



To:	Dylan Adams-Chute	Date:	December 3, 2020
Client:	YTG – Community Services Land Development Branch	Memo No.:	001
From:	Myles Plaunt, CET	File:	ENG.WARC03386-77
Subject:	Slope Stability Assessment Lone Tree Area West of Teslin, Yukon		

1.0 INTRODUCTION

At the request of Mr. Dylan Adams-Chute, Project Manager for the Government of Yukon – Community Services – Land Development Branch, Tetra Tech Canada Inc. (Tetra Tech) has completed a slope stability assessment of the above captioned site.

Authorization to proceed was by way of a Government of Yukon - Agreement for Consultant Services signed on November 16, 2020. This memorandum is subject to Tetra Tech's Limitations on the Use of this Document, which is attached in Appendix A.

2.0 SITE CONDITIONS

2.1 General Location

The study area is a sliver of land overlooking Teslin Lake located between the current Alaska Highway alignment and the old Alaska Highway between Lone Tree Creek and Deadman Creek near Teslin, Yukon. The east portion of the study area is the Teslin Tlingit Council (TTC) R-13A land selection and the west end of the study area belongs to the Yukon Government (YG).

The site is accessed along the Old Alaska Highway which intersects the current highway alignment at the east and west ends.

The location of the site (Figure 3 - Conceptual Development Plan prepared by 3 Pikas and dated 2020/06/09) is attached for reference.

2.2 Terrain & Surficial Geology

Terrain conditions throughout the study area was observed during the October 25, 2018 site reconnaissance. Slopes were fairly consistent throughout with localized variation. In general:

- Slopes throughout the TTC end of the study area range from gentle to moderate. No excessively steep slopes were noted throughout the east end of the study area. Terrain throughout the YG end is gently rolling and no slopes exceeding 10% were noted.
- It is a little steeper from the Old Alaska Highway down to the lake, where sections with slopes that are up to 20% exist.

Two surficial geology maps were reviewed to assess geotechnical conditions throughout the study area, including:

- Geological Survey of Canada map number 1891A – Surficial Geology – Teslin; and,
- Soils and Surficial Geology – Southern Lakes Project (1980 to 1982) – Map Sheet 105 C SW prepared by Morison, McKenna and Davies

Details from the two map sheets are summarized as:

- Deposition throughout this area is from the Morley Bay Soil Association Complex.
- Soils throughout include morainal (till) in general, and locally overlain by glaciolacustrine sediments.
- The morainal soils have cobbles and boulders throughout.
- Both the morainal and lacustrine sediments are described as loamy (which is encouraging when assessing potential for on-site sewage system feasibility).
- The till soils can be either lodgement till (sediments deposited below the glacial ice) and ablation till (sediments moved along the surface of the glacier (again, this information is important when assessing on-site sewage disposal system feasibility as the lodgement tills tend to be much denser than the ablation tills).

The site reconnaissance confirmed the presence of both morainal and lacustrine soils. Exposures along the up-gradient side of both the Old Alaska Highway and the current highway alignment show areas with fine grained sediments only (lacustrine) and areas with gravel, cobbles and boulders in a silt matrix (morainal). Development throughout the TTC end will encounter these soils while the west end of the YG section will possibly transition into the Deadman Creek alluvial gravels.

2.3 Soil Conditions Observed During Testpitting

The testpitting program was completed on August 7, 2019. Six testpits were excavated to a termination depth of 3.0 m using a Kubota KXD57-4 tracked excavator sub-contracted from Deadman Creek Enterprises of Teslin, Yukon. Two testpits were excavated within the YG portion of the development area and four testpits were excavated throughout the TTC portion.

Sand and silt till with cobbles and the occasional boulder was noted at all testpit locations. No bedrock, groundwater or permafrost was observed during testpitting.

2.4 Site Drainage

The entire study area is located along a south facing slope that extends well north of the current Alaska Highway corridor. Up-slope there is probably exposed bedrock and scree. Runoff from this slope is channeled through culverts on the current highway alignment and down through the study area. Conceptual design by 3 Pikas has taken this into consideration as green spaces have been identified for the portions of the site downgradient of the two culverts noted on the Alaska Highway.

At approximately 2.4 km in from the east end, a major slide area was noted (slightly west of the S-209B site). This slide may have been the result of poor control of surface water, or perhaps a seepage zone under the Old Alaska Highway embankment.

3.0 GEOMETRIC SLOPE STABILITY ASSESSMENT

In advance of completing the slope stability assessment, LIDAR data supplied by YG was used to create a site plan with contour information. This site plan is presented as Figure 1, attached. Cross sections were created at three typical locations along the length of the proposed development area. The locations of the sections are also presented on Figure 1.

As mentioned above, the steeper sections are located between the Old Alaska Highway and Teslin Lake so the slope stability assessment is focused on that area.

Sections analyzed are presented as Figure 2, attached. Slope angles; the horizontal distance between the lake and the Old Alaska Highway; the vertical distance between the beach and the Old Alaska Highway; along with the soil properties of the sand and silt till soils observed throughout the site were considered during this assessment.

Tetra Tech considers two scenarios when completing a geometric slope stability assessment. One scenario is for slopes where stable soil conditions exist and the other is where slopes are potentially unstable and prone to seasonal erosion and surface sloughing (like the escarpment soils above Downtown Whitehorse).

The assessment completed for the three sections analyzed suggest that there are no slope stability issues associated with the proposed residential development and no additional development or building setbacks are required.

It is understood that the TTC section of the Old Alaska Highway will be upgraded and the upgrades will require clearing to 10 m from the embankment center line on both sides. This should have no impact on slope stability as long as no additional clearing of trees and ground cover be completed beyond the clearing limits on the down gradient side. This additional clearing will in fact be more of a grubbing operation where regrowth along both the up-gradient side and down-gradient side of the original Old Alaska Highway alignment will be removed. Once the upgrades are complete, it is recommended that all down-gradient sideslopes be reseeded with an appropriate grass blend (if done correctly, the grass will assist in preventing woody species from growing along the right-of-way, which would once again impede site lines and become a maintenance issue.

Below the cleared right of way and the lake (as mentioned in Section 2.4), upgradient surface water flow must be controlled and if design includes new culvert installations through the Old Alaska Highway embankment, energy dissipation measures must be included so that erosion channels are not allowed to form.

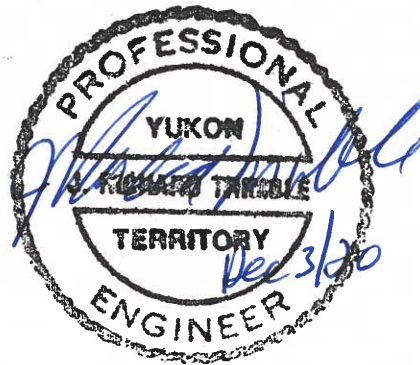
4.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Government of Yukon – Community Services – Land Development Branch and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Government of Yukon – Community Services – Land Development Branch, or for any application other than the work performed as part of this specific request. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix A.

5.0 CLOSURE

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

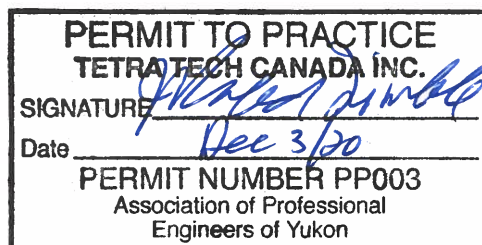
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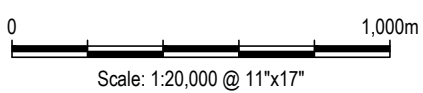
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Attachments: Figure 1 – Site Plan Showing Contour Information
Figure 2 – Cross Sections
Figure 3 – Conceptual Development Plan (3 Pikas)
Appendix A - Limitations on the Use of this Document





NOTE : CONTOURS IN SURVEY AREA ARE AT 2 m MINOR INTERVALS AND 10 m MAJOR INTERVALS



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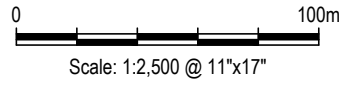
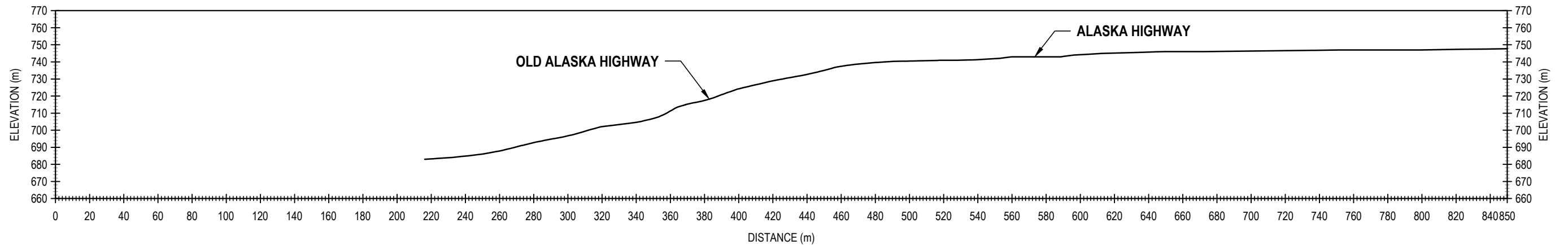
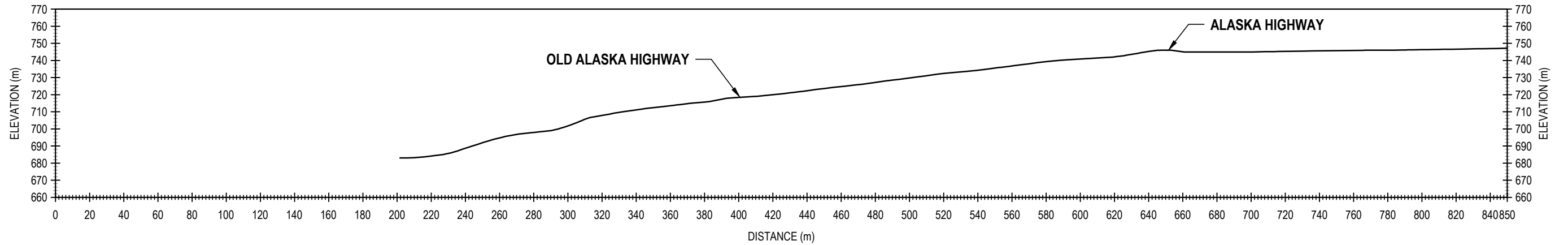
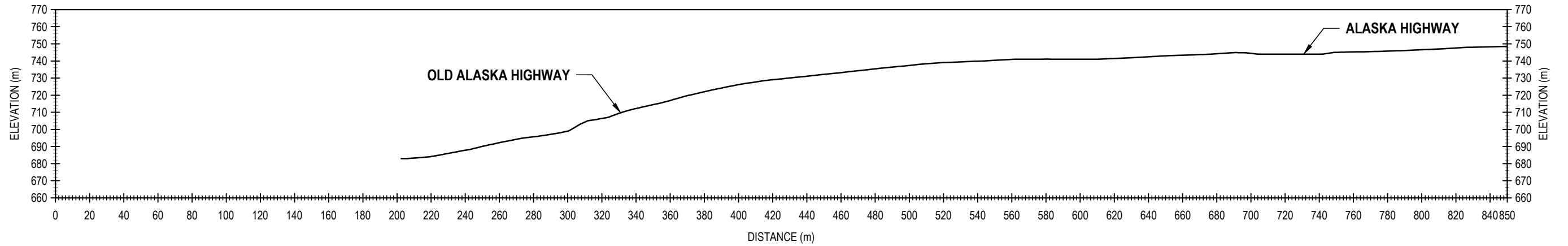
**LONE TREE SLOPE STABILITY ASSESSMENT
TESLIN, YUKON**

SITE PLAN PRESENTING CONTOUR INFORMATION

PROJECT NO. ENG.WARC03386-77	DWN CB	CKD MCP	REV 0
OFFICE EBA-WHSE	DATE November 17, 2020		

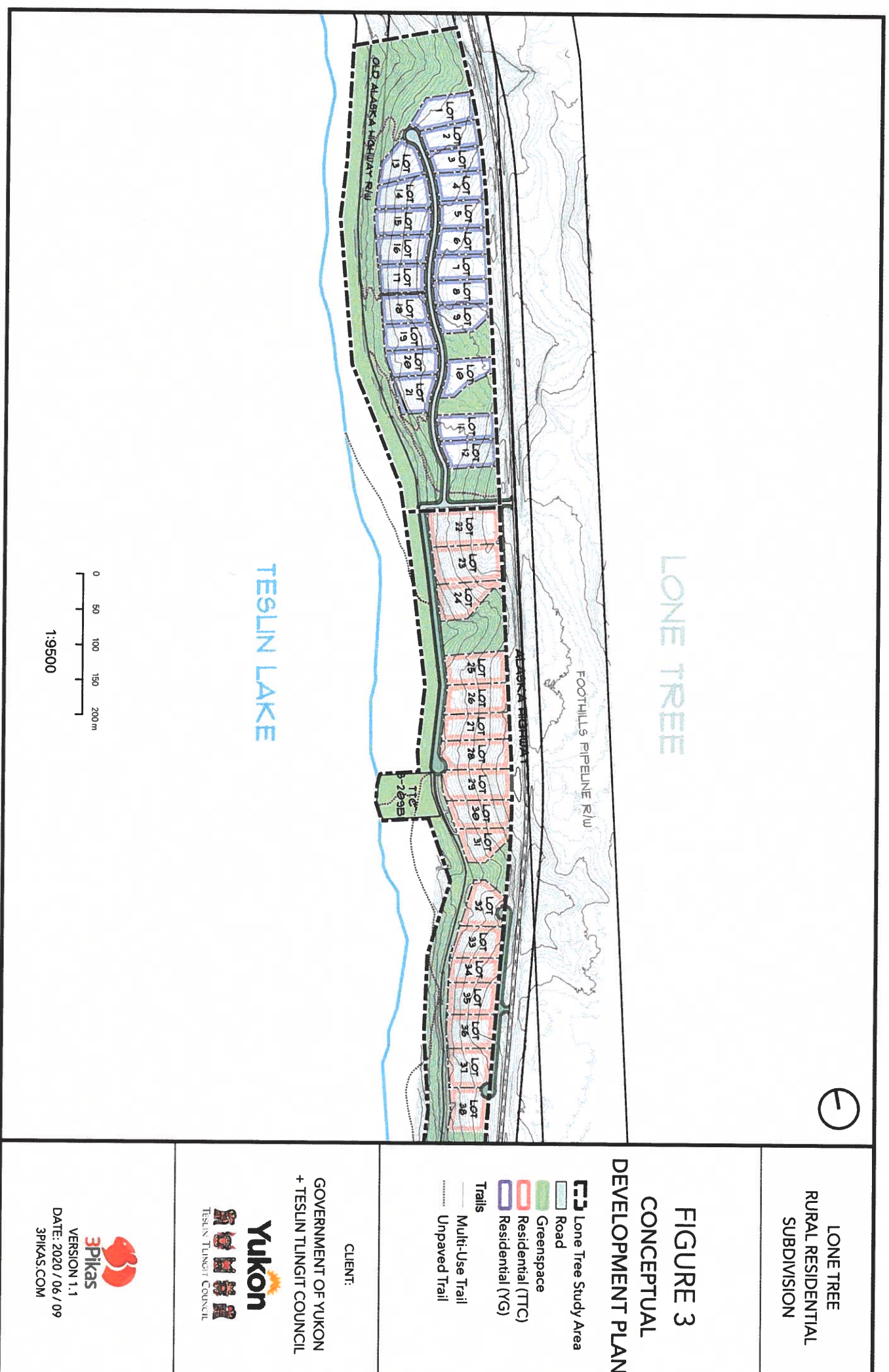
Figure 1

Q:\Whitehorse\Data\0201\drawings\Teslin\ENG\WARC03386-77 Lone Tree Slope Stability Assessment\ENG\WARC03386-77 Fig. 1-R0.dwg [FIGURE 2] November 19, 2020 - 5:37:38 pm (BY: BUCHAN, CAMERON)



<p>CLIENT</p>	LONE TREE SLOPE STABILITY ASSESSMENT TESLIN, YUKON			
	CROSS-SECTIONS			
	<p>PROJECT NO. ENG.WARC03386-77</p>	<p>DWN CB</p>	<p>CKD MCP</p>	<p>REV 0</p>
	<p>OFFICE EBA-WHSE</p>	<p>DATE November 18, 2020</p>		<p>Figure 2</p>

FIGURE 3: CONCEPTUAL DEVELOPMENT PLAN



APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL – YUKON GOVERNMENT

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the use of TETRA TECH's Client, its officers, employees, agents, representatives, successors and assigns (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH. Any changes to the conclusions, opinions, and recommendations presented in TETRA TECH's Professional Document must be authorized by TETRA TECH.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems, as per agreed project deliverable formats. TETRA TECH makes no representation about the compatibility of these files with the Client's future software and hardware systems.

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document.

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

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.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, and subject to the standard of care herein, 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, except where TETRA TECH has subcontracted for such information.

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 report, 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 make, 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 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the Client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

1.8 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.

1.9 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.

1.10 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.

1.11 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.

1.12 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.

1.13 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.

1.14 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.

1.15 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.

1.16 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.

1.17 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.

1.18 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.

1.19 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.