Topic: Caribou and moose: Movement, habitat, methodology: Risk - characterization of adverse residual effects (DAR Section 4.5.4, Table 10.3)

Preamble from the Mackenzie Valley Environmental Impact Review Board (Review Board):
The DAR provides the following definitions for 'likelihood' and 'magnitude,' but it is unclear how these are applied in the characterization of adverse residual effects.

a) Likelihood – the probability that the residual effect will occur is described as certain, possible or unlikely
- Unlikely: The residual effect is almost certainly not to occur.
- Possible: The residual effect could occur.
- Certain: The residual effect will certainly occur.

b) Magnitude – the amount of change in a measurable parameter or variable relative to existing conditions, defined for each VC as low, moderate, high, or other qualifier as deemed appropriate

These categories for likelihood are problematic. For example, effects that are unlikely or certain are, logically, also possible. It would be more useful to know what effects are likely (that is, with a ≥50% probability of occurrence).

In responding to this IR, the Review Board requires analysis from ECC and any other relevant expert departments. Please make it clear what information was provided by each department and how that information was used in the developer's response.

Request from the Review Board:

A. What are the qualitative or quantitative differences in probability rankings of certain, possible, and likely (see examples below)? What percentage probability does each of these likelihoods refer to? For example:

   - does "certain" mean over 90% probability? Over 95%?
   - does "possible" mean less than 90 to more than 10% probability?
   - does "unlikely" mean less than 10% probability? Less than 5%?

B. In Table 10.16, the likelihood of residual effects on movement, mortality risk, and health of caribou and moose in the Local Assessment Area are all characterized as "possible."

   - Does the characterization of a "possible" likelihood have any meaningful influence on the assessment?
   - Are likelihoods applied to estimate the overall risk of a residual effect to boreal caribou and moose?

Response from the Government of the Northwest Territories:

A. The Government of Northwest Territories (GNWT) included "likelihood" as a descriptor of each predicted impact to address the Project's Terms of Reference (ToR) requirement to "*…describe… the likelihood and certainty of the* [predicted] *impact*" (MVEIRB 2015, pg. 13).

The MVEIRB's environmental assessment guidelines describe "likelihood" qualitatively, in concert with certainty ("*… the developer will also describe… the likelihood and certainty of the impact")* , where "*In this sense, likelihood is based on the probability of an event (such as an early frost) occurring, while certainty refers to the limits of our theoretical accuracy in predicting"* (MVEIRB 2004, pg. 30).

Accordingly, the GNWT has assigned a qualitative probability to whether a residual effect will occur. These are defined as follows:

Unlikely: The residual effect probably will not occur (for instance, because there is a potential effect pathway, but a mitigation measure is known to be completely effective at preventing a residual effect (e.g., avoidance). .

Possible: The residual effect could occur; however, it is not certain. For instance, the effect might have been observed in similar development projects in a different setting, a mitigation measure may not be completely effective, or a human response may be unknown.

Certain: The residual effect will certainly occur, without doubt. For instance, as observed on similar development projects, or something so obvious that it certainly will occur (e.g., the Project footprint certainly replaces the habitat that pre-existed underneath the footprint).

B. The Project will have some residual effects that are unavoidable and certain to occur (e.g., direct habitat loss due to vegetation removal). For other residual effects, such as change in movement, mortality risk or health, it is more reasonable to predict that the effect is possible because we cannot predict with certainty how species or individual animals will respond to Project-related disturbance, proposed mitigation measures, or other potential confounding factors. Likelihood, on its own is not a particularly meaningful characterization in environmental assessment. However, if discussed in the context of the certainty of residual effects, particularly significant residual effects, it can help to prioritize mitigation measures, and identify where additional follow-up monitoring and adaptive management may be needed. The GNWT has made determinations of significance of residual effects on caribou and moose in Section 10.6, and discussed prediction confidence (i.e., level of confidence in its determinations of significance) for residual effects on caribou and moose in Section 10.7.

The response to this Information Request has been prepared in accordance with the Government of the Northwest Territories' Whole of Government Approach to the Mackenzie Valley Highway Environmental Assessment. Subject matter expertise from all relevant line departments has been considered in the drafting, review, and approval of this response. The GNWT is confident that all line departments are contributing to efforts to minimize negative social, cultural, and environmental impacts, while maximizing benefits for NWT residents from this project.

The following departments have been specifically involved in the drafting, review and approval of this response:

- Department of Infrastructure
- Department of Environment and Climate Change

References

Mackenzie Valley Review Board. 2015. Terms of Reference (EA1213-02) Mackenzie Valley Highway Extension Project Wrigley to Norman Wells. Yellowknife, NT. Available at: https://reviewboard.ca/upload/project_document/EA1213-02_Revised_Terms_of_Reference.PDF

Topic: Caribou and moose: Significant adverse impacts to caribou habitat (DAR Section 10.0 and Table 10.7)

Preamble from the Mackenzie Valley Environmental Impact Review Board (Review Board):
It is unusual for a developer of a project to present findings that its project will have significant adverse impacts to a valued component without proposing creative ways of reducing the level of impact so that, in its view, the adverse impact would no longer be significant.

In the DAR, GNWT predicts that residual effects to caribou habitat will further contribute to the exceedance of a conservation-based threshold. These effects are predicted to be significant. However, apart from standard mitigations presented in Table 10.7, GNWT does not propose additional actions in the mitigation hierarchy to reduce these adverse impacts to the level where they would no longer be significant.

In responding to this IR, the Review Board requires analysis from ECC and any other relevant expert departments. Please make it clear what information was provided by each department and how that information was used in the developer's response.

Request from the Review Board:
Please provide additional mitigation suggestions beyond those already described that may reduce adverse impacts of the project to boreal caribou habitat so that, in GNWT's opinion, the impacts would no longer be significant.

Response from the Government of the Northwest Territories:

The Government of Northwest Territories (GNWT) indicates in the Developer's Assessment Report (DAR) that the Caribou and Moose Local Assessment Area (LAA) has a high level of existing human and natural disturbance (52% of total area). However, the cumulative level of disturbance does not exceed the regional thresholds set for the larger Sahtu (30%) and Southern NWT (40%) boreal caribou range planning boundaries (GNWT, 2019). With the Project included, the disturbance is 21% in the Sahtu Region caribou range planning boundary and 43% in the Southern NWT caribou range planning boundary. The GNWT has updated the values reported in Table 10.18, of the Developer's Assessment Report (DAR) in its response to MVEIRB IR#52).

"*Creative*" ways of reducing Project-related contributions to existing levels of impact are challenging given that: (1) the Project footprint accounts for an additional 0.006% (2,532 ha) of disturbance in the Sahtu and 0.004% (666 ha) of disturbance in the Southern NWT boreal caribou range planning boundaries; and, (2) natural disturbance (fire) represents a substantial proportion of total disturbance in the Sahtu (>15%) and Southern NWT (>33%) boreal caribou range planning boundaries (GNWT, 2019). Additional project-specific mitigation measures, if warranted, will have to consider regional-level changes to burn frequency and extent, which is beyond the capacity of this Project, on its own, to address. Existing regional cumulative effects on caribou habitat may be addressed through the restoration of linear features as suggested in the Tłı̨chǫ Final Caribou Offset Plan (Associated Environmental Consultants Inc., 2021).

The last step in the mitigation hierarchy is habitat offsetting, first discussed in Section 10.4.2.2 (Change in Habitat/Mitigation). As discussed in that section (pp. 10-48) "*… The GNWT-ECC is currently reviewing internal draft documents, which could form the basis for the GNWT's policies for offsetting ... The GNWT will apply relevant policies for offsetting for biodiversity to the Project if/when such policies are in effect.*"

The Southern NWT range plan for boreal caribou will identify areas where Basic, Enhanced and Intensive management actions are required to address habitat disturbance. As described in the NWT Framework for boreal caribou range planning (GNWT, 2019), offsets would only be required for new long-term habitat disturbance footprints in Enhanced and Intensive management areas. As the Southern NWT range plan has not yet been completed, it is unclear whether any portions of the Project would fall within Enhanced or Intensive management areas.

Work on the range plan and offsetting policy is ongoing. If this information is available during the Environmental Assessment, it will be considered in the context of this Project. The GNWT will wait for the Southern NWT range plan and offsetting policy to be in place before proposing offsetting to mitigate project impacts.

The response to this Information Request has been prepared in accordance with the Government of the Northwest Territories' Whole of Government Approach to the Mackenzie Valley Highway Environmental Assessment. Subject matter expertise from all relevant line departments has been considered in the drafting, review, and approval of this response. The GNWT is confident that all line departments are contributing to efforts to minimize negative social, cultural, and environmental impacts, while maximizing benefits for NWT residents from this project.

The following departments have been specifically involved in the drafting, review and approval of this response:

- Department of Infrastructure
- Department of Environment and Climate Change

References

Associated Environmental Consultants Inc. 2021. Tlicho All-Season Road Final Boreal Caribou Habitat Offset Plan. Prepared for the Government of Northwest Territories, Department of Infrastructure, Yellowknife, NWT, Canada. 137 pp. (https://wrrb.ca/sites/default/files/Tlicho%20All%20Season%20Road%20Caribou%20Habitat%20Offset%20Plan%20_WRRB_0.pdf)

GNWT. 2019. A Framework for Boreal Caribou Range Planning. Department of Environment and Natural Resources, Government of Northwest Territories, Yellowknife, Northwest Territories, Canada. 87 pp. (https://www.gov.nt.ca/ecc/sites/ecc/files/resources/boreal_caribou_range_planning_framework_2019_-_cadre_de_planification_de_laire_de_repartition_du_caribou_boreal_2019.pdf)

Topic: MVEIRB IR 63 - Caribou and moose: Mitigation and offsetting impacts to caribou habitat (DAR sections 10.4.2.2, 10.8.1)

Preamble from the Mackenzie Valley Environmental Impact Review Board (Review Board):

The DAR predicts significant adverse impacts from the Mackenzie Valley Highway project to boreal caribou habitat but does not propose an approach to mitigating those impacts. Offsetting is the final step in the mitigation hierarchy. However, offsetting or any other mitigation alternative is not proposed in the DAR, despite a finding of significant impacts to caribou habitat. The Board notes that in 10.8.1, the developer will "evaluate the approach to offsetting proposed for the Tłı̨chǫ Highway (GNWT 2021c) and will seek input on offsetting options for the Project during and following the environmental assessment". However, no specific offsets are proposed.

The GNWT's Final Wording for Measures (PR#180) for the Review Board's Report of Environmental Assessment of the Tłı̨chǫ All-season Road required offsetting to mitigate significant impacts to caribou habitat. Specifically, measure 6-3 required a Habitat Offset and Restoration Plan. To meet this requirement, the developer (GNWT) prepared the Tłı̨chǫ All-Season Road Final Boreal Caribou Habitat Offset Plan (PR#171).

The GNWT's 2022 Annual Measures Report (PR#367 for EA1617-01) describes how each measure from the Report of Environmental Assessment of the Tłı̨chǫ All-season Road is being implemented. In the 2022 Annual Measures Report, implementation of measure 6-3 states that:

"Funding has now been secured for the next steps as follows:

1. Development of Implementation Plan

2. Field Implementation of the Plan A Request for Proposals is currently being prepared for the development of an Implementation Plan in 2024."

MVRB information request #3, Lessons Learned: Tłı̨chǫ Highway, was issued to GNWT on March 15, 2024. However, in its response, GNWT did not describe any progress on the implementation of measure 6-3, the Caribou Habitat Offset Plan, or any lessons learned regarding offsetting impacts to caribou habitat from the Tłı̨chǫ Highway. GNWT's response to information request #3 on page 7 states that a report on programs under the Wildlife Management and Monitoring Plan will be completed in the fall of 2024, but it is not clear if this would include an assessment of implementation of caribou habitat offsetting.

Section 10.4.2.2 of the DAR references that GNWT-ECC is interested in developing guidance documents concerning offsetting for biodiversity.

In responding to this IR, the Review Board requires analysis from ECC and any other relevant expert departments. Please make it clear what information was provided by each department and how that information was used in the developer's response

Request from the Review Board:

A. Are there specific additional mitigations to mitigate significant adverse impacts on caribou habitat that could be effective prior to considering offsetting as the final step in the mitigation hierarchy? Suggest additional mitigation that could be successful.

B. Please explain why specific offsetting actions have not been proposed as a mitigation for the identified significant adverse impacts to caribou habitat. Suggest specific offsetting actions that could be successful to mitigate significant adverse impacts to caribou habitat.

C. Describe any offsetting actions, lessons learned, challenges, opportunities, and results of offsetting significant impacts to caribou habitat for the Tłı̨chǫ Highway.

D. Would implementation of any offsetting actions as mitigation for the Mackenzie Valley Highway change the developer's prediction of significant adverse impacts to caribou habitat?

E. How would offsetting for biodiversity differ from offsetting specifically for boreal caribou?

Response from the Government of the Northwest Territories:

A. The conclusion of a "significant" residual impact to habitat was due to the fact that the LAA and Southern NWT already exceed the 35% disturbance threshold used to define a "significant" impact (exceedance of established conservation threshold), but the project's contribution to increasing disturbance in these areas is quite small (0.15%). Despite this conclusion, there is evidence that self-sustaining boreal caribou populations can occur in ranges with >35% disturbance (such as the SK1 range where the critical habitat management threshold is 60% disturbance)[1]. Section 10.4 and Table 10.7 of the DAR describe several mitigation measures to

[1] https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/plans/Rs-CaribouBorealeAmdMod-v01-2020Dec-Eng.pdf

reduce impacts to caribou habitat. Re-using the existing MVWR alignment to the greatest extent feasible, keeping the width of the cleared right of way to the minimum necessary for safe operation of the highway, and closure and reclamation of temporary access roads, quarries, etc. no longer needed post-construction, are the most effective measures to mitigate impacts to habitat. The proposed alignment already primarily occurs within areas that are currently predicted to be "not selected" (RSF bins 5 and lower) by boreal caribou, so further adjustments to the alignment of the MVH may not provide significant additional mitigation.

B. Specific offsetting locations were not contemplated in the DAR, as the need for offsets for impacts to boreal caribou habitat are unclear at this time. As described in the DAR, the MVH alignment would impact very little (0.03 %) of "Selected" (RSF bins 6 and higher) boreal caribou habitat available in the Local Assessment Area, and analysis of boreal caribou collar data suggested infrequent crossing of the alignment or use of areas directly adjacent to the existing MVWR alignment (with perhaps the exception of the segment between the Great Bear River to Norman Wells). Although a range plan for the Southern NWT region has not yet been finalized, discussions with the Southern NWT range plan working group were based on the GNWT's Framework for Boreal Caribou Range Planning (2019) which includes guidance on what should be included in range plans. Range plans should consider current habitat conditions, important areas for caribou (identified by traditional or scientific knowledge) and existing land protection and development interests. The MVH corridor has been considered by the Southern NWT range plan working group in their discussions as well as the suitability of the habitat in that area. If the working group were to identify the MVH corridor as a basic management class area, habitat offsets would not be required under the range plan for new long-term habitat disturbances in that area. Specific offsetting actions that could be successful to mitigate significant adverse impacts, after all measures to avoid, minimize and restore the effects of MVH have been exhausted, include functional and ecological restoration of existing legacy human disturbance features within the LAA that are not showing signs of sufficient natural recovery.

C. GNWT recently finalized the procurement process to hire a contractor to develop the Implementation Plan for the Tłı̨chǫ Highway habitat offset program. Development of the implementation plan will involve the identification of candidate disturbance features for application of habitat restoration treatments, community consultation to determine which features to prioritize or avoid, and field investigations to assess status of natural revegetation, factors limiting revegetation success, and development of site-specific restoration treatments. Once the Implementation Plan is completed, contractors would be hired to implement the specific restoration treatments and conduct follow-up monitoring to determine restoration success. As restoration treatments have yet to be defined and implemented it is too early to comment on results or lessons learned regarding the Tłı̨chǫ Highway offset program. However, one challenge that may be unique to the Tłı̨chǫ Highway project and the Wek'eezhii portion of the boreal caribou range is the limited availability of human disturbance features to use as potential offset sites due to the lower human disturbance levels in that region.

D. Implementation of offsetting actions for the MVH project would not likely change the developer's prediction of significant adverse impacts to caribou habitat, because, as noted in response to 'A' (above), the LAA and Southern NWT portion of the boreal caribou range already exceed an established conservation threshold for habitat disturbance (>35% disturbance). Current disturbance levels reported in the DAR are 52.3% in the LAA and 39.25% in the Southern NWT range planning area (DAR Table 10.18).

E. Offsets for biodiversity would have the objective of benefiting or offsetting impacts to a range of species (plants, wildlife, etc.), or have as an objective to offset impacts to a specific measure of biodiversity (e.g. species richness). In contrast, offsets for boreal caribou would attempt to compensate for effects specific to boreal caribou or their habitat. Such offsets might have indirect benefits to a wider range of species, but it would not be the primary consideration.

The response to this Information Request has been prepared in accordance with the Government of the Northwest Territories' Whole of Government Approach to the Mackenzie Valley Highway Environmental Assessment. Subject matter expertise from all relevant line departments has been considered in the drafting, review, and approval of this response. The GNWT is confident that all line departments are contributing to efforts to minimize negative social, cultural, and environmental impacts, while maximizing benefits for NWT residents from this project.

The following departments have been specifically involved in the drafting, review and approval of this response:

- Environment and Climate Change
- Infrastructure

Topic: Caribou and moose: Impacts and monitoring with optimal construction schedule (DAR section DAR Section 5.4.1, RB ORS overarching IR 1)

Preamble from the Mackenzie Valley Environmental Impact Review Board (Review Board):
The GNWT response to MVRB IR#1 (June 19) describes an optimal construction schedule of three to four years (subject to assumptions including financing and timing of project authorizations). This construction schedule could have different impact pathways, mitigations and monitoring options to caribou and moose compared with the conceptual schedule of twenty years described in the DAR.

In responding to this IR, the Review Board requires analysis from ECC and any other relevant expert departments. Please make it clear what information was provided by each department and how that information was used in the developer's response.

Request from the Review Board:
How would a shorter project timeline change impact predictions on caribou and moose? How would the optimal construction timeline change the mitigation and monitoring of caribou and moose?

Response from the Government of the Northwest Territories:

The 'optimal timeline' of 3-4 years referenced in the Government of the Northwest Territories (GNWT)'s response to MVEIRB Information Request (IR)#1 does not replace the GNWT's Project and project construction schedule of 10 years of construction over a 20-year period, as described in the Developer's Assessment Report (DAR). Rather, the GNWT considers the 3–4-year construction timeline an alternative method to construction.

The GNWT has included with its submission a supplemental filing which provides a qualitative evaluation of the accelerated construction timeline (GNWT, 2024). Specifically, Section 3.2.7.8 provides a relative comparison of residual effects on caribou and moose from changes in habitat, movement, mortality risk and health between the Project construction approach as assessed in the DAR, and the accelerated construction alternative. The comparison is applied to the construction phase only. As noted in Section 3.2.7, comparing the accelerated construction alternative to the Project construction approach is based on applying the same mitigation measures to the same potential effects as assessed in the DAR.

The response to this IR has been prepared in accordance with the GNWT's Whole of Government Approach to the Mackenzie Valley Highway Environmental Assessment. Subject matter expertise from all relevant line departments has been considered in the drafting, review, and approval of this response. The GNWT is confident that all line departments are contributing to efforts to minimize negative social, cultural, and environmental impacts, while maximizing benefits for NWT residents from this project.

The following departments have been specifically involved in the drafting, review and approval of this response:

- Department of Infrastructure
- Department of Environment and Climate Change

Topic: MVEIRB IR 65 - Wildlife: Effectiveness of Plans and Adaptive management (RB ORS overarching IR 2)

Preamble from the Mackenzie Valley Environmental Impact Review Board (Review Board):

The developer, in its response to IR#2, has provided ample evidence that future conditions will change considerably from historic conditions used for the baseline in the DAR. Despite this, the developer concludes that "current conditions are adequate to predict project effects, proposed management plans are likely to be effective, and conclusions can be relied upon" (p2 of GNWT response to IR#2).

The Review Board remains concerned about how predictions made with historical environmental conditions that will change significantly over the life of the project can lead to reliable impact predictions. Realistic and reasonable predictions are needed to identify and develop appropriate mitigation.

The developer has proposed adaptive management of the effects of the highway. The developer states: "Where a variance between the actual and predicted effects occur, a determination is made as to whether modifications or other actions are necessary to revise the existing mitigation measures." (DAR Vol 4, sect 23.2, p23-3). The above statement speaks to comparing predicted and observed effects. The starting point for this comparison is having reliable predictions.

In addition, the Review Board is concerned that, based on the evidence provided by the developer, both predicted and observed effects may be difficult to determine. For predicted effects, the certainty of large-scale change to future conditions leads to concern about whether these predictions are accurate. With respect to observing actual effects, it is uncertain how monitoring can determine if observed changes to a VC are caused by the highway or by other factors such as climate change, hunting and harvesting, or some combination of cumulative effects. This will make it difficult to determine how to best mitigate those impacts.

Further, adaptive management requires monitoring to compare results against benchmarks, goals, or predictions (DAR volume 4, section 23.2, p 23-3). The Board is unaware of the developer providing benchmarks or goals for boreal caribou or moose.

In responding to this IR, the Review Board requires analysis from ECC and any other relevant expert departments. Please make it clear what information was provided by each department and how that information was used in the developer's response

Request from the Review Board:

A. Please clarify how the effectiveness of management plans (WMMP or adaptive management plans) will be measured.

B. Please describe how the GNWT will attempt to identify the source (effects of the highway, or climate change-related effects, or hunting or harvesting, or future developments, or a combination of cumulative effects) of future changes to caribou and moose abundance, mortality, movement and distribution that may be identified by proposed monitoring?

C. For the purposes of adaptative management, can the GNWT provide goals, benchmarks, thresholds, or action levels that would apply to moose or boreal caribou?

D. If caribou or moose populations were observed to be adversely affected in the region of the MVH, can the developer provide examples of specific mitigations and management actions that could be implemented to counter these effects?

Response from the Government of the Northwest Territories:

A. The Government of Northwest Territories (GNWT) recognizes the challenges associated with discerning Project-related effects from other factors such as climate change, hunting and harvesting, or other combination of factors that can affect future environmental conditions. The GNWT acknowledges this issue and attempts to address it by implementing the actions described in the draft Wildlife Management and Monitoring Plan (WMMP) Version 1.0 (Wildlife Effects Monitoring, Section 5.2).

The Draft WMMP Section 6 (Adaptive Management) emphasizes that monitoring results will provide the necessary data to evaluate the effectiveness of mitigation measures in reducing project-related effects and to provide opportunities to adjust and improve mitigation measures, as required. The GNWT also acknowledges that where changes to wildlife are observed through monitoring, they may not be attributable to the performance of project-specific mitigation measures. For this reason, the results must be reviewed with the relevant stakeholders.

Section 6.1 (Adaptive Co-Management) describes the intent to distribute regularly issued reports to all stakeholders. "*Through the adaptive co-management process, stakeholders will collaborate to find consensus on a solution. During the construction phase, a mitigation audit will be undertaken annually to document the success of the proposed mitigation measures.*" The annual reporting process is intended to be similar to that used on the Tłı̨chǫ Highway (e.g., GNWT, 2024).

Overall, the GNWT will rely on data collection programs, analysis of response to construction and operations and maintenance, and technical and Traditional Knowledge input from co-management partners to monitor the effectiveness of management plans.

B. It is difficult for any monitoring program (unless conducted in a controlled/laboratory setting) to pinpoint specific sources of changes observed in caribou or moose populations. The use of statistical models could help identify the factors which explain notable variations in observed population trends or changes in distribution. Similar to WMMP programs under the Tłı̨chǫ Highway WMMP, collar-based monitoring of boreal caribou and periodic moose surveys provide broad scale (regional) information about changes in population trend and distribution of these species, but the specific sources of these changes will be challenging to tease apart, because they occur in an uncontrolled natural system. The GNWT recently started a NWT Cumulative Impact Monitoring Program (CIMP)-funded research project (CIMP247) to evaluate which factors (fire and human habitat disturbance, weather, etc.) have the greatest influence on annual boreal caribou survival and calf recruitment, using collar-based monitoring information from study areas across the southern NWT. This research may help to identify what factors are most likely to be the future source of population or distribution changes for boreal caribou along the MVH corridor, and what factors to consider in analyses of future monitoring data from the MVH WMMP. Other sources of information that can help to identify potential or likely causes of population changes include investigating the cause of mortality of collared caribou, collecting

information about the health and condition of caribou during capture operations or from samples and observations of caribou and moose submitted by harvesters, and monitoring harvest levels (both non-Indigenous and Indigenous).

C. Section 6.2.2 of the Tłı̨chǫ Highway WMMP (v. 6.2) provides some examples of specific adaptive management thresholds and actions used for the construction and operations phase of that project that apply to moose and caribou. The Project WMMP will be updated to include more specific measurable adaptive management thresholds against which to report. Such thresholds will be identified in the WMMP and further refined based on feedback from the environmental assessment (EA), and post-EA review processes before final approval of the WMMP.

D. It is not reasonable to identify additional mitigation and management efforts based on a hypothetical scenario of caribou or moose populations being adversely affected in the region of the Mackenzie Valley Highway because we do not know whether the potential adverse effects will be project-related.

   The mitigation measures identified in the WMMP (Section 4, Mitigation Measures) are adequate to reduce potential adverse effects on caribou and moose in the Caribou and Moose local assessment area. If there is evidence to suggest that the project has resulted in adverse effects on caribou or moose that warrant a review of the mitigation measure(s), a two-step process will be followed using an adaptive management approach: 1) determine whether the mitigation measures were implemented as planned, and 2) in discussions with co-management partners, attempt to determine what the root cause of the adverse effect on caribou and moose is and discuss additional mitigation measures that might be known to be effective.

The response to this Information Request has been prepared in accordance with the GNWT's Whole of Government Approach to the Mackenzie Valley Highway Environmental Assessment. Subject matter expertise from all relevant line departments has been considered in the drafting, review, and approval of this response. The GNWT is confident that all line departments are contributing to efforts to minimize negative social, cultural, and environmental impacts, while maximizing benefits for NWT residents from this project.

The following departments have been specifically involved in the drafting, review and approval of this response:

- Department of Infrastructure
- Department of Environment and Climate Change

References

GNWT. 2024. Water Licence (W2020L8-0001) Annual Report 2023 for the Tłı̨chǫ Highway (Tłı̨chǫ All-Season Road). Prepared for the Government of the Northwest Territories Department of Infrastructure (GNWT-INF) by NorthStar Infrastructure, GNWT-INF and GNWT Environment and Climate Change. 54 + app. pp. (https://www.gov.nt.ca/ecc/sites/ecc/files/resources/tlicho_highway_water_licence_w2020l8-0001_annual_report_2023_may_31_2024.pdf)

Topic: Route alternatives: Alternative means, road alignment proposed by Pehdzéh Kį First Nation (DAR section 5.2.3, table 5.2, section 7.2)

Preamble from the Mackenzie Valley Environmental Impact Review Board (Review Board):
Section 7.2.3.2 gives a very high-level overview in a comparative evaluation of alternatives, resulting in the preferred route over the inland route alternative.
The Review Board needs to understand the full rationale for dismissing the alternative route alignment.

Table 7.1 presents the criteria used to evaluate routes and includes technical, economic, and environmental criteria. The criteria in the table does not include social or cultural values or Traditional Knowledge. Table 5.2 describes an alignment recommendation from Pehdzéh Kį First Nation from approximately km 711-764. Comprehensive evaluation criteria for selecting a route must include social and cultural values of communities and Traditional Knowledge of Indigenous organizations near the route, not just technical, economic, and environmental criteria. The alignment recommendation from Pehdzéh Kį First Nation needs examination, particularly given the proponent's engagement challenges with the community of Wrigley.

Throughout the DAR, the GNWT indicates that it is not willing to relocate existing bridges. The Review Board understands the reluctance of GNWT to relocate existing bridges, as described in section 5.2.3. However, this highway will be in place indefinitely. The best routing alternative should not necessarily be determined by historic placement of bridges with short to medium term lifespans and routing alignment originally chosen for use during the winter only. Reasons for not considering this request beyond the brief notes in table 5.2 are not described in the Developer's Assessment Report. The developer should also take into account ecological considerations now and in the future (for example, climate change refugia for caribou).

Request from the Review Board:
Please use a comprehensive alternatives analysis to describe the pros and cons of the inland alternative route (compared to the preferred route) in greater detail than in section 7.2, including:

A. Add social/cultural and Traditional Knowledge criteria to table 7.1 by incorporating engagement from table 5.2, and any other engagement and Traditional Knowledge in the criteria used to evaluate the alternative route. Describe if the developer's preferred route alternative changed based on the social/cultural and Traditional Knowledge criteria added to Table 7.1.

B. Provide more details about why the developer will not consider moving bridges. Describe the pros and cons of moving bridges away from wet areas on the winter road alignment to the upland route.

C. Describe how the developer has considered and assessed the alignment recommendation from km 711 to 764 proposed by Pehdzéh Kį First Nation. Summarize any ongoing discussions with Pehdzéh Kį First Nation on route alignment options near Wrigley and between Wrigley and the Blackwater River bridge.

D. Please describe the extent that the existing winter road route selection reflected non-winter ecological considerations (such as flowing surface water; biodiversity of unfrozen wetlands in the spring, summer, and fall; or use of the area by wildlife outside of frozen conditions).

E. Please provide an analysis of the potential for and the location of future climate change refugia along the proposed highway Local Assessment Area.

Response from the Government of the Northwest Territories:

It is the Government of Northwest Territories' (GNWT)'s opinion that the information presented in Section 7.2 of the Developer's Assessment Report (DAR) addresses the requirements of Section 3.5 of the Terms of Reference (ToR) to provide a descriptive comparison of alternate routes, using environmental, social and technical criteria and rationale. The ToR also asked that the GNWT indicate how community engagement and consultation and traditional knowledge have influenced the determinations on route options.

The following provides specific responses to each request.

A. There are two parts to this response: (1) the basis of the alternative route selection; and (2) the criteria used to evaluate the routes.

Firstly, engagement input was used to identify the alternative to the Project Route (the Inland Route Alternative). Specifically, this alternative route was selected to address the engagement comments about general alignment in the Dehcho Region, and other related comments about moving specific bridges (Ochre River, Whitesand Creek, Vermillion Creek South, Bob's Canyon Creek, and Dam Creek) further from the Mackenzie River (see Table 5.2). Secondly, the criteria used to compare the routes were also selected, in part, on engagement input. The criteria used to evaluate routes are presented in Table 7.1. Seven of the nine criteria align with the routing-related engagement comments summarized in Table 5.2, and the other two align with the request to add social/cultural and Traditional Knowledge criteria; specifically:

- Reduce footprint through areas of traditional, cultural and ecological importance
- Avoid known archaeological and heritage resources where practicable

The comparison of alternatives presented in the DAR in Section 7.2.3 addresses the ToR requirements and the Information Request, and therefore, the GNWT views the information currently provided to be adequate.

As noted in Section 2.2.2 of the DAR (Who the GNWT Engaged), Section 3.2.2 (Project-Specific Traditional Land and Resource Use Studies), and the GNWT's response to ORS MVEIRB-20, the GNWT acknowledges that more Traditional Knowledge and engagement input may be forthcoming, and that it will be duly considered and incorporated into the assessment, as appropriate.

B. Since approximately 2001, the GNWT has significantly invested in upgrading bridges along the Mackenzie Valley Winter Road (MVWR) in an effort to extend the operating season of the MVWR. Multi-span bridges such as the Ochre River Bridge, Whitesand Creek Bridge, Vermillion Creek South Bridge, Blackwater River Bridge, and Saline River Bridge were built in 2001 (Blackwater in 2010). These, and most other bridges along the MVWR built since 2014 have a design life of 75 years.

These bridges have been designed based on site-specific flow, channel, and geotechnical conditions; as a result, "moving" these bridges would involve demolishing the old bridge and building a new bridge at significant cost and additional impact to the environment. Of all of the existing bridges on the MVWR, three along the Project alignment are considered portable "bush" bridges that have a superstructure that is able to be lifted off its foundation. These can be transported in a single piece, and can be installed on a new foundation, if it is the economically, ecologically, and culturally best

option. These include Dam Creek Bridge, Devil's Canyon Creek Bridge and Gotcha Creek Bridge.

With that context, the GNWT's intention is to retain the existing bridges located along the MVWR that are functioning as intended, and that accommodate the design criteria of the highway. Should any performance issues be identified at any existing structures, these will be addressed on a case-by-case basis, as per normal operations and maintenance for existing assets within the NWT highway network.

In the request, the reference to wet areas as a consideration for bridges is not clear. Surface water is not a major constraint for bridges, as bridges are anchored on deep foundations, and therefore surface conditions do not impact bridge integrity.

C. The GNWT has acknowledged and considered previous engagement input received from Pehdzéh Kį First Nation on the highway route (e.g., Dessau (2012 [PR#13]) as summarized in Table 5.2 of the DAR (Summary of Consideration of Engagement Input on Design). For the reasons described in Section 7.2.3, the GNWT's preferred route in the Dehcho Region is the Project Route, and the GNWT has, where possible, accommodated engagement input, such as widening the alignment routing corridor (KM 709.5 to 711), to provide options for highway routing to address areas of concern within the design parameters and objectives as stated in Section 5.2.2. The GNWT is committed to engaging further with Pehdzéh Kį First Nation and other Indigenous Governments, Indigenous Organizations, and other affected parties on the Project.

The GNWT has provided support to Pehdzéh Kį First Nation for a Traditional Land and Resource Use Study and alternate route investigation. Once received, the GNWT will review the information and consider it in the context of the Project in a supplemental report.

D. A winter road route (mostly the MVWR as is present today) pre-dates any available documented studies, and likely did not consider non-winter conditions. However, from 1973 to 1976, Public Works and Government Services Canada (PWGSC) completed geotechnical, hydrotechnical, archaeological and terrain evaluation studies to inform the detailed design of an all-season road alignment ("the 1974 PWGSC Alignment"), which was based on generally following the winter road where conditions were favourable. The PWGSC Alignment recommended deviations around wetlands and lakes, sensitive terrain and soils, and areas with excessive sideslopes; and revising steep approaches to some major stream crossings. The PWGSC studies and designs, and subsequent engineering and environmental studies completed by the GNWT since 2010, have informed the present routing, which also generally follows the MVWR. Regarding consideration of ecological conditions, as one example, the GNWT prefers to follow the MVWR alignment as a way to reduce potential effects of the Project on wildlife – particularly boreal caribou – associated with change in habitat.

E. In compiling the Developer's Assessment Report, the GNWT followed the MVEIRB's 2015 Terms of Reference for the environmental assessment. The information requested falls outside of the scope of information required by the Terms of Reference and scope of this environmental assessment.

As such, the requested analysis was not done; however, since July 2023, GNWT-ECC and the Natural Resources Canada Canadian Forestry Centre have been collaborating to map areas across the Northwest Territories and surrounding areas which are more resistant to climate change impacts. These include areas that are less likely to burn (fire refugia) or experience negative effects of drought (drought refugia), as well as areas that are warming more slowly than their surroundings (thermal refugia). Identifying these refugia areas which are more resistant to climate change impacts, along

with the landscape features that promote climate buffering effects can be useful, as they can then be factored into planning for future development, and where to focus on conservation measures.

Topic: Drone footage or video from a helicopter of route and ground-level photos during the open water season (DAR Chapter 5, Appendix 5A)

Preamble from the Mackenzie Valley Environmental Impact Review Board (Review Board):

The Developer's Assessment Report is mostly text, with very few photos of the proposed highway route. Appendix 17A (Technical Data - Fish and Fish Habitat) has some good photos but does not show the complete route. Visual representation of the project route can help parties understand existing conditions.

The map book in Appendix 5 gives an aerial plan view of the highway corridor. Low-level drone footage and a comprehensive ground-level photo map book of the route would help parties and the Board better understand existing ground conditions, water crossings, timber resources, wildlife habitat, and other values along the proposed route.

A video of the Tłı̨chǫ highway route taken from a helicopter was made by the developer and shown to the Review Board and parties for the Tłı̨chǫ highway during the environmental assessment phase. This video helped all parties during that EA.

Request from the Review Board:

Please submit the following visual materials:

- drone footage or video from a helicopter of the entire route during the summer open water season.

- summer ground-level photos at intervals where there is a change in topography or ground conditions to complement the plan view map book in Appendix 5A

- ground-level and airborne photos of proposed quarry sites.

Response from the Government of the Northwest Territories:

In compiling the Developer's Assessment Report (DAR), the Government of the Northwest Territories (GNWT) followed the Mackenzie Valley Environmental Impact Review board (MVEIRB)'s 2015 Terms of Reference for the environmental assessment (MVEIRB, 2015). The information requested (video, drone, and ground-level photos) falls outside of the scope of information required by the Terms of Reference for this environmental assessment. Please refer to Appendix 5A of the DAR (Project Mapbook), and Appendix 14A – Appendix A (RSA Figures) for *maps* showing the Project's setting in relation to topographical features, existing infrastructure, bedrock geology, and surficial geology within the Regional Study Area (RSA). Appendix 14A – Appendix B provides more detailed mapping of surficial geology within the Local Study Area. This mapping is presented on an overlay of publicly-available *satellite imagery*: World Topographic Map: Northwest Territories, ESRI, HERE, Garmin, FAO, NOAA, USGS, EPA, NRCan, Parks Canada, as of 2021.

While the GNWT can appreciate that a product such as high-resolution georeferenced video would allow parties to "see" the route from the air, it is an unnecessary expense in the context of the Environmental Assessment, and during a time of fiscal sustainability. Further, in the GNWT's experience, it would be difficult to distribute due to its file size, and the GNWT is aware of the data / download limitations of many of the parties.

To further assist the Review Board, the GNWT has provided a selection of photos taken during Project-specific field programs and engagement, of the following:

- Proposed borrow and quarry sources, per Table 5.4 of the DAR, except for Edie Lake Quarry, which is an existing GNWT quarry (see Figures 67-1 to 67-14). The location of these sources is shown in Figure 1.2.1 (Overview), and Appendix 5A (Project Mapbook) of the DAR.

- Representative photos of common dominant surficial material encountered in the RSA (see Table 67-1)

Figure 67-1 Overview conditions at Source 10.043 - A) Facing North; B) Exposed sand and gravel material within the existing pit

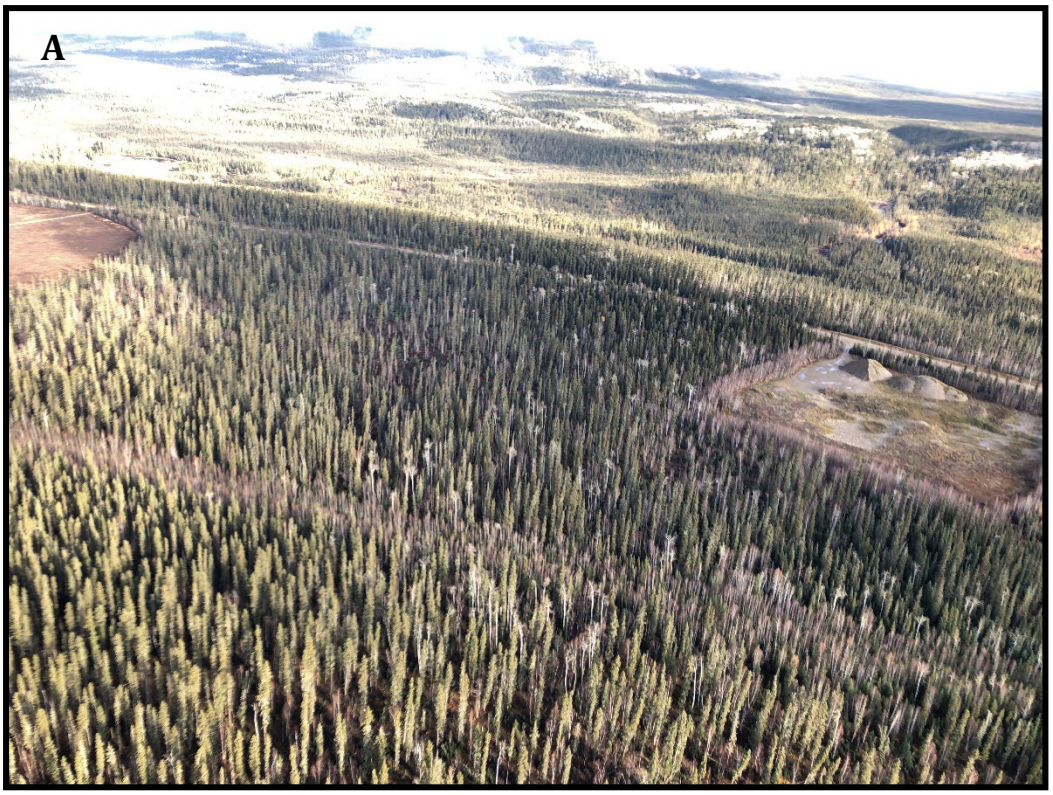
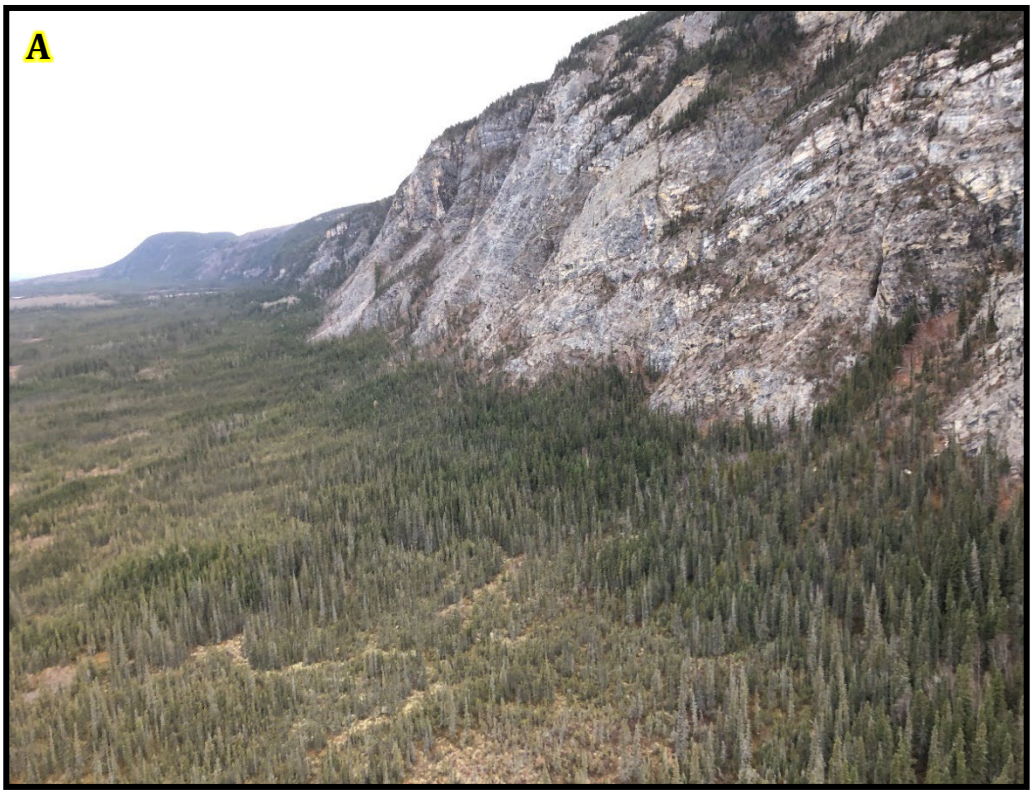


Figure 67-2 Overview conditions at Source 10.028 - A) Facing Southwest; B) Facing North



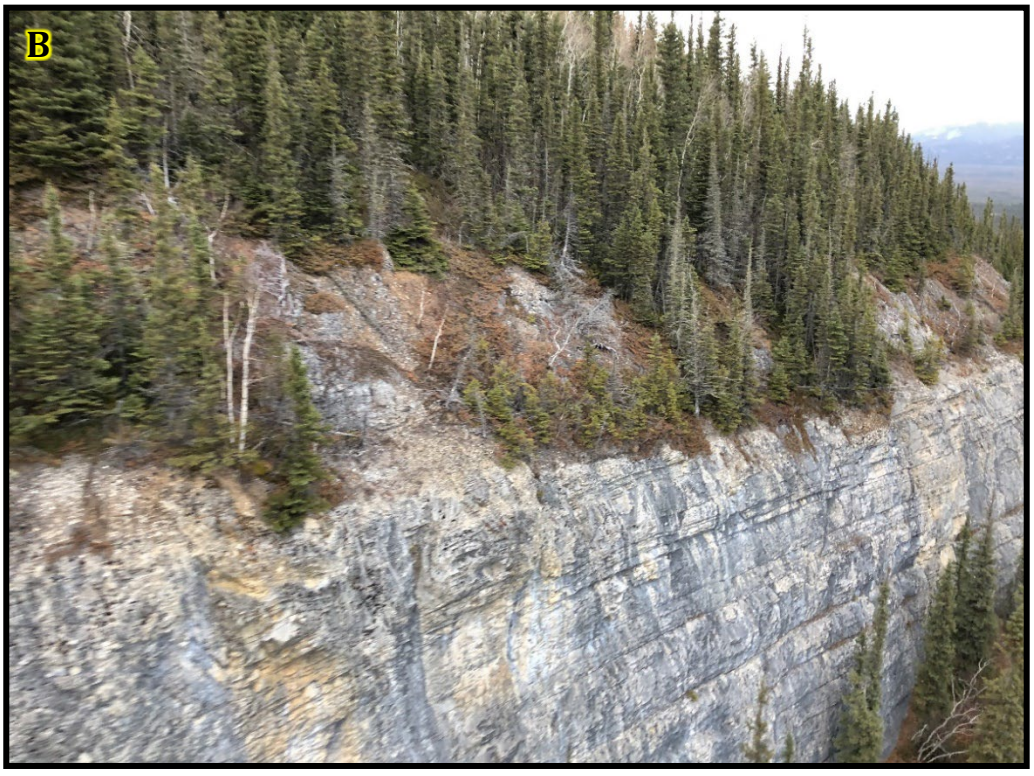


Figure 67-3 Overview conditions at Source 10.020 - A) Facing Northwest; B) Cut line leading to the cleared pit area; C) Exposed sand and gravel material

Figure 67-4 Overview conditions at Source 10.014A - A) Facing Northwest; B) Undisturbed forested terrain; C) Sand and gravel observed from a shallow test pit

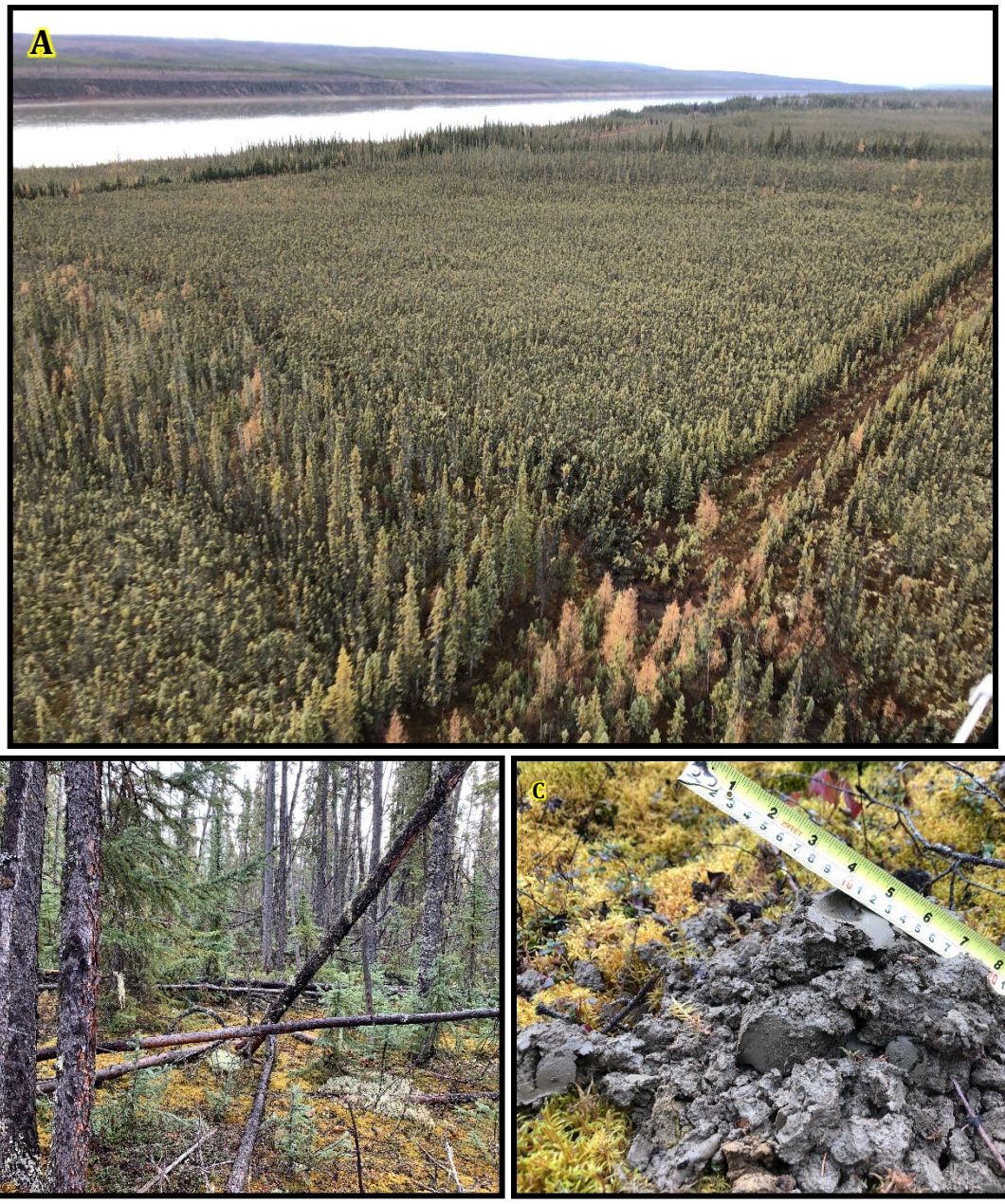


Figure 67-5 Overview conditions at Source 10.007 - A) Facing Southeast; B) Disturbed terrain along the winter road; C) Sand and gravel observed from a shallow test pit

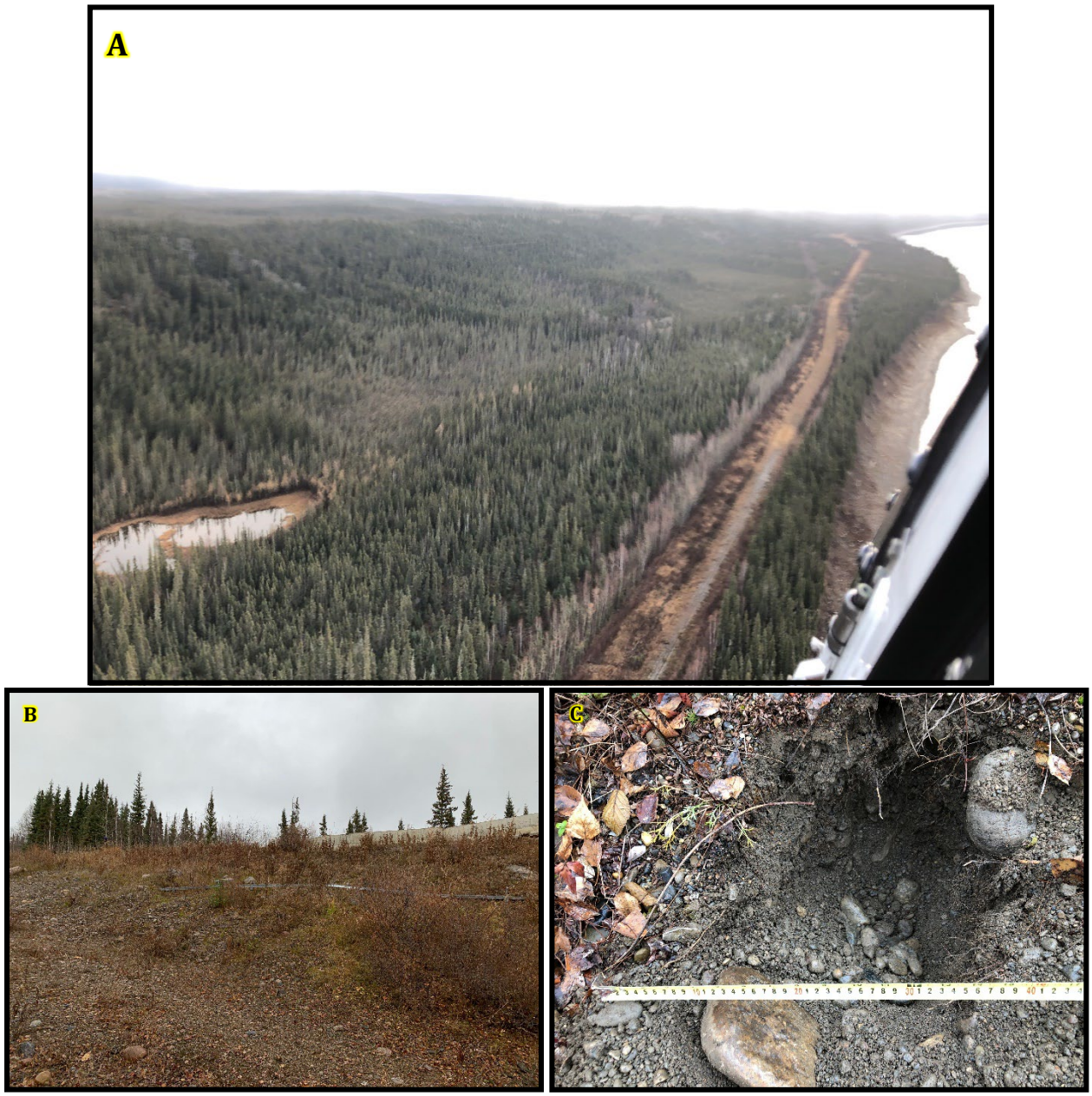


Figure 67-6 Overview conditions at Source 10.004 - A) Facing West; B) Overgrown Cutline - Facing South; C) Wetland Northeast of the Site

Figure 67-7 Overview conditions at Source 9.043 - A) Facing Northeast; B) Gravel pile in existing source; C) Sand and gravel observed from a shallow test pit

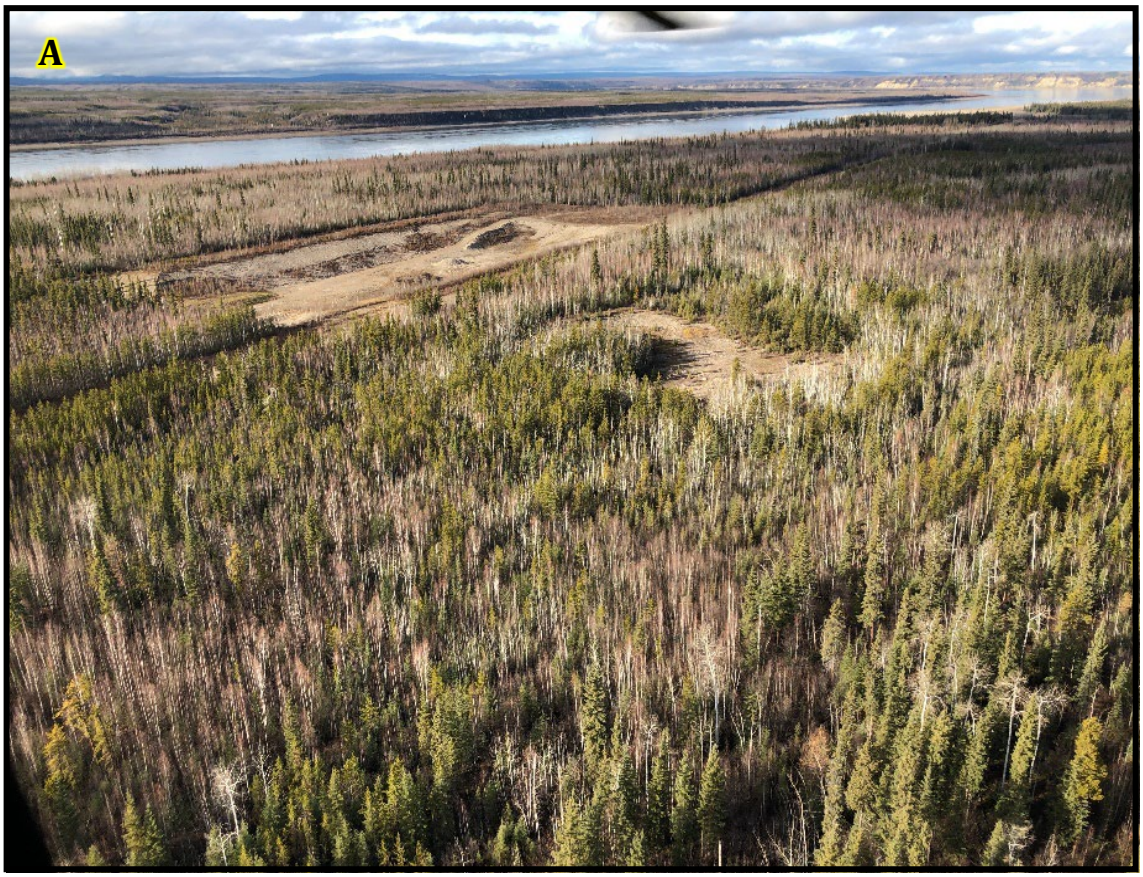
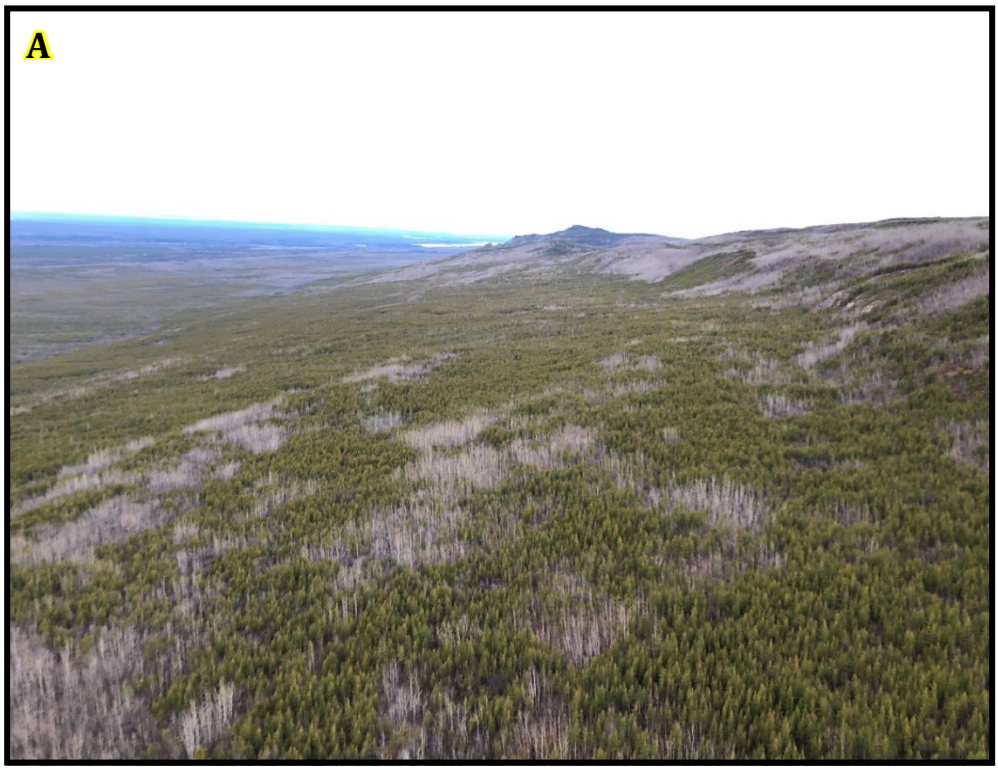


Figure 67-8 Overview conditions at Source 9.025B - A) Westernmost portion of the Source - Facing North; B) Facing Southeast



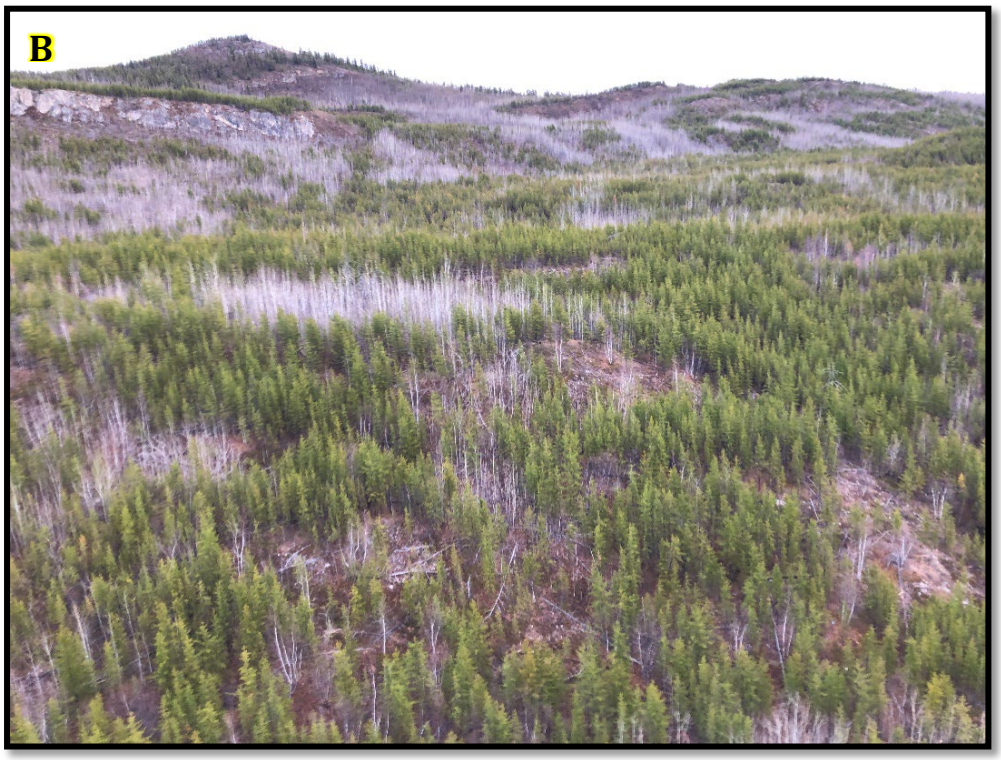


Figure 67-9 Overview conditions at Source 9.019 – A) Eastern View of Bedrock Ridge; B) Bedrock Exposure; C) Site Access – Facing West

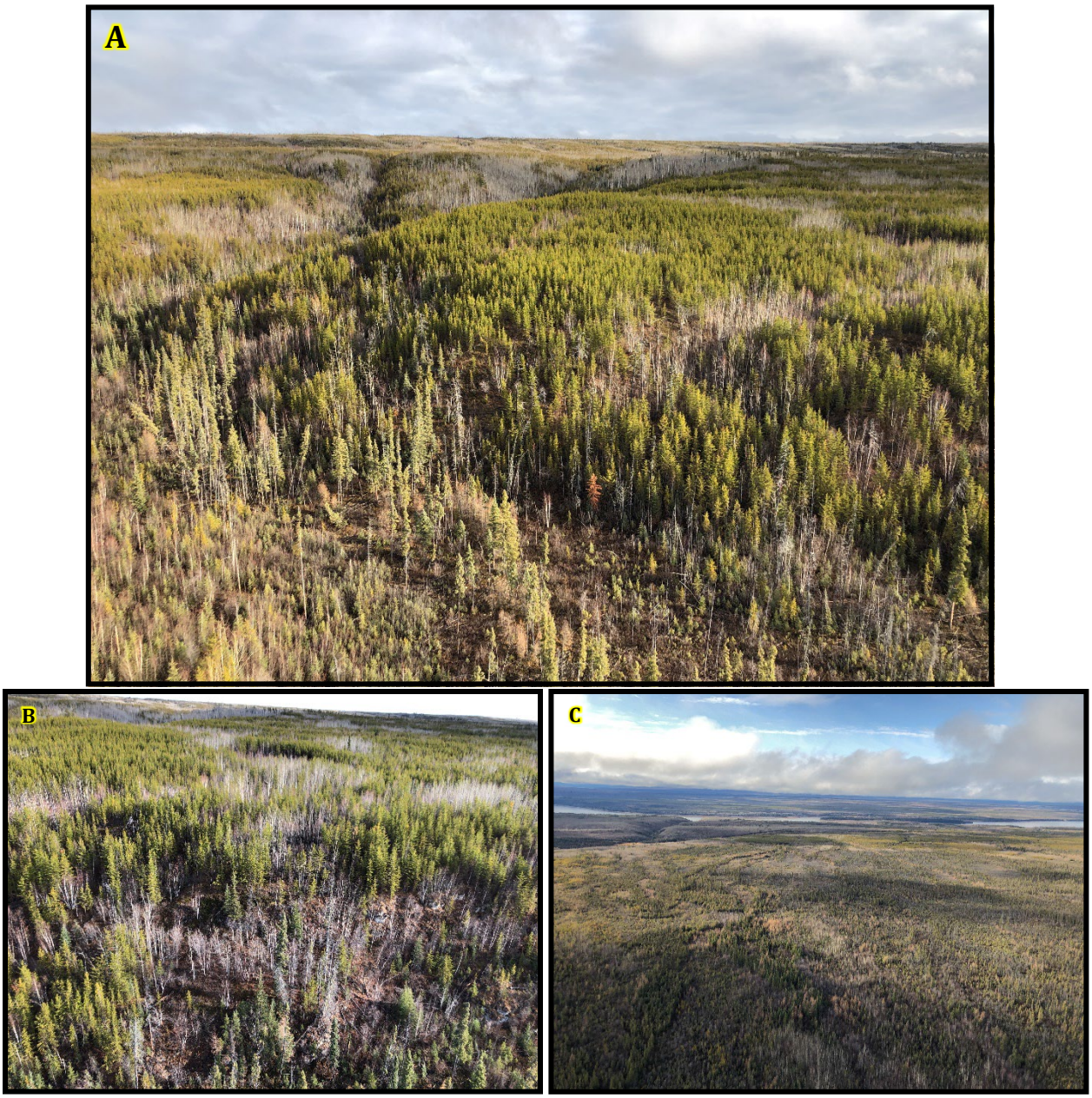


Figure 67-10 Overview conditions at Source 9.002 – A) Facing Northwest; B) Undisturbed forested terrain; C) Sand and gravel observed from a shallow test pit

Figure 67-11 Overview conditions at Source 8.039 – A) Facing Southwest; B) Northern Slope; C) Bedrock Exposure

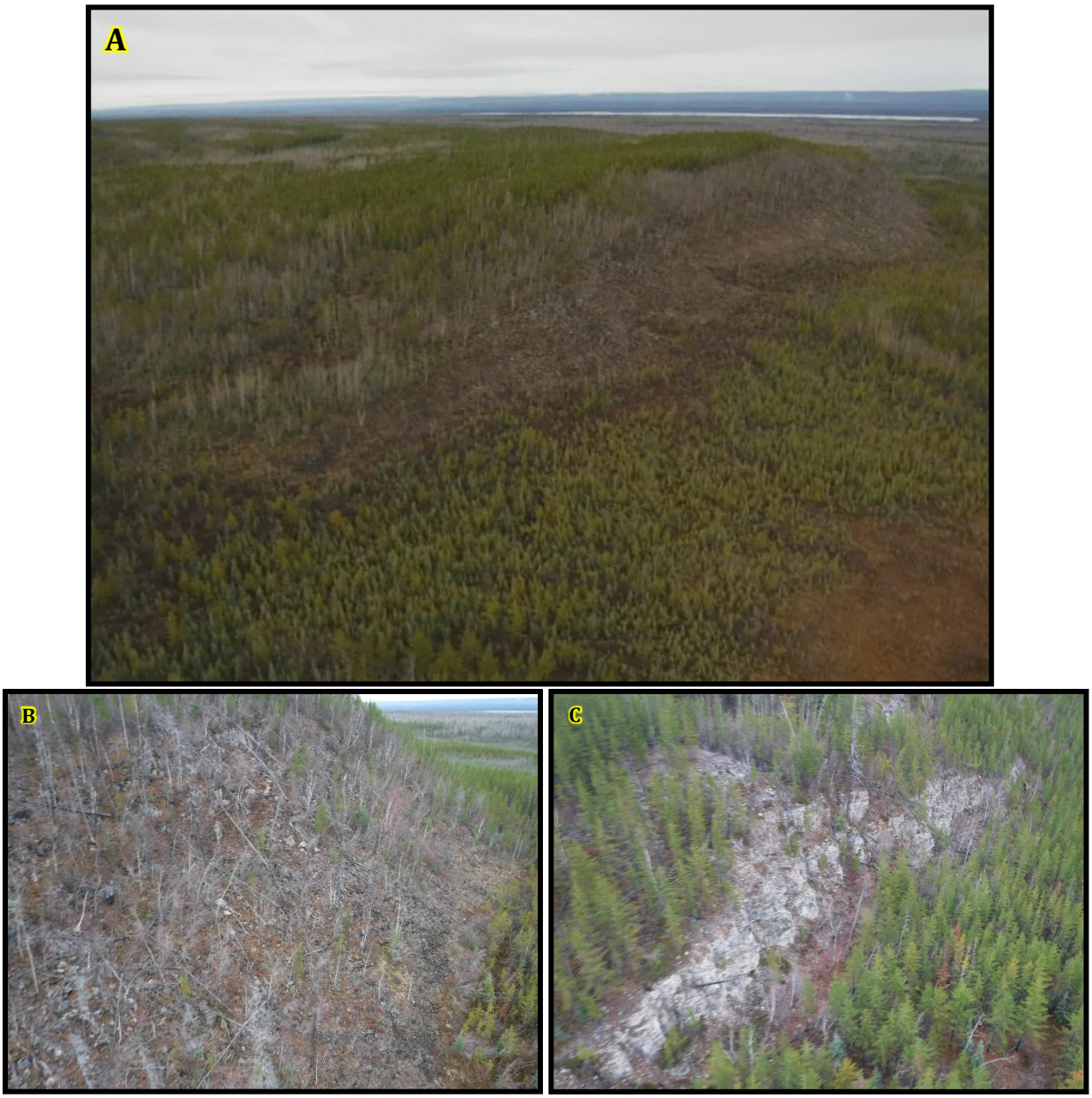


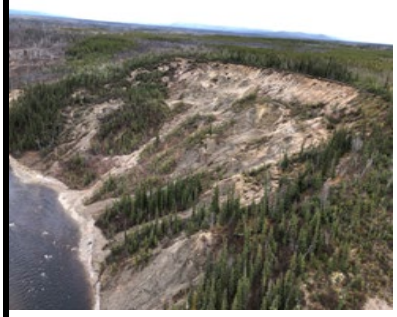
Figure 67-12 Overview conditions at Source 7.109 – A) Facing North; B) Veneer of soil over bedrock

Figure 67-13 Overview conditions at Source 7.090, facing East

Figure 67-14 Overview conditions at Source 7.083 – Existing Quarry, facing Northeast

Table 67-1 Dominant Surficial Materials Encountered in the RSA

Key Terrain Type	Characteristics
Bedrock 	The bedrock within the RSA for soils, terrain, and permafrost includes a complex series of geologic units, primarily consisting of clastic sedimentary rocks (shales and sandstones) and chemical sedimentary rocks (dominantly limestones and dolostone). In general, the bedrock in the RSA is covered by a thick mantle of surficial material. Areas of exposed rock within the RSA include dolostone ridge of Bear Rock immediately west of the confluence of the Mackenzie River and the Great Bear River, and Mount Gaudet, approximately 11 kilometres north of Wrigley. The Mackenzie Valley Winter Road is seen in the photo.
Till 	Till in the RSA is generally composed of clay, silt, minor sand and a small percentage of pebbles, cobbles, and boulders. Thickness ranges from less than 2 metres (m)(veneer), to up to 30 m (blanket). Areas of till deposits range from flat to gently undulating plains to more dissected topography directly overlying bedrock. The Norman Wells Pipeline and Mackenzie Valley Winter Road are seen in the center of the photo.
Glaciofluvial  	Glaciofluvial materials have been deposited by glacial meltwater streams. These materials are composed of gravel, sand and silt in varying amounts. Along the RSA these materials are generally found as terraces alongside existing streams, with lesser areas mapped as plains, fans and ridges. Glaciofluvial deposits can range from less than 1 m thick to up to 30 m (example below). An existing bridge on the Mackenzie Valley Winter Road is seen in the left of the bottom photo.

Key Terrain Type	Characteristics
Glaciolacustrine  	Glaciolacustrine materials are sediments deposited in and along the margins of former glacial lakes. Within the southern and central portion of the RSA, glaciolacustrine materials are dominantly composed of silt and fine sand, but locally can contain gravel and/or clay. These materials are generally found on flat-to-gently undulating terrain. The Norman Wells Pipeline and Mackenzie Valley Winter Road are seen in the center of the bottom photo.
Colluvium 	Colluvium is material that has reached its present position as a direct result of gravity-induced movement, either by slow mass movement (e.g. solifluction) and by landslides. Along the RSA, colluvial materials can be derived both from bedrock and from pre-existing deposits of other surficial materials.
Organic 	Organic materials are deposits mainly composed of organic materials resulting from the accumulation of vegetative matter, typically in poorly to very poorly drained, level and depressional areas. These areas are generally level to very gently sloping, and bogs can have scattered mounds of organic material. Along the RSA, organic deposits occur both as fens and as bogs. The fens range in thickness from 2 m to 3 m and the bogs from 1.5 m to 7 m.

Key Terrain Type	Characteristics
Fluvial 	Alluvial (fluvial) materials are those that have been transported by streams and rivers and typically occupy valley floors. Textures range from clayey silty sand to very gravelly sand. These deposits typically occur as plains (floodplains) and terraces. The Mackenzie Valley Winter Road is seen in the center of the photo.
Eolian 	Eolian materials are eroded, transported and deposited by wind action. These materials generally consist of fine to medium sand and silt and are not compacted. Eolian deposits present along the RSA often occur as a thin veneer overlying flat to gently undulating landscapes. A few parallel to sub-parallel dunes are present, however, they are forested and not visible. The Mackenzie Valley Winter Road is seen in the center of the photo.

Topic: Project description: Seasonality of road access (DAR section 5.2, 5.3)

Preamble from the Mackenzie Valley Environmental Impact Review Board (Review Board):
The project would greatly increase access to many communities along the route, but is also still time limited based on the essential links at ferry/ice road crossings (such as at Fort Simpson, Wrigley, and Bear River). There will be freeze up and thaw times when access will still be limited, and future climate change may still affect the timing, if it affects the ferry/ice road crossings.

In responding to this IR, the Review Board requires analysis from ECC and any other relevant expert departments. Please make it clear what information was provided by each department and how that information was used in the developer's response.

Request from the Review Board:

A. Describe whether there are any concerns with water levels and access at these crossings, considering climate change.

B. Please describe how the seasonal lack of access might affect impact predictions for communities.

Response from the Government of the Northwest Territories:

A. The end-to-end use of the Mackenzie Valley Highway from Wrigley to Norman Wells will be subject to the crossing of the Great Bear River. Currently, this is a winter road crossing. If the Great Bear River Bridge is constructed (a reasonably foreseeable project), this crossing will be open year-round. The connection of the Mackenzie Valley Highway to other Northwest Territories (NWT) Highways in the Dehcho Region (Highway #1, #7) and beyond will be subject to existing ferry and ice crossings at N'dulee and Fort Simpson, which are also not part of the Project. These crossings are not available when the ice crossing is being constructed, and during spring break-up. The timing and duration of these closures is dependent on annual environmental conditions, which may change over time. Current ferry operations are subject to water levels, as well as other operational considerations, and these factors will continue to influence ferry operations in the future, irrespective of the Project. It is predicted that water levels on the Mackenzie River will continue to fluctuate in response to climate change. The trajectory of change is not unidirectional; we expect to see water levels higher and lower than previous historic bounds.

B. The Project does not propose to create continuous, year-round access to Tulita and Norman Wells, as access to these communities will be subject to temporary annual closures of the Highway #1 at ferry/ice crossings (Winter Roads Average Open/Close Dates | Infrastructure (gov.nt.ca)). Those conditions are outside of the project description and operating conditions of the Project. These annual closures already affect access to Wrigley. These temporary road closures have been accounted for in the assessment of effects on communities.

The response to this Information Request has been prepared in accordance with the Government of the Northwest Territories (GNWT)'s Whole of Government Approach to the Mackenzie Valley Highway Environmental Assessment. Subject matter expertise from all relevant line departments has been considered in the drafting, review, and approval of this response. The GNWT is confident that all line departments are contributing to efforts to minimize negative social, cultural, and environmental impacts, while maximizing benefits for NWT residents from this project.

The following departments have been specifically involved in the drafting, review and approval of this response:

- Department of Infrastructure
- Department of Environment and Climate Change

Topic: Road design: Low Volume Road Design and cumulative effects (DAR Chapter 26)

Preamble from the Mackenzie Valley Environmental Impact Review Board (Review Board):

The highway is designed as a Low-Volume Road for no more than 200 vehicles daily (pp. 26-8).
If future conditions change (for example, due to increased development [as suggested in GNWT's answer to Review Board's comment #2], impossibility of travel by water or air due to climate change), road traffic might exceed 200 vehicles a day. In addition, the closure of Imperial Oil's Norman Wells operations or other industrial development in the region could lead to oversized traffic and heavy road loads. The road should be designed for its intended functions.

Request from the Review Board:

A. Please describe the consequences for highway maintenance and road safety of having more than 200 vehicles daily on the highway.

B. Will the road be designed to support oversized or heavy traffic? For example, for the closure of Imperial Oil's Norman Wells Operations or for future mining or oil and gas development.

Response from the Government of the Northwest Territories:

The Government of Northwest Territories (GNWT) has identified and assessed the effects of reasonably foreseeable developments in Section 27 of the Developer's Assessment Report (DAR), and has previously discussed the predicted annual average daily traffic (AADT) in several responses to Online Review System (ORS) comments, such as ADKFN-1 and MVEIRB-6. Regarding the claim, as stated in the preamble, that AADT could exceed 200 vehicles per day, the GNWT is not aware of the basis of this, nor does it currently have information to substantiate this. Notwithstanding this, responses to requests part A and B are provided below.

A. Section 5.5.9.1 of the DAR states that the design of the highway anticipates an average traffic volume of 50 vehicles per day (AADT), including a mix of vehicles such as pickup trucks and truck trailers. The Transportation Association of Canada [TAC], 2017 Rural Arterial Undivided (RAU)-90 design for roads designated as "Low Volume Road", used in the Project's design basis, allows for average daily traffic of up to 200 vehicles per day. Therefore, the highway's design traffic capacity to accommodate potential future highway users up to 200 vehicles per day is not a traffic prediction or a capacity restriction for the highway - it is a design designation (i.e., 50 AADT is less than 200 AADT). As such, the Project is designed to accommodate four times the traffic than what is actually anticipated.

Within the TAC (2017) design guide is a design standard for 'Special Roads' (TAC 2020), which specifies safety-related parameters such as road lane and shoulder widths and the steepness of side slopes. The design requirements for a road where AADT exceeds 200 vehicles per day (not a Low Volume Road) are different. For example, roadway shoulders are required to be wider, and side slopes are required to be flatter than for a low volume road.

Highway maintenance, specifically grading and resurfacing, is required regardless of the traffic volume or road designation, though maintenance requirements increase with more traffic use. This is to account for various factors, including material erosion, ground movement and wear and tear. Note that the Low Volume Road standard does not establish the requirements for structural design for the roadway itself, as that is based upon other considerations determined during detailed design.

The need to potentially accommodate industrial users beyond the planned design capacity of the highway and/or address additional maintenance requirements will be evaluated if/when such a need is foreseeable. Such a potential accommodation of heavy/outsized loads for instance would normally not change the recommended road design for typical traffic loading.

B. The design of the highway anticipates an AADT of 50 vehicles per day, including a mix of vehicles such as pickup trucks and truck trailers up to a weight of 64,000 kilograms, which is a CL-625 standard highway loading. The highway is designed to accommodate potential future industrial users up to 200 vehicles AADT, within the load limits of the existing bridges on the Mackenzie Valley Winter Road, which meet the CL-625 highway loading standard. New crossing structures on the Project will be designed to the CL-800 highway loading standard, which accommodates heavier loading of up to 82,000 kilograms. Regarding the request to verify that the Project's design supports potential future traffic types, the GNWT is unaware of information that would dictate the need to accommodate vehicles beyond those currently part of the design.

References

TAC (Transportation Association of Canada). 2017. Geometric Design Guide for Canadian Roads. 3rd ed.

TAC. 2020. Geometric Design Guide for Special Roads.

Topic: Permafrost: Failure mode analysis (DAR Chapter 14)

Preamble from the Mackenzie Valley Environmental Impact Review Board (Review Board):
The Developer's Assessment Report lacks a failure mode analysis considering permafrost as a design feature in the roadbed (mentioned on p.14-24), requested in the Terms of Reference (PR#66 - TOR, p.27). The failure mode analysis should consider how different parts of the project could fail under different initiating conditions (including low probability high consequence ones), root causes of failures (including cascading systemic failures), likelihoods, and what the resulting severity of consequences would be on the overall system (including on highway function and VCs). The failure mode is important for understanding and predicting maintenance costs and resourcing, particularly considering the potential for changes related to climate change over the operating life of the highway in a region with karst terrain.

In responding to this IR, the Review Board requires analysis from ECC and any other relevant expert departments. Please make it clear what information was provided by each department and how that information was used in the developer's response.

Request from the Review Board:
Will the developer conduct a failure modes analysis based on additional geotechnical information once the routing alignment is known for both the construction and operations and maintenance phases? Will this be available for meaningful consideration in the EA?

Response from the Government of the Northwest Territories:

As noted in Section 14.4.1 of the Developer's Assessment Report, failure modes analyses have not yet been completed, and will not be completed and available for review during the environmental assessment, because the design does not yet incorporate site-specific geotechnical information. The geotechnical studies needed to obtain data about subsurface ground conditions to inform detailed design will be conducted once there is greater certainty of the alignment routing corridor (currently subject to the environmental assessment). However, the GNWT believes that the current basis of engineering road design is adequate for the current purposes of MVEIRB in satisfaction of the Terms of Reference, and that the GNWT's commitment for subsequent design and analysis, is appropriate and will adequately consider the range of geotechnical conditions to be potentially encountered along the highway route.

Failure mode analysis will be conducted as part of the detailed design process, in specific areas where failure risk needs to be considered, such as locations where there is a high embankment, significant road cuts, and areas of anticipated thermal erosion (such as areas of overflow icing) where potential for failure is related to the presence and disturbance of ground ice. Potential failure modes to be analyzed may include (but are not limited to) differential thaw settlement, loss of soil strength, landslides, and localized slumping.

Risks and risk analyses are typically evaluated in order of priority by: life safety considerations; minimizing environmental damage or disruption; construction cost; and, maintenance costs and maintainability.

The response to this Information Request has been prepared in accordance with the Government of the Northwest Territories' Whole of Government Approach to the Mackenzie Valley Highway Environmental Assessment. Subject matter expertise from all relevant line departments has been considered in the drafting, review, and approval of this response. The GNWT is confident that all line departments are contributing to efforts to minimize negative social, cultural, and environmental impacts, while maximizing benefits for NWT residents from this project.

The following departments have been specifically involved in the drafting, review and approval of this response:

- Department of Infrastructure
- Department of Environment and Climate Change