

## Reviewer Comments and Proponent Responses

**Project: Mackenzie Valley Highway**

**Board: Mackenzie Valley Environmental Impact Review Board**

**Organization: GNWT-INF (Infrastructure)**

No.	Topic	Reviewer Comment	Proponent Response	Reviewer Response
<b>Liidlii Kue First Nation (Ft Simpson) (LKFN) - Trieneke Gastmeier</b>				
1	Vol 3, 1 of 13, 14.0 p 14- 2, 14A p 5, 15.0 p 1, 16.0 p3	The Sahtu Land Use Plan is included in this document, and though the Dehcho Land Use plan is still under development, documents will be forthcoming in 2025.	<p>The GNWT previously responded to a similar request in MVEIRB Round 1 IR#40.</p> <p>The 2006 Final Draft Dehcho Land Use Plan (dDLUP) was not approved by the Government of Northwest Territories (GNWT), and the Government of Canada and, so there is currently no land use plan in place in the Dehcho Region. The Dehcho Land Use Planning Committee (the Committee) continues to revise the Draft Interim Plan. Respecting the ongoing revision of the dDLUP, and the lack of an approved document at the time of filing of the Developer’s Assessment Report (DAR), the management direction provided by the dDLUP, and the Conservation Zones and Special Management Zones described in the dDLUP were not applied to the Mackenzie Valley Highway Project (the Project). Other information contained in the dDLUP was considered in the DAR. The dDLUP describes the cultural importance of traditional lands and resources to Dehcho First Nations and Sahtu Dene and Métis peoples; refers to important cultural areas and harvesting locations; lists culturally important plants, animals, and fish; and stresses the importance of traditional values and principles in land use planning. This information was incorporated into the DAR where appropriate.</p> <p>The Dehcho Land Use Plan Background Report (Dehcho Land Use Planning Committee [DLUPC, 2006]) was reviewed during the development of the DAR, but not directly incorporated, because there was more relevant and timely detailed scientific literature, available datasets, engagement input, and project-specific data and mapping available or collected for the project-specific study areas.</p>	Please note some commitment to respect the dDLUP once a final version is approved.

2	Vol 3, 1 of 13, 14.0 p 14- 5; 14.0 p 14- 29	<p>GNWT response to comments does not adequately address: "which affects the land and the permafrost and can influence the flow of creeks; Community engagement participants stated there are increased landslides and sloughing and permafrost thawing, accelerated by climate change." In the DAR, it is stated warm discontinuous permafrost found within the PDA is especially susceptible to degradation. Given the term of operation (and even the duration of construction), it is likely that the extent of warm discontinuous permafrost will increase over the course of the project. Consideration of the evolution of permafrost thaw over the course of the construction and operation phases are important.</p>	<p>For clarity, the GNWT reproduces the full text of Table 14.1 of the Developer’s Assessment Report (DAR) paraphrased by the reviewer as:</p> <ul style="list-style-type: none"> <li>• “NWRRRC study participants observed that weather in the TLRU study area has changed over the last few years, attributed to cumulative effects and warming temperatures, which affects the land and the permafrost and can influence the flow of creeks.” (NWRRRC, 2023)</li> <li>• “Community engagement participants stated there are increased landslides and sloughing and permafrost thawing, accelerated by climate change.” (from April to July 2022 Engagement)</li> </ul> <p>The GNWT’s response to comments in Table 14.1 of the DAR identifies some of the ways that these concerns will be addressed in design. The GNWT’s approach to design, including consideration of permafrost, is detailed in the preamble to R2 LKFN IR#12.</p> <p>Clearing of the right-of-way and associated changes to the surface geothermal regime, and climate warming together contribute to the anticipated permafrost degradation noted in the request. Importantly, geothermal modeling used to provide insights into these anticipated processes is highly dependent on the accuracy of the input parameters. Modeled results are therefore not considered absolute, but rather one line of evidence among many to inform decision-making which will be used by the GNWT.</p> <p>Findings from the 2006 Mackenzie Gas Project (MGP) study, as well as similar studies, highlight that in the short-term, during construction, clearing of the right-of-way and the associated alterations to the surface geothermal regime will have the most immediate impact on permafrost degradation.</p> <p>Climate conditions have evolved substantially since the MGP work was conducted in the early 2000s, with present data indicating that climate change has been intensifying. Over the long term, the sustained effects of climate change could surpass the initial impacts of right-of-way clearing, and related alterations. This longer-term warming of the climate has the potential to become the dominant driver of permafrost degradation over the long-term design life of the road.</p> <p>Recognizing that both short-term and long-term factors influence permafrost dynamics, these factors will be evaluated during construction and long-term road operation, acknowledging their varying impacts over time.</p> <p>The GNWT has detailed how monitoring activities included in the Draft Permafrost Protection Plan (PPP) will be implemented (Volume 5 of the DAR). These activities will emphasize early detection of changes in permafrost in the Project development area and local assessment area, including visual inspections, ground temperature monitoring, and climatic data reviews. As mentioned in the In DAR section 24.5.2, the GNWT committed to:</p> <ul style="list-style-type: none"> <li>• Periodic surrounding surface surveys using remote sensing techniques every 5 to 20 years to identify areas where surface features such as ground elevation, vegetation cover, surface water flow, or areas of pond development have changed</li> <li>• Visual observations of embankment performance (e.g., signs of cracking, sloughing) and the effectiveness of roadway design and mitigation measures with regard to modification of drainage</li> </ul>	<p>The proponents response does not address: anticipated but unpredictable changes to hydrologic systems (and ground stability) posed by climate change in proposed design. Implement monitoring for change detection and early warning system for landslides, permafrost thaw, and changes in hydrology. Consider that land types which are considered stable under current thermal conditions may not be stable in the future (directly or indirectly related to the project)</p>
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			<p>conditions (e.g., presence of ponding water or winter icings)</p> <ul style="list-style-type: none"><li>• Engineer inspections after severe events to verify the integrity of roadway and drainage systems</li><li>• Frequent inspections of the performance of the infrastructure (e.g., culverts are clear in the spring and the fall)</li><li>• Where permafrost is encountered and where practical, monitoring of the thermal regimes to assess if the embankment performs as designed.</li><li>• Monitoring of the thermal regime of representative terrain types along the corridor is important for assessing embankment performance against thermal change in undisturbed terrain. Regular monitoring of road maintenance efforts and climate data to better correlate the change in road surface with climate-related parameters and their potential changes</li></ul> <p>While the GNWT recognize that additional follow-up monitoring and adaptive management may be needed as the Project advances beyond the activities currently included in the PPP, it is expected that the current monitoring commitments will prove effective in reducing potential effects of the Project on permafrost and hydrologic systems.</p>	
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3	Vol 3, 1 of 13, 14.0 p 14- 8, p 14- 17	Effect pathways for permafrost thaw are missing.	<p>Effect pathways related to construction, operation, and maintenance activities are included in Section 14, Table 14.2 (Potential Effects, Effects Pathways, and Measurable Parameters for Terrain, Soils, and Permafrost) of the Developer’s Assessment Report (DAR). The identified pathways include permafrost thaw resulting from activities such as vehicle traffic and clearing during construction; and from changes to local drainage pattern, erosion, and/or ponding along the embankment, including effects of snow distribution on the ground thermal regime during operations (road use) and maintenance activities. These activities involve potential project interactions with permafrost during operations and maintenance activities, as indicated in Table 14.4 of the DAR. Activities such as grading and dust control will have limited interaction with permafrost since they are performed on the road surface. As explained in Section 5.4.6.2 of the DAR, and illustrated in Figure 2, embankment is placed directly on the ground surface. Road base is thereafter placed on the constructed embankment and compacted; therefore, these activities do not interact with terrain, soils, and permafrost.</p> <p>The draft Permafrost Protection Plan (PPP; Section 5 of the DAR) accounts for potential permafrost thaw from snow accumulation along the sides of the road embankment. The timing of this effect will be updated in Table A.1 as part of the DAR Addendum to include the operations and maintenance phase as well.</p> <p>As stated in the PPP, the monitoring program will study the thermal regime of the infrastructure and surrounding area, and how factors such as surface ponding, revegetation, and patterns of snow accumulation affect the thermal regime. These monitoring activities will assist in adaptively managing the design and maintenance activities aimed at protecting the ground thermal regime where needed, and in identifying specific areas where mitigative or restorative efforts may be required.</p> <p>With regard to snow management and mitigation, Table A.1 of the PPP details potential mitigation techniques that may be employed where needed to protect the infrastructure from the effects of permafrost thaw, such as the following:</p> <ul style="list-style-type: none"> <li>• Accumulated snow drifts may be plowed or flattened to reduce the potential long-term effects on permafrost.</li> <li>• Snow removal, if required, will be focused on the lee side of higher sections and where snow tends to drift.</li> <li>• In areas where snow drifting becomes a reoccurring issue, the below strategies may be implemented to reduce drifting and accumulation: <ul style="list-style-type: none"> <li>– Snow fencing can be installed upwind of road embankments to keep snow drifts off the road surface and away from drainage ditches.</li> <li>– Additional embankment material can be added alongside slopes to decrease the slope gradient.</li> </ul> </li> </ul> <p>While various techniques will be applied to prevent or mitigate project-induced permafrost degradation along the roadway, it is well understood that permafrost under and near the embankment will continue to change as a result of the Project and natural factors such as climate change. Residual effects from changes to permafrost within the Project development area and portions of the local</p>	<p>Though many of the factors highlighted are summarised in the proponents response, little information is provided regarding vegetation clearing, and long-term impacts of road use and maintenance. A clear description of a snow management plan would still be advantageous as details regarding snow management are not comprehensively presented.</p>
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			assessment area are, therefore, expected to be long-term as the road will be permanent, and irreversible as a return to baseline conditions will not be achievable (Section 14.4.4.3 of the DAR).	
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4	Vol 3, 1 of 13, 14.0 p 14- 8; Vol 4, 23.5 p 23 - 8	<p>Key measurement and monitoring of parameters for permafrost thaw are missing in several areas throughout the report. These are necessary to characterize the heterogeneity of permafrost in the project area and establish baseline conditions. For example, the proposed thermal regime monitoring may not fully capture permafrost health in "warm" (near freezing-point) permafrost.</p>	<p>Using currently available data, and data planned to be captured as part of future geotechnical investigations, it is expected that sufficient permafrost-related information will be available to document ground ice conditions, and capture relative heterogeneity of permafrost across the alignment to support highway design. Geotechnical methods provide more reliable information about soil conditions than geophysical techniques, such as those identified by the reviewer. Existing information is adequate to support the environmental assessment predictions.</p> <p>Site-specific data obtained from both historical and recent field investigation programs, such as those referenced below, were used to document baseline conditions along the alignment route. This includes published literature data, online database records, and findings from recent geotechnical studies conducted for the GNWT along the Mackenzie Valley Winter Road. A complete list of references used to support the baseline characterization of permafrost conditions for the purpose of environmental assessment is presented in Chapter 14 of the Developer's Assessment Report (DAR).</p> <p>In 2020, Tetra Tech Canada Inc. (Tetra Tech) completed geotechnical and geophysical investigations in support for advancing design and engineering of the Mount Gaudet Access Road (MGAR) near Wrigley, and the Prohibition Creek Access Road (PCAR) near Norman Wells which are expected to be upgraded to an all-season highway standard as part of the Mackenzie Valley Highway (a portion of the PCAR has now been constructed) (Tetra Tech, 2020a; 2020b; 2020c; 2020d). The geotechnical and geophysical findings presented to GNWT as part of these studies were referenced in Section 14 of the DAR to better document local subsurface conditions. Similar geotechnical investigations will be conducted along the MVH route as part of the design process. These studies provide examples of the type of detailed sitespecific information collected to support highway design, compared to the type of information used during environmental assessment to support effects predictions, but also illustrates how available information has been used.</p> <p>Regarding thermal regime monitoring, included in Tetra Tech studies were the installation of eleven multi-bead ground temperature cables. These cables are still in place and monitoring permafrost. Data obtained to date (2022) confirmed that permafrost encountered along those alignment sections are characterized as "warm", with average temperatures being near the thawing-point (e.g., between 0°C and -2°C). Ground temperature monitoring will be initiated at key terrain locations along the full MVH route, and the summary of subsurface conditions encountered along the MGAR and PCAR study areas will be used, alongside the additional data collected from future geotechnical programs, to support the next stage of engineering design.</p> <p>In addition to the borehole drilling program, two geophysical methods were used to investigate permafrost along the PCAR and MGAR: Capacitively Coupled Resistivity and Ground Penetrating Radar. Data obtained from these surveys were used in conjunction with boreholes and laboratory findings to document the variability of subsurface conditions across various terrain types (as represented by surficial geology such as till, glaciofluvial, glaciolacustrine deposits, etc.). Where relevant, the Project will incorporate regional geophysical data from other organizations, and implement or facilitate local geophysical investigations to spatially extend substrate characterizations from geotechnical drilling at spatial scales similar to the PCAR and MGAR, where needed to support design.</p> <p>Additional geotechnical field investigations will be conducted to support highway design. The combination of activities and analyses to be included in these investigations will be chosen based on</p>	<p>Good to hear that geotechnical investigation is planned, and it is hoped that geotechnical investigation will also inform the final road alignment.</p>
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			specific geotechnical parameters required to advance roadway design (e.g., borehole drilling, geophysical surveys, material sampling, laboratory analyses, thermal monitoring, and modelling, etc.).	
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5	Vol 3, 1 of 13, 14.0 p 8 -9, 14A p 3 ; 15 p9, 16 p 12, a16 p 25; Vol 4, 24.3 p 24-16	<p>The map of assessment area shows that RAA often encompasses the Mackenzie river, but not systematically, and there is no downstream monitoring proposed on this waterway. The discussion of permafrost degradation during the operation and maintenance phase does not include the potential for retrogressive thaw slumps and interactions with the Mackenzie river. LAA definition insufficient in some regions where hydrologic impact is notable: eg where icings may develop at culverts and redirect GW flow, where surface water networks are disrupted and effects are felt throughout the entire downstream catchment (which may extend beyond 0.5 km), and may also impact underlying permafrost. The establishment of assessment areas for groundwater does not include the vertical depth to be assessed. Groundwater flow paths can extend up to 100s of meters in the subsurface depending on permeability, gradients, and heterogeneity. Inclusion of the scope of the assessment is essential. In addition, the lateral extend of groundwater impact is intimately linked with the depth of study - deeper flow paths operate on much larger lateral scales.</p>	<p>The local assessment area (LAA) for terrain, soils, and permafrost is the area within 500 metres of either side of the proposed road alignment route centerline, access roads, and quarry and borrow sources. This buffer is considered adequate to capture the area within which measurable project-related effects on terrain, soils, and permafrost (direct or indirect) may occur. While the buffer overlaps the Mackenzie River at a few locations, the area of interest for the assessment of effects specific to terrain, soils, and permafrost consists of the overland area only. The LAAs for surface water quantity and groundwater quantity are defined in Section 15.1.4.1, and the LAAs for surface water and sediment quality, and groundwater quality are defined in Section 16.1.4.1.</p> <p>The GNWT has considered ongoing changes in the course of the Mackenzie River and other geoprocesses within the LAA in relation to the proposed alignment. Where required, further adjustments to the horizontal highway alignment will occur as part of the detail design process is unstable terrain conditions (including shoreline erosion), that have potential to impact the project are observed.</p> <p>While the GNWT recognizes that groundwater flow paths can extend for hundreds of meters in subsurface formations, it is anticipated that interactions between the project groundwater will primarily occur at relatively shallow depths (e.g., in the range of elevations separating the road surface to the Mackenzie River channel).</p> <p>Along the alignment, groundwater flow will proceed within unfrozen zones (taliks) located alongside and under the central portion of the road. To promote drainage, the sections of the highway located in permafrost (as well as other sections not in permafrost) will use equalization culverts, sized according to anticipated winter flows, at all low spots to allow passage of groundwater across the road and re-connection to the groundwater regime. Based on the documented baseline conditions, extending the LAA or regional assessment area to a larger/deeper footprint (i.e., both lateral and vertical extents) is not expected to result in changes to potential project-related effects on permafrost or groundwater.</p>	<p>It is positive that alignment will be reconsidered based on slope stability considerations. Additional consideration of water crossings of tributaries to the Mackenzie ought to be considered. Groundwater impacts including icings may still be problematic in fine-grained sediments and organic lowland soils, and require additional consideration in a final design stage.</p>
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6	Vol 3, 1 of 13, 14.0 p 14- 11	<p>Description of timing includes no sensitivity with the example that winter activities do not impact frozen soils. Though there are no obvious direct impacts, indirect impacts are easily felt even when soils are frozen through compaction or alteration of snowpack, increased load on soils resulting in deformation etc.</p>	<p>While increased loads on non-frozen soils would result in ground deformation, winter activities on frozen soils (e.g., vehicular traffic) are not expected to result in measurable impacts on soils, terrain or permafrost.</p> <p>The GNWT acknowledges the possibility of localized changes to frozen soils, changes that may be measurable in a laboratory setting. The definition has been changed to “No to low sensitivity”.</p> <p>Mitigation measures specific to winter activities will be implemented during construction activities to reduce impacts to frozen soils. Examples of winter mitigation measures include limiting off-road travel to frozen conditions (approximately December 15 to April 1; where possible), maintaining a minimum of 10 centimetres of packed snow on frozen off-road travel surfaces.</p> <p>Based on the expected absence of measurable impacts to frozen soils, the description of the timing of residual effects on terrain, soils, and permafrost, collectively, in Table 14.3 (Chapter 14, Section 14.1.5 of the Developer’s Assessment Report) can be described as “no sensitivity”.</p>	<p>Consider the example of seismic lines, primarily cut in the winter, without removal of snow. These clearings scar the landscape for decades, and through a combination of change to vegetation and compaction of surface soils in the winter, often lead to permafrost loss in the Dehcho region.</p>
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7	Vol 3, 1 of 13, 14.0 p 14- 12 Vol 4, 24.4 p 24 - 20, PPP- 17,14A - 22, 28 and throughout outdated data	Data scarcity is a pervasive issue across the region, and existing data is often outdated (e.g. 1970s investigation reports for roadway alignment), but reconnaissance was completed for the borrow and quarry sites. Further reconnaissance is recommended for areas with poor data quality or missing data, as well as areas most susceptible to climate change to understand baseline conditions in more detail. Given the dated nature of figure 4.2 in 14A and the stated dependence on recent (2020) site investigations by tetrattech, can you re-classify the reaches of the MVH based on permafrost type? Literature review is based primarily on technical reports and does not include recent scientific literature.	<p>While the GNWT recognizes the overall scarcity of site-specific permafrost data across the region, the prediction confidence in the existing data is considered adequate to properly assess permafrost-related effects. This confidence is based on professional judgement, the overall quality of publicly available and project data, experience learned from similar projects, as well as the expected effectiveness of the proposed mitigation measures.</p> <p>The GNWT's commitment to permafrost monitoring is described in the Permafrost Protection Plan (Volume 5 of the Developer's Assessment Report). Thermistors will be used at specific locations, representative of key terrain types along the Wrigley to Norman Wells right-of-way (ROW), to provide information such as ground temperature to inform mitigation measures for design and identify how the thermal regime changes over time. Ground temperature instrumentation was installed in summer 2020 (Tetra Tech, 2020a; b). Additional monitoring instrumentation may be identified during final design and installed during construction of the Project. The details regarding the instrumentation setup (i.e., instrument type and locations, data collection schedule, etc.) will be confirmed as the highway design advances. These existing ground temperature monitoring locations are presented on a map found in Appendix 14A, Figure 14.6 of the Developer's Assessment Report (DAR). This data will be used to inform the potential impact of infrastructure development, as well as to monitor predicted changes to infrastructure over the lifetime of the project.</p> <p>Regarding the use of available water quality data, the GNWT previously provided a detailed response to Online Review System LKFN-28 during the public review of the DAR.</p>	Though the report does include technical data from recent surveys in some portions, these are not reflected in the presented understanding of system function, e.g. 14.2.2.4
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8	PPP - 17, monitoring	<p>The assessment of sparse weather station data as a proxy for an interpretation of climatic data is inadequate and does not sufficiently complement ground temperature monitoring to establish the continued health of permafrost. An action plan to increase data availability to anticipate and predict changes to the road, and to enhance early detection of road failure through monitoring could be a key element to maintenance. It is unclear where current ground temperature monitoring equipment is installed, whether its coverage is adequate to interpolate the behaviour in each land cover type and region. Regardless of the existing installation, post-construction thermistor installation within the ROW, on the embankment, and on the road itself are invaluable tools for the early detection of thermal deterioration of infrastructure.</p>	<p>The GNWT has detailed how monitoring activities included in the Draft Permafrost Protection Plan (PPP) will be implemented (Volume 5 of the Developer’s Assessment Report [DAR]) to monitor the infrastructure and changes to surrounding terrain and permafrost. These activities will emphasize early detection of changes in permafrost in the Project development area (PDA) and local assessment area (LAA), not the regional assessment area, including visual inspections, ground temperature monitoring, and climatic data reviews. The rationale for focusing the monitoring activities to the Project PDA and LAA, is that it is within these areas that measurable project-related effects on terrain, soils and permafrost (direct or indirect) are expected to occur.</p> <p>As noted in the GNWT’s response to Round 2 LKFN IR#2 and initially detailed in Section 24.5.2 of the DAR, the GNWT has committed to:</p> <ul style="list-style-type: none"> <li>• Periodic surrounding surface surveys using remote sensing techniques every 5- to 20 years to identify areas where surface features such as ground elevation, vegetation cover, surface water flow, or areas of pond development have changed</li> <li>• Visual observations of embankment performance (e.g., signs of cracking, sloughing) and the effectiveness of roadway design and mitigation measures with regard to modification of drainage conditions (e.g., presence of ponding water or winter icings)</li> <li>• Engineer inspections after severe events to verify the integrity of roadway and drainage systems</li> <li>• Frequent inspections of the performance of the infrastructure (e.g., culverts are clear in the spring and the fall)</li> <li>• Monitoring of the thermal regime of representative terrain types along the corridor is important for assessing embankment performance against thermal change in undisturbed terrain. Regular monitoring of road maintenance efforts and climate data to better correlate the change in road surface with climate-related parameters and their potential changes.</li> </ul> <p>While the GNWT recognizes that additional follow-up monitoring and adaptive management may be needed as the Project advances, it is expected that the permafrost mitigation measures, combined with proposed monitoring will prove effective in reducing potential effects of degrading permafrost on the Project and on hydrologic systems.</p>	<p>Consideration of partnerships with LKFN and others is still recommended for monitoring. Leveraging the experience and observations of people familiar with the region will enhance early detection. In addition, slope stability monitoring should be considered where the alignment is in proximity to the Mackenzie, such as soil moisture measurement.</p>
9	PPP - 15	<p>Training staff to identify issues may also be augmented by the appropriate selection of monitors with knowledge of local terrain</p>		

10	Vol 3, 1 of 13, 14.0 p 14- 13, 14A -9	<p>Mapping was performed based on surface materials, expression, depth to bedrock, and processes, but not vegetation or permafrost probability/permafrost mapping/ice content mapping. Data describing soils along the route is drawn from coarse resolution and potentially outdated databases. Though data scarcity across the North is challenging, in the context of this project, the coverage of organic soils is critical to understanding thermal and mechanical properties. These soils change based on climate, slope stability, and wildfire among other processes. Many of the listed products are also not ground-truthed in the region of interest. Data on landslides is similarly at least 10 years old, which is potentially inadequate in a rapidly thawing permafrost environment.</p>	<p>The GNWT thanks the reviewer for additional regional permafrost-references. Information contained within these documents will be reviewed in advance of the development of the detailed design.</p> <p>The GNWT recognizes that permafrost environments are highly dynamic, and often experience unprecedented rates of changes, which may be attributed to climate change. While increased baseline assessment studies, including mapping, could strengthen the understanding of permafrost and its interaction with other key ecosystem components, the terrain-related information compiled to support the effect assessment is considered adequate.</p> <p>As explained in the GNWT’s response to Round 2 LKFN IR#12, the highway design is not complete. Additional site-specific studies will be completed to inform detailed design and permitting. The following are examples of studies that will be used to advance the Project’s design:</p> <ul style="list-style-type: none"> <li>• Additional hydrotechnical and icings (aufeis) investigations at watercourse crossings for culvert design, as needed</li> <li>• Detailed terrain analysis, geotechnical and thermal investigations, and topographic survey for embankment design</li> <li>• Geotechnical investigations at deep road cuts and selected water crossings</li> <li>• Ground temperature readings at existing monitoring points</li> <li>• Engagement with GNWT and academic specialists familiar with available and ongoing terrain mapping in the Mackenzie Valley and the Northwest Territories’ Thermokarst Mapping Collective project.</li> </ul> <p>Should the Mackenzie Valley Environmental Impact Review Board recommend approval of the Project, the Project will proceed to the regulatory review phase. Details from the studies listed above will be provided during the regulatory review. The GNWT will also share the results of studies done to inform detailed design and permitting with Łíídlıı Kųę First Nation as part of GNWT’s ongoing engagement with Łíídlıı Kųę First Nation.</p>	<p>Should the additional baseline information indicate that the current alignment includes geotechnical challenges or sites likely to be negatively impacted by climate change, disturbance, or otherwise impact the function of the planned MVH, consideration of re-alignment is recommended.</p>
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11	Vol 3, 1 of 13, 14.0 p 14- 19, 25	Table 14.5 - Terrain conditions may also be affected by permafrost thaw processes leading to failure of slopes, thaw slumps, active layer detachments, and failures in ground competency	<p>The GNWT acknowledges that terrain conditions may also be affected by permafrost thaw processes resulting from project-related ground disturbance, leading to failure of slopes, thaw slumps, active layer detachments, and failures in ground competency.</p> <p>As discussed in the Permafrost Protection Plan (Volume 5 of the Developer’s Assessment Report [DAR]), there is a very close relationship between physical erosion (e.g., the mobilization of soil particles by water flow) and thermal erosion (e.g., changes to the thermal regime). It is well understood that thermal erosion may result in physical erosion (i.e., increase active layer thaw leading to the occurrence of a slope failure) and vice-versa.</p> <p>This close relationship between physical and thermal properties was acknowledged as part of the assessment of potential effects on terrain, soils and permafrost, including within Table 14.5 (Chapter 14.4 of the DAR) where both the changes in physical and thermal properties are listed under the potential effect types.</p> <p>Detailed terrain mapping and geoprocesses, such as permafrost thaw and mass movements, have been identified as part of baseline studies (Appendix 14A of the DAR). Where required, further adjustments to the horizontal highway alignment may occur as part of the detail design process, including where unstable terrain conditions are observed.</p>	Thank you
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12	<p>General comment on Permafrost and road alignment Vol 3, 1 of 13, 14.0 p 14- 30, PPP - 10, PPP - 11, PPP - Table A1 placement on frozen groundm 14A - Table 4.4 alignment ; 24.5 (p 24 -21</p>	<p>Geotechnical site investigation for the identification of ice-rich sediment is an invaluable resource in infrastructure design. Consider the recent re-alignment of the Alaska Hwy near Whitehorse (in the ibex valley) where the road was originally constructed on presumed ice-rich sediment, and thaw slumping along the Takhini river pose a risk to the road. It is noted that, "Additional geotechnical information to inform design will be collected once there is certainty of the alignment routing corridor (upon completion of the environmental assessment)". We have concerns that there is not enough flexibility in the design of the alignment route as new information becomes available and that current designs are relying on outdated baseline information. In particular, where new alignment sections are constructed, laying the road base on top of organic rich soils using a fill-only technique is more likely to cause adverse effects in the long-run. Thick (3-8m) organic deposits exist in this region with porosities of &gt;80%. Considering the life-span of the project, it can be expected thaw will occur of these ice rich soils, leading considerable consolidation and ongoing maintenance and safety issues. In addition, the placement of construction</p>	<p>Please see the attached response.</p>	<p>Thank you for the detailed response we are especially hapy to read: "Flexibility in alignment: The design remains flexible, and adjustments to the alignment will be considered based on the findings of future geotechnical investigations, within the presented design criteria and objectives of Section 5.2 of the DAR." as well as "Balancing anticipated future maintenance requirements and capital construction cost to minimize life cycle cost of the project.". Our remaining concern is related to the magnitude of change that will be considered (i.e. will teh alignment only fall within the specific corridor, or will other options be considered?) as well as the decision thresholds selected. We look forward to continued consultation relatign to results of geotechnical site investigations, proposed excavation of organic soils, and other specific design decisions as the project evolves.</p>
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		<p>material directly on frozen ground while it does protect the immediate integrity of the ground does not allow for detailed assessment of suitability of substrate materials, identification of segregated ice or ice-rich conditions, and does not consider the hydrologic and landscape function of a region. In addition, organic surface soils and vegetation are extremely prone to compaction and as they decompose will cause significant deformation of the road surface. Finally, throughout the report and PPP, it is often noted that mitigation measures will be employed "where possible" (e.g., "project design will avoid ice-rich areas where possible"), but there is not description of what will be done if measures are not possible.</p>		
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<p>13</p>	<p>Vol 3, 1 of 13, 14.0 p 14-19, 23, 25, 26 14A P 44</p>	<p>Drainage considerations do not include groundwater icings or culvert dimensioning and anchoring practices appropriate to permafrost environments. Icings exist in the LAA and further documentation of their locations will assist in culvert design and construction with groundwater movement considerations.</p>	<p>Icings and culvert design</p> <p>As discussed in the GNWT's response to Round 1 Information Request (IR) Mackenzie Valley Environmental Impact Review Board (MVEIRB)#71, no site-specific culvert designs have been completed. Culvert designs will be completed based on site-specific flow and channel information as well as geotechnical information (if needed), as part of detailed design, and once the route of the highway is confirmed as an outcome of the environmental assessment. Łíídlıı Kúę First Nation will have the opportunity to review and comment on culvert design information during the water licencing and land use permitting process. Table 5.2 of the Developer's Assessment Report (DAR) identifies the minimum culvert design criteria that will be applied to all culverts.</p> <p>The GNWT has already noted specific locations of overflow and icings communicated as part of engagement on the Project. These are communicated as descriptive locations (e.g., "north of Steep Creek"), and as georeferenced locations provided in private comments on the GNWT's interactive map tool included on the "Have Your Say" page (Mackenzie Valley Highway Project   Have Your Say - Government of Northwest Territories (nwt-tno.ca)). Prior to completing detailed design, the GNWT will compile and disseminate reports of current overflow/aufeis locations and extent on the existing Mackenzie Valley Winter Road (MVWR) to inform the detailed design process of crossing locations. One of the information sources will be MVWR maintenance records, and additional observations after the MVWR is seasonally closed will be recorded as other site-specific studies are completed to support design. Where icing may be expected, larger/higher capacity culverts will be installed to address blockage concerns. Where icings are known or suspected to be an issue, engineers assume and account for the presence of icings in the design as a safety factor for the culvert flow capacity. A safety factor may be applied differently by each Engineer of Record, depending on the specific site conditions; therefore, the GNWT does not currently have a specific design criteria for this. Generally, the culvert will be a larger diameter than it would be if ice were not accounted for. Once an Engineer of Record for the detailed design is retained, the exact method to account for icings in specific culvert design will be determined. See also the GNWT's response to R1 CanNor IR#05.</p> <p>Effects of road freezing on groundwater flow regimes</p> <p>The GNWT's response to ORS LKFN-22 explains why the proposed design approach is not likely to cause groundwater flow path issues or cause flooding and washouts.</p> <p>Areas potentially affected by seepage</p> <p>The length of road expected to be affected by seepage identified in Appendix 14A, Table 5.4 of the DAR was determined by compiling the combined length of the proposed alignment crossing terrain map units for which seepage was added as a geoprocess (LSA Terrain Mapping, Appendix 14A [Appendix B]). This mapping is based on the terrain classification system from Howes and Kenk (1997), where relatively homogeneous terrain units (or polygons) are delineated on the basis of surficial materials (e.g., till, glaciolacustrine), surface expression (e.g., hummocky, fan), depth to bedrock (e.g., veneer, blanket) or stratigraphic composition (i.e., identifying the expected subsurface material), slopes, and geomorphological processes.</p> <p>The length of road expected to be affected by seepage process was, therefore, estimated based on desktop interpretation of terrain conditions where physical indicators (e.g., the presence of rills, levees</p>	<p>The consideration of mapping icings and culvert design is good. Additional study of groundwater flow and connectivity may enhance the resilience of designs to ensure that the patterns of flow are reflected in the mitigation strategies. This additional understanding will ensure that culverts and water crossings not only account for icings occurring in the time immediately preceding construction, but also that they reflect the potential future changes in the landscape, allowing the design to be resilient to future conditions.</p>
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			and/or flow paths) or vegetation indicators (distinct vegetation communities) are indicative of water movement.	
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15	Vol 4, 24,2 p 24-6	<p>Table 24.3 and 24.4 assume stationarity in climate data between 1981 and 2010. From work across the territory, there have been significant trends in both temperature and precipitation in similar regions, including Fort Simpson. Presenting aggregated summary data for this entire period when it is likely that a trend exists in the climate data provides an unreliable baseline condition.</p>	Please see attached response (table)	<p>While this table provides excellent context and indicate non-stationary baseline data. We hope the proponene considers this in the analysis of past conditions.</p>
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16	Vol 4, 24,2 p 24-10,11,18	The increase in precipitation for RCP 8.5 is given for the Fort Simpson A baseline but not the Norman Wells A baseline, is it expected to differ? Table 24.8 lists a predicted decrease in Freeze-Thaw days, but this contradicts many current studies indicating increased variability in weather patterns leading to an increase in midwinter melt events and to late/early - season snowfalls etc.	Please see attached response (table)	The clarified climate profile provided is very helpful. Based on the regime shift to potentially include over winter freeze-thaw days, what considerations for snow management, icings, and potential runoff should be considered?
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17	Vol 4, 24,2 p 24-11	<p>The geological hazards depicted relate largely to the interaction of permafrost and proposed infrastructure, but do not link to the climate change direction described above.</p>	<p>Both climate change influences and disturbances due to the Project were considered in relation to geological hazards.</p> <p>As mentioned in the Developer's Assessment Report (DAR) under the geological hazards section (Section 24.2.5), climate change will exacerbate localized Project-caused degradation of permafrost. Changes in climate include increased ground temperatures, leading to a deepening of the active layer, (i.e., the seasonally thawed surface layer above permafrost), higher fall precipitation, and talik development, which can all increase near-surface groundwater movement year round. Thawing permafrost may also generate changes in soil moisture, resulting in ground subsidence where ice-rich soils are located. These interactions are discussed under the Climate Change Considerations section of the Soils, Terrain and Permafrost Technical Data Report (Appendix 14A of the DAR).</p> <p>While Chapter 14 of the DAR describes mitigation measures to reduce the effects of the Project on permafrost, the Project does not aim to have no effects on permafrost. These effects, along with those expected to be exacerbated by combined effects of climate change, are a consideration in the design of the Project, as further detailed in the GNWT's response to Round 2 LKFN IR#12.</p>	<p>To clarify, it is recommended that the proponent consider the combined effects of climate change (e.g. heavy rain AND permafrost thaw simultaneously) on the proposed infrastructure. Will it still be safe to use under these conditions? What other modes of failure might present themselves from the combined impacts?</p>
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18	Vol 4, 24.3 p 24-12, 14	<p>Issues with the statement: "The Project will take approximately 10 years to construct, over a timeframe of up to 20 years. Consequently, climate change effects are likely to be more pronounced during operation, since activities associated with operation are expected to continue for a much longer time." Work at the Scotty Creek Research Station shows current active permafrost thaw as a result of climate change, and simulations show significant projected loss of permafrost and hydrological regime shift over the next two decades.</p>	<p>Changes to permafrost are expected in the assessment areas prior to (without) and due to the Project, and these changes will continue over the life of the Project, as noted in Chapter 14. Changes in climate parameters (temperature, precipitation, frost and freeze-thaw days), and wildfires will continue to influence permafrost thaw through the range of predictive modeling (2080s), as presented in the Climate Change Resilience Assessment (Appendix 24A), and subsequent updates (K'alo-Stantec [2024]; Round 1 MVEIRB IR#2). Permafrost thaw poses a risk to the Project during both construction and operation due to its potential to lead to settlement, changes in surface drainage, or localized erosion (Section 24.3.1 and 24.3.2). The above reports note that permafrost thaw (increases in active layer thickness) due to changes in climate conditions is currently observed in the Northwest Territories, with continued thaw and loss projected in a warming climate.</p> <p>The effects on permafrost in the local assessment area will likely be pronounced during the construction period (i.e., 10 years over a timeframe of 20 years) due to the clearing of the right-of-way and other work areas, and other ground disturbances. Nevertheless, when considering the effects of climate change overall (taking into consideration the various climate parameters highlighted in the Developer's Assessment Report [DAR]), impactful events (such as extreme heat and precipitation events) are projected to become more frequent and intense in a warming climate, with changes (not due to the Project) becoming more pronounced during the operations phase. Once constructed, the highway will be operated and maintained indefinitely, far surpassing the initial 20 year timeframe associated to the construction period. Considering the effects of climate change overall, it was therefore noted in the DAR that the effects are likely to be more pronounced in the operations phase.</p>	Thank you
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19	General comment on Permafrost, 26.4.3 p 26 - 44, PPP - 12, PPP - Table A1	Much of the permafrost especially in the Dehcho region is ecosystem protected, meaning that any disturbance to current conditions is likely to lead to permafrost loss.	<p>The GNWT notes that the current, early design, acknowledges the Project's setting with areas of permafrost, and its intended long-term operation within a changing climate. Permafrost and climate change are factored into the design parameters and objectives, and will be further considered in the detailed design, based on site-specific conditions and data.</p> <p>The Project spans from extensive discontinuous permafrost near Norman Wells, to sporadic discontinuous permafrost near Wrigley. The Project will encounter permafrost along most, but not all, of the route, and not all of the permafrost will be thaw-sensitive. Thawing of ice-rich soils can lead to effects on the Project itself, and/or effects on the surrounding environment. Both will be addressed in design. Specific localized permafrost protection techniques may be considered in detailed design; however, the Project does not aim to preserve permafrost beneath the roadway. The Project will avoid constructing on thaw-sensitive soils, where possible. If construction on such soils is unavoidable, the design will aim to address the issue, and mitigation measures will be developed accordingly for potential effects of thaw-sensitive soils. Additional discussion related to ice-rich permafrost areas that are sensitive to thaw can be found in the preamble text to the GNWT's response to Round 2 LKFN IR#12. A list of mitigations related to permafrost and/or vegetation are detailed in the Developer's Assessment Report (Table 14.5 and Table 18.8, respectively). Examples of mitigation specific to vegetation clearing include the following:</p> <ul style="list-style-type: none"> <li>• Clearing will be limited to areas required for construction and safe operations (i.e., to the width of the ROW and approved access roads).</li> <li>• Project vehicles will be confined to existing roads and trails to avoid disturbing vegetated areas.</li> <li>• If surface organic material must be removed for construction, it will be stockpiled and reapplied where possible.</li> <li>• Tree roots will be grubbed only in areas required for construction or stripping.</li> <li>• Organic material and topsoil will be set aside for use during reclamation, to the extent possible.</li> <li>• Undisturbed areas will be avoided until they are scheduled for clearing/stripping to limit unnecessary soil degradation and compaction.</li> </ul> <p>With respect to manual clearing, the GNWT recognizes the importance of sensitive areas and areas of traditional (cultural) significance; and, as stated in Table 18.8, clearing will be completed by hand, where required, to prevent damage to the ground.</p>	Plans for potential reclamation of areas, as well as the development of suitable cover materials for the shoulder of the road is recommended to enhance the resilience of the MVH, in addition to the methods outlined here.
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20	Vol 4, 24.3 p 24-12	Table 24.9 summarizes mitigation measures, but these do not include monitoring techniques, preventative measures, or early warning systems	<p>The Łı́dłı́KúęFirst Nation's (LKFN's) recommendation to include monitoring techniques, preventative measures, and early warning systems to address areas of high risk to the infrastructure is appreciated and aligns with the GNWT's commitment to adaptive management strategies. Monitoring is not included in Table 24.9 because monitoring, on its own, is not considered mitigation.</p> <p>As stated in the GNWT's response to Round 2 LKFN IR#08, the GNWT has detailed how monitoring activities included in the Draft Permafrost Protection Plan will be implemented (Volume 5 of the Developer's Assessment Report). These activities will emphasize early detection of changes in permafrost and ground conditions in the Project development area, and local assessment area, including visual inspections, ground temperature monitoring, and climatic data reviews. The development of monitoring techniques, site-specific investigations, and early warning systems will be undertaken as the Project design advances to implement measures that are tailored to the final alignment design, and informed by the most up-to-date geotechnical, environmental, and hydrological data which has not yet been collected (see preamble to the GNWT's response to Round 2 LKFN IR#12).</p> <p>As the Project design progresses, further geotechnical site investigations and other site-specific studies will be undertaken, and the GNWT will continue engagement with stakeholders to integrate local knowledge and expertise into risk identification and mitigation planning</p>	Thank you
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21	PPP - Table A1, 16	<p>Issues with "deploy methods to limit thermal disturbance". Long-term mitigation and remediation measures such as snow management, thermosyphons, choice of construction materials based on thermal properties and other strategies are not included.</p>	<p>The Łíídlı́Kúę First Nation's concerns regarding the inclusion of long-term mitigation and remediation measures to address thermal disturbance in permafrost regions are appreciated. The GNWT recognizes the importance of integrating sustainable, long-term strategies to limit thermal disturbance, where necessary, to promote the resilience of the infrastructure over the Project's lifetime. Additional relevant mitigation measures identified in the draft Permafrost Protection Plan are included below:</p> <ul style="list-style-type: none"> <li>• Snow management: To manage localized ground insulation and control thermal exchange, snow berms or controlled clearing methods can be implemented in areas with ice-rich permafrost to either retain snow for insulation or reduce snow accumulation that could accelerate thaw.</li> <li>• Choice of construction materials: Incorporation of geotextiles or geogrids to improve load distribution, and enhance stability. Materials such as granular fills with low thermal conductivity may be used to reduce heat transfer to the ground. Use of these materials will be prioritized in areas with warm discontinuous permafrost or high ice content to slow thaw progression.</li> <li>• Drainage Management: To reduce water pooling along the embankment, long-term drainage features such as culverts will be designed to direct water to the downslope side of the embankment to reduce project-related thermal disturbance and permafrost degradation.</li> <li>• Vegetation and Surface Stabilization: Closure and reclamation will promote re-establishment of vegetation ground cover to help stabilize thermal conditions and reduce ground exposure.</li> </ul> <p>Łíídlı́Kúę First Nation will continue to have the opportunity for input into the draft PPP as part of Project permitting</p>	Thank you
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22	14A - 17; 14A - 29, table 4.6; 14A - Figure 4.7; 16A p 9, 12	Supporting information missing or erroneous in description of permafrost systems.	<p>Scientific literature and to some extent, simplified descriptions, were used to help with the characterization of permafrost processes throughout the Technical Data Report (TDR). The GNWT acknowledges the reviewer's technical information on permafrost, more specifically on the dynamic of thaw depth and suprapermfrost taliks. While the description is correct, and the information provides additional general understanding on permafrost systems, incorporating this information into the baseline studies is not expected to result in changes to the findings of the effect assessment.</p> <p>Similarly, while the design team will consider the potential presence of suprapermfrost taliks under the highway alignment, its presence is not expected to significantly alter the design of the highway; for example calling for different embankment structure, or necessitating changes to the horizontal or vertical alignments.</p> <p>In terms of groundwater flow and how it interacts with permafrost and taliks, this is addressed in Appendix 15B – Hydrogeology Technical Data Report and in Water Quantity Section 15 (Assessment of Potential Effects on Water Quantity).</p>	<p>In response to: "Similarly, while the design team will consider the potential presence of suprapermfrost taliks under the highway alignment, its presence is not expected to significantly alter the design of the highway; for example calling for different embankment structure, or necessitating changes to the horizontal or vertical alignments." : the configuration of supra and sub-permafrost flow is the driver of the location, magnitude, and frequency of icings, which can severely impact roadways. Consideration of these in the technical understanding used to develop the designs of embankments etc. should take place.</p>
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23	Vol 3, 1 of 13, 14.0 p 14- 16	Issues with Table 14.4 - Road base placement, compaction and surfacing have no interaction.	The GNWT, in Table 14.4, identifies that embankment construction has potential to interact with terrain, soils, and permafrost. As explained in Section 5.4.6.2 of the Developer's Assessment Report, and illustrated in Figure 2, embankment is often placed directly on the ground surface. Road base is thereafter placed on the constructed embankment and compacted; therefore, these activities do not interact with terrain, soils, and permafrost. Construction activities that increase the weight of the embankment, especially when the underlying ground is thawed, do have the potential to further compact terrain.	Though the short-term activities outlined here may not directly impact permafrost, the change in albedo alone cannot be avoided and will influence the surface energy balance.
24	Vol 3, 1 of 13, 14.0 p 14- 16/17	Issues with Table 14.4 - water extraction for construction and operational dust control. Unclear where the source of this water is coming from. Smaller water features and upstream sources alters the hydrology, soil moisture, and permafrost conditions.	As stated in Section 5.4.11 of the Developer's Assessment Report (DAR), all creeks and rivers between Wrigley and Prohibition Creek with existing bridge or bridge-sized culvert crossings, and the Mackenzie River, where accessible, are potential sources for water withdrawal. Potential lake water sources are identified in Table 5.7. Additional studies of water sources will be completed prior to construction to support applications for water licence(s), and prior to use, to confirm withdrawal is in accordance with guidelines (e.g., DFO, 2010; DFO, 2013) and licence conditions. The assessment of potential effects on water quantity from water withdrawal is presented in Section 15.4.2 of the DAR.	Please clearly state the intended withdrawal sites and allow for consultation to ensure these are not important fish habitat, hydrologic features, or responsible for key ecosystem services.
25	Vol 3, 1 of 13, 14.0 p 14- 33	How does Little Bear River Quarry have no impact on Terrain or Soils? Even if it is an active quarry already, extraction of materials must at least modify the terrain?	As previously explained in the GNWT's response to Online Review System MVEIRB-23, the Little Bear River Quarry is an existing material source on the west side of the Mackenzie River. As it is outside of the Regional Assessment Area for Terrain, Soils, and Permafrost, it should not have been included in Chapter 14, Table 14.7 of the Developer's Assessment Report (page 14-33). There are no changes to the conclusions of the assessment of residual cumulative effects, as there are no potential cumulative interactions between the Project and the Little Bear River Quarry. Table 14.7 will be revised accordingly to remove mention of the Little Bear River Quarry as part of the DAR Addendum.	Understood

26	Vol 3, 1 of 13, 14.0 p 14- 34, 35	Mining and exploration are listed to have no interaction, the same may apply the Enbridge maintenance camp	<p>Past, present, and reasonably foreseeable future mining and exploration projects and activities (and other projects and activities) within 15 kilometres (km) of the Project are identified in Table 4.2 of the Developer’s Assessment Report. The single identified exploration project (drilling and exploration at the Wrigley Zinc property) identified in Table 4.2 will not interact with terrain, soils, and permafrost as its location, and timing does not overlap with the Regional Study Area (RAA) for terrain, soils, and permafrost.</p> <p>As discussed in the GNWT’s response to Mackenzie Valley Environmental Impact Review Board (MVEIRB) Round 1 Information Request (IR) #51, the GNWT is not aware of any proposed future exploration or mining projects in the RAA, though the GNWT does anticipate that future users of the highway will include industrial traffic to support exploration, development, operations, and/or closure and reclamation of natural resource developments such as oil and gas, mining, and forestry. These future users are accounted for in the estimated average annual daily traffic of 50 vehicles per day, which is used as a basis for the assessment. As described in the GNWT’s response to Round 1 MVEIRB IR #69, highway maintenance, such as grading and resurfacing, is required regardless of the traffic volume or road designation. Though maintenance requirements increase with more traffic use to account for various factors, including material erosion, ground movement, and wear and tear, the need to potentially accommodate industrial users beyond the current planned design capacity of the highway and/or address additional maintenance requirements will be evaluated if/when such a need is foreseeable and is outside of the scope of the Project. Future unforeseeable developments would be required to undergo project-specific review under the regulatory framework of the Mackenzie Valley Resource Management Act. These developments would need to consider impacts from increased road use on operation and maintenance of the highway.</p>	This clarification is suitable, but may indicate that interaction is likely.
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27	Vol 3, 1 of 13, 14.0 p 14- 39	<p>We disagree with the following statement: "To some degree, effects such as thermal erosion or the thawing of permafrost is inevitable due to the change in thermal equilibrium that will be triggered by the construction. These effects, wherever they occur, are expected to be localized and of low magnitude. The extent of localized changes to terrain, soils and permafrost is difficult to predict, however, most likely to correspond to areas where surface disturbance will occur (i.e., PDA)." Hydrologic changes resulting from the road placement can have widespread effects to surface and subsurface systems, which would in turn alter permafrost conditions in the LAA or RAA.</p>	<p>The GNWT notes discrepancies between the characterization of the magnitude of terrain effects when comparing the cited text from Section 14.6.1 of the Developer's Assessment Report (DAR) (i.e., low magnitude), and the permafrost magnitude description of "moderate" as displayed in Table 14.6 of the DAR.</p> <p>The text in Section 14.6.1 will be adjusted in the DAR Addendum to state that "these effects, wherever they occur, are expected to be localized and of moderate magnitude". This "moderate" characterization refers to effects that may exceed baseline conditions and have localized effects on ecological function (e.g., permafrost melt leading to increase moisture or ponding, then contributing to a change in vegetation).</p> <p>Relevant experience on projects such as Highway 3 and the Tłı̄çhō Highway, which are also constructed partially on permafrost, show the proposed design approach unlikely to cause hydrologic changes, for example, groundwater flow path issues or flooding and washouts. The Mackenzie Valley Highway is not expected to have permafrost to grow into its embankment. The sections of the alignment located in permafrost (as well as other sections not in permafrost) will use equalization culverts to allow passage of water across the road without disrupting drainage regimes.</p> <p>The expected effectiveness of the proposed mitigation measures is another factor allowing the GNWT to state that permafrost-related effects, wherever they occur, are expected to be localized and of moderate magnitude.</p>	Thank you
28	Vol 3, 1 of 13, 14.0 p 14- 39	<p>The prediction confidence is considered to be moderate to high, however it is based on in situ data collected in the 1990s at the latest, and many areas have undergone changes to permafrost conditions, while no geotechnical data for the site is available</p>	<p>As discussed in the GNWT's response to Round 2 LKFN IR#07, while the GNWT recognizes the overall scarcity of site-specific permafrost data across the region, the prediction confidence in the existing data is considered adequate at the environmental assessment stage to properly assess permafrost-related effects. This moderate to high confidence is based on professional judgement, the overall quality of publicly available and project data, and experience learned from similar projects, as well as the expected effectiveness of the proposed design approach and other mitigation measures suggested in the Developer's Assessment Report. It is important to note that Chapter 14 of the Developer's Assessment Report refers to terrain, soils, and permafrost. Therefore, the moderate to high prediction confidence, relates to a range of interconnected elements, not just permafrost.</p> <p>While the GNWT recognizes that additional site-specific geotechnical data will benefit the advancement of detailed design, the limited available data along portions of the alignment does not influence the prediction confidence as conservative assumptions on the potential presence of thaw sensitive permafrost were taken into account in the assessment of potential residual effects. The GNWT has committed to conducting additional geotechnical investigations for the Project with the purpose of providing site-specific data to support the advancement of detailed design. Should the Project proceed to permitting/licensing, reports of geotechnical investigations that support highway and culvert designs will be available for public review as part of the Land and Water Board's permitting/licensing process.</p>	The respondent appreciates that additional geotechnical data will be assessed, and that once these data become available perhaps the confidence could be "very high"

29	Vol 4, 24,2 p 24-15	<p>Given the moderate/low confidence in the predicted decrease in dry spells, and the current non-negligible dry conditions, it seems likely that low water condition may be present and have potential to affect the project progress as it relates to water availability</p>	<p>The most recent climate resilience assessment of June 2024 (K'alo-Stantec, 2024; R1 MVEIRB IR#2) identified a slightly decreasing trend in terms of dry spells from 29 consecutive days to 25 for the Norman Wells area and from 29 to 27 for the Fort Simpson area by the 2080s. Due to the relatively small change over a long period of time, and due to the medium-low confidence in the projection, decreased dry spells were not factored into the construction schedule and activities used as the basis of the environmental assessment (Section 5.4 of the Developer's Assessment Report). Direct observations in the region during recent years have seen unusually intense dry spells, resulting in low water levels.</p> <p>Low water levels in navigable waters, which can result from longer and more frequent dry spells, could adversely affect delivery of equipment and materials to construction sites by shortening barging seasons or imposing weight limits on barges. Small reductions in operating windows or weight limits can be accommodated through adaptive construction scheduling. More severe limits, such as the ones posed by the low water levels of 2024, would likely result in increased costs, e.g. by deploying more barges (lighter loads) or transporting and staging goods in winter, to offset restrictions. Such restrictions may also result in construction delays.</p> <p>Dry spells and low water levels also have the potential to limit water withdrawal sources for construction purposes (e.g., compaction or dust suppression). Smaller waterbodies may become unavailable for water withdrawal. Limitations on water withdrawal sources can be managed in different ways, including:</p> <ul style="list-style-type: none"> <li>• Construction scheduling: e.g., by focusing on construction in areas with less severe limitations during dry spells</li> <li>• Withdrawing water from fewer, bigger sources and transporting it over longer distances</li> </ul> <p>Both options have limitations. There is limited flexibility in the sequencing of road segments due to the linear nature of the project and the limited number of access points to the road corridor. Transporting water over long distances will add cost.</p> <p>Construction scheduling will be the responsibility of the contractor in consultation with GNWT. The prevalence of dry spells during the construction period is uncertain at this time. Therefore, the development of detailed contingency plans would be premature, especially without the input of the contractor carrying out the work. The GNWT will work with the selected contractor to develop contingency plans as construction schedules and activities are being prepared.</p> <p>Over the longer term, the availability of the highway will mitigate the effects of low water levels on Mackenzie Valley communities by allowing the shift in transport of materials or supplies from barges to the road itself.</p>	Thank you
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30	Vol 4, 24,2 p 24-15	Though the project is not dependent on below-zero days, the change to Freeze thaw days is likely to prolong the ice-on and breakup periods, meaning that water crossings which are serviced by boats in summer and ice roads in winter will have longer delays for the shoulder season when machinery will not be able to cross, and delays to personnel etc. are expected	<p>Longer ice-on or breakup periods have the potential to affect the construction of the Project by reducing or shifting the operating seasons of the existing Mackenzie Valley Winter Road and/or the barges that provide supplies and equipment to the Project. The effect could be similar to that of extended dry spells resulting in low water levels (see the GNWT's response to Online Review System LKFN-29) and may adversely affect the delivery of equipment and materials. Like with dry spells, reduced winter road and/or barging seasons could be managed by adjustments to construction staging or scheduling. Significantly longer durations may result in increased costs and potential construction delays. This is especially true if an unusually early and long breakup period were to be coupled with low water levels due to intense dry spells.</p> <p>As construction scheduling will be the responsibility of the contractor in consultation with GNWT, developing contingency plans at this stage would be premature. The GNWT will work with the selected contractor to develop contingency plans as construction schedules and activities are being prepared. Changes in ice-on or break up duration do not have effects on construction work at any given site once equipment and materials are in place.</p>	Thank you
31	Vol 4, 24.5 p24 - 23	Proposed remote sensing surveys and change detection on a frequency of 5 - 20 years is inadequate. Changes in hydrology and permafrost conditions due to the rapid warming in the Dehcho region occur at much shorter timescales and for this type of monitoring to be effective it should be implemented at least every 5 years and preferably annually.	<p>In Developer's Assessment Report, Section 24.5.2, the GNWT committed to:</p> <ul style="list-style-type: none"> <li>• Periodic surrounding surface surveys using remote sensing techniques every 5 to 20 years to identify areas where surface features such as ground elevation, vegetation cover, surface water flow, or areas of pond development have changed</li> </ul> <p>In addition to remote sensing surveys, changes in terrain, permafrost, and surface water conditions will also be monitored through visual observations, engineer inspections, and maintenance logs.</p> <p>The actual time between the remote sensing surveys will depend on multiple factors, including:</p> <ul style="list-style-type: none"> <li>• Consultation with First Nations and communities (e.g., observed changes by land users could trigger an earlier survey)</li> <li>• Climate monitoring at Norman Wells and Tulita (the data being measured at these two stations may indicate accelerated changes are taking place, and this in turn could trigger more frequent surveys)</li> <li>• Outside events (extreme weather events or earthquakes could result in earlier surveys)</li> <li>• Availability of appropriate imagery / data (e.g. Radar Sat data) to support the monitoring</li> <li>• Previous survey results (e.g., several surveys showing no change could result in a frequency reduction, while observed significant changes result in increased frequency)</li> <li>• Elapsed time since construction (immediately after construction the frequency could be higher)</li> <li>• Budgetary constraints</li> </ul> <p>In some instances, surveys may be conducted more frequently than 5 years, depending on the changes to the variables outlined above. Also, surveys may be conducted more frequently in specific areas of concern. Ongoing annual surveys would be difficult to implement as imagery and resources to carry out surveys may not always be available. It would not be a cost-effective way to monitor changes.</p>	This explanation is suitable, but if indeed consideration of surveys at less-than 5 year intervals is likely, please indicate this in the report. In addition, at the SCRS, year-to-year changes have notable impact on the system which can often be detected in aerial imagery. Perhaps a range of 2 - 10 years?

			Landscape level changes, such as elevation changes or changes in surface water flow may not be detectable with any confidence from one year to the next.	
<b>32</b>	14A - 6	"More permafrost than before" - there is less, it is thawing in this discontinuous region.	This was a typo and will be corrected in the Developer's Assessment Report (DAR) Addendum or revised DAR. The quoted sentence in Appendix 14A of the DAR (Section 3.1.2) should read "less permafrost than before".	Thank you

33	14A - 11	<p>Issues with, "As a general rule, surficial materials occupying less than 20% of a polygon were not indicated in the terrain unit label". In the case of thermokarst features or geohazards, these should be mapped regardless of their small fraction of the landscape as they indicate the presence of thawing permafrost.</p>	<p>Thermokarst features were mapped as part of the local study area terrain mapping, either as individual features or as part of larger terrain map units when present in greater concentration. In the absence of terrain mapping guidelines specific to the Northwest Territories, the widely accepted terrain mapping guidelines of the Province of British Columbia were used to guide the mapping (Resources Inventory Committee, 1996 and Howes and Kenk, 1997).</p> <p>To support the description of baseline conditions, the identification of terrain map units characterized by the presence of thermokarst features or other geoprocesses and geohazards (e.g., seepage, gullying, mass movements) was conducted at scales varying between 1:5,000 and 1:10,000 (i.e. depending on the size of the observed features).</p> <p>The locations of terrain map units impacted by thermokarst are presented in the 1:10,000 scale surficial geology Figures A.8 to A.23 presented in Appendix 14A of the Developer's Assessment Report.</p>	<p>Thank you for the clarification</p>
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34	14A - 16	<p>Need clarification on the statement "Within 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. Surface water may be present in fens in the summer months and be unfrozen to depths of 3 m or more." These values are important for understanding permafrost thaw-induced landcover changes in this landscape, and are not adequately justified. In addition, the fens are quite narrow, and there is no mention of peat plateau (raised bogs?) in this classification.</p>	<p>The thickness of organic soil in wetlands of the regional study area (RSA) is expected to range widely, most likely within the range of 1 to 3 m.</p> <p>At the local study area (LSA) terrain mapping scale (1:10,000), bogs and fens were not separated, but rather classified as organic terrain map units, either expected to consist of a veneer (i.e., &lt; 1 m in thickness) or blanket (&gt; 1m in thickness) overlying predominantly fine-grained moraine and glaciolacustrine sediments. Since areas of thick organic accumulations often have ice-rich permafrost, special attention was given to delineate areas of organic veneers and organic blankets, but also areas showing signs of thermokarst.</p> <p>While peat plateaus are not specifically mentioned in the referred section of Chapter 14A, their occurrence in both the LSA and RSA is discussed in Chapter 14A of the DAR; examples include Section 4.6.1 Thermokarst, Section 5.2.2 Permafrost Distribution.</p>	<p>Please clarify how peat plateau are classified if not in the organic terrain map units</p>
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35	14A - 37	<p>The discussion of thermokarst features does not include comment on their resilience to climate change and their interaction (thermal and hydrologic) with the landscape.</p>	<p>The GNWT is aware of the occurrence of peat plateaus along the Project development area, some of which exhibit thermokarst features (such as collapsed or hummocky topography, pits and depressions).</p> <p>The presence of thick peat deposits, ice-rich soils, and potentially unstable ground represent adverse conditions to any infrastructure development project in areas underlain by permafrost. As part of the initial highway routing process, attention was given to select a route that stayed away from areas of soils and terrain that may be potentially problematic to the Project. Additional site-specific geotechnical studies will be completed as part of the detailed design following the environmental assessment. Observations and data to be obtained as part of these studies will further inform on areas characterized by, or susceptible, to thermokarst processes. Reports of geotechnical investigations will support regulatory authorizations, as they were for the construction of the Canyon Creek All Season Access Road and Prohibition Creek Access Road – Phase 1.</p> <p>While increased baseline assessment studies could strengthen the discussion of thermokarst features (or of their resilience to climate change and interaction with the landscape), the current thermokarst-related information compiled to support the effect assessment as presented in Appendix 14A of the Developer’s Assessment Report is considered by the GNWT to be adequate.</p>	<p>It is appreciated that routing avoided problematic areas to permafrost. However, considering the proposed alignment, it is plausible that frost-susceptible and thermokarst terrain still lies within the ROW, though it may be currently thermally stable. Some measure of forecasting would be valuable to understand likely changes to thermokarst systems.</p>
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36	14A - p 46, 52	<p>At the bottom of p. 46, it is stated that many small slope destabilization are present beneath the dense canopy cover, but on page 52 only large landslide features are considered as threats to the MVH.</p>	<p>The ŁídlııKúę First Nation’s concerns regarding the consideration of small-scale slope destabilization processes are acknowledged. While the focus on large landslide features is essential for assessing major threats to the Project, it is recognized that small-scale slope destabilization processes could have localized impacts on embankment stability.</p> <p>Small-scale slope process such as seepage flow paths, eroding gullies and small landslides were delineated and classified as part of the local study area terrain mapping. These features, depending on their size, are either mapped as individual polygons, or if too small to be visible on the 1:10,000 map atlas (see Appendix 14A of the Developer’s Assessment Report), are identified using map symbols. Small-scale slope destabilization processes will be assessed and incorporated into the design as design advances. Site specific techniques may include:</p> <ul style="list-style-type: none"> <li>• Localized slope stabilization: For embankments in areas prone to small-scale slope destabilization, slope stabilization measures such as toe reinforcement, grading, and vegetation re-establishment will be considered.</li> <li>• Drainage improvements: Surface and subsurface drainage will be prioritized to reduce water accumulation, a key driver of small-scale slope movements.</li> <li>• Erosion control: Use of erosion control riprap and geosynthetics in susceptible areas will mitigate surface erosion and small-scale instability</li> </ul>	Thank you
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37	Vol 3 15 p 10-11	the assessment of the magnitude of surface water and groundwater effects is challenging. Why is a % difference used for streamflow while 2m is used for groundwater?	<p>It is agreed that a percent change would be useful to measure impacts; however, without an adequate historical data record, and limited number of historical groundwater monitoring wells installed within the regional assessment area to quantify normal seasonal groundwater table variations, it is not possible to provide a meaningful percentage to assess change to groundwater given the inherent uncertainty associated with groundwater, notably in a permafrost environment.</p> <p>Despite the lack of availability of regional groundwater data, the assessment methods are appropriate to the Project. Project related changes to the groundwater table would also be identified using connected biophysical indicator responses (e.g., surface water, vegetation) that are inferred to respond in a manner congruent with the descriptor (e.g., low = slow response). Given the elevated and linear nature of the project, impacts to groundwater quantity can reasonably be expected to be minimal.</p> <p>The note in Section 15, Table 15.3 also clarifies the reasoning for using the percentages for potential surface water changes, as per the comments made by Łíídlıı Kųę First Nation in the preamble.</p>	Thank you, while this explanation is fully acceptable, the specificity of "2m" is concerning as it provides means for change outside a realm suitable for the ecosystem. Please consider revising the language to something similar to "variation in groundwater significant to landscape, e.g. 2m in coarse-textured soils, or changes causing noable effect in other ecosystem variables
38	Vol 3 15 p 16, 24	In water bodies less than 1.5m deep, the interpretation of withdrawal should be reconsidered. If no withdrawals in the ice-on period occur for vulnerable lakes between 1.5 and 3 m deep, they should also occur in these shallower waterbodies. Aquatic life typically overwinters in mud at the bottom of these features, and is protected by	The GNWT acknowledges that water withdrawal from certain shallow lakes (<1.5 metres) in winter may not be appropriate. The GNWT's preference is to withdraw from lake water sources that are >3.0 metres deep. Preliminary results of studies of water sources near the Project are included in Table 15.6 of the Developer's Assessment Report; additional studies of water availability are ongoing to support future regulatory applications for water sources.	Thank you

		<p>the water and ice overlaying. If water beneath the ice is removed, this air gap is likely to be detrimental to this aquatic life</p>		
39	Vol 3 15 p31	<p>The impacts of permafrost loss on GW are stated to be most important in extensive and continuous regions. This may be erroneous based on likely permafrost distribution in discontinuous regions. Ecosystem protected permafrost persists in (highly permeable) organic soils, while it is more readily lost from mineral soils with higher thermal conductivity (and lower permeability). This means that impacts to the ecosystem protected permafrost could significantly enhance recharge in discontinuous and sporadic permafrost regions.</p>	<p>The GNWT agrees that permafrost impacts may also occur in sporadic discontinuous permafrost regions (e.g., southernmost portion of the Project near Wrigley); however, based on the overall spatial extent, the effects on groundwater quantity are more likely to occur where permafrost is classified as extensive discontinuous.</p> <p>The referred text in Section 15.4.4.1.3 of the Developer's Assessment Report (Permafrost Degradation; Volume 3, Section 15, p.31) states that as a general rule, the Project effects on groundwater quantity are more likely to occur where permafrost is classified as extensive discontinuous. Based on regional permafrost mapping (e.g., Heginbottom 2000), this would correspond to the northernmost portion of the Project.</p> <p>The statement illustrates that there is an expected increased presence (or extent) of permafrost in that region (i.e., 65% to 90% of the area of exposed land surface), but also the expected increased ground ice content (10 to 20%), when compared to areas of sporadic discontinuous permafrost expected to be present further south along the highway.</p> <p>At the Project scale, the increased spatial extent, and increased ground ice content, would make permafrost degradation, where occurring, result in greater effects to groundwater quantities (e.g., increase moisture and seepage runoff associated to permafrost melt).</p>	<p>Groundwater quantity is determined by the quantity of recharge, and the impact of permafrost on groundwater quantity could relate either to the vertical percolation of groundwater into the system, or the lateral flow of groundwater. Flow is governed by the product of the hydraulic conductivity or permeability of the material and the hydraulic gradient, or pressure gradient inducing the flow. Permafrost presence primarily impacts the permeability of the system as it fills the pore spaces of the media with ice, impeding flow. Permafrost loss is therefore most impactful both in the vertical and lateral movement of water in high-permeability materials. If the</p>

				<p>surficial materials are similar in the discontinuous and extensive discontinuous regions, then certainly the statement made by the proponent is accurate, however based on our interpretation of the maps, the extensive discontinuous regions are dominated by lower permeability materials. If these materials thaw, there is actually very little impact on the infiltration and groundwater storage. Moisture (soil moisture?), seepage, and surface water runoff are impacted by groundwater volume, and a symptom of a change to this system, not a driver.</p>
40	Vol 3 16 p 10, 50	<p>Temperature is not listed as one of the water quality metrics to be monitored. Temperature is a key control on dissolved oxygen and a habitat requirement for many fish and other aquatic species</p>	<p>In the GNWT's response to Round 1 Mackenzie Valley Environmental Impact Review Board Information Request #74, Attachment 1 (draft Water Monitoring Plan), temperature has been included as part of the additional in-situ physical parameters that may be considered for additional water quality monitoring at locations identified to be important for drinking water and fish harvesting during in-stream construction.</p>	<p>Thank you</p>

41	15A p 12	<p>Many of the historic gauges available from the WSC network are no longer operational and thus pre- and post- construction timeseries cannot be compared. It is odd that the most recent data is from 2018. Are there no more recent records? It is critical to have pre-construction baseline data to directly compare with post-construction conditions.</p>	<p>As previously stated in the response to ORS LKFN-29, the purpose of the referenced study (Developer's Assessment Report, Appendix 15A) was to provide general estimates for water availability in lakes and streams for the purpose of environmental assessment; it was not intended to support future water withdrawal licences. To support the water licence application, and to comply with applicable regulatory requirements, the GNWT will collect site-specific lake and stream data prior to and during construction, as needed, to confirm water availability (per DFO 2010, DFO2013, MVLWB 2021a, and MVLWB2021b) in the streams and lakes that will be selected as sources of water withdrawal. The GNWT does not plan to install additional stream gauges for the Project.</p> <p>Table 3.2 of Appendix 15A of the Developer's Assessment Report lists the ten Water Survey of Canada (WSC) hydrometric stations in the RSA. For clarification, four of those WSC stations were decommissioned prior to the Mackenzie Valley Highway referral to an environmental assessment in 2013. Five of those stations are still operational and have data that extends beyond 2018 that can be used to support regulatory approvals, as applicable.</p>	<p>It would be valuable to consider additional stream gauging to establish the impact of the project. Are there any regions in which this might be considered?</p>
42	15A p 18, 20+B79	<p>The assessment of peak flow using an empirical relation is not recommended in a basin subject to climate change. This equation should not be used without an assessment of the temporal stationarity of flow in the respective catchments</p>	<p>The GNWT notes that the purpose of Appendix 15A was to provide general estimates of baseline flow conditions for the purpose of environmental assessment, not to support parameters such as peak flows needed for detailed design or low flows needed to confirm water availability before water withdrawals.</p> <p>The GNWT agrees that there may be more appropriate tools or models to estimate: 1) low flows to confirm water availability for withdrawal, and 2) peak flows to support the detailed design of culverts. Additional site-specific stream data will be needed to confirm water availability for withdrawal per water licence conditions, and Fisheries and Oceans Canada's (DFO) Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada (DFO 2013). Additionally, detailed design of culverts will require further site data and desktop analysis to estimate peak flows. The GNWT has conceptually addressed how drainage structures will be designed in consideration of climate-influenced flood and peak flows in its response to Round 1 MVEIRB IR#72.</p>	<p>The proponent's response does not address the estimation of changes in flow due to climate change, and does not include direct measurement of flows, which might be possible in conjunction with other site investigations.</p>

43	16A p 3	The RSA here is 10 km while in the report body it is 15km	Appendix 16A, page 3 of the Developer's Assessment Report (DAR) does not mention a 10 kilometre (km) Regional Study Area (RSA) for surface water quality. The first mention of the RSA occurs in Section 2.3 (page 5 of Appendix 16A), which describes the RSA as a 15 km buffer around the Project development area to maintain consistency with the surface water quantity technical data report (Appendix 15A of the DAR).	Will this be clarified in the report?
44	Appendix A, sub-Appendix B terrain mapping	Some planned ROW is outside the region of exploration for the fibre link and additional surveying is required	Please see the attached response (table).	
45	Vol 3, pg 15-18	The conceptual hydrogeological model does not consider the effects of permafrost thaw on the system. Development of suprapermafrost taliks from permafrost thaw (either from the project disturbance or climate warming) will accelerate permafrost thaw and alter the routing of surface and subsurface flow systems.	<p>Given the high degree of individual inherent uncertainty associated with climate change, permafrost, and groundwater as well as lack of availability of regional groundwater data (as noted in the GNWT's response to Round 2 LKFN IR#37), the development of a meaningful predictive conceptual hydrogeological model would not be feasible.</p> <p>Climate-related changes to the local and regional groundwater regime are briefly described in Section 5.3 in the Hydrogeology Technical Data Report (Appendix 15B). The change in groundwater flow from permafrost degradation is discussed as a potential effect in Section 15.4.4.1.3 of the Developer's Assessment Report (DAR). Mitigations identified to reduce these effects are included in Table 15.8. These include installing drainage culverts along the roadway to facilitate water movement and to maintain drainage patterns, applying snow management techniques, implementing the Erosion and Sedimentation Control Plan (ESCP), and implementing the Permafrost Protection Plan (PPP). Section 15.7.2 of the Developer's Assessment Report states that the prediction of groundwater changes due to climate change is considered a gap or uncertainty in data. Monitoring and inspection of the infrastructure per the ESCP and PPP will identify if there are locations where additional mitigative actions may be required (for example, per Table A-1, modifying the location or number of drainage culverts in consultation with the Engineer as based on observed site conditions, or modifying snow management techniques).</p>	Thank you for clarifying that permafrost thaw results in additional uncertainty in the model, a discussion of this uncertainty and potential primary impacts on the conceptual model would be beneficial.
46	Vol 3, pg 15-24	"quarry operations will be located a minimum of 100 m from the ordinary high-water mark of any waterbody" This seems arbitrary and should be dependent on the subsurface material.	<p>The minimum distance of 100 metres (m) from the high-water mark was chosen because it aligns with territorial guidance and standard land use permit conditions for developments in the Mackenzie Valley. The 100 m distance is the minimum distance requirement.</p> <p>As the project progresses, this distance is adaptable to the conditions found in and around a potential quarry. If the geotechnical drilling program conducted around a quarry location identifies higher hydraulic conductivity material, the distance between the waterbody and the Quarry will be reassessed to reduce groundwater and surface water impacts and simplify quarry development and operation.</p>	Please reflect this flexibility and commitment to protecting ground and surface water resources in establishing the distance between the high-water mark and a quarry.

47	Vol 3, pg 15-24, Table 15.8	It is not mentioned that "Bear Rock Sinkhole" is just 325 m from the Prohibition Creek Quarry and that Karst is well known in the area of borrow sources. Karstic features can lead to rapid changes in groundwater flow and contaminant transport.	<p>The GNWT has identified the location of a prominent sinkhole near Prohibition Creek (also known as the Vermillion Creek Sinkhole) in Appendix 14A. As part of quarry development planning, geotechnical drilling will be conducted to delineate the quarry boundaries and determine the resources available. If karstic features/indicators or high volumes of groundwater that may be due to karst systems are encountered during the borehole drilling program, the Quarry Development Plan (QDP) will be updated to address the karst conditions. From a construction perspective, persistent groundwater flow conditions are not favorable for quarry development and if encountered the feasibility of the quarry location will be reduced and alternative locations will likely be explored.</p> <p>Mitigation measures for potential karst stratigraphy will be included in the QDP.</p>	Thnak you
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48	Section 23.5.6	<p>The Proponent has acknowledged that there is a lack of available baseline conditions in the surface water bodies that will be impacted by the Project in Section 23.5.6 and in their response to LKFN Comment 28 on the DAR. While this is to some extent understandable given the remoteness of many water crossings and the number of watercrossings, it is not possible for LKFN to accept that qualitative assessments are the only suitable means by which impacts to water quality can be assessed. Our members exercise their rights in the watercourses along the route and need to have confidence that it will continue to be safe for them to exercise their rights during the construction and operation of the MVH. Additionally, it is worth noting that water quality at some water crossings could be improved over current conditions by having a constructed crossing where there is currently an ice bridge on the winter road.</p>	<p>In Section 6 of the draft Water Monitoring Plan provided in the GNWT's response to Round 1 MVEIRB IR#74, Attachment 1, the GNWT commits to:</p> <ul style="list-style-type: none"> <li>• Incorporating engagement input into the monitoring plans, where appropriate and applicable</li> <li>• Discussing how best to integrate community-based monitoring into the Project</li> <li>• Discussing with the Guardian Program to explore how to best implement it for Project monitoring</li> <li>• Employing Environmental Monitors as part of the contracting of the Project</li> </ul> <p>The GNWT has received the Project-specific traditional land and resource use study report from the Łíídlı́ Kúé First Nation and will consider relevant information in the draft Plan's continued development. In specific cases where it may be appropriate to investigate potential project-related effects (such as drinking water sources within the Local Assessment Area [LAA]), available surface water and sediment quality data may be used to support future project-specific monitoring programs.</p> <p>Ongoing engagement with Indigenous Governments, Indigenous Organizations, and other affected parties will also help inform the design of future project-specific monitoring programs to account for specific water uses and water-use locations within the LAA.</p> <p>The GNWT is interested in having prompt discussions with LKFN to define specifically how the Guardian Program will be involved with the Project.</p>	(not for me)
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49	Chapter 27	<p>In many of the commitments of the commitments tables, the Proponent has stated that they will abide by a commitment "where possible", such as Commitment #21: "Project design will avoid ice-rich areas <i>where possible</i>" LKFN is not reassured by comments where the proponent states that they will honour a commitment "where possible", because this language is highly subjective and leaves the proponent immense discretion on what is considered possible. It is hard to trust that these commitments are indeed real when the proponent can argue in any instance that it is not possible to honour their commitment.</p>	<p>The GNWT provides detailed discussion of the approach to, and progression of design, in the preamble text to the GNWT's response to R2 LKFN IR#12. The GNWT maintains that design objectives are not applied in isolation, and cannot all be met for the length of the highway.</p> <p>The terms "where possible" and "to the extent possible" are used to reflect the practical and technical limitations of implementing all design objectives and best practices for the entire length of the highway. While the intent is to honor these commitments, the use of these terms acknowledges that certain site-specific conditions, unforeseen circumstances, or conflicting priorities (e.g., technical and environmental constraints) may limit the ability to apply a commitment in every instance.</p> <p>The following examples cited in the request are illustrated:</p> <ul style="list-style-type: none"> <li>• Commitment #2: The area of direct ground disturbance will be limited by following the pre-existing Mackenzie Valley Winter Road (MVWR) road alignment to the extent possible. The geometric criteria for an all-season road (Table 5.1) are different from those of the Mackenzie Valley Winter Road. This, and other considerations such as engagement input, preclude following the MVWR along its length.</li> <li>• Commitment #11: Grading of stream banks at approaches shall be limited where possible. For example, at numerous watercourse crossings, excavation of the watercourse bank will be needed when approaching the crossing, to meet the geometric design safety standards for the approaches to the crossing structure.</li> <li>• Commitment #21: Avoidance of ice-rich areas where possible. Avoiding ice-rich areas is a priority; however, complete avoidance may not be feasible in some locations due to constraints such as the lack of viable route options, the presence of other sensitive areas (e.g., wetlands or wildlife habitats), or engineering requirements (design grades or curves).</li> <li>• Commitment #22: Steep grades where subsidence may occur as a result of permafrost thaw will be avoided, where possible. For example, the current MVWR has grades as steep as 13% approaching crossings. The Project design criteria uses 6% maximum grades, to meet the geometric design safety standards for the bridge approaches. This design criteria may not be able to be achieved in all cases due to ground support conditions. Steeper grades, with a reduction in speed, may be required to be used for bridge approaches in a few locations.</li> <li>• Commitment #23: To the extent possible, plan the Project highway alignment to avoid the base of Bear Rock. This commitment has been addressed, as the route has been revised to pass 2 km to the north of Bear Rock in response to engagement input.</li> <li>• Commitment #24: Known areas of collection of plants of interest to Indigenous Governments, Indigenous Organizations, and other affected parties will be avoided where possible. Avoiding areas of plant collection may not be possible due to geometric or technical constraints. Mitigation can be discussed with affected Indigenous parties. Areas of plant collection that could potentially be impacted by the Project are identified in Table 11.18 of Developer's Assessment Report.</li> <li>• Commitment #38: If surface organic material must be removed for construction, it will be stockpiled and re-applied where possible. Organic material, where it occurs in limited thickness and is mixed with overburden when stripped, is difficult to salvage, and therefore may not be unsuitable for use in</li> </ul>	<p>The revised version of the statement is much improved. There remains some additional need to express what will be done if the commitment is deemed not possible. An explanation and process for review of the proposed mitigation measures is encouraged.</p>
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			<p>reclamation.</p> <ul style="list-style-type: none"> <li>• Commitment #39: Off-road travel will be limited to frozen conditions (approximately December 15 to April 1), where possible. Vehicles (such as pickup trucks and all-terrain vehicles) may need to travel within the right-of-way or other project trails during construction.</li> <li>• Commitment #40: Organic material and topsoil will be set aside for use during reclamation, where possible. Organic material, where it occurs in limited thickness and is mixed with overburden when stripped, is difficult to salvage, and therefore may not be unsuitable for use in reclamation.</li> </ul> <p>The following criteria will help guide the interpretation of "where possible" or "to the extent possible" as design advances:</p> <ol style="list-style-type: none"> <li>1. Feasibility Assessment: Technical, environmental, and socio-economic factors will be evaluated to determine the feasibility of implementing a commitment.</li> <li>2. Site-Specific Conditions: Commitments will be applied based on the specific conditions encountered during construction and operation phases, with efforts to reduce impacts where full implementation is not feasible.</li> <li>3. Alternative Solutions: If a commitment cannot be implemented in a particular instance, alternative measures will be explored to achieve similar outcomes.</li> <li>4. Documentation and Justification: Any instance where a commitment cannot be fully honored will be documented, including the reasons why it was not possible and the alternative measures taken.</li> </ol> <p>To address Łíídlıı Kųę First Nation’s concern, the relevant commitments will be revised as per above in the addendum to the Developer’s Assessment Report. An example of the approach to be used is outlined below:</p> <p>Original: “Project design will avoid ice-rich areas where possible.”</p> <p>Revised: “Project design will prioritize avoiding ice-rich areas. Where avoidance is not feasible due to technical, environmental, or operational constraints, mitigations to impacts will be considered and implemented.”</p>	
50	Supporting Memo	LKFN's technical consultants prepared the attached memo to summarize key concerns related to the permafrost technical		

		comments LKFN has uploaded.		
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