Bureau of Statistics (2013)

## 7.2.2 Whatì

Whatì was formally known as Lac La Martre until it was officially changed in 2005 under the Tłı̨chǫ Agreement. Whatì, located on Lac La Martre at 63°08'N, 117°06'W is approximately 164 km northwest of Yellowknife by air.

The population of Whatì was 519 in 2012, with approximately 99% identified as Aboriginal (Bureau of Statistics 2013). The annual growth rate averaged 0.4% between 2001 to 2012, which was lower than the territorial average of 0.7%. In 2008, 47% of the population hunted and fished and 78% of households reported that country food accounted for at least half of their diet (Bureau of Statistics 2013). Approximately 93% of Aboriginal residents reported speaking an Aboriginal language in 2009. Table 7-4 summarizes the population, gender, age and education of Whatì residents.

### Table 7-4 Whatì Population, Age, and Education Data

| | |
|---|---|
| **Total Population (2012)** | 519 |
| **Number of males** | 274 |
| **Number of females** | 245 |
| **Age (2012)** | |
| **% 0-14 years** | 30 |
| **% 15-24 years** | 17 |
| **% 25-44 years** | 33 |
| **% 45-59 years** | 11 |
| **% 60 years and older** | 9 |
| **% of population with High School Diploma or more (2009)** | 33.6 |

**Source**: GNWT Bureau of Statistics (2013)

The main sources of employment in Whatì are related to diamond mining and public services. There is a store, Bed and Breakfast accommodation, fire hall, health centre, school and RCMP Detachment.

Community employment data are summarized in Table 7-5. In 2009, 156 residents aged 15 years and older participated in the labour force which equated to a participation rate of 59.4% (Bureau of Statistics 2013). The unemployment rate for Whatì was 27.1% in 2009, above the territorial rate of 10.3% (Bureau of Statistics 2013). The employment rate was higher for those residents who had a high school diploma or higher levels of education, than residents without (i.e., 58.7% versus 34.1%).

More detailed socioeconomic and cultural information on Whatì is provided in Section 4 of Appendix B, *Eleke tse di – Watch Each Other: A Socio-Economic Issues Scoping Study for a Potential All-Weather Road to Whatì*.

### Table 7-5 Whatì Employment Data

| | |
|---|---|
| **Number of people 15 years and older in the Labour Force (2009)** | 156 |
| **% of population that worked (2008)** | 64 |
| **% of population that worked more than 26 weeks (2008)** | 54 |
| **Potential Available Labour Supply (number of unemployed) (2009)** | 85 |
| **% That Would Do Rotational** | 59 |
| **% Male** | 65 |
| **% Aboriginal** | 100 |
| **Labour Force Profile (2009)** | |
| **% government, health, social services or education** | 46 |
| **% goods producing** | 36 |
| **% other industries** | 17 |
| **Average Family Income ($) (2010)** | 66,393 |

**Source:** GNWT Bureau of Statistics (2013)

### 7.2.3 Infrastructure

Infrastructure in the region is limited. A single all-season road, Highway 3, connects Behchokǫ̀ with Yellowknife and the southern NWT. Winter roads are built annually to connect Whatì, Gamètì and Wekweètì with Highway 3.[9] Each community has an airstrip and other municipal infrastructure including water supply, sewage and solid waste disposal, schools and community halls. The Snare River hydro - electric system, which consists of four generating stations, supplies hydro electric energy to Behchokǫ̀ and Yellowknife. Electricity in Gamètì and Whatì is provided through local diesel generators. Telephone and internet services are available in all communities.

## 7.3 Tourism

Tourism within the Whatì area has been limited as Whatì residents have previously been reluctant to risk the pristine environment and exceptional fishing of Lac la Martre. However, in recent years, the potential of eco- and cultural tourism has been of central interest to the Tłı̨chǫ Government as tourism is seen as a sustainable future economic sector (MacDonald 2015).

The Tłı̨chǫ *Traditional Knowledge* and *Socio-economic Issues Scoping* reports have identified that the Tłı̨chǫ have been wary of non-residents constructing cabins, hunting and fishing on their land as they perceive these activities will cause increased pressure to the environment, which may affect their culture and heritage (TG 2015; MacDonald 2015). However, the Tłı̨chǫ Government recognizes that ecotourism (touring natural habitats in a manner meant to minimize ecological impact) will allow for a balanced approach as it can help protect the land, while also providing local benefits for Tłı̨chǫ residents. Because the Tłı̨chǫ Government has the authorization to regulate cabin construction under the Tłı̨chǫ Land Use Plan, TG will be able to ensure cabin leases are authorized in a sustainable manner.

All of the economic studies that have been conducted in relation to the proposed TASR have indicated that the road should increase regional tourism. Currently, a relatively small fishing lodge on Lac la Martre is the only tourism operation on Tłı̨chǫ Lands; therefore, there is ample space for growth (MacDonald 2015).

Local residents of Whatì have identified that the proposed TASR will allow tourism to develop as a viable industry:

> *"[It's] a clean industry that we need to look at," according to one of the Whatì Community Government councilors. "[Whatì will see] a lot more visitors, from people coming to sightsee, drive the road for fun, come and look for crafts, dry fish, see if they can hire someone to take them out on a boat or skijoring (service provider, December 2013)" (MacDonald 2015).*

Though GNWT's Industry, Tourism and Investment (ITI) department does not expect the proposed TASR to attract more tourists to the NWT because the community of Behchokǫ̀ currently receives very little

[9] More information on existing transportation infrastructure deficits specific to Whatì, one of the primary drivers for the all-season road proposal, are provided in Sections 5.1 and 5.2.1 of Appendix B.

leisure tourism, ITI has stated that the road may open up the area to local recreational users, including those in Yellowknife, if a day use area were set up in proximity to the La Martre Falls.

## 7.4 (Socio)Economics

During initial investigations into the feasibility of an overland road to Whatì, DOT contracted Nichols Applied Management to conduct an economic analysis to examine the financial costs and implications of the proposed realignment (Nichols 2006). Because almost a decade passed since this initial report and the project scope had changed, DOT, in conjunction with the Tłı̨chǫ Government and Community Government of Whatì, requested further economic studies to be undertaken. During 2014/2015, three studies were produced: Community Government of Whatì's *Micro-Economic Analysis of the All-Season Road* (2015); *Economic Evaluation of the Tłı̨chǫ Road* by Nichols Applied Management (2015); and *Eleke tse di – Watch Each Other: A Socio-Economic Issues Scoping Study for a Potential All-Weather Road to Whatì* (MacDonald 2015), which are located in Appendices V, C and B, respectively. The highlights of these studies, which have quantified the economic and socioeconomic impacts, are presented below and include a discussion of other general opportunities of the proposed TASR. Though the highlights are informative, review (in full) of the mentioned documents provides a more detailed picture, especially with respect to socioeconomic aspects. Please note the terms "all-season" and "all-weather" are used interchangeably in these studies.

The notes from the Special Inter-Agency Committee meeting on June 24, 2015 in Whatì (Appendix E) are also useful to review as they demonstrate how the Tłı̨chǫ Government, GNWT, and Community Government of Whatì are developing measures to manage the aspects discussed in the three studies.

### 7.4.1 Comprehensive Study of the Highway (Socio)Economic Impacts

Community Government of Whatì's ***Micro-Economic Analysis of the All-Season Road*** (March 2015):

In March 2015, the Community Government of Whatì developed a grassroots micro-economic report that considered construction of the TASR as well as pre and post construction impacts and highlighted the economic development impacts and opportunities for the community. This report not only considered employment opportunities in construction but considered the many 'spin-off' opportunities for new business and services in the community of Whatì. The report surmised that significant increases in employment would generate new business opportunities in fields not related to construction (such as, child care, hotel management, building construction, food service, mechanical repair, expediting, tourism, etc.).

The micro-economic analysis also considered economic benefits as they shift from road construction to road maintenance and considered the economies of scale with respect to a possible road to the proposed Fortune Minerals' NICO Mine project. The report also considered how an all-season road could stimulate additional exploration in the area that would equate to additional employment opportunities in a longer view. This report is clear in its vision of short, medium and long term economic benefits to the community.

***Economic Evaluation of the Tłı̨chǫ Road*** by Nichols Applied Management (March 2015):

This report presented an analysis of the economic implications of the proposed TASR between Highway 3 and Whatì. A Macroeconomic Policy Framework (MPF) Lens Analysis, produced by the GNWT's Department of Finance, focused on the benefits of the TASR accruing to the NWT economy as well as the GNWT fiscal position of the NICO project going ahead, while the Nichols' analysis took a broad, NWT-wide perspective by:

- comparing direct economic costs and benefits (in constant 2014 dollars). It does not include spin-off or indirect and inducted effects;
- including only real resources used or created by a project and ignored transfers, such as taxes and royalties, and financial flows, such as financing; and
- including a broad set of community benefits and costs between 2015 and 2044:
    - reduced costs of winter road construction and maintenance;
    - reduced cost of constructing and maintaining the all-weather road;
    - increased benefits accruing to the community associated with easier business and governmental travel between Whatì and Behchokǫ̀/Yellowknife, and reduced medical travel costs;
    - increased travel costs incurred by Whatì residents associated with more frequent travel between Whatì and Behchokǫ̀/Yellowknife;
    - reduced costs of living in Whatì due to year-round road access; and
    - a proxy for the non-market value accruing to the Whatì residents of increased access to Behchokǫ̀/Yellowknife.

It was found that an economic cost benefit analysis (CBA) that quantified the major community and industry costs and benefits indicated that the economic benefits exceeded the economic costs by $12 million. Under base case assumptions and using a 7% real discount rate, the benefit/cost ratio is estimated to be 1.01; however, the result is sensitive to product prices. The combined NICO and community net economic benefits of the proposed TASR are estimated to be $122 million under a high product price and at minus $98 million under a low product price scenario.

***Eleke tse di – Watch Each Other: A Socio-Economic Issues Scoping Study for a Potential All-Weather Road to Whatì, Tłı̨chǫ Region, Northwest Territories*** by Alistair MacDonald (March 2015):

The socioeconomic study concluded that people are excited about:

- access to more and cheaper goods;
- long-term transportation solution (especially with climate change);
- job and economic development opportunities from the road and potential mining development;
- increased mobility; access to the outside world;
- opportunities for employment in road building;

- hospitality – hotels and restaurants;
- housing for workers, people moving into Whatì;
- access to road system; and
- the opportunity to grown as a community.

And that they are concerned about the following:

- outsiders coming in – reduced safety and security and sense of community;
- increased industrial development opened up by the road (not just the proposed NICO mine), and effects on the lands and water;
- increased contamination risks;
- reduced emphasis on local cultural/harvesting activities;
- kids (especially) accessing drugs and alcohol;
- people leaving the community far too often; and
- becoming like Behchokǫ̀ (a strong stigma about social crisis is Behchokǫ̀ was expressed).

As a result of the study, leadership and staff sat down with a list of mitigations that had been generated through focus groups, interviews and community consultations (in the socioeconomic study) and prioritized policies and programs that were feasible. The resulting list of mitigations are the programs and policies that both Tłı̨chǫ and Whatì Community Governments have committed to implement (see Appendix B and Section 8.11 for further details).

### 7.4.2 Economic Impacts from the Construction and Maintenance of the Highway

One of the economic impacts from the construction and maintenance of the proposed TASR is short-term and long-term employment. The Community Government of Whatì's *Micro-Economic Analysis of the All-Season Road* anticipates 10 new jobs in Whatì after construction in order to perform the daily maintenance and safety requirements on the road (2015). During construction, DOT anticipates requiring up to 300 employees working 2 week rotations to satisfy construction requirements for the road. As construction of the proposed TASR commences, there will be the opportunity for Fortune Minerals to begin construction of the NICO mine; however, this is dependent upon whether they have procured the necessary funds. Further details pertaining to the NICO project are discussed as a part of the cumulative effects, which are located in Section 9. Under the assumption Fortune procures the necessary funds to begin its own construction, Fortune anticipates the construction of the NICO mine to generate approximately 300 jobs and has committed to maximizing the employment of the Tłı̨chǫ people; construction of the access road to the NICO project will also generate approximately 100 jobs (Whatì 2015). Direct employment from the mine with or without underground operations will peak at between 188 to 269 jobs and Fortune anticipates that indirect and induced employment during the life of the mine will be 1,335 and 2,026 person years, respectively (Whatì 2015).

### 7.4.3 Reduction in Cost of Living

By reducing transport costs in Whatì, the cost of living for residents will decline, improving economic wellbeing overall. The cost of living in Whatì is estimated to reduce by at least $342,000 per year (Nichols 2015). Currently, there are 115 residential dwellings in Whatì; therefore, per household, yearly transportation costs would be reduced by approximately $2970.

### 7.4.4 Other Opportunities

Other opportunities, such as the option to connect Whatì to the Snare Hydro Electric System, are difficult to quantify but include the following:

#### *7.4.4.1 Cost of Government Program Service Delivery*

The TASR will reduce the cost of providing government services and programs delivered in the region through a reduction in travel costs, operation and maintenance costs for health, education, social, and recreational facilities and services, capital programs, and local municipal services and programs.

#### *7.4.4.2 Social Aspects*

The TASR will provide Whatì residents year-round road connection to communities in the southern Northwest Territories and the rest of Canada, thereby allowing cheaper, easier, and safer access to regional facilities, programs, and services in health care, education and recreation. This will help to promote family, community, and sports events, such as school indoor soccer and hockey tournaments, community feasts and festivals, and make family get-togethers such as weddings or reunions more affordable.

Though there are numerous social benefits associated with the TASR, social concerns (such as the possibility for increased substance abuse, perceived security issues, and a discomfort with the unknown), which are discussed in detail in the socioeconomic report, have also been expressed. These concerns are expected to be managed using various tools which are further discussed in Section 8.

#### *7.4.4.3 Future Business Development*

As the TASR will expand the transportation system in the NWT, new opportunities, that would not have been possible without all-season access to the Wek'èezhìı area, become achievable. In addition to the items already mentioned (hospitality, tourism, hydro), the following business opportunities may become a future focus.

The TASR will provide additional resource extraction opportunities in the area as access for exploration companies will be induced with the introduction of guaranteed all-season access. This lack of access has been identified as a current development hurdle by ITI and the NWT & Nunavut Chamber of Mines.

The Whatì airport, with the addition of ancillary buildings, could also become a hub that services the Sahtu communities. The reduced air distance would then in turn lower costs for Sahtu communities as the majority of items could be trucked to Whatì.

### 7.4.5 Opportunities to Develop a Future Workforce

During the consultations associated with preparation of this PDR, the question of training and education opportunities arose. Although this document does not commit any organization or agency to the training and education of a future workforce, it is relevant to identify opportunities that could be undertaken now in preparation for the future. For example, training and career planning could begin at the high school level in the communities.

Speaking to this subject, during the June 24, 2015 Special Inter-Agency Committee meeting, Aurora College indicated that it was going to be working on training for small business and customer service, and will be ready to work on equipment training opportunities. Education, Culture and Employment (ECE) also indicated that in the next six months there would be an Employment Transition Officer for the North Slave Region. The Tłı̨chǫ Community Service Agency (TSCA) and ECE are working together on establishing funding for training. ECE also has a program in place that allows people with a criminal background to overcome this barrier with respect to employment in a strict security environment, such as the mining sector (Appendix E).

Construction of the TASR will present business and employment opportunities for general labourers, equipment operators, surveyors, environmental monitors, camp staff (cooks, camp managers, custodians), expeditors, engineering and technical staff, and construction administrators, among others. Although the TASR construction is a onetime opportunity, the result will be a well-trained and educated workforce that will serve the needs of future infrastructure development, as well as make the development of that infrastructure in the Tłı̨chǫ area more attractive. The economic and social benefits presented provide a vision of opportunities beyond the construction of the TASR, relative but not limited to:

- road management and operation by DOT (equipment operators, highway patrol, maintenance foremen, expeditors, engineering and technical staff, environmental monitors and administrative staff, expeditors and logistics specialists, etc.);
- land access management (enforcement, environmental and wildlife monitors, technical planning staff, etc.);
- tourism and associated community-based service business (environmental and wildlife monitors, professional guides, tourist accommodations, campgrounds and RV hookups, communications and promotions specialists, business administration professionals, chefs, restaurant managers, expeditors, logistics specialists, etc.); and
- resource and exploration opportunities and associated community-based service businesses (environmental and wildlife monitors, technical and engineering specialists, camp support staff, expeditors, logistics specialists, drivers and local administrative and management staff, etc.).

# 8 PROPOSED MITIGATION AND ANTICIPATED ENVIRONMENTAL IMPACTS

The following section reviews the proposed project activities and outlines potential environmental effects and mitigation measures associated with the construction of the proposed TASR.

## 8.1 Approach to Environmental Management

DOT is committed to constructing the proposed TASR, borrow sources, construction camps and associated access roads in a safe and environmentally responsible manner. Environmental studies, including a completed 2013 environmental assessment, have been conducted with respect to Fortune Minerals' NICO mine project. The proposed mining development's regional study area is adjacent to the northern edges of the proposed TASR. Due to the proximity of said mining development with respect to the proposed TASR, DOT has reviewed the *Report of Environmental Assessment and Reasons for Decision: Fortune Minerals Limited NICO Project* (MVEIRB 2013) as a means to consider the concerns identified during the environmental assessment which may be mirrored by the proposed TASR. The mitigation techniques associated with the proposed TASR herein have been developed with consideration for the Reasons for Decision for the NICO project, as well as from the lessons learned with respect to the current construction of the Inuvik-Tuktoyaktuk Highway and its Environmental Impact Assessment. A review of other proposed road projects within the NWT and their suggested impacts and mitigations have also helped in building this knowledge base.

The existing broad framework for environmental management of the road construction project consists of:

- Regulatory and other management instruments (Section 3) that define environmental terms and conditions, including:
    - Land and Water Board preliminary screening decision, including recommended Land Use Permit and Water Licence Terms and Conditions;
    - Land Use Permit Terms and Conditions;
    - Quarry Permit Terms and Conditions;
    - Water Licence Terms and Conditions;
    - Directions from the Tłı̨chǫ Government and ENR;
    - DFO Fisheries Protection Program website (www.dfo-mpo.gc.ca/pnw-ppe/fpp-ppp/index-eng.html); and
    - Explosives permits.
- Use of experienced construction contractors, local where available;
- Avoidance and protection of sensitive terrain and habitats;

- Avoidance of identified heritage and archaeological sites; and
- Requiring contractors to adhere to approved management plans, which include:
    - Contractor HSE manuals including general spill contingency and emergency response plans;
    - Contractor standard operating procedures documents;
    - Site-specific health and safety plans;
    - Site-specific spill contingency plans; and
    - Training related to the above to ensure that all environmental management plans are implemented effectively.

In relation to socioeconomic and cultural impact management, the Tłı̨chǫ Government, GNWT and the Community Government of Whatì are committed to working cooperatively to develop plans, programs and policies to manage and monitor potential adverse socioeconomic and cultural impacts from the proposed TASR, and maximize benefits to Tłı̨chǫ citizens, on an on-going basis through the regulatory, construction and operations phases of the proposed TASR. As mentioned throughout this document, the Tłı̨chǫ Government and Whatì Community Government have prepared a motion (Appendix D), which consists of a full list of agreed upon mitigation commitments.

## 8.2 Air Quality and Emissions

Dust and air emissions associated with the construction of the proposed TASR are expected to have localized[10] and temporary[11] effects on air quality in the vicinity of the proposed TASR, borrow sources and access roads when appropriate mitigations such as blast mats are used.

Dust particles of various sizes will be generated by handling of embankment and granular materials in borrow sources and along the proposed TASR corridor during construction. Heavy equipment movements, loading and unloading material, crushing, screening, blasting, erosion from stockpiles, vehicle traffic, etc. are expected to contribute to dust generation. Dust control products such as calcium and magnesium chloride that are traditionally used in spot applications each year as part of highways maintenance, can coat granular dust particles and the chemical can become airborne with the dust particle as the dust control application nears the end of its serviceable life (a few months without re-watering). Larger particles (>44 microns diameter) are typically associated with nuisance issues, while smaller particles (<10 microns diameter) can potentially create human health issues at elevated levels in populated areas.

The application of water, as per the GNWT *Guideline for Dust Suppression* (2013), from nearby, suitable water sources, will be effective during summer construction periods in controlling dust created by loading and unloading materials, stockpiling, and wind erosion. Any water extracted for dust control or other

[10] Localized: restricted to the proposed TASR corridor (60 m ROW), including temporary access roads and borrow sources.
[11] Temporary: restricted to construction activities occurring during summer.

purposes will be undertaken in accordance with the Northwest Territories Water Licence requirements and DFO water withdrawal criteria.

Once the proposed TASR is in operation, dust control applications with products other than water are expected to be undertaken in selected areas, such as curves and approaches to waterbodies.

Emissions from diesel engine combustion exhaust during (CO, $NO_x$, $SO_2$ and PM) construction and operation will be generated and can negatively impact air quality in the local area around where the equipment is operating at the particular time. To minimize emissions from construction and maintenance equipment, contractors will be required to keep equipment well maintained and in good operating condition, and to minimize unnecessary idling even during winter months. Power sources will be included at construction camps to minimize the need to keep a vehicle or equipment running during cold weather.

Daily incineration of combustible waste at camp site locations is not expected to impact air quality as incinerators will be operated and maintained as per manufacturers' expectations and will follow the project's Waste Management Plan (Appendix N). Incinerator use will follow Environment Canada's Guideline for Batch Waste Incineration and meet applicable standards (Canadian Standards Association or Underwriters' Laboratories of Canada).

Table 8-1 summarizes the potential impacts and associated mitigation measures that will be applied to maintain air quality and emissions.

### Table 8-1 Potential Air Quality and Emissions Impacts and Mitigations

| Potential Impacts | Mitigation Measures |
|---|---|
| Deposition of dust onto vegetation; migratory birds, eggs and nests; and waterbodies located within proposed TASR (60 m ROW), access roads and borrow sources | • Water from nearby, suitable water sources, as per the GNWT *Guideline for Dust Suppression* (2013), will be applied during summer construction<br>• Slow speeds (50 km/h) for haul trucks and other vehicles susceptible to creating excessive dust during summer construction will be enforced<br>• Blast mats will be utilized when blasting<br>• Additional measures associated with bird breeding are discussed under Section 8.7 (Wildlife) |
| Greenhouse gas emissions from diesel engines and incineration | • Federal & Territorial emissions standards will be followed<br>• Equipment will be well maintained and in good operating condition<br>• Unnecessary idling will be minimized<br>• Vehicles or equipment will be plugged in at camps to minimize need to keep running during cold weather<br>• Incinerators will be operated and maintained as per manufacturers' expectations |

## 8.3 Noise

Most noise during the construction phase will be associated with equipment operation and, if required, blasting activities to break up borrow material during excavation. Increases in noise level and unfamiliar noise will disturb wildlife.

Trucks will typically be dump trucks or other haul trucks, operating at slow speeds. Noise levels associated with such trucks are typically within 78-82 dBA at 15 m from the truck. This noise level is low[12] and the impact will be to the local area within which the specific activity is taking place.

Although there are no local noise regulations that directly apply to construction, the contractors will be directed to apply reasonable mitigation to reduce possible effects associated with construction noise. These will include adequate maintenance of their construction equipment, including mufflers.

Blasting activities require special care in planning and execution. The use of explosives will be timed to avoid periods when sensitive wildlife species are in the area. Locations will be chosen to avoid potential harm to fish species in local waterbodies. Prudent design, best management practices and mitigation can be combined to minimize sound levels during the construction phase.

Aggregate borrow activities, including blasting will be intermittent and temporary in nature[13]. Most of the noise will be associated with earth-moving equipment operation during periods of aggregate borrow activity. Best management practices and mitigation measures will be applied to reduce the effect of noise.

Examples of prudent design and management practices include those listed in Table 8-2.

### Table 8-2 Potential Noise Impacts and Mitigation

| Potential Impacts | Mitigation Measures |
|---|---|
| Noise level and unfamiliar noise associated with construction (traffic and equipment operation, blasting, and aggregate crushing) will disturb wildlife and fish | • Construction activities will be limited during sensitive periods to minimize effects on wildlife. For example surface blasting will be suspended when caribou are identified within a 'danger zone'. Further details pertaining to wildlife and blasting can be found in the WMMP and Quarry Operations Plan, respectively<br>• Effective logistics planning such as the use of vans or extended cab pick-up trucks to transport workers to minimize vehicle movements will be utilized<br>• Regular maintenance of equipment and provision of appropriate mufflers for all internal combustion engines will be ensured |

## 8.4 Climate Change

The proposed TASR is not expected to have an impact on climate change. The anticipated volume of vehicle traffic for the TASR is low (20-40 vehicles/day) and with the general standard that vehicles remain in good working order, vehicle emissions and their effect on climate change through the contribution of greenhouse gases are expected to be negligible. Instead, the effects of climate change (i.e. warming temperatures, greater precipitation, extreme and unpredictable weather events) could have an impact on the stability of the proposed TASR from operation, maintenance, and preservation aspects, potentially resulting in negative impacts to the surrounding environment.

Road stability could be impacted if the effects of climate change are not mitigated during the planning stages of construction. Maintaining the stability of permafrost will help ensure the success of the road.

[12] Using the simplified calculation (-6 dB/doubling of distance; BRD 2015), it is estimated that at a distance of approximately 1 km construction noise will be reduced to typical background levels (30-40 dBA).
[13] Intermittent and temporary can be described as being limited to the specific borrow sources and/or ROW segment under construction. It is expected that if and when blasting is required, it will only occur once daily.

The design parameters and construction techniques chosen will be based on geotechnical analysis and will help in mitigating permafrost melt by avoiding shallow ice rich deposits and/or utilizing suitable techniques which will insulate the permafrost layer. Increased precipitation as a result of climate change have also been accounted for by ensuring water crossings can compensate for the potential of increased flow and the road surface itself can accommodate increased rain events. This was accomplished by following the hydrology recommendations for a 1 in 100 year flood.

A risk-based approach for incorporating climate change into design of road infrastructure on permafrost is now recommended practice. The challenge for design and construction over thaw-sensitive permafrost terrain is to assess the capital cost of constructing the proposed TASR and the long-term maintenance implications. The design parameters and construction techniques take into account consideration of these risks and provide mitigative approaches to the proposed TASR design. The two most significant elements of the design are the use of non-woven geotextile between existing ground and the embankment, and maintaining minimum height, based on terrain type, to mitigate heat gain that can result in thawing of the permafrost. In the design, the depth to which excavation and backfill takes place at any particular location is determined on the basis of the anticipated effect of the insulating effort was as well as the ice content and soil characteristics within the depth of thermal degradation that could be expected. Preliminary estimates of such have been made in the design. When the geotechnical investigation at later stages in the project development is used to confirm the subsurface characteristics along the proposed TASR, depth of fill and excavation and backfill will be refined in the detailed design.

As with roadway cuts, ditching in permafrost will be avoided whenever possible. In the preliminary design that is accomplished by increasing the number of cross drainage culverts to eliminate or minimize the ponding or flow of surface runoff water along the toe of the embankment. In some sections along the proposed TASR, ditching in the permafrost is unavoidable. To eliminate undesirable ponding or to improve dispersal of drainage flows, the following principal has been followed in the preliminary design:

- due to the general susceptibility of permafrost materials to erosion when thawed or thawing, the gradient of any necessary ditches is kept as flat as possible.

Another risk factor that is related to climate uncertainty is precipitation, including both summer rain and winter snow. Building conservatism into a design to account for climatic warming is more complex than simply projecting air temperature trends into the future. The greatest risk is often associated with extreme events that are now being observed in northern Canada. Unprecedented warm winters are often followed by rapid and early thaw. High snow cover years are resulting in extreme snow drifting that blankets the downwind sideslopes, insulating the surface and raising the ground temperature under the fringes of the embankment. Standing water against the sideslopes retards winter freezeback of the active layer and can accelerate thaw below the sideslopes.

Key mitigative measures, in addition to those noted above, incorporated into the design parameters to manage uncertainty related to future climate trends and extremes in the discontinuous permafrost region that this proposed TASR will be constructed in include:

- thick embankments that insulate and stabilize the active layer and the use of non-woven geotextiles for reinforcement;

- where available, use of porous embankment materials, such as coarser gravels, to reduce the risk of ponding along the toe of the embankment;
- where such material is not available, the use of culverts to balance surface flow has been included; and
- adoption of construction methods that minimize cuts and minimize disturbance of the natural vegetation before fill is placed.

Of greater importance is what activities are undertaken after the proposed TASR is put into operation. Given the uncertainty of the events associated with climate change, greater vigilance and effort on the part of maintenance operators will be required including: greater effort for spring culvert clearing and fall protection of culverts and drainage structures, more frequent inspections, and monitoring of the performance of the infrastructure. There will also be greater need for additional resources for maintenance and rehabilitation in the face of potential permafrost degradation.

## 8.5 Terrain, Soils and Permafrost

Terrain integrity is an integral component of the landscape, since soils, vegetation, wildlife, wildlife habitat, and ultimately land use are determined by terrain conditions, water and climate. Permafrost influences drainage patterns, and thereby terrain integrity and surface processes, while soils are fundamental influences on vegetation. As the proposed TASR will be built on terrain that falls within Canada's extensive discontinuous permafrost zone, appropriate mitigations will be necessary to maintain the various aspects of terrain, soils and permafrost.

### 8.5.1 Permafrost

Permafrost with little or no ice generally does not cause engineering problems; whereas, ice-rich permafrost can cause serious problems if allowed to thaw. As noted in the previous section, an increase of average temperatures due to climate change can result in the thawing of permafrost, which has an impact on the proposed TASR itself. Alternatively, the construction and maintenance activities for the proposed TASR and the physical presence of the proposed TASR embankment can cause ground disturbance and/or a change in the ground/air temperature balance, the effect of which is an increase in the active layer and permafrost thaw. Thawing of permafrost may result in instability of the proposed TASR's structure, which can then create loss of habitat, impact erosion, and lead to structural failure on the proposed TASR that presents safety issues. Thawing of permafrost can also result in ponding of surface water and can cause other drainage issues that have similar impacts as those noted above.

### 8.5.2 Terrain

Activities that will affect the terrain during construction of the proposed TASR include the removal of overburden at borrow sites, the excavation of construction material from borrow sources, temporary construction camps, construction of the proposed TASR and re-contouring of construction sites and associated facilities.

Suitable borrow sources will be selected as close to the proposed TASR corridor as possible to minimize haul distances. The borrow sources will be operated and reclaimed in a manner consistent with Lands quarry permit requirements and existing environmental standards and guidelines. To further minimize potential impacts on the permafrost through ground disturbance, where possible, temporary winter access roads, constructed over frozen ground, will be employed for access to borrow sources.

As per the requirements issued under quarry permits, site-specific reclamation plans (as a section under the QOPs) will be prepared and approved prior to the commencement of operations at each proposed material source. Material sources will be permanently reclaimed when use of that source is complete in accordance with the applicable reclamation plan. Progressive reclamation will occur to ensure that only areas with active borrowing will be disturbed. Mined out areas will be re-contoured and re-vegetated, if possible to mimic the surrounding terrain upon completion of borrowing activities.

The potential effects of activities on terrain can be related to surface disturbance during construction that can cause damage to soils, permafrost, cause erosion, and alter landforms. Mitigation strategies to reduce effects on soils and landforms include those listed in Table 8-3 and discussed in Section 8.5.3.

### Table 8-3 Potential Terrain, Soils and Permafrost Impacts and Mitigations

| Potential Impacts | Mitigation Measures |
|---|---|
| Erosion and drainage pattern changes as a result of construction related activities (including overburden removal and excavation) | • Potential erosion will be controlled by utilizing an effective road design (including use of engineered culverts and bridges)<br>• Slopes will be stabilized, if required<br>• Re-vegetation with native species, where possible<br>• DOT's *Erosion and Sediment Control Manual* (Appendix W) will be followed<br>• Runoff velocities will be kept low |
| Soil damage as a result of construction related activities (including potential soil contamination due to accidental spills) | • Surface disturbance will be limited<br>• Construction on highly saturated soil (primarily during freshet) will be avoided where practical or suitable ground equipment will be utilized to prevent unnecessary soil damage through rutting, etc.<br>• Geotextile will protect the organic layer in areas where there is concern<br>• Borrow sources will be selected by considering various criteria, such as distance from TASR corridor and whether the area has already been disturbed by the 2014 forest fires<br>• Adherence to SOPs for fuel handling and follow Spill Contingency Plan |
| Permafrost thaw as a result of construction related activities | • During geotechnical investigations, ice-rich permafrost areas will be identified and avoided if possible. Cut-fill operations will be avoided where there is the possibility of hitting ice-rich permafrost and instead geotextile will be laid and sensitive areas will be filled.<br>• During susceptible seasons (spring, summer, fall), suitable ground equipment will be utilized to prevent |
| Erosion and drainage pattern changes as a result of permafrost thaw | • Area of ground disturbance will be minimized by following the pre-existing winter road alignment<br>• Providing sufficient cross drains along the roadway will facilitate water movement and maintain drainage patterns<br>• Erosion and drainage patterns will be monitored and the number of cross drains and locations will be increased if warranted and will provide remedial erosion protection |

**Table 8-3 (Continued) Potential Terrain, Soils and Permafrost Impacts and Mitigations**

| Potential Impacts | Mitigation Measures |
|---|---|
| Permafrost thaw as a result of natural conditions (forest fires, climate change) | • Disturbance of the active layer during construction and maintenance activities will be minimized.<br>• Areas, such as forest fire areas, where permafrost thaw may be accelerated in the future, will be identified and monitored.<br>• Steep grades where subsidence may occur as a result of permafrost thaw will be avoided, where possible. |
| Changes in landforms (e.g. loss of critical esker or beach ridge landforms for aggregate resources) | • The use of eskers and beach ridge landforms for aggregate sources will be minimized by using bedrock quarries whenever possible.<br>• The fewest number of bedrock quarries for use as aggregate sources will be utilized.<br>• Progressive reclamation will be carried out throughout the construction, which includes quarry sites. |

### 8.5.3 Mitigation

General mitigation strategies to minimize potential effects to terrain integrity may be required. The following strategies are recommended by Lands (2014c), unless otherwise specified, and will be utilized where it is practical and possible in meeting engineering criteria. These include, but may not be limited to the following:

- avoidance of ground that is susceptible to erosion and subsidence as well as unstable slopes and slide areas and deep valleys because they retain snow and inhibit ground freezing and wet areas such as peatlands, wetlands, seeps and springs;
- avoidance of waterbodies (except for stream crossings), to prevent erosion and sediment deposition into the water. To prevent sedimentation and erosion, vegetated buffer strips of at least 30 m width are recommended between roads and waterbodies;
- construction of stream crossings at the point of lowest grade to minimize potential soil erosion and protect the stream banks. Utilization of engineered culverts and bridges that accommodate the highest annual flows;
- avoidance of patterned ground, fine grained soils, particularly clay and sedge wetlands and peatlands in permafrost terrain due to high near-surface ground ice content;
- if possible, avoidance of locations with ground ice in areas of discontinuous permafrost. Areas of black spruce or peatlands indicate the presence of ice-rich permafrost. Isolated patches of permafrost can also be cleared and allowed to melt prior to construction;
- utilization of brush that is cleared for road construction as ditch blocks for erosion control and to insulate permafrost terrain;
- low road grades and proper drainage to reduce soil erosion; and
- utilization of low pressure vehicles for the early phase of the road construction season and only higher pressure equipment when the ground surface is strong enough to prevent rutting.

These mitigations are intended to minimize disturbance to terrain, landforms, permafrost, and soils. After implementation of these mitigation measures it is possible that some residual effects to terrain permafrost and soils still remain, such as:

- deepening of the active layer and thawing of potential ground ice; and
- compaction and erosion of soils along the road alignment.

## 8.6 Vegetation

Vegetation in the Taiga Ecoregion provides habitat for many species of wildlife. As the proposed TASR follows a predominantly disturbed route and additional portions were further disturbed during the 2014 forest fire season, limited adverse effects to vegetation are expected and will be prevented and mitigated utilizing the techniques described below.

When constructed, the proposed TASR will have a footprint that includes a 60 m ROW that is approximately 94 km in length and possibly two to three borrow sources that will be needed for long-term maintenance of the road. During construction, the footprint will be larger given that there are more borrow sources used during construction (up to a total of 5 borrow sources out of the 39 potential borrow sources identified in this PDR will be used) that will be closed and reclaimed when construction is complete. There is a direct impact to vegetation within the footprint ranging from permanent removal (i.e. 8.5 m completed road surface) to frequent cutting and regrowth (i.e. clearing and cutting of the ROW on either side of the TASR as part of maintenance activities) to removal and restoration (i.e. in borrow sources and access roads that are used for construction only). During construction it is expected that a large portion (if not all) of the 60 m ROW will need to be cleared in order to accommodate the construction process with heavy equipment. After construction is complete, it is expected that the ROW will undergo regrowth aside from the 8.5 m driving surface and however much of the embankment that is required to be cleared for safety purposes with respect to driving and sight lines.

In addition to the direct effects from the construction, several indirect effects may also occur, including the introduction of non-native or invasive plant species, alteration of the hydrology conditions (either ponding of water or reducing water flow), and increased erosion or slumping whereby changing plant communities. Pomeroy (1985) indicates ponding of water from the construction of roads may lead to the degradation of the underlying permafrost and eventual changes in hydrologic conditions and, thus, the vegetation community.

Vehicle traffic and road maintenance activities (including snow removal, grading, and possibly dust suppressants) will continue throughout the life of the TASR. These activities have the potential to directly or indirectly alter vegetation cover and plant assemblages, plant phenology, fire frequencies, and additional vegetation loss.

The amount of dust produced along the proposed TASR will increase during operation. Dust loading is expected to be localized and seasonal. Dust along the roads can lead to early snow melt, which in turn leads to early green up. In addition, dust loading may lower vegetation cover and change plant assemblages. Dust suppressants (including chloride based) may also negatively affect vegetation health (Goodrich et al. 2008). Even though the proposed TASR is anticipated to have low traffic volumes (20-40

vehicles/day), dust generation at key locations (curves, bridge approaches, etc.) will be addressed during the operation of the TASR.

Snow removal and grading will be necessary during winter operations; however, the buildup of snow in the ditches has the potential to affect the vegetation communities due to delayed melting in the spring.

In addition, the proposed TASR may increase access to off-road areas, which may result in additional vegetation loss or plant damage, and an increased risk of forest fires.

The mitigations to minimize the impact to vegetation are relative to minimizing the size of the footprint, avoid locations of rare plants, and keep water from ponding. To do this specific measures include those listed in Table 8-4.

### Table 8-4 Potential Vegetation Impacts and Mitigations

| Potential Impacts | Mitigation Measures |
|---|---|
| Introduction of non-native and invasive species (includes *Melilotus albus, M. officinalis, Sonchus arvensis, Crepis tectorum, Trifolium hybridgum, Medicago sativa,* and *Bromus inermis*) | • Construction machinery will be cleaned prior to entering and leaving native vegetation communities to reduce the potential introduction or spreading of non-native and invasive species<br>• Annual monitoring of roadsides for invasive species will be conducted each year of construction and invasive vegetation will be controlled immediately to eliminate seed production and long term establishment. This monitoring will be incorporated into general O&M processes for at least two years after construction to account for additional time that may be needed to observe establishment of invasive species.<br>• Any required reseeding will be done so with an approved local seed mixture |
| Loss of rare plant species and rare ecological communities | • Setbacks will be established around wetlands, rare plant populations and rare ecological communities, where practical, to restrict adjacent vegetation clearing activities. If avoidance is not an option, suitable mitigation strategies will be determined in consultation with ENR<br>• Flagging and/or fencing of rare plant populations and rare ecological communities situated adjacent to the TASR will occur where practical<br>• The project footprint will be surveyed by a qualified biologist/botanist for the presence of rare plant species in advance of construction, if required<br>• A presentation on rare plant species that could occur within the project footprint will be made available to workers, if required |
| Increased erosion or slumping, which changes plant communities | • Vegetation removal will be minimized at the clear-span abutments and culvert installations. Approved site-stabilization will be conducted as required<br>• Standard erosion and sedimentation control best management practices will be employed during construction and operation of the all-season road by following DOT's *Erosion and Sediment Control Manual* (2013) |
| Alteration of hydrology (ponding or reduced flow), which changes plant communities | • Culverts will be utilized where appropriate to maintain existing hydrological conditions in lowland areas and to avoid or minimize ponding along the TASR or the drying out of isolated sections of potentially affected wet lowlands<br>• Culverts will be inspected, particularly during spring flows, and any blockages will be removed to prevent ponding |
| Loss and alteration of vegetation and wetland communities within proposed TASR | • Reclamation of first 60 km of Tłı̨chǫ winter road system will help to balance the vegetation disturbance that will result within the TASR corridor<br>• Borrow pits will be closed as soon as they are no longer required, and reclaimed in a progressive manner, as described in the applicable Quarry Operations Plan<br>• Borrow sources and road design will be selected to minimize footprint |

### Table 8-4 (Continued) Potential Vegetation Impacts and Mitigations

| Potential Impacts | Mitigation Measures |
|---|---|
| | • Utilization of a predominantly pre-disturbed route cleared of vegetation limits the amount of vegetation required to be removed during construction. Widths vary along route, but in general, there is at least a 3 m cleared corridor for the entirety of the proposed route. The sandy south end of the route is naturally wider as is the north end of the route, which was utilized as a timber harvesting area<br>• Recent (2014) forest fires along a portion of the corridor limits the amount of vegetation required to be removed during construction as the vegetation has been removed naturally<br>• Where possible, borrow source locations that have been disturbed by the forest fires will also be selected to reduce loss of vegetation<br>• Low ground pressure equipment will be utilized for initial construction to reduce compaction and rutting |
| Dust loading may lower vegetation cover; change plant assemblages; and lead to early snow melt | • GNWT *Guideline for Dust Suppression* (2013) will be employed during summer to control the dust created by general traffic and loading and unloading materials, which could affect the vegetation cover in areas adjacent to the applicable activities<br>• Speed limits will be enforced to suppress dust production<br>• DOT's *Erosion and Sediment Control Manual* will be utilized to prevent erosion, which can encourage dust |
| Buildup of snow in ditches may delay vegetation growth | • Vegetation along ditches are required to be limited in height in order to maintain appropriate visibility while driving. Delayed vegetation growth can therefore be beneficial as hedging along highway will be reduced |
| Increased off-road access may result in additional vegetation loss and an increased risk of forest fires | • Construction vehicles will only operate on designated roads, access trails or constructed embankments and workers will not walk off-site onto land at any time of year, unless there is a specific requirement (i.e. waste recovery)<br>• Access roads to borrow sources will be closed off to prevent recreational users from using the roads in the future |
| Loss of vegetation from spills of deleterious substances | • To protect vegetation from spills of deleterious substances, all contractors and employees will follow the procedures detailed in the Spill Contingency Plan |

The above measures are intended to mitigate potential effects to vegetation, wetlands, and rare plants and communities. There is limited site-specific information on rare plant occurrences within the proposed TASR corridor; therefore, some rare plants may occur within the ROW that have not been identified during the 2014 ground truthing fieldwork. It is expected that the presentation on rare plants should help workers identify these plants in the field so they can be flagged if they are encountered during activities such as erosion and sediment control. Vegetation is expected to be eliminated in certain areas (such as the 8.5 m driving surface) but mitigations such as reclaiming the 60 km Tłı̨chǫ winter road corridor will be employed as a countermeasure.

## 8.7 Wildlife

The project description outlines the potential effects on wildlife and associated mitigation measures. The report recognizes that some uncertainties exist regarding the potential impacts to wildlife inhabiting the area along the proposed TASR. The Tłı̨chǫ Government and DOT plan to apply best available mitigation strategies that address these potential impacts.

Roads can affect wildlife in several possible ways. Roads can be considered habitat when they provide wildlife with some requisites for survival such as food or shelter (e.g., insect relief for caribou). A road is a conduit when wildlife moves along it (e.g., a wolf traveling on a wind-swept road during winter). Roads may be barriers or filters if wildlife movements across them are blocked completely or selectively, respectively. Roads may act as sources (provide habitat) if wildlife living in the corridor disperses into surrounding habitat (e.g., small mammals such as red foxes). Alternatively, they may act as sinks if wildlife is attracted and die as a result (e.g., collisions).

The physical existence of the proposed TASR, the habitats it traverses, patterns and intensity of use by wildlife, and patterns and intensity of vehicle traffic all play major roles in determining the extent to which a road may affect wildlife. Wildlife responses to the construction activities of the proposed TASR and its associated borrow source developments, the physical presence of the proposed TASR, and human activity along the proposed TASR depend, in part, on whether or not they are resident, seasonally resident or migratory. Individuals of some species are likely to exhibit some degree of habituation to activities associated with the all-season operation of the proposed TASR.

A cursory list of potential direct and indirect effects on wildlife from the construction and operation of the proposed TASR include:

- habitat loss and/or alteration;
- reduction in habitat connectivity;
- habitat fragmentation;
- increased human disturbance;
- increased hunting pressure, including in areas previously not as accessible; and
- wildlife mortality.

It is expected that the majority of disturbances to wildlife during construction will be of a temporary[14] nature.. Biological effects experienced during construction of the proposed TASR and the physical existence of the TASR corridor afterwards are not anticipated to drastically affect the ecological integrity of the area as sections of the corridor have been significantly affected by the 2014 forest fires in addition to the sections considered significantly disturbed from previous road use. A residual effect is anticipated due to the expected long term presence of the corridor itself; however, the mitigations discussed herein demonstrate that these effects will not represent a management challenge.

### 8.7.1 Potential Effects

As mentioned above, the potential effects on wildlife and wildlife habitat as a result of the construction and operation of the proposed TASR include: habitat loss and/or alteration; reduction in habitat connectivity; habitat fragmentation; increased human disturbance; increased hunting pressure, including in areas previously not as accessible; and wildlife mortality. Direct habitat loss and alteration is anticipated to be limited to the clearing of trees and vegetation along the proposed TASR corridor

[14] Temporary: limited to the segment of road undergoing construction at any one time.

(approximately 564 hectares, though this value should be lower due to aforementioned disturbance). Indirect habitat loss may occur in adjacent habitats due to habitat fragmentation and noise and light associated with operations. Habitat degradation may arise from unintentional spillage of fuel, lubricant, anti-freeze or other contaminants during construction or operation. Loss of wildlife may arise due to an increase in access related to hunting and vehicle collisions. These potential wildlife issues are discussed in the following sections: habitat loss or alteration, degradation, habitat connectivity and fragmentation, and wildlife mortality, while the potential mitigations are discussed thereafter.

#### *8.7.1.1 Habitat Loss or Alteration*

Roads eliminate the habitat upon which they are built. Potential impacts of a road are dependent on the road route and the type of construction. For example, if the route was located on the Shield, which would require substantial blasting through pristine land, the potential impacts would be vastly different. The footprint of this proposed TASR is anticipated to be approximately 94 km long by 60 m wide. The amount of habitat that could be lost to the road is estimated to be approximately 564 ha. Localized, temporary habitat loss is expected at the four to five borrow source locations and their accompanying access roads; however, once construction is complete, these locations are expected to undergo progressive reclamation. Areas will be re-contoured and re-vegetated, if possible to match the surrounding terrain upon completion of excavation activities. Habitat loss associated with the borrow sources is expected to remain low as the preferred sites will be evaluated based on their disturbance level (e.g. whether the areas have recently been impacted by forest fires).

Habitats in the vicinity of roads are effectively lost to many species (Jalkotzy et al. 1997). Species with large home ranges and or those that move large distances, such as caribou, are more vulnerable to habitat loss than species with smaller area needs (Clevenger and Huijser 2009). In addition, populations of species that occur in low densities (including those designated with special conservation status) may be especially vulnerable to further human disturbances and habitat loss (Clevenger and Huijser 2009).

The construction of the proposed TASR will open habitat patches, such as stands of previously undisturbed forest, an impact that can be minimized given that much of the proposed TASR will be along an existing alignment. This will alter the habitat for the local plant and animal species by introducing “habitat edges”, which differ from a patch of inner contiguous habitat with respect to light regime, moisture levels, microclimatic conditions, available shelter and security. New habitat edges may benefit edge-dwelling species and habitat generalists, but can be expected to negatively affect interior forest species whose tolerance for environmental change is limited. Habitat specialists are typically more sensitive to disturbances.

#### *8.7.1.2 Habitat Degradation*

Habitat degradation resulting from the proposed TASR may include damage to local vegetation, either physically or through the effects of dust or other contaminants. Nitrous oxides and sulphur dioxide emitted from power generators and construction equipment are potential sources of environmental effects.

Air emissions associated with the proposed TASR are unlikely to affect feeding habitats for wildlife. Air quality effects associated with particular construction activities and local meteorological conditions will be minimal and temporary.

Dust created by road traffic during the summer months is expected to settle within 300 m of roads. The quantity of dust is unlikely to have a significant effect on vegetation and wildlife as water and/or other approved dust suppressants will be employed to minimize potential issues associated with dust. The accidental spillage of fuel, lubricants and/or anti-freeze at work sites or during transportation represents a potential hazard. In the event of a spill, cleanup measures will be implemented immediately as per the standards in the Spill Contingency Plan.

#### *8.7.1.3 Habitat Connectivity and Fragmentation*

The proposed TASR may create a barrier to small forest mammal and amphibian movements (Foresman 2004). Because these animals are often prey for larger carnivores and raptors, they are vulnerable crossing areas without protective cover. These species are more likely to be preyed upon crossing the road, and may avoid crossing altogether. Thus, the proposed TASR may negatively affect small forest mammal and amphibian dispersal, resulting in fragmentation of the populations.

Increased noise and edge effects may make adjacent habitats less favourable for many species. Some species may avoid the proposed TASR or change their pattern of use (Jalkotzy et al. 1997; Clevenger and Huijser 2009). Animals that avoid or hesitate to cross roads or those that are disturbed by a vehicle expend greater energy. This expenditure of energy may be considerable in the winter if snow depths are high or the surrounding landscape provides little security cover and animals must travel further for security cover.

Jalkotzy et al. (1997) reported that roads with little traffic are frequently used by a number of wildlife species (including wolves, black bear, caribou) as travel routes. However, in northeastern Alberta, roads were considered semi-permeable barriers to boreal caribou movements (Dyer 1999). Clevenger and Huijser (2009) indicated low traffic volumes (less than 2,500 annual average daily traffic volumes) had little effect on the number of animals attempting to cross the road.

The portions of the proposed corridor are currently used by trucks, snowmobiles and all-terrain vehicles (ATV). If the proposed TASR is constructed, off-road traffic may increase as access will be more easily available. For example, woodland caribou have been documented to abandon areas frequented by snowmobiles (Dyer 1999).

#### *8.7.1.4 Wildlife Mortality*

Potential direct and indirect wildlife mortality may occur as a result of the proposed TASR. Direct effects include wildlife-vehicle collisions. Indirect effects include increased predation, hunting, trapping and problem wildlife as a result of the proposed TASR.

### *HUNTING*

The primary source of indirect mortality is related to human access (Jalkotzy et al. 1997). As access becomes easier, furbearer trapping, hunting and poaching is likely to increase in areas that were not easily accessible prior to the TASR construction. An increase in trapping, hunting and poaching along the proposed TASR may lead to over-harvesting of populations if not properly managed. Wildlife, such as bears, wolverines and foxes may become attracted to the harvesters' gut piles, food wastes and wildlife killed by vehicles which may result in more human encounters with wildlife and more problem wildlife.

The proposed TASR will allow hunters and trappers greater access to harvesting areas adjacent to the road and more remote areas off the road on a year-round basis and, consequently, will likely increase harvest pressure on caribou, moose furbearers, and waterfowl. Though the road follows disturbed habitat that is currently accessible to ATV's and snowmobiles, the road will allow larger vehicles into the area with greater ease, which could facilitate larger harvests.

Some residents of the Tłı̨chǫ area have expressed concern that hunting pressure on caribou and other wildlife may increase as a direct consequence of building the highway (TG 2015). To protect wildlife, organizations such as WRRB, TG and GNWT Departments of Lands and ENR will need to continue to work together to develop guidelines and conditions for use within the Wek'èezhìı area. Possible steps include the Tłı̨chǫ Government utilizing its authority to establish hunting regulations within Tłı̨chǫ lands as well as a public awareness program that would include signage along the proposed TASR corridor highlighting hunting restrictions and discouraging excessive hunting along the corridor. Options for new check stations and better and more accurate community reporting are also being explored.

### *ROAD KILLS*

Traffic-related mortality can be linked to several factors including traffic density, vehicle speed and/or road width. Any of these factors can directly affect the success of an animal crossing the road, with an increase in any factor reducing the probability of an animal crossing safely.

Amphibians, birds and small mammals are the species groups most often injured or killed by traffic collisions (Foresman 2004). However, vehicle collisions with large mammals are also a human safety and property hazard and as a result are the most commonly reported wildlife encounter along roadways. Clevenger and Huijser (2009) indicated at low traffic volumes (less than 2,500 annual average daily traffic volumes) traffic related mortality is generally low. The proposed TASR is expected to have low levels of traffic (in the order of 20-40 vehicles per day) at most times, which includes expected traffic volumes associated with the proposed mining development (Fortune Minerals' NICO mine) north of the TASR. Because traffic levels are expected to be so low and the posted speed limit will only be 70 km/h, the occurrence of potential traffic related mortality along the proposed TASR will also be low.

Certain species, such as herbivores (e.g. boreal caribou and moose) and bears may be attracted to the road ditches in search of food, especially in the spring when plant emergence may be earlier than in the forest (Gibeau and Herrero 1998; Dyer 1999). Carnivores (including raptors) may be attracted to the proposed TASR to prey on these foraging animals or carrion (Jalkotzy et al. 1997). Wildlife mortality, for all species in the vicinity of the proposed TASR, may occur as a result of vehicle collisions.

Because caribou are a highly valued species, an option to close parts of the proposed TASR if and when caribou are noted to be crossing the road may be implemented in order to prevent caribou mortality. This closure would be communicated through the various DOT communication tools (e.g. Twitter, website, and electronic road signs).

Bison-vehicle collisions are a traffic safety challenge unique to the Northwest Territories; however, in the past five years, the number of collisions has been steadily decreasing since a high point that occurred in 2008 (DOT 2015b). An increase in bison awareness through one of DOT's Drive Alive! initiatives is considered to be a contributing factor to the reduction in bison-vehicle collisions. The Drive Alive! bison awareness will be implemented along the proposed TASR and in conjunction with a lower posted speed limit (70 km/h vs. +90 km/h), bison mortality should be effectively mitigated should bison begin to utilize the proposed TASR corridor.

#### *8.7.1.5 Species Related Effects*

Care has been taken in analyzing and describing the potential effects of specific wildlife species that have been identified as having significant value to various users. These species have been selected based on conservation status and their cultural and economic value as identified by the Tłı̨chǫ TK report, community consultations and ENR input. The selected species: wolverine, moose, barren-ground and boreal woodland caribou, bison, and birds with special conservation status.

##### *WOLVERINE*

During road construction and operation there is a risk of disturbing denning wolverines and a risk of increased mortality due to improved access for hunters and trappers, vehicle collisions, and human-wildlife interaction as wolverines can be attracted to waste disposal or storage facilities during construction activities.

The effects of disturbances on wolverines are not well-documented; however, wolverines have been reported to be sensitive to human activity, especially during denning. The locations of wolverine dens within the proposed TASR corridor are unknown. Disturbance, including noise associated with construction activity, at natal den sites may cause den abandonment (Magoun and Copeland 1998; COSEWIC 2003). While the consequence of disturbing a natal wolverine den is high, the probability of this occurring is expected to be very low given that construction activities will be confined to the surface of a predominantly disturbed site and the temporary nature of construction activity. Wolverine densities are generally low throughout their range, even in optimal conditions (Banci 1994). Low reproductive rates and delayed sexual maturity reduces the potential of wolverine to sustain high mortality rates (COSEWIC 2003).

Wolverines are active all year long and the risk of increased mortality from vehicle collisions exists; however, few wolverine/vehicle collisions have historically been reported. One collision occurred on the Tibbitt to Contwoyto winter road in 1996 (EBA 2001). ENR's North Slave regional staff have also mentioned that a wolverine had been killed by a vehicle near Snap Lake in March 2009. Waste from construction activities may act as an attractant to wolverine and other wildlife, creating problem wildlife situations, which may result in destruction of wolverines due to safety concerns. Effective mitigation

measures will need to consider the design of buildings and camps used during construction, odour and waste management strategies, as well as education and awareness of crews involved in construction activity. Mitigation measures outlined below will minimize the potential for wolverines to be attracted to construction activities or waste storage and disposal sites.

### *MOOSE, BARREN-GROUND AND BOREAL WOODLAND CARIBOU*

Potential effects on barren-ground caribou, boreal woodland caribou and moose include physical and physiological disturbance from road construction and operation, loss of habitat, and increased risk of mortality due to predation, improved hunting access and vehicle collisions.

Caribou are known to be sensitive to sensory disturbance (noise from machines, human presence and vehicles; Dyer et al. 2001), while moose may be somewhat more tolerant of disturbance. Many factors affect the size of a zone of influence of a disturbance, such as topography, the presence of security cover, and environmental conditions such as wind and snow cover. Displacement from areas with construction activity could cause temporary reductions in core security areas and foraging efficiency, and increased movement resulting in increased stress and higher energy expenditure (Leblond et al. 2013; Bradshaw et al. 1998; Horejsi 1981). Traffic along the road may affect the behavior and movement of caribou. The road may act as a barrier, disrupting migratory behavior of barren-ground caribou, and resulting in some habitat becoming inaccessible to a portion of the population (Trombulak and Frissell 1999). A literature review of the response of reindeer and caribou by Wolfe et al. (2000) found a zone of influence (ZOI)[15] has been demonstrated for roads located in the barren-ground caribou range, with avoidance of up to 4-6 km, depending on traffic levels (reviewed by Wolfe et al. 2000). Group composition may also impact responses to traffic for caribou, as cow-calf groups of barren-ground caribou have been found to respond to lower levels of disturbance than other group types. However, the permeability of the road for caribou and moose movement might increase if animals become habituated to it.

The proposed TASR is located toward the eastern edge of boreal woodland caribou range. Construction and operation of the proposed TASR will cause both direct habitat loss and most likely functional habitat loss for boreal caribou. Woodland caribou (boreal and mountain ecotypes) have been observed to avoid roads by distances varying between 0.25 – 5 km (Cumming and Hyer 1998, Oberg 2001, Schindler et al. 2007, LeBlond et al. 2013, Polfus et al. 2011, Fortin et al. 2013). The degree of avoidance appears to be related to road traffic volume, although avoidance of low use roads may be as great as 1 km (Polfus et al. 2011; low use defined as gravel/dirt roads excluding ATV trails). Although the potential amount of functional habitat loss was estimated using Environment Canada's definition of habitat disturbance (i.e. a 500 m buffer; EC 2012), the ZOI of the proposed TASR may be greater than assumed in the analysis below.

When the draft Recovery Strategy for boreal caribou was released in 2011, the Northwest Territories (NT1 range) had 69% undisturbed habitat. Based on the amount of habitat disturbance in the range at that time, the population was considered to be self-sustaining. As of fall 2015, the amount of undisturbed habitat has fallen to 66%, largely due to new fires. There is generally more habitat disturbance in the

[15] ZOI: is a horizontal measure of the area in which wildlife could be affected by an activity. Topography, presence of security cover, wind and snow cover can affect ZOI ratings.

southern portion of the range. The North Slave region portion of the range had 52.4% undisturbed habitat (47.6% disturbance) as of fall 2015. Most of the habitat disturbance in this portion of the range is due to fire (47.4% disturbance). Buffered human disturbances currently make up <1% of the total disturbance footprint in the region. Although the NWT boreal caribou population as a whole is likely to be self-sustaining because there is currently >65% undisturbed habitat within the entire NT1 range, boreal caribou in the North Slave portion of the range may be at greater risk as there is currently <65% undisturbed habitat in the region.

Approximately 35 km of the proposed TASR is within the existing buffered anthropogenic disturbance footprint mapped by Environment Canada using 1:50,000 Landsat imagery from 2008-2012. An additional 32 km of the proposed road has been impacted by fires ≤40 years old (Figure 8-1). This means that only 27 km of the road will pass through an area defined as currently undisturbed habitat for boreal caribou. A 500 m buffer was added to the proposed TASR corridor, assuming a cleared right-of-way width 60 m, to assess the potential change to total disturbance footprint in the North Slave portion of the boreal caribou range. If a 60 m cleared ROW is assumed, the road would add 2862 ha of new buffered disturbance to the range. These calculations account for overlap with the current combined fire and human disturbance footprint. Under this scenario, the project would add <1% of new disturbance to the North Slave portion of the range, increasing the total combined fire and human disturbance footprint from 47.57% to 45.63%. These calculations do not include the buffered footprint of borrow sources needed to construct and maintain the road; however, using the rough estimate of 220 hectares for the combined borrow sources and access roads and disregarding the fact that a number of the potential sources fall within the fire/human disturbance areas, the project would still equate to <1% of new disturbance in the North Slave portion of the range.

Vehicle collisions with ungulates are a concern for road developments. One incidence of barren-ground caribou mortality from a vehicle collision was reported on the Tibbitt to Contwoyto winter road between 1996 and 2001 (EBA 2001). Dominion Diamond's Developer's Assessment Report (DAR) for the Jay Project provided an updated number of 5 mortalities in 1999 with two additional caribou being struck by a vehicle in January 2014 (2014). Dominion Diamond's DAR also stated that at least 2 caribou mortalities resulted from a pick-up truck on the Gahcho Kue Project winter access road in February 2014 (2014). Vehicle collisions are not considered a major threat to boreal woodland caribou conservation (EC 2012; SARC 2012). Although traffic volume is expected to be low, mitigations to reduce the risk of vehicle collisions will be implemented.

Increased risk of hunting mortality to ungulate species is possible due to improved access. Boreal woodland caribou in the NWT are harvested by residents between July 15$^{th}$ and January 31$^{st}$ and by Aboriginal residents during any season but are not a preferred target and are usually harvested opportunistically. The proposed TASR is expected to improve access to hunters. Although hunting is thought to pose a risk to its conservation, it is estimated that only 80 boreal woodland caribou were harvested annually in the NWT in the 2000s; this estimate may be unreliable due to underreporting or species misidentification (SARC 2012). As mentioned in Section 6.6.1, the southernmost portion of the Bathurst herd's annual range overlaps the proposed TASR corridor; however, they have not been detected within the proposed corridor in recent years as the population has been in a period of decline. Until the population begins to recover to higher numbers, increased hunting mortality as a result of

improved access is unlikely due to their lack of presence. Moose are also harvested seasonally by residents, non-residents and at any time of the year by Aboriginal hunters, and may be subject to increased hunting pressure with the proposed TASR.

It should be noted that the perpendicular trails currently in existence within the proposed TASR corridor (as illustrated in the TK report), are predominantly winter trails and are used by snowmobiles. These trails are listed as transportation trails to reach hunting grounds well outside the project area (such as hunting within the Horn Plateau) or for trapping; therefore, though the TASR corridor will create easier access to these trails, it is unlikely this access will increase harvesting within the surrounding project area. The hunting areas located within the Horn Plateau require snowmobiles to pack ample supplies, including fuel, in order to successfully complete the expedition.

Additionally, improved access may increase predation on moose, barren-ground caribou and boreal woodland caribou. Human-made linear features such as roads have been documented to facilitate the movement of predators, including wolf and bear, across the landscape which has resulted in increased predation rates on boreal woodland caribou (Houle et al. 2010; Roever et al. 2008). The Tłı̨chǫ TK study has also indicated that the presence of bison, as a result of human-made linear features, can have negative effects on woodland caribou (TG 2015). Increases in predation by human-induced habitat alterations have been identified as a major threat to the conservation of boreal woodland caribou (EC 2012; SARC 2012).

Under the NWT CIMP Project Factsheet 1999 to 2016, Jody Pellissey and Jennifer Baltzer were provided funding in 2015/2016 to investigate the impacts of wildfire on caribou and their habitat (CIMP 2015). As 2015/2016 was the first year for each study, there are no published results currently available. DOT will continue to track the programs in case their results can be applied to the proposed TASR in the near future.

### *BISON*

Potential effects on bison include physical and physiological disturbance from road construction and operation, loss or gain of habitat, and increased risk of mortality due to improved hunting access and vehicle collisions.

Bison may be somewhat more tolerant of sensory disturbances (noise from machines, human presence and vehicles) and are known to habituate to vehicles. Many factors affect the size of a zone of influence of a disturbance, such as topography, the presence of security cover, and environmental conditions such as wind and snow cover. Displacement of bison from areas of project activity could cause temporary reductions in core security areas and foraging efficiency, and increased movement resulting in increased stress and higher energy expenditure as observed for moose and caribou (Leblond et al. 2013; Bradshaw et al. 1998; Horejsi 1981). Traffic along the proposed TASR may affect the behaviour and movement of bison. Traffic can disrupt foraging and resting bison while the proposed TASR corridor is likely to act as a travel corridor. Given the temporary nature of construction activities and implementation of mitigation measures, indirect habitat loss and sensory disturbance to bison is expected to be negligible.

Vehicle collisions are a significant source of mortality for the Mackenzie wood bison population. There have been nearly 300 recorded collisions resulting in over 400 bison killed on highways in the NWT since

1998. Over 5% of the Mackenzie population was killed in collisions on Highway 3 in each of 2012 and 2013; however, it should be noted that the posted speed limit for Highway 3 (90-100 km/hr) is greater than that of the proposed TASR (70 km/hr) and bison collisions have been on the decline since 2008 (DOT 2015b).

#### *BIRDS – SPECIAL CONSERVATION STATUS*

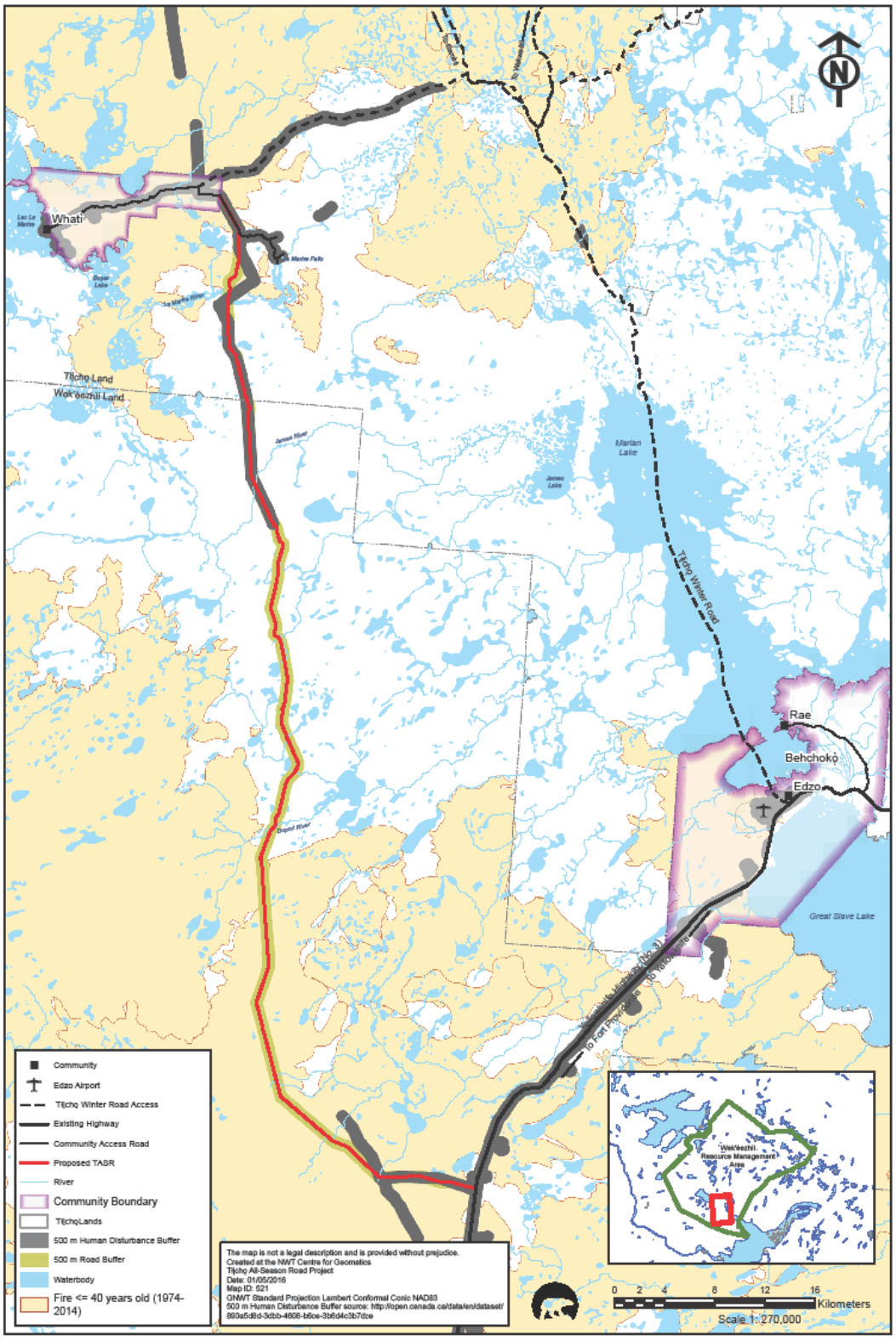
A total of ten bird species with special conservation status exist or potentially exist in the vicinity of the proposed TASR. The species include the Bank Swallow, Barn Swallow, Common Nighthawk, Horned Grebe, Olive-sided Flycatcher, Peregrine Falcon, Rusty Blackbird, Short-eared Owl, Yellow Rail and Red-necked Phalarope. Potential effects to these bird species include disturbance or destruction of nests, dusting effects, collisions with vehicles, and habitat loss and degradation from human activities (ENR 2014b).

### 8.7.2 Mitigation

The following mitigation measures presented in Table 8-5 have been developed for the proposed TASR and are expected to minimize and manage effects on wildlife. The draft Wildlife Management and Monitoring Plan (WMMP; Section 10.4 and Appendix M), which has and will continue to be developed with the help of ENR, further describes the implementation process for said mitigations.

Government of Northwest Territories

**Figure 8-1 Disturbance Footprint of Forest Fires ≤40 Years Old (1974-2014) and Environment Canada's 500 m Human Disturbance Buffer (EC 2013) Overlapped with a 500 m Zone of Influence Buffer Along Proposed TASR in Application with Boreal Caribou Range**



## Table 8-5 Potential Wildlife-Related TASR Impacts and Mitigation Measures

| Potential Effects | Mitigation Measures |
|---|---|
| Habitat Loss and/or Alteration | • Proposed TASR corridor will be 60 m wide and clearing will be limited to only those areas required<br>• Selected borrow source footprints will be as small as possible and will be located as close as possible to the TASR ROW to ensure access roads are as short as possible<br>• Progressive reclamation of borrow sources and access roads will further reduce the amount of habitat lost and/or altered<br>• Previously disturbed areas will be used, wherever possible. Specific focus will be made to utilizing borrow sources that have been impacted by recent forest fires and establishing the proposed TASR corridor along the already anthropomorphized alignment<br>• Personnel will not travel off-site (corridor) unless there is a specific requirement (e.g. waste retrieval)<br>• An approved Wildlife Management and Monitoring Plan (WMMP) will be developed by referencing recovery strategies from current wildlife committees to minimize effects to critical habitat. For example, reviewing details published by the Bathurst Caribou Range Planning Committee, national recovery strategy for boreal caribou, Implementation Plan for Boreal Woodland Caribou in the NWT 2010-2015, and the boreal woodland caribou range plan strategy when it has been finalized. Adaptive management will be a component of the WMMP. This plan will also include a component for wildlife observation logs<br>• The reports by Jody Pellissey and Jennifer Baltzer, with respect to the impacts of wildfires on caribou and their habitat, will be reviewed when the reports are available to verify if they have additional caribou management suggestions<br>• If a key wildlife feature of a species at risk is discovered, ENR and/or EC will be contacted and activity may be temporarily suspended pending consultation with these agencies<br>• Reclamation of the current Tłı̨chǫ winter road (KM 0-60) will help to offset new habitat loss<br>• Dust suppression techniques (as per the GNWT *Guideline for Dust Suppression* and DOT's *Erosion and Sediment Control Manual*) will be utilized to prevent dust from spreading onto vegetation outside of the ROW. Enforcing slow speeds and utilizing blast maps during blasting will also help with dust suppression<br>• Equipment entering the construction zone will be cleaned prior to ensure non-native/invasive species of vegetation do not spread and impact native species populations. If non-native/invasive species are identified within the proposed TASR corridor, they will be removed<br>• DOT's *Erosion and Sediment Control Manual*, in conjunction with a suitable road design, will be utilized to ensure erosion and sediment control, in addition to slope stabilization are maintained, which should help in preventing damage to riparian, stream, wetland and lake habitat<br>• An approved Spill Contingency Plan will be followed to ensure spills are prevented and if they were to occur as a result of an accident, that they will be controlled to prevent the spills from impacting a large area<br>• The strategies recommended by Lands' *Northern Land Use Guidelines* (2014a, b, c) will be employed<br>• Bathurst Caribou Range Planning Boundary indicates the northern section of the proposed TASR will intersect with the edge of the proposed planning boundary; however, annual range utilization for the Bathurst caribou indicates that the proposed TASR is well outside this range. It is therefore expected that the TASR will not directly affect these caribou |
| Sensory and other Disturbances | • Construction activities will be limited during sensitive periods to minimize effects on wildlife. For example surface blasting will be suspended when caribou are identified within a 'danger zone' and the period for no harm or disturbance to migratory birds and their nesting habitat will be observed. Further details pertaining to wildlife and blasting can be found in the WMMP and Quarry Operations Plan, respectively |

## Table 8-5 (Continued) Summary of Wildlife-Related TASR Design Mitigation Measures

| Potential Effects | Mitigation Measures |
|---|---|
| | • Equipment will be in good operating condition and will utilize mufflers to ensure construction noise remains comparable to background levels at a distance of 1 km<br>• During construction, the number of vehicles in operation will be reduced by ensuring workers are transported to site via vans or extended crew cabs<br>• Observations of species at risk by project staff will be reported to ENR<br>• Construction operations will be temporarily suspended when species at risk and barren-ground caribou are within 500 m of construction activities<br>• A pre-disturbance survey will be conducted for active dens and nests with the help of ENR, within 500 m of the proposed TASR footprint, to ensure important bear, wolverine, and bird habitat are avoided<br>• Recommended setback distances for dens will be followed as per an approved land use permit and WMMP<br>• In the event that an active den is identified during construction, ENR will be consulted to determine an appropriate strategy<br>• Wildlife monitors will be on site to monitor wildlife and manage risks<br>• During winter, snow banks within the proposed TASR footprint will be kept low and escape points will be ploughed out for wildlife crossing. Frequency and distance intervals will be discussed with ENR during the finalization of the WMMP<br>• Traffic volumes during operation of TASR will be low (20-40 vehicles/day), which should prevent the extent of disturbance<br>• Operating the TASR in a predominantly disturbed area will reduce the amount of potential sensory issues and disturbances as most wildlife already avoid recent fire-disturbed areas |
| Wildlife Incidents | • An appropriately designated supervisor will educate all field workers on the applicable practices contained within the various environmental management plans, including the WMMP<br>• An appropriately designated supervisor will provide all field workers with Bear Aware training and general wildlife awareness<br>• The successful contractor will follow the wildlife-human interaction procedures outlined in the WMMP, which includes Bear Aware training and safe working distances from wildlife<br>• Workers will avoid all interactions with wildlife unless crew safety is at risk<br>• Field workers will not feed, harass or approach wildlife<br>• Birds, nests and eggs will be left intact. If an active nest is directly near or in the path of a borrow source site, a no-work zone will be established and crews will work in another area within the approved borrow site until birds have vacated the nests (May to mid-August)<br>• Clearing during bird nesting and fledging season in all habitat types will be avoided (May to mid-August); however, if vegetation clearing is required within this time, pre-clearing nest surveys and no-work zones for identified active nesting sites will be conducted<br>• All humans/wildlife conflicts and incidents will be reported to the appropriately designated supervisor and documented<br>• All significant wildlife features, such as nests and dens will be documented and reported. This includes possible raptor nest and bear den surveys prior to commencing construction<br>• Firearms will not be allowed on-site except for firearms in the possession and control of authorized wildlife monitors<br>• No hunting or fishing by field workers will be permitted<br>• All food and stored garbage will be kept in bear-proof areas or bear-proof containers to prevent wildlife attractants<br>• Any grease, oils, fuels stored on-site will be stored in bear-proof areas or containers and the approved Waste Management Plan will be followed |

## Table 8-5 (Continued) Summary of Wildlife-Related TASR Design Mitigation Measures

| Potential Effects | Mitigation Measures |
|---|---|
| | • Operators will implement the Observe, Record and Report Policy, encouraging workers to report any suspicious activities related to wildlife. The appropriately designated supervisor will be responsible for obtaining and reporting this information to the appropriate responsible agency<br>• Wildlife sightings will be recorded (including GPS location data if possible) and submitted to the DOT Environment Division on a monthly basis and included in annual permit reporting to WLWB<br>• MACA will work with communities to implement actions to reduce the number and frequency of bison within communities (Wood Bison strategy) |
| Wildlife Attraction to Site and Waste Management | • Waste products will be stored in secured containers and transported to appropriate facilities<br>• Wildlife deterrent mechanisms (including fencing and lights) will be used as needed<br>• Camps and buildings will be designed to prevent wildlife interactions<br>• Adequate lighting will be installed in areas where it is essential to detect bears that may be in the vicinity<br>• Personnel will follow an approved Waste Management Plan |
| Wildlife Mortality | • Traffic volumes are expected to be low (20-40 vehicles), which should minimize risk of collisions<br>• Appropriate signage along the road will be installed to notify drivers of potential collision with wildlife and to discourage hunting within the proposed TASR corridor<br>• Appropriate speed limit signs will be posted along the road and will be enforced<br>• Tłı̨chǫ Government may establish hunting regulations on Tłı̨chǫ lands to manage hunting<br>• New check stations and better, more accurate community reporting are being explored by ENR<br>• A public awareness program established by ENR and/or the Tłı̨chǫ Government should help to reduce excessive hunting within the proposed TASR corridor<br>• Reclamation of KM 0-60 of the Tłı̨chǫ winter road could help to displace winter harvest pressure<br>• Wildlife incidents and human-wildlife interaction will be prevented as per the mitigations described above. These mitigations will reduce the likelihood of wildlife-human interactions that require wildlife to be terminated<br>• Any key species mortality will be immediately reported to appropriate territorial (ENR) and federal (EC) wildlife authorities<br>• Maintenance measures to reduce attraction of wildlife to the proposed TASR corridor will be employed<br>• Temporary closure of the proposed TASR and/or reducing speed limit could occur when key species (such as caribou or bison) are noted to be within the corridor. Precise details will be established during the finalization of the WMMP, which will include ENR input<br>• Access management (including closing off borrow source access roads to the public during reclamation) techniques will be employed to deter the public's access to undisturbed wildlife habitat<br>• Under the guidance of ENR, additional methods will be developed to prevent the proposed TASR from becoming a bison attractant<br>• Road salt will avoided where possible as salt is a known attractant to wildlife. Untreated sand and gravel will be utilized during the winter for traction management<br>• Roadside vegetation will be cleared and maintained to ensure a clear line of sight while driving<br>• Vegetation clearing will be scheduled to occur prior to the bird nesting period to prevent birds from nesting within the TASR corridor once it is in operation |

**Table 8-5 (Continued) Summary of Wildlife-Related TASR Design Mitigation Measures**

| Potential Effects | Mitigation Measures |
|---|---|
| | • Additional mitigation to minimize effects on wildlife will be developed through ongoing discussions with ENR and the approval of a WMMP<br>• Additional mitigation to minimize effects on hunted species will be developed through ongoing discussions with ENR, Lands, the Tłı̨chǫ Government and the approval of a WMMP<br>• Multiple mortalities of other species will be reported to EC (e.g. multiple birds striking infrastructure over several months, or single incident of a large flock of migratory birds striking infrastructure)<br>• Current habitat disturbance levels within proposed TASR corridor suggests wildlife, such as caribou, will already be avoiding area |
| Spills of Hydrocarbons or Toxic Substances Resulting in Injury to Wildlife and/or Wildlife Habitat | • Vehicles will be equipped with spill kits and fuelled 100 m away from waterbodies<br>• Fuel storage areas will be equipped with spill kits, will be located at least 100 m away from waterbodies and large fuel storage tanks (2,000 L to 50,000 L) will be double walled<br>• Spill response and containment will be completed expeditiously in accordance with the approved site-specific Spill Contingency Plan and the contractor's HSE manual and procedures<br>• Appropriate deterrents will be used to discourage wildlife from entering affected area<br>• Territorial (ENR) and federal (EC) authorities will be contacted immediately to determine appropriate course of action, which may including capturing, relocating or treating contaminated wildlife |

## 8.8 Hydrology and Water Quality

Water is a defining feature for much of the NWT's environment, which includes water-formed features such as karst topography, widespread permafrost, deltas and internationally recognized wetlands. Lakes, rivers, groundwater and wetlands predominate much of the landscape and help to ensure the survival of fish and wildlife species (ENR 2010b).

Water quality and water quantity are the two components of concern in relation to establishing the proposed TASR.

Possible effects that may occur as a result of the construction of the proposed TASR include, but are not limited to:

- reduction of water quality as a result of deposition of deleterious substances (by way of accidental spills, sediment release, erosion, permafrost melting and dust from vehicles); and
- changes to flow regimes during spring freshet.

### 8.8.1 Mitigation

The following mitigation measures presented in Table 8-6 have been developed for the proposed TASR and are expected to minimize and manage effects on water quality and water quantity. Additional mitigations with respect to bridge and culvert construction as it attributes to fisheries (and therefore water) can be found in Table 8-7.

## Table 8-6 Potential Water Quality and Quantity Impacts and Mitigations

| Potential Impacts | Mitigation Measures |
|---|---|
| Water quality affected by deposition of deleterious substances | • DOT's *Erosion and Sediment Control Manual* and GNWT's *Dust Suppression Guidelines* will be adhered to in order to keep dust levels down. This will prevent excess dust from settling on surface water<br>• Vehicle speeds will be enforced to also help to reduce the amount of dust that could settle on surface water<br>• DOT's *Erosion and Sediment Control Manual* (Appendix W) will be followed to ensure best management practices are followed with respect to the installation and design of culverts and bridges<br>• Culverts will be appropriately sized to avoid backwatering and washouts<br>• Silt fencing will be installed where required to control possible sediment releases during construction and post construction<br>• An approved Spill Contingency Plan will be followed to help prevent spills from deleterious substances from entering the waterways and will help to efficiently control and clean up a spill should one occur. Methods include ensuring refueling occurs 100 m away from a waterbody and utilizing double-walled fuel tanks<br>• DFO Shoreline and Re-vegetation and Stabilization measures (2013a) will be employed to prevent erosion along banks<br>• Progressive reclamation of borrow sources and access roads through revegetation and contouring will help prevent dust and sediment from entering waterbodies<br>• In-stream work during road crossing construction will either be avoided or be limited to when watercourses within or adjacent to the construction area are not flowing or during low flow conditions<br>• Major construction activities will be delayed during high rainfall events<br>• DFO's *Working Near Water Manual* (Cott and Moore 2003) and DOT best management practices will be followed, where applicable<br>• All sewage and greywater will be stored in lift stations and removed from site via vacuum truck to an approved facility prevent any discharge onto the land or into the water<br>• In addition to following the SCP, particular attention will be made to ensure equipment working less than 100 m from waterbodies are equipped with appropriate spill pans to prevent delirious substances from entering waterways<br>• Geochemical testing of materials utilized during road construction will prevent ARD and metal leaching potential sources from being selected; thereby limiting these substances from entering waterways within the proposed TASR corridor<br>• During construction of bridges and culverts where flow is present, turbidity grab samples will be collected 50 m upstream and 100 m downstream of the areas undergoing construction on a daily basis to ensure sediment has not entered the waterbody in question. After construction of each bridge and culvert, turbidity grab samples will be collected on a weekly basis for four consecutive weeks to ensure the banks and structures have stabilized and are not contributing to increased turbidity. Sampling will then be reduced to once monthly during periods of open water for the remainder of construction. Grab samples will comply with CCME guidelines for turbidity. If at any time, downstream grab samples exceed CCME guidelines, workers will ensure the appropriate steps are followed with respect to the In-Field Water Analysis Plan. Further details can be found in DOT's draft In-Field Water Analysis Plan (Appendix AA). Borrow sources will be selected to ensure the material is not susceptible to ARD or heavy metal leaching. This step will ensure that suspended sediments are the only possible parameter which could affect water quality during construction. Water quality testing as a result of a hydrocarbon spill (or a spilled deleterious substance other than sediment) will be subject to separate testing independent of regular in-field monitoring |

**Table 8-6 (Continued) Potential Water Quality and Quantity Impacts and Mitigations**

| Potential Impacts | Mitigation Measures |
|---|---|
| Water quality affected by amount of water extracted | • Bathymetric surveys will be conducted at potential water sources requiring more than 100 $m^3$ to be withdrawn over the course of one ice-covered period (i.e. for camp use) and the DFO *Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut* (2010) will be followed |
| Changes in flow | • Bridges and culverts will be designed to withstand a 1 in 100 year flood flow rate<br>• Equalization culverts will be installed at least every 500 m to prevent ponding<br>• Geothermal investigations will ensure areas with permafrost are avoided and/or geotextile is used to prevent any possible melting which could contribute to changes in water volume<br>• Road design criteria has considered an appropriate slope ratio along the proposed TASR to ensure slopes do not erode during a rain event<br>• Water withdrawals from local waterbodies for use in camps and dust suppression will follow the appropriate guidelines (DFO's *Protocol for Winter Water Withdrawal in NWT*) to ensure water volume is not negatively affected<br>• Regular maintenance will occur along the TASR to ensure culverts are clear of debris (including ice during spring thaw)<br>• Borrow sources will be selected with a preference for already disturbed sites (e.g. impacted by recent forest fires) to reduce the possibility of erosion and changing drainage patterns<br>• Lands' *Northern Land Use Guidelines: Pits and Quarries* will be followed, including: not excavating pits below water table and ensuring water management structures can accommodate for peak periods of thaw and precipitation<br>• Ponding in pits will be avoided by installing drainage ditches or channels to prevent any possible permafrost degradation. |

#### *GROUNDWATER MITIGATIONS*

Effects to groundwater quantity, quality and flow patterns are predicted to be low or negligible. Road design criteria attempts to avoid ill-suited terrain, such as karst features which may include year-round groundwater flow. Part of the road design includes installing equalization culverts at least every 500 m to prevent the constructed road from impacting groundwater flow. During borrow source selection, each potential source will be analyzed for heavy metals and ARD potential. Only borrow sources that are identified as lacking heavy metals and ARD potential will be selected as sources to construct the road. By implementing this standard, groundwater quality will not be impacted by construction activities. The approved Spill Contingency Plan will also help in mitigation potential spills that could enter the groundwater.

The mitigations above are intended to prevent changes to water quantity, limit sedimentation of waterbodies and watercourses, and effects to water quality from project operations.

## 8.9 Fish and Fish Habitat

The proposed TASR corridor intersects with important fish habitat for Aboriginal, commercial and recreational fisheries. These fisheries have economic, social and cultural value to the people of the region and should be protected.

On November 25, 2013, amendments to the *Fisheries Act* came into effect. The changes focus the *Act* on protecting the productivity of Aboriginal, commercial and recreational fisheries. The federal government now focuses protection rules on real and significant threats to fisheries and the habitat that supports them, while setting clear standards and guidelines for routine projects.

DFO has indicated that current guidance and standards are coming with respect to protecting fisheries resources around road projects; in the meantime, DOT is utilizing existing DFO guidance. By thinking of the road and watercourse both as transportation corridors (roadway transporting people vs. watercourse transporting water, sediment, flora and fauna), DOT has evaluated the best and most effective crossing design so as to minimize any conflict between the watercourses and the proposed TASR.

Under the *Fisheries Act*, all fish that are part of an Aboriginal, commercial or recreational fishery and the components that support such a fishery are valued. Valued fish and fish habitat components for the project are also defined by resource users, management boards, and regulation. The proposed TASR is situated in a region of productive fish habitat. Species of value due to their habitat requirements and their economic and cultural importance to the people of the region include Northern Pike, Arctic Grayling, Lake Trout, Lake Whitefish, Inconnu, and Walleye.

Potential effects to fish and fish habitat may occur through project alterations to aspects of the aquatic environment including water quality, habitat productivity, and fish passage. Several DFO and Lands documents discuss potential effects of road construction to fish and fish habitat (Lands 2014c; DFO 2014). Potential effects that may result from road construction include, but are not limited to:

- effect of ground compaction on banks and beds of rivers, streams, and lakes;
- disturbance to riparian areas, erosion and sedimentation;
- reduced water quantity and quality in overwintering fish habitats with the source waterbody or downstream watercourses as a result of water withdrawals;
- increased risk of spills or waterway contaminations due to accidents, accidental spills and other emergencies along the route;
- increased fishing pressures as a result of improved access; or
- impingement or entrainment of fish during water withdrawal.

The installation of improperly designed culverts and bridges could lead to blockages of fish movements or loss of habitat during the winter period and during spring break-up due to ice jams, which can disrupt important migratory runs of fish. Additionally, damage to riparian areas can cause erosion and sedimentation.

There is the potential for accidental spills of fuels and other materials resulting in the release of deleterious substances into a watercourse or waterbodies. Accidental spills can occur from malfunctions of equipment such as hydraulic and fluid leaks, spills during equipment refueling or from a fuel tanker losing its load.

Additional access to fishing areas by the proposed TASR can also increase pressure on fish populations from Aboriginal and/or recreational fishing. Human activity in and around fish bearing streams may alter the distribution of localized fish populations.

DFO outlines the Fisheries Protection Program on their website, which includes measures to avoid causing harm to fish and fish habitat. These measures, along with those listed in Lands' document (2014c), outline the best management practices to minimize environmental disturbance through appropriate construction of water crossing structures such as culverts and bridges.

Table 8-7 describes mitigation strategies to address potential environmental effects on fish and fish habitat for the proposed TASR. Additional detail is provided in the draft Fish and Fish Habitat Protection Plan (FFHPP; Appendix X). Appropriate DFO timing windows will be used to avoid in-stream work in fish bearing streams during critical periods, such as spawning (DFO 2013). For this project, in-water activity will only occur between July 16th and September 14th or if the watercourse is dry or frozen solid.

### Table 8-7 Potential Fish Habitat Impacts and Mitigations

| Activity | Potential Impacts | Mitigation Measures |
|---|---|---|
| Bridge Construction | Direct loss of riparian habitat | • Best management practices for riparian habitat will be followed<br>• Clear span bridge design and construction methods shall limit the amount of habitat lost |
| | Pressure changes from detonation of explosives (for abutment installation, if necessary) | • The *Guidelines for the use of explosives in or near Canadian fisheries waters* (Wright and Hopky 1998) will be followed |
| | Direct loss of in-stream habitat due to piles/piers | • Only clear span bridges will be constructed<br>• In-stream work shall be restricted to no flow periods or abide by the DFO fish timing windows for the NWT<br>• Erosion and sediment control measures will be installed and maintained |
| | Flow changes due to stream constriction | • Abutments to be placed at a sufficient distance from active stream channel and riparian vegetation to avoid stream constriction |
| Culvert Installation | Direct loss of habitat | • Best management practices for culvert installation will be followed (such as DFO's Measures to Avoid Causing Harm to Fish and Fish Habitat)<br>• In-stream work shall be restricted to no flow periods or abide by the DFO fish timing windows for the NWT |
| | Migration barrier | • Best management practices for culvert installation will be followed and includes fish friendly sizing of culverts with 10% embedded<br>• Culverts will be sized by incorporating the DFO velocity information regarding fish passage (discussed in Section 6.7.3)<br>• Annual monitoring will occur to detect culvert subsidence or lifting |

**Table 8-7 (Continued) Potential Fish Habitat Impacts and Mitigations**

| Activity | Potential Impacts | Mitigation Measures |
|---|---|---|
| | Sediment release during construction | • Erosion and sediment control measures will be installed and maintained |
| | Changes in stream flow patterns | • Erosion and sediment control measures will be installed and maintained |
| Use of Heavy Equipment | Erosion and sedimentation | • Sufficient buffer zone distance will be maintained from lakes, where possible<br>• Erosion and sediment control measures will be installed and maintained, such as sloping, riprap, silt fencing and ditches and across drainage channels<br>• Dust suppression techniques (such as watering road) will be utilized to limit the amount of dust entering the water |
| Quarry Development | Erosion and sedimentation<br>Noise, vibration and pressure changes from use of explosives | • Sufficient amount of undisturbed land will be maintained between quarry and any water body (expected to be 100 m)<br>• Erosion and sediment control measures and best management practices will be employed<br>• Borrow source material will be evaluated for metals and acid rock drainage (ARD) potential prior to source selection. Sources will be selected to ensure material does not contribute to ARD. This method will prevent ARD and metal leaching from impacting water quality, fish and fish habitat |
| Water Extraction | Oxygen level depressions<br>Exposure of eggs and larvae<br>Reduction of available habitat for spring spawners<br>Winter fish kill | • DFO Protocol for Winter Water Withdrawal will be followed |
| Public Access | Increased exploitation due to improved access to remote fishing areas | • ENR will ensure public education and enforcement of *NWT Fishery Regulations* |
| | Risks to watercourses due to vehicle collisions and release of contaminants into a waterbody | • Operating speed of highway will reflect road design standards, which will also account for climate conditions<br>• Territory-wide DOT public awareness campaigns help to promote safe driving |

The application of the above mitigations and the additional mitigations listed in the Fish and Fish Habitat Protection Plan (FFHPP) should minimize and manage effects on fish and fish habitat. There will be no serious harm to fish. More detailed information on the activities, aspects and impacts and how they are mitigated can be found in the *Fisheries Protection Self-Assessment Serious Harm Impacts Determination Record* for the proposed TASR (Appendix T).

## 8.10 Cultural and Heritage Resources

The following section discusses the approach that will be taken to manage the construction of the proposed TASR while minimizing potential effects to archaeological sites.

In relation to other cultural values beyond archaeology, Section 5.2.3 of Appendix B highlights some of the harvesting and cultural benefits and risks identified during the 2013-2014 consultations with Whatì community members. They include concerns about reduced wildlife available for harvesting due to physical impacts of an all-season road and increased harvesting competition, changes to intra-community dynamics that reduce cultural practices and transmission, and damage to the land reducing the strong connection of community members to their cultural landscape.

The Tłı̨cho Government and the Community Government of Whatì have developed a list of commitments that includes policies and programs that should mitigate the community safety, economic development, community preparedness and governance issues identified for the life of the proposed TASR (Appendix D). Additional environmental and wildlife mitigations related to community concerns have also been discussed in the sections above.

### 8.10.1 Known Archaeological Sites

One previously recorded archaeological site (Appendix U) is located approximately 200 m from the proposed TASR corridor. While this site currently falls outside the development footprint and no site disturbance is anticipated, avoidance will continue. The potential for the construction of the proposed TASR to affect archaeology sites exists; DOT will establish a buffer of minimally 30 m around identified sites to ensure ongoing avoidance and where practical and possible, a 100 m buffer will be established.

Should the proposed TASR corridor change and encroach on the 30 m buffer zone of the previously recorded archaeology site (identified in Appendix U), community and PWNHC consultation will be conducted to ensure that the community and PWNHC do not have concerns with the impact of this location. Due to conversations with Tłı̨chǫ members and the evidence of recent use at this site, it is perceived to have low heritage value (Appendix U).

Routing options have been developed to avoid the significant cultural sites identified in the Tłı̨chǫ Traditional Knowledge study (TG 2015), such as the La Martre Falls. Should the proposed TASR corridor change during final alignment decisions, these identified sites will again be considered, an appropriate buffer will be used and the applicable communities will be consulted, where required.

### 8.10.2 Archaeological Site Find Protocol

The Department of Transportation has drafted an Archaeological Site Find Protocol (Appendix Y) to provide guidance to employees and contractors conducting ground disturbing operations. The document provides the framework for identifying archaeological deposits and avoiding unforeseen disturbance to cultural heritage resources. The Protocol, consisting of two parts, ensures employees and contractors are educated of the regulations, what archaeological sites look like and how they can be identified prior to engaging in ground disturbing operations and what procedural steps should be followed if a suspected archaeological or heritage resource is identified.

#### *8.10.2.1 Education*

This section ensures employees are aware that archaeological sites are protected by law, provides examples of what archaeological sites look like and how they can be identified.

#### *8.10.2.2 Discovery Protocol*

This section describes the necessary steps required when a suspected archaeological site is identified by an employee or contractor in the field. It includes the form that will need to be filled out and submitted to the project manager, who will then pass the information along to the PWNHC.

If materials are encountered during the course of development that could be archaeological or heritage resources, the following steps are recommended:

- Cease all forms of ground disturbance in the immediate vicinity of the find and leave all possible archaeological or heritage materials in place.
- Establish a protective buffer of at least 30 m around the extent of the find area and demarcate the buffer in a highly visible and clear manner (e.g., with “No Work Zone” flagging).
- Record the GPS location of the found materials, if possible.
- Briefly note the type of archaeological materials encountered and their location, including the depth below surface of the find, if possible.
- Photograph the exposed materials, preferably with a scale (a yellow plastic field binder will suffice).
- Notify Tom Andrews (Territorial Archaeologist) at PWNHC (tom.andrews@gov.nt.ca or 867-873-7258).

### 8.10.3 Additional Archaeological Overviews and/or AIAs

As mentioned in Section 7.1, no borrow sources were included in Stantec’s AIA as the specific borrow sources that will be utilized for construction of the proposed TASR have not been finalized. A subsequent archaeological overview/AIA of high potential areas may be required at a later date to address the archaeological potential amongst the chosen borrow sources, due to the typically high archaeological potential with high, well-drained, elevated features. DOT will work in conjunction with PWNHC in assessing the suitability of the proposed borrow sources and will ensure source selection considers cultural and heritage sites and maintains a suitable protective buffer.

## 8.11 Communities

The proposed TASR involves the relocation of an existing winter road to a predominantly disturbed land based all-season alignment. The overland alignment will allow an extension of the annual operating period; as such, there will be increased business and employment opportunities during the initial construction phase and a slight increase during subsequent annual maintenance periods.

The proposed TASR should result in a decrease in the cost of living as a result of continued vehicular access to the community. Year round vehicular access to the community will reduce passenger air travel, which is considered a greater risk in the NWT, and increase the consistent flow of goods and people into and out of the region (Appendix B). Population (short-term and long-term) increases in Whatì during and after construction of the TASR are likely; the Community Government of Whatì and the Tłı̨chǫ Government have already fielded many calls from citizens regarding possible opportunities in Whatì. These citizens are keen to relocate to participate in potential work associated with the road and the Fortune Minerals' NICO mine. Community growth requirements need to be planned for in advance in order to manage pressures on existing physical and social infrastructure.

Following the commitments agreed to by the Tłı̨chǫ Government and Community Government of Whatì in Motion 2015-018, both governments have been taking a proactive approach in preparing Whatì for this potential population increase. For example, a June 24, 2015 Special Inter-Agency Committee meeting (Appendix E) described additional steps that have been taken and/or will be implemented to fulfill the mitigations outlined in Motion 2015-018.

As described in Section 7.4.1 and TG's socioeconomic report (Appendix B), residents of Whatì are concerned about what an all-season road may bring in terms of increased outsider presence, changes in the amount of time residents spend in the community, and other community cohesion issues. Public safety at home and on the road is among the utmost concern raised by Whatì residents.

Year round access to the community by road may increase the amount of illegal substances transported to Whatì. This is a population health concern that is being taken very seriously by the Tłı̨chǫ Government and the Community Government of Whatì, which they feel will be addressed with Motion 2015-018 (Appendix D). The RCMP can inspect vehicles for illegal substances if they have reasonable grounds to do so, which assists in reducing the amount of illegal substances entering Whatì. The RCMP will continue to patrol and conduct check stops on the winter road system as well as the new all-season road. Community members who have information about bootlegging or trafficking activity are encouraged to anonymously report this information to Crime Stoppers. The RCMP works with each NWT community to identify their policing priorities, and then develops community-specific Policing Action Plans that take into account the financial and human resources available to them. Should bootlegging be identified as a priority by Whatì, or any other community, then the RCMP will work in partnership with the community to achieve the identified objectives.

Table 8-8 provides a summary of the potential community impacts and mitigations associated with the proposed TASR.

### Table 8-8 Potential Community Impacts and Mitigations

| Potential Impacts | Mitigation Measures |
|---|---|
| Overfishing, hunting and cabin erection by non-residents and/or tourists, which may damage Tłı̨chǫ culture and land | • Tłı̨chǫ Government will continue to manage cabin construction on Tłı̨chǫ lands through the mechanisms that have been put into place by way of the Tłı̨chǫ LUP<br>• ENR will enforce the NWT's fishery regulations which are in place to prevent overfishing of any one area<br>• ENR will enforce the NWT's hunting regulations which are in place to prevent overharvesting of any one area |

## Table 8-8 (Continued) Potential Community Impacts and Mitigations

| Potential Impacts | Mitigation Measures |
|---|---|
| Overfishing, hunting and cabin erection by non-residents and/or tourists, which may damage Tłı̨chǫ culture and land | • Lands will continue to conduct a land use scoping study of the Wek'èezhìı Management Area, which could help to establish land use guidelines in the Wek'èezhìı area in the future<br>• TG and/or the Community Government of Whatì will erect signage to prevent damage to culturally significant areas (such as the La Martre Falls) |
| Increased illegal substances entering Whatì, which may affect community cohesion, increase crime and family violence | • If bootlegging and trafficking are identified by a community as a policing priority in its annual policing plan, the Department of Justice's Community Justice Division and the RCMP will assist in providing increased education and awareness around the issues, including the negative impacts of bootlegging and trafficking on the community and the consequences for perpetrators<br>• The RCMP will conduct patrols and check stops and will inspect vehicles for illegal substances if they have reasonable grounds to do so<br>• The GNWT has a number of initiatives in place for the prevention of family violence, including a pilot program called a *"New Day"* to help adult men reduce their violent behaviour in intimate and family relationships and *"What Will it Take?"*, a social marketing campaign aimed at changing attitudes and beliefs about family violence. It also has services in place to help victims of family violence, such as the ability to apply for an emergency protection order "24/7", community-based Victim Services, and funding to support the five NWT family violence shelters and victims living in regions without shelters<br>• RCMP "G" Division has a *Family Violence Coordinator* position that monitors high risk files, provides training and support to Members responding to family violence situations, and represents the RCMP on family violence committees<br>• Steps established by Motion 2015-018 will help to mitigate this identified concern |
| Decreased cost of living | • Positive impact that does not need to be mitigated |
| Increased population, which may stress available public infrastructure | • Steps are underway to establish a Local Housing Organization in Whatì<br>• Current public infrastructure (such as sewage and water treatment) can accommodate an increased population<br>• Ongoing and continued Special Inter-Agency committee meetings will develop further steps to mitigate this identified concern |
| Increased local business opportunities and employment during construction and operation of highway and mine | • GNWT will follow its Business Incentive Policy, which provides for local preference in the awarding of contracts for the proposed TASR, in addition to Section 26.3 of the Tłı̨chǫ Agreement on Government Employment and Contracts |

Commitments from Tłı̨chǫ Government and Community Government of Whatì (Motion 2015-018) are included below.

### *COMMUNITY SAFETY*

*Our goal is to strengthen community security and safety through resilient policing, policies and programs.*

The Community Government of Whatì is investigating two options to strengthen community security: Community Bylaw Officer and Aboriginal Policing Program. This is an issue that needs to be addressed

jointly by the Tłı̨chǫ Government and the Community Government of Whatì, as well as other supportive agencies.

There is a need to provide on-the-land treatment for substance abusers, using the healing-power of the elders and the land. This is a social issue that needs to be addressed by Tłı̨chǫ Community Services Agency (TCSA), and one recommendation is to introduce the Nishi Program by accessing a variety of funding sources.

There is currently an alcohol prohibition in place in Whatì. Annually, TCSA, the RCMP and the GNWT allocate a large sum of prohibition enforcement and responding to the negative impacts which are most often ineffective. The Community Government of Whatì would like to review the possibility of revisiting the prohibition ban, in favour of more proactive resilience strategies for managing alcohol and drug consumption in the community.

### *ECONOMIC DEVELOPMENT*

*Our goal is to strengthen community economic development through programs and resources.*

The need has been shown for increased business acumen for local entrepreneurs, in order to maximize local procurement opportunities from the road and mine. The Tłı̨chǫ Government currently maintains Economic Development Officers (EDO) in the communities who assist Tłı̨chǫ residents in establishing their own businesses. It may create a larger benefit for the Tłı̨chǫ Government to redirect each local EDO to focus on local economic development issues.

### *COMMUNITY PREPAREDNESS*

*Our goal is to prepare the community of Whatì for road development through programs, intergovernmental coordination and provision of resources.*

The Community Government of Whatì has an active Community Emergency Management Plan and completes regular training and exercises of staff, Council and various community members. In 2014, the relevance of this training and preparedness was graphically demonstrated as wildlife fires came within 5 km of the community.

The Community Government of Whatì is an active supporter of a local Inter-Agency Committee which includes the RCMP, Health, various TCSA agencies, and the Tłı̨chǫ Government. Whatì Inter-Agency responds to issues related to community preparedness. Issues such as emergency response, social programs, and the community and lands concerns are all brought to this monthly forum. Reasonable discussions about costs, liabilities and insurance will need to be addressed at this forum. Both parties commit to continuing this community forum in order to coordinate among agencies.

The Community Government of Whatì commits to clear and ongoing communication with citizens in the region, using appropriate means. These may include posters, door-to-door mail-outs, newsletters, as well as public meetings.

Housing stock and condition is an ongoing barrier to community well-being and preparedness. There is insufficient information on housing and the barriers, but key issues to investigate include income support, home ownership, property management, and local organization, as well as financing. A Local Housing Organization (LHO) is being established in Whatì, but there needs to be further development and

information gathered. Both parties recommend a fact finding investigation on this topic, within the next six months and, based on the findings, further commitments can be made. In order to propel action forward on this topic, this issue should also be on the Tłı̨chǫ Chief Executive Council (CEC) agenda.

There is a need for locally agreed-upon goals and plans for Community Well-Being. The Whatì Inter-Agency Committee should develop a small set of community based goals of resilience. As an example: A number of local gardens, and the support of a community garden, could be an example, with goals set for 2020 and 2025. The Community Government of Whatì commits to forming a small set of community goals during the 2015 Strategic Planning process (March 6 & 7), and then monitoring progress towards goals over-time.

***GOVERNANCE***

*Our goal is to prepare the citizens and governments for road development through development of predictable regulations, policies and support of services.*

There is desire for development of 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. The GNWT and the Tłı̨chǫ Government commit to working together to develop clear guidance on this topic, and provide effective management.

The Tłı̨chǫ government will develop mineral policy for Tłı̨chǫ Lands so that there is clear and predictable regulation in the region.

Mitigation strategies identified above are intended to enhance project benefits and avoid or reduce adverse effects. The combined forces of the GNWT, Tłı̨chǫ Government, and Community Government of Whatì will be working closely together to ensure that on balance, the effects of the proposed TASR on communities, the Tłı̨chǫ region, and the NWT, will be positive and long-term in nature, and that adverse effects will be manageable. Community government support of the proposed TASR from Whatì, Gamètì, Wekweètì and Behchokǫ̀ and from the Tłı̨chǫ Government (see signed Engagement documents) demonstrates that these members believe the suggested mitigations are acceptable.

## 8.12 Environmental Effects on the Proposed TASR

The potential effects of the environment on the proposed TASR include:

- geohazards
- climate change
- (forest) fire

For this proposed TASR, effects of the following geohazards: mass movements, seismic events, karst generated subsidence, hydrologic and erosion hazards, thaw subsidence and thermokarst are considered.

Mass movements could affect the road if the corridor was routed through unstable terrain with many steep slopes and/or sensitive surficial materials. However, the selected road corridor has been routed over stable Paleozoic rocks covered by till and glaciofluvial and glaciolacustrine materials. Mass movements in sloping thick fine grained glaciolacustrine materials may be possible but unlikely.

The proposed TASR is entirely situated in a low seismic hazard zone (NRCan 2013). The likelihood of this geohazard affecting the proposed TASR is therefore negligible.

While some gypsum formations may occur near the southern part of the road, no karst features have been observed directly along the road alignment (Ford 2009). The likelihood of this geohazard affecting the proposed TASR is therefore low though Ford does mention that there are likely to be some attractive displays of small-scale gypsum coastal karst within the 85K – Rae mapsheet and that further studies are warranted (2009). Geotechnical investigations undertaken during final road design should identify whether these small-scale karst locations will need to be avoided.

Hydrologic hazards such as vertical and lateral scour or avulsion are possible at stream crossings. Erosion hazards are present especially at the end of the winter season when snow on the road surface melts. Thaw subsidence and thermokarst is possible if the road was routed over surficial material that has ground ice. Road design standards take these hazards into consideration and select proper materials to ensure these hazards are avoided and/or mitigated. Considerations include designing bridges and culverts to withstand 1 in 100 year floods and avoiding areas of discontinuous permafrost and/or utilizing geotextile.

Forest fires change the microclimate of the area affected and thereby the ground thermal regime.

Measures to mitigate potential effects of the environment on the project include, but may not be limited to the following:

- sloping thick fine grained glaciolacustrine materials will be avoided, where practical;
- erosion control and bank stabilization measures will be used at stream crossings and near waterbodies, where required;
- road will be routed to avoid potential karst features;
- drainage improvement and erosion control measures will be used along the road alignment to mitigate potential erosion by meltwater during freshet;
- locations with ground ice, patterned ground, fine grained soils, particularly clay and sedge wetlands and peatlands in permafrost terrain due to high near-surface ground ice content will be avoided, where possible;
- low road grades and proper drainage will be utilized to reduce soil erosion; and
- ongoing monitoring of terrain, permafrost and soils condition along the road will be part of the follow-up and road maintenance.

## 8.13 Accidents and Malfunctions

Accidents and malfunctions during construction may include:

- fuel storage, transportation and handling system failures;
- vehicle collisions;

- hydraulic fuel or other liquid discharge from machinery;
- bridge or culvert failure during construction or operations; and
- fire.

To minimize risks of accidents or malfunctions occurring and to minimize possible risks to the environment from such potential accidents or malfunctions, a number of preventative and mitigation measures will be employed. The overriding preventative and mitigation measures to be employed include:

- implementation of best management and industry practices as appropriate to prevent or minimize the occurrence of accidents or malfunctions;
- ensuring that all contractors onsite have industry-compliant and satisfactory Health, Safety and Environmental (HSE) policies, programs and manuals and that they are successfully implemented throughout the project;
- compliance with land use permit, quarry permit and water licence requirements and conditions issued for the construction project;
- conformance with existing applicable GNWT and Workers' Safety and Compensation Commission legislation and standards;
- fuel and other hydrocarbons will be stored in accordance to storage tank regulations under the *Canadian Environmental Protection Act, 1999* and the CCME's *Environmental Code of Practice* for storage of these products (CCME 2003);
- any uncontrolled discharge will be immediately managed to stop discharge and begin the mitigation process. Spills will be reported to the 24-hour Spill Report Line (867.920.8130) according to current guidelines;
- spill containment and clean-up activities will be implemented in accordance with the site-specific Spill Contingency Plan that will be developed by the successful contractor (e.g. Appendix L); and
- safety measures to prevent vehicle accidents on the alignment have been and will continue to be incorporated into the proposed TASR design. Measures to avoid or minimize accidents, particularly those which may occur at or near a watercourse crossing, will include posted speed limits, adequate signage altering drivers to road curves, and upcoming bridges. Bridge design will incorporate guardrails to prevent a vehicle from going off the highway and into a watercourse in the event of an accident.

The key strategy will be to prevent accidents from occurring through education and enforcement. With the application and implementation of the preventative and mitigation measures as outlined, no significant fuel, chemical or other product spills are expected to occur.

# 9 CUMULATIVE EFFECTS

Cumulative effects are those impacts (biophysical, socio-cultural, or economic) that result from a proposed development in combination with other past, present, or reasonably foreseeable future developments.

An assessment of cumulative effects provides a more complete understanding of what might happen to valued components beyond the influence of the project alone and is a required component for projects that have been referred to environmental assessment. A detailed cumulative effects assessment provides a glimpse into environmental and socioeconomic conditions as they are now and how they may change in the future with development. This contributes to a better understanding of what might or might not happen if the project proceeds.

Typically, cumulative effects assessments address effects that:

- extend over a larger area;
- are of longer term duration;
- act in conjunction with other projects/activities on the same VCs; and
- are reasonably probable, considering possible future projects/activities and impacts.

A cumulative effects assessment typically involves the application of the following four basic steps:

1. identify the valued parts of the environment that are potentially affected by the proposed development;
2. determine what other past, present or reasonably foreseeable future developments will affect these parts of the environment;
3. predict the effects of the proposed development in combination with these other developments; and
4. identify ways to manage the combined impacts.

Since the term ‘environment’ in the *MVRMA* is defined to include biophysical, socioeconomic and cultural components, scoping may identify purely social or cultural issues, in addition to ecological ones.

For the proposed TASR, an attempt has been made to conduct a preliminary cumulative effects review in order to aid in the preliminary screening process with the WLWB. This brief summary should provide regulatory decision makers and land and resources managers with a suitable amount of detail to assess whether the construction of the proposed TASR will contribute to cumulative effects in the Wek’èezhìı area and whether any additional mitigations are required.

For the purposes of this preliminary cumulative effects assessment, the spatial boundaries included a 100 km buffer zone surrounding the proposed TASR corridor in order to assess past and present projects in the area. While a 100 km buffer zone was also used to assess potential future projects, in certain

instances, considerations were made to extend this boundary. Because construction of an all-season road will enable increased mineral exploration to the area as a result of improved access at a reduced cost, known mineral deposits (e.g. Nighthawk's Indin Lake property) outside the boundary were also considered. Developments within the community government boundaries of Whatì and Behchokǫ̀ were excluded from analysis even though both communities fell within the 100 km boundary.

For the purposes of this preliminary cumulative effects assessment, the temporal (time frame) boundary for the assessment was established at forty years. The proposed TASR is anticipated to be constructed and then be in operation indefinitely; however, it is difficult to gauge projects that far into the future. Forty years was selected as the measure as a proposed mineral mine that has completed the environmental assessment process (NICO mine) is expected to be in operation and then be fully remediated within the forty-year time period. It remains unknown at this time whether construction of any other proposed future projects will proceed before or after construction of the road has been completed.

## 9.1 Identified areas of concern

During the engagement process for the proposed TASR, the following items were identified as concerns related to the road: air quality and noise levels, increased access to hunting areas, vehicle-wildlife collisions, caribou-specific concerns, and community social problems (for example, those associated with increased substance abuse). These concerns have since been addressed with appropriate mitigations (Section 8); however, should additional projects, which are expected to have similar concerns associated with them, proceed within the same spatial boundary, cumulative effects may result. These cumulative effects may then require additional mitigations in order to suitably manage the risks as a whole. Section 9.2 considers the current and probable activity within the TASR's spatial boundary and considers whether cumulative effects are expected.

## 9.2 Past, Present and Future Projects/Activities Considered

Due to the proximity of Fortune Minerals' NICO Mine project to the proposed TASR, a review of cumulative effects listed in their Developer's Assessment Report was conducted. This report indicated that "previous and existing developments in the Tłı̨chǫ/North Slave region includes mineral exploration programs, historic remediated and non-remediated contaminated sites, winter roads, all-weather roads, hydro power development, transmission line, hunting and fishing lodges, proposed and existing protected areas, mines, mineral exploration camps, staging areas, quarries and communication structures" (Fortune 2011). This statement was confirmed by conducting a review of the NWT Discovery Portal (ENR 2015), which provided a 2014 spatial dataset of development sites located within the North Slave and South Slave Regions of the NWT (Golder 2014). Past, existing and potential future projects considered in this preliminary cumulative effects assessment therefore include:

- existing Tłı̨chǫ Winter Road System;
- community users of the land;
- current exploration leases and significant discovery leases;
- hydroelectric generation systems; and

- contaminated and remediated sites.

Brief descriptions of each of these projects and activities and how they may contribute to possible cumulative effects in relation to the proposed construction and operation of the TASR are provided in the following sections. Figure 9-1 provides visual representation of the discussed projects in relation to the proposed TASR; it also includes the disturbance footprint data from Figure 8-1 to help illustrate overall disturbance in the Wek'èezhìı area.

### 9.2.1 Past and Existing Projects

#### *TŁIĮCHǪ WINTER ROAD SYSTEM*

The Tłı̨chǫ Winter Road System currently connects the communities of Whatì, Wekweètì and Gamètì. Should the proposed TASR be constructed, the first 60 km of the current winter road starting from Highway 3 would be remediated. The remaining sections of winter road would remain in place in order to connect the communities of Wekweètì and Gamètì. It is not expected that the Tłı̨chǫ Winter Road System would contribute to any cumulative effects as the traffic from these communities are expected to be diverted to the proposed TASR during the winter road season rather than needing to construct a winter road across Marian Lake.

#### *WOODS OPERATIONS*

Timber harvesting permits have been authorized along Highway 3 and in close proximity to the proposed TASR (access was via the old winter road). Currently there are only two active timber harvesting operations located adjacent to Highway 3. As these timber harvesting operations are considered to be of a small scale, it is unlikely they will contribute to any cumulative effects. It is recognized that the construction of the TASR could result in additional wood harvesting applications as a result of improving access to a significant burn area. The TRWG recognizes that additional woods operations could contribute to cumulative effects by increasing the level of disturbance surrounding the proposed TASR corridor; however, if permits are only approved for harvesting of dead/burned wood, the level of disturbance is expected to be low. As recent burn areas are already considered disturbed from an environmental perspective, harvesting of said wood should not increase disturbance. The TRWG views the harvesting of wood in burn areas adjacent to the proposed TASR as a positive as the operations would contribute to economic development of the region. As timber harvesting can result in increased erosion to an area, care would need to be taken to ensure harvesting does not occur directly adjacent to the TASR corridor. Timber harvesting permits may need to take into consideration their effect on erosion in a given area.

#### *SNARE HYDRO SYSTEM*

The Dogrib Power Corporation (DPC) operates a Class 1 hydropower generation system within the Snare Cascades. Its water licence is in effect until May 2024 though it is expected that DPC will apply for additional renewal licences when the time comes. The Snare hydro system provides power to the

communities of Yellowknife and Behchokǫ̀ by way of transmission lines. The current Snare hydro system is not expected to contribute to cumulative effects.

### *CONTAMINATED SITES*

Indigenous and Northern Affairs Canada (INAC) is currently and has been responsible for the cleanup of multiple contaminated sites within the Wek'èezhìı area. These sites are in various stages of remediation. In certain instances, new exploration projects are working alongside long-term post closure monitoring programs; such as the case with the Colomac mine site. Colomac and Rayrock mine sites are the only contaminated sites that INAC is currently remediating/monitoring within the Wek'èezhìı area according to WLWB's online registry. Both mine sites are accessed by the Tłı̨chǫ Winter Road System.

According to INAC's contaminated sites website, in 2011, Nighthawk Gold Corp. negotiated an agreement to exchange a number of mineral claims and leases at the Colomac site in return for Nighthawk Gold remediating three other contaminated sites in the Wek'èezhìı area (AANDC 2013). These sites were the Spider Lake exploration site, Diversified/Indigo Mine, and Chalco Lake exploration. Currently, Nighthawk Gold has a LUP with the WLWB for purposes of remediating these sites. The permit (W2012X0003) expires in 2017. A June 2013 letter from the inspector indicated that the Chalco site remediation is complete. As of June 2013, the Diversified and Spider sites were still not fully remediated. There have been no additional updates on the WLWB registry for these two sites (WLWB 2013).

According to the Federal Contaminated Sites inventory, various contaminated sites within the Wek'èezhìı area have been closed (TBS 2015). Some of these sites include contaminated sites located within or along: the old Lac La Martre winter road, Fort Rae area, Indin Lake, Lac La Martre, Marian Lake, Ray Lakes area, Russell Lake, Snare Lake, Horn Plateau/Marian Lake area, Rayrock power line, Slemon Lake, and Wijinnedi Lake. The remaining active sites include: Wijinnedi Lake (East), Horn Plateau/Marian Lake area – Rex and Norris Lake. Their associated site numbers are 00000202, 00023646, and 00023689, respectively. These sites are ranked as a medium priority for the federal government and therefore no dates have been assigned with respect to final remediation. The Sun-Rose site (#C1034001) is also ranked as medium priority; however, it has been assigned a date range of 2017 through to 2021 for expected remediation. The North Inca mine site (#C128001) was listed as a high priority for action which was to be completed during the 2014/2015 year. In 2012, the WLWB granted final clearance of Land Use Permit W2009X0002 which was a requirement to complete remediation of the North Inca mine site (WLWB 2012). The final clearance papers indicated that the long term monitoring that was to continue would not require a LUP. There is no additional information available for this site.

The Mackenzie Valley Land and Water Board (MVLWB) online registry indicates that INAC has submitted an application in order to utilize a historic winter road alignment (also known as the Denison winter road) for purposes of remediating mine sites in that area (e.g. Terra and Sawmill Bay). This application has yet to be finalized. It is expected that this road will only be in operation during the first and last year of the project, that it would only be open for three to five weeks when used and traffic volumes would remain low (<150 trucks per year; MVLWB 2015). This volume of traffic is not expected to affect estimated daily traffic volumes of the proposed TASR and therefore is not expected to contribute to cumulative effects.

### *ACTIVE EXPLORATION PROJECTS IN 2014*

As summarized in the *2014 NWT Mineral Exploration Overview* (Falck and Gochnauer 2015) published by ITI, the companies listed in Table 9-1 undertook sampling in 2014 at their respective properties. The table also includes the distance of these properties to the proposed TASR. Currently, these projects remain in the exploration phase and as such are not expected to contribute to any cumulative effects. It is difficult to gauge whether the projects themselves will become established mines over the next 40 years. Due to their geographic location, with the exception of DEMCo's Bugow and Nighthawk Gold's Colomac sites[16], these projects are not likely to contribute to cumulative effects related to the TASR.

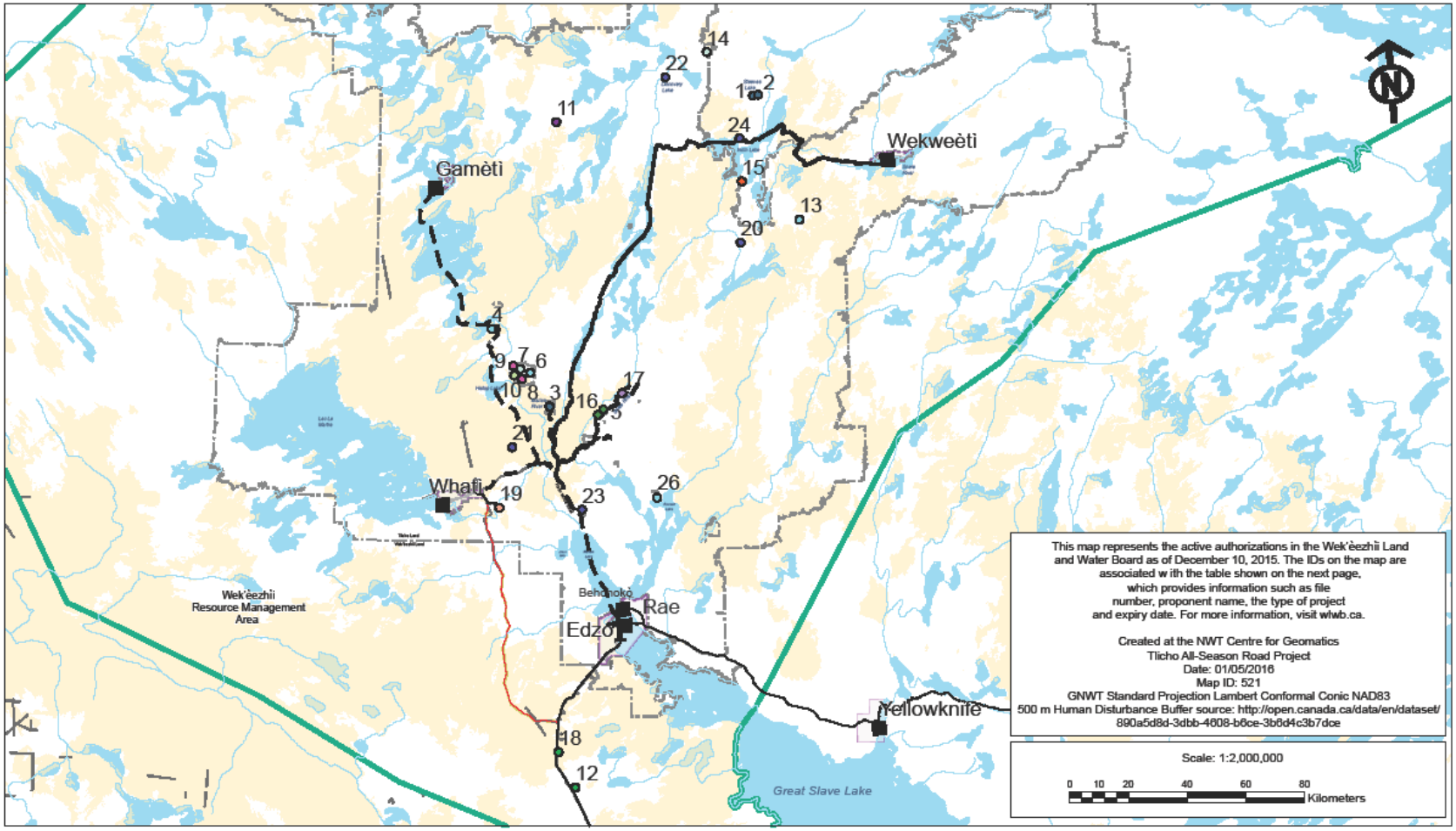
If any of the active exploration projects were to become established mines, it is unlikely most would make use of the proposed TASR due to their geographic location. Therefore, increased traffic along the road is not likely and (aside for caribou-specific concerns due to their large habitat range) the general environmental concerns identified during the TASR consultations would not be expected to increase as a result of these possible projects.

The only projects that may utilize the proposed TASR in the future would be those associated with DEMCo and Nighthawk. DEMCo's Bugow site, which is located north of Russell Lake, could potentially utilize the proposed TASR; however, a spur road starting from the north end of the TASR would need to be constructed if DEMCo wanted to make use of the all-season road. DEMCo would need to commit to constructing a road which would be between 30-50 km, which is comparable to the road that is needed for NICO mine (see Section 9.2.2 for addition info on NICO). DEMCo's additional site, Terra Mine, located on the edge of Great Bear Lake could possibly be reached via the proposed TASR if an all-season road were built to Gamètì though DEMCo would still need to construct a substantial spur road north to the mine site. If only winter access was needed, use of the old Denison winter road, which is expected to be reestablished by INAC in order to remediate the old mines in that area, may be possible. Nighthawk's conglomerate of sites surrounding the old Colomac Mine site and Indin and Damoti lakes could make use of the proposed TASR though an all-season road to Wekweètì would improve the likelihood of developing the mine site. As the past producing Colomac Mine was built, operated and closed via a winter road from Highway 3 with assistance from the 1500 m airstrip still in existence, it is possible Nighthawk could pursue this option if it is more financially feasible. BFR Copper & Gold Inc. is currently undergoing exploration at the Mazenod property which is between the NICO and Sue Dianne areas. If the area proves successful, BFR could potentially utilize NICO's haul road in order to limit the amount of road they would be required to construct to have all-season access. If the project required the installation of a public all-season road to Gamètì prior to construction, the project would most likely exceed the temporal boundary associated with the proposed TASR.

[16] Also known as the Indin Lake Gold Property.

Government of Northwest Territories

Figure 9-1 Past, present and future projects or activities considered with respect to possible cumulative effects in relation to the proposed TASR.
*(Figure 8-1 disturbance data included for reference.)*






| ID | File Number | Proponent | Activity Type | Expires |
|---|---|---|---|---|
| 1 | W2014X0004 | AANDC-CARD (Colomac LUP Post Closure Monitoring/Maintenance) | Miscellaneous | 1/25/2020 |
| 2 | W2014L6-0003 | AANDC-CARD (Colomac Water Licence, Post Closure Monitoring/Maintenance) | Miscellaneous | 1/22/2022 |
| 3 | W2015X0006 | AANDC-CARD (Rayrock Assessment and Remediation) | Miscellaneous | 8/13/2020 |
| 4 | W2013C0002 | BFR Copper& Gold Inc. (Mazenod Exploration Project) | Mining Exploration | 5/17/2018 |
| 5 | W2014L4-0001 | Dogrib Power Corporation (Snare River Power– Snare Cascades) | Power | 5/29/2024 |
| 6 | W2009C0001 | Fortune Minerals Limited (NICO Exploration) | Mining Exploration | 3/25/2016 |
| 7 | W2011L2-0002 | Fortune Minerals Limited (NICO Exploration) | Industrial-Water | 1/22/2017 |
| 8 | W2008L2-0004 | Fortune Minerals Limited (NICO Mine) | Mining and Milling -Water | 7/21/2026 |
| 9 | W2008D0016 | Fortune Minerals Limited (NICO Mine) | Mining and Milling -Water | 6/16/2019 |
| 10 | W2013T0008 | Fortune Minerals Limited (NICO Staging Area) | Staging | 12/22/2018 |
| 11 | W2014F0003 | GNWT DOT (Wekweeti Winter Road) | Road Public | 12/14/2019 |
| 12 | W2015W0007 | Kerry Smith (Wood-cutting along Highway #3) | Woods Ops | 8/12/2020 |
| 13 | W2012C0002 | Nighthawk Gold Corp. (Damoti Lake and Colomac Exploration) | Mining Exploration | 2/28/2017 |
| 14 | W2012L1-0002 | Nighthawk Gold Corp. (Damoti Lake and Colomac Industrial) | Industrial-Water | 2/27/2019 |
| 15 | W2012X0003 | Nighthawk Gold Corp. (Remediation at Damoti Lake, Diversitied, Chalco Lake & Spider Lake) | Remediation | 2/28/2017 |
| 16 | N1L4-0150 | Northwest Territories Power Corporation (Snare River Power Snare Rapids, Snare Falls and Snare Forks) | Power | 5/25/2024 |
| 17 | W2014F0002 | Northwest Territories Power Corporation (Snare River Winter Road) | Road Private | 10/26/2019 |
| 18 | W2011W0003 | Sands Enterprise (Wood cutting along Highway #3) | Woods Ops | 8/10/2016 |
| 19 | W2010S0007 | SNC-Lavalin Inc. (Geotechnical Drilling at La Martre Falls) | Geotechnical | 1/31/2016 |
| 20 | 202 | AANDC - Wijinnedi Lake (East) | Historic Contamination | N/A |
| 21 | 23646 | AANDC - Horn Plateau/Marian Lake Area - Rex | Historic Contamination | N/A |
| 22 | 23689 | AANDC - Norris Lake | Historic Contamination | N/A |
| 23 | C1034001 | AANDC - Sun-Rose Claim | Historic Contamination | N/A |
| 24 | C1028001 | AANDC - North Inca Mine | Historic Contamination | N/A |
| 25 | 403 | AANDC Sawmill Bay *(not on map as it is north of Gamèti near Great Bear Lake)* | Historic Contamination | N/A |
| 26 | | DEMCo - Bugow | Mining Exploration | N/A |

## Table 9-1 Summary of NWT active exploration projects in 2014 near the proposed TASR corridor

| Operator/ Partners | Property | Commodity | Sampling and other work | Distance to proposed TASR (km) | Comments |
|---|---|---|---|---|---|
| DEMCo | Terra Mine/Bugow | Au, Ag, REE | Prospecting, sampling historic core | ~50 and +250 | Bugow is located just north of Russell Lake. Access to site could be via TASR though a spur road would be required |
| Dewar/Kendrik | Hanging Stone | Au | 186 chip and grab samples | +100 | Within Yellowknife area, would never utilize TASR to reach site |
| New Discovery Mines | MON | Au | Prospecting, bulk samples planned | +100 | Within Yellowknife area, would never utilize TASR to reach site |
| Nighthawk Gold Corp | Indin Lake, Colomac, Kim, Cass | Au | Drilling, sampling historic core, prospecting | ~170 | Could utilize TASR, but would need the Tłı̨chǫ all-season road system to expand further north |
| Nickerson | AYE/Handle | Au | Drilling, chip sampling | +100 | Within Yellowknife area, would never utilize TASR to reach site |
| TerraX Minerals Inc. | Yellowknife City Gold (northbelt, Walsh Lake, U-Breccia, and Ryan Lake) | Au | Drilling, mapping, prospecting, surveying | ~130 | Within Yellowknife area, would never utilize TASR to reach site |
| Tyhee Gold Corp | Clan Lake, Ormsby, Nicholas Lake | Au | | ~120-150 | Within Yellowknife area, would never utilize TASR to reach site |
| Westhaven Ventures/Dave Nickerson | Mona | Au, Ni | Drilling | +100 | Within Yellowknife area, would never utilize TASR to reach site |
| GGL Resources Corp | Awry Lake Fishback Project | Diamonds | Drilling | ~150 | Within Yellowknife area, would never utilize TASR to reach site |
| BFR Copper & Gold Inc. | Mazenod Lake | Au, Cu | Analyzing survey data | ~60 | Could utilize TASR and possibly NICO's haul road in order to reduce amount of road BFR would need to construct |

*Note: Ag – Silver Au – Gold Ni – Nickel REE – Rare Earth Element*
*Reference: Falck and Gochnauer 2015; WLWB Registry*

### 9.2.2 Potential Future Projects

#### *FORTUNE MINERALS LTD. NICO MINE*

Fortune Minerals Ltd.'s NICO Cobalt-Gold-Bismuth-Copper project consists of a proposed open pit and underground mine located approximately 50 km northeast of Whatì. This project also requires construction of an approximately 51 km private haul road prior to development of the mine itself, which is expected to connect into the community access road built by Whatì or directly into the proposed TASR. This project was referred to the Mackenzie Valley Environmental Impact Review Board for an environmental assessment. The Board's January 2013 Reasons for Decision indicated that the project is "likely to cause significant adverse impacts to the environment including water, wildlife and the cultural environment" and issued a set of measures in their report that will, if adopted, ensure the impacts suggested are no longer significant (MVEIRB 2013).

Fortune Minerals indicated that development of the mine could not begin until a public all-season road was built that would connect the community of Whatì to Highway 3 as constructing an additional 100 km of road themselves did not make the project financially feasible. If the proposed TASR is constructed, it will support Fortune Minerals' ongoing efforts in procuring financing for the NICO project and construction of the private haul road and mine would most likely commence simultaneously along with the proposed TASR by initially utilizing the Tłı̨chǫ Winter Road System.

Due to the proximity of the NICO mine project and its reliance on an all-season road that connects to Highway 3, the project needed to be considered as a part of the cumulative effects for the proposed TASR. However, as the expected road requirements of the mine were considered during the design process of the proposed TASR, additional effects, aside from those discussed at length in Section 8 as a part of the mitigations, are not expected. Traffic volumes associated with the mining project were integrated into the projected traffic volumes described in this PDR (20 to 40 vehicles) and thus suitable mitigations have been discussed in Section 8.

As the potential impact to caribou was highlighted as a significant concern during Fortune Minerals' EA process, Measure #8 from the Reasons for Decision stated that the GNWT and Tłı̨chǫ Government would be required to establish and co-chair an expert working group to develop a response framework for cumulative impacts with respect to barren-ground caribou and would provide direction to Fortune Minerals to manage its project related to cumulative effects on caribou (MVEIRB 2013). Because caribou have also been highlighted as a species of concern with respect to the proposed TASR, it is expected that the proposed TASR will incorporate any additional mitigations related to caribou as directed by the same working group in order to manage the cumulative effects.

#### *NAILII HYDROELECTRIC PROJECT*

This project would be established at the falls on the La Martre River and connect to the community of Whatì. Initial investigations conducted by the community of Whatì were for a small run of the river project; however, it became evident that the project could be expanded into a larger commercial hydro project which could serve the Yellowknife and Behchokǫ̀ regions and surplus power could be made available to the NICO project (Whatì 2010). The Tłı̨chǫ Investment Corporation was provided funds by CanNor in

order to complete a feasibility study in 2011 (CanNor 2011). The results from this study are not publically available. If this project were to proceed, transmissions lines would need to be installed to both the east and west of the falls in order to connect power into the Snare hydro system and to connect the community of Whatì. It is possible that the community access road corridor would be wide enough to easily accommodate transmission lines rather than needing to construct a parallel corridor for the lines.

#### *TŁĮCHǪ/WHATÌ PARK AREA AT LA MARTRE FALLS*

The Tłı̨chǫ Government and community of Whatì are working collaboratively to establish a framework which will allow for a potential park area situated near La Martre Falls. A potential park could attract tourism and therefore increase traffic along the TASR, which could in turn increase the potential for wildlife collisions. Park plans are still in the preliminary stage and there is no concrete timeframe with respect to this possible project. Conservative estimates associated with increased tourism as a result of the park would still keep traffic levels within the definition of a low volume road.

## 9.3 Mitigation of Possible Cumulative Effects

The mitigation measures for the proposed TASR described in Section 8 are intended to decrease the risk of potential project effects concerning things such as air quality and noise levels, vehicle-wildlife collisions, invasive vegetation, increased erosion, water quality, fish habitat, increased hunting access, socioeconomics and various additional wildlife concerns. These mitigations are expected to be equally effective in mitigating any possible cumulative effects associated with future projects in the area.

Due to the large habitat range of boreal woodland and barren-ground caribou, these species are more susceptible to cumulative effects. The Review Board's Reasons for Decision for Fortune Minerals' NICO project supports this assessment and identified that additional mitigations would be required to ensure caribou are not significantly affected by project development. As mentioned under Section 9.2.2, Measure #8 from the Reasons for Decision indicated that a working group to develop a response framework for cumulative impacts with respect to barren-ground caribou would be required to sufficiently mitigate this risk. It is expected that the proposed TASR will adhere to the response framework once it is fully developed and this paired with an approved WMMP should prevent significant negative environmental effects.

In addition to the mentioned mitigations, Lands has completed a scoping study for a Wek'èezhìı Management Area land use plan. A land use plan on public lands would help manage cumulative effects on lands outside of Tłı̨chǫ lands. Developing a land use plan would help in mitigating excessive mineral exploration and cabin building within the Wek'èezhìı area and is therefore considered an asset in managing any additional future impacts.

# 10 MANAGEMENT PLANS

Management plans are a necessity in order to ensure project activities proceed in a safe and environmentally conscious manner. Depending on the selected project delivery method, which is contingent on funding, certain management plans are expected to be finalized by the contractor selected to implement construction. The contractor management plans will be approved by DOT prior to final submission to the Board; this will ensure DOT standards of practice are maintained. The draft management plans described herein are expected to be adopted in full or utilized in part where contractor best management plans exceed the draft plans. The management plans describe the techniques that will be employed and the practices that will be adhered to in order to meet the commitments stated in this PDR and to meet the conditions of approvals and permits. In certain instances, management plans such as the WMMP and Archaeological Site Find Protocol have been drafted by the GNWT and the successful contractor will be responsible for adhering to them without alterations.

## 10.1 Engagement Plan

The Engagement Plan is meant to identify engagement activities the GNWT and TG intend to carry out during the life of the authorizations issued by the WLWB. This plan includes details pertaining to engagement methods and planning. It also includes the completed engagement summaries and logs, which are a part of the engagement record. This plan can be found in Appendix E.

## 10.2 Quarry Operations Plan(s)

Quarry Operations Plan(s) will be submitted with the application for quarry permits. The successful contractor for the project will be responsible for providing a final plan that follows the applicable pit and quarry guidelines. The Quarry Operations Plan (QOP) also contains the necessary camp details as camps are expected to be erected at certain quarry locations. This plan will also outline the details pertaining to explosives management. A draft QOP can be found in Appendix K for illustrative purposes. The successful contractor will ensure the details within the plan are accurate. It is expected that the contractor will be required to make substantial changes to the current draft QOP as final borrow sources have not be selected and therefore concrete details cannot be described. By ensuring the appropriate guidelines are referenced and adhered to, despite current unknowns, appropriate mitigations will be utilized to prevent any possible environmental impacts.

## 10.3 Spill Contingency Plan

A draft Spill Contingency Plan (SCP) has been included in Appendix L. The draft Spill Contingency Plan describes the steps that will be taken in the event of a fuel, oil, sewage or chemical spill. This includes a description of clean-up materials and tools, waste handling, and large spills. In addition, this document describes how to report a spill and includes contact names and phone numbers. The successful contractor for the construction project will be responsible for submitting a final SCP prior to the

commencement of the operations in accordance with the *Guidelines for Spill Contingency Planning* (INAC 2007).

## 10.4 Wildlife Management and Monitoring Plan (WMMP)

The WMMP is intended to describe wildlife and wildlife habitat mitigation measures, applicable legislation and regulations, monitoring, and reporting requirements applicable to species at risk and species of management concern. In conjunction with ENR's Wildlife Division, DOT has drafted a WMMP that can be found in Appendix M. This draft plan will undergo further refinement pending any comments received during the application screening process and will be updated in consultation with ENR. It is expected that DOT and ENR will work collaboratively to produce a final WMMP that can be utilized by the project. As ENR's Wildlife Management and Monitoring Plan Guidelines are still in draft, it is understood that the draft WMMP, located in Appendix M, will need to be updated to reflect ENR's final guideline requirements once they are released.

## 10.5 Waste Management Plan

A draft Waste Management Plan (WMP) has been included in Appendix N. The successful contractor for the project will be responsible for submitting a final WMP prior to the commencement of operations in accordance with both the *Guidelines for Developing a Waste Management Plan* (MVLWB 2011) and the *Guideline for the General Management of Hazardous Waste in the NWT* (ENR 1998).

The WMP will:

- identify waste sources and related types, including but not limited to liquid, solid, non-hazardous, hazardous and approximate quantities;
- describe all onsite or remote treatment and disposal methods;
- describe all waste streams to be transported offsite and final disposal locations;
- describe related waste segregation strategies for the identified waste sources and accommodate their respective storage, treatment, transport and disposal; and
- describe food and food contaminated waste management methods to mitigate animal attraction from source to transport, treatment or disposal.

## 10.6 Sediment and Erosion Control Plan

As it is the Department of Transportation's responsibility to operate and maintain the public highways across the Northwest Territories, DOT has a multitude of years' experience in ensuring adequate erosion and sediment control measures are in place along highways and during construction. DOT makes use of its current version of the Erosion and Sediment Control Manual during all construction, operation and maintenance activities. DOT will utilize this manual as its sediment and erosion control plan. A copy of the manual can be found in Appendix W.

## 10.7 Fish and Fish Habitat Protection Plan (FFHPP)

The FFHPP is intended to provide mitigation measures against activities such as accidental fuel spills, water withdrawal, and overpressures in waterbodies or watercourses related to the use of explosives. Measures include mitigation for the TASR corridor, installation of watercourse crossing structures, highway maintenance, camp operations, waste and fuel storage, accidental spills and conducting borrow pit operations. A draft version of this plan can be found in Appendix X. A final version of the document will be submitted to the Board prior to commencing construction. A majority of the information summarized in this plan can be found in the aforementioned management plans, but has been repeated to highlight how these techniques specifically protect fish and fish habitat.

## 10.8 Archaeological Site Chance Find Protocol

As mentioned in the proposed mitigation section, the Department of Transportation has drafted an Archaeological Site Chance Find Protocol (Appendix Y) to provide guidance to employees and contractors conducting ground disturbing operations. The document provides the framework for identifying archaeological deposits and avoiding unforeseen disturbance to cultural heritage resources. The Protocol, consisting of two parts, ensures employees and contractors are educated of the regulations, what archaeological sites look like and how they can be identified prior to engaging in ground disturbing operations and what procedural steps should be followed if a suspected archaeological or heritage resource is identified.

## 10.9 Emergency Response Plan

An Emergency Response Plan (ERP) will be produced and provided by the successful contractor. It will include details of how to deal with various emergency situations such as a fire, vehicle or mobile equipment incident, serious medical incidents, camp evacuation and wildlife encounters. A draft ERP, which has been utilized for past DOT projects, has been included as Appendix Z.

## 10.10 In-Field Water Analysis Plan

A draft In-Field Water Analysis Plan has been included as Appendix AA. This Plan will provide guidance to onsite environmental monitors with respect to how to conduct sampling and what steps should be taken pending in-field results. This procedure should effectively manage the potential risk of increased sediment releases into the aquatic environment as a result of construction activities.

## 10.11 Geochemical Analysis Plan

In order to ensure materials utilized within the proposed TASR corridor are not susceptible to acid rock drainage and/or metal leaching, geochemical testing of borrow sources will occur prior to selecting final sources. DOT will be responsible for collecting the appropriate grab samples and sending them to an appropriate laboratory for analysis. DOT will then contract an appropriate consulting firm that is capable of analyzing the results to assess which sources are suitable for construction. Prior to collecting field samples, DOT will ensure the field collector follows the sampling protocol established by the laboratory.

The selected parameters requiring analysis will be established by the consulting firm that will analyze the laboratory data to ensure the correct parameters are selected for analysis by the laboratory.

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# APPENDIX A

## Access to Tłı̨chǫ Lands GNWT/TG joint letter March 2016

Letter not sent directly to WLWB, but rather included as the complete application package to the Board.

# APPENDIX B

## A Socio-Economic Issues Scoping Study for a Potential All-Weather Road to Whatì, Tłı̨chǫ Region, NT March 2015

# APPENDIX C

## Nichols Economic Evaluation of the Tłı̨chǫ Road March 2015

# APPENDIX D Motion 2015-018

# APPENDIX E

## Engagement Plan and Record (log and summaries)

Community Meeting Notes

Issues Raised and Input Provided during Public Meetings in Tłı̨chǫ Communities

Issues Raised and Input Provided by Government, Resource Managers and Industry

# APPENDIX F

## Tłı̨chǫ Grand Chief to DOT Minister, letter May 1, 2013

# APPENDIX G

## 1:2,500 Map book of proposed TASR corridor

# APPENDIX H

## TASR Photo Presentation: Conditions along route in June 2014

# APPENDIX I

## Major Bridge and Culvert Conceptual Designs 2016

# APPENDIX J

## Granular and Bedrock Prospects along Proposed TASR 2015

# APPENDIX K draft Quarry Operations Plan

# APPENDIX L draft Spill Contingency Plan

# APPENDIX M

## draft Wildlife Management and Monitoring Plan (WMMP)

# APPENDIX N draft Waste Management Plan

# APPENDIX O

## Landfill Authorizations from Whatì and Behchokǫ̀

# APPENDIX P

## Kavik AXYS Terrain Alignment Sheets Route A 2008

# APPENDIX Q

## 2014 DOT Ground truthing observations and photos

# APPENDIX R

## Stantec Tli Cho Road Alignment, Hydrologic and Hydraulic Study 2014

# APPENDIX S

## Stantec Hydrotechnical Progress Report August 2014

# APPENDIX T

## Fisheries Protection Self-Assessment Serious Harm Impacts Determination Record February 2016

# APPENDIX U

## Stantec Archaeological Impact Assessment Report August 2014

# APPENDIX V

## Whatì Micro-Economic Analysis of the All-Season Road March 2015

# APPENDIX W

## DOT's Erosion and Sediment Control Manual January 2013

# APPENDIX X draft Fish and Fish Habitat Protection Plan

# APPENDIX Y Archaeological Site Chance Find Protocol

# APPENDIX Z draft Emergency Response Plan

# APPENDIX AA draft In-Field Water Analysis Plan

# APPENDIX BB 11x 17 Figures