MACKENZIE VALLEY HIGHWAY PROJECT – REVISED DAR

CHAPTER 5: DETAILED PROJECT DESCRIPTION - DRAFT FOR ENGAGEMENT

SEPTEMBER | 2026

Government of Northwest Territories

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English

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French

Kīspin ki nitawihtīn ē nīhīyawihk ōma ācimōwin, tipwāsinān.
Cree

Tłı̨chǫ yatı k'ę̀è. Dı wegodı newǫ dè, gots'o gonede.
Tłı̨chǫ

ʔerıhtł'ís Dëne Sųłıné yatı t'a huts'elkër xa beyáyatı theɔ́ą ɔat'e, nuwe ts'ën yółtı.
Chipewyan

Edı gondı dehgáh got'ı̨e zhatıé k'ǫ́é edatł'éh enahddhę nıde naxets'é edahłí.
South Slavey

K'áhshó got'ı̨ne xədə k'é hederı ɔedı̨htl'é yerınıwę nídé dúle.
North Slavey

Jii gwandak izhii ginjìk vat'atr'ijąhch'uu zhit yinohthan jì', diits'àt ginohkhìi.
Gwich'in

Uvanittuaq ilitchurisukupku Inuvialuktun, ququaqluta.
Inuvialuktun

ᑕᒃᓂᐊ ᑎᑎᖅᑲᐃᑦ ᐱᓕᒍᐹᑦ ᐃᓄᒃᑎᑐᓪᓗᒍᑎᓄᒃ, ᐅᕐᖑᑦᑎᓵᓄᑦ ᐅᖁᓕᔪᓐᓇᖅᑐᑎᑦ.
Inuktitut

Hapkua titiqqat pijumagupkit Inuinnaqtun, uvaptinnut hivajarlutit.
Inuinnaqtun

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Acronyms / Abbreviations

°C	degrees Celsius
AADT	average annual daily traffic
ARD	acid rock drainage
CCASAR	Canyon Creek All-season Access Road
CHBDC	Canadian Highway Bridge Design Code
cm	centimetre
DFO	Fisheries and Oceans Canada
EA	environmental assessment
Enbridge	Enbridge Pipelines (NW) Inc.
ESCP	Erosion and Sediment Control Plan
GNWT	Government of the Northwest Territories
ha	hectare
km	kilometre
km/h	kilometre per hour
kPa	kilopascal
m	metre
m^3	million cubic metre
ML	metal leaching
mm	millimetre
mm/s	millimetre per second
MVFL	Mackenzie Valley Fibre Link
MVWR	Mackenzie Valley Winter Road
NPR	Neutralization Potential Ratio
NWT	Northwest Territories

PAG ..... potentially acid generating

PCAR ..... Prohibition Creek Access Road

PDA ..... Project Development Area

PDR ..... Project Description Report

the Project ..... Mackenzie Valley Highway Project

QDP ..... Quarry Development Plan

RevDAR ..... Revised Developer's Assessment Report

ROW ..... right-of-way

TAC ..... Transportation Association of Canada

TMP ..... Traffic Management Plan

TRRC ..... Tulita Renewable Resource Council

SCP ..... Spill Contingency Plan

SPCSP ..... structural plate corrugated steel pipe

WMMP ..... Wildlife Management and Monitoring Plan

WMP ..... Waste Management Plan

5 Detailed Project Description

This document (intended to be placed as Chapter 5 of the Revised Developer's Assessment Report[RevDAR]) provides detailed information about the physical works and activities included within the scope of the Government of the Northwest Territories (GNWT)'s proposed Mackenzie Valley Highway Project (the Project). The Project involves the extension of the all-season Mackenzie Highway (Northwest Territories Highway #1) between Wrigley, Tulita, Norman Wells, and Fort Good Hope to replace the seasonal Mackenzie Valley Winter Road (MVWR) along this portion. The highway will continue northward to connect with Northwest Territories (NWT) Highway #8 (Dempster Highway) between Tsiigehtchic and Inuvik. The works and activities described in this document are provided to a level of detail needed to complete the assessment of potential effects of the Project on the biophysical and human environment, while providing flexibility in the design and construction execution. Figure 5.1 shows the location of project physical works and activities to be used as the basis of the environmental assessment and other relevant non-project features referenced throughout the RevDAR (such as the MVWR). This document also describes the design basis, the level of design development, and the relationship of the Project to existing and planned infrastructure.

5.1 Project Overview

The Project will include construction of approximately 775 kilometres (km) of new all-season gravel highway between Highway #1 approximately 3 km south of Wrigley and the Dempster Highway at a location between Tsiigehtchic and Inuvik. The Project will connect to certain existing and planned watercourse crossing structures (bridges and culverts) along the MVWR, and 35 km of previously constructed or to be constructed highway between Prohibition Creek and Norman Wells, which includes the Prohibition Creek Access Road [PCAR], Canyon Creek All-season Access Road [CCASAR], and the Great Bear River Bridge project in Tulita, which will be advanced as a separate project.

The Project will also include the construction and operation of temporary and permanent quarry and borrow sources, as well as the operations and maintenance of an approximate contiguous total 810 km of highway between Wrigley, Tulita, Norman Wells, Fort Good Hope, and Dempster Highway.

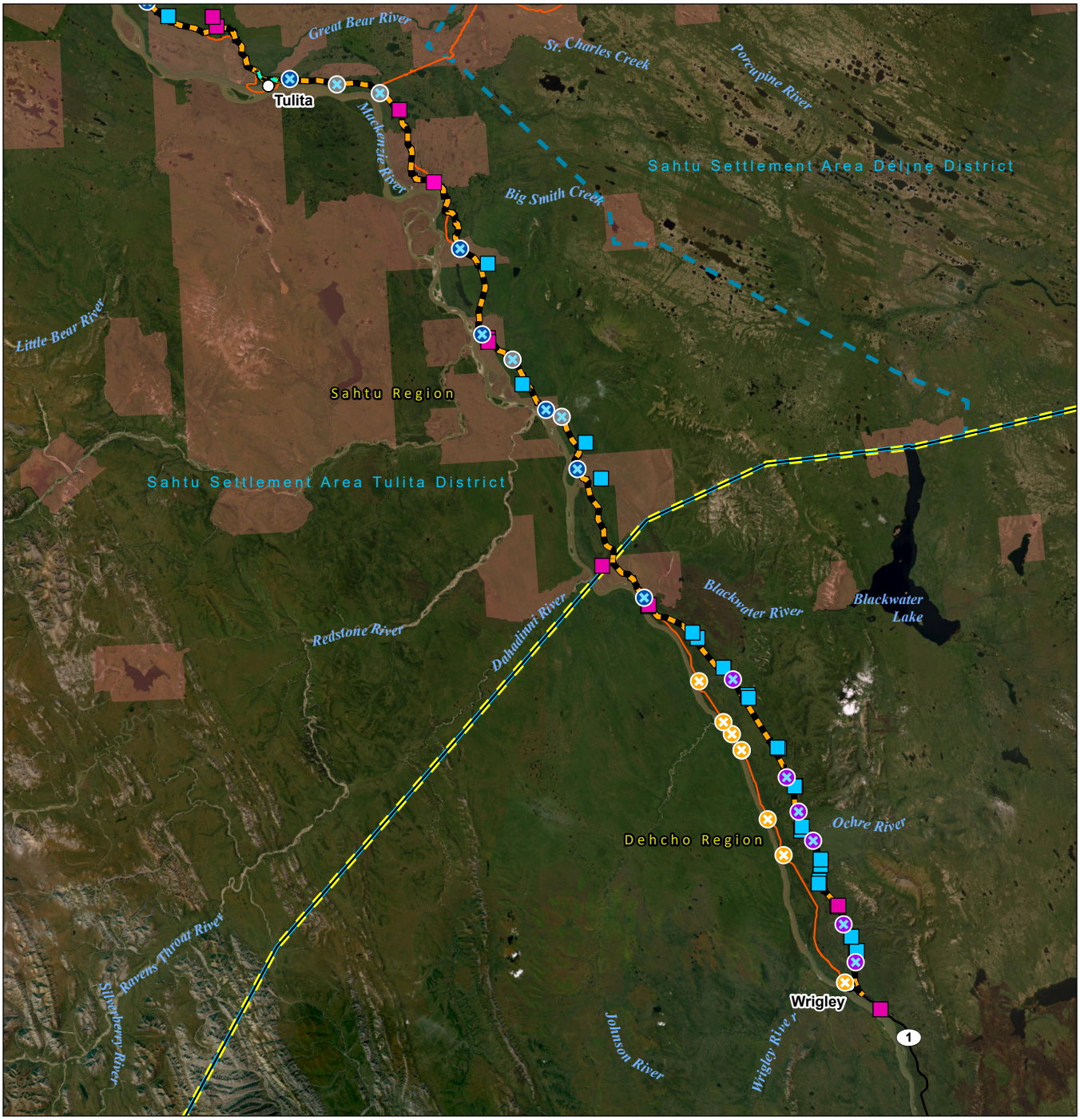
The Project is located on public lands and Sahtu Settlement Lands within the Sahtu Region and Dehcho Region, and public lands and Gwich'in Private Lands in the Gwich'in Region, as shown in Figure 5.1. The Project will connect to and make use of the MVWR and the Great Bear River Bridge project (if completed) during construction. Public access along the MVWR will be maintained during construction of the Project, including portions of the MVWR that need to be operated, until the full highway is connected from end to end.

5.1.1 Route Options in the Gwich'in Region

Based on feedback received from the Gwich'in Tribal Council, Gwich'in organizations, and community members during meetings held in July 2026, there are four highway route options in the Gwich'in Region. The locations of these route options are shown on Figure 5.1. Option A, as described below, was previously identified as the preferred route by the Gwich'in Tribal Council and GNWT in the Project Description Report (PDR) for the Gwich'in Settlement Area (Gwich'in Tribal Council and GNWT, 2011).

A corridor is used to show the area within which the final highway will be located. A corridor provides flexibility to finalize the highway route to be constructed once engagement and engineering designs are completed. South of Norman Wells, the corridor is 1 km wide, and the highway route is shown as the centerline of this corridor. North of Norman Wells, a 2 km wide corridor is used to allow for more flexibility in route selection, reflecting an early status of routing studies and engagement on this portion of the Project. Four route options are identified in the Gwich'in Settlement Area:

- Route Option A (2011 PDR Route): Based on preferred highway route identified in the Project Description Report for the Gwich'in Settlement Area (Gwich'in Tribal Council and GNWT, 2011). It follows the Mackenzie Valley Fibre Link (MVFL) and previously proposed corridor for the Mackenzie Gas Project pipeline. It connects to the Dempster Highway approximately 20 km southeast of Inuvik. Route Option A is approximately 182 km from the border of the Sahtu Region and Gwich'in Region.
- Route Option B: Based on a route suggested by Tetł'it Gwich'in Council; from approximately 10 km south of Thunder River, this route heads west, towards the Mackenzie River to join the Dempster Highway approximately 5 km north of Tsiigehtchic. Route Option B is approximately 180 km from the border of the Sahtu Region and Gwich'in Region.
- Route Option C: Based on the Public Works Canada 1974 highway concept route and an existing cutline; this route shares approximately 85 km in common with Route Option B, then heads north to connect to the Dempster Highway approximately 60 km north of Tsiigehtchic. Route Option C is approximately 183 km from the border of the Sahtu Region and Gwich'in Region.
- 2011 PDR Option: Based on the Public Works Canada 1974 highway concept route and presented as an alternative option to the preferred highway route identified in the Project Description Report for the Gwich'in Settlement Area (Gwich'in Tribal Council and GNWT, 2011). This route option shares approximately 53 km in common with Route Option A, then heads northwest to connect to Route Option C approximately 30 km south of the Dempster Highway.



Notes

1. Coordinate System: NAD 1983 UTM 9

2. Data Sources: GNWT (Government of the Northwest Territories) Centre for Geomatics. n.d. Inventory of Landscape Change Map Viewer, GNWT. Centre for Geomatics. n.d. Open Data, MVLWB. n.d. Public Registry, Sahtu Land and Water Board. n.d. Public Registry, Environment and Natural Resources GNWT, Government of Canada, Stantec

- Bridge to be Replaced
- Existing Bridge
- Existing Bridge to be Removed
- Potential Future Bridge
- Proposed New Bridge
- Potential Quarry
- Potential Borrow Source
- Route Option A (2011 PDR Route)
- Route Option B
- Route Option C
- 2011 PDR Option
- Shared Route
- Canyon Creek All Season Access Road (Constructed)
- Prohibition Creek Access Road (Constructed in 2024)
- Prohibition Creek Access Road (remaining portion to be constructed)
- Proposed Great Bear River Bridge Project (Not in Scope of Project)
- Mackenzie Valley Fibre Line
- Northwest Territories Highway
- Winter Road
- Gwich'in Land Use Plan Conservation Zone

Land Authority Parcel

- Gwich'in Settlement Land
- Sahtu Settlement Land
- Region Boundary
- District Boundary
- Settlement Area Boundary

N

0 10 20 Kilometres

(At original document size of 8.5x11)
1:1,200,000

Project Location
Wrigley to Inuvik, NWT

Prepared by DS on 9/2/2026
TR by GH on 9/2/2026

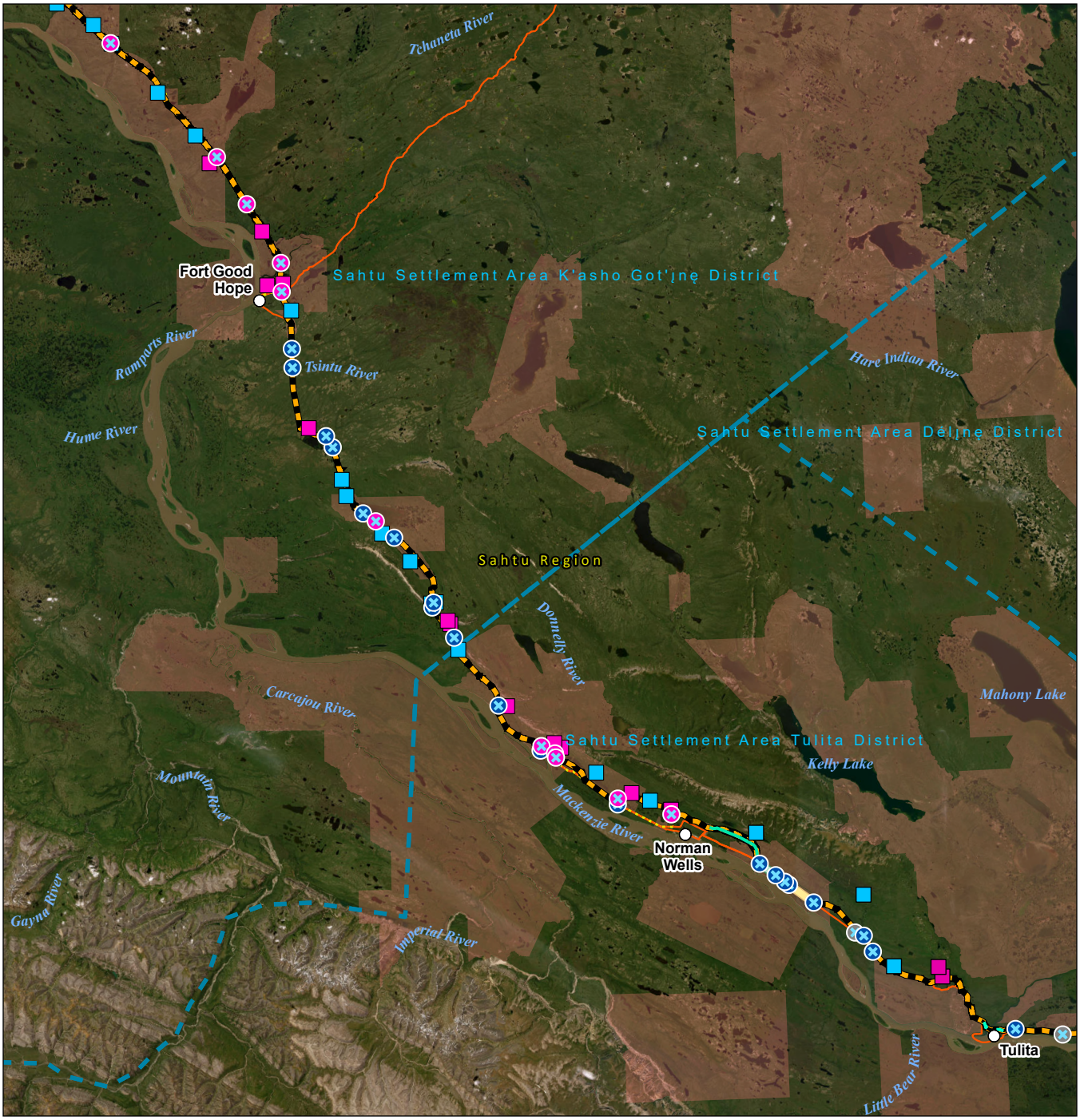
Client/Project
123515768-019

Government of the Northwest Territories
Mackenzie Valley Highway Project

Figure No.
5.1

DRAFT

Title
Mackenzie Valley Highway Project - Overview



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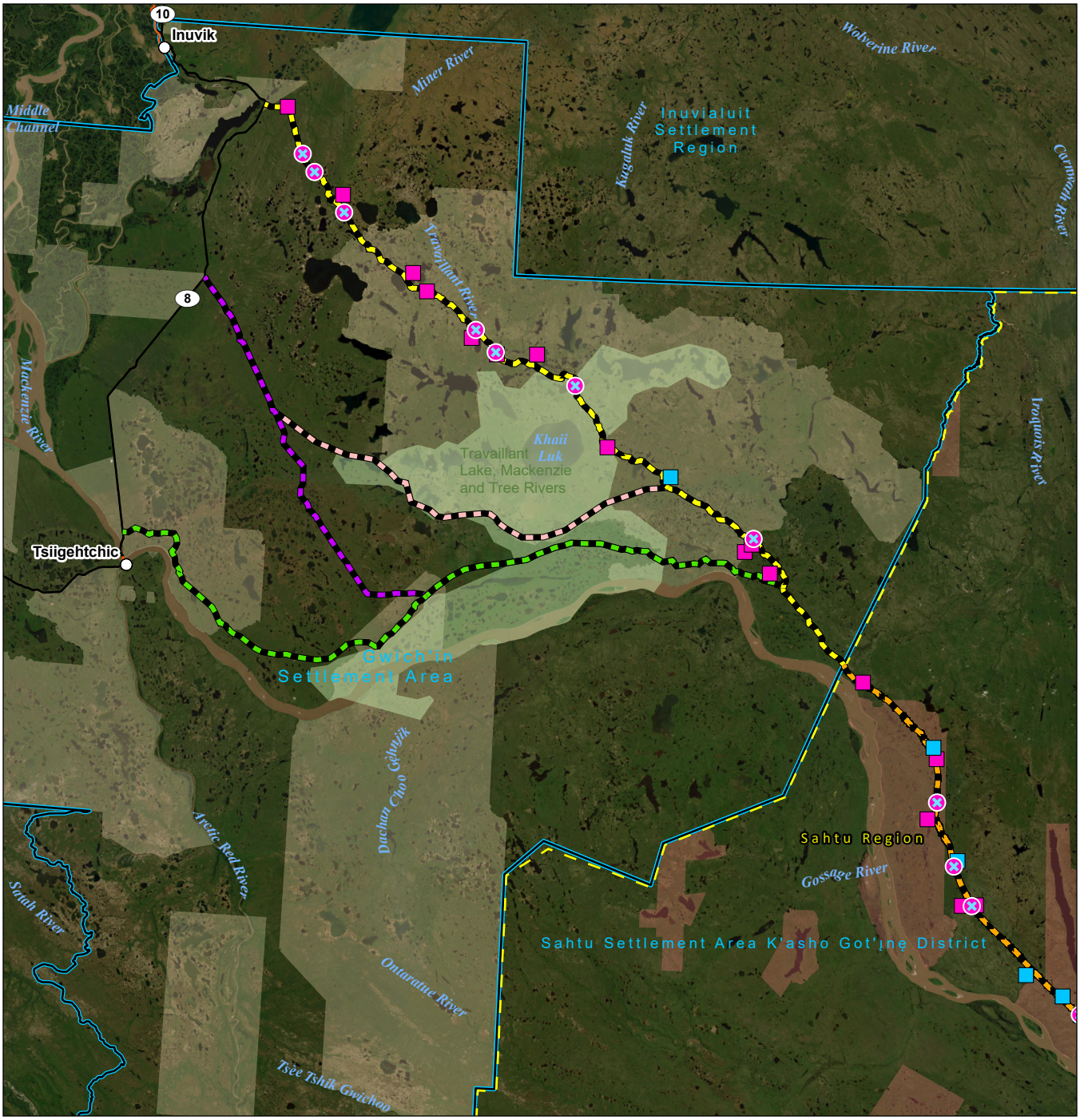

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Project Location
Wrigley to Inuvik, NWT

Prepared by DS on 9/2/2026
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Client/Project
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Government of the Northwest Territories
Mackenzie Valley Highway Project

Figure No.
5.1

DRAFT

Title
Mackenzie Valley Highway Project - Overview

5.1.2 Summary of Project Works and Activities

The Project includes the following physical works and activities:

- Widening of the existing cleared MVWR right-of-way (ROW), and clearing of new ROW
- Construction of approximately 775 km of new all-season gravel highway embankment (106 km in the Dehcho Region, 487 km in the Sahtu Region, 182 km in the Gwich'in Region, and intermittent pullouts)
- Construction of bridge and bridge-culvert structures (major crossings)
- Installation of culverts over minor crossings and for drainage
- Construction and operation of temporary and permanent borrow sources and quarries, and associated all-season access roads
- Water withdrawal and water use for winter access, highway construction, and highway maintenance
- Construction and operation of temporary support infrastructure and workspaces, including camps, maintenance yards, laydown and staging areas, and fuel storage areas, airstrips, and barge landings
- Staging, supply and resupply of equipment, materials, fuel, and personnel
- Construction and operation of permanent maintenance yards
- Closure and reclamation of temporary borrow sources, quarries, and workspaces
- Removal and rehabilitation of existing bridge and bridge-culvert crossings where replaced by new structures
- Demobilization of equipment and materials
- Closure and reclamation of portions of the MVWR ROW not used for the Project
- Relocation of portions of the MVFL
- Operations and maintenance activities including snow clearing, grading, dust control, and bridge and culvert maintenance
- Use of the highway

The Project does not include:

- Construction of the Great Bear River Bridge project, which is being advanced as a separate project
- Construction of the Mackenzie River (N'Dulee) Bridge and the Liard River Bridge, which will be advanced as separate projects

- Operations and maintenance of the MVWR as required for public safety, including repair or replacement of existing watercourse crossing structures (for example Oscar Creek Bridge relocation), until such time that segments of the Mackenzie Valley Highway (the Project) are opened to traffic and replace the MVWR. Existing road segments, including the PCAR, CCASAR, and certain watercourse crossing structures (bridges and culverts) along the MVWR, as well as the Great Bear River Bridge (after it is constructed) will be integrated into the operations and maintenance of the Project.
- Use of existing and authorized municipal, commercial, or public infrastructure or services, such as municipal solid waste and wastewater facilities, transportation services and the MVWR

5.2 Design Basis and Considerations

The following subsections describe the Project design basis, design parameters and objectives, design considerations, and design development.

5.2.1 Design Basis

The Project's design is guided by:

- Safety requirements
- Engineering and environmental standards and best practices
- Engagement input, including Traditional Knowledge

The current Project highway alignment (route) design is at approximately 10% design definition. This level of design is appropriate for environmental assessment as it provides the basis for a highway alignment routing corridor within which to assess effects while providing flexibility for future design considerations. Future updates to design will include refinements to horizontal and vertical highway design based on additional geotechnical and environmental investigations, engagement and consultation input, land ownership considerations and relevant inputs from the environmental assessment. The route of the Project highway as shown in the mapbook included in Appendix 5A is the centerline of an approximately 1 km wide corridor south of Norman Wells and 2 km wide corridor north of Norman Wells. This corridor is anticipated to accommodate the highway route as the design advances within the parameters of the design criteria.

The Project highway route, including route options in the Gwich'in Region, have been informed by: previous routing studies completed by Public Works Canada in the 1970s; published environmental, geotechnical, and Traditional Knowledge studies completed by Imperial Oil Resources Ventures Limited in support of the Mackenzie Gas Project in the late 1990s and early 2000s; and input received during community engagement on the Project by the GNWT since 2010.

The current project highway route and options improves the route previously presented in Project Description Reports for the Dehcho Region (Dessau, 2012 [PR#13]), Tulita District of the Sahtu Region (5658 NWT and GNWT, 2011 [PR#16]), K'ahsho Got'ine District of the Sahtu Region (K'ahsho Development Foundation and GNWT, 2012), and Gwich'in Region (Gwich'in Tribal Council and GNWT, 2011) based on additional studies and engagement input, and taking into account updated design principles and criteria. Key studies and engagement activities completed and planned since 2012 that have, and will continue to, inform planning and engineering design are:

- Acquisition of updated light detection and ranging (LiDAR) imagery
- Prospective borrow source data compilation and field reconnaissance Wrigley to Norman Wells (K'alo Stantec, 2021), and ongoing
- Terrain mapping and field validation (K'alo Stantec, 2022a; 2025a,b)
- Climate change and resilience assessment (K'alo Stantec, 2022b; K'alo Stantec, 2024)
- Archaeological Impact Assessments (completed and ongoing)
- Hydrotechnical assessments (Tetra Tech, 2021, 2022, and ongoing)
- Fish and fish habitat assessments (K'alo Stantec, 2022c, and ongoing)
- Desktop-based assessments of water availability (K'alo Stantec, 2022d, 2023)
- Geotechnical investigations of borrow sources, quarries, crossings and alignment
- Tulita Renewable Resources Council Traditional Land and Resource Use Study (Tulita Renewable Resource Council [TRRC], 2022)
- Norman Wells Renewable Resources Council Traditional Land and Resource Use Study (Norman Wells Renewable Resource Council [NWRRC], 2023)
- Łíídlıı̨ Kų́ę́ First Nation Dene Knowledge, Land Use and Occupancy Study (LKFN, 2025)
- Pehdzeh Ki First Nation Land Use and Occupancy and Traditional Ecological Knowledge study information (confidential)
- Engagement with Indigenous Governments, Indigenous Organizations, and other affected parties in the Gwich'in, Sahtu and Dehcho regions from 2009 to 2026

5.2.2 Design Parameters and Objectives

The following design parameters and objectives will be applied to the Project design. These design parameters have been selected because they reflect published standards and best practices and the findings of the climate change and resilience assessment:

- Meet Rural Arterial Undivided (RAU)-90 design designation (Transportation Association of Canada [TAC], 2017)
- Expected annual average daily traffic volume is up to 200 vehicles per day, for an indeterminate time
- Reduce the area of new disturbance by following the MVWR alignment to the extent that the geometric criteria for an all-season road (Table 5.1) permits, and in consideration of engagement input, or technical and environmental factors.

- Align the highway route to existing MVWR watercourse crossing structures (bridges and bridge-sized culverts) where appropriate, to reduce new disturbance in and near watercourses
- All new bridges and bridge-culverts must follow the GNWT's Structures (Bridges) Design Guidelines (Version 1.0; Dec 2024)
- Limit ROW clearing width to 60 metres (m) in width, except where large cut or fill sections are required
- Situate the highway near to, and prioritize use of, existing and proximal quarries and borrow sources where possible, to reduce the area of new disturbance and need for new access roads
- Reduce footprint through areas of traditional, cultural, and ecological importance
- Avoid known archaeological and heritage resources where practicable
- Avoid known and potential ice-rich and unstable terrain where practicable (sensitive terrain)
- Avoid areas of wetlands, to the extent possible
- Optimize use of natural topography to reduce material requirements (such as avoiding the need for deep fills)
- Reflect community engagement input to the extent practicable
- Maintain cost-effectiveness in construction, operations, and maintenance

The specific design criteria applied to highway and bridge-culvert design are detailed in Table 5.1. The posted speed limit will be 80 kilometres per hour (km/h) except in specific locations where the speed limit will be reduced for safety (such as the approach to bridges). The embankment height may vary from 1.4 to over 2.0 m above the ground surface, dependent on soil and ground conditions, and consideration of permafrost. The minimum embankment height at any given location will be informed based on thermal considerations, particularly in relation to permafrost conditions specific to each location. The embankment design will consider whether it is desirable to preserve underlying permafrost, or to allow for thawing over time, which will influence embankment thickness requirements. In some sections, embankments may be thicker to provide insulation and limit heat transfer to the ground, whereas in non-permafrost areas, the embankment height may be optimized based on structural and drainage needs.

The sideslopes of the embankment will generally be at a ratio of one vertical unit to three horizontal units (1V:3H). This may be increased to 1V:2.5H in specific areas such as deep fills. A typical highway cross section is shown in Figure 5.2 and typical culvert design cross section is shown in Figure 5.3.

Table 5.1 Road and Bridge-Culvert Design Criteria/Standards for the Project

Criterion	Value	Detail
General		
Design Designation	RAU - 90	Rural Arterial Undivided (Low Volume Road – Average Daily Traffic not exceeding 200 vehicles per day)
Design Speed	90 km/h	Posted Speed Limit – 80 km/h
Design Guidelines and Reference		All design parameters must meet or exceed the National Standards established by applicable governing/regulatory bodies. For exemptions to any of the criteria established herein, a technical memo must be submitted to the Director of Highways and Marine Division with substantiation and rationale for the change prior to approval. The following resources govern the design: • TAC Geometric Design Guidelines March 2020 for Special Roads (TAC, 2020a) • TAC Geometric Design Guidelines June 2017 (TAC, 2017)
Roadway Design		
Horizontal Alignment		
Desirable Curve Radius Minimum Curve Radius	600 m 340 m	The desirable radius is applicable for the entire length of roadway. Minimum radii should be avoided wherever possible. The minimum radius is also applicable for the entire length of the roadway; however, exceptions will be permitted on a site-specific basis.
Minimum Passing Sight Distance	610 m	Horizontal sight distances are to be verified on all curves.
Stopping Sight Distance (minimum)	160 m	There is no requirement for continuous passing opportunities for the entire length of roadway. However, the design will endeavor to allow for passing opportunities as per TAC minimum requirement.
Superelevation (e max)	0.06 m/m	As based on appropriate Superelevation Tables for minimum and desirable “A” Parameters for each curve radius and design speed. Spirals not required on all curves requiring superelevation.
Minimum Spiral Parameter - “A” Value	N/A	
Intersections with highway	WB20 design vehicle for turning	Acceleration and deceleration lanes are required on the Mackenzie Valley Highway. The lanes do not have to be chipsealed.

Criterion	Value	Detail
Vertical Alignment		
Minimum Stopping Sight Distance Minimum Decision Sight Distance Minimum Passing Sight Distance	160 m 275 m 610 m	Where the minimum Stopping Sight Distance is used, the sight should be verified using an object height of 0.38 m and an eye height of 1.05 m. Where the minimum Decision Sight Distance is used, the sight should be verified using an object height of 0.15 m and an eye height of 1.05 m. Where the minimum Passing Sight Distance is used, the sight should be verified using an object height of 1.30 m and an eye height of 1.05 m. Variances may be accepted by the GNWT on a case-by-case basis.
Minimum Crest "K" Value	39	As per TAC Geometric Design Guidelines June 2017 variances may be accepted by the GNWT on a case-by-case basis.
Minimum Sag "K" Value	38	As per TAC Geometric Design GuidelinesJune 2017; variances may be accepted by the GNWT on a case-by-case basis.
Minimum Length of Vertical Curve	90 m	Variances may be accepted by the GNWT on a case-by-case basis.
Maximum Gradient	6%	Variances may be accepted by the GNWT on a case-by-case basis.
Cross Section		
Finished Roadway Width	9.0 m	In guardrail installation areas, an additional 1.0 m in width shall be added for each side that guardrail is installed.
Travel Lane Cross Slope	4%	-
Lane Width	3.75 m	Roadway will accommodate two lanes at 3.75 m each
Shoulder Width including Rounding	0.75 m	Shoulders will be constructed on both sides of the roadway
Side Slope / Fill Slope Ratio Normal Minimum (with Toe of Slope in water area)	3:1 3:1	Use rock fill only in the water.
Slope Stabilization Requirements	>4.0 m	Slope stabilization features shall be designed for fills over 4.0 m in height (for example, benched embankment and Mechanically Stabilized Earth wall) based on recommendations in Thermal Analysis Report for further recommendations/direction.
Minimum Embankment Height (Above Original Ground Level)	TBD	To be determined during detailed design
Surface Gravel Thickness	200 mm	200 millimetre (mm) thick surfacing course and 150 mm to 250 mm thick sub-base course (20 mm and 50 mm minus materials). To be confirmed in detailed design.
Roadside Pullouts		
Location	TBD	Roadside pullouts to be provided at approximate one half (1/2) hour travel intervals per the (GNWT Department of Infrastructure) Standard drawings

Criterion	Value	Detail
Guardrails		
Location	TBD	Guardrail shall be designed for in areas with embankment heights of 4.0 m or greater and/or areas where water bodies are close enough to the highway to be considered a hazard. The British Columbia Ministry of Transport Warrant Guide and practical safety considerations will be used for determining barrier installation locations.
Delineator and Reflectors	As needed	Traffic delineators are required on all horizontal radii and shall be spaced appropriately for the design speed and horizontal curvature of the radii. When required, as a minimum, delineators have to be provided on the outside of curve.
Drainage/Equalization Culverts (Up to 1,500 mm Diameter)		
Detailed Specifications	800 mm to <1,500 mm diameter	Per the GNWT Standard drawings and Specifications: • SD-400-01-51 • Standard Specifications – Division 4 Structures Sections 1 – Supply and Installation of Corrugated Steel Pipe Culverts
Bridge-Culverts (Greater than 1,500 mm Diameter[1])		
Design Guidelines and Reference	-	Per the following standards and guidelines: • Canadian Highway Bridge Design Code CAN/CSA Standard S6-current • Transportation Association of Canada's Guide to Bridge Hydraulics – current edition • Alberta Transportation's Design Guidelines for Bridge Size Culverts • Alberta Transportation's Roadside Design Guide and related Design Bulletins
Type	-	Open-bottomed or closed structures which meet regulatory requirements Corrugated steel pipe is not acceptable
Minimum Cover	1.5 m	As measured vertically from the culvert obvert to the roadway shoulder
Minimum Clear Roadway	10.0 m	Clear distance between guardrails where present, or embankment shoulder to shoulder where guardrails are not present
Bedding Camber	-	All bridge-culverts must be installed with camber suitable for the geotechnical conditions.

Criterion	Value	Detail
Hydrotechnical	-	Freeboard shall be measured above the high-water or high-high ice level plus one-sixth the culvert rise to allow for events related to freshet, icing conditions (aufeis), and the dike effect of the new road embankment. The minimum invert burial depth shall equal 10% of the culvert rise to a maximum depth maximum of 500 mm. The structure shall be designed for a 1:100 year flood event and the dike effect caused by the new road embankment.[2] Technical requirements of AT Bridge Conceptual Design Guidelines; Design Bulletin #45; and Bridge Best Practice Guideline #7 shall be satisfied, except for the criteria as specified in this document.
Structural Bedding	-	Bedding is to be founded on stable, structurally suitable soils: • Poor sub-soils are to be excavated and removed. • An engineered foundation is required when permafrost is encountered.
Structural Backfill	-	Provide source and specifications of material/methods to be used which meet or exceed Canadian Highway Bridge Design Code (CHBDC) requirements; engineered geosynthetic reinforced soil backfill is acceptable
Ends	Required	Must be beveled as per CHBDC
End Treatments	Required	Must protect against hydraulic uplift, piping, undermining and ice jacking (for example using cut-off walls, impermeable barriers, sufficient load on bridge-culvert ends to prevent uplift, etc.)
Scour Protection	Required	Transportation Association of Canada's Guide to Bridge Hydraulics – current edition requirements must be satisfied or exceeded.
Plate Thickness	-	Provide engineering rationale for selected metal thickness to meet the design life and to accommodate expected rate of section loss
Corrosion Protection	-	Select appropriate bridge-culvert material and coating to suit site conditions (water, soil, and abrasion)
Solarity Effects	-	At northern latitudes, the sun is lower on the horizon and there are longer daylight hours resulting in differential temperatures across a structure; which requires the application of larger thermal expansion coefficients than provided in CHBDC.

Criterion	Value	Detail
Sustainability, durability and functionality	-	The following design criteria will be considered: • Climate change and sustainability issues to be identified and addressed in the design report • Include effects from forest fires on surface drainage and streams; such as loss/changes in vegetation, burned mineral soils, etc. • Logistics: Length, heights, and mass of pre-fabricated elements must be carefully planned to suit transportation/haul constraints, and launching/lifting machinery • Minimize maintenance requirements • Beaver activity, debris collection, ice/snow accumulation in bridge-culverts and under bridges, overflow (aufeis), freshet, etc. • Erosion and sediment control
Bridges		
Design Guidelines and Reference	-	Per the following standards and guidelines: • CHBDC CAN/CSA Standard S6-current • Transportation Association of Canada's Guide to Bridge Hydraulics – current edition • Alberta Transportation's Roadside Design Guide and related Design Bulletins • Government of Northwest Territories Department of Infrastructure: Structures (Bridges) Design Guidelines - Version 1.0 December 2024 (GNWT 2024)
Design Loading	CL-800	The minimum highway bridge design live load shall be the CL-800 plus Dynamic Load Allowance
Highway Class	Class A	As defined in the CHBDC
Minimum clear roadway	9 m	As measured curb to curb for two-lane bridges
Approach slabs	Required	Required at all bridges to mitigate loss of fill at bridge / gravel road interface and to avoid grader / plow damage
Geometrics		Where practical, bridges shall be located on tangent horizontal alignments. Max skew < 20 degrees. For deck drainage a minimum longitudinal grade of 1% is desirable and a maximum longitudinal grade on a bridge structure shall not exceed 3%. Bridge decks shall have a 2% cross fall away from crown lines unless the grade line over the bridge structure is super-elevated. The top of abutment seats, pier caps and curbs shall have a wash slope of 3%.

Criterion	Value	Detail
Hydrotechnical		Freeboard shall be measured between the underside of the girder and the high-high water or high-high ice level plus 1.5m to allow for events related to freshet, icing conditions (aufeis), and the dike effect of the new road embankment. The structure shall be designed for a 1:100 year flood event and the dike effect caused by the new road embankment. Technical requirements of Alberta Transportation Bridge Conceptual Design Guidelines; Design Bulletin #45; and Bridge Best Practice Guideline #7 shall be satisfied, except for the criteria as specified in this document.

Notes:

m/m: numeric value for superelevation

TBD: to be determined

1 Culverts >1,500 mm are designed based on hydrotechnical site conditions and in accordance with applicable design standards for flow and fish passage

2 The most appropriate applicable standard is CSA W231:25 - *Developing and Interpreting Intensity-Duration-Frequency (IDF) Information Under a Changing Climate*.

Figure 5.2 Typical Highway Cross Section

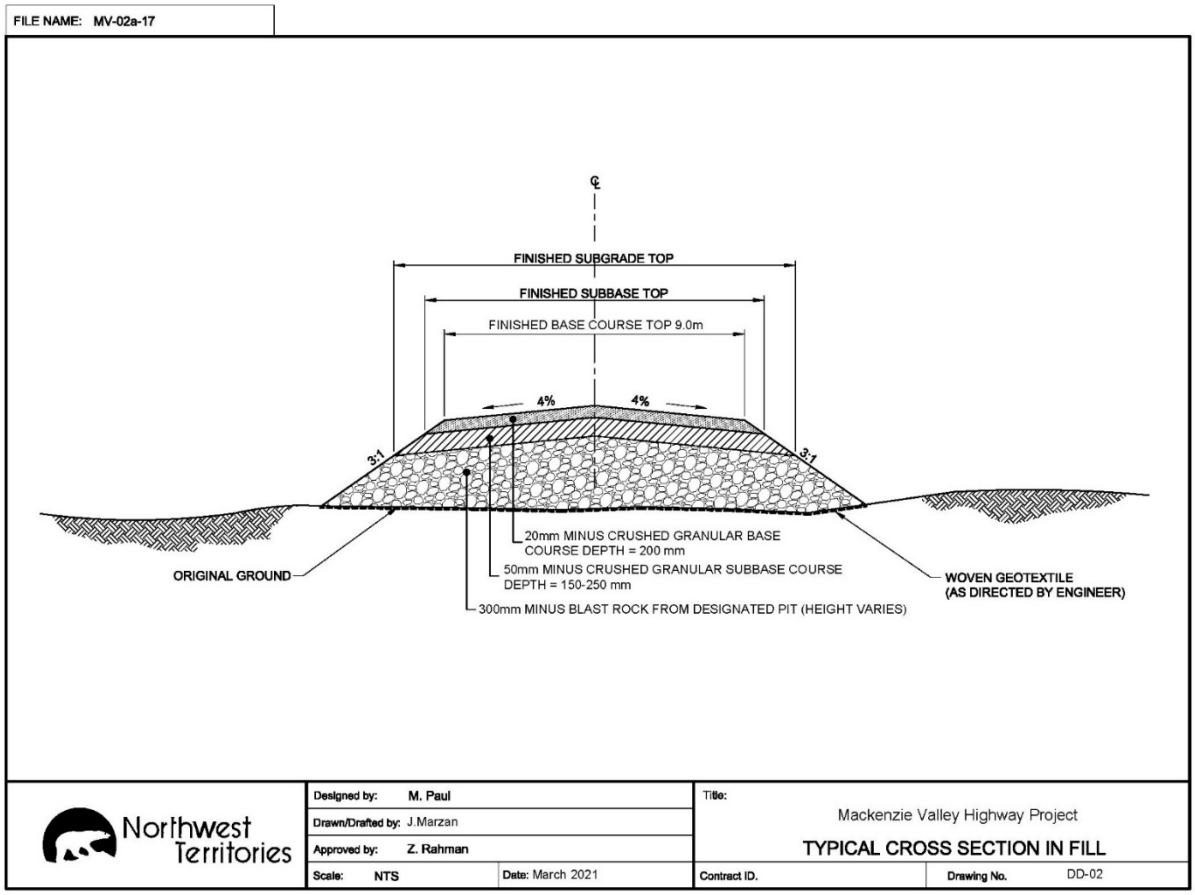
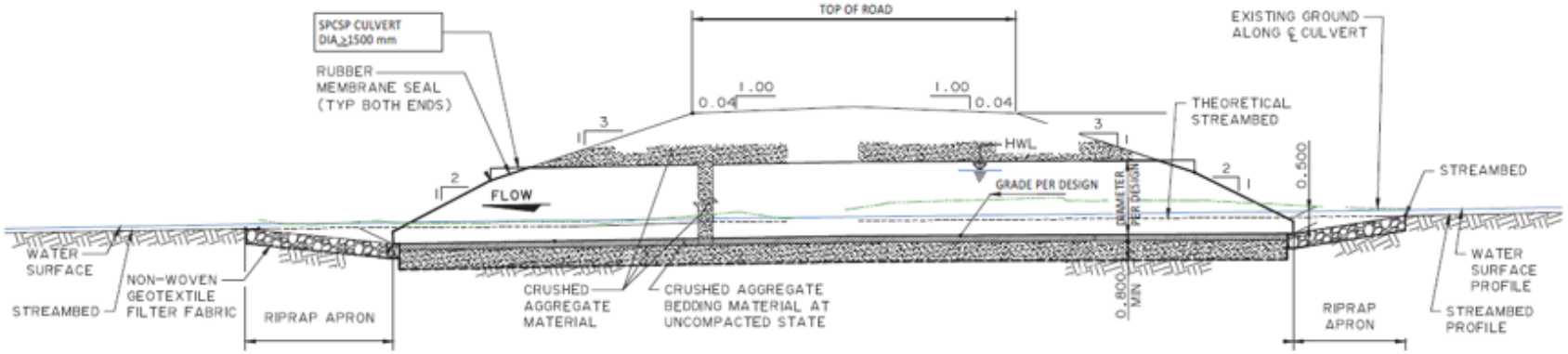


Figure 5.3 Typical Drainage Culvert Design Cross Section



5.2.3 Design Considerations

The Project route is at approximately 10% design definition. The final highway alignment may change as design progresses but will remain within the approximately 1 km wide corridor identified south of Norman Wells and 2 km wide corridor north of Norman Wells, except at specific watercourse crossing locations where the routing corridor is extended to accommodate the consideration of additional crossing options. Alignment changes within this corridor may be required to address geometric requirements, environmental or geotechnical constraints, and/or input received during the environmental assessment process leading up to the design of the final highway alignment to be constructed.

Exceptions to the design criteria may be needed in some areas where terrain conditions constrain the final design alignment. For example, to maintain required sight distance when crossing a steep valley, the design speed limit may locally be reduced from 90 km/h to reduce the amount of fill required to achieve the corresponding vertical curve, or a different design approach may be used (such as a road cut). Design exceptions may be applied to horizontal curves, vertical curves, speeds, and grades.

5.2.3.1 Consideration of Engagement Input and Traditional Knowledge

The Project design has been, and will continue to be influenced by comments or concerns raised during Project engagement with Indigenous Governments, Indigenous Organizations, and other affected parties in Fort Simpson (Łíídlıı Kųę); Wrigley (Pehdzeh Ki First Nation); Tulita; Norman Wells; Fort Good Hope (K'asho Got'ine), hereafter referred as Fort Good Hope; Colville Lake (K’áhbamítúé), hereafter referred to as Colville Lake; Tsiigehtchic; Aklavik; Fort McPherson; and Inuvik.

Additional details of GNWT’s consideration of engagement input in Project design will be included in the Revised DAR to reflect outcomes of GNWT’s ongoing and planned engagement during the fall of 2026.

5.2.3.2 Consideration of Permafrost

The design acknowledges that the Project will be constructed and operated in areas of permafrost, and in a projected warming climate. Permafrost conditions, ground-ice content, drainage, terrain sensitivity, and anticipated changes to the ground thermal regime are therefore important inputs to alignment selection, embankment design, drainage consideration and design, construction planning, and long-term monitoring and maintenance. These aspects will be further considered in detailed design, based on site-specific conditions and data.

Permafrost is ground (soil, rock, or sediment) that remains at, or below, 0 degrees Celsius (°C) for at least two consecutive years (Canadian Permafrost Association, June 2024). Permafrost is a thermal condition, rather than a specific material, meaning that permafrost can consist of various types of soil or rock that contain none, some, or substantial ice. The most important factor for design is not whether permafrost is present, but whether the ground is ice-rich and susceptible to

thawing. Thawing of ice in the ground can cause loss of soil strength, settlement, differential movement, changes in drainage, erosion, and instability. By comparison, permafrost (ground) that is ice-poor may undergo relatively limited settlement when thawed, depending on the soil type.

The Project spans from sporadic discontinuous permafrost near Wrigley, to extensive discontinuous permafrost near Norman Wells, to continuous permafrost north of Fort Good Hope (see Figure 5.4). The continuity, temperature, ground-ice content, and thaw sensitivity varies considerably from south to north, and over short distances, when crossing different terrain types. For example, silty soils, organic terrain, peatlands, poorly drained lowlands, and areas affected by existing thaw features generally present greater potential to be ice-rich and thaw-sensitive. Granular deposits and bedrock typically contain less ice, and are less thaw-sensitive. In all cases, site-specific investigation is required to confirm the ground conditions and the applicable design response.

Project design intends to avoid or reduce disturbance to particularly thaw-sensitive terrain where practical, and where doing so does not create greater environmental, constructability, safety, or lifecycle impacts. Where avoidance is not practical, the design will use site-specific measures to manage anticipated thaw, settlement, drainage changes, and deformation. Design approaches will not be assigned solely on the basis of broad north-to-south permafrost zones.

Ground temperature data from the Geological Survey of Canada (e.g., Duchesne et al., 2020) and from project-specific investigations (Tetra Tech, 2020b, 2020c) were used to characterize permafrost conditions, and to identify particularly thaw-sensitive soils that need to be considered in the detailed design to limit effects on the Project and on permafrost. Data recording sites within approximately 5 km of the Project, show that annual mean ground temperatures at a depth of zero annual amplitude (or at the deepest available measurements) range from above 0°C (i.e., absence of permafrost) to approximately -2°C.

Long-term ground temperature records indicate that permafrost has continued to warm throughout the Mackenzie Valley, and at many monitoring sites ground temperatures remain above the International Polar Year (2007–2009) baseline, accompanied by a general increase in active layer thickness (Smith et al., 2024; Duchesne et al., 2020). Warm permafrost (0 to -2°C) is considered to be particularly susceptible to thaw. Near-surface warm permafrost will likely degrade in the next decades due to climate warming, even without the presence of the Project. Ongoing and additional ground temperature monitoring will be conducted to inform embankment design.

A primary focus of the design is maintaining the safety of road users and maintaining the integrity of the road embankment. Changes to the local ground thermal regime in permafrost areas are certain to occur due to climate change, as well as project activities such as clearing, excavation, culvert installation during construction, and right-of-way brushing and snow clearing during operations. While the Project design aims to minimize the effects of permafrost thaw, these changes will be managed to maintain road stability and long-term functionality. The appropriate approach will be considered for varying terrain segments based on ground temperature, ground-ice content, embankment geometry, drainage, constructability, predicted thaw settlement, and expected

lifecycle performance. Detailed terrain mapping, geotechnical boreholes and test pits, geophysical surveys, laboratory testing, ground-temperature data, and engineering analyses will be used to define design segments and select suitable measures for each segment of the Project.

At the northern end of the proposed Project route, where colder, continuous permafrost is expected, the detailed design will aim to reduce permafrost thaw and degradation through fill-only construction, additional embankment thickness, retention of the existing organic material where appropriate, and measures that limit water pooling. The feasibility and expected effectiveness of this approach will be confirmed through geotechnical and thermal analyses during detailed design.

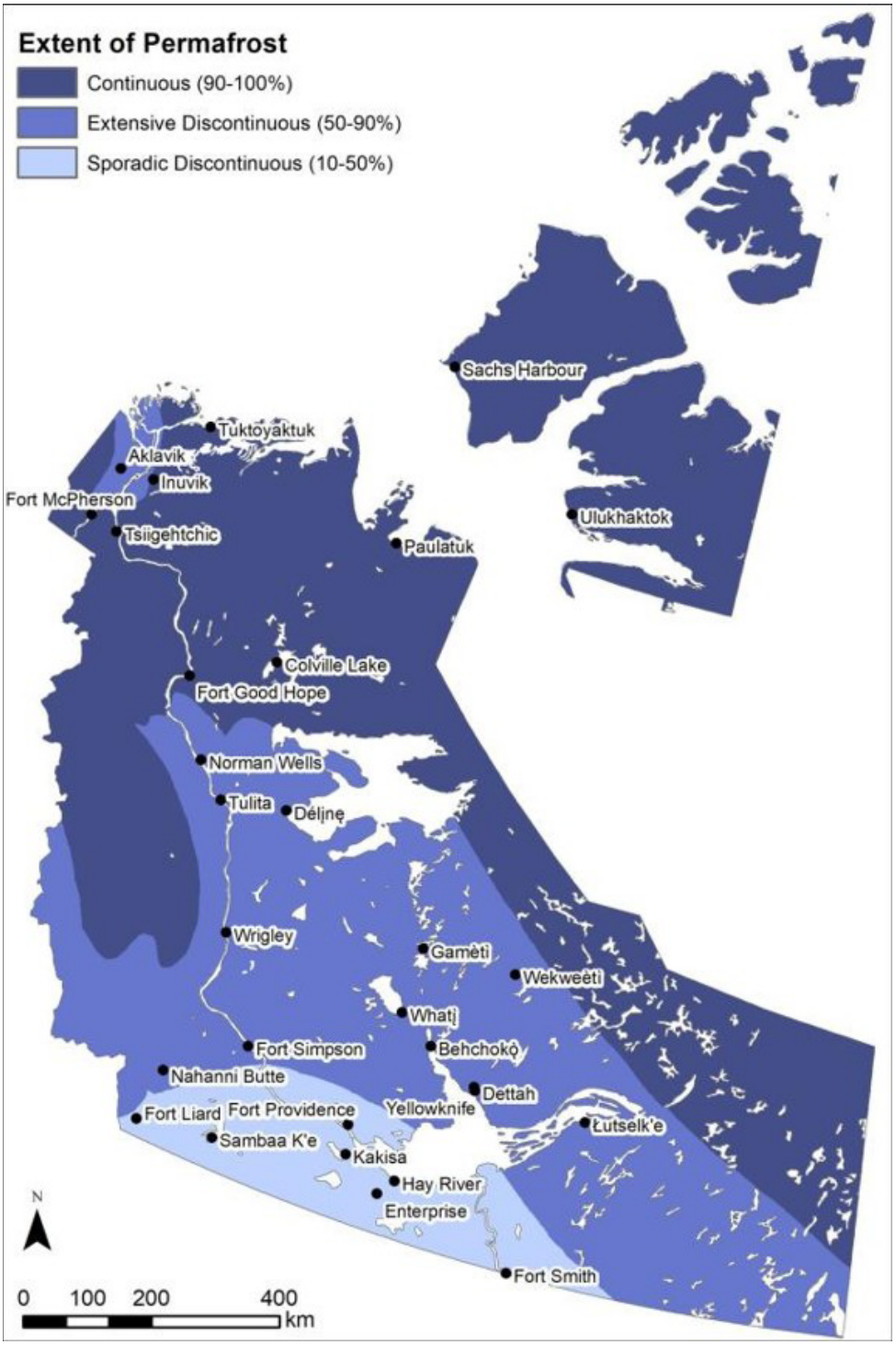
In the southern portion of the proposed Project route, in the warm sporadic discontinuous permafrost, no attempt will be made to prevent or reduce permafrost thaw and degradation, as it won't be possible to prevent thaw of permafrost along the highway ROW over time.

During detailed design, and based on information from additional technical studies, design methods can be varied by the Engineer of Record to address the concerns identified above. These site-specific methods and techniques to be considered include:

- Adjusting the horizontal alignment of the road to avoid particularly challenging ground conditions
- Optimizing the vertical gradient of the roadway and of road ditches to maintain drainage with settlements
- Using a thicker embankment to limit heat transfer into thaw-sensitive ground
- Incorporating geotextiles or geogrids to provide separation of materials, improve load distribution, enhance embankment stability and bridge localized differential settlements
- Retaining the existing organic mat where it provides a thermal benefit, or removing unsuitable organic or soft soils where excavation is shown to improve performance and can be completed without causing greater thaw, drainage, or environmental effects.
- Implementing drainage structures to mitigate water pooling against the road embankment, which can accelerate permafrost thaw

The need for one or more of these measures will be determined during subsequent design stages using segment-specific performance criteria and supporting geotechnical and thermal analyses. A design matrix may be used to relate terrain type, permafrost temperature, ground-ice content, predicted thaw settlement, drainage conditions, and consequence of poor performance to the selected embankment and construction approach. Detailed design will also identify monitoring locations, performance thresholds and adaptive-management responses.

Figure 5.4 Extent of Permafrost (from GNWT, 2022)



5.2.3.3 Consideration of Overflow / Icing

Prior to completing detailed design of the highway, the GNWT will compile reports of current overflow and/or icing (aufeis) locations and the extent of effects on the existing MVWR and MVFL. In addition, the GNWT will conduct supplemental icing surveys to inform the detailed design of bridges and bridge-culverts to address blockage concerns. Where icings are known to be a potential issue, they will be assumed and accounted for in the design as a safety factor for the culvert flow capacity. Generally, this will result in the culvert having a larger diameter. The method to account for icings in specific culvert design will be determined by the Engineer of Record.

In specific areas where groundwater flows are anticipated to come to the surface and combine with surface runoff on the uphill side of the embankment, the design will include a combination of ditching (where appropriate) along the uphill side of the embankment, and sloping of the ditches and graded areas towards regularly spaced equalization (drainage) culverts. This will facilitate drainage and reduce ponding on the uphill side of the embankment. Culverts will be designed to accommodate thaw cables/pipes for use in removing ice blockages, if needed (per design criteria).

5.2.4 Design Development from Environmental Assessment to Construction

The current level of design development is adequate for assessing the significance of potential effects of the Project on the environment. The progression from the current level of design to a constructable design will not change the scope of Project works and activities upon which the environmental assessment (EA) is based (see Section 5.1.2), except where influenced by the outcomes of the EA. Detailed, site-specific designs will continue to advance to support regulatory applications and construction tender within the routing corridor. This will include detailed design of the embankment, road cuts, bridges, bridge-culvert structures, and drainage culverts. Additional studies that have or will be completed to support detailed design and permitting include:

- Additional fisheries, hydrotechnical and icings (aufeis) investigations at watercourse crossings for bridge and culvert design as needed
- Detailed terrain analysis, geotechnical and thermal investigations, and topographic survey for embankment design
- Geotechnical investigations at deep road cuts and selected water crossings
- Traditional Knowledge / Traditional Land and Resource Use studies
- Ground temperature readings at existing monitoring points
- Archaeological impact assessment for mitigation planning
- Geotechnical and geochemical investigations at borrow/quarry sources to prove material volumes, quality, and acid rock drainage (ARD)/metal leaching (ML) potential

These studies will be subject to their own regulatory approvals, including requirements for consultation and engagement.

As the design progresses, the GNWT commits to:

- Completing a design that addresses site-specific terrain, soil, and permafrost conditions once the geotechnical investigations within a defined routing corridor are complete
- Balancing anticipated future maintenance requirements and capital construction cost to minimize life cycle cost of the project
- Engaging with affected Indigenous Governments, Indigenous Organizations, and other specific affected parties by sharing study findings and incorporating local knowledge and Traditional Knowledge into the alignment and mitigation strategies
- Adaptive management that applies flexibility in construction methods, mitigation measures, and maintenance activities in response to monitoring results so as to respond to unexpected conditions

5.3 Existing Infrastructure

The Project will overlap spatially and temporally with the following existing and planned infrastructure, as described in the following subsections. These are described here to provide full context of these projects in relation to the Project being assessed.

- Mackenzie Valley Winter Road, including existing watercourse crossing structures
- Canyon Creek All Season Access Road (CCASAR) and Prohibition Creek Access Road (PCAR)
- Mackenzie Valley Fibre Link
- Norman Wells Pipeline
- Great Bear River Bridge
- Dempster Highway

5.3.1 Mackenzie Valley Winter Road

The MVWR is part of the GNWT's public highway system and provides winter access to Sahtu communities north of Wrigley, including Tulita, Norman Wells, and Fort Good Hope. Additional winter roads connect to the MVWR, providing seasonal access to Déljne and Colville Lake. The MVWR is an approximately 20 m wide ROW within which a travel surface is annually cleared and packed with snow and ice for use. The MVWR between Wrigley and Prohibition Creek (which is the terminus of the CCASAR and PCAR) currently includes 39 single-lane bridges and bridge-culverts which extend the operating season of the road. Some of these structures will be retained and incorporated into the design, some will be replaced at their current location, and some will be removed and replaced with new, two-lane crossings at a different location. A summary of the existing bridges on the MVWR and their relation to the Project, as based on the current design definition is provided in Table 5.7. The decision to use or replace existing bridges reflects ongoing engagement and will continue to be reviewed as part of detailed design. Additional details of anticipated new bridges and bridge-culverts is provided in Section 5.4.7.

Table 5.2 Existing Bridges on the MVWR

Existing Crossing on MVWR	Type	Location on MVWR (KP)	Relation to Project
Hodgson Creek	Bridge	691.4	To be removed, and replaced with new bridge at different location
Ochre River	Bridge	722.4	To be removed, and replaced with new bridge at different location
Whitesand Creek	Bridge	731.0	To be removed, and replaced with two new bridges at different location
Strawberry Creek	Bridge-culverts (2)	746.5	To be removed
Vermillion Creek South	Bridge	750.1	To be removed
Bob's Canyon Creek	Bridge-culvert	753.5	To be removed
Dam Creek	Bridge	764.4	To be removed, and replaced with new bridge at different location
Blackwater River	Bridge	784.1	Project will connect to this bridge
Steep Creek	Bridge	816.5	Project will connect to this bridge
Devil's Canyon	Bridge	828.0	To be replaced with new bridge at the current location
Saline River	Bridge	831.8	Project will connect to this bridge
Seagrams Creek	Bridge	844.0	To be replaced with new bridge at the current location
Little Smith Creek	Bridge	852.4	Project will connect to this bridge
Big Smith Creek	Bridge	872.0	Project will connect to this bridge
Gotcha Creek	Bridge	912.0	To be replaced with new bridge at the current location
Twelve Mile Creek	Bridge	922.0	To be replaced with new bridge at the current location
Four Mile Creek	Bridge-culvert	931.0	Project will connect to this bridge-culvert
No Name Creek	Bridge	N/A	Not required for Project
Jungle Ridge Creek	Bridge	967.7	Project will connect to this bridge
Notta Creek	Bridge	971.4	Project will connect to this bridge
Vermillion Creek North	Bridge	973.4	To be replaced with new bridge at the current location
Prohibition Creek	Bridge	N/A	Part of Prohibition Creek Access Road
Christina Creek	Bridge	N/A	Part of Prohibition Creek Access Road
Hellava Creek	Bridge	N/A	Part of Prohibition Creek Access Road

Existing Crossing on MVWR	Type	Location on MVWR (KP)	Relation to Project
Francis Creek	Bridge	N/A	Part of Prohibition Creek Access Road
Canyon Creek	Bridge	N/A	Part of Canyon Creek All-season Access Road
Billy Creek	Bridge	1030.8	To bereplaced with a new bridge at a different location
Oscar Creek	Bridge	1050.8	The replacement of this bridge with a new bridge at a different location is being undertaken as a separate project.
Elliot Creek	Bridge	1072.4	Project will connect to this bridge
Hanna Creek	Bridge	1083	Project will connect to this bridge
Gibsons Creek South	Bridge	1090	Project will connect to this bridge
Gibsons Creek North	Bridge	1091	Project will connect to this bridge
Overflow Creek	Bridge	1107	Project will connect to this bridge
Donnelly River	Bridge	1116	Project will connect to this bridge
Denise (Snafu) Creek	Bridge	1130	Project will connect to this bridge
Rachelle Creek	Bridge	1133	Project will connect to this bridge
Tsintu Creek	Bridge	1151	Project will connect to this bridge
Lynn Creek	Bridge	1154	Project will connect to this bridge

The MVWR is open to traffic during the following times, with an approximate average daily traffic load of 50 vehicles per day:

- Wrigley to Tulita: December 14 to March 31 (20-year average [2025])
- Tulita to Norman Wells: December 21 to April 5 (20-year average [2025])
- Norman Wells to Fort Good Hope: December 20 to April 6 (20-year average [2025])

The Project will share the ROW of the MVWR along some of its length, and construction of the Project will be ongoing when the MVWR is open to public traffic. Public access along the MVWR will be maintained during Project construction, including portions of the MVWR that need to be operated until the full highway is connected from end to end. Measures to be implemented to maintain public access and safety during construction include:

- A Traffic Management Plan (TMP) will be implemented that:
  - Identifies the sections of the MVWR to be affected by construction
  - Illustrates work zones and construction equipment movements
  - Illustrates public vehicle detours
  - Specifies requirements for escorts, signage, lighting, and speed reductions

  - Specifies work times and measures for public safety during non-work times
  - Specifies communication protocols between the project construction team and MVWR operations team
- Construction activities will be scheduled to reduce disruption to public and commercial vehicle access on the MVWR, where possible

The annual construction and maintenance of the MVWR includes snow clearing, watering, grading, culvert and bridge maintenance, and vegetation management (brushing) within the ROW in accordance with existing authorizations.

5.3.2 Canyon Creek All Season Access Road and Prohibition Creek Access Roads

The CCASAR and PCAR are all-season roads that together extend 28 km southeast of Norman Wells to Prohibition Creek. The CCASAR was constructed to replace the MVWR with a new ROW located approximately 2.8 km to the northeast between Norman Wells and Canyon Creek. The PCAR will replace the MVWR between Canyon Creek and Prohibition Creek with a 60 m ROW and fill roadway following the MVWR alignment. Construction of 6.3 km of the PCAR from Canyon Creek to Christina Creek was completed in 2023, with the construction of the remaining 6.7 km anticipated to start in 2027. Maintenance activities along the CCASAR-PCAR include snow clearing, grading, dust control, bridge and culvert maintenance, and vegetation management. The CCASAR and PCAR are currently accessible to the public year-round from Norman Wells only. The CCASAR and PCAR will become part of and will be operated and maintained as part of the Mackenzie Valley Highway and are designed to the same highway standard.

5.3.3 Mackenzie Valley Fibre Link

The MVFL is a fibre optic cable located within a 6 m wide ROW, buried at a depth between 0.3 to 0.5 m below the ground surface. The MVFL mostly parallels and shares a ROW with the MVWR between Norman Wells and Fort Good Hope. North of Fort Good Hope, the MVFL has its own ROW. Although the MVFL does not require routine access for day-to-day operations, periodic access is necessary for repairs or equipment replacement. The location of the MVFL is marked with utilidor markers along the length of its ROW. The Project may cross the MVFL in places, though this will be determined in final design. Prior to start of construction, the GNWT (or its contractor) will identify the location of the MVFL and will work with the operator of the MVFL to obtain approval to implement appropriate precautions to prevent damage to the fibre optic cable. The location of the MVFL will be communicated to site personnel and the area will be avoided during construction.

Portions of the MVFL will need to be relocated to the new highway ROW. This is described further in Section 5.4.9.

5.3.4 Norman Wells Pipeline

Enbridge Pipelines (NW) Inc. (Enbridge) operated Line 21 (the Norman Wells Pipeline) between

1985 and 2026. The pipeline carried crude oil 870 km from Norman Wells to Zama, Alberta, until operation of the Norman Wells production facility ceased in 2026. The pipeline is buried within a 25 m wide cleared ROW that is situated between 0 km to 5 km of the route from Wrigley to Norman Wells. The Project will cross the pipeline in several locations that are yet to be determined. Pipeline crossing requirements will be determined in consultation with Enbridge for each particular crossing at the time of detailed design. All crossings, prior to construction at each site, require completion of any relevant regulatory applications (to be determined on a case-by-case basis depending on specific characteristics of the crossing) and subsequent approval from the pipeline owner. The application includes the need for a detailed design that must consider environmental and geotechnical issues. The final design will be in accordance with Enbridge's requirements for safety and access, for example specific requirements for depth of fill. This approach reduces potential for damage to the pipeline.

5.3.5 Great Bear River Bridge

An ice crossing of the Great Bear River at Tulita is constructed annually as part of the operations and maintenance of the MVWR (see Section 5.3.1). A new permanent all-season bridge over the river (Great Bear River Bridge) is planned to be constructed between 2027 and 2031. The bridge will provide an all-season crossing of the Great Bear River at Tulita to replace the MVWR ice crossing and will include new road approaches on both sides of the river, extending approximately 4 km to Four Mile Creek southeast of the Hamlet of Tulita and to the municipal boundary 2 km northwest of the river. These road approaches have been designed to the same highway standard as the Mackenzie Valley Highway. As with the CCASAR and PCAR, the Great Bear River Bridge will become part of and will be operated and maintained as part of the Mackenzie Valley Highway once constructed.

5.3.6 Dempster Highway

The Dempster Highway begins 40 km east of Dawson City and extends 736 km to Inuvik. The highway is a single lane all season highway that is open from approximately June 10 to October 14 in summer and December 15 to April 30 in winter. Ferry / ice crossings of the Peel River and Mackenzie River require seasonal closures of the highway. The Project will connect with the Dempster Highway at one of three locations, depending on the Route Option chosen.

The average annual daily traffic (AADT) on the Dempster highway west of Midway Lake over the past 10 years of record-keeping (2017-2026) is 39 vehicles (R. Thom, personal communication, July 15, 2026). This traffic counter location is appropriate because it represents through-traffic on the Dempster Highway, rather than local community traffic.

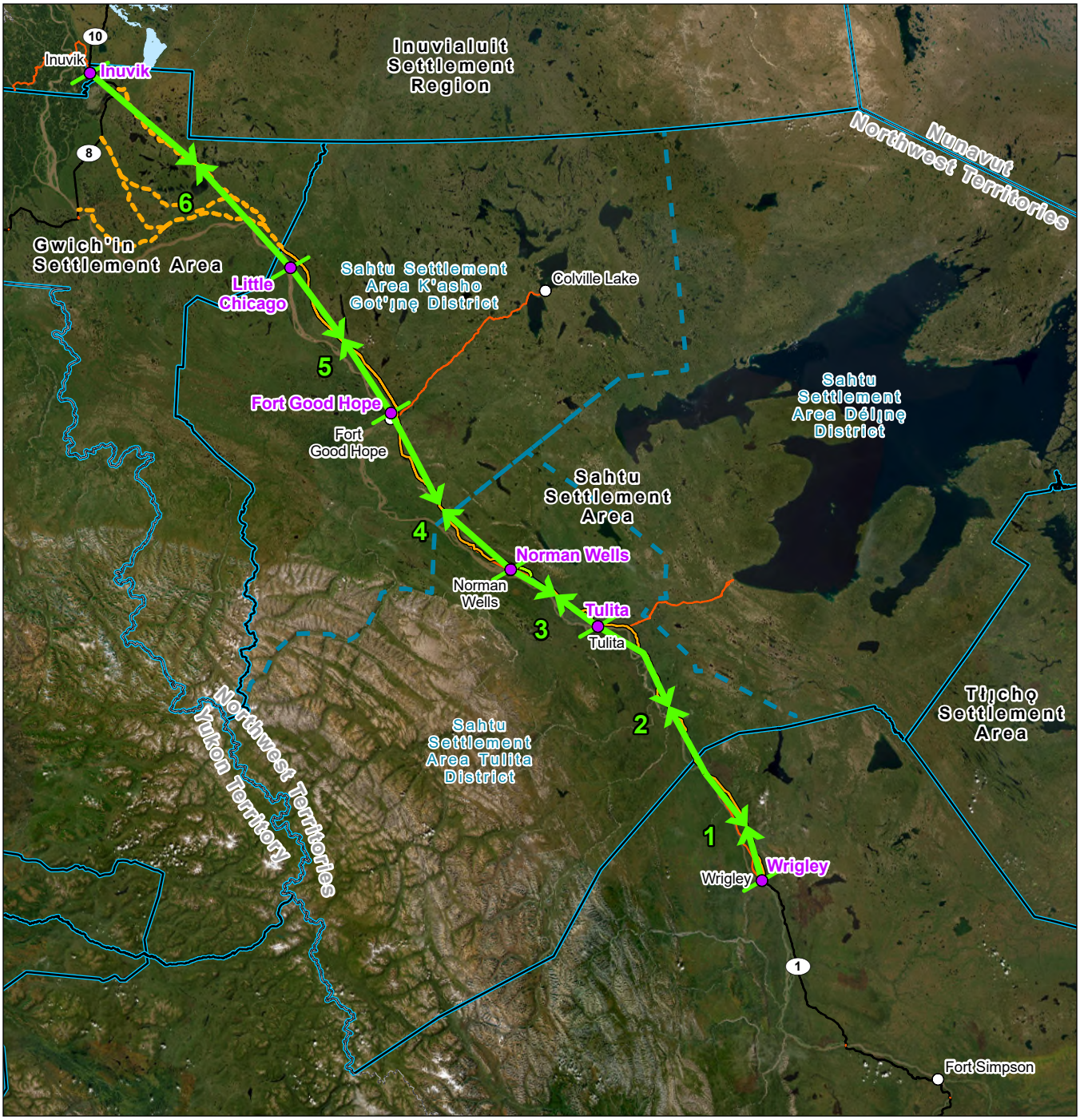
5.4 Construction Schedule and Activities

The Project schedule and activities to be completed during the construction phase are described in the following sections.

5.4.1 Construction Schedule

The Project will take approximately three to four years to construct, assuming all six segments begin construction concurrently. The schedule used for the EA is conceptual and reflects a concurrent approach to segment construction. The six segments are conceptually described below, and illustrated in Figure 5.5. An additional three years is anticipated to be needed to remove existing bridges on the MVWR that will not be incorporated into the design.

- Segment 1: Wrigley to a location near the Dehcho / Sahtu border (106 km)
- Segment 2: Dehcho / Sahtu border to Tulita (138 km)
- Segment 3: Tulita to the Prohibition Creek Access Road (Norman Wells) (48 km)
- Segment 4: Norman Wells to Fort Good Hope (154 km)
- Segment 5: Fort Good Hope to Little Chicago (128 km)
- Segment 6: Little Chicago to Dempster Highway (approximately 201 km, depending on the routing option selected)



- Potential Camp/Staging Location
- Construction Advancement
- Route Option
- Mackenzie Valley Highway
- Great Bear River Bridge (Proposed)
- Canyon Creek All Season Access Road (Constructed)
- Prohibition Creek Access Road (In Construction)

- Community
- Northwest Territories Highway
- Winter Road
- District Boundary
- Settlement Area Boundary
- Territorial Boundary

N

0 25 50 75 100 Kilometres

(At original document size of 8.5x11)
1:4,250,000

Notes

1. Coordinate System: NAD 1983 UTM 9

2. Data Sources: GNWT (Government of the Northwest Territories) Centre for Geomatics. n.d. Inventory of Landscape Change Map Viewer, GNWT. Centre for Geomatics. n.d. Open Data, MVLWB. n.d. Public Registry, Sahtu Land and Water Board. n.d. Public Registry, Environment and Natural Resources GNWT, Government of Canada, Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by SL on 9/3/2026
TR by DS on 9/3/2026

Client/Project
123515768-040

Government of the Northwest Territories
Mackenzie Valley Highway Project

Figure No.
5-5

DRAFT

Title
Conceptual Construction Segments

Conceptually, it is anticipated that construction of each highway segment would advance simultaneously from two locations (construction headings), at a progress of approximately 20 km per year, per heading. The construction methodology will be determined by the contractor(s) selected to construct each segment. The start points and progress would be based on the need to develop material sources (quarry or borrow), complexity of bridge crossings, and the availability and location of construction camps and staging areas.

The timing and duration of each construction segment is dependent on the GNWT securing construction funding and regulatory approvals. The conceptual schedule assumes the Project would be fully constructed and open for use by 2032. Segments will be opened for use as they are completed.

Mobilization of equipment and material would generally occur in summer (April to November) via barge and using existing all-season roads, or in winter (December to March) by winter road. Construction would generally occur year-round, with certain specific activities to be completed in winter or summer only as discussed in the subsections that follow.

The conceptual schedule used as the basis for the EA is presented in Figure 5.6. Within the realistic though conceptual schedule, one or more of the segments may take more or less time to construct than what is depicted.

Figure 5.6 Conceptual Project Schedule

	Highway Construction				Highway Operations											
									Bridge Removal							
Project Activity	**Y1**		**Y2**		**Y3**		**Y4**		**Y5**		**Y6**		**Y7**		**Y8**	
Mobilization and Resupply		and seasonally														
Camp Operations																
Clearing and Winter Access Road																
Quarrying and Construction																
Relocation of the MVFL																
Removal of Bridges																
Demobilization																
Highway Operations and Maintenance																
Post-Construction Monitoring																

White cells = summer (April to November)
Grey cells = winter (December to March)
Orange cells = highway construction activities
Blue cells = bridge removal activities
Purple cells = highway operations and maintenance activities; segments to be opened as they are constructed

5.4.2 Mobilization, Staging and Resupply

Project construction will require that all equipment, materials, fuel, camps, and other supplies be mobilized to designated construction start locations. Based on the conceptual schedule, and for the purpose of the assessment, it is assumed that construction will advance simultaneously on all six segments, and that construction will proceed in two directions from each construction segment start point, as shown in Figure 5.5. The construction methodology will be determined by the contractor(s) selected to construct each segment. The start points will be based on the need to develop material (quarry or borrow) sources and the availability of staging areas. Staging areas are areas where equipment and materials brought during annual or periodic resupply are temporarily stored prior to or after project use. Fuel will be transferred from staging areas to approved Project fuel storage tanks in designated areas. Staging areas that have been identified for potential use include:

- End of the existing Mackenzie Highway near Wrigley
- Existing staging areas within municipal boundaries (Fort Good Hope, Norman Wells, Tulita, Wrigley)
- Locations of existing or planned borrow/quarry sources
- New barge landing areas at Little Chicago and in Fort Good Hope
- Locations along the Dempster Highway north of Tsiigehtchic
- Temporary airstrips, helicopter pads, and access roads within the ROW
- Other suitable areas, including previously disturbed areas that may be identified during community engagement

Equipment, materials, fuel, and other supplies are anticipated to be mobilized by Marine Transportation Services barges on the Mackenzie River during the open-water season, using existing barge landings in Wrigley, Tulita, Norman Wells, and Fort Good Hope, and new planned barge landings at Little Chicago and Fort Good Hope. Little Chicago is an area located approximately 30 km south of the Sahtu/Gwich'in boundary on the east shore of the Mackenzie River that is suitable for development of a barge landing. Little Chicago will require minor grading at or near the shore to provide a suitable area for barge landing and off loading, development of a short access road to higher ground, and site preparation for a staging area. A new potential barge landing in Fort Good Hope is proposed to be located near the north end of the community. Equipment, materials, fuel, and other supplies will also be mobilized by the MVWR in the winter, or any time of year on existing all-season roads, including the Mackenzie Highway and Dempster Highway, or via aircraft to existing or temporary airstrips. Some equipment and supplies may be locally available in Inuvik, Fort Good Hope, Norman Wells, Tulita, and Wrigley. Preliminary estimates suggest that 10 barges and/or 500 trucks may be required to complete each mobilization; however, these numbers are still being confirmed. Updated estimates will be provided in the Revised DAR.

Temporary staging and laydown areas will be established as Project construction progresses to facilitate efficient movement of equipment and materials. These locations will include temporary fuel and refueling facilities, piles, bridge parts, culverts, geotextile, granular materials, erosion control materials, spill response equipment, emergency shelter, and first aid facilities. These temporary laydown areas may be relocated once or twice per year as construction progresses. The locations of permanent and temporary staging and laydown areas will be confirmed by the contractor prior to construction.

Resupply to the Project will be completed annually or semi-annually for bulk items such as fuel, geotextile, and bridge parts. Other supplies such as equipment parts and camp supplies are anticipated to be delivered more regularly using the Mackenzie Highway, Dempster Highway, and MVWR. Five to ten barges and/or 50 to 100 trucks may be required annually to resupply each construction segment.

5.4.3 Camps and Maintenance Yards

Temporary construction camps will be required to house contractors and GNWT personnel. Camps are expected to be located no more than 50 km apart and may be combined with other infrastructure (e.g., borrow sources) to reduce the Project footprint. Primary camps are estimated to accommodate 150-200 workers for two construction spreads. Smaller satellite camps of 20 to 40 persons may be needed to support bridge construction. Details about the anticipated workforce are provided in Section 5.4.16. It is assumed that one or two dedicated Project construction camps will be established for each construction segment, to be confirmed by the contractor. Locations being considered for construction camps currently include:

- Existing camp facilities within Norman Wells
- Dedicated camp locations within municipal boundaries of Fort Good Hope, Norman Wells, and/or Tulita
- Locations outside of municipal boundaries such as at one or more borrow sources or quarries to be accessed from the Dempster Highway, Mackenzie Highway, or MVWR, including Source 9.002 near Big Smith Creek

Community input will be considered in determining the size and location of camps. Through the Project-specific engagement process, engagement participants stated preference for camps to be located at existing disturbed areas such as borrow sources, and away from the community. In Norman Wells, engagement participants asked that consideration be given to repurposing construction camps to provide housing. The GNWT will consider repurposing construction camps once construction is complete. Each construction camp will consist of mobile trailers for accommodations, office, kitchen, laundry and washroom facilities, and first aid facilities. Each camp will include parking for light vehicles, waste transfer, and temporary waste management facilities. Camps are assumed to supply their own heating and power for lighting and auxiliary equipment using diesel fueled generators and heaters.

Potable water for camps will be obtained from the closest municipal supply, or from proximal water sources. The location of water sources to be approved will be presented in regulatory applications (see Section 5.4.13).

Certain camp wastes such as sewage, greywater, and domestic wastes unsuitable for incineration will be disposed of at licenced municipal facilities where practicable to do so, subject to approval of the community government. Other methods to manage wastewater will be considered in accordance with applicable guidelines (GNWT, 2015a). Other wastes, such as recyclables and hazardous wastes, will be transferred to an accredited waste transfer company for disposal. Wastes suitable for incineration, such as food waste and cardboard, will be incinerated on site in accordance with applicable guidelines.

Maintenance yards will be used for storage and maintenance of heavy equipment and equipment refueling and may include temporary material stockpiles. Any of the borrow/quarry sources used for construction may be used as temporary maintenance yards, though areas proximal to the alignment are preferred. Temporary maintenance yards will include:

- Maintenance shelter
- Material stockpile
- Fuel storage
- Equipment parking area
- Waste management area

All camps and temporary maintenance yards will have controlled access to Project personnel only.

5.4.4 Clearing and Access

Where the Project highway alignment follows the MVWR, the ROW will need to be widened to 60 m. In some places, including between Wrigley and the Blackwater River, and from Fort Good Hope to the Dempster Highway, a new ROW will need to be cleared to 60 m width. Access roads to quarry and borrow sources, where needed, will be cleared to 30 m width. Trees and standing deadfall will be cleared using heavy equipment, in winter when the ground is frozen to reduce effects on the environment. Hand felling will be used where required to protect sensitive terrain. Merchantable timber (>14 centimetres [cm] diameter at breast height) will be limbed and decked in a dry area and made available to a receiver holding an authorization, such as a timber cutting permit or licence from the GNWT. Non-merchantable trees will be limbed and stacked for community salvage, where possible. Clearing, except hand-clearing, will be done in winter to protect the ground from erosion and rutting.

In the northern portion of the proposed Project route, disturbance to native ground will be avoided where possible, to protect permafrost. Where needed and appropriate to be removed, tree stumps and roots will be removed by grubbing. Organic topsoil will be salvaged and stockpiled for use in reclamation of other areas. Through the Project-specific engagement program, engagement participants requested that unused topsoil removed during construction be given to communities for their use. Brush and unsalvageable timber will be walked down and temporarily windrowed at

the edge of the ROW before being mulched and spread across the ROW once the embankment is constructed. In other cleared areas, it will remain windrowed at the edge of the cleared area.

A summary of the estimated new areas to be cleared for Project activities will be provided in Table 5.3 following initial engagement on the Project description. The table will also approximate the areas not needed for operations and maintenance, to be reclaimed during the construction phase. Reclamation is further discussed in Section 5.4.10.

As noted in Section 5.2.4, the ultimate design alignment of the Project has not been finalized. The summary of areas to be cleared will be estimated based on the route as defined for the EA. To address potential uncertainty associated with the new clearing on the assessment of effects on the environment, the assessment (where applicable), will provide metrics associated with clearing a new ROW along the entire length of the new highway to be constructed, though the new ROW may overlap existing cleared ROW (MVWR or MVFL) in places.

Table 5.3 Summary of Estimated Areas to be Cleared

Type of Clearing	Description	Approximate New Areas to be Cleared (ha)	Approximate Area to be Reclaimed (ha)
Quarry/borrow sources and access roads -temporary[1]	Areas to be developed for construction only	TBD[1]	TBD
Quarry/borrow sources and access roads – permanent[2]	Areas to be developed for long-term maintenance use	TBD	TBD
Temporary camps, maintenance yards, staging and laydown areas	Assume these will all be located at previously cleared sites where possible	TBD	TBD
Highway ROW [3]	Clearing of new ROW to 60 m width	TBD	TBD
	Total		

Notes:

TBD indicates that values and assumptions will be provided following initial engagement on the project description

ha: hectare

5.4.4.1 Total Project Footprint

The estimated total footprint (also referred to as the Project Development Area [PDA]) of the Project includes:

- 775 km of permanent highway ROW at 60 m width
- Approximately 49 temporary borrow and quarry sources, assumed to be average 10 ha each, and access roads on 30 m ROW
- Approximately 25 permanent borrow and quarry sources, and access roads on 30 m ROW
- Camp / staging areas (estimated as approximately 12 ha)

Of the PDA, temporary borrow sources and access roads, camps / staging areas, and the MVWR will be reclaimed following construction.

5.4.5 Quarrying

5.4.5.1 Material Requirements

The Project is estimated to require 29 million cubic metres (m^3) of granular and rock material for road embankment, road base, borrow/quarry source access roads, workspaces/staging areas, permanent maintenance camps, and erosion protection, based on estimates provided in the PDRs (GNWT, 2013). This estimate is considered (+/- 50%) based on the current level of design but is likely low, due to additional length of highway and bridges to be constructed in the Dehcho Region since the initial PDR.

One hundred and twenty-five potential material sources were previously identified for construction of the Project (GNWT, 2013), and through ongoing engagement. For the purpose of the assessment, it is assumed that 74 borrow / quarry sources will be needed for construction, at an average spacing of one source every 10 km. These are shown in Figure 5.1. Of these, it is assumed that one source every 20 – 25 km will continue to be used for road maintenance during Project operations and as such will become a permanent borrow / quarry sources. Table 5.4 identifies all potential material sources. These sources have been identified based on their probable volumes of material, quality of material, and/or other considerations, as reported in K'alo Stantec (2021), 5658 NWT and GNWT (2011), K'asho Development Foundation (2012), and Gwich'in Tribal Council and GNWT (2011). The borrow / quarry sources to be used for construction and to support ongoing maintenance will be selected by the GNWT and its contractor and Indigenous Government land owner, as applicable. The GNWT may apply to regulators to use more, or fewer, or different sources than those shown in Figure 5-1, applying the same mitigation measures. The number and location of sources will be confirmed as geotechnical and environmental investigations, design and community engagement progresses prior to permitting. The selection of borrow / quarry sources will be based on:

- Geotechnical investigations to confirm material suitability, including geotechnical properties and ice content

- Geochemical analyses to test material's ARD/ML potential
- Development considerations, such as access, drainage, and topography
- Land access and ownership
- Community input and Traditional Knowledge
- Identification of unmitigable constraints such as archaeological resources or critical habitat for species at risk
- Material type quantity requirements per highway section and haul distance

Quarries and borrow sources will be accessed year-round. Those sources that are not directly on the alignment will require construction of an access road.

In addition to the borrow sources and quarries, rock or granular material may be sourced from road cuts, thus reducing the number of quarries and borrow sources to be developed, or the volume taken from these sources. The location of road cuts and suitability of material will be assessed further following geotechnical investigations and design advancement (see Section 5.4.6).

Table 5.4 Potential Quarry and Borrow Sources Gwich'in Region (on Route Option A)

Source	Location on Route Option A (KM) [2]	Land Ownership	Material Type	Estimated Volume (Mm^3)[1]
5.014	1344	Territorial	Granular	2.0
4.103a	1353.3	Territorial	Granular	1.5
4.103b	1353.3	Private (Gwich'in)	Granular	1.5
KP_1378	1377.5	Private (Gwich'in)	Rock	2.3
4.059AP	1391	Private (Gwich'in)	Granular	20.0
4.039P	1417.8	Private (Gwich'in)	Granular	1.0
4.038APA	1426.2	Private (Gwich'in)	Granular	25.0
KP1433	1433	Private (Gwich'in)	Granular	0.5
4.27a	1446.5	Private (Gwich'in)	Granular	5.5
4.27b	1452.9	Private (Gwich'in)	Granular	5.5
2.064	1474.3	Territorial	Granular	0.2
KP_1497	1496.8	Territorial	Granular	0.1

Notes:

[1] As reported in Gwich'in Tribal Council and GNWT (2011), and as estimated through desktop review

[2] Per Appendix 5A (map book)

Table 5.5 Potential Quarry and Borrow Sources Sahtu Region

Source	Location on Route Option A (KM) [2]	Land Ownership	Material Type	Estimated Volume (Mm^3)[1]
9.037	798.3	Territorial	Granular	6.3
9.025B	813	Private (Sahtu)	Rock	8.5
9.019	821.6	Territorial	Rock	7.3
9.010	839.2	Territorial	Rock	5.7
9.002	850.4	Private (Sahtu), Existing[3]	Granular	3.1
9.002A	852.0	Territorial	Granular	2.4
8.039	865.7	Territorial/ Private (Sahtu)	Rock	7.3
20.086P	889.0	Private (Sahtu)	Granular	1.2
8.058P	907.3	Territorial	Granular	0.2
Dhu1[3]	952	Territorial	Granular	4.3
Dhu2	952	Territorial	Granular	2.7
7.090	962.7	Territorial	Rock	5.0
7.083	978	Territorial, Existing[3]	Rock	1.5
Edie Lake Quarry	Off CCASAR	Territorial, Existing[3]	Rock	2.5
7.049P	1024	Commissioner	Granular	2.5
7.47	1028.5	Commissioner	Rock	3.1
7.046P	1032.3	Private (Sahtu)	Granular	0.7
2167	1042	Private (Sahtu)	Rock	3.3
7.36	1053	Private (Sahtu)	Granular	3.5
7.35	1053.5	Private (Sahtu)	Granular	15.0
7.025P	1069	Private (Sahtu)	Granular	15.0
7.018P	1083.4	Private (Sahtu)	Rock	Unlimited
7.14	1089	Territorial	Granular	Unlimited
7.10	1094.8	Territorial	Rock	Unlimited
KG-1a	1094.9	Territorial	Rock	Unlimited
KG-2	1105.5	Private (Sahtu)	Rock	Unlimited
7.5	1113.7	Private (Sahtu)	Rock	0.5
KG-3	1124.5	Private (Sahtu)	Rock	Unlimited
7.03	1127.6	Territorial	Rock	Unlimited

Source	Location on Route Option A (KM) [2]	Land Ownership	Material Type	Estimated Volume (Mm^3)[1]
KG-4	1140.9	Territorial	Granular	0.1
KG-5	1166.2	Territorial	Rock	0.1
KP_1172	1171.9	Commissioner	Granular	6.4
6.80	1172.5	Private (Sahtu)	Granular	25.0
KG-7	1183.5	Territorial	Granular	0.2
6.53	1201.5	Private (Sahtu)	Granular	3.0
KG-11	1207	Private (Sahtu)	Rock	Unlimited
KG-12	1218.2	Private (Sahtu)	Rock	Unlimited
KG-14	1232	Private (Sahtu)	Rock	1.5
KG-15	1237.4	Private (Sahtu)	Rock	Unlimited
6.17	1245.5	Territorial	Rock	0.1
KG-16	1262.8	Territorial	Granular	0.05
6.14	1263.6	Territorial	Granular	1.0
KG-18	1272.7	Territorial	Rock	Unlimited
KG-20	1281.8	Private (Sahtu)	Granular	55.0
5.36	1293.8	Private (Sahtu)	Granular	0.3
KP_1296	1296.1	Private (Sahtu)	Rock	Unlimited
KG-23	1315.3	Territorial	Granular	Unlimited

Notes:

[1] As reported in K'alo Stantec (2021), K'asho Development Foundation (2012), and as estimated through desktop review

[2] Per Appendix 5A (map book)

[3] "Existing" means a portion of the source has been developed in the past

Table 5.6 Potential Quarry and Borrow Sources Dehcho Region

Source	Location on Route Option A (KM) [2]	Land Ownership	Material Type	Estimated Volume (Mm^3)
10.043	7 km S of Wrigley on Highway #1	Territorial, Existing	Granular	1.0
Q_D1	699.1	Territorial	Rock	Not Avail
Q_D2	702.5	Territorial	Rock	Not Avail
BS_D3-E	709.2	Territorial	Granular	Not Avail

Source	Location on Route Option A (KM) [2]	Land Ownership	Material Type	Estimated Volume (Mm^3)
BS_D3-W	709.2	Territorial	Granular	Not Avail
Q_D3	715.1	Territorial (Land Withdrawal) [4]	Rock	Not Avail
Q_D4	720.0	Territorial	Rock	Not Avail
Q_D5	728.0	Territorial	Rock	Not Avail
Q_D6	736.0	Territorial (Land Withdrawal) [4]	Rock	Not Avail
Q_D7	744.5	Territorial (Land Withdrawal) [4]	Rock	Not Avail
Q_D8	756	Territorial (Land Withdrawal)[4]	Rock	Not Avail
Q_D9	763.5	Territorial	Rock	Not Avail
Q_D10	773	Territorial	Rock	Not Avail
9.043	783.5	Territorial, Existing	Granular	1.8

Notes:

[1] As reported in K'alo Stantec (2021), and as estimated through desktop review

[2] Per Appendix 5A (map book)

[3] "Existing" means a portion of the source has been developed in the past

[4] Interim Land Withdrawal R-048-2014

5.4.5.2 Material Geochemistry – Acid-Rock Drainage and Metal Leaching Potential

Rock material sources to be used for the Project will be tested for ARD and ML potential prior to seeking authorizations (such as Quarry Permits) in general accordance with methods in the Mine Environmental Neutral Drainage Prediction Manual (Price, 2009), or other NWT guidance as may be applicable at the time. Additional samples will be collected from each proposed quarry and rock cut source (as applicable), based on the proposed tonnage of material to be extracted. Results of analytical testing will be used to classify materials based on their Neutralization Potential Ratio (NPR), where:

$$NPR = \frac{Neutralization\ Potential\ (NP)}{Acid\ Potential\ (AP)}$$

Rock sources with NPR less than 1.0 are considered potentially acid generating (PAG) and will not be used for the Project. Rock sources to be used for the Project with NPR greater than 3.0 are considered to have low acid generating potential and suitable for use on the Project. Project sources with NPR between 1.0 and 3.0 that cannot reasonably be avoided will be further evaluated to identify if PAG can be mitigated through measures such as site-specific planning, designated use of material, and water management. A partial geochemical evaluation has been completed for some sources identified in Table 5.7, including borrow material sources where material could require crushing. These sources were found to have non-acid generating, non-metal leaching material (K'alo Stantec, 2021). Generally, rock material sources proposed are anticipated to have low ARD

potential due to their location within geological units dominated by carbonate and dolomitic rocks with high neutralization potential. As stated previously, additional testing will be completed at all sources proposed for development where crushing will be required, in accordance with applicable guidance.

5.4.5.3 Quarry and Borrow Source Development and Operations

Quarries are rock material sources. The development of quarry sources will require:

- Constructing all-season access roads to sources
- Stripping of overburden vegetation and soils
- Development of an area to be used for explosives storage and mixing
- Blasting
- Crushing and sorting
- Stockpiling at the source and at specified locations along the ROW

Borrow sources are granular material sources. The development of borrow sources will require:

- Constructing all-season access roads to sources
- Stripping of overburden vegetation and soils
- Ripping and excavation of material
- Material sizing and sorting
- Stockpiling at the source and at specified locations along the ROW

Access roads to quarry and borrow sources are anticipated to consist of a 30 m wide cleared ROW and 8 m wide granular embankment to accommodate equipment at speeds of up to 50 km/h. Final routing and design of access roads will coincide with alignment design. Access roads are anticipated to be constructed following the methods for constructing embankment (see Section 5.4.6). The development and operation of quarries and borrow sources will coincide with the timing of embankment construction, which may occur year-round.

A Quarry Development Plan (QDP) will be developed for each material source, in accordance with the Northern Land Use Guidelines – Pits and Quarries (GNWT, 2015b) and as required by the Quarrying Permit Application. Notably, the QDPs will describe the activities to be conducted at each quarry and measures to be implemented to mitigate effects on the environment, such as erosion and sedimentation control, water management, wildlife protection, and use and storage of explosives. Best practices to be incorporated into quarry planning and QDPs include:

- The Project will limit clearing to areas required for construction and safe operations.
- Measures will be implemented to reduce ponding, erosion, and damage to permafrost during borrow source and quarry operations and closure.
- Borrow sources will not be located in areas where there is a high groundwater table.

- Only material with low ARD and/or ML potential will be used for the Project (per Section 5.4.5.2).
- Borrow source and quarry development and operations will follow measures specified in the Wildlife Management and Monitoring Plan (WMMP).
- Borrow source and quarry design and development operations will take into account public safety.
- Vegetation buffers will be used as visual barriers and to protect riparian vegetation, as appropriate.
- Organic material and topsoil will be set aside for use during reclamation.
- Blasting will not occur within 100 m of fish-bearing waterbodies such that instantaneous pressure will be less than 50 kilopascal (kPa) where fish may be present and particle velocity will be less than 13 millimetres per second (mm/s) near a spawning bed where eggs or larval fish may be present.

Regarding transportation, manufacture, use and transportation of explosives, details of these activities will be developed by the contractor(s) selected by the GNWT to construct the Project. It is not anticipated that explosives will be manufactured on site. It is more likely that pre-packaged ammonium-nitrate-fuel-oil emulsion explosives will be used, consistent with other GNWT highway and quarry development projects. Pre-packaged explosives are likely to be stored at one or more quarries or other designated areas. During construction and/or operation of the quarry. The locations of explosives storage have not yet been determined. These will be determined by the contractor(s) selected by the GNWT to construct the Project. The assessment assumes that explosives will be transported to quarries along constructed portions of the Project and quarry access roads. An Explosives Management Plan will be developed for the Project prior to construction to support regulatory authorizations.

5.4.6 Embankment Construction

The Project may be constructed year-round, with embankment (the coarsest material placed at the base) generally placed in winter, and the sub-base and base course (upper layers) placed and compacted in summer.

Generally, embankment construction will proceed as:

1. Clearing and grubbing (where needed) of the ROW in winter
2. Placement of geotextile on original ground in winter
3. Placement of embankment by end-dumping material in winter
4. Installation of culverts in summer or winter
5. Placement of sub-base and base course and compaction in summer

Clearing has been described in Section 5.4.4. Geotextile will be placed on the cleared ground surface. Where construction of embankment proceeds in winter, snow will be cleared from the ROW before geotextile placement.

5.4.6.1 Winter Travel Lane and Winter Access Road

To support winter construction access and resupply, a winter road or travel lane is necessary to allow vehicles such as haul trucks to turn around after placing embankment material. The embankment itself does not provide sufficient width for this purpose. A winter road or winter travel lane provides a compacted snow and ice surface for construction vehicles, thereby protecting the native ground and helping to mitigate erosion, rutting, and soil damage within the ROW.

In areas where the Project alignment follows the route of the existing MVWR, the MVWR will be moved to the edge of the new (wider) 60 m wide ROW and used to support movement of equipment working to construct new embankment centered in the ROW, as was done during the construction of the PCAR. Where the Project ROW does not follow the MVWR, a separate winter travel lane will be alongside the embankment to facilitate movement of equipment. Water for constructing the Project winter travel lane, where needed, will be sourced from the Mackenzie River and other sources as authorized for water withdrawal (see Section 5.4.13).

Based on the current route, it is estimated that over 600 km of winter travel lane may need to be constructed. The amount of winter travel lane to be constructed each year will depend on the construction contractor's methods and rate of progress.

To access the existing bridges needing to be removed along the existing MVWR in the Dehcho Region, a winter access road will need to be constructed annually. This winter access road will follow the route of the existing MVWR, and will be constructed along a portion of its length from Wrigley to Blackwater River each year, as needed to allow for two bridges and/or two culverts to be removed each year.

5.4.6.2 Embankment Placement

Embankment, consisting of blast rock and granular fill, will be placed directly on the geotextile in varying thicknesses to meet the design parameters. Generally, thicker fills are required in areas of sensitive soils and in valleys. Material will be placed by end-dumping embankment material off previously placed embankment, then leveling the fill material, thus advancing the working area. Embankment placement may be completed in several "lifts" or layers until the specified thickness is achieved. The embankment may be allowed to settle for a full year prior to placing sub-base and base course.

The design of the Project approaches to existing crossings will be site-specific to each crossing. As part of tying in the new double-lane embankment to existing single-lane bridges, the Project geometrics will be tapered down to one lane far in advance of the water crossing. Some work around existing bridges may be required to extend rip rap to accommodate the wider embankment approaches in accordance with the final design

5.4.6.3 Road Base, Compaction and Surfacing

Placement of sub-base and base course on top of embankment will occur during unfrozen

conditions, which allows material to be shaped and compacted. These activities will be conducted using the constructed embankment as the travel and work surface for equipment. Placement of the final surface material (the driving surface) will be completed in the final year of construction. The final surface material will be sourced from specific quarry or borrow sources that contain suitable material. During compaction and surfacing, water is needed for compaction and dust control. Water used for compaction will be sourced from the Mackenzie River and other authorized sources (see Section 5.4.13).

5.4.6.4 Road Cuts

Road cuts may be needed where the grades (slope) at a steep valley approach or hill can be reduced by excavating into the hill slope. The current design identifies at least 14 locations where road cuts may be required. Road cuts are expected to be accommodated within the 60 m wide ROW, but local exceptions may be required in accordance with the final design.

The need for road cuts, road cut locations and size will be confirmed during final design and will be influenced by road operational requirements, public safety, geotechnical conditions, and the suitability of the material from the cuts to be used as road embankment. Road cuts will generally not be used in sensitive terrain, such as unstable slopes and soils with high ice content. Alternate design approaches (such as switchbacks) will be considered at each of these locations and will involve modifying design criteria (such as reducing the design and posted speed limits). Through the Project-specific engagement process, engagement participants stated that they support the need for road cuts in steep valleys such as at the approaches to existing bridges.

Road cuts will be constructed in the summer or winter, after the ROW has been cleared. Road cuts into rock will be blasted and material suitable for road construction will be crushed and stockpiled within the ROW for use. Road cuts in granular material will be excavated. Material removed from road cuts that is unsuitable for road construction may be spread along the ROW or hauled to a quarry/borrow source for disposal, if nearby.

5.4.7 Watercourse Crossings

The Project will cross intermittent and permanent watercourses requiring installation of new bridges, large (greater than 1.5 m diameter) bridge-culverts, and small (less than 1.5 m diameter) drainage/equalization culverts. The Project design will use some existing bridge and bridge- culvert structures located over major watercourses along the MVWR. The design of approaches to existing crossings will be site-specific to each crossing. As part of tying in the new double-lane embankment to existing single-lane bridges, the Project geometrics will be tapered down to one lane far in advance of the water crossing, and will accommodate the need to stop to let opposing traffic cross the bridge. Some work around existing bridges may be required to extend rip rap to accommodate the wider embankment approaches in accordance with the final design.

Erosion and sedimentation is a potential concern when constructing new water crossing structures or connecting to existing water crossing structures. The GNWT will implement an Erosion and Sediment Control Plan (ESCP) based on industry best management practices for erosion prevention

and sediment control (see draft ESCP in Volume 5; and GNWT, 2025a).

5.4.7.1 Bridges

It is estimated that 30 to 35 new bridges will be required. The anticipated location and structure type is summarized in Table 5.7. The final crossing location, number, and type of structures will be determined during final design. All new crossing structures will provide two-lane width. The type of structure will be determined by the bank-to-bank width of the watercourse, and other considerations, such as approach slopes and bank conditions. All bridges will be supported on steel piles, and generally, multi-span bridges will require placement of piers on the bank slope and/or within the streambed, whereas single-span bridges may not require works within water. The bridge structure may consist of concrete and/or steel sections which would likely be brought to site by road, and assembled on site. Smaller bridges are assumed to require one year to construct, whereas larger bridges and bridge-culverts will take two years to install. Generally, in-stream construction will occur during low or no flow conditions where possible.

It is anticipated that several watercourses where new bridges are to be installed are considered navigable waters under the meaning in the *Canadian Navigable Waters Act*.

Table 5.7 Anticipated Location and Type of New Bridges

Crossing Name	Region	Approximate Location (KM)	Anticipated Structure
Bridge 1 (Hodgson Creek Tributary)	Dehcho	697.3	Bridge (single span)
Hodgson Creek	Dehcho	705.2	Bridge (multi-span)
Ochre River	Dehcho	724.2	Bridge (multi-span)
Whitesand Creek South	Dehcho	730.8	Bridge (multi-span)
Whitesand Creek North	Dehcho	738.3	Bridge (multi-span)
Dam Creek	Dehcho	760.8	Bridge (single span)
Devils' Canyon	Sahtu	828.4	Bridge (multi-span)
Seagrams Creek	Sahtu	844.3	Bridge (single span)
Gotcha Creek	Sahtu	912.7	Bridge (single span)
Twelve Mile Creek	Sahtu	922.0	Bridge (single span)
Vermillion Creek North	Sahtu	973.3	Bridge (multi-span)
Bosworth Creek	Sahtu	1023.5	Bridge (multi-span)
Billy Creek	Sahtu	1035.2	Bridge (multi-span)
Unnamed / Chick Creek	Sahtu	1116.3	Bridge or bridge-culvert
Jackfish Creek	Sahtu	1170.2	Bridge or bridge-culvert
Hare Indian (Rabbitskin) River	Sahtu	1176	Bridge (multi-span)

Crossing Name	Region	Approximate Location (KM)	Anticipated Structure
Unnamed	Sahtu	1189.7	Bridge or bridge-culvert
Loon River	Sahtu	1200.8	Bridge (multi-span)
Tieda River	Sahtu	1232.1	Bridge (multi-span)
Payne Creek	Sahtu	1262.7	Bridge or bridge-culvert
Unnamed	Sahtu	1271.4	Bridge (single span)
Unnamed	Sahtu	1285	Bridge (single span)
Thunder River	Sahtu	1354	Bridge (multi-span)
Crossing #1410D	Gwich'in	1405.9	Bridge (multi-span)
Crossing #1430B	Gwich'in	1426.5	Bridge (multi-span)
Travaillant River	Gwich'in	1432.7	Bridge (multi-span)
Crossing #1470F	Gwich'in	1471.4	Bridge (multi-span)
Crossing #1480F	Gwich'in	1482.4	Bridge (multi-span)
Crossing #1490A	Gwich'in	1486.8	Bridge (multi-span)

5.4.7.2 Bridge-Culverts

An undetermined number of new bridge-culverts (structural culverts greater than 1.5 m diameter) will be required. Bridge-culverts will consist of structural plate corrugated steel pipe (SPCSP) and may be closed-bottom or open-bottom type. Site-specific culvert design and installation will take into account topography, road geometry, substrate material, fish passage, and fish habitat considerations as based on hydrotechnical and fish and fish habitat studies (Appendix 17A; K'alo Stantec, 2022c; Tetra Tech, 2021, 2022), and other considerations such as icing (aufeis), as applicable. Final culvert design will specify requirements for excavation, preparation of culvert bedding, and placement of erosion protection (such as rip rap). Culverts will be installed in the summer or winter, in accordance with specifications, or as determined by the contractor. Prior to culvert installation, temporary crossings such as portable bridges may be used if needed to reduce disturbance within the watercourse and in riparian areas. Culvert installation will avoid restricted activity timing windows where applicable, and where possible, as based on the site-specific fish and fish habitat study information and recommendations therein.

Through the Project-specific engagement process, engagement participants stated that they have seen other large culverts blocking small fish and some that have collapsed; they urged caution when building these culverts. During project-specific engagement and Traditional Knowledge studies, participants did not identify any proposed new culvert installation locations that are used for boat access.

The following measures to protect fish and fish habitat will be implemented during installation of bridges and bridge-culverts and temporary crossings where fish and fish habitat is present, as

detailed in the draft Fish and Fish Habitat Protection Plan:

- Follow Fisheries and Oceans Canada (DFO) measures to protect fish and fish habitat and codes of practice:
  - *Interim code of practice: temporary cofferdams and diversion channels*
  - *Code of practice: Clear span bridges*
  - *Code of practice: Ice bridges and snow fills*
  - *Code of practice: Temporary fords*
- Follow measures in the ESCP
- Respect DFO *Northwest Territories Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat*

An undetermined number of additional small-diameter drainage/equalization culverts (less than 1.5 m diameter) will be installed at smaller and undefined drainages without fish habitat and cross-slopes as identified during design to promote and maintain drainage through the embankment at a frequency of approximately three to five culverts per km. Through the Project-specific engagement process, engagement participants were supportive of culverts that would help with drainage and to prevent overflow of the highway.

5.4.7.3 Beaver Dam Removal

The TRRC reports that there are many beaver dams that have caused overflow [of the MVWR] (TRRC, 2022). Construction of the embankment or installation of culverts may require removal of existing beaver dams or lodges to re-establish or maintain natural watercourse flow and to prevent flooding. The identification of beaver dams will be completed prior to construction. Beaver dam removal, if required, will be done in accordance with the DFO *Code of practice: Beaver dam breaching and removal*, a GNWT General Wildlife Permit, the WMMP, and with input from local land and resource managers.

5.4.8 Bridge Removal

The portion of the Project in the Dehcho Region is located well to the east of the MVWR. Once this portion of Project is operational, the corresponding bridges along the MVWR will be removed, and the areas reclaimed.

Equipment, fuel, camps, and other supplies will be mobilized along a winter access road to the designated locations near bridges to be removed during the upcoming winter season. Staging areas near the bridges will temporarily store equipment and fuel needed during bridge removal. One or more temporary work camps would be required to support the removal of bridges and relocation of the MVFL fibre line. It is assumed that camps will be located at existing camp locations, at existing borrow sources along the MVWR, or at one or more at each of the bridge locations proposed for removal. Camps may accommodate approximately 40 people.

Bridge and bridge-culvert deconstruction and removal activities would likely be completed in

winter, to reduce potential effects on fish, and due to the need to access via winter access road. Deconstruction will involve dismantling and cutting each bridge and culvert into transportable pieces. These pieces will need to be temporarily stored in a laydown area for transport either on the winter road or all-season highway. Bridge piles will be cut below ground surface, and the bridge approaches would be graded to approximate pre-development conditions. It is assumed that two bridges / bridge-culverts will be disassembled and removed each winter season. The bridge pieces will be disposed of at a facility able to accept this material outside of the Northwest Territories. It is anticipated that several watercourses where bridges are to be removed are considered navigable waters under the meaning in the *Canadian Navigable Waters Act*.

Construction equipment, camps, and other materials will be demobilized along the winter access road during the final winter season of bridge removal. Following the removal and grading of the bridge areas, active re-seeding or planting will be used at bridge approaches to reduce potential for erosion, soil loss, and sedimentation into the watercourse. This may include application of an approved seed mix, or planting of willow stakes or seedlings in spring or late fall. An approved planting plan will be required. Seeding and/or planting of each area is assumed to take one year, including monitoring of establishment success. Away from watercourses, unused portions of the MVWR and temporary workspace locations will be left to revegetate naturally.

5.4.9 Relocation of the Mackenzie Valley Fibre Line

Replacement of the MVFL fibre line may be needed where the Project route deviates from the MVFL location along extended portions (for example between Wrigley and Blackwater River). Where needed, a new section of fibre line will be installed within the new ROW. The GNWT prefers to abandon the old fibre line in place to reduce potential impacts associated with removing the line. The decision to remove or abandon the line in place will be determined based on ongoing engagement with Indigenous Governments, and the MVFL owner (Northern Lights General Partnership). Once connected, the removal of the old fibre line will be completed during winter at the same time as bridge and bridge-culvert deconstruction and removal activities due to the need for access provided by the winter road. Using existing staging areas and temporary disturbances from the bridge deconstruction activities, the fibre line will need to be detached from the bridge connections and transported to a temporary laydown at a new location. It is assumed that fibre line at bridges and bridge-culverts will be removed at the same frequency as bridge removal; approximately two per winter season.

The GNWT will work with Northern Lights General Partnership, to develop the approach for the relocation of the MVFL fibre line. It is anticipated that new fibre line installation will involve trenching and placement of new fibre line on the edge of the highway ROW and the re-installation of fibre line on constructed bridges. The installation will be in accordance with the Northern Lights General Partnership's specifications.

5.4.10 Closure and Reclamation of Camps, Temporary Quarries, Maintenance Areas, and Mackenzie Valley Winter Road

Once each segment of the Project is constructed, there will be temporary camps, borrow sources/quarries, access roads, maintenance yards (all considered temporary workspaces), and sections of the MVWR that will no longer be required.

All structures, equipment, and materials will be removed from these temporary workspaces as soon as they are no longer needed, which may include relocating materials and equipment to the next work location. Wastes will be handled and managed as per the Project Waste Management Plan (WMP). These areas will be visited during the summer to confirm that all debris has been collected. Areas suspected to be contaminated by fuel or other contaminants will be assessed and remediated.

Borrow sources and quarries and associated access roads not required for highway maintenance are planned to be closed and reclaimed, in accordance with the QDP, input from the landowner (for Sahtu Settlement Lands and Gwich'in Lands) and Indigenous Governments, Indigenous Organizations, and other affected parties as appropriate. Objectives of closure and reclamation of temporary workspaces include:

- Leaving the site in a condition that is safe for people and wildlife
- Promoting drainage and preventing project-related erosion and degradation of permafrost
- Promoting natural revegetation

Specific closure activities at temporary workspaces will include:

- Removing all equipment, wastes, and contaminated soils
- Contouring excavations to reduce steep slopes
- Sloping the pit floor of borrow sources/quarries to reduce ponding of water
- Directing surface runoff away from existing waterbodies
- Installing erosion control measures if necessary
- Replacing soil and organic material to promote re-establishment of vegetation

Abandoned sections of the MVWR ROW and access roads will be allowed to revegetate naturally. Vehicle access to quarry access roads will be discouraged by placing boulders and ditching the access road or will follow recommendations from the landowner. Access to abandoned sections of MVWR will be discouraged by placing boulders or wood debris and reflective signage and/or markings across the former ROW where it is intersected by the new highway. Restricting vehicle access will prevent rutting and promote revegetation. Snowmobile access is not expected to be affected.

Access to privately owned cabins and land use areas will be evaluated on a case-by-case basis to determine if the access will be retained by the GNWT.

5.4.11 Demobilization

It is anticipated that demobilization of construction equipment, camps, scrap materials, and waste will occur progressively toward the end of construction of each segment of the highway. Equipment and materials not needed for final summer construction activities may be demobilized on the MVWR or on the segment of newly constructed highway, if applicable. Remaining equipment, materials, camps, scrap materials, and waste are likely to be demobilized by barge at the end of the summer season from existing barge landing locations. The demobilization schedule will be determined by the contractor. Some equipment or materials may be retained for maintenance or community use, at the discretion of the GNWT and the construction and maintenance contractor(s).

5.4.12 Equipment and Fuel Use

The following heavy equipment is anticipated to be required for construction of each project segment:

- Excavators
- Bulldozers
- Graders
- Mulchers
- Tree harvesters
- Cranes
- Water trucks
- Vacuum trucks
- Fuel trucks
- Mobile drills
- Haul trucks
- Piling rigs
- Crushers and screeners
- Rock trucks
- Loaders
- Compaction equipment

Diesel fuel required for equipment will be stored in approved bulk fuel storage tanks with secondary containment. Fuel will be stored in designated locations such as quarries or maintenance yards. Mobile equipment will be refueled using fuel trucks and trucks with tidy tanks. Personnel will be trained in refueling, fuel handing procedures and spill response, in accordance with the Spill Contingency Plan (SCP).

5.4.13 Water Use

Water will be used for camp operations, winter access road and winter travel lane construction, compaction, and dust control. Water for road compaction and camp operations will be withdrawn in winter and summer from the Mackenzie River and other authorized sources. Drinking water will be sourced from municipal systems in Wrigley, Tulita, Norman Wells, Fort Good Hope, Inuvik, or lake or river sources nearby to camps. Water withdrawal will be in accordance with DFO measures to protect fish and fish habitat, the *DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut* (DFO, 2010), *Interim code of practice: end-of-pipe fish protection screens for small water intakes in freshwater,* and *Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada* (DFO, 2013). The estimated annual water use for the Project is summarized in Table 5.8.

Table 5.8 Estimated Annual Water Use for the Project During Construction

Water Use	Source	Estimated Daily Volume (all sources) (m^3)	Annual Volume (m^3)	Timing
Potable Water	Municipal Distribution	10	3,000	300 days per year
Camp Operations (non-potable)	Municipal Distribution or Authorized Water Sources	30 per camp	9,000 per camp	300 days per year
Winter Access Road and Travel Lane Construction	Mackenzie River and Authorized Sources	>300	10,000 to 20,000	Winter
Compaction and Dust Control	Mackenzie River and Authorized Sources	>300	10,000	Summer

Water sources to be used for construction will be selected based on available flows and volumes based on applying the DFO requirements for protecting fish and fish habitat. In winter during Project construction, the GNWT will be concurrently constructing and maintaining the MVWR, which is a separate project. The project contractor and the GNWT may use the same water sources for the Project and MVWR. The GNWT will consider the available water in each source based on all known potential users when applying for one or more water licences to use water. Generally, lake water sources and large rivers will provide water in winter, whereas smaller river and creek sources are available in summer. Options such as the use of a pipeline will be considered to access the Mackenzie River as a water source.

Lake water sources for construction will be selected based on anticipated water availability. Studies of potential water sources are ongoing. The suitability of water sources will be based on bathymetric surveys (ongoing) and community input. Bathymetric surveys provide lake depth and volume to determine the available under-ice volume that can be taken from each source in accordance with the DFO guidance (DFO, 2010). This information will be used to support approval to take water from suitable sources (through a water licence).

Water use will be greatest during construction. A smaller subset of water sources will continue to be used during operations and maintenance for dust control, when water use needs are much reduced (10 – 50 m^3/day).

All major creeks and rivers between Wrigley and the Dempster Highway (those with existing or planned bridge crossings), and the Mackenzie River, where accessible, are potential sources for water withdrawal. Water withdrawals from watercourses will be limited to certain months of the year when flows meet minimum requirements for ecological protection (DFO, 2013) – generally April to October, or as otherwise authorized. A desktop evaluation of water availability in watercourses between Wrigley and Prohibition Creek is presented in K'alo Stantec 2022d and 2023. Additional studies of lake and/or river sources will be required to support Project authorizations.

During engagement with Indigenous Governments, Indigenous Organizations, and other affected parties, participants identified streams and lakes suitable for water withdrawal. For example, concerns were raised about water withdrawal from Trout Lake at the base of Bear Rock (Petınıʔah) so it has been removed from consideration as a potential water source for the Project.

5.4.14 Wastes

During Project construction, various waste materials will be generated and hazardous materials will be used. The collection, transportation, treatment, and disposal of waste materials, including hazardous wastes generated during construction activities, will be in accordance with the WMP. Details of waste volumes and waste management will be developed by the GNWT and the contractor prior to construction in accordance with regulatory requirements (land use permit[s] and water licence[s]).

The following types of waste will be generated during Project construction:

- Camp greywater
- Camp sewage
- Camp solid waste
- Recyclables
- Hazardous waste

Management of greywater and sewage will include the storage of wastewater generated at the construction camps and the periodic transport and disposal of this waste. Sewage will be stored in temporary tanks, removed by vacuum truck, and transported to sewage lagoon facilities in Wrigley, Tulita, Norman Wells, or Fort Good Hope that agree to accept project sewage. Greywater will be transported to sewage lagoon facilities or may be deposited to a greywater sump in accordance with the Northern Land Use Guidelines (GNWT, 2015b), if approved to do so by the Inspector. Construction camps are assumed to have capacity for 150 - 200 people, depending on the construction season. The wastewater generation associated with the maximum number of people (up to 200 people) per camp, will be approximately 30 m^3 (30,000 litres) per day during peak occupancy.

The management of solid waste from the camps and construction activities may include incineration or the storage of the solid waste and the periodic collection of the wastes in a covered container vehicle. Waste will be hauled for disposal to municipal solid waste disposal facilities at Fort Good Hope, Norman Wells, Inuvik, and/or other municipal facilities that agree to accept project waste. Solid waste generated per camp during maximum occupancy (200 people) will be approximately 2 m^3 per day. The GNWT will negotiate agreements with the municipalities to receive this waste. If municipal facilities are unable to accept solid waste, containerized waste will be transported by road to an alternate accredited facility approved to accept the specified Project wastes.

Certain wastes, such as food-contaminated waste and cardboard, are suitable for incineration. Incineration may be used to divert certain types of wastes from municipal solid waste facilities. Incinerators, if intended to be used by the contractor, will be operated in accordance with applicable guidelines and best practices at the time, including Canadian Council of Ministers of the Environment (CCME) Canada-wide Standards for Dioxins and Furans, CCME Canada-wide Standards for Mercury, and Environment and Climate Change Canada (ECCC) Technical Document for Batch Waste Incineration (ECCC, 2010).

There are currently no facilities in the Sahtu or Dehcho regions licenced to accept and manage recyclables or hazardous wastes from commercial operations. Recyclable wastes and hazardous wastes will be backhauled for disposal and/or recycling at accredited facilities capable of accepting such wastes within or outside of the NWT.

5.4.15 Access and Site Security

The MVWR will be open to public and commercial traffic and Indigenous land users throughout Project construction during the winter. As outlined in Section 5.3.1, a TMP will be applied to identify, control, and report safety risks to project personnel and the public. Examples of safety and security measures to be applied include:

- Access to construction workspaces will be allowed for authorized construction personnel only
- Signage and physical barriers will be used to identify restricted areas to provide separation between workspaces and the MVWR for public safety and security
- Access to quarries/borrow sources during active quarrying and hauling will not be permitted
- Access to the constructed embankment during periods when the MVWR is closed will not be permitted due to safety concerns
- Barriers will be used to restrict vehicle access until construction is completed and the Project is commissioned for use

5.4.16 Construction Employment and Contracting

5.4.16.1 Estimated Workforce and Seasonal Timing

For the purpose of the EA, it is estimated that the contractor's construction workforce will be 40 to 70 persons per crew. Up to 10 additional personnel per segment may include the GNWT's Engineers and contractor's specialists that are not present on regular rotation. There may be one or two crews working out of each camp during construction, and there could be up to seven camps operated concurrently, depending on the planning and delivery of project construction. This means that there could be up to 12 crews working simultaneously.

The estimated direct construction workforce required to complete the conceptual Project schedule is:

- Approximately 960 - 1,680 contractor's construction personnel (40-70 persons per crew, 12 crews, plus cross-shift)
- Approximately 80-100 contractor's supervisors (3 - 4 supervisory personnel per cross-shift)
- Approximately 20-30 contractors' environmental/wildlife monitors (1 per crew per cross-shift)
- Approximately140-200 contractor's camp services personnel (for example, cooks, first aid, cleaning, per camp, including cross-shift)
- Contractor's construction administration and management personnel

The Project is assumed to be constructed during approximately 300 days per year, with potential non-construction periods representing times of spring freshet (May-June) and while the MVWR is being constructed annually (November-December). The workforce(s) needed to remove existing bridges once the highway is open to traffic will be smaller (approximately 20 – 40 persons).

Additional contracted jobs and business opportunities on the Project will be related to supply and resupply, waste hauling, equipment and material supply, and personnel transport.

5.4.16.2 Workforce Arrangements

For the purpose of the EA, and reflecting the conceptual construction schedule, the following workforce arrangements are assumed:

- Workers will be employed based on 12 hours per day, 14 day rotations.
- Work is conducted on a day shift only. GNWT may approve addition shifts (e.g., a night shift) if it is beneficial to the Project.
- The GNWT will require that the contractor(s) prioritize hiring from local communities and from elsewhere in the NWT; the remainder of the workforce is expected to be from outside of the NWT. The GNWT's commitment to maximizing local employment includes:
  - providing readiness funding to support training and employment activities
  - working with communities and Aurora College to identify community-based training opportunities
  - other initiatives related to procurement or supporting employment and training
- NWT Bureau of Statistics estimated an available labour supply (for 2019) of 1,237 individuals (444 in the Sahtu Region and 793 in the Dehcho Region) (NWT Bureau of Statistics, 2020). Of those, approximately 863 individuals indicated a willingness to work in rotational shift employment; it is assumed that 100 individuals will be hired from this pool in the Sahtu and Dehcho communities. Updated statistics from the NWT Bureau of Statistics related to the available labour supply in the NWT will be provided in the Revised DAR.

- Workers from Inuvik, Fort Good Hope, Norman Wells, Tulita, and Wrigley will have the option to reside in their home community during their rotation, if possible, with shuttles transporting them to the worksite when ground transportation is available. These workers will stay in the construction camp at other times.
- Most positions are likely to be seasonal, full-time. The number of workers required by occupation or skill would be determined during the detailed design of the Project.

Construction workforce arrangements will be determined by the contractor(s) in discussion with the GNWT to meet the construction objectives. Workforce arrangements may differ from segment to segment.

5.4.16.3 Qualifications and Training

Construction of the Project will present business and employment opportunities for general labourers, equipment operators, surveyors, environmental monitors, camp staff (cooks, camp managers, custodians), expeditors, engineering and technical staff, and construction administrators, among others. As noted above, there will be additional employment opportunities associated with the need for supply and resupply, waste haul, equipment and material supply, and personnel transport.

With the intention of maximizing hiring from the Gwich'in, Sahtu and Dehcho regions, the GNWT will facilitate job readiness and training as follows:

- The construction schedule will be shared with communities once finalized to encourage local residents to undertake applicable training programs in anticipation of project employment.
- The GNWT and Project contractor(s) will have roles in supporting recruitment and skills training for local workers. The GNWT will work with local academic institutions in the design of short-duration, skill-based courses for northern residents to improve job readiness, expand the available labour pool, and enhance local skill capacity. The availability of training programs would be dependent on the level of interest and expected enrollment of community members.
- Contractor(s) will be required to report on training, including the types of training provided and the number of employees trained.
- The GNWT will share information about Labour Market Programs, which provide support for individuals, employers, organizations, and communities.

5.4.16.4 Procurement Policy

Specific procurement plans will be determined closer to the time of tender, through discussion with Indigenous Governments.

5.4.17 Roles and Responsibilities of Communities

Confirmation of roles and responsibilities of communities during construction will be developed as applicable. The GNWT intends to negotiate agreements with municipalities with existing potable water, wastewater and solid waste facilities to provide potable water and to receive Project wastes.

5.4.18 Summary of Construction Activities and Timing

The assumed schedule of activities in the construction phase used in the EA is summarized in Table 5.9. As indicated in Section 5.4.1, the EA assumes that all six segments will be constructed concurrently.

Table 5.9 Summary of Construction Activities and Timing Used for Assessment

Activity per Segment (6 Segments Total)[1]	Assumed Timing[2]
Highway Construction	
Mobilization and staging of equipment, materials, and fuel by highways, barges, and/or MVWR	Summer and/or winter, prior to the first year of construction of each segment
Resupply	Annually in summer and winter for each construction segment (approximately 3-4 years)
Establishment and operation of camps and maintenance yards	Annually, year-round for each construction segment (approximately 3-4 years)
Clearing of ROW, camps and workspaces; construction of winter access road and winter travel lane	Winter for each construction segment (approximately 3-4 years)
Borrow source and quarry development and operations, including blasting, crushing, sorting, and stockpiling	Year-round for each construction segment (approximately 3-4 years)
Material haul	Year-round for each construction segment (approximately 3-4 years)
Embankment and quarry access road construction, including road cuts	Winter, during first 1-2 years of construction of each segment; blasting/excavation of road cuts may occur in summer or winter
Bridge and culvert installation	Summer or winter for each construction segment (approximately 3-4 years)
Road base placement, compaction, and surfacing	Summer, during last 2 years of construction of each segment
Water withdrawal	Winter and summer as required to support construction activities
MVFL relocation	Final winter of construction

Activity per Segment (6 Segments Total)[1]	Assumed Timing[2]
Closure and reclamation of MVWR and temporary borrow sources/quarries, camps, and workspaces	Summer, during final year of construction of each segment
Bridge Removal[3]	
Establishment and operation of camp	Annually in winter during bridge removal (3 years), once highway is operational
Construction of winter access road, including water withdrawal	Annually in winter during bridge removal (3 years)
Demolition and removal of existing bridges	Annually in winter (3 years)
Reclamation of bridge approaches	Summer following removal of each bridge (3 years)
Demobilization	Summer and/or winter following the completion of each segment

Notes:

1 As described in Section 5.4.1

2 Summer: April to November; Winter: December to March

3 Refers to bridge removal on the MVWR in the Dehcho Region

5.5 Operations and Maintenance Works and Activities

As a preface to this section, operations and maintenance activities are those activities that are necessary to operate the Project as a highway under the *Motor Vehicles Act*. This includes operating and maintaining each of the segments of the Project until they together become a contiguous highway. Operations and maintenance activities include routine activities within the ROW such as snow clearing, brushing, resurfacing, grading, culvert and bridge maintenance, and dust control. Other physical works and activities outside of the ROW required to support ongoing highway maintenance, such as quarrying (Section 5.5.5), maintenance yards (Section 5.5.6), and water use (Section 5.5.7), are part of the Project.

5.5.1 Responsibilities

The Mackenzie Valley Highway will become a permanent part of the NWT highways system. Once commissioned for use, operations and maintenance activities within the ROW of the Mackenzie Valley Highway will be the responsibility of the GNWT Department of Infrastructure.

5.5.2 Snow Clearing, Grading and Dust Control

The driving surface of the Project, including access roads will be maintained and repaired regularly for safety and to mitigate environmental effects. Snow clearing will be conducted following snowfall events. Snow clearing involves pushing snow from travel lanes and shoulders onto the sideslopes where meltwater is diverted into drainage culverts and off the driving surface. The height of snowbanks will be minimized to the extent possible and to a height of less than 1 m.

Resurfacing and grading will be conducted regularly in summer to repair potholes and address washboard. This may require placement of additional granular material. While repairs are being completed, temporary traffic controls will be implemented.

Once the Project is constructed, the GNWT anticipates primarily using dust suppressant for dust control. Based on the GNWT's experience maintaining NWT's gravel highways, dust suppressant is more effective than water for dust control during highway operations and maintenance, and results in an improved driving surface. The GNWT conducts dust suppression in accordance with the Guideline for Dust Suppression (GNWT, 2013) (the Guideline). Calcium chloride and DL10 are the only approved dust suppressants in the NWT, and currently only calcium chloride is used by the GNWT on NWT highways #1-7. No other dust suppressants are being considered. The GNWT currently applies calcium chloride to NWT gravel highways once every year following annual resurfacing. The GNWT directs its contractors to apply calcium chloride product ("product") meeting its specifications using methods to ensure complete absorption of the product into the road surface to mitigate impacts on the environment. This includes requirements to adhere to the following:

- Sufficient water is to be applied to permit complete absorption of the product into the road surface.
- Product is not to be applied when precipitation is imminent or when the road surface is saturated.
- Product is not applied in proximity to waterbodies or on bridge decks.
- Product is applied over the full width of the travel surface, and product must remain on the road surface.

The GNWT monitors the application of product by requiring the contractor to provide a work schedule, results of product chemical testing, records of daily spread quantities, weather conditions, and delivery certificates.

5.5.3 Right-of-Way Vegetation Control

The cleared ROW will require periodic clearing of vegetation (brushing) to maintain sight distances for public safety. Brushing will involve using a track-mounted mower to clear saplings and shrubs. Brushing may be required approximately every three years and will generally be completed in September or October. Brushed material will be chipped or mulched and left on the ROW.

5.5.4 Culvert and Bridge Maintenance

Each completed segment of the Project, including existing bridges and culverts along the MVWR, as well as new culverts constructed as part of the Project, will be integrated into the operations and maintenance of the Mackenzie Valley Highway.

Culvert and bridge maintenance is conducted annually on highways throughout the NWT. Culvert maintenance will likely be completed in late winter to clear obstructions such as branches and ice. This can be done by hand or using portable equipment to reduce disturbance to riparian areas. Bridge maintenance is conducted as needed to repair guardrails, decking, and bridge approaches.

5.5.5 Quarrying

A subset of the borrow sources and quarries used for construction will remain open as material sources for maintenance of the highway. It is estimated that one third of the construction sources will become permanent. Potential permanent borrow and quarry sources will be selected from Tables 5.4 to 5.6, based on design requirements and engagement input. These borrow sources and quarries will have permanent access roads and may be operated year-round, or intermittently. Activities to occur at these locations include annual blasting, crushing, sorting, and stockpiling of granular material, primarily during summer. These permanent sources will retain material stockpiles year-round but equipment will be removed annually when not in use, except where the borrow source/quarry is also the location of a permanent maintenance yard (see Section 5.5.3). It is estimated that 30,000 m^3 to 50,000 m^3 of gravel is needed annually for road maintenance.

If and when permanent material sources need to be closed, they will be closed and reclaimed in accordance with the QDP and objectives and activities described for closing quarry sources in Section 5.4.10. Progressive reclamation will be ongoing.

5.5.6 Maintenance Yards

Permanent maintenance yards (facilities) will be located at permanent borrow/quarry sources proximal to the alignment to facilitate ongoing maintenance of the Project during the operations and maintenance phase. Their locations have not yet been determined. These permanent maintenance areas will include:

- Maintenance garage and office
- Material stockpiles
- Fuel storage
- Equipment parking area

Permanent maintenance areas will have controlled access to project personnel only.

5.5.7 Summary of Water Use for Operations and Maintenance

During operations and maintenance, water will be used for dust control. Water will be withdrawn in summer from authorized locations. Water withdrawal will be in accordance with DFO measures to protect fish and fish habitat, *Interim code of practice: end-of-pipe fish protection screens for small water intakes in freshwater,* the *DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut* (DFO, 2010), and *Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada* (DFO, 2013). The estimated water use for operations and maintenance is summarized in Table 5.10.

Table 5.10 Estimated Annual Water Use for the Project During Operations and Maintenance

Water Use	Estimated Daily Volume (all sources) (m^3)	Annual Volume (m^3)	Timing
Compaction and Dust Control	100	10,000	Summer

5.5.8 Post-construction Monitoring

Following construction, the GNWT will conduct compliance and effects monitoring in accordance with regulatory requirements and project-specific management plans to verify mitigation effectiveness, confirm environmental assessment predictions, and support adaptive management. Monitoring results will be reported as required and shared with Indigenous Governments, Indigenous Organizations, communities, and regulators. Community-based monitoring opportunities, including Indigenous Guardians and Environmental Monitors, may also be incorporated into monitoring programs, where appropriate. Examples of roles and responsibilities related to post-construction monitoring include:

<u>GNWT's Role:</u>

- Overall responsibility for implementing and overseeing post-construction monitoring programs
- Verify compliance with regulatory approvals, permits, licences, and management plans
- Review monitoring results and implement adaptive management measures where required
- Report monitoring results to regulators and share information with Indigenous Governments, communities, and other affected parties

<u>Contractor(s)' and Consultant(s)' Role:</u>

- Conduct field monitoring, inspections, data collection, and reporting in accordance with approved monitoring plans
- Identify and communicate any non-compliance issues or unexpected effects
- Support corrective actions and mitigation measures where required

<u>Regulatory Authorities' Role:</u>

- Review monitoring reports and assess compliance with approval conditions
- Provide direction on additional monitoring, mitigation, or adaptive management requirements, as necessary

Indigenous Governments, Indigenous Organizations, and Communities' Role:

- Provide input into the design and implementation of monitoring programs, where appropriate
- Participate in community-based monitoring initiatives, including Guardian and Environmental Monitor programs where applicable
- Share local and Indigenous Knowledge to support interpretation of monitoring results and adaptive management

MVH Corridor Working Group Role:

- Review monitoring results and provide advice on monitoring, mitigation, and adaptive management
- Facilitate information sharing among project partners, regulators, Indigenous Governments, and other affected parties

5.5.9 Maintenance Employment and Contracting

The operations and maintenance of the Mackenzie Valley Highway will be the responsibility of the GNWT Department of Infrastructure. Annual operations and maintenance priorities and budgets are approved as part of the government's annual budget cycle. Annual maintenance costs are estimated at $16 million to $40 million based on maintenance costs for other NWT Highways (GNWT, 2025b). Maintenance costs are anticipated to be higher for the northern portion of the Mackenzie Valley Highway than southern areas.

To undertake highway operations and maintenance, the following is an estimate of the workforce requirements, per region, supported by a maintenance yard:

- Five to eight heavy equipment operators and one supervisor during summer and winter
- Three to four casual labourers during summer

Heavy equipment operators are anticipated to be qualified to operate several types of equipment such as a grader, tandem truck, bottom dump trailer and water truck. Casual labour will be required for duties such as traffic control, litter management, visual inspections and sign maintenance.

5.5.10 Operations

The Mackenzie Valley Highway's principal purpose is to facilitate vehicle movements. It will therefore be the highway's presence that will lead to certain potential effects which must be assessed, such as those resulting from public use of the highway. Operations activities that are part of the Project include the highway's presence and the public use of the highway.

5.5.10.1 Traffic Volumes

Anticipated traffic volumes on the Mackenzie Valley Highway once constructed will reflect:

- Local traffic travelling between the communities
- Commercial traffic needed for community operations and resupply
- Traffic associated with operating small businesses, such as tourism
- Traffic associated with the National Defence related activities and emergency response during emergencies (such as wildfires)
- Industrial traffic to support exploration, development, operations and/or closure and reclamation of natural resource developments, such as oil and gas, mining, or forestry

The design of the Mackenzie Valley Highway and the assessment of potential effects on the environment as assessed in the DAR anticipates an AADT volume of up to 200 vehicles per day, including a mix of vehicles such as pickup trucks and truck trailers up to a weight of 64,000 kilograms. The approximate current AADT on the Dempster Highway west of Midway Lake over the past 10 years of record-keeping (2017-2026) is 39 vehicles (R. Thom, personal communication, July 15, 2026), whereas AADT on the MVWR over the past ten years of record-keeping is 58 vehicles per day. Diverting all vehicle traffic from the Dempster Highway to the Mackenzie Valley Highway would not exceed AADT of 200 vehicles per day.

The Mackenzie Valley Highway will accommodate potential future industrial users within the estimated AADT of up to 200 vehicles per day, within the load limits of the existing bridges. The need to accommodate industrial users beyond the design capacity of the highway and/or address additional maintenance required will be evaluated based on user needs.

5.5.11 Summary of Operations and Maintenance Works and Activities Timing

The anticipated schedule of works and activities during the operations and maintenance phase is summarized in Table 5.11.

Table 5.11 Summary of Operations and Maintenance Works and Activities Timing

Works or Activity	Timing
Borrow source and quarry operations, including blasting, crushing, sorting, and stockpiling	Summer, annually
Material haul and stockpiling	Summer, annually
Operation of and activities at maintenance yards	Year-round, annually
Water withdrawal for dust control	Summer, annually
Presence and public use of the highway	Year-round, annually
Highway and access road maintenance including repair, grading and dust control	Summer, annually

Works or Activity	Timing
Highway and access road snow clearing	Winter, annually
Vegetation control	Late summer, every three years
Bridge and culvert maintenance	Winter and summer, as needed

5.6 Closure and Reclamation

The Project will become part of the NWT Highway system, operated and maintained as capital infrastructure. The Mackenzie Valley Highway will be permanent infrastructure intended to be open in perpetuity; therefore, closure and reclamation of the Mackenzie Valley Highway is not within the scope of the Project and not a phase of the temporal scope of the assessment (see Section 4.3.3.2). The closure and reclamation of the MVWR, quarries and maintenance areas was described in Section 5.4.10.

5.7 References

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Appendix 5A Project Mapbook