Borrow Source 9.002
Geotechnical Data Report

Mackenzie Valley Highway Project
Sahtú Settlement Area, Northwest Territories

PRESENTED TO

Government of the Northwest Territories
K'alo-Stantec Limited

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ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
ASTM	American Society for Testing and Materials
GNWT-INF	Government of the Northwest Territories, Department of Infrastructure
GSC	Geological Survey of Canada
K'alo-Stantec	K'alo-Stantec Limited
KM	Kilometre Marker
MGP	Mackenzie Gas Project
MVFL	Mackenzie Valley Fibre Link
MVH	Mackenzie Valley Highway
MVWR	Mackenzie Valley Winter Road
Northridge	Northridge Contracting Ltd.
NT	Northwest Territories
Ollerhead	Ollerhead & Associates Ltd.
Program	Borrow Source *9.002* Geotechnical Investigation Program
Project	Mackenzie Valley Highway Project
Tetra Tech	Tetra Tech Canada Inc.
TMS	Tulita Monitoring Service Ltd.
Willowlake	Willowlake Environmental Ltd.

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1.0 INTRODUCTION

The Government of the Northwest Territories, Department of Infrastructure (GNWT-INF) is advancing environmental permitting and engineering for the Mackenzie Valley Highway (MVH or the Project) from Wrigley to Tulita and Norman Wells, Northwest Territories (NT). The MVH is a proposed two-lane, all-season gravel highway approximately 321 km in length that is planned to replace the seasonal Mackenzie Valley Winter Road (MVWR). As part of the Project, the GNWT-INF is looking to identify and evaluate existing and potential granular borrow sources to support construction of the MVH in the Sahtú Settlement Area between MVWR Kilometre Marker (KM) 850 and Tulít'a (MVWR KM 940). In 2024, four existing or potential granular borrow sources (the Borrow Sources) along this section of the MVH were selected for further investigation: *9.002* (MVWR KM 851), *BS895* (MVWR KM 895), *BS899* (MVWR KM 899), and *BS900* (MVWR KM 900).

The team of Tetra Tech Canada Inc. (Tetra Tech) and K'alo-Stantec Limited (K'alo-Stantec) were retained under Standing Offer Agreement Contract *SC-INF01-7455* to conduct a geotechnical investigation program (the Program) for the Borrow Sources in Winter 2025. The objective of the Program was to characterize the subsurface materials and extents at the Borrow Sources to support future design and construction of the MVH. The Borrow Sources selected for this Program included one primary granular borrow source (*9.002*) identified in Table 5.4 of the *2023 Mackenzie Valley Highway Project Developer's Assessment Report* (GNWT 2023) as well as three new potential granular borrow sources *(BS895, BS899, BS900*) identified by Tetra Tech and K'alo-Stantec within the "Tulita Gap" (Tetra Tech 2024).

This report presents the results of the data collected from the geotechnical investigation conducted at Borrow Source *9.002*, including geotechnical testpit logs, geotechnical laboratory test results, field photographs, and site figures. It also provides an engineering assessment of the borrow material quality and suitability for use in MVH construction.

1.1 Borrow Source Description

Borrow Source *9.002* is an existing granular borrow source located in the Sahtú Settlement Area at MVWR KM 851, as shown on Figure 1 (see Figures section). The granular borrow source is intersected by the MVWR and consists of two separate land parcels: North (264,752 m^2) and South (178,207 m^2). It is located southeast of Little Smith Creek (MVWR KM 853.8) and is approximately 2 km east of the Mackenzie River (K'alo-Stantec 2021a).

The granular borrow source consists of a large glaciofluvial terrace approximately 2.4 km in length and 0.7 km in width. The terrace is characterized by good drainage and moderate vegetation density, with dense growths of spruce and birch supported by a thin topsoil layer. The granular deposit is stratified, comprising fine-grained to medium-grained sand and coarse-grained gravel.

Borrow Source *9.002* is situated on privately-owned (Sahtú) land and is planned to be a permanent granular borrow source to support construction, operations, and maintenance of the MVH. Nearby developments include the MVWR, the Mackenzie Valley Fibre Link (MVFL), and the Enbridge Line 21 Pipeline. The MVWR and MVFL intersect the existing granular borrow source and are in close proximity to both of its land parcels. Enbridge's Line 21 Pipeline is located approximately 200 m west of the existing granular borrow source.

1.2 Relevant Background Information

Borrow Source *9.002* (formerly Site No. 228) was first identified and investigated in 1973 by PEMCAN Services "72" during development of the MVH (K'alo-Stantec 2021a). A geotechnical investigation of the potential granular borrow source, including seven boreholes and one testpit, was conducted in February 1973. Relevant background data from this past geotechnical investigation program is provided in Appendix A.

In 2007, the borrow source (formerly Site No. 9.002PB) was also investigated as part of the Mackenzie Gas Project (MGP) to support its preliminary engineering design (EBA 2007). A geotechnical and geophysical investigation program of the existing granular borrow source was conducted in February 2007, which included one borehole, four testpits, and two geophysical survey profiles. The MGP program confirmed a significant deposit of well-graded sand and gravel and the combination of geotechnical drilling, geotechnical testpitting, and geophysical surveys provided confidence in Borrow Source *9.002*'s thickness, lateral extent, and gradational structure.

Several other borrow source studies have previously been conducted for the Project and were referenced during the Program, as listed in Table 1-1. Other relevant background information provided to Tetra Tech included spatial data and aerial imagery for the Program's Borrow Sources.

Table 1-1: Relevant Background Information for Borrow Source *9.002*

Document Title	Date Issued	Reference	Key Information
Mackenzie Gas Project – Winter 2007 Geotechnical and Geophysical Program Data Report for Borrow Prospect Investigations, Sahtu Settlement Area, Tulita District	November 2007	EBA (2007)	▪ Previous geotechnical and geophysical investigation data, including geotechnical borehole and testpit logs, geotechnical laboratory test results, site photographs, and geophysical survey profiles. ▪ Description of subsurface conditions for Borrow Source *9.002*, including stratigraphy, groundwater, active layer depths, and permafrost presence.
Mackenzie Valley Highway – Desktop Review of Prospect Borrow Sources	September 11, 2020	K'alo-Stantec (2020a)	▪ Desktop assessment and findings identifying Borrow Source *9.002* as a viable primary granular borrow source.
Mackenzie Valley Highway – Assessment of Prospective Borrow Sources – Geotechnical Engineering Recommendations	December 11, 2020	K'alo-Stantec (2020b)	▪ Geotechnical recommendations for granular borrow source investigation and characterization on the Project.
Mackenzie Valley Highway Extension Project – Prospective Borrow Sources Assessment	February 2021	K'alo-Stantec (2021a)	▪ Desktop evaluation of borrow sources supplemented by a field reconnaissance. ▪ Identifies Borrow Source *9.002* as a primary source with a substantial volume of high-quality granular material.
Summary of Borrow Source / Quarry Evaluations Leading to Selection of 15 Primary Sources	May 5, 2021	K'alo-Stantec (2021b)	▪ Summarizes previous evaluations of Borrow Source *9.002*, including its selection as a primary source for construction and long-term maintenance. ▪ Outlines technical, environmental, and land use considerations.

1.3 Program Subcontractors

Support for the Program, including surveying, site access clearing, geotechnical testpitting, and environmental monitoring, was provided by the following NT-based subcontractors:

- Surveying:
  - Ollerhead & Associates Ltd. (Ollerhead) of Yellowknife, NT.
- Site Access Clearing:
  - Willowlake Environmental Ltd. (Willowlake) of Tulít'a, NT.
- Geotechnical Testpitting:
  - Northridge Contracting Ltd. (Northridge) of Norman Wells, NT.
- Environmental Monitoring:
  - Tulita Monitoring Service Ltd. (TMS) of Tulít'a, NT.

2.0 GEOTECHNICAL INVESTIGATION

The geotechnical investigation of Borrow Source *9.002* was conducted between March 9 to 26, 2025 and included three main activities: surveying, site access clearing, and geotechnical testpitting. Environmental monitoring was conducted throughout the Program to ensure all activities were environmental and wildlife compliant.

Surveying for Borrow Source *9.002* was carried out by Ollerhead on March 9 and 10, 2025 and included the layout of testpit locations and their associated cutline alignments for site access. Site access clearing, including vegetation mulching and snow clearing, was conducted on March 19 and 20, 2025 to facilitate geotechnical testpitting. The testpit locations and associated access cutlines were mulched and hand cleared by Willowlake, under the supervision of Teri Brito, P.Eng. (BC) of Tetra Tech and an environmental monitor from TMS.

Geotechnical testpitting at Borrow Source *9.002* was conducted on March 25 and 26, 2025. A total of seven testpits were excavated as part of the Program using a Northridge hydraulic excavator. Geotechnical logging, photography, and sampling was performed by April Graves, E.I.T., of Tetra Tech.

The location of Borrow Source *9.002* and its associated testpits are shown on Figure 1 (see Figures section). Select field photographs from the geotechnical investigation are shown on Photos 1 to 18 (see Photographs section). Geotechnical testpit logs for Borrow Source *9.002* are presented in Appendix B.

2.1 Testpit Locations and Methodology

Seven testpits were excavated as part of the geotechnical investigation for Borrow Source *9.002*, as shown on Figure 1 (see Figures section). Testpit coordinates are summarized in Table 2-1 and presented in Table A (see Tables section).

Table 2-1: Testpit Information for Borrow Source *9.002*

Testpit Number	Mackenzie Valley Highway Location (MVWR KM)	Testpit Coordinates (m, UTM Zone 10: NAD83)		Ground Elevation (m)	Completion Depth (m)
		Northing	Easting		
TP25-9.002-01	851.2	7,145,895	416,882	126.9	6.0
TP25-9.002-02	851.0	7,145,719	417,068	128.4	6.0
TP25-9.002-03	851.2	7,145,996	417,180	129.8	6.0
TP25-9.002-04	851.0	7,145,804	417,210	130.0	6.0
TP25-9.002-05	850.8	7,145,599	417,329	132.9	6.0
TP25-9.002-06	850.7	7,145,199	416,965	130.5	6.0
TP25-9.002-07	850.4	7,144,835	417,235	133.0	6.0

Ollerhead surveyed and staked the testpit locations in the field prior to geotechnical testpitting. Following the completion of geotechnical testpitting, the as-excavated testpit coordinates and elevations were surveyed by Ollerhead, as shown on the geotechnical testpit logs in Appendix B.

The geotechnical testpitting was completed using a CAT 329E hydraulic excavator, owned and operated by Northridge. Each testpit was excavated to the maximum depth achievable by the excavator or until effective refusal was encountered. Following completion, the testpits were backfilled with the excavated material in the reverse sequence it was removed (i.e., organics on top). The material was nominally compacted and mounded over the testpit excavation to match the original ground surface.

2.2 Geotechnical Logging and Sampling

All recovered soils were logged and photographed at their respective testpit locations, allowing for accurate classification and sampling of the subsurface materials encountered.

Soils were classified according to the *Modified Unified Soil Classification* system. The frozen state of the soils was described according to the National Research Council Canada's *Ground Ice Classification* system. Soil logging consisted of identifying the following parameters:

- Soil Composition
- Particle Size
- Angularity/Shape
- Moisture
- Plasticity
- Colour
- Frozen/Unfrozen State
- Ground Ice Description

Representative soil samples (i.e., grab samples) were taken at approximately 1 m intervals or where a change in stratigraphy was noted as the testpit was excavated. The disturbed samples were placed in plastic bags, double-bagged for moisture preservation, and transported to Tetra Tech's materials laboratory in Yellowknife for geotechnical laboratory testing.

2.3 Geotechnical Laboratory Testing

Geotechnical laboratory testing on recovered soil samples from Borrow Source *9.002* was completed at Tetra Tech's materials laboratory in Yellowknife, NT. The geotechnical laboratory testing program included:

- Moisture Contents;
- Particle Size Analyses (Sieves);
- Atterberg Limits;
- Moisture-Density Relationship (Standard Proctor); and
- Flat and Elongated Particles (including Fractured Face Counts).

Geotechnical laboratory testing results for Borrow Source *9.002* are summarized in Table B (see Tables section) and are shown on the geotechnical testpit logs in Appendix B. Detailed results for all geotechnical laboratory testing for Borrow Source *9.002* are provided in Appendix C.

2.3.1 Moisture Contents

Moisture contents were determined, in accordance with ASTM *D2216*, on a total of 42 soil samples from Borrow Source *9.002*. Moisture content values ranged from 0.2% to 24.3%. Results are presented in Table B (see Tables section) and on the geotechnical testpit logs in Appendix B.

2.3.2 Particle Size Analyses

Particle size analyses (i.e., sieves) were performed on select soil samples from Borrow Source *9.002* to characterize the borrow material. A total of 16 sieves were completed, in accordance with ASTM *D6913*. The particle size analyses test results are summarized in Table 2-2.

Table 2-2: Particle Size Analyses Test Results for Borrow Source *9.002*

Testpit Number	Sample Depth (m)		Moisture Content (%)	Particle Size Distribution (%)		
	From	To		Gravel	Sand	Silt and Clay
TP25-9.002-01	0.9	1.0	6.4	28	42	30
	4.5	5.0	16.6	8	85	7
TP25-9.002-02	0.9	1.0	2.1	22	77	1
	1.8	2.0	1.8	33	65	2
	5.0	5.5	6.0	3	96	1
TP25-9.002-03	0.9	1.0	2.3	54	41	5
	3.5	4.0	2.4	5	94	1
TP25-9.002-04	0.9	1.0	5.5	13	31	56
	2.5	3.0	0.2	6	93	1
TP25-9.002-05	0.9	1.0	1.7	59	37	4
	3.5	4.0	1.9	9	90	1
	5.5	6.0	7.7	0	77	23
TP25-9.002-06	1.0	1.1	1.7	55	44	1
	5.7	5.9	12.7	19	73	8
TP25-9.002-07	0.9	1.0	2.3	70	27	3
	4.0	4.5	1.9	47	52	1

2.3.3 Atterberg Limits

Atterberg Limits testing was conducted on four fine-grained soil samples obtained from testpits at Borrow Source *9.002*, in accordance with ASTM *D4318*. The Atterberg Limits test results are summarized in Table 2-3.

Table 2-3: Atterberg Limits Test Results for Borrow Source *9.002*

Testpit Number	Sample Depth (m)		Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Modified Unified Soil Classification
	From	To					
TP25-9.002-01	1.8	2.0	4.7	-	-	-	NP
TP25-9.002-02	5.7	6.0	23.0	52	23	29	CH
TP25-9.002-03	5.9	6.0	19.6	27	17	10	CL
TP25-9.002-04	5.9	6.0	24.3	-	-	-	NP

2.3.4 Moisture-Density Relationship

Moisture-Density Relationship (Standard Proctor) testing, in accordance with ASTM *D698*, was performed on one representative bulk sample from Borrow Source *9.002*. The Moisture-Density Relationship test result is summarized in Table 2-4.

Table 2-4: Moisture-Density Relationship Test Result for Borrow Source *9.002*

Testpit Number	Sample Depth (m)		Moisture Content (%)	Maximum Dry Density (kg/m^3)	Optimum Moisture Content (%)
	From	To			
TP25-9.002-04	2.5	3.0	0.2	1760	13.5

2.3.5 Flat and Elongated Particles (including Fractured Face Counts)

Flat and Elongated Particles testing, in accordance with ASTM *D4791-19*, was performed on 16 coarse-grained soil samples from Borrow Source *9.002*. Each sample was tested at flat/elongated ratios of 2:1 and 3:1. Fractured face counts were also completed on each sample. The Flat and Elongated Particles test results are summarized in Table 2-5.

Table 2-5: Flat and Elongated Particles Test Results for Borrow Source *9.002*

Testpit Number	Sample Depth (m)		Weighted Average of Flat and Elongated Particles (%, 5 mm Retained)		Fractured Face Count (%, 2 or more faces)
	From	To	2:1 Ratio	3:1 Ratio	
TP25-9.002-01	0.9	1.0	0.0	0.0	2.6
	1.8	2.0	0.0	0.0	0.1
TP25-9.002-02	0.9	1.0	0.0	0.0	0.5
	1.8	2.0	0.0	0.0	0.2
TP25-9.002-03	0.9	1.0	0.0	0.0	0.4
	2.7	3.0	0.0	0.0	1.8
	4.5	5.0	0.0	0.0	0.5

Table 2-5: Flat and Elongated Particles Test Results for Borrow Source *9.002*

Testpit Number	Sample Depth (m)		Weighted Average of Flat and Elongated Particles (%, 5 mm Retained)		Fractured Face Count (%, 2 or more faces)
	From	To	2:1 Ratio	3:1 Ratio	
TP25-9.002-04	0.9	1.0	0.0	0.0	0.2
	1.8	2.0	0.0	0.0	0.5
	2.8	3.0	0.0	0.0	1.4
TP25-9.002-05	0.9	1.0	0.0	0.0	1.0
	1.8	2.0	0.0	0.0	0.1
	2.7	3.0	0.0	0.0	0.6
TP25-9.002-06	1.0	1.1	0.0	0.0	5.9
	2.6	3.0	0.0	0.0	1.5
	4.5	5.0	0.0	0.0	2.7
TP25-9.002-07	0.9	1.0	0.0	0.0	0.9
	1.9	2.0	0.0	0.0	1.2
	4.5	5.0	0.0	0.0	0.2
	5.0	5.5	0.0	0.0	0.8

3.0 SUBSURFACE CONDITIONS

The subsurface conditions for Borrow Source *9.002* are summarized herein based on the geotechnical findings from the Program. Testpit locations are shown on a site plan of the borrow source on Figure 1 (see Figures section). Geotechnical data is presented in on the geotechnical testpit logs in Appendix B.

3.1 Stratigraphy

The subsurface conditions identified for Borrow Source *9.002* consisted of four primary stratigraphic layers:

- Gravel and Sand (also Gravel, Sandy)
- Sand, Gravelly
- Silt, Sandy
- Clay

At ground surface, Borrow Source *9.002* was covered with a 100 mm-thick layer of Organics (Peat or Topsoil), which was frozen and brown to black in colour. The following subsections provide detailed descriptions of each primary stratigraphic layer identified for Borrow Source *9.002*.

3.1.1 Gravel and Sand

A Gravel and Sand (also Gravel, Sandy) layer was encountered beneath the Organics (Peat or Topsoil) layer in all testpits completed for Borrow Source *9.002*, except Testpits *TP25-9.002-01* and *TP25-9.002-04*. The layer ranged in thickness from approximately 0.7 m to 1.4 m and was underlain by a Sand, Gravelly layer.

The Gravel and Sand layer consisted of medium to coarse-grained sand with trace silt and subrounded to rounded gravel. The granular material was brown in colour and exhibited moisture contents between 1.7% and 2.3%, which was described as *Dry* when unfrozen. The coarse-grained soil layer contained nearly no flat and elongated particles with fractured face counts (2 or more faces) ranging from 0.4% to 5.9%.

3.1.2 Sand, Gravelly

A Sand, Gravelly layer was encountered in all the Borrow Source *9.002* testpits. The layer underlays the Gravel and Sand layer in most of the testpits, except for Testpits *TP25-9.002-04* (Silt, Sandy) and *TP25-9.002-01* (Organics). The Sand, Gravelly layer ranged in thickness from 4.4 m to 5.9 m and extended to the depth of excavation in all testpits, except for Testpits *TP25-9.002-02* and *TP25-9.002-03*.

The Sand, Gravelly layer was generally described as containing some gravel and trace silt. In Testpits *TP25-9.002-01* (0.1 m to 2.5 m depth), *TP25-9.002-04* (5.9 m to 6.0 m depth), and *TP25-9.002-05* (5.6 m to 6.0 m depth), the layer exhibited silty characteristics. Gravel content typically decreased with depth, ranging from gravelly near the top of the layer to no visible gravel at depth. The granular material was brown to dark brown in colour. Moisture contents ranged from 1.1% to 16.6%, which were described as *Dry* to *Wet* when unfrozen. The coarse-grained soil layer contained nearly no flat and elongated particles with fractured face counts (2 or more faces) ranging from 0.1% to 2.7%.

3.1.3 Silt, Sandy

A layer of Silt, Sandy was observed only in Testpit *TP25-9.002-04*, underlying the Organics (Peat or Topsoil) layer to a depth of 0.9 m below ground surface. The layer was brown in colour and contained some gravel and trace clay. When unfrozen, the fine-grained material had a moisture content of 5.5%.

3.1.4 Clay

Clay was encountered at the base of excavation in Testpits *TP25-9.002-02* and *TP25-9.002-03*, underlying the Sand, Gravelly layer. This fine-grained material was encountered at the maximum depth of excavation and is at least 0.2 m thick.

The Clay was typically silty with trace to some sand and trace gravel. The layer was dark brown or grey in colour. In Testpit *TP25-9.002-02*, the Clay was high plastic (*CH*) with a moisture content of 23.0%. In Testpit *TP25-9.002-03*, the Clay was low plastic (*CL*) with a moisture content of 19.6%. In both cases, the moisture contents were within the range between the plastic and liquid limits of the fine-grained material.

3.2 Groundwater

Groundwater was not encountered in any of the testpits completed for Borrow Source *9.002*.

3.3 Active Layer

The depth of the active layer (i.e., seasonal thaw depth) is anticipated to vary locally across Borrow Source *9.002* depending on the surficial materials, depth of bedrock, and depth of groundwater as well as the thickness of vegetation and snow cover. During the Program, the depth of the active layer was not accurately determined due to the dryness of the granular materials encountered and the limited frozen/unfrozen indicators.

The Geological Survey of Canada (GSC) maintains a series of active layer monitoring sites within the Mackenzie Valley, several of which have been in operation since the early 1990s (K'alo-Stantec 2023). GSC Site ID *OFP-01* is located near MVWR KM 881 and is considered the closest and most relevant active layer monitoring site to Borrow Source *9.002.* The site is located within a *Till, plain* (*Tp*) deposit and has similar vegetation cover to Borrow Source *9.002*, which recorded maximum thaw depths of up to 3.1 m below ground surface. These values are considered representative of the expected active layer conditions at Borrow Source *9.002*.

3.4 Permafrost

No permafrost soils were identified in the testpits completed for Borrow Source *9.002*.

4.0 BORROW SOURCE ASSESSMENT

Findings from the geotechnical investigation of Borrow Source *9.002* have been developed based on the new data collected by Tetra Tech during the Program as well as the available background data. Background data for Borrow Source *9.002* is provided in Appendix A. Geotechnical data from the Program is presented on the geotechnical testpit logs in Appendix B.

4.1 Estimated Granular Material Quantities

The approximate surface area of Borrow Source *9.002* is 442,959 m², as shown on Figure 1 (see Figures section). Combining this information with results from the geotechnical investigation, estimated granular material quantities were calculated based on the surface area of the potential granular borrow source that was previously mapped (K'alo-Stantec 2021a).

Testpit findings are assumed to be representative of the subsurface conditions within Borrow Source *9.002*; however, the actual extent of granular materials may extend beyond or could be smaller than the borrow source boundaries identified on Figure 1.

Estimated granular material quantities for the Gravel and Sand layer and the Sand, Gravelly layer are provided in Table 4-1. The Silt, Sandy and Clay layers encountered in Borrow Source *9.002* are predominantly fine-grained, poorly-graded materials and are not considered suitable for MVH construction.

Table 4-1: Estimated Granular Material Quantities for Borrow Source *9.002*

Granular Material Type	Surface Area (m^2)	Average Granular Material Thickness (m)	Estimated Granular Material Quantity (m^3)
Gravel and Sand	442,959	0.9	400,000
Sand, Gravelly		4.8 [1]	2,126,000
TOTAL			**2,526,000**

[1] *Sand, Gravelly layer extended to the depth of investigation in each testpit; however, the thickness of the deposit may be greater.*

4.2 Granular Material Suitability

Tetra Tech reviewed and assessed the following granular materials against the crushed aggregate types specified for NT highways in the GNWT-INF's *Standard Specifications for Highway Construction* (GNWT 2021). Particle size analyses test results were compared against the specified gradations outlined in *Division 5 (Granular Materials), Section 1 (Crushed Aggregate Production)* of the standard specification. Granular materials that conformed to the specified gradation were deemed *Suitable* and those that did not were deemed *Not Suitable*.

For all *Suitable* granular materials, oversize materials (i.e., cobbles and boulders) should be screened out or crushed prior to use. All organics and deleterious materials (e.g., vegetation, ice, snow) should be removed and stockpiled prior to the extraction of granular materials.

4.2.1 Gravel and Sand

The Gravel and Sand (also Gravel, Sandy) layer encountered at Borrow Source *9.002* was generally well-graded and contained medium-grained sand to coarse-grained gravel and trace fines (i.e., silt and clay). Tetra Tech assessed the layer's granular material suitability against the GNWT-INF's standard specifications (GNWT 2021) for each crushed aggregate type, as outlined below:

- Embankment Rock Fill (5.1.3.4b, i):
  - *Not Suitable* (All Classes, including Class 150 mm, Class 200 mm, and Class 300 mm).
- Granular Base Course (5.1.3.4b, ii):
  - *Suitable* (All Classes, including Class 12.5 mm, Class 16.0 mm, Class 19.0 mm, and Class 20.0 mm).
- Granular Subbase (5.1.3.4b, iii):
  - *Suitable* (All Classes, including Class 40 mm, Class 50 mm, Class 76 mm, Class 80 mm, and Class 100 mm).

4.2.2 Sand, Gravelly

The Sand, Gravelly layer encountered at Borrow Source *9.002* was typically medium-grained sand with some gravel and trace silt. Tetra Tech assessed the suitability of this granular material against the GNWT-INF's standard specifications (GNWT 2021) for each crushed aggregate type, as outlined below:

- Embankment Rock Fill (5.1.3.4b, i):
  - *Not Suitable* (All Classes, including Class 150 mm, Class 200 mm, and Class 300 mm).
- Granular Base Course (5.1.3.4b, ii):
  - *Not Suitable* (All Classes, including Class 12.5 mm, Class 16.0 mm, Class 19.0 mm, and Class 20.0 mm).
- Granular Subbase (5.1.3.4b, iii):
  - Class 40 mm: *Not Suitable*
  - Class 50 mm: *Not Suitable*
  - Class 76 mm: *Suitable*
  - Class 80 mm: *Not Suitable*
  - Class 100 mm: *Suitable*

5.0 CLOSURE

We trust this data report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
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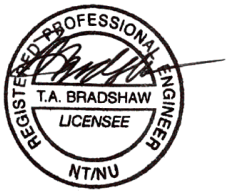

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TABLES

TABLE A: GEOTECHNICAL INVESTIGATION INFORMATION SUMMARY

Project: Mackenzie Valley Highway, Borrow Source 9.002
Project Number: 704-ENG.EARC03299-03
Client: Government of the Northwest Territories (K'alo-Stantec)
Location: Sahtú Settlement Area, Northwest Territories

TETRA TECH

Coordinate System: UTM with NAD83, Zone 10N
Completion Dates: March 25 to 26, 2025
Logged By: April Graves
Total Testpits: 7

Testpit Number	Mackenzie Valley Highway Location (MVWR KM)	Testpit Coordinates (m, NAD83 [CSRS] Epoch 2010)		Ground Elevation (m)	Completion Depth (m)	Completion Elevation (m)	Groundwater Depth (m)	Groundwater Elevation (m)	Completion Date
		Northing	Easting						
TP25-9.002-01	851.2	7,145,895.0	416,882.0	126.9	6.0	120.9	-	-	March 25, 2025
TP25-9.002-02	851.0	7,145,719.0	417,068.1	128.4	6.0	122.4	-	-	March 25, 2025
TP25-9.002-03	851.2	7,145,995.6	417,180.0	129.8	6.0	123.8	-	-	March 26, 2025
TP25-9.002-04	851.0	7,145,803.9	417,210.0	130.0	6.0	124.0	-	-	March 26, 2025
TP25-9.002-05	850.8	7,145,599.1	417,328.7	132.9	6.0	126.9	-	-	March 26, 2025
TP25-9.002-06	850.7	7,145,199.0	416,965.1	130.5	6.0	124.5	-	-	March 25, 2025
TP25-9.002-07	850.4	7,144,835.0	417,235.0	133.0	6.0	127.0	-	-	March 25, 2025

TABLE B: GEOTECHNICAL LABORATORY TEST RESULTS SUMMARY

Project: Mackenzie Valley Highway, Borrow Source 9.002
Project Number: 704-ENG.EARC03299-03
Client: Government of the Northwest Territories (K'alo-Stantec)
Location: Sahtú Settlement Area, Northwest Territories

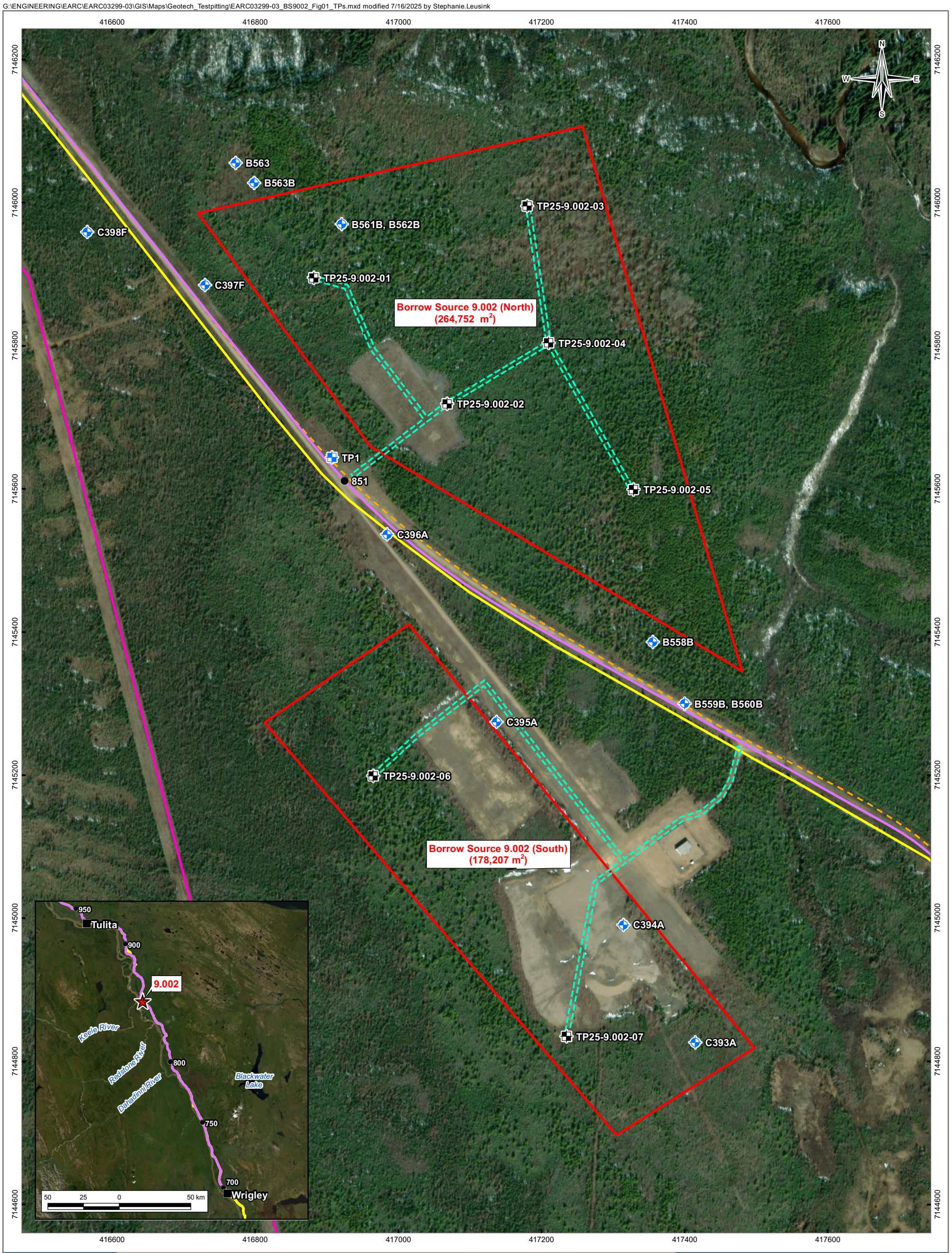
TETRA TECH

Sampled By: April Graves
Sample Date: March 25 to 26, 2025
Tested By: Yellowknife Materials Laboratory
Total Testpits: 7

Testpit Number	Sample Number	Sample Type	Sample Depth (m)		Moisture Content (%)	Particle Size Distribution (%)				Atterberg Limits			Modified Unified Soil Classification	Maximum Dry Density (kg/m^3)	Optimum Moisture Content (%)	Fractured Face Count (%)
			From	To		Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index				
TP25-9.002-01	G1	Grab	0.9	1.0	6.4	28	42	30		-	-	-	SM	-	-	2.6
	G2	Grab	1.8	2.0	4.7	-	-	-		N/A	N/A	N/A	NP	-	-	0.1
	G3	Grab	2.6	3.0	2.1	-	-	-		-	-	-	-	-	-	-
	G4	Grab	3.5	4.0	16.3	-	-	-		-	-	-	-	-	-	-
	G5	Grab	4.5	5.0	16.6	8	85	7		-	-	-	SP	-	-	-
	G6	Grab	5.0	6.0	-	-	-	-		-	-	-	-	-	-	-
TP25-9.002-02	G1	Grab	0.9	1.0	2.1	22	77	1		-	-	-	SP	-	-	0.5
	G2	Grab	1.8	2.0	1.8	33	65	2		-	-	-	SP	-	-	0.2
	G3	Grab	2.6	3.0	2.2	-	-	-		-	-	-	-	-	-	-
	G4	Grab	4.0	4.5	3.7	-	-	-		-	-	-	-	-	-	-
	G5	Grab	5.0	5.5	6.0	3	96	1		-	-	-	SP	-	-	-
	G6	Grab	5.7	6.0	23.0	-	-	-		52	23	29	CH	-	-	-
TP25-9.002-03	G1	Grab	0.9	1.0	2.3	54	41	5		-	-	-	GP	-	-	0.4
	G2	Grab	1.8	2.0	2.0	-	-	-		-	-	-	-	-	-	-
	G3	Grab	2.7	3.0	2.4	-	-	-		-	-	-	-	-	-	1.8
	G4	Grab	3.5	4.0	2.4	5	94	1		-	-	-	SP	-	-	-
	G5	Grab	4.5	5.0	2.2	-	-	-		-	-	-	-	-	-	0.5
	G6	Grab	5.9	6.0	19.6	-	-	-		27	17	10	CL	-	-	-
TP25-9.002-04	G1	Grab	0.9	1.0	5.5	13	31	56		-	-	-	ML	-	-	0.2
	G2	Grab	1.8	2.0	2.5	-	-	-		-	-	-	-	-	-	0.5
	G3	Grab	2.5	3.0	0.2	6	93	1		-	-	-	SP	1760	13.5	-
	G4	Grab	2.8	3.0	2.1	-	-	-		-	-	-	-	-	-	1.4
	G5	Grab	3.8	4.3	2.5	-	-	-		-	-	-	-	-	-	-
	G6	Grab	4.5	5.0	2.9	-	-	-		-	-	-	-	-	-	-
	G7	Grab	5.9	6.0	24.3	-	-	-		N/A	N/A	N/A	NP	-	-	-
TP25-9.002-05	G1	Grab	0.9	1.0	1.7	59	37	4		-	-	-	GP	-	-	1.0
	G2	Grab	1.8	2.0	1.3	-	-	-		-	-	-	-	-	-	0.1
	G3	Grab	2.7	3.0	2.3	-	-	-		-	-	-	-	-	-	0.6
	G4	Grab	3.5	4.0	1.9	9	90	1		-	-	-	SP	-	-	-
	G5	Grab	4.5	5.0	2.8			-		-	-	-	-	-	-	-
	G6	Grab	5.5	6.0	7.7	0	77	23		-	-	-	SM	-	-	-
TP25-9.002-06	G1	Grab	1.0	1.1	1.7	55	44	1		-	-	-	GP	-	-	5.9
	G2	Grab	2.1	2.3	1.1	-	-	-		-	-	-	-	-	-	-
	G3	Grab	2.6	3.0	2.3	-	-	-		-	-	-	-	-	-	1.5
	G4	Grab	3.5	4.0	1.9	-	-	-		-	-	-	-	-	-	-
	G5	Grab	4.5	5.0	5.1	-	-	-		-	-	-	-	-	-	2.7
	G6	Grab	5.7	5.9	12.7	19	73	8		-	-	-	SP	-	-	-
TP25-9.002-07	G1	Grab	0.9	1.0	2.3	70	27	3		-	-	-	GW	-	-	0.9
	G2	Grab	1.9	2.0	4.6	-	-	-		-	-	-	-	-	-	1.2
	G3	Grab	2.8	3.0	2.3	-	-	-		-	-	-	-	-	-	-
	G4	Grab	4.0	4.5	1.9	47	52	1		-	-	-	SP	-	-	0.2
	G5	Grab	5.0	5.5	2.0	-	-	-		-	-	-	-	-	-	0.8
	G6	Grab	5.5	6.0	2.0	-	-	-		-	-	-	-	-	-	-

FIGURES

G:\ENGINEERING\EARC\EARC03299-03\GIS\Maps\Geotech_Testpitting\EARC03299-03_BS9002_Fig01_TPs.mxd modified 7/16/2025 by Stephanie.Leusink



LEGEND

- 2025 Testpit (Tetra Tech, 2025)
- 1973 Borehole (PEMCAN, 1973)
- 1973 Testpit (PEMCAN, 1973)
- Proposed Mackenzie Valley Highway Alignment Kilometre Marker
- Potential Borrow Source
- Access Trail
- Proposed Mackenzie Valley Highway Alignment (2022 IFEA)
- Mackenzie Valley Winter Road
- Enbridge Line 21 Pipeline
- Mackenzie Valley Fibre Link

NOTES
Base data source:
Imagery provided by ESRI; Maxar (2024)

STATUS
ISSUED FOR USE

MACKENZIE VALLEY HIGHWAY WINTER 2025 GEOTECHNICAL

Borrow Source 9.002 Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

Scale: 1:5,000
100 50 0 100
Metres

TETRA TECH
Kálo-Stantec

FILE NO.				
EARC03299-03_BS9002_Fig01_TPs.mxd				
OFFICE	**DWN**	**CKD**	**APVD**	**REV**
Tt-EDM	SL	MRB	TB	1
DATE	**PROJECT NO.**			
Sept. 26, 2025	ENG.EARC03299-03			

Figure 1

PHOTOGRAPHS

Photo 1: Borrow Source *9.002* (North) Site Access Clearing
Site access clearing in progress near MVWR KM 850
(Photo Date: March 19, 2025)

Photo 2: Borrow Source *9.002* (North), Testpit *TP25-9.002-01*
Site access clearing completed for Testpit *TP25-9.002-01*
(Photo Date: March 20, 2025)

Photo 3: Borrow Source *9.002* (North) Testpitting
Excavating for Testpit *TP25-9.002-01*
(Photo Date: March 25, 2025)

Photo 4: Borrow Source *9.002* (North) Testpitting
Backfilling completed for Testpit *TP25-9.002-05*
(Photo Date: March 26, 2025)

Photo 5: Borrow Source *9.002* (North), Testpit *TP25-9.002-01*
Sand excavated from Testpit *TP25-9.002-01*
(Photo Date: March 25, 2025)

Photo 6: Borrow Source *9.002* (North), Testpit *TP25-9.002-01*
Sand observed in Testpit *TP25-9.002-01*
(Photo Date: March 25, 2025)

Photo 7: Borrow Source *9.002* (North), Testpit *TP25-9.002-02*
Gravel and Sand excavated from Testpit *TP25-9.002-02*
(Photo Date: March 25, 2025)

Photo 8: Borrow Source *9.002* (North), Testpit *TP25-9.002-02*
Gravel and Sand observed in Testpit *TP25-9.002-02*
(Photo Date: March 25, 2025)

Photo 9: Borrow Source *9.002* (North), Testpit *TP25-9.002-03*
Gravel and Sand excavated from Testpit *TP25-9.002-03*
(Photo Date: March 26, 2025)

Photo 10: Borrow Source *9.002* (North), Testpit *TP25-9.002-03*
Gravel and Sand observed in Testpit *TP25-9.002-03*
(Photo Date: March 26, 2025)

Photo 11: Borrow Source *9.002* (North), Testpit *TP25-9.002-04*
Silt and Sand excavated from Testpit *TP25-9.002-04*
(Photo Date: March 26, 2025)

Photo 12: Borrow Source *9.002* (North), Testpit *TP25-9.002-04*
Silt and Sand observed in Testpit *TP25-9.002-04*
(Photo Date: March 26, 2025)

Photo 13: Borrow Source *9.002* (North), Testpit *TP25-9.002-05*
Gravel and Sand excavated from Testpit *TP25-9.002-05*
(Photo Date: March 26, 2025)

Photo 14: Borrow Source *9.002* (North), Testpit *TP25-9.002-05*
Gravel and Sand observed in Testpit *TP25-9.002-05*
(Photo Date: March 26, 2025)

Photo 15: Borrow Source *9.002* (South), Testpit *TP25-9.002-06*
Gravel and Sand excavated from Testpit *TP25-9.002-06*
(Photo Date: March 25, 2025)

Photo 16: Borrow Source *9.002* (South), Testpit *TP25-9.002-06*
Gravel and Sand observed in Testpit *TP25-9.002-06*
(Photo Date: March 25, 2025)

Photo 17: Borrow Source *9.002* (South), Testpit *TP25-9.002-07*
Gravel and Sand excavated from Testpit *TP25-9.002-07*
(Photo Date: March 25, 2025)

Photo 18: Borrow Source *9.002* (South), Testpit *TP25-9.002-07*
Gravel and Sand observed in Testpit *TP25-9.002-07*
(Photo Date: March 25, 2025)

APPENDIX A

BORROW SOURCE *9.002* BACKGROUND DATA (K'ALO-STANTEC 2021A)

Borrow Source ID	9.002	**Borrow Type**	Granular (existing)
Cross Reference IDs	228 (4); (19)		
Location / Land Ownership	Private (Sahtu)		
Coordinates (Lat/Long)	64° 25' 13.541"		-124° 43' 2.640"
Coordinates (UTM)	UTM 10	7144983	417270
MVWR KM Station / Distance	851	Intersected by MVWR	

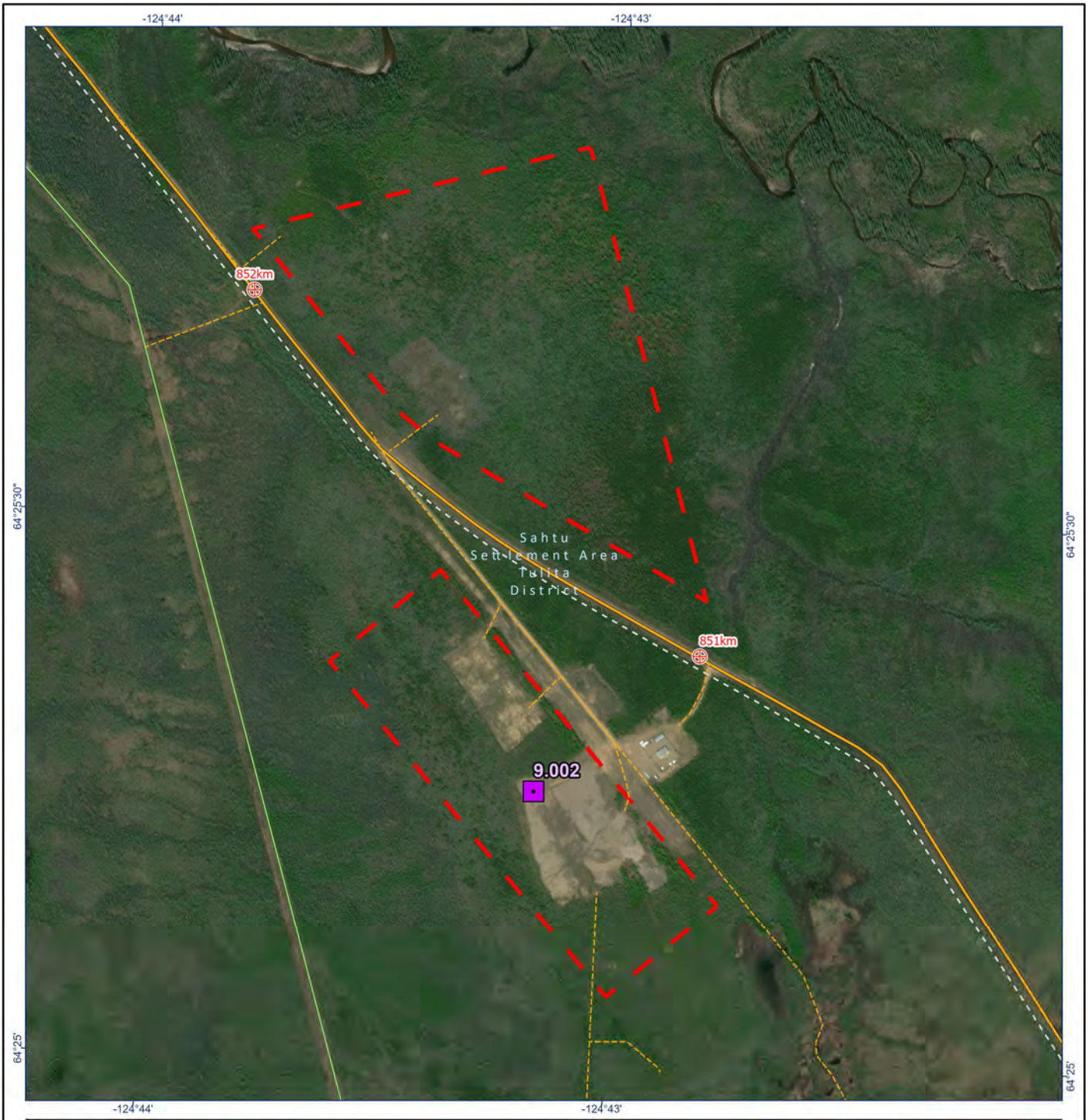
Site Description			
Existing granular borrow source. Site consists of a large glaciofluvial terrace (approximately 2.4 km in length and 0.7 km in width) southeast of the Little Smith Creek, 2 km upstream from the east bank of the Mackenzie River.			
Drainage	Good	**Vegetation density**	Moderate

Material Type	Sand and gravel; stratified; fine to medium sand; medium gravel.		
Material Class	2, 3		
Expected material thickness (m)	Variable. Average 4.6 m thick (19).		
Overburden type and thickness (m)	A thin topsoil layer (approximately 0.2 m thick) overlain the granular deposit and supports dense growths of spruce and birch (4).		
Reported volumes (in millions of m^3)	**Proven** 2.4 (19; includes volume for 9.002A and B)	**Probable** 0.6 (19; includes volume for 9.002A and B) 6.0 (4; includes volume for 9.002A)	**Prospective** 3.0 (19; includes volume for 9.002A and B)
Updated Volume Estimate (in millions of m^3)	3.1		

Access
• Existing access via MVWR.

Available Geotechnical Data
• 8 BH (max depth of 7.6 m).

Development Constraints and Restrictions
• Potentially unstable moderate sloping colluvium ravine located on the northern end of the deposit. • Respect of 65 m buffer with MVWR and 300 m buffer with the Norman Wells to Zama Lake Pipeline.



Notes

1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Imagery: Earthstar Geographics
   World Topographic Map: Esri, FAO, NOAA, NRCan
   World Hillshade: Esri, USGS

Borrow Source

Granular
- Primary
- Secondary

Quarry
- Primary
- Secondary

- Existing Cutline and Trail
- Prime Prospect Area
- Mackenzie Valley Winter Road (MVWR) Kilometer Post
- Mackenzie Valley Winter Road (MVWR)
- All-Season Road (Hwy 1)
- Winter Road
- Mackenzie Valley Fibre Link
- Norman Wells to Zama Lake pipeline (Enbridge)
- District Boundary
- Region Boundary
- Settlement Area Boundary

0 0.08 0.16 Kilometres

(At original document size of 8.5x11)
1:10,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

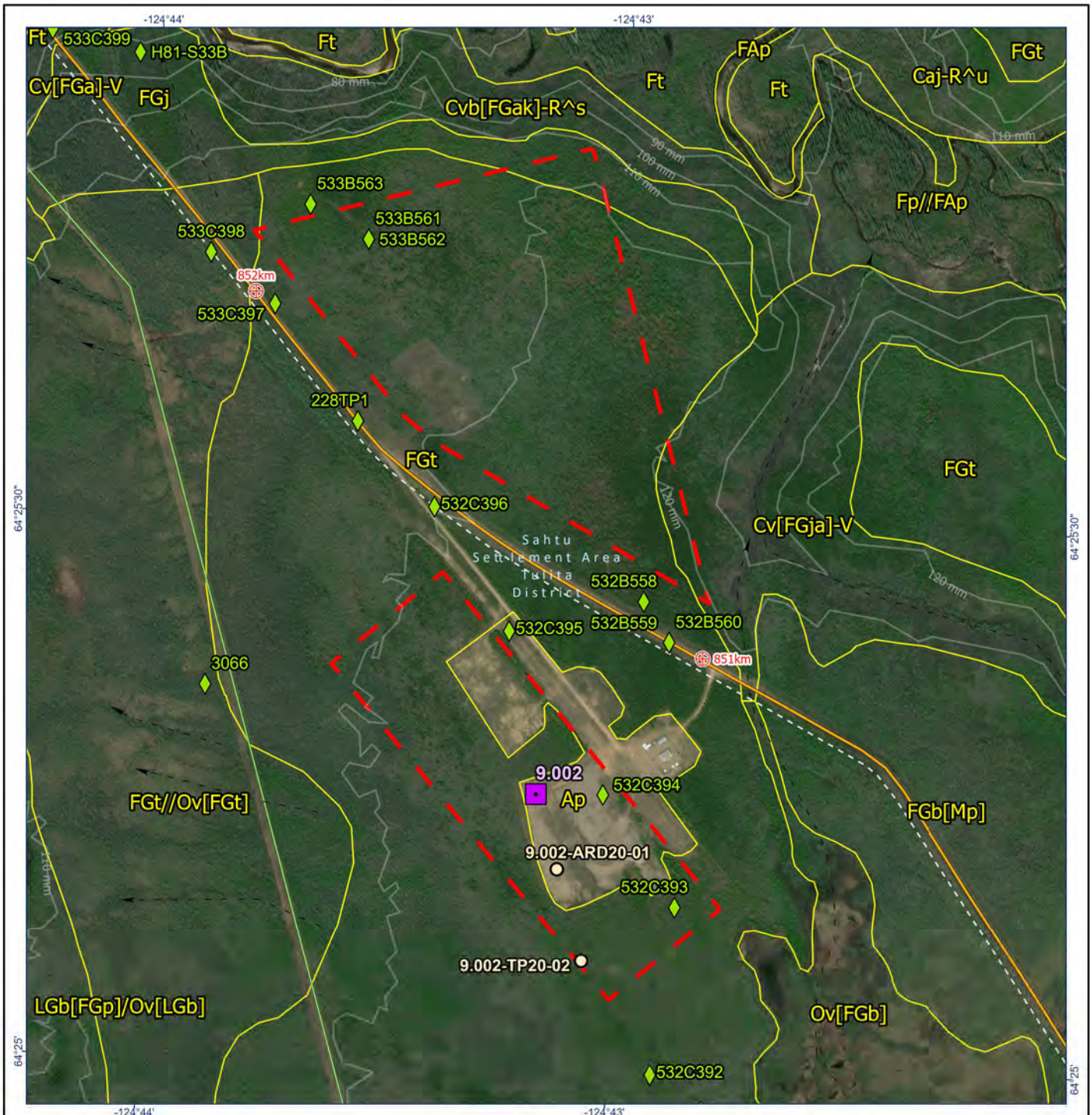
Prepared by CES on 2021-02-04
TR by OP on 2021-02-05

Client/Project
144903077-0005 REVB

Government of Northwest Territories
Mackenzie Valley Highway

Figure No.
D.76

Title
9.002 Overview



Terrain Mapping Legend

Surficial Material

Colluvial	(C)
Fluvial	(F)
Glaciofluvial	(GF)
Glaciolacustrine	(GL)
Till	(M)
Organic	(O)
Bedrock	(R)
Anthropogenic	(A)

Surface Expression

Veneer (<1m)	v
Blanket (>1m)	b
Fan	f
Plain (0-5%)	p
Gentle Slope (6-26%)	j
Moderate slope (27-49%)	a
Moderately steep slope (50-70%)	k
Steep slope (>70%)	s
Undulating	u
Terrace	t
Ridge	r
Rolling	m

Composite Symbols

Underlying Surface Material [ ]

Geoprocess

Flooding	-F
Gullying	-V
Meandering	-M
Seepage	-L
Mass Movement	-R
Ice Wedge	-Xw
Thermokarst	-Xt

Borrow Source

Granular
- Primary
- Secondary

Quarry
- Primary
- Secondary

- Existing Testhole
- 2020 Field Observation Site
- 10m Contour Interval
- Drainage Flowpath

- Prime Prospect Area
- Terrain Mapping
- Mackenzie Valley Winter Road (MVWR) KM Marker
- Mackenzie Valley Winter Road (MVWR)
- All-Season Road (Hwy 1)
- Winter Road
- Mackenzie Valley Fibre Link
- Norman Wells to Zama Lake pipeline (Enbridge)
- District Boundary
- Region Boundary
- Settlement Area Boundary

Example of terrain map unit symbol

Ov[Fp] -F

Organic veneer overlying a fluvial plain — Potential for flooding

Notes

1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Imagery: Earthstar Geographics
World Topographic Map: Esri, FAO, NOAA, NRCan
World Hillshade: Esri, USGS

0 100 200 Meters

(At original document size of 8.5x11)
1:10,000

N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

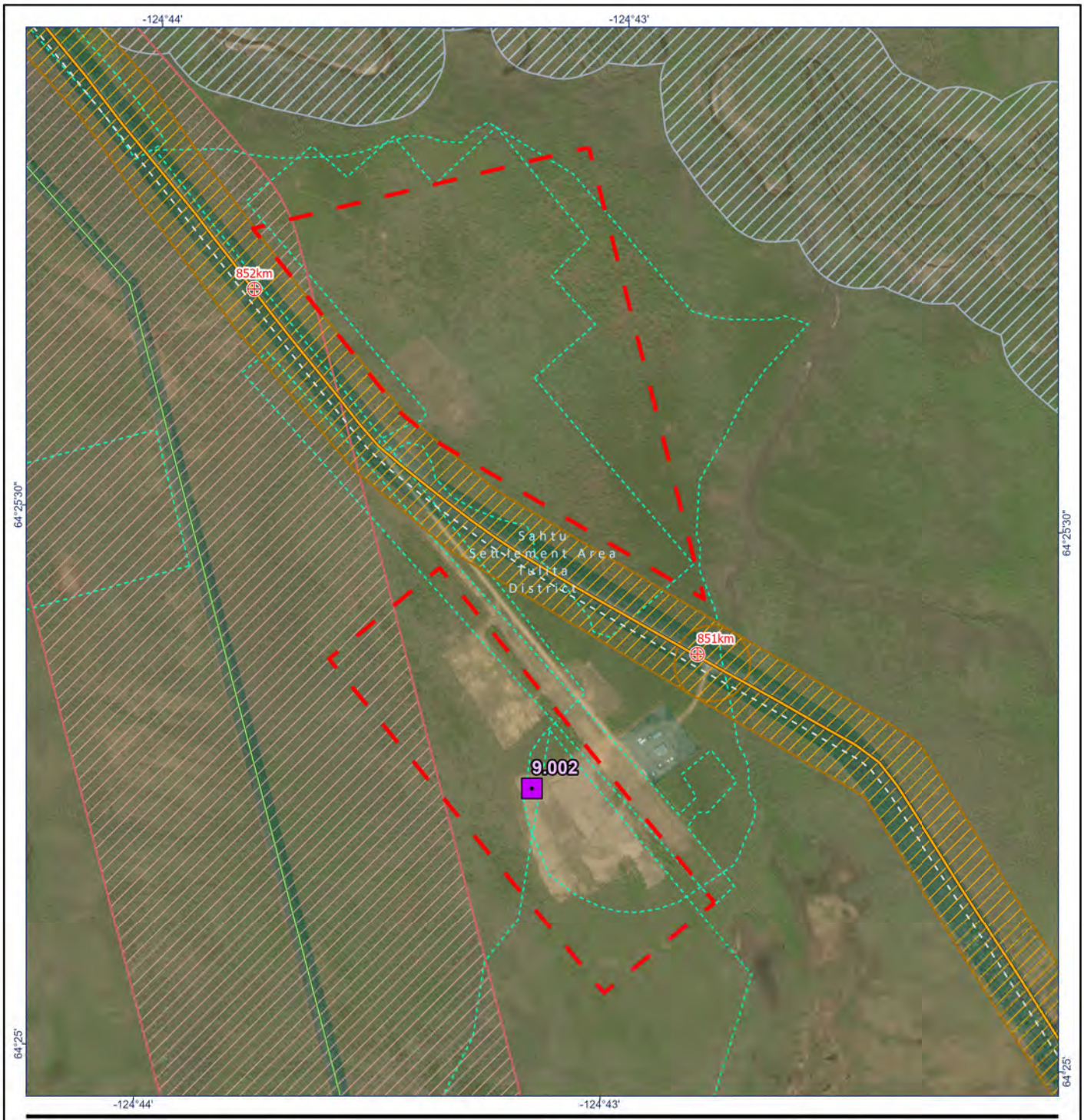
Prepared by CES on 2021-02-04
TR by OP on 2021-02-05

Client/Project
144903077-0007 REVB

Government of Northwest Territories
Mackenzie Valley Highway

Figure No.
D.77

Title
9.002 Terrain Mapping



Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: Centre for Geomatics Government of NWT, Government of Canada, Stantec
3. Background: World Imagery: Earthstar Geographics
World Topographic Map: Esri, FAO, NOAA, NRCan
World Hillshade: Esri, USGS

Borrow Source
- Granular
  - Primary
  - Secondary
- Quarry
  - Primary
  - Secondary
- Archeological Surveyed Area

Restriction Area
- Mackenzie Valley Winter Road (MVWR) 65m Buffer
- Norman Wells to Zama Lake pipeline (Enbridge) 300m Buffer
- Watercourse and Waterbody 100m Buffer

- Prime Prospect Area
- Mackenzie Valley Winter Road (MVWR) KM Marker
- Mackenzie Valley Winter Road (MVWR)
- All-Season Road (Hwy 1)
- Winter Road
- Mackenzie Valley Fibre Link
- Norman Wells to Zama Lake pipeline (Enbridge)
- District Boundary

Land Authority
- Sahtu
- Territorial
- Region Boundary
- Settlement Area Boundary

0 100 200 Meters
(At original document size of 8.5x11)
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N

Kálo-Stantec

Project Location
Wrigley to Norman Wells, NWT

Prepared by CES on 2021-02-04
TR by OP on 2021-02-05

Client/Project
144903077-0006 REVB

Government of Northwest Territories
Mackenzie Valley Highway

Figure No.
D.78

Title
9.002 Restriction Areas

SITE NO. 228

Located adjacent to the southeast bank of Little Smith Creek, Site 228 consists of a large glaciofluvial outwash plain which encompasses the proposed Mackenzie Highway from Mile 532 to Mile 534.

Type of Material: Sand and Gravel; medium grained, well graded.

Estimated Volume: 8,000,000 cubic yards.

Assessment: Good quality material suitable in the pit run condition as general fill for the construction of road bases and utility backfill. Site 228 is recommended for development.

LEGEND

- All weather road
- Existing trails and cutlines
- Proposed Gas Pipeline
- ⊙ DH Drill Hole
- Required access
- Site limit
- Proposed Mackenzie Highway
- ⊕ TP Test Pit

Airphoto No. A22933/83

Approximate scale: 1" = 3,000'

ENVIRONMENT

Site 228 is located adjacent to the southeast bank of Little Smith Creek approximately 1 mile upstream from the east bank of the Mackenzie River. The southern portion of the site encompasses the proposed Mackenzie Highway right-of-way at Mile 532 to Mile 534. The site consists of a large glaciofluvial outwash plain which in total is approximately 3 miles in length and slightly less than $\frac{1}{2}$ mile in width. The site area is separated into two segments by a small stream; the east bank of the meandering Little Smith Creek stream channel forms the western boundary. The site area appears to be relatively well drained and the steep south bank of Little Smith Creek exhibits numerous dry erosional gullies.

The glaciofluvial plain consists of stratified fine to medium grained sands and medium grained gravels. In general, the predominance of gravel was noted nearer to the surface within the outlined site area. A very shallow layer of topsoil approximately 6 inches in depth overlies the granular materials and supports dense growths of spruce and birch ranging in height to 40 feet and in trunk diameter to 12 inches. The understory growth is moderately dense and consists primarily of small bushes.

There are no known critical wildlife areas in the vicinity of Site 228. However, the site is within a region which is periodically hunted and trapped by northern residents.

The CNT pole line and the proposed Mackenzie Highway both traverse the width of the southern segment of the site area thus ensuring good access to future borrow pit areas. The proposed gas pipeline route is located approximately $1\frac{1}{2}$ miles northeast of Site 228.

DEVELOPMENT

The exploratory drill holes which were carried out on Site 228 by the engineering consultant for the Federal Department of Public Works showed the following conditions relative to the quality and quantity of available granular materials:

- Fine to medium grained gravels predominate in the initial 5 to 10 feet of the glaciofluvial deposit.
- Medium grained sand underlies the surficial layer of gravel to depths in excess of the drill holes.
- The depth of recoverable granular materials is considered to be in excess of 20 to 30 feet, although an average depth of 15 feet was used in calculation of volume.
- The sand and gravel deposits are suitable for quality granular fill material in the pit run condition in the construction of road bases, pipeline berms and other general embankment construction. The coarse grained gravels can be used in the production of concrete, base and surface course aggregates.
- The overburden material consisting primarily of topsoil is generally less than 1 foot in depth.

- It is considered that granular materials in excess of 8,000,000 cubic yards are potentially recoverable from Site 228.

Site 228 is recommended as a potential source of granular materials and the following development guidelines should be considered:

- The existing tree growth and related vegetation should be cleared and removed in accordance with current land use guidelines.

- The organic topsoil should be stripped, removed and stockpiled adjacent to the borrow pit areas in designated locations.

- Operating procedures during borrow pit development should be maintained whereby surficial waste materials do not drain into the active Little Smith Creek channel nor into the small unnamed stream channel.

- A vegetation buffer zone of adequate breadth should be retained between the outer limits of the borrow pit areas and the eastern shoreline of Little Smith Creek as well as in the areas adjacent to the small unnamed stream channel.

- Stands of natural growth should be retained between borrow pit areas in order to facilitate regrowth through natural regeneration.

- The use of dozers, overhead loaders and conventional ripping equipment should adequately remove the material from this site.

- The production of quality surface course and concrete aggregate material may be possible by exercising selective excavation procedures during the development of borrow pits. The production of higher quality aggregates will dictate the need of screening, crushing and washing plants to ensure satisfactory properties for specified construction requirements.

- Additional laboratory tests to evaluate specific physical and chemical properties of the granular materials will be required, if the material is to be considered for the production of concrete aggregates.

ABANDONMENT AND REHABILITATION

Abandonment and rehabilitation procedures should include:

- Recontouring of the pit areas to provide general drainage that is compatible with the natural drainage of the adjacent terrain.

- Replacing stockpiled surficial waste material and organic topsoil on the abandoned recontoured pit areas.

- Reseeding of the recontoured pit areas should be considered in areas that may pose

erosional problems. At these locations, the artificial reseeding of annuals and perennials will result in a semi-permanent cover growth prior to reestablishment of native species.

DETAILED DRILL HOLE LOG

SITE NO. 228

HOLE NO. C 393A

DATE: FEB. 9, 1973

LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

DRILLING METHOD: ☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS: GEN'L CLASS	GROUND ICE CONDITIONS: N.R.C. CLASS	GROUND ICE CONDITIONS: EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
0		Pt	0.5 TOPSOIL:					0
2		GW	GRAVEL: - sand and cobbles					2
4							MC GS	4
5.0								
6			SAND:					6
8								8
10		SP	- pebbles and cobbles					10
12								12
14								14
15.0			END OF HOLE 15.0' Insulated hole					
16								16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228

HOLE NO. C 396A

DATE: FEB. 10, 1973 | LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

DRILLING METHOD: ☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS: GEN'L CLASS	GROUND ICE CONDITIONS: N.R.C. CLASS	GROUND ICE CONDITIONS: EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
0								0
2		GW	GRAVEL:					2
4								4
6		SW						6
8								8
10		SP	SAND & PEBBLES:					10
12								12
14		SW						14
15.0			END OF HOLE					
16								16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228

HOLE NO. C 398F

DATE:

LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

DRILLING METHOD: ☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

DEPTH (Feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS: GEN'L CLASS	GROUND ICE CONDITIONS: N.R.C. CLASS	GROUND ICE CONDITIONS: EST'D CONT.	SAMPLE TYPE	DEPTH (Feet)
0								0
3		GW	GRAVEL:					3
4.0								
6		CL	SILTY CLAY:					6
9								9
12				UF				12
15		CL						15
18								18
21		CL		UF				21
24		CL						24
25.0			END OF HOLE 25.0'					
27								27

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228 HOLE NO. TP 1

DATE: FEB. 10, 1973 | LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

DRILLING METHOD: ☐ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☒ OTHER: DISPOSAL PIT

DEPTH (Feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS: GEN'L CLASS	GROUND ICE CONDITIONS: N.R.C. CLASS	GROUND ICE CONDITIONS: EST'D CONT.	SAMPLE TYPE	DEPTH (Feet)
0								0
1		GW	GRAVEL					1
2								2
3							GS	3
4								4
5								5
6			6.0 END OF PIT					6

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228 HOLE NO. C 5548

DATE: FEB. 12, 1973 LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

DRILLING METHOD: ☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS: GEN'L CLASS	GROUND ICE CONDITIONS: N.R.C. CLASS	GROUND ICE CONDITIONS: EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
0								0
1			GRAVEL:	UF				1
2								2
3								3
4		GW	- sandy, dry					4
5								5
6								6
7								7
			7.0 END OF HOLE 7.0' Hole caved in					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228

HOLE NO. B 556B

DATE: FEB. 13, 1973

LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

DRILLING METHOD: ☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS: GEN'L CLASS	GROUND ICE CONDITIONS: N.R.C. CLASS	GROUND ICE CONDITIONS: EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
0								0
1			SAND:					1
2		SP	- gravel, cobbles, boulders					2
3							MC GS	3
4								4
5			5.0 END OF HOLE 5.0' Hole sloughing Very dry					5

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228

HOLE NO. B 560B

DATE: FEB. 13, 1973

LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

DRILLING METHOD: ☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS: GEN'L CLASS	GROUND ICE CONDITIONS: N.R.C. CLASS	GROUND ICE CONDITIONS: EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
0								0
1			SAND:					1
2			- pebbles, gravel and cobbles					2
3								3
4								4
5								5
			5.0 END OF HOLE 5.0' Hole sloughing Very dry					

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

DETAILED DRILL HOLE LOG

SITE NO. 228 HOLE NO. B 563B

DATE: FEB. 13, 1973 LOGGED BY: ☐ PEMCAN ☒ UNDERWOOD

DRILLING METHOD: ☒ AIR CONVENTIONAL ☐ AIR REVERSE CIRCULATION ☐ OTHER:

DEPTH (feet)	GRAPH SYMBOL	UNIFIED GROUP SYMBOL	MATERIAL DESCRIPTION	GROUND ICE CONDITIONS: GEN'L CLASS	GROUND ICE CONDITIONS: N.R.C. CLASS	GROUND ICE CONDITIONS: EST'D CONT.	SAMPLE TYPE	DEPTH (feet)
0		SW	SAND:				MC GS	0
2								2
4								4
6								6
8		SP	- silt, gravel pebbles, wet					8
10								10
12								12
14		SW	- very wet					14
15.0			END OF HOLE 15.0'					
16								16

GOVERNMENT OF CANADA
DEPARTMENT OF INDIAN AFFAIRS
AND NORTHERN DEVELOPMENT

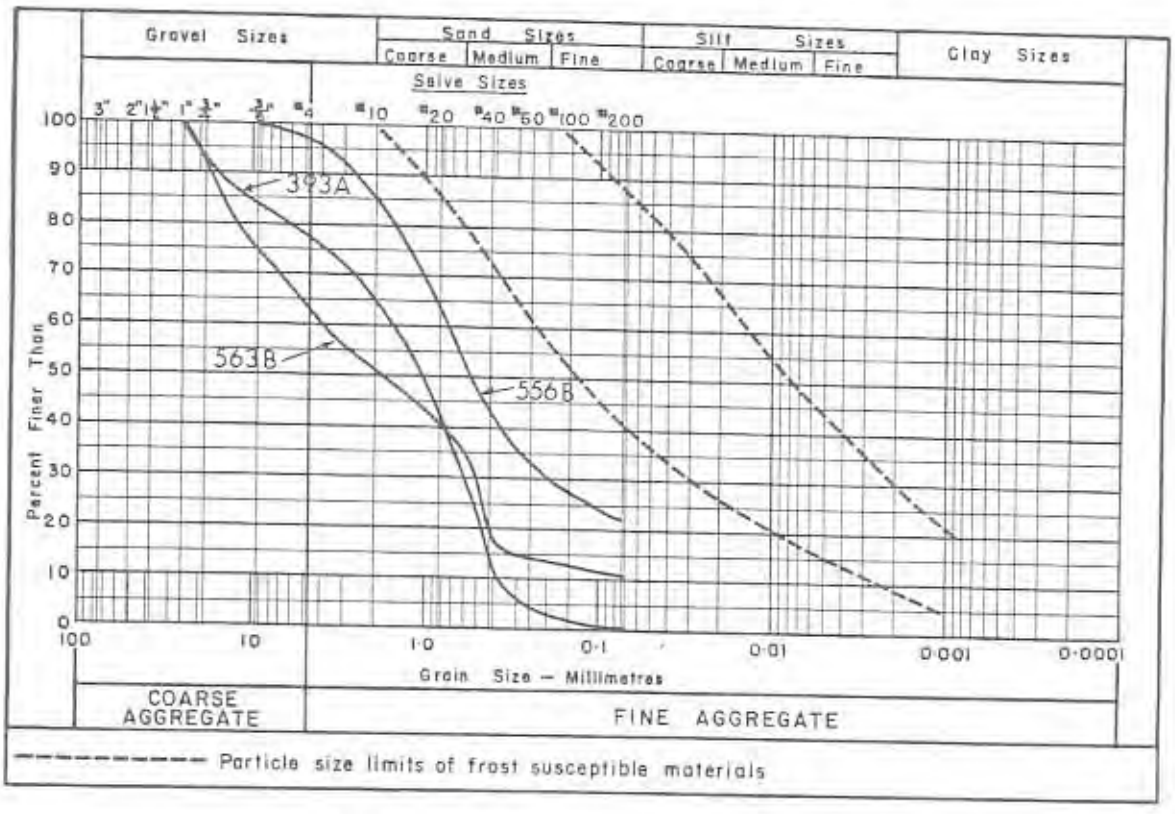
GRANULAR MATERIALS INVENTORY

PEMCAN SERVICES "72"

SUMMARY OF LABORATORY TEST DATA

Sample Location:	228/556B	228/563B	228/393A
Sample Depth (Feet):	3.0-4.0	1.0-2.0	4.0-5.0
Moisture Content (%):	3.0	4.0	2.0
Ice Content (%):	-	-	-
Organic Content (%):	-	-	-

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

SUMMARY OF LABORATORY TEST DATA

Sample Location: 228/(sampled by Underwood from Disposal Pit)

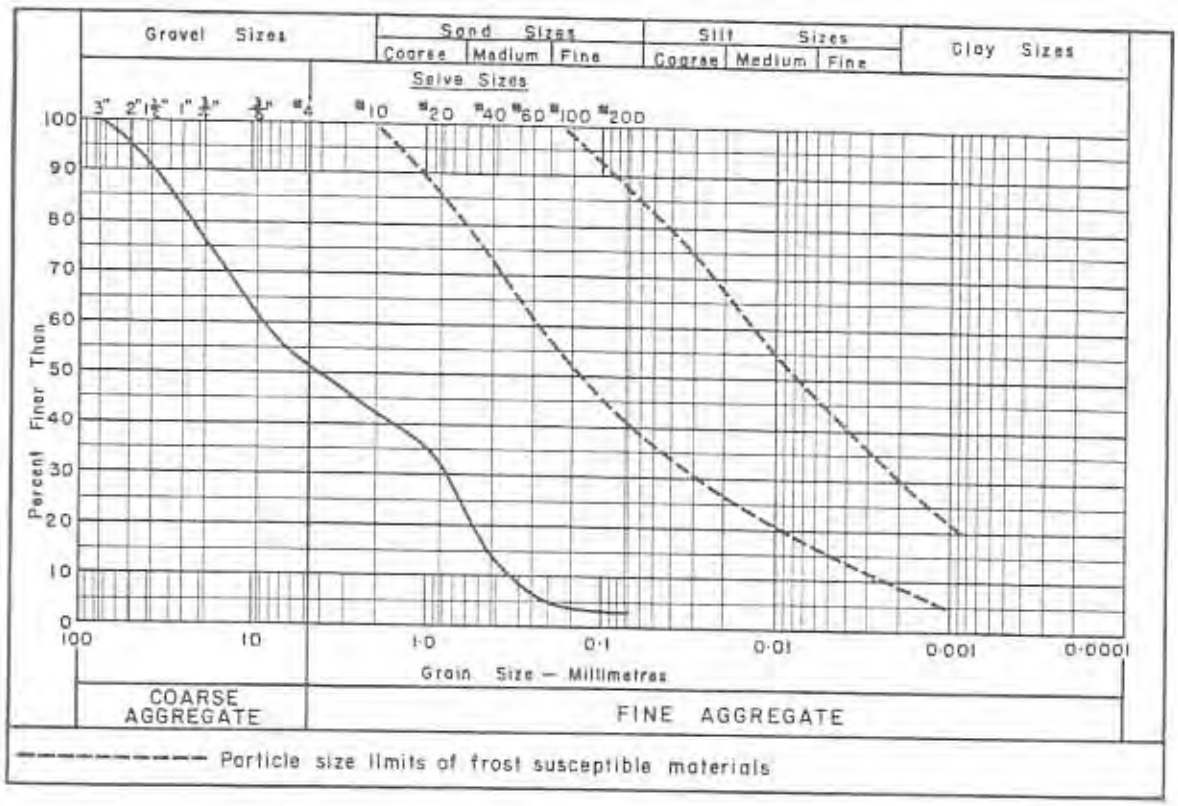
Sample Depth (Feet): -

Moisture Content (%): -

Ice Content (%): -

Organic Content (%): -

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

Limestone	46.5%
Granitic	39.2%
Volcanic	10.5%
Chert	1.4%
Deleterious	
Schist	1.4%
Silicious sandstone	1.0%

Los Angeles Abrasion Test: Per cent Loss - 21.6

SUMMARY OF LABORATORY TEST DATA

Sample Location: 228/(sampled by Underwood from Disposal Pit)

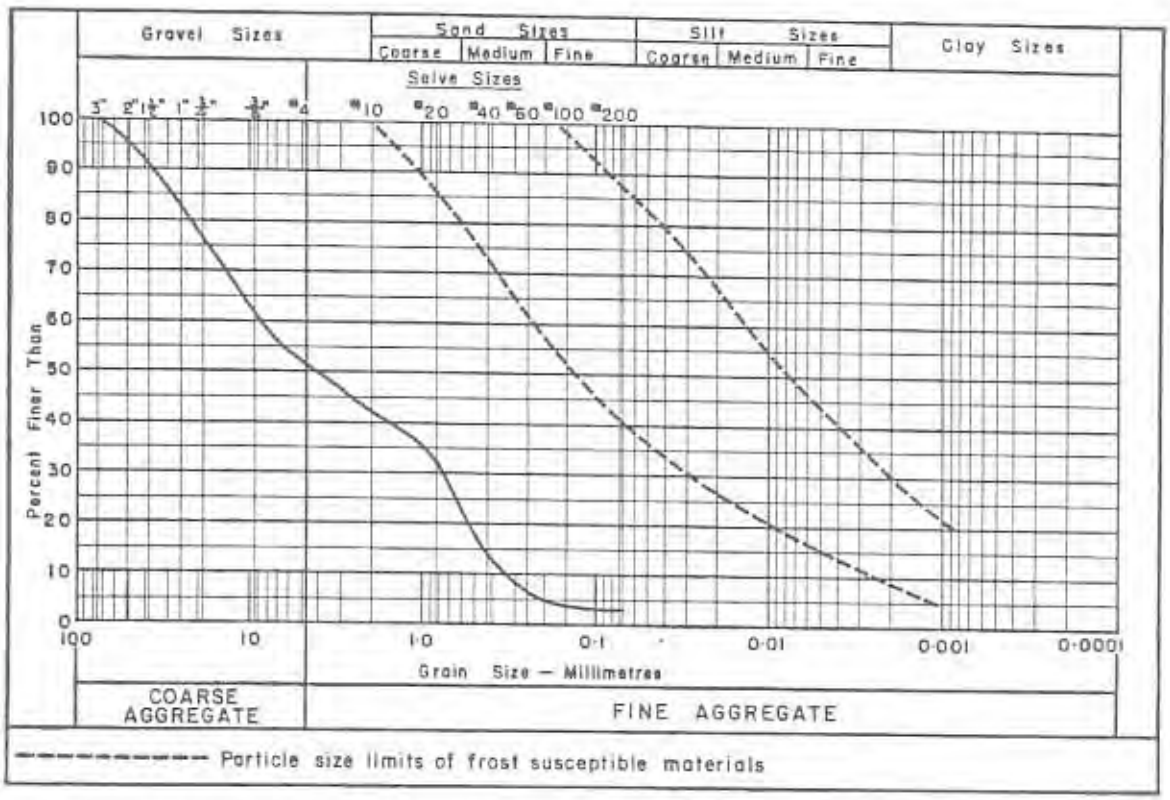
Sample Depth (Feet): -

Moisture Content (%): -

Ice Content (%): -

Organic Content (%): -

GRAIN SIZE DISTRIBUTION:



PETROGRAPHIC ANALYSIS:

Limestone	46.5%
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Volcanic	10.5%
Chert	1.4%
Deleterious	
Schist	1.4%
Silicious sandstone	1.0%

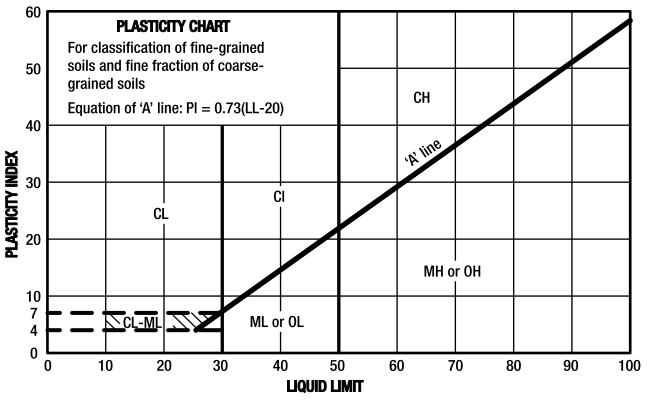
Los Angeles Abrasion Test: Per cent Loss - 21.6

APPENDIX B

GEOTECHNICAL TESTPIT LOGS

MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS More than 50% retained on 75 µm sieve*	GRAVELS 50% or more of coarse fraction retained on 4.75 mm sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines GW, GP, SW, SP GM, GC, SM, SC Borderline Classification requiring use of dual symbols $C_U = D_{60} / D_{10}$ Greater than 4 $C_C = \frac{(D_{30})2}{D_{10} \times D_{60}}$ Between 1 and 3	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW	
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits plot above "A" line or plasticity index greater than 7	
	SANDS More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines	Less than 5% Pass 75 µm sieve More than 12% Pass 75 µm sieve 5% to 12% Pass 75 µm sieve $C_U = D_{60}/D_{10}$ Greater than 6 $C_C = \frac{(D_{30})2}{D_{10} \times D_{60}}$ Between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW	
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures	Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above "A" line or plasticity index greater than 7	
FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS Liquid limit <50		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands of slight plasticity		
	SILTS Liquid limit >50		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit <30		CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays		
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit 30-50		CI	Inorganic clays of medium plasticity, silty clays		
	CLAYS Above "A" line on plasticity chart negligible organic content Liquid limit >50		CH	Inorganic clays of high plasticity, fat clays		
	ORGANIC SILTS AND CLAYS Liquid limit <50		OL	Organic silts and organic silty clays of low plasticity		
	ORGANIC SILTS AND CLAYS Liquid limit >50		OH	Organic clays of medium to high plasticity		
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils		



* Based on the material passing the 75 mm sieve

† ASTM Designation D 2487, for identification procedure see D 2488 USC as modified by PFRA

SOIL COMPONENTS

FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS	
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR
GRAVEL coarse fine	75 mm 19 mm	19 mm 4.75 mm	>35 % 21 to 35 % 11 to 20 % >0 to 10 %	"and" "y-adjective" "some" "trace"
SAND coarse medium fine	4.75 mm 2.00 mm 425 µm	2.00 mm 425 µm 75 µm		
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior	

OVERSIZE MATERIAL

Rounded or subrounded

COBBLES	75 mm to 300 mm
BOULDERS	> 300 mm

Not rounded

ROCK FRAGMENTS	>75 mm
ROCKS	> 0.76 cubic metre in volume

TETRA TECH

GROUND ICE DESCRIPTION

VISIBLE ICE LESS THAN 50% BY VOLUME

GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
V	Vx	Individual ice crystals or inclusions		
	Vc	Ice coatings on particles		
	Vr	Random or irregularly oriented ice formations		
	Vs	Stratified or distinctly oriented ice formations		
	Vu	Ice formations uniformly distributed throughout frozen soil		

ICE NOT VISIBLE

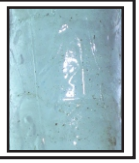
GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
N	Nf	Poorly-bonded or friable		
	Nbn	No excess ice, well-bonded		
	Nbe	Excess ice, well-bonded		

LEGEND: Soil ☐ Ice ■

NOTES:

1. Dual symbols are used to indicate borderline or mixed ice classifications.
2. Visual estimates of ice contents indicated on borehole logs ± 5%
3. This system of ground ice description has been modified from NRC Technical Memo 79, Guide to the Field Description of Permafrost for Engineering Purposes.

VISIBLE ICE GREATER THAN 50% BY VOLUME

GROUP SYMBOL	SYMBOL	SUBGROUP DESCRIPTION	SKETCH	PHOTOGRAPH
ICE	ICE + Soil Type	Ice with soil inclusions (greater than 25 mm thick)		
	ICE	Ice without soil inclusions (greater than 25 mm thick)		

TETRA TECH

BOREHOLE KEYSHEET

Water Level Measurement

 Measured in standpipe, piezometer or well

 Inferred

Sample Types

 A-Casing

 Core

 Disturbed, Bag, Grab

 HQ Core

 Jar

 Jar and Bag

 75 mm SPT

 No Recovery

 Split Spoon/SPT

 Tube

 CRREL Core

Backfill Materials

 Asphalt

 Bentonite

 Cement/ Grout

 Drill Cuttings

 Grout

 Gravel

 Sand

 Slough

 Topsoil Backfill

Lithology - Graphical Legend[1]

 Asphalt

 Bedrock

 Cobbles/Boulders

 Clay

 Coal

 Concrete

 Fill

 Gravel

 Limestone

 Mudstone

 Organics

 Peat

 Sand

 Sandstone

 Shale

 Silt

 Siltstone

 Conglomerate

 Topsoil

 Till

1. The graphical legend is an approximation and for visual representation only. Soil strata may comprise a combination of the basic symbols shown above. Particle sizes are not drawn to scale

TETRA TECH

Testpit No: **TP25-9.002-01**

Project: Mackenzie Valley Highway Geotechnical	Project No: ENG.EARC03299-03
Location: Borrow Source 9.002	Ground Elev: 126.9 m
Sahtú Settlement Area, Northwest Territories	UTM: 416882 E; 7145895 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Particle Size Distribution: Sand (%)	Particle Size Distribution: Silt & Clay (%): Silt (%)	Particle Size Distribution: Silt & Clay (%): Clay (%)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		ORGANICS - black, (100 mm thick)	Frozen									
		SAND - silty, gravelly, rounded gravel, brown										
1		- dark brown			G1	28	42	30		6.4	●	126
		- some silt, some gravel										
2					G2					4.7	●	125
		- trace silt, trace gravel, brown										
3	Excavation				G3					2.1	●	124
		- moist	Unfrozen									
		- wet										
4					G4					16.3	●	123
5					G5	8	85	7		16.6	●	122
					G6							
6		END OF TESTPIT (6.0 metres) Note: Stopped due to sloughing										121
7												120
7.5												

Contractor: Northridge Contracting Ltd.	Completion of Drilling: 6 m
Equipment Type: CAT 329E Hydraulic Excavator	Start Date: 2025 March 25
Logged By: AG	Completion Date: 2025 March 25
Reviewed By: TB	Page 1 of 1

Testpit No: **TP25-9.002-02**

Project: Mackenzie Valley Highway Geotechnical	Project No: ENG.EARC03299-03
Location: Borrow Source 9.002	Ground Elev: 128.4 m
Sahtú Settlement Area, Northwest Territories	UTM: 417068.1 E; 7145719 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Particle Size Distribution: Sand (%)	Particle Size Distribution: Silt & Clay (%): Silt (%)	Particle Size Distribution: Silt & Clay (%): Clay (%)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		ORGANICS - black, (100 mm thick)	Frozen									
		GRAVEL - sandy, trace silt, subrounded gravel, brown										128
1		SAND - gravelly, trace silt, brown			G1	22	77		1	2.1		
												127
2					G2	33	65		2	1.8		
		- some gravel										
		- trace gravel, dark brown										126
3	Excavation				G3					2.2		
		- damp	Unfrozen									
												125
4					G4					3.7		
												124
5		- moist			G5	3	96		1	6		
												123
		CLAY - some silt, some sand, trace gravel, wet, high plastic, grey			G6					23		
6		END OF TESTPIT (6.0 metres) Note: Stopped due to sloughing										
												122
7												
7.5												121

TETRA TECH

Contractor: Northridge Contracting Ltd.	Completion of Drilling: 6 m
Equipment Type: CAT 329E Hydraulic Excavator	Start Date: 2025 March 25
Logged By: AG	Completion Date: 2025 March 25
Reviewed By: TB	Page 1 of 1

Testpit No: **TP25-9.002-03**

Project: Mackenzie Valley Highway Geotechnical	Project No: ENG.EARC03299-03
Location: Borrow Source 9.002	Ground Elev: 129.8 m
Sahtú Settlement Area, Northwest Territories	UTM: 417180 E; 7145995.6 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Particle Size Distribution: Sand (%)	Particle Size Distribution: Silt & Clay (%): Silt (%)	Particle Size Distribution: Silt & Clay (%): Clay (%)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		ORGANICS - brown, (100 mm thick)	Frozen									
		GRAVEL AND SAND - trace silt, subrounded gravel, coarse grained sand, brown, hydrocarbon odour										
1					G1	54	41	5		2.3		129
		SAND - gravelly, trace silt, occasional cobbles, medium to coarse grained sand, brown										
2		- some gravel			G2					2		128
		- trace gravel										
		- 100 mm thick clay layer - silty, gravelly										
3	Excavation				G3					2.4		127
		- damp	Unfrozen									
					G4	5	94	1		2.4		126
4												
					G5					2.2		125
5		- some gravel, medium grained sand										
												124
6		CLAY - silty, trace gravel, trace sand, moist, firm, low plastic, dark brown			G6					19.6		
		END OF TESTPIT (6.0 metres)										
		Note: Stopped due to maximum reach of excavator										
7												123
7.5												

Contractor: Northridge Contracting Ltd.	Completion of Drilling: 6 m
Equipment Type: CAT 329E Hydraulic Excavator	Start Date: 2025 March 26
Logged By: AG	Completion Date: 2025 March 26
Reviewed By: TB	Page 1 of 1

TETRA TECH

Testpit No: **TP25-9.002-04**

Project: Mackenzie Valley Highway Geotechnical	Project No: ENG.EARC03299-03
Location: Borrow Source 9.002	Ground Elev: 130 m
Sahtú Settlement Area, Northwest Territories	UTM: 417210 E; 7145803.9 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Particle Size Distribution: Sand (%)	Particle Size Distribution: Silt & Clay (%): Silt (%)	Particle Size Distribution: Silt & Clay (%): Clay (%)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		ORGANICS - brown, (100 mm thick)	Frozen									130
		SILT - sandy, some gravel, trace clay, brown										
1		SAND - some gravel, trace silt, subrounded gravel, brown			G1	13	31	56		5.5		129
		- subangular gravel										
2		- dark brown			G2					2.5		128
		- trace gravel, subrounded gravel, brown										
		- (Proctor Testing - Max. Dry Density 1760 kg/m³, Optimum Moisture Content 13.5%)			P3	6	93	1		0.2		
					G4					2.1		
3	Excavation	- dry	Unfrozen									127
4		- damp, dark brown			G5					2.5		126
					G6					2.9		
5		- moist										125
6		- silty, some clay, wet			G7					24.3		124
		END OF TESTPIT (6.0 metres) Note: Stopped due to maximum reach of excavator										
7												123
7.5												

Contractor: Northridge Contracting Ltd.	Completion of Drilling: 6 m
Equipment Type: CAT 329E Hydraulic Excavator	Start Date: 2025 March 26
Logged By: AG	Completion Date: 2025 March 26
Reviewed By: TB	Page 1 of 1

NORTHERN ZONE10.GPJ EBA.GDT 25-9-11

Testpit No: **TP25-9.002-05**

Project: Mackenzie Valley Highway Geotechnical	Project No: ENG.EARC03299-03
Location: Borrow Source 9.002	Ground Elev: 132.9 m
Sahtú Settlement Area, Northwest Territories	UTM: 417328.7 E; 7145599.1 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Particle Size Distribution: Sand (%)	Particle Size Distribution: Silt & Clay (%): Silt (%)	Particle Size Distribution: Silt & Clay (%): Clay (%)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		ORGANICS - brown, (100 mm thick)	Frozen									
		GRAVEL AND SAND - some silt, subrounded gravel, medium to coarse grained sand, brown										
1	Excavation	- trace silt			G1	59	37	4		1.7		132
		SAND - gravelly, some silt, medium to coarse grained sand, subrounded gravel, brown										
		- trace silt			G2					1.3		
2		- hydrocarbon odour										131
		- some gravel			G3					2.3		
3		- dry	Unfrozen									130
		- trace gravel, medium grained sand, dark brown			G4	9	90	1		1.9		
4												129
		- some silt, damp, brown			G5					2.8		
5												128
		- silty, no visible gravel, fine grained sand, moist			G6	0	77	23		7.7		
6		END OF TESTPIT (6.0 metres) Note: Stopped due to sloughing										127
7												126
7.5												

Contractor: Northridge Contracting Ltd.	Completion of Drilling: 6 m
Equipment Type: CAT 329E Hydraulic Excavator	Start Date: 2025 March 26
Logged By: AG	Completion Date: 2025 March 26
Reviewed By: TB	Page 1 of 1

Testpit No: **TP25-9.002-06**

Government of Northwest Territories / Gouvernement des Territoires du Nord-Ouest

Project: Mackenzie Valley Highway Geotechnical	Project No: ENG.EARC03299-03
Location: Borrow Source 9.002	Ground Elev: 130.5 m
Sahtú Settlement Area, Northwest Territories	UTM: 416965.1 E; 7145199 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Particle Size Distribution: Sand (%)	Particle Size Distribution: Silt & Clay (%): Silt (%)	Particle Size Distribution: Silt & Clay (%): Clay (%)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0		ORGANICS - brown, (100 mm thick)	Frozen									130
		GRAVEL AND SAND - some cobbles, trace silt, brown										
1					G1	55	44		1	1.7	●	
		SAND - some gravel, some cobbles, trace silt, brown										129
2					G2					1.1	●	
					G3					2.3	●	128
3	Excavation	- dry	Unfrozen									
		- dark brown			G4					1.9	●	127
4		- damp										
		- some angular boulders, moist, brown			G5					5.1	●	126
5												
		- wet, dark brown										125
6					G6	19	73		8	12.7	●	
		END OF TESTPIT (6.0 metres) Note: Stopped due to maximum reach of excavator										124
7												
7.5												123

TETRA TECH

Contractor: Northridge Contracting Ltd.	Completion of Drilling: 6 m
Equipment Type: CAT 329E Hydraulic Excavator	Start Date: 2025 March 25
Logged By: AG	Completion Date: 2025 March 25
Reviewed By: TB	Page 1 of 1

NORTHERN ZONE10.GPJ EBA.GDT 25-9-11

Testpit No: **TP25-9.002-07**

Project: Mackenzie Valley Highway Geotechnical	Project No: ENG.EARC03299-03
Location: Borrow Source 9.002	Ground Elev: 133 m
Sahtú Settlement Area, Northwest Territories	UTM: 417235 E; 7144835 N; Z 10

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Clay (%)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
0												133
		ORGANICS - brown, (100 mm thick)	Frozen									
		GRAVEL - sandy, some cobbles, trace silt, medium to coarse grained sand, rounded gravel, brown										
1					G1	70	27	3		2.3		132
		SAND - gravelly, some cobbles, trace silt, medium to coarse grained sand, rounded gravel, brown										
2					G2					4.6		131
	Excavation											
3		- subrounded gravel - dry			G3					2.3		130
			Unfrozen									
		SAND AND GRAVEL - trace silt, medium to coarse grained sand, subrounded gravel, dry, brown										
4					G4	47	52	1		1.9		129
		SAND - gravelly, some cobbles, trace silt, medium to coarse grained sand, rounded gravel, dry, brown										
5					G5					2		128
					G6					2		
6		END OF TESTPIT (6.0 metres) Note: Stopped due to sloughing										127
7												126
7.5												

Contractor: Northridge Contracting Ltd.	Completion of Drilling: 6 m
Equipment Type: CAT 329E Hydraulic Excavator	Start Date: 2025 March 25
Logged By: AG	Completion Date: 2025 March 25
Reviewed By: TB	Page 1 of 1

APPENDIX C

GEOTECHNICAL LABORATORY TEST RESULTS

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	Mackenzie Valley Highway Sathu Borrow Sources	Borrow Source:	9.002
Project Number:	704-ENG.EARC003299-03.007	Date Tested:	May 31-June 11, 2025
Client:	K'alo Stantec Limited	Tested By:	TO/AH
Project Manager:	Thomas Bradshaw	Page:	1 of 3

T.P. Number	Depth (m)	Moisture Content (%)	Visual Description of Soil
TP25-9.002-01	0.9-1.0	6.4	SAND, silty, gravelly, dark brown
TP25-9.002-01	1.8-2.0	4.7	SAND, gravelly, some silt, dark brown
TP25-9.002-01	2.6-3.0	2.1	SAND, trace gravel, trace silt, brown
TP25-9.002-01	3.5-4.0	16.3	SAND, trace gravel, trace silt, brown
TP25-9.002-01	4.5-5.0	16.6	SAND, trace gravel, trace silt, brown
TP25-9.002-02	0.9-1.0	2.1	SAND, gravelly, trace silt, brown
TP25-9.002-02	1.8-2.0	1.8	SAND, gravelly, trace silt, brown
TP25-9.002-02	2.6-3.0	2.2	SAND, trace gravel, trace silt, dark brown
TP25-9.002-02	4.0-4.5	3.7	SAND, trace gravel, trace silt, dark brown
TP25-9.002-02	5.0-5.5	6.0	SAND, trace gravel, trace silt, dark brown
TP25-9.002-02	5.7-6.0	23.0	CLAY, silty, some sand, dark brown
TP25-9.002-03	0.9-1.0	2.3	GRAVEL and SAND, trace silt, brown
TP25-9.002-03	1.8-2.0	2.0	SAND, gravelly, trace silt, brown
TP25-9.002-03	2.7-3.0	2.4	SAND, trace gravel, trace silt, brown
TP25-9.002-03	3.5-4.0	2.4	SAND, trace gravel, trace silt, brown
TP25-9.002-03	4.5-5.0	2.2	SAND, trace gravel, trace silt, brown
TP25-9.002-03	5.9-6.0	19.6	CLAY, silty, trace gravel, trace sand, dark brown

Reviewed By: _____ P.Eng.

TETRA TECH

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	Mackenzie Valley Highway Sathu Borrow Sources	Borrow Source:	9.002
Project Number:	704-ENG.EARC003299-03.007	Date Tested:	June 12-13, 2025
Client:	K'alo Stantec Limited	Tested By:	AH
Project Manager:	Thomas Bradshaw	Page:	2 of 3

T.P. Number	Depth (m)	Moisture Content (%)	Visual Description of Soil
TP25-9.002-04	0.9-1.0	5.5	SILT, sandy, some gravel, trace clay, brown
TP25-9.002-04	1.8-2.0	2.5	SAND, some gravel, trace silt, dark brown
TP25-9.002-04	2.5-3.0	0.2	SAND, trace gravel, trace silt, brown
TP25-9.002-04	2.8-3.0	2.1	SAND, trace gravel, trace silt, brown
TP25-9.002-04	3.8-4.3	2.5	SAND, trace gravel, trace silt, dark brown
TP25-9.002-04	4.5-5.0	2.9	SAND, trace gravel, trace silt, dark brown
TP25-9.002-04	5.9-6.0	24.3	SAND, silty, some clay, dark brown
TP25-9.002-05	0.9-1.0	1.7	GRAVEL and SAND, trace silt, brown
TP25-9.002-05	1.8-2.0	1.3	SAND, gravelly, trace silt, brown
TP25-9.002-05	2.7-3.0	2.3	SAND, some gravel, trace silt, brown
TP25-9.002-05	3.5-4.0	1.9	SAND, trace gravel, trace silt, dark brown
TP25-9.002-05	4.5-5.0	2.8	SAND, trace gravel, trace silt, brown
TP25-9.002-05	5.5-6.0	7.7	SAND, silty, brown
TP25-9.002-06	1.0-1.1	1.7	GRAVEL and SAND, trace silt, brown
TP25-9.002-06	2.1-2.3	1.1	SAND, some gravel, trace silt, brown
TP25-9.002-06	2.6-3.0	2.3	SAND, some gravel, trace silt, brown
TP25-9.002-06	3.5-4.0	1.9	SAND, some gravel, trace silt, dark brown
TP25-9.002-06	4.5-5.0	5.1	SAND, some gravel, trace silt, brown
TP25-9.002-06	5.7-5.9	12.7	SAND, some gravel, trace silt, dark brown

Reviewed By: _____ P.Eng.

TETRA TECH

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	Mackenzie Valley Highway Sathu Borrow Sources	Sample No.:	9.002
Project Number:	704-ENG.EARC003299-03.007	Date Tested:	June 13, 2025
Client:	K'alo Stantec Limited	Tested By:	AH
Project Manager:	Thomas Bradshaw	Page:	3 of 3

T.P. Number	Depth (m)	Moisture Content (%)	Visual Description of Soil
TP25-9.002-07	0.9-1.0	2.3	GRAVEL, sandy, trace silt, trace organics, brown
TP25-9.002-07	1.9-2.0	4.6	SAND, gravelly, trace silt, brown
TP25-9.002-07	2.8-3.0	2.3	SAND, gravelly, trace silt, brown
TP25-9.002-07	4.0-4.5	1.9	SAND and GRAVEL, trace silt, brown
TP25-9.002-07	5.0-5.5	2.0	SAND, gravelly, trace silt, brown
TP25-9.002-07	5.5-6.0	2.0	SAND, gravelly, trace silt, brown

Reviewed By: _____ P.Eng.

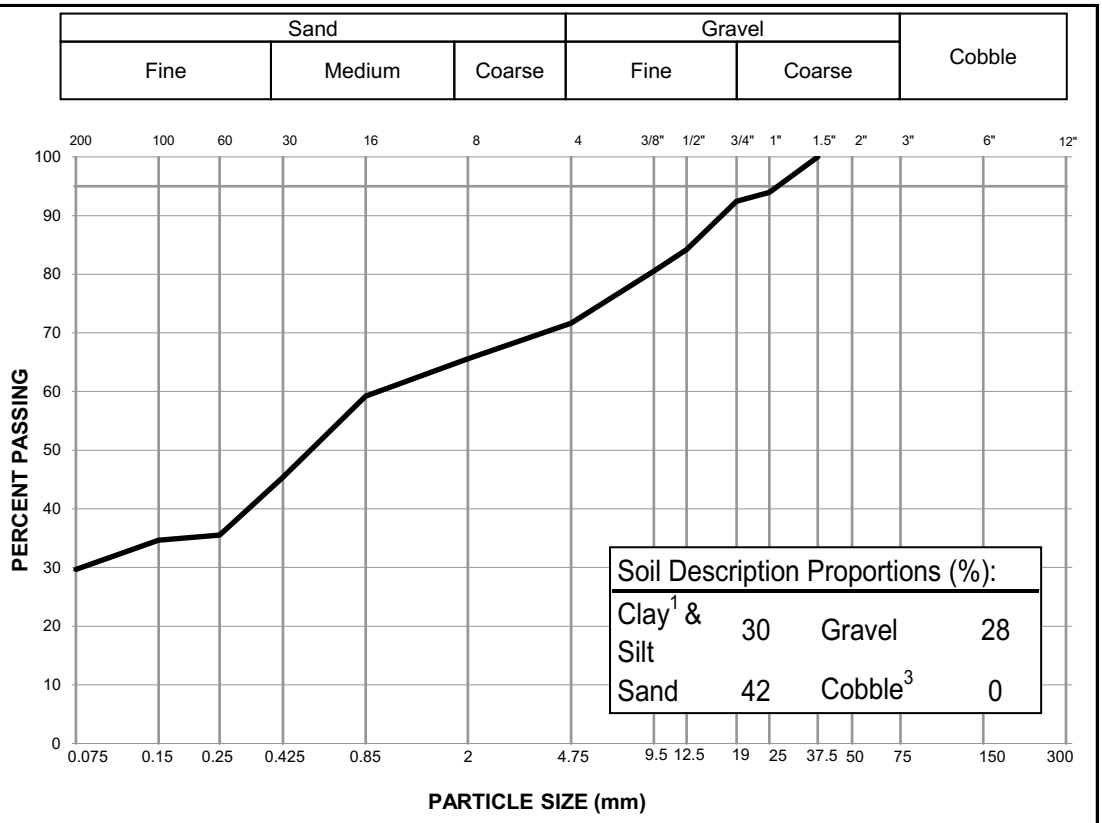
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-01
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-01
Client:	K'alo-Stantec Limited	Sample Depth:	0.9-1.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025 By: AH	Date sampled:	March 25, 2025
Soil Description[2]:	SAND, silty, gravelly, dark brown	Sampled By:	AG
		USC Classification:	SM Cu: #N/A
Moisture Content:	6.4%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	100
25	94
19	92
12.5	84
9.5	81
4.75	72
2	66
0.85	59
0.425	45
0.25	36
0.15	35
0.075	29.7



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

_____

Reviewed By: _____ P.Eng.

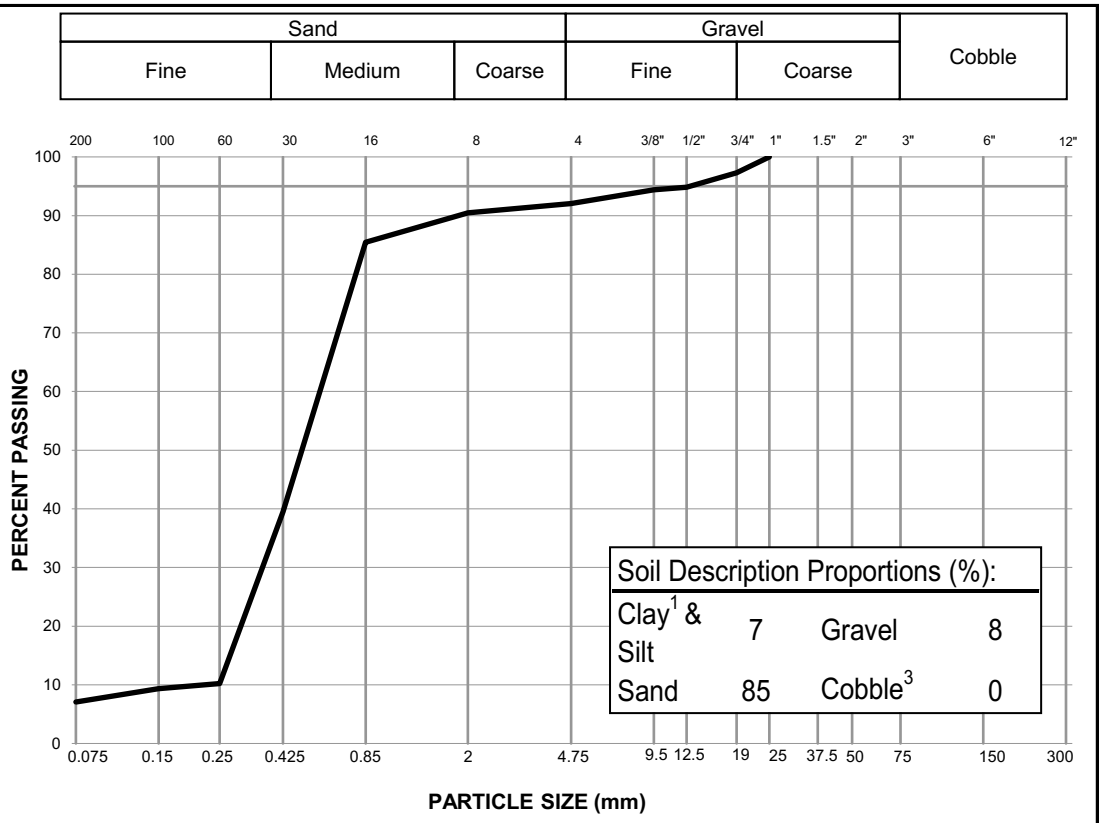
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-05
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-01
Client:	K'alo-Stantec Limited	Sample Depth:	4.5-5.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 12, 2025 By: AH	Date sampled:	March 25, 2025
Soil Description[2]:	SAND, trace gravel, trace silt, brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.7
Moisture Content:	8.3%		Cc: 1.0

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	
25	100
19	97
12.5	95
9.5	94
4.75	92
2	90
0.85	85
0.425	40
0.25	10
0.15	9
0.075	7.1



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

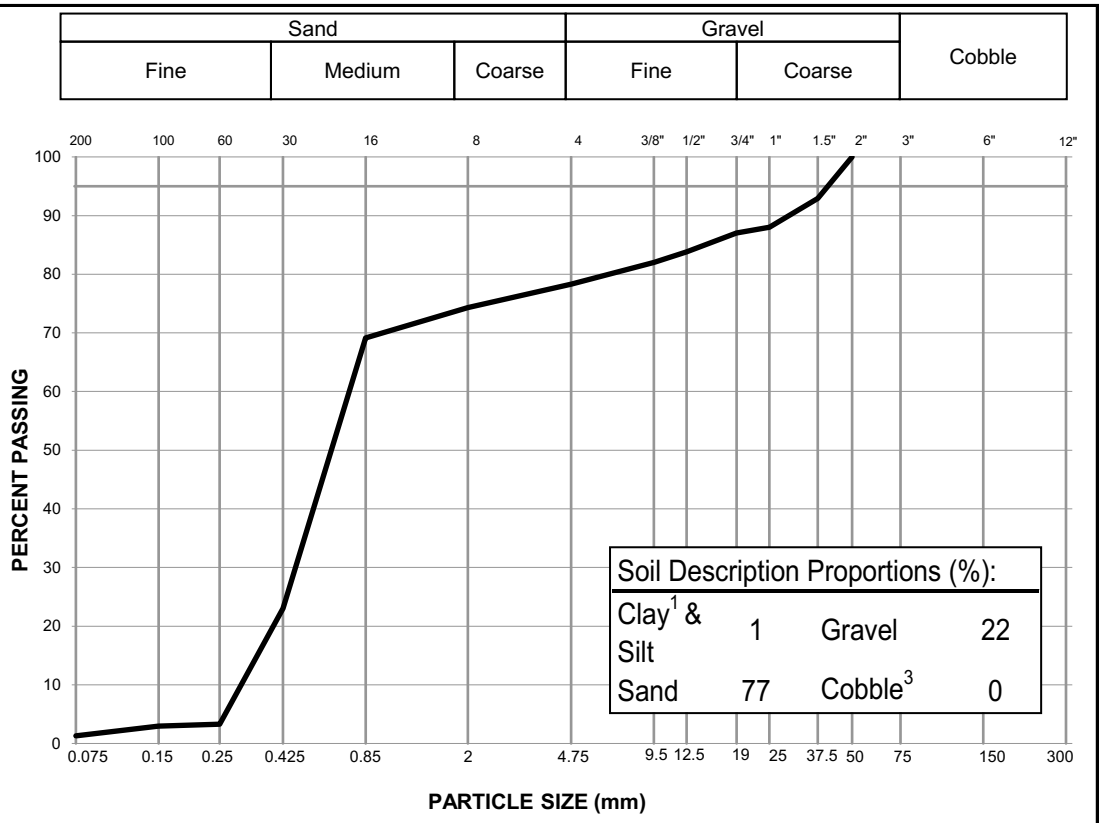
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-07
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-02
Client:	K'alo-Stantec Limited	Sample Depth:	0.9-1.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 13, 2025 By: AH	Date sampled:	March 25, 2025
Soil Description[2]:	SAND, gravelly, trace silt, brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.5
Moisture Content:	1.7%		Cc: 1.0

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
37.5	93
25	88
19	87
12.5	84
9.5	82
4.75	78
2	74
0.85	69
0.425	23
0.25	3
0.15	3
0.075	1.3



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

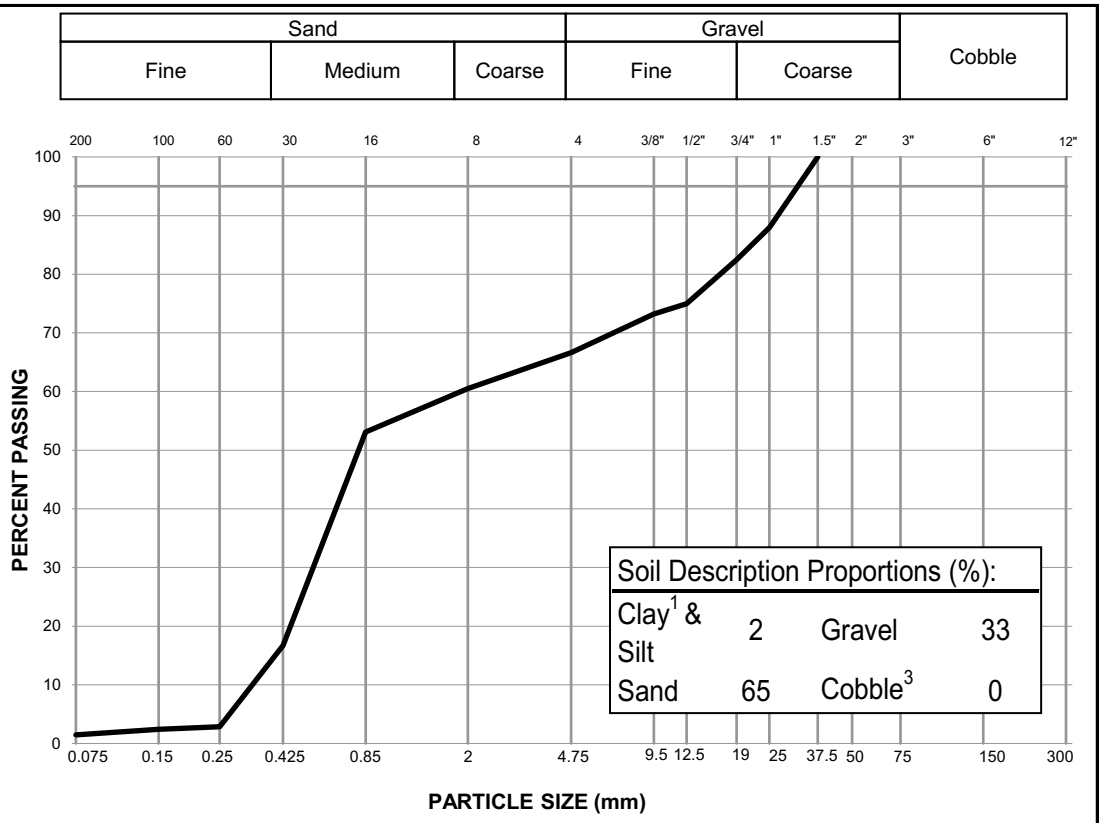
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-08
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-02
Client:	K'alo-Stantec Limited	Sample Depth:	1.8 - 2.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025 By: AH	Date sampled:	March 25, 2025
Soil Description[2]:	SAND, gravelly, trace silt, brown	Sampled By:	AG
		USC Classification:	SP Cu: 5.6
Moisture Content:	1.7%		Cc: 0.5

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	100
25	88
19	82
12.5	75
9.5	73
4.75	67
2	61
0.85	53
0.425	17
0.25	3
0.15	2
0.075	1.5



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

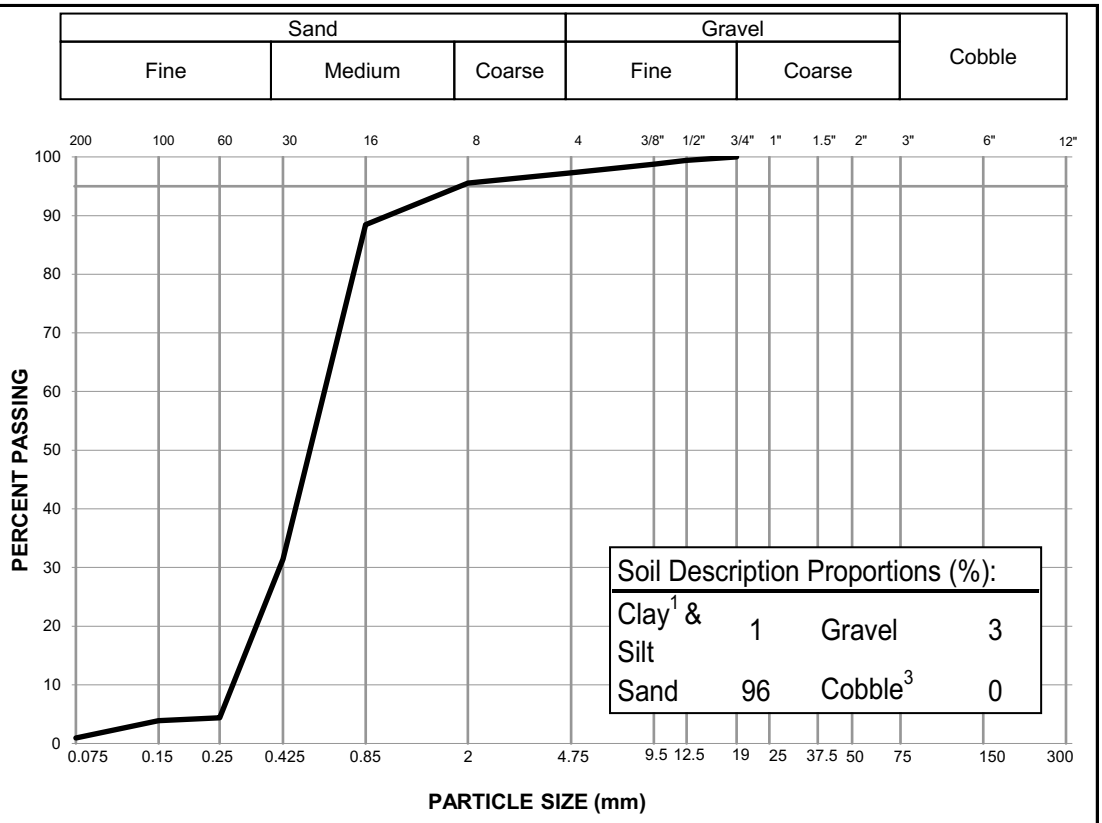
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-11
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-02
Client:	K'alo-Stantec Limited	Sample Depth:	5.0-5.5 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 19, 2025 By: AH	Date sampled:	March 25, 2025
Soil Description[2]:	SAND, trace gravel, trace silt, dark brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.2
Moisture Content:	14.6%		Cc: 0.9

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	
25	
19	100
12.5	99
9.5	99
4.75	97
2	96
0.85	88
0.425	31
0.25	4
0.15	4
0.075	0.9



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

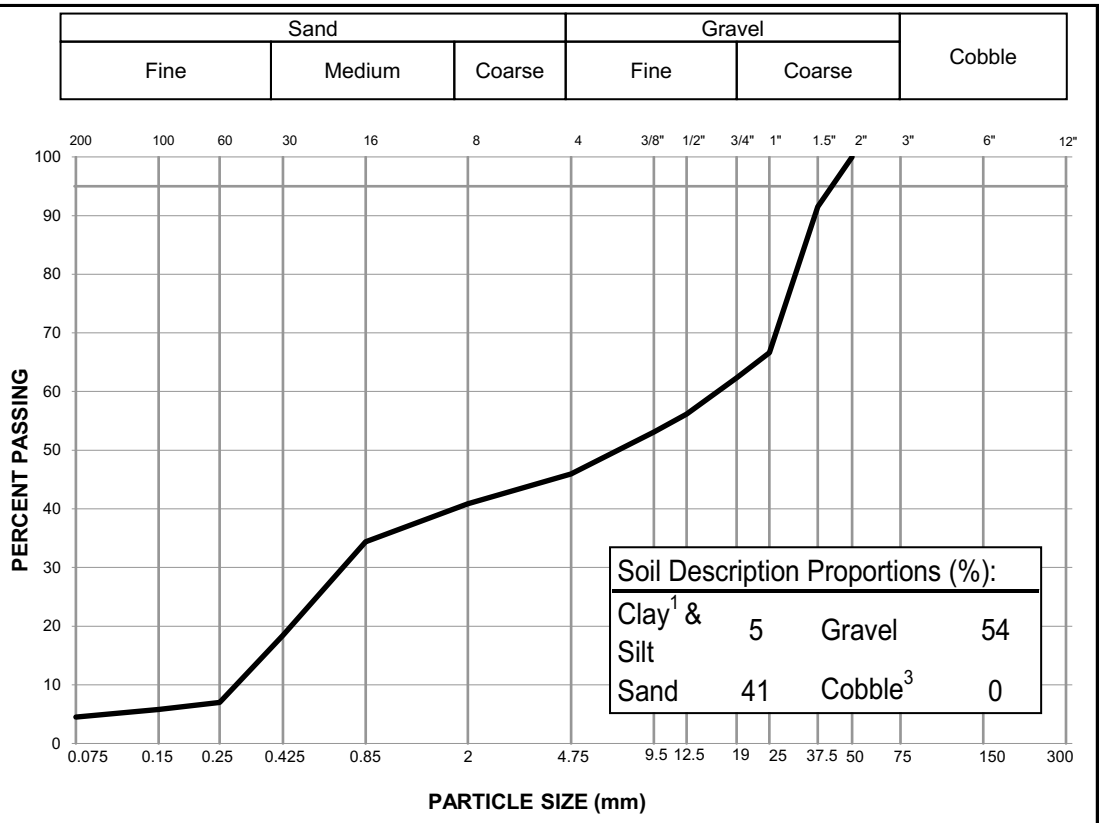
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-13
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-03
Client:	K'alo-Stantec Limited	Sample Depth:	0.9-1.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 14, 2025 By: AH	Date sampled:	March 26, 2025
Soil Description[2]:	GRAVEL and SAND, trace silt, brown	Sampled By:	AG
		USC Classification:	GP Cu: 55.9
Moisture Content:	1.9%		Cc: 0.1

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
37.5	92
25	67
19	62
12.5	56
9.5	53
4.75	46
2	41
0.85	34
0.425	18
0.25	7
0.15	6
0.075	4.5



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

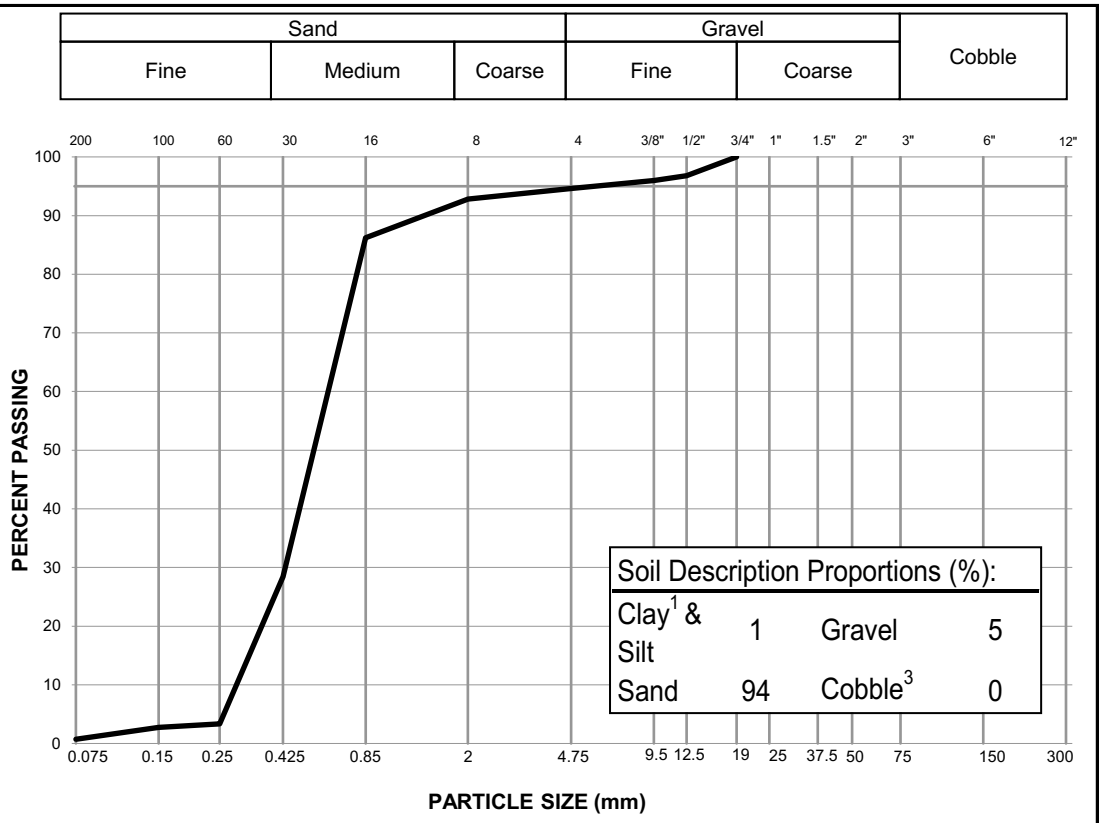
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-16
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-03
Client:	K'alo-Stantec Limited	Sample Depth:	3.5-4.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 14, 2025 By: AH	Date sampled:	March 26, 2025
Soil Description[2]:	SAND, trace gravel, trace silt, brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.2
Moisture Content:	14.0%		Cc: 1.0

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	
25	
19	100
12.5	97
9.5	96
4.75	95
2	93
0.85	86
0.425	28
0.25	3
0.15	3
0.075	0.7



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

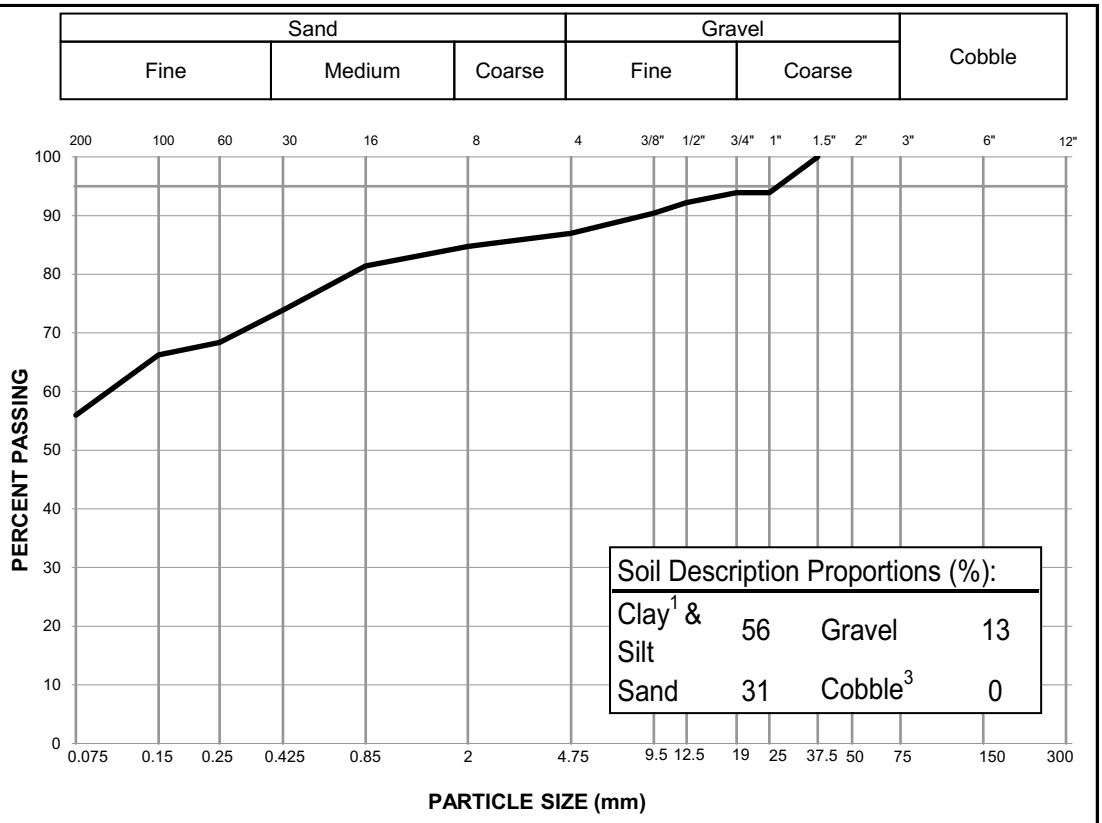
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-19
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-04
Client:	K'alo-Stantec Limited	Sample Depth:	0.9-1.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025 By: AH	Date sampled:	March 25, 2025
Soil Description[2]:	SILT, sandy, some gravel, trace clay, brown	Sampled By:	AG
		USC Classification:	ML Cu: #N/A
Moisture Content:	7.7%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	100
25	94
19	94
12.5	92
9.5	90
4.75	87
2	85
0.85	81
0.425	74
0.25	68
0.15	66
0.075	56.0



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

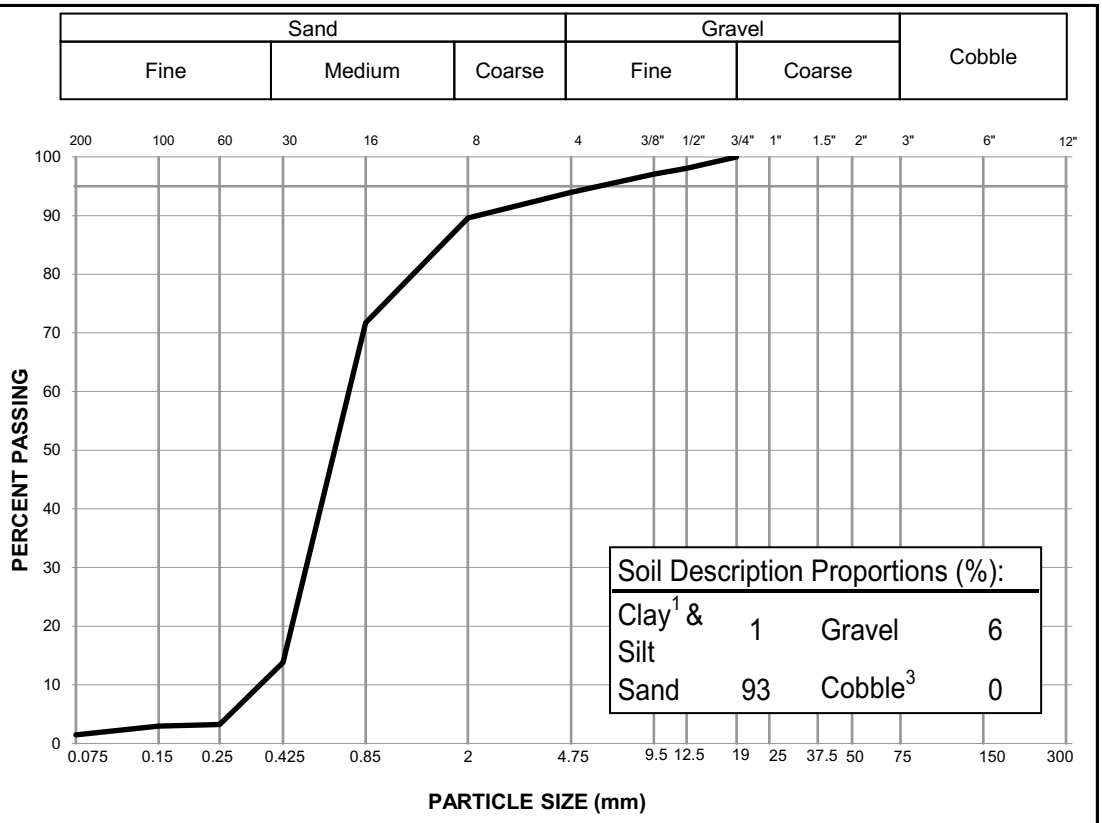
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-21
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-04
Client:	K'alo-Stantec Limited	Sample Depth:	2.5-3.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 16, 2025 By: AH	Date sampled:	March 26, 2025
Soil Description[2]:	SAND, trace gravel, trace silt, brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.1
Moisture Content:	0.2%		Cc: 1.1

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	
25	
19	100
12.5	98
9.5	97
4.75	94
2	90
0.85	72
0.425	14
0.25	3
0.15	3
0.075	1.5



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

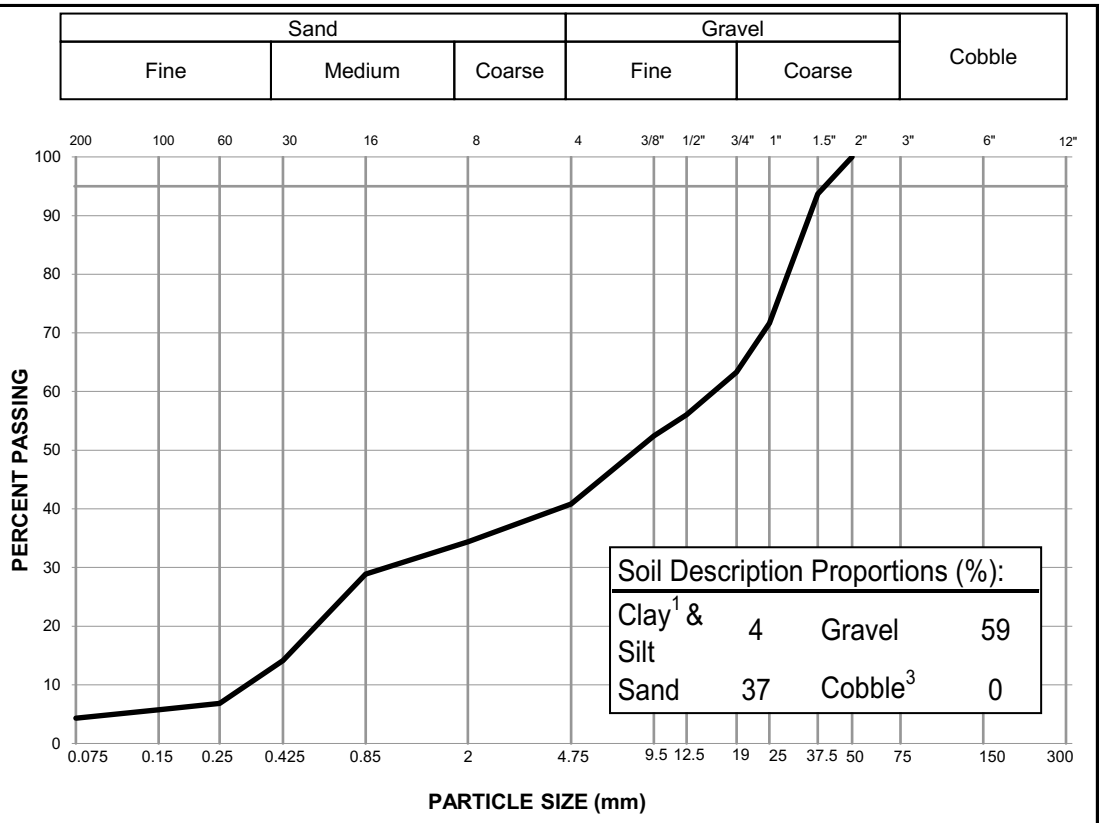
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sathu Borrow Sources	Sample No.:	1361-26
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sathu Settlement Area, NWT	Sample Loc.:	TP25-9.002-05
Client:	K'alo-Stantec Limited	Sample Depth:	0.9-1.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025 By: AH	Date sampled:	March 26, 2025
Soil Description[2]:	GRAVEL and SAND, trace silt, brown,	Sampled By:	AG
		USC Classification:	GP Cu: 49.2
Moisture Content:	1.5%		Cc: 0.2

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
37.5	94
25	72
19	63
12.5	56
9.5	52
4.75	41
2	34
0.85	29
0.425	14
0.25	7
0.15	6
0.075	4.3



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

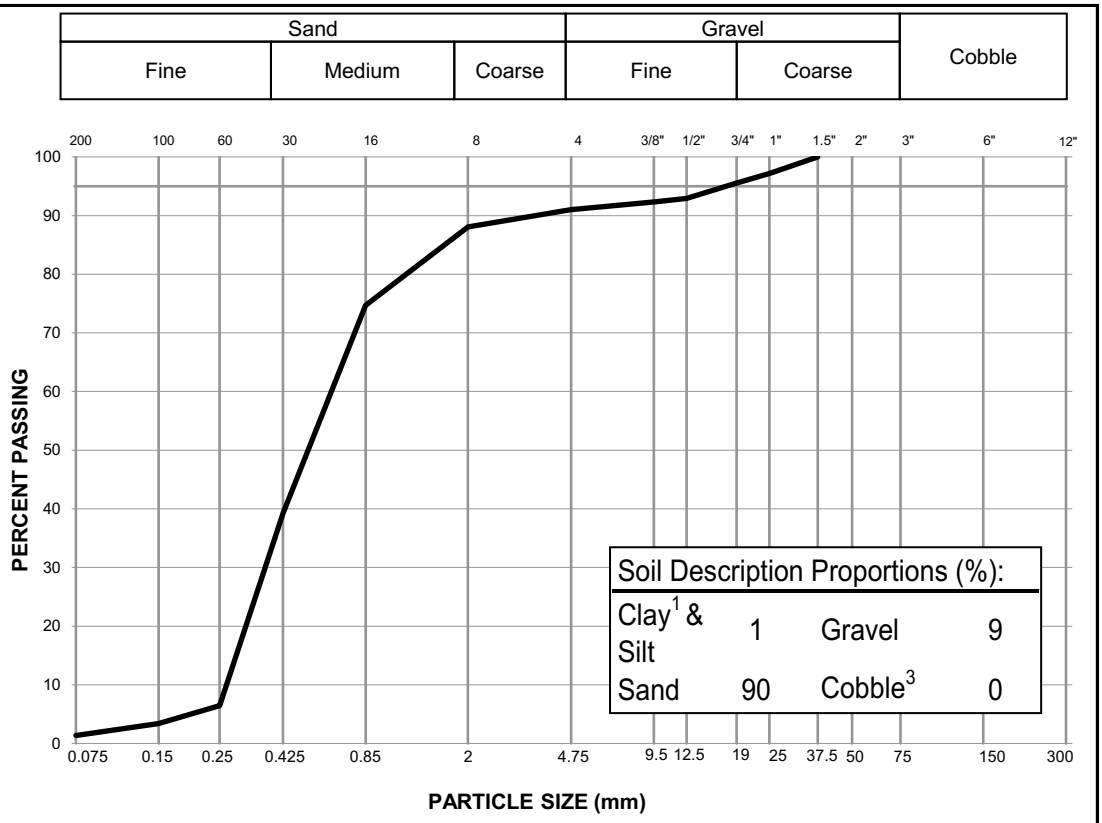
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-29
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-05
Client:	K'alo-Stantec Limited	Sample Depth:	3.5-4.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025 By: AH	Date sampled:	March 26, 2025
Soil Description[2]:	SAND, trace gravel, trace silt, dark brown	Sampled By:	AG
		USC Classification:	SP Cu: 2.5
Moisture Content:	2.1%		Cc: 0.8

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	100
25	97
19	96
12.5	93
9.5	92
4.75	91
2	88
0.85	75
0.425	39
0.25	6
0.15	3
0.075	1.4



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

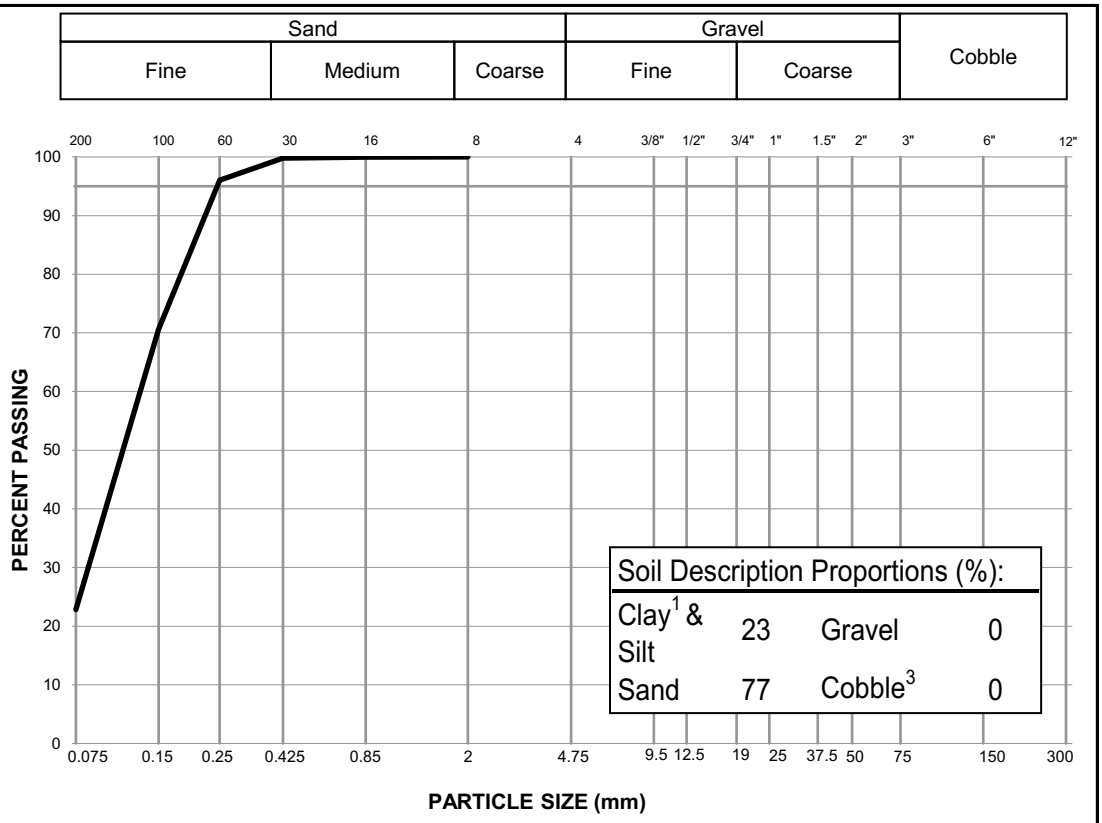
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-31
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-05
Client:	K'alo-Stantec Limited	Sample Depth:	5.5-6.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025 By: AH	Date sampled:	March 26, 2025
Soil Description[2]:	SAND, silty, brown	Sampled By:	AG
		USC Classification:	SM Cu: #N/A
Moisture Content:	8.9%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	
25	
19	
12.5	
9.5	
4.75	
2	100
0.85	100
0.425	100
0.25	96
0.15	71
0.075	22.8



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

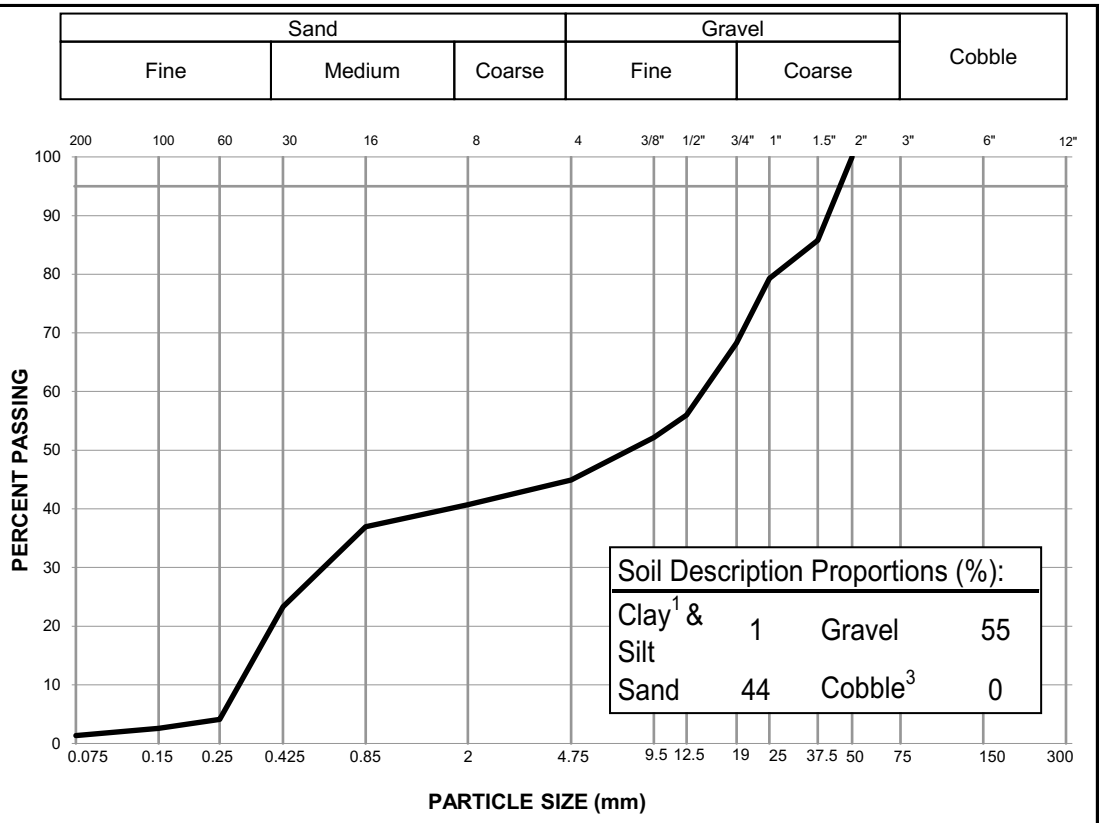
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-32
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-06
Client:	K'alo-Stantec Limited	Sample Depth:	1.0-1.1 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 13, 2025 By: AH	Date sampled:	March 25, 2025
Soil Description[2]:	GRAVEL and SAND, trace silt, brown	Sampled By:	AG
		USC Classification:	GP Cu: 48.2
Moisture Content:	1.5%		Cc: 0.1

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
37.5	86
25	79
19	68
12.5	56
9.5	52
4.75	45
2	41
0.85	37
0.425	23
0.25	4
0.15	3
0.075	1.3



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

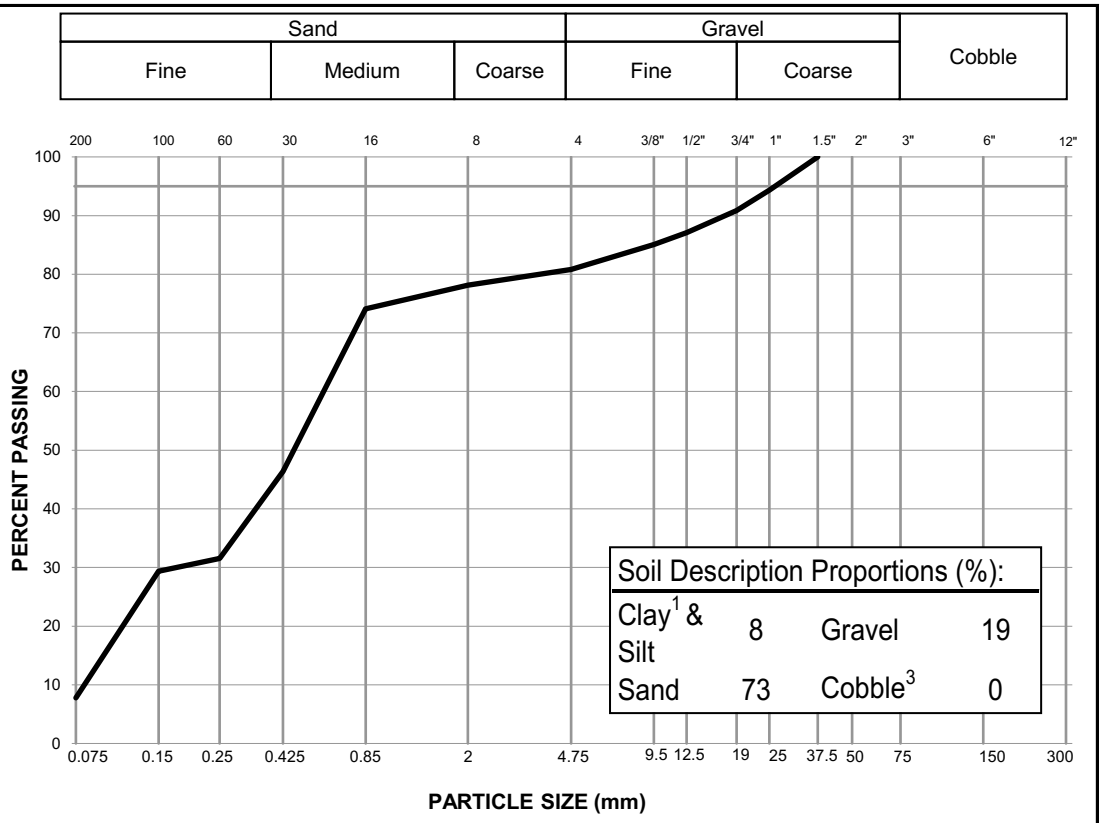
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-37
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-06
Client:	K'alo-Stantec Limited	Sample Depth:	5.7-5.9 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 15, 2025 By: AH	Date sampled:	March 26, 2025
Soil Description[2]:	SAND, some gravel, trace silt, dark brown	Sampled By:	AG
		USC Classification:	SP Cu: 7.7
Moisture Content:	12.7%		Cc: 0.6

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	100
25	94
19	91
12.5	87
9.5	85
4.75	81
2	78
0.85	74
0.425	46
0.25	32
0.15	29
0.075	7.8



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

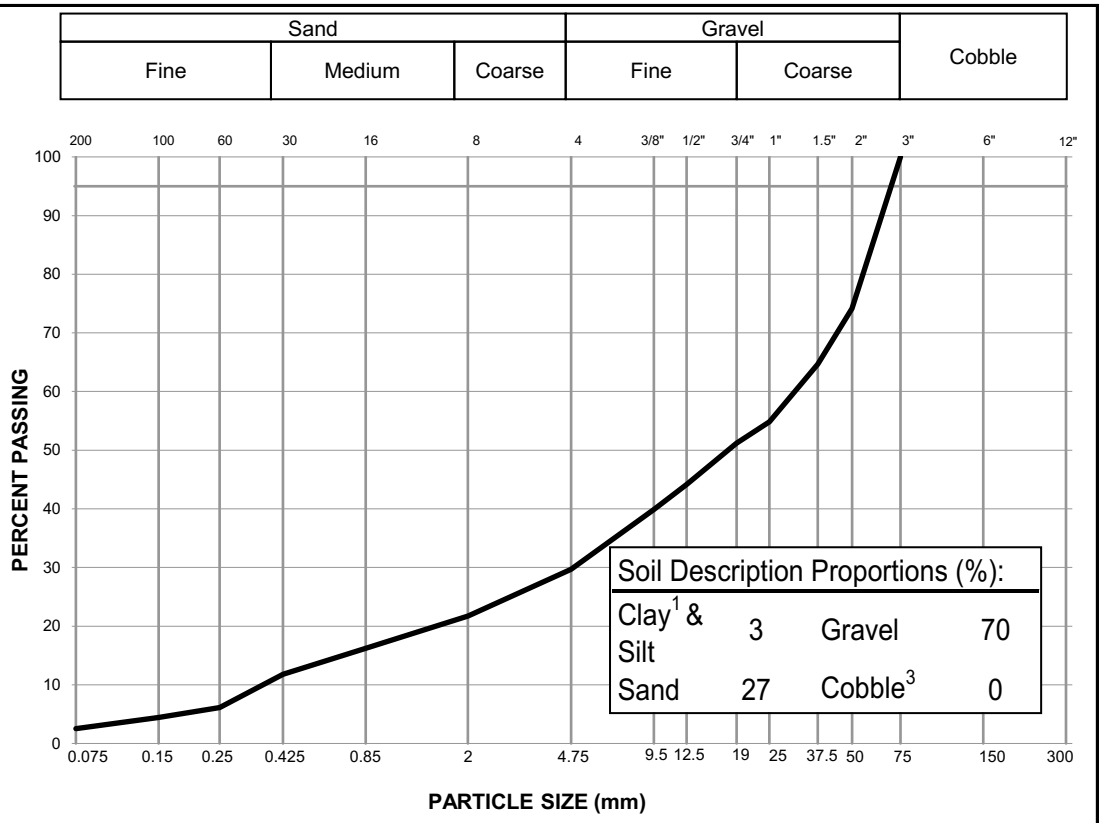
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sahtu Borrow Sources	Sample No.:	1361-38
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlement Area, NWT	Sample Loc.:	TP25-9.002-07
Client:	K'alo-Stantec Limited	Sample Depth:	0.9-1.0 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 13, 2025 By: AH	Date sampled:	March 25, 2025
Soil Description[2]:	GRAVEL, sandy, trace silt, trace organics, brown	Sampled By:	AG
		USC Classification:	GW Cu: 85.6
Moisture Content:	1.7%		Cc: 2.1

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	74
37.5	65
25	55
19	51
12.5	44
9.5	40
4.75	30
2	22
0.85	16
0.425	12
0.25	6
0.15	4
0.075	2.5



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

Reviewed By: _____ P.Eng.

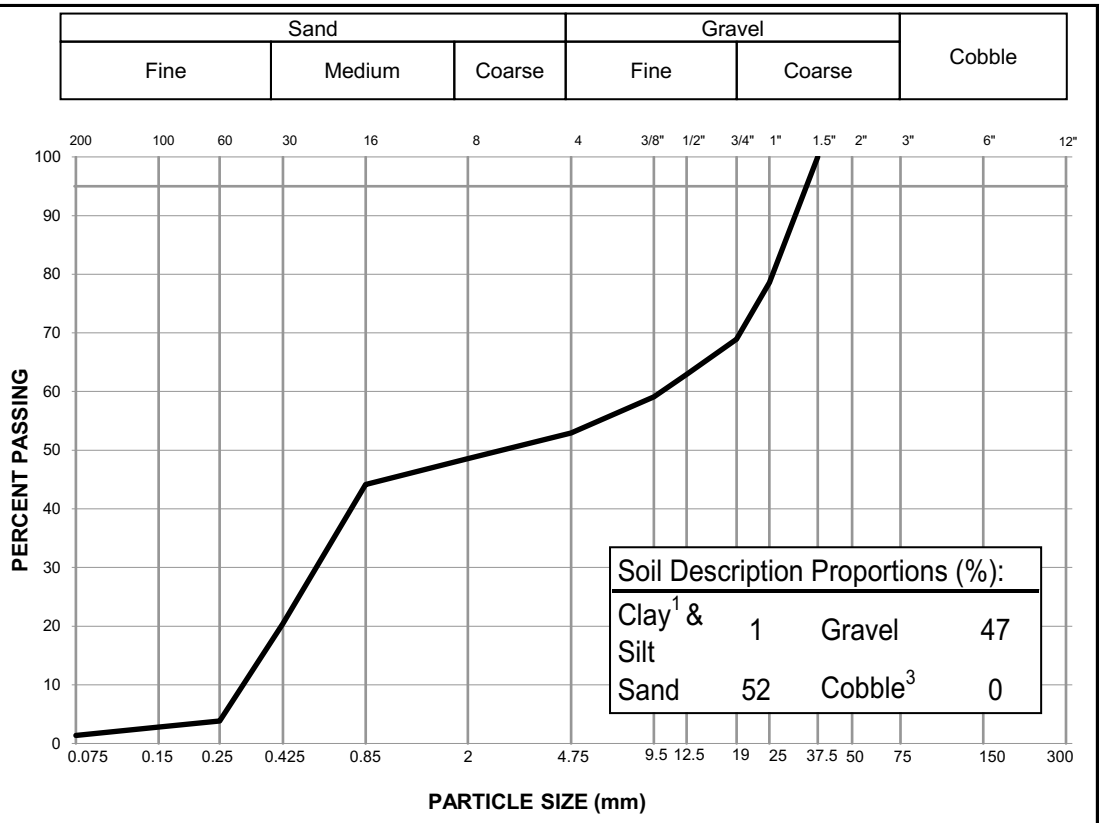
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D6913

Project:	MVH Sathu Borrow Sources	Sample No.:	1361-41
Project No.:	ENG.EARC03299-03.007	Material Type:	In Situ
Site:	Sahtu Settlment Area, NWT	Sample Loc.:	TP25-9.002-07
Client:	K'alo-Stantec Limited	Sample Depth:	4.0-4.5 m
Client Rep.:	Dennis Kefalas	Sampling Method:	Grab
Date Tested:	June 14, 2025 By: AH	Date sampled:	March 26, 2025
Soil Description[2]:	SAND and GRAVEL, trace silt, brown	Sampled By:	AG
		USC Classification:	SP Cu: 32.4
Moisture Content:	1.5%		Cc: 0.1

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
37.5	100
25	79
19	69
12.5	63
9.5	59
4.75	53
2	49
0.85	44
0.425	20
0.25	4
0.15	3
0.075	1.4



Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: _____

Remarks: _____

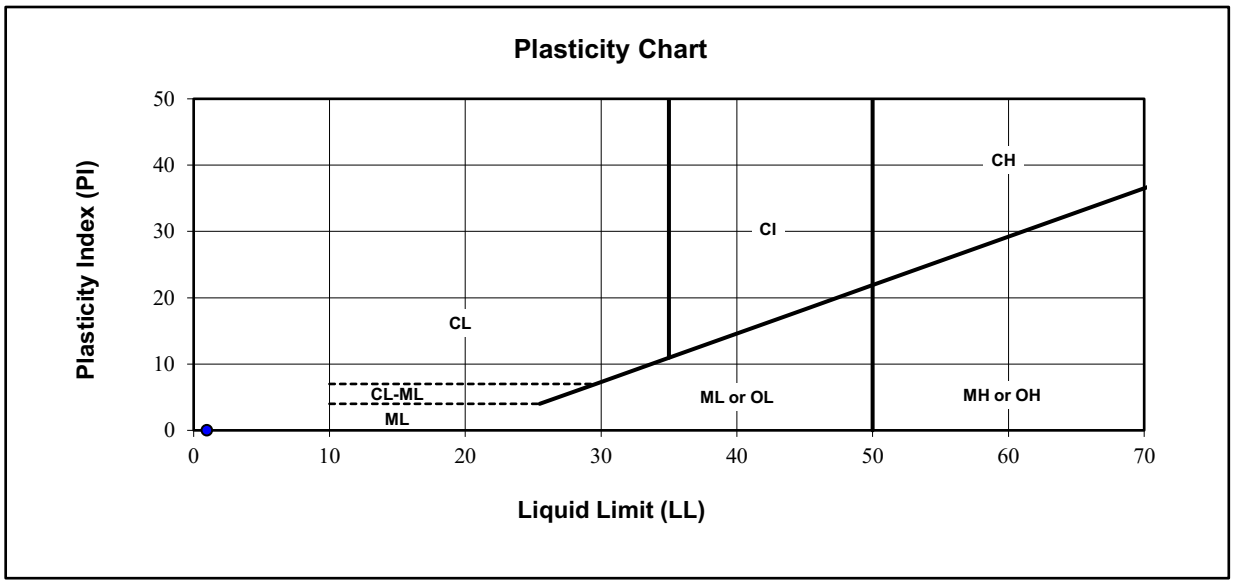
Reviewed By: _____ P.Eng.

TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Mackenzie Valley Highway Borrow Sources	Sample Number:	1361-02
		Sample Location:	TP25-9.002-01
Project No:	704-ENG.EARC03299-03.005	Depth:	1.8-2.0 m
Client:	K'alo-Stantec Limited	Sampled By:	AG
		Tested By:	TO
		Date Sampled:	March 25, 2025
		Date Tested:	June 19, 2025



Liquid Limit (LL) :	N/A	Natural Moisture (%)	4.7
Plastic Limit (PL):	N/A	Soil Plasticity:	Non Plastic
Plasticity Index (PI) :	**N/A**	Mod.USCS Symbol*:	NP

*In accordance with Canadian Foundation Engineering Manual 5th Edition (2023), LL in the range of 35 to 50 is classified as medium plastic.

Remarks:

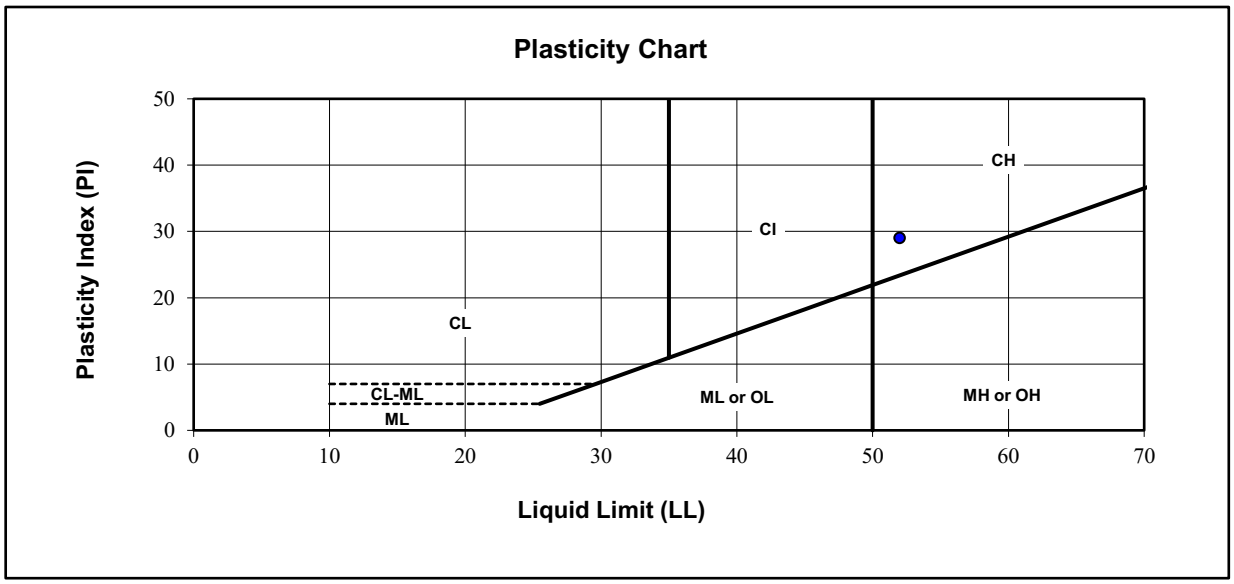
Reviewed By: P.Eng.

TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Mackenzie Valley Highway Borrow Sources	Sample Number:	1361-12
		Sample Location:	TP25-9.002-02
Project No:	704-ENG.EARC03299-03.005	Depth:	5.7-6.0 m
Client:	K'alo-Stantec Limited	Sampled By:	AG
		Tested By:	TO/EC
		Date Sampled:	March 25, 2025
		Date Tested:	June 21, 2025



Liquid Limit (LL) :	52	Natural Moisture (%)	26.5
Plastic Limit (PL):	23	Soil Plasticity:	High
Plasticity Index (PI) :	**29**	Mod.USCS Symbol*:	CH

*In accordance with Canadian Foundation Engineering Manual 5th Edition (2023), LL in the range of 35 to 50 is classified as medium plastic.

Remarks:

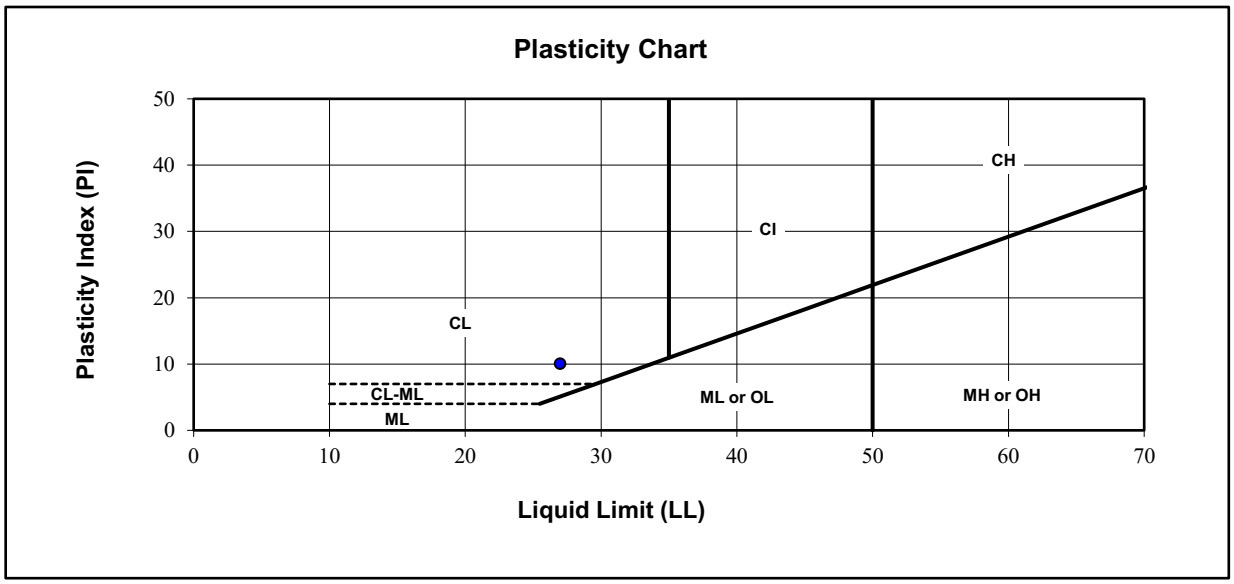
Reviewed By: _____ P.Eng.

TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Mackenzie Valley Highway Borrow Sources	Sample Number:	1361-18
		Sample Location:	TP25-9.002-03
Project No:	704-ENG.EARC03299-03.005	Depth:	5.9-6.0 m
Client:	K'alo-Stantec Limited	Sampled By:	AG
		Tested By:	TO
		Date Sampled:	March 25, 2025
		Date Tested:	June 20, 2025



Liquid Limit (LL) :	27	Natural Moisture (%)	19.5
Plastic Limit (PL):	17	Soil Plasticity:	Low
Plasticity Index (PI) :	**10**	Mod.USCS Symbol*:	CL

*In accordance with Canadian Foundation Engineering Manual 5th Edition (2023), LL in the range of 35 to 50 is classified as medium plastic.

Remarks:

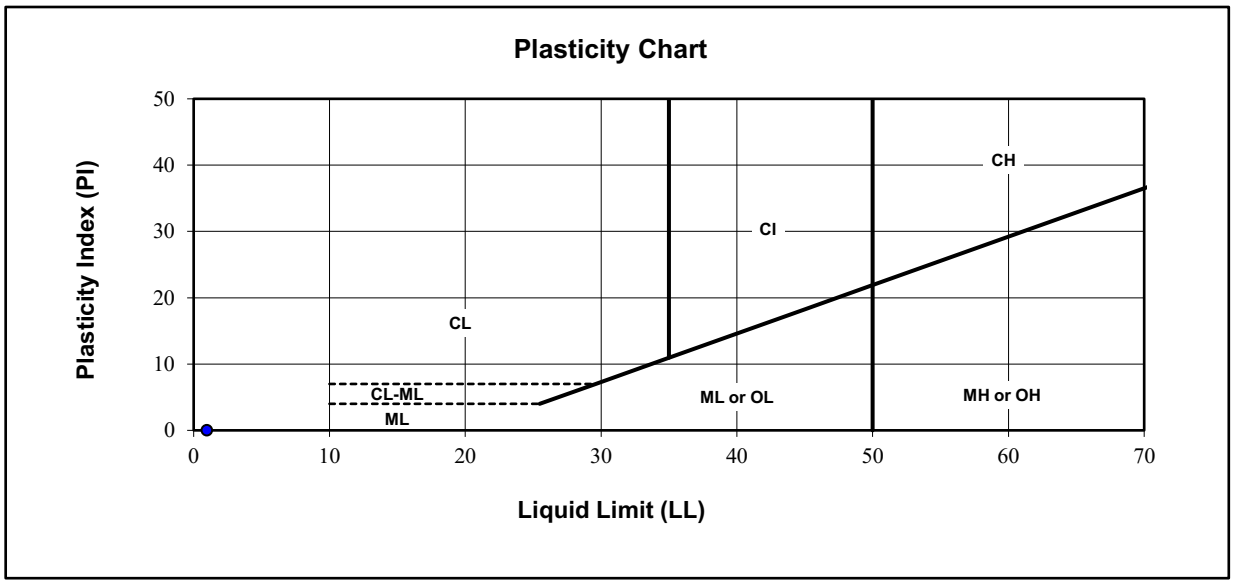
Reviewed By: _____ P.Eng.

TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	Mackenzie Valley Highway Borrow Sources	Sample Number:	1361-25
		Sample Location:	TP25-9.002-04
Project No:	704-ENG.EARC03299-03.005	Depth:	5.9-6.0 m
Client:	K'alo-Stantec Limited	Sampled By:	AG
		Tested By:	TO
		Date Sampled:	March 25, 2025
		Date Tested:	June 19, 2025



Liquid Limit (LL) :	N/A	Natural Moisture (%)	24.9
Plastic Limit (PL):	N/A	Soil Plasticity:	Non Plastic
Plasticity Index (PI) :	**N/A**	Mod.USCS Symbol*:	NP

*In accordance with Canadian Foundation Engineering Manual 5th Edition (2023), LL in the range of 35 to 50 is classified as medium plastic.

Remarks:

Reviewed By: _____ P.Eng.

TETRA TECH

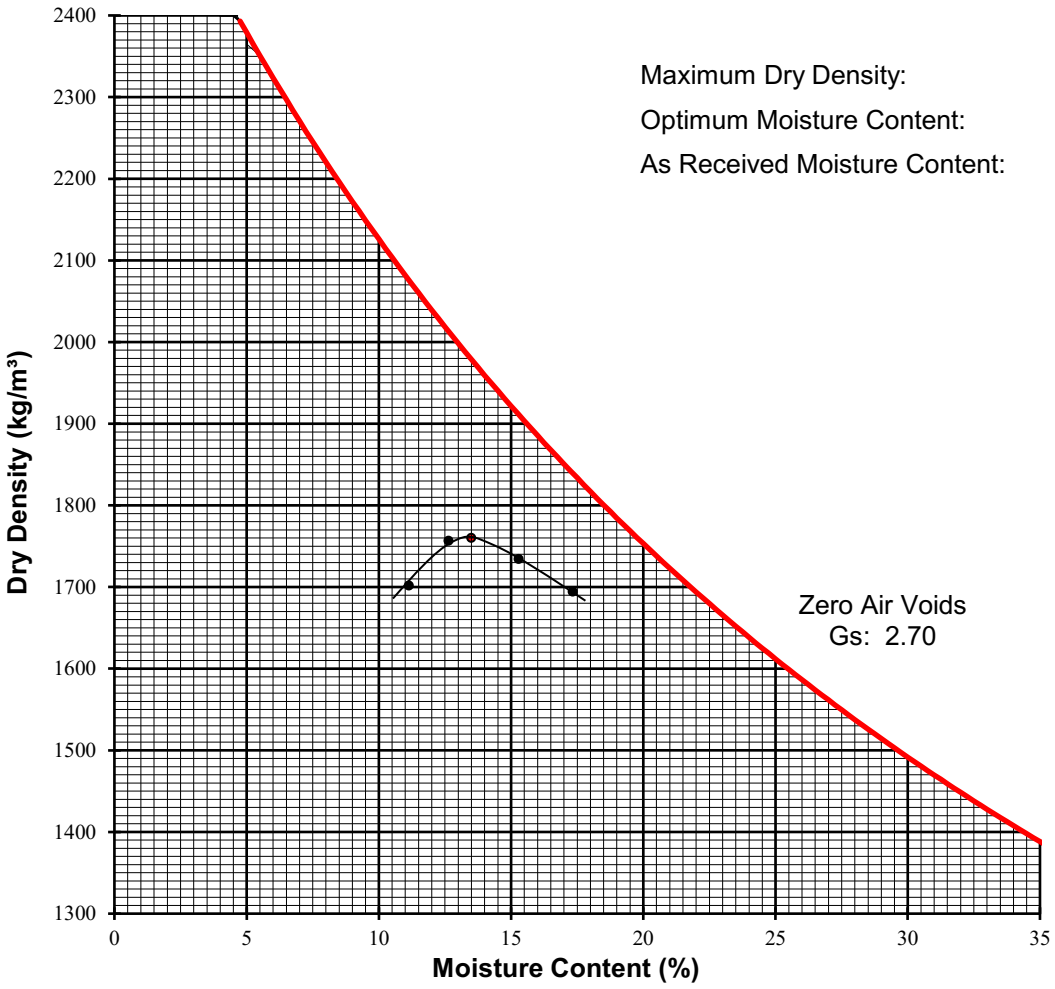
MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D698 (Standard Proctor)

Project:	Mackenzie Valley Highway Sahtu Borrow Sources	Sample No.:	1361-21
Project No.:	704-ENG.EARC03299-03.005	Sampled By:	AG
Client:	K'alo Stantec Limited	Date Received:	26-Mar-25
		Test Date:	27-Jun-25
Source:	TP25-9.002-04	Test By:	TO
		Test Method:	B (Manual)

Sample Location: 2.5-3.0 m

Sample Description: SAND, trace gravel, trace silt, brown



Maximum Dry Density:	**1760**	kg/m³
Optimum Moisture Content:	**13.5**	%
As Received Moisture Content:	0.2	%

Remarks:

Reviewed By: _____ P.Eng.

TETRA TECH

APPENDIX D

TETRA TECH'S LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

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If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

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While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this document, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to explore, address or consider and has not explored, addressed or considered any environmental or regulatory issues associated with development on the subject site.

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems, methods and standards employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.9 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historical environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional exploration and review may be necessary.

1.11 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

Construction activity can impact structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques, and construction sequence are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, and the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

1.15 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued satisfactory performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

1.16 DESIGN PARAMETERS

Bearing capacities for Limit States or Allowable Stress Design, strength/stiffness properties and similar geotechnical design parameters quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition used in this report. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions considered in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

1.18 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This document has been prepared based on the applicable codes, standards, guidelines or best practice as identified in the report. Some mandated codes, standards and guidelines (such as ASTM, AASHTO Bridge Design/Construction Codes, Canadian Highway Bridge Design Code, National/Provincial Building Codes) are routinely updated and corrections made. TETRA TECH cannot predict nor be held liable for any such future changes, amendments, errors or omissions in these documents that may have a bearing on the assessment, design or analyses included in this report.