

December 5, 2018

Government of Yukon
Department of Community Services
Rural Land Development - Land Development Branch
Box 2703
Whitehorse, YT Y1A 2C6

ISSUED FOR REVIEW
FILE: ENG.WARC03386-21
Via Email: kevin.fisher@gov.yk.ca

Attention: Mr. Kevin Fisher, Program Manager

Subject: Thompson Drive Country Residential Site Development Suitability
Watson Lake, Yukon

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by Kevin Fisher, Program Manager for the Government of Yukon (YG), Community Services, Rural Land Development, Land Development Branch to provide a geotechnical overview of the proposed country residential development area off Thompson Drive located north of Watson Lake along the Campbell Highway.

To meet the objectives of this project, the following tasks have been completed:

- An in-house project file search did not reveal any testhole data specific to the Thompson Road subject site. However, information presented on the Yukon Geological Survey Map File 2005-7 – Watson Lake Area suggests that the surficial soil deposition in this area is predominantly glaciofluvial with sand and gravel throughout.
- A site reconnaissance was completed on October 18, 2018 to assess current conditions throughout the study area.
- Based on the conditions noted during the site reconnaissance, a summary of terrain and soil conditions is presented.
- Potential for country residential development are discussed and recommendations for roadway construction, conventional foundation construction and on-site sewage disposal system design and construction are presented.

2.0 SITE CONDITIONS

2.1 Location and Current Land Use

The study area is located along the west side of the Campbell Highway approximately 8 km north of the Alaska Highway intersection (refer to Figure 1). The actual study area is bordered by the Campbell Highway to the east, Ptarmigan Road to the west, Thompson Drive to the south and it extends north to a wet, low lying area (which has limited development potential).

Existing development along Thompson Drive and Ptarmigan Road is an area that extends approximately from km 6.5 (across from the ski hill entrance) to km 8 of the Campbell Highway. All lots have lake frontage and are considered small by current country residential standards when compared to other Government of Yukon projects.

This project assesses potential for infill development between Ptarmigan Road and the highway north of Thompson Road.

2.2 Terrain Conditions

In general, slopes throughout the study area are very gentle (less than 5%). Proceeding north of the last lot on Ptarmigan Road, the slope overlooking Watson Lake is quite steep and the slope down to the wet low-lying area (to the north) is moderately steep. Terrain conditions should have no negative impacts on the proposed development.

2.3 Vegetation

Ground cover consists of moss and organic soil and tree cover is a mixture of poplar with white spruce. Willows were noted throughout the low-lying area to the north.

2.4 Soil Conditions

The presence of glaciofluvial soils, as presented on the Yukon Geological Survey Map File 2005-7 - Watson Lake Area, was confirmed during the October 18, 2018 site reconnaissance. In general, the site is likely underlain with granular soils and there is likely surficial silts just below the organic root mat.

Neither bedrock or seepage zones (suggesting a perched water table) were noted during the site reconnaissance.

2.5 Site Grades and Drainage

In general, the site appears to be well drained with the exception of the low lying area at the north end of the study area.

3.0 DEVELOPMENT POTENTIAL AND RECOMMENDATIONS

The development potential for this study area is considered very good. Development considerations related to this site include:

- As mentioned above, development along most of Thompson Drive and Ptarmigan Road is considered cottage lot development which implies smaller lots. If used for recreational purposes, smaller lot sizes are acceptable but this type of development can get complicated if the area is being used for year round living and the homeowner needs space for a residential structure, an on-site sewage disposal system and a domestic water supply well. In 2006, Tetra Tech (operating as EBA Engineering Consultants Ltd) was involved in a complicated project (due to small lot sizes and setback distances from the high-water mark of Watson Lake). A lot enlargement and a more expensive pump-up system were the only solutions. To avoid future problems for the current study area, it is Tetra Tech's recommendation that larger lot sizes be considered.
- The wet, low-lying area at the north end of the site is poorly drained and the underlying soils are probably saturated. Therefore, it is recommended that the development area not extend into this poorly drained area.
- To get a sense of how many suitably sized lots could be developed throughout the site, a conceptual plan was developed and presented on the attached general location map (Figure 1). Lot yield was 10 lots and it provides a second access point into and out of the area (always a good feature in case of forest fire).

3.1 Minimum Lot Size

For country residential site development projects completed throughout the Yukon and northern British Columbia by Tetra Tech, a minimum lot size of 1 ha is typically recommended. Since there are few constraints associated

with this study area, the 1 ha requirement can be relaxed but should be kept as close to 1 ha as possible in order to ensure an alternate location for an on-site sewage disposal system in case of failure of the original installation.

3.2 Roadway Construction

The geotechnical conditions are likely to be fairly consistent throughout the developable portion of the study area with roadway construction on a good quality glaciofluvial (granular) subgrade. The following recommendations for roadway construction apply.

All surficial silts encountered during access road construction should be sub-cut, exposing the glaciofluvial soils. The majority of the site is fairly flat so it is important that proper ditch lines be constructed to divert surface water away from the constructed embankment.

It is anticipated that access roads will either be a gravel or BST surfaced roadway so the recommended structure over the glaciofluvial subgrade surface should be 150 mm of Gran A (20 mm crushed basecourse gravel) over 300 mm of Gran D (80 mm pit run sub-base gravel). Imported gravel should meet the gradation specifications presented in Table 1.

Table 1: Recommended Granular Material Specifications

80 mm Pit Run Gravel		20 mm Crushed Basecourse Gravel	
Particle Size (mm)	% Passing by Mass	Particle Size (mm)	% Passing by Mass
80.000	100	-	-
25.000	55-100	20.000	100
12.500	42-84	12.500	64-100
5.000	26-65	5.000	36-72
1.250	11-47	1.250	12-42
0.315	3-30	0.315	4-22
0.080	0-8	0.080	3-6

All imported gravel is to be placed in lifts no thicker than 200 mm, moisture conditioned, and compacted to at least 98% of Standard Proctor Maximum Dry Density (as per ASTM D698).

3.2.1 Borrow Sources

It is anticipated that imported gravel used on this project will come from a Government of Yukon gravel source. If unavailable at the time of construction, there are local contractors who can supply.

3.3 Foundations

The glaciofluvial soils underlying the site are considered ideal for supporting conventional shallow foundation systems including strip & spread footing and thickened monolithic slab-on-grade construction. Helical pile foundations are gaining popularity throughout the Yukon but the granular nature of the glaciofluvial soils (and the possible presence of cobbles) may limit potential for this foundation option.

Typically, residential housing construction relies on NBCC requirements. For non-conventional foundations, Tetra Tech can provide bearing resistances (ULS and SLS) and an appropriate seismic site classification for foundation design.

3.3.1 Frost Penetration & Seasonal Frost Heave Potential

The glaciofluvial soils are less frost susceptible than till soils which are also common in the Watson Lake area. However, there is still potential for the soils to be somewhat frost susceptible if the silt content of the granular soils is greater than 15%.

3.3.2 Foundation Insulation Recommendations

Current local codes typically dictate the use of insulation around all foundations. However, the minimum insulation thickness and distance out from the foundation elements are often considered to be insufficient when dealing with frost susceptible soils. Tetra Tech always recommends insulating foundations constructed on frost susceptible soils to mitigate potential for seasonal frost-heave damage and it should be noted that Tetra Tech recommendations for insulation thickness and distance out from the perimeter foundation system are not generic. The frost susceptibility of soils supporting building foundations must be considered along with footing burial depth and the amount of protective soil cover over the footings. Tetra Tech or qualified geotechnical personnel should be contacted to provide site specific insulation recommendations if foundation construction is on frost susceptible soils.

4.0 ON-SITE SEWAGE DISPOSAL SYSTEM POTENTIAL

The glaciofluvial soils underlying this site are considered acceptable for on-site sewage disposal system design and construction. However, the following should be considered:

- The underlying glaciofluvial soils may have a percolation rate of less than 5 minutes/25 mm. This will necessitate the requirement to install a 600 mm thick sand filter in order to ensure treatment along with disposal.
- As mentioned above, it is preferable to have adequate lot sizing to ensure sufficient space for establishing a back-up absorption field in case the original field fails.
- Absorption field, shallow absorption trench, and chamber systems are all considered appropriate for the study area.
- All systems must be designed and installed in accordance with the Yukon Government's Environmental Health Guidelines. This includes site specific permitting, percolation testing, design and construction, as well as the as-built documentation to support approval.

5.0 RECOMMENDATIONS FOR ADDITIONAL GEOTECHNICAL WORK

Potential for development from a geotechnical aspect has been established but this project would benefit from a final design stage geotechnical evaluation that would include a series of testpits along roadways and additional testpits on lots to establish preferable on-site sewage disposal system solutions. Ideally, this work would be completed after the roadways have been cleared of trees but this site has enough access points that would allow this work to be completed in advance of project predesign.

6.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Government of Yukon 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 Government of Yukon, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Tetra Tech's General Conditions are provided in Appendix A of this report.

7.0 CLOSURE

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

Respectively Submitted,
Tetra Tech Canada Inc.



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Attachments: Figure 1: General Location Map and Conceptual Design
Appendix A: Tetra Tech's Limitations on the Use of This Document

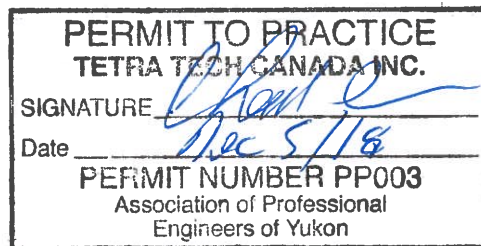
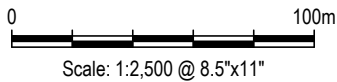


FIGURE 1

General Location Map and Possible Development Concept Plan

Q:\Whitehorse\Data\0201\drawings\Watson Lake\ENG-WARC\ENG-WARC03386-21 Thompson Road Country Residential Development\ENG-WARC03386-21 Fig.1-R0.dwg [FIGURE 1] December 05, 2018 - 9:23:49 am (BY: BUCHAN, CAMERON)



CLIENT



**THOMPSON ROAD COUNTRY
RESIDENTIAL DEVELOPMENT**

**GENERAL LOCATION AND
POSSIBLE DEVELOPMENT CONCEPT**

PROJECT NO. ENG.WARC03386-21	DWN CB	CKD MCP	REV 0
OFFICE EBA-WHSE	DATE December 5, 2018		

Figure 1

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").

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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.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or 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. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

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

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, 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.