Fulford Ganges Road at Alders Avenue Proposed Alignment Sewer, Salt Spring Island, BC

PRESENTED TO

MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE

FEBRUARY 27, 2024
ISSUED FOR USE
FILE: 704-TRN.PAVE03225-05

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TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 PROJECT DESCRIPTION 1
2.1 Project Scope 1

3.0 BACKGROUND REVIEW 2
3.1 Water Resource Atlas 2
3.2 Surficial Geology 2
3.3 Bedrock Geology 2

4.0 GEOTECHNICAL EXPLORATION 2
4.1 Utility Locate 2
4.2 Drilling 2
4.3 Soil Sampling 3
4.4 Geotechnical Laboratory Testing 3

5.0 GEOTECHNICAL DESCRIPTION OF THE SITE 3
5.1 Soil Conditions 3
5.2 Groundwater Conditions 4
5.3 Site Seismicity 4
5.3.1 Seismic Site Classification 4
5.4 Liquefaction Potential 4

6.0 DISCUSSION AND RECOMMENDATIONS 4
6.1 Temporary Excavation and Trenching 4
6.2 Bedding and Backfill 5
6.2.1 Utility Trenches 5
6.2.2 Engineered Fill 5

7.0 CLOSURE 6

REFERENCES 7

LIST OF TABLES IN TEXT

Table 5-1: Summary of Borehole Stratigraphy 3
Table 5-2: Selected Ground Accelerations for a 1 in 475 Seismic Event 4

APPENDIX SECTIONS

FIGURES

Figure 1 Site Location Plan
Figure 2 Borehole Location Plan

APPENDICES

Appendix A Tetra Tech's Limitations on the Use of this Document
Appendix B Borehole Logs

ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
MoTI	Ministry of Transportation and Infrastructure
NBCC	National Building Code of Canada
NR Can	Natural Resources Canada
MPMDD	Modified Proctor Maximum Dry Density
SPT	Standard Penetration Test

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Ministry of Transportation and Infrastructure 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 Ministry of Transportation and Infrastructure, 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. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by the Ministry of Transportation and Infrastructure (MoTI) to provide a geotechnical exploration program to support the proposed storm sewer alignment for the section of Fulford-Ganges Road along Alders Avenue (the Site) in Salt Spring Island, BC. The location of the Site is shown on Figure 1.

Tetra Tech's scope of services is described in our proposal, "Additional Geotechnical Assessment for Proposed Sewer Alignment on Alders Road, Salt Spring Island, BC", issued for use August 23, 2023. This report includes a description of the project, findings of Tetra Tech's background review, site exploration, and geotechnical recommendations based on findings. The scope of work was prepared based on discussions between Mr. Vipin Sharma of Tetra Tech, Mr. Rampaul Dulay of Stantec Consulting, and Mr. Salem Bahamdun of MoTI.

2.0 PROJECT DESCRIPTION

Tetra Tech understands that the storm sewer alignment on Alders Road runs from the northeast side of Fulford-Ganges Road down to Ganges Harbour for an approximate length of 0.23 km. Alders Road has a legal Right of Way all the way to the harbour with a couple private accesses.

MoTI retained Tetra Tech in 2021 to provide a pavement evaluation and rehabilitation options for the Fulford Ganges Road from Cranberry Road to Seaview Avenue. The pavement recommendations were provided in an Issued for Use Report dated November 23, 2021.

The work plan and cost estimate are provided for carrying out the geotechnical exploration to support the geotechnical and pavement recommendations for the proposed storm sewer alignment.

2.1 Project Scope

The project's scope of work included the following:

- Review of available coal mine, bedrock, water well log, and surficial geology maps;
- Review of other readily sources of background information for the site, if available (e.g., geotechnical reports completed by Tetra Tech and others);
- Coordinate the drilling program with MoTI and the Indigenous Relations Coordinator;
- Complete BC OneCall notifications and hire an independent utility locating contractor to clear the proposed borehole locations of underground utilities;
- Auger drilling within the proposed storm sewer alignment to determine existing subgrade soil conditions;
- Completion of laboratory testing on select samples from the drilling program;
- Preparation of a summary of geotechnical borehole exploration in the report; and
- Compiling and reviewing the field data to develop geotechnical recommendations.

3.0 BACKGROUND REVIEW

3.1 Water Resource Atlas

According to the BC Water Resource Atlas (https://maps.gov.bc.ca/ess/hm/wrbc/), there is one well that was drilled around 17 m southwest of the site, and one well that was drilled approximately 59 m northwest of the site. The southwest well record indicates gravel and silty sand can be found from the surface to a depth of 112 meters. The northwest well record indicates fine sand and till are located at depths ranging from 32 meters to 61 meters and from 92 meters to 107 meters, respectively.

3.2 Surficial Geology

A review of the map “Soils of South Vancouver Island” from Soil Survey Report No. 44 (BC Ministry of Environment) indicates that the surficial geology in the area consists of soils belonging to the St. Mary and Suffolk Soils. The soil types found in St. Mary are of marine or fluvial origin and have a gravelly sandy loam surface texture. Suffolk soils are marine in origin and have stone free surface horizons that vary from loam to silt loam in texture.

3.3 Bedrock Geology

The “Bedrock Geology” geographic dataset maintained by the BC Ministry of Energy, Mines and Petroleum Resources (updated January 14, 2020) indicates that the bedrock at the Site consists of Nanaimo Group undivided sedimentary rocks.

4.0 GEOTECHNICAL EXPLORATION

4.1 Utility Locate

Prior to drilling activities, Tetra Tech completed ground disturbance notifications (i.e., BC1Call) for the Site. Proposed borehole locations were cleared on-site by Kelly's First Call Locating.

4.2 Drilling

Drilling was undertaken on October 13, 2023. The drilling exploration was supervised by Ophelie Kacoutie, EIT, of Tetra Tech, and monitored by Patrick Dolan, archaeologist with WSP. A total of three boreholes were completed using a truck-mounted auger operated by Drillwell. The borehole locations are shown in Figure 2, with geotechnical borehole logs provided in Appendix B.

Two boreholes were completed along Alders Road in the northbound lane, in front of 281 and 112 Alders Avenue. One borehole was completed off-road on the west side of 123 Alders Road. No monitoring wells were installed for this project.

The drilling exploration aimed for a target depth between 3.0 to 8.0 meters below ground surface (mbgs). The depth achieved during the exploration ranged from 3.96 m to 7.62 m. Standard Penetration Tests (SPTs) were completed in each boreholes with drilling.

Upon completion, most boreholes were filled with drill cuttings and patched with cold mix asphalt by Drillwell. The off-road borehole was filled only with drill cuttings.

4.3 Soil Sampling

Soil samples were collected from multiple depth intervals (See geotechnical logs in Appendix B). Geotechnical samples were collected directly off the drill augers using a clean trowel or nitrile gloves and stored in plastic soil bags.

4.4 Geotechnical Laboratory Testing

Laboratory testing consisted of visual and moisture tests.

5.0 GEOTECHNICAL DESCRIPTION OF THE SITE

5.1 Soil Conditions

Complete descriptions of conditions encountered are provided on the borehole logs in Appendix B. Generalized descriptions of encountered conditions are described in Table 5-1 below. Borehole locations are shown in Figure 2.

Table 5-1: Summary of Borehole Stratigraphy

Soil Type	BH23-01 (m)	BH23-02 (m)	BH23-03 (m)
ASPHALT (thickness in mm)	0 to 0.03	0 to 0.06	N.E
TOPSOIL (thickness in mm)	N.E	N.E	0 to 0.05
SAND, SILT and SAND (FILL), silty or trace gravel, occasional cobbles.	0.03 to 0.80	0.06 to 1.50	N.E
COBBLES and BOULDERS.	N.E	N.E	4.10 to 4.57
SILT or SILT and SAND, sandy, some gravel or clay, trace clay or gravel.	0.80 to 3.95	N.E	N.E
SAND, gravelly or silty, some gravel or some silt.	N.E	1.50 to 7.60	0.05 to 6.10

N.E – Not encountered

5.2 Groundwater Conditions

Groundwater was encountered at 3.05 mbgs in BH23-02. No monitoring wells were installed during the drilling exploration.

5.3 Site Seismicity

5.3.1 Seismic Site Classification

Calculated peak ground and selected spectral accelerations for selected frequencies (in units of gravitational acceleration, g) at the Site are shown in Table 5-2, below. Accelerations are calculated by Natural Resources Canada (NR Can) Seismic Hazard Calculator and are interpolated from NR Can Seismic Hazard Maps. The accelerations provided are from the 2020 National Building Code of Canada (NBCC).

Peak Ground Acceleration (PGA), Peak Ground Velocity (PGV), and Spectral Acceleration (Sa(T), where T is the period in seconds) values from the 2020 NRCan Seismic Hazard Calculator tool are presented in Table 5-2, below. Table 4.1.8.4.-A of the NBCC 2015 states the Site should be classified as a Site Class C.

Table 5-2: Selected Ground Accelerations for a 1 in 475 Seismic Event

PGA (Site Class C)	Sa (0.2)	Sa (0.5)	Sa (1.0)	Sa (2.0)	Sa (5.0)	Sa (10.0)
0.653	1.52	1.29	0.745	0.453	0.118	0.0464

5.4 Liquefaction Potential

Liquefaction occurs when pressures increase in the soil-air-liquid matrix that causes the matrix to lose internal stability and behave as a liquid. Liquefaction can occur due to seismic forces or from rapid changes to pore water pressures. For liquefaction to occur, the soil needs to be saturated, have a high void ratio, and have a particular grain size distribution. Generally, liquefaction occurs in loose granular or fine-grained soils below groundwater level. Liquefaction is generally not considered a risk at the site based on the consistency of the soils.

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 Temporary Excavation and Trenching

Open trench excavations are expected for the proposed alignment sewer. All excavations must comply with WorkSafe BC requirements and industry best practices. Notwithstanding the following recommendations, the final responsibility for excavations resides with the contractor performing the excavation.

In general, Tetra Tech can make the following recommendations regarding temporary excavations.

- Where trenches are initiated in the pavement that will not be replaced, pavement should be saw cut to provide replacement pavement with a clean face to butt against;
- Slopes for excavation greater than 1.2 m will be based on site conditions at the time of excavation, with inspection and approval being required by a geotechnical engineer;

- Trenches should generally be sloped no steeper than 1H:1V in loose granular soils or use appropriate temporary shoring to prevent sloughing of the trench sidewalls, such as trench boxing;
- Any shoring carried out must be in good practice and done in accordance with WorkSafe BC; and
- Excavations up to approximately 3 m are expected to be relatively dry if completed during the summer months. Minor groundwater seepage may be encountered perched above less permeable soil layers or in excavations below 3 m; however, this should be confirmed through additional groundwater monitoring.

Due to the required setbacks from existing utilities, borehole exploration was not able to determine the properties of the backfill in existing trenches. Shoring design should be in accordance with generally accepted soil and rock mechanics principles. All potential failure modes should be considered, including shallow-wedge failure and block failure. The effect of any potential surcharges from the road should be taken into consideration. If required, Tetra Tech could provide a cost estimate for shoring design.

6.2 Bedding and Backfill

6.2.1 Utility Trenches

All trench backfill must be approved and placed in accordance with good practices and should meet Ministry of Transportation specifications, including compaction levels that must be confirmed by field density testing. Placement of utility bedding material should meet the Ministry of Transportation specifications for engineered fill.

6.2.2 Engineered Fill

Engineered Fill should consist of an approved, well-graded granular soils with a maximum particle size of 75 mm and less than 10% fines, placed in horizontal lifts not exceeding 300 mm and compacted to a minimum of 95% Modified Proctor Maximum Dry Density (MPMDD) at a moisture content ±2% of optimum. Each lift should be tested to confirm adequate compaction before subsequent lifts are placed. Thicker lifts may only be used if test results confirm that materials and equipment used are such that the required density can be achieved.

7.0 CLOSURE

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

Respectfully submitted,
Tetra Tech Canada Inc.

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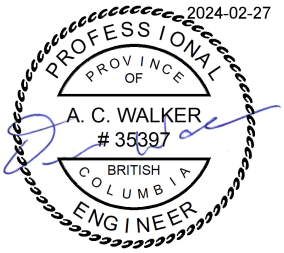

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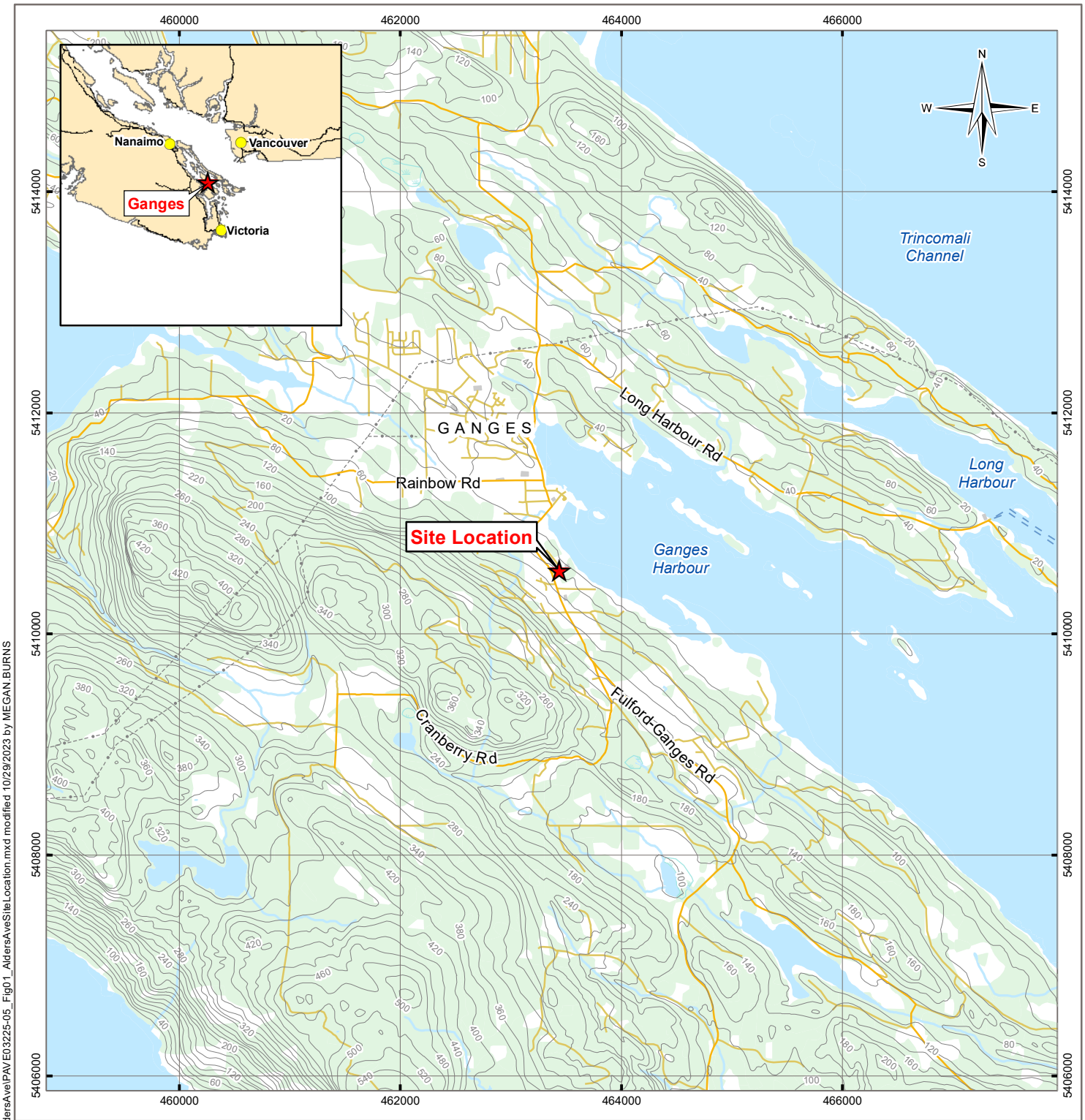
FIGURES

Figure 1 Site Location Plan
Figure 2 Borehole Location Plan



LEGEND

- Site Location
- Main Road
- Local Road
- Ferry
- Power Line
- Building
- Park
- Residential Area
- Contour (20 m)
- Watercourse
- Waterbody
- Wetland
- Wooded Area

NOTES
Base data source: CanVec 1:50,000.

STATUS
ISSUED FOR USE

ADDITIONAL GEOTECHNICAL ASSESSMENT PROPOSED SEWER ALIGNMENT ALDERS AVE, SALTSPRING ISLAND, BC

Site Location Plan

PROJECTION UTM Zone 10		**DATUM** NAD83		**CLIENT** Ministry of Transportation & Infrastructure
Scale: 1:50,000 (1 0.5 0 1 Kilometres)				TETRA TECH
FILE NO. PAVE03225-05_Fig01_AldersAveSiteLocation.mxd				
OFFICE Tt-VANC	**DWN** DS/MB	**CKD** SL	**APVD** OK	**REV** 0
DATE October 29, 2023	**PROJECT NO.** TRN.PAVE03225-05			**Figure 1**

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LEGEND

- Borehole
- Main Road
- Local Road

NOTES
Base data source: CanVec 1:50,000
Imagery provided by ESRI; Maxar (2022)

STATUS
ISSUED FOR USE

Scale: 1:1,500
20 10 0 20
Metres

PROJECTION	DATUM
UTM Zone 10	NAD83

FILE NO.
PAVE03225-05_Fig02_AldersAveBHLoc.mxd

CLIENT
Ministry of Transportation & Infrastructure

TETRA TECH

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	MRB	SL	OK	0

DATE	PROJECT NO.
October 29, 2023	TRN.PAVE03225-05

ADDITIONAL GEOTECHNICAL ASSESSMENT PROPOSED SEWER ALIGNMENT ALDERS AVE, SALTSPRING ISLAND, BC

Borehole Location Plan

Figure 2

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

DESIGN REPORT

1.1 USE OF DOCUMENT AND OWNERSHIP

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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.

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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 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, 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 so stipulated in the Design Report, TETRA TECH was not retained to explore, address or consider, and has not explored, addressed or considered any environmental or regulatory issues associated with the project specific design.

1.8 CALCULATIONS AND DESIGNS

TETRA TECH may have undertaken design calculations and prepared project specific designs in accordance with terms of reference that were previously set out in consultation with, and agreement of, TETRA TECH's client. These designs have been prepared to a standard that is consistent with current industry practice. Notwithstanding, if any error or omission is detected by TETRA TECH's Client or any party that is authorized to use the Design Report, the error or omission should be immediately drawn to the attention of TETRA TECH.

1.9 GEOTECHNICAL CONDITIONS

A Geotechnical Report is commonly the basis upon which the specific project design has been completed. It is incumbent upon TETRA TECH's Client, and any other authorized party, to be knowledgeable of the level of risk that has been incorporated into the project design, in consideration of the level of the geotechnical information that was reasonably acquired to facilitate completion of the design.

If a Geotechnical Report was prepared for the project by TETRA TECH, it may be included in the Design Report as appropriate. The Geotechnical Report contains Limitations that should be read in conjunction with these Limitations for the Design Report.

1.10 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This report 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.

APPENDIX B

BOREHOLE LOGS

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
- NQ Core
- 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
- Till
- Topsoil

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

TERMS USED ON BOREHOLE LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on 0.075 mm sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

DESCRIPTIVE TERMS	RELATIVE DENSITY	N (blows per 0.3 m)
Very Loose	0 to 20%	0 to 4
Loose	20 to 40%	4 to 10
Compact	40 to 75%	10 to 30
Dense	75 to 90%	30 to 50
Very Dense	90 to 100%	greater than 50

The number of blows, N, on a 51 mm O.D. split spoon sampler of a 63.5 kg weight falling 0.76 m, required to drive the sampler a distance of 0.3 m from 0.15 m to 0.45 m.

FINE GRAINED SOILS (major portion passing 0.075 mm sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

DESCRIPTIVE TERMS	UNCONFINED COMPRESSIVE STRENGTHS (kPa)
Very Soft	Less than 25
Soft	25 to 50
Firm	50 to 100
Stiff	100 to 200
Very Stiff	200 to 400
Hard	Greater than 400

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

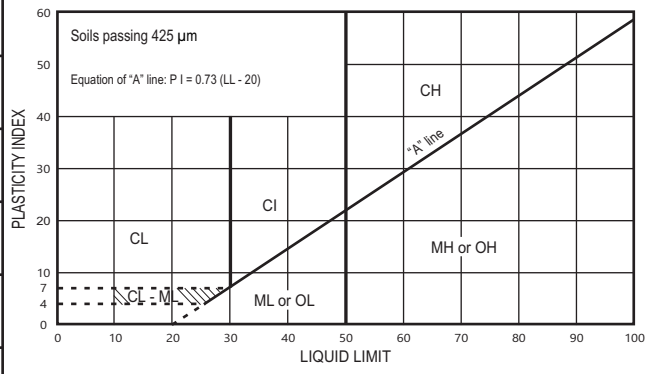
GENERAL DESCRIPTIVE TERMS

Slickensided - having inclined planes of weakness that are slick and glossy in appearance.
Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
Laminated - composed of thin layers of varying colour and texture.
Interbedded - composed of alternate layers of different soil types.
Calcareous - containing appreciable quantities of calcium carbonate.;
Well graded - having wide range in grain sizes and substantial amounts of intermediate particle sizes.
Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

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: Less than 5% Pass 75 µm sieve; More than 12% Pass 75 µm sieve; 5% to 12% Pass 75 µm sieve. 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
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits plot above "A" line or plasticity index greater than 7; Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
	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	$C_U = D_{60}/D_{10}$ 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
			SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above "A" line or plasticity index greater than 7; Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
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	For classification of fine-grained soils and fine fraction of coarse-grained soils.
		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	
		Liquid limit 30-50	CI	Inorganic clays of medium plasticity, silty clays	
		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	
		Liquid limit >50	OH	Organic clays of medium to high plasticity	
HIGHLY ORGANIC SOILS			PT	Peat and other highly organic soils	

PLASTICITY CHART



*Based on the material passing the 75 mm sieve
Reference: ASTM Designation D2487, for identification procedure see D2488. 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	75 mm	19 mm	>35 %	"and"
fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"
SAND				
coarse	4.75 mm	2.00 mm	10 to 20 %	"some"
medium	2.00 mm	425 µm		
fine	425 µm	75 µm	>0 to 10 %	"trace"
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

Tt_Modified Unified Soil Classification.cdr

TETRA TECH

ROCK DESCRIPTION TERMS USED ON BOREHOLE LOGS

MECHANICAL STRENGTH CALCULATIONS

TERM	UCS* (MPa)	GRADE	FIELD IDENTIFICATION**
Extremely Strong	> 250	R6	Specimen can only be chipped with geological hammer
Very Strong	100-250	R5	Specimen requires many blows of geological hammer to fracture
Strong	50-100	R4	Specimen requires more than one blow of geological hammer to fracture
Medium Strong	25-50	R3	Cannot be scraped or peeled with pocket knife; can be fractured with single firm blow of geologic hammer
Weak	5-25	R2	Can be peeled by pocket knife with difficulty; shallow indentation made by firm blow with geological hammer
Very Weak	1-5	R1	Crumbles under firm blow with point of geological hammer; can be peeled by a pocket knife
Extremely Weak	0.25-1	R0	Indented by thumbnail

***UCS - unconfined compressive strength; **Correlations determined by Field Identification are approximate.**

GRAIN SIZE

NON-CARBONATE DETRITAL SEDIMENTARY ROCKS		OTHER ROCKS	GRAIN SIZE
Conglomerate or Breccia		Very Coarse Grained	More than 80 mm
Conglomerate or Breccia		Coarse Grained	4 to 80 mm
Sandstone [1]		Medium Grained	80 µm to 4mm
FISSILE	**NON-FISSILE**		
Silt Shale	Siltstone	Fine Grained	> 2/3 silt-sized (2 to 80 µm)
Mud Shale	Mudstone	Fine Grained	Silt and clay-sized (<80 µm)
Clay Shale	Claystone	Very Fine Grained	> 2/3 clay-sized (<2 µm)

[1] Sandstone further subdivided where appropriate into fine, medium, coarse

DISCONTINUITY SPACING

BEDDING	OTHER DISCONTINUITY	SPACING
Very Thickly Bedded	Very Widely Spaced	More than 2 m
Thickly Bedded	Widely Spaced	600 mm to 2 m
Medium Bedded	Moderately Widely Spaced	200 to 600 mm
Thinly Bedded	Closely Spaced	60 to 200 mm
Very Thinly Bedded	Very Closely Spaced	20 to 60 mm
Laminated	Extremely Closely Spaced	6 to 20 mm
Thinly Laminated	Extremely Closely Spaced	2 to 6 mm
Fissile	Extremely Closely Spaced	Less than 2 mm

ROCK QUALITY

TERM	RQD
Very Poor Quality	0 to 25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

WEATHERED STATE

TERM	DEGREE
Fresh	No visible signs of weathering
Slightly Weathered	Weathering only on open discontinuity surfaces
Moderately Weathered	Rock mass weathered but not friable
Highly Weathered	Rock mass weathered and partly friable
Completely Weathered	Wholly decomposed but texture and structure preserved
Residual Soil	Original rock texture and structure destroyed

CORE RECOVERY

TERM	DESCRIPTION
Total Core Recovery	Total recovery expressed as a percentage of run length
Solid Recovery	Solid recovery expressed as a percentage of run length
Rock Quality Designation	Sum of lengths of solid core more than100mm long expressed as a percentage of run length
(RQD) Fracture Frequency (FF)	The number of fractures per metre of core (FF's in excess of 30denoted at 30+)

TETRA TECH

Ministry of Transportation and Infrastructure

Borehole No: **BH23-01**

Project: Fulford Ganges Road To Alders Avenue	Project No: 704-TRN.PAVE03225-05
Location: Alders Avenue	Ground Elev: 42 m
Salt Spring Island, BC	

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Field Blowcount (blows/300 mm) □ SPT 20 40 60 80	▲ Pocket Pen. (kPa) ▲ 100 200 300 400; Field Vane (kPa) Post-Peak ◇ Peak ◆ 10 20 30 40; Plastic Limit Moisture Content Liquid Limit 20 40 60 80	Elevation (m)
0			ASPHALT (Crocodile Cracking)						42
	Solid Stem Auger		SAND (FILL), silty, some gravel, damp, loose (inferred), brown; subrounded gravel up to 2.5 cm nominal diameter.			G1			
1			SAND and SILT, some gravel, moist, compact (inferred), brown; subrounded gravel up to 4.5 cm nominal diameter.			G2			41
2			SILT, sandy, some gravel, trace clay, moist, stiff, brown; subrounded gravel up to 3.5 cm nominal diameter.			G3			40
3			SPT at 3.05 m: 5/10/19/30 (N=19) Recovery: 61% -SILT, sandy, some clay, trace gravel, moist, brown.			SPT1			39
4			End of hole at 3.96 m, refusal of auger on inferred bedrock, dry completion. Backfill with cutting and cold patch mix.						38
5									37
6									36
7									35
8									34
9									33
10									32

TETRA TECH

Contractor: DRILLWELL	Completion Depth: 3.96 m
Equipment Type: Truck-mounted Auger	Start Date: 2023 October 13
Logged By: OK	Completion Date: 2023 October 13
Reviewed By: AW	Page 1 of 1

Ministry of Transportation and Infrastructure

Borehole No: **BH23-02**

Project: Fulford Ganges Road To Alders Avenue	Project No: 704-TRN.PAVE03225-05
Location: Alders Avenue	Ground Elev: 37 m
Salt Spring Island, BC	

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Field Blowcount (blows/300 mm) □ SPT	Field Vane (kPa) Post-Peak ◇ Peak	Plastic Limit / Moisture Content / Liquid Limit	Elevation (m)
0			ASPHALT LAYER				20 40 60 80	10 20 30 40	20 40 60 80	37
			SILT and SAND (FILL), trace gravel, trace cobbles, moist, soft to stiff (inferred), brown; subrounded gravel up to 2 cm nominal diameter.			G1				
1										36
			SAND, silty, some gravel, moist, compact (inferred), brown; angular subrounded gravel up to 4 cm nominal diameter.			G2				
2			SAND, silty, some gravel, moist, stiff, brown; angular subrounded gravel up to 4 cm nominal diameter.			G3				35
3 ▼			Water encountered at 3.05 m.							34
	Solid Stem Auger		SPT at 3.05 m: 30/33/40/40 (N=73) -Recovery: 30% -Sand, some gravel, some silt, moist, brown. -Gravel stuck in spoon annulus.			SPT1	□			
4						G4				33
			SAND, silty, some gravel, moist, very dense, dark brown; subrounded gravel up to 2 cm nominal diameter.			G5				
5										32
6										31
7										30
			End of hole at 7.62 m. Target depth reached, moist completion. Backfill with cutting and cold patch mix.							
8										29
9										28
10										27

TETRA TECH

Contractor: DRILLWELL	Completion Depth: 7.62 m
Equipment Type: Truck-mounted Auger	Start Date: 2023 October 13
Logged By: OK	Completion Date: 2023 October 13
Reviewed By: AW	Page 1 of 1

Ministry of Transportation and Infrastructure

Borehole No: **BH23-03**

Project: Fulford Ganges Road To Alders Avenue	Project No: 704-TRN.PAVE03225-05
Location: Alders Avenue	Ground Elev: 33 m
Salt Spring Island, BC	

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Field Blowcount (blows/300 mm) □ SPT 20 40 60 80	▲ Pocket Pen. (kPa) ▲ 100 200 300 400; Field Vane (kPa) Post-Peak ◇ Peak ◆ 10 20 30 40; Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	Elevation (m)
0			TOPSOIL (rootlets), organics.			G1			33
			SAND, gravelly, trace silt, loose (inferred), damp, dark brown; subrounded gravel up to 2.5 cm nominal diameter.						
			SAND, some gravel and silt, compact (inferred), damp, dark brown; subrounded gravel up to 3.5 cm nominal diameter.			G2			
1									32
			SAND, silty, some gravel, compact to dense (inferred), moist, brown; subrounded gravel up to 2.5 cm nominal diameter. -Layer of brick.			G3			
2									31
						G4			
3									30
			SPT at 3.10 m: 14/23/40/40 (N=63) -Recovery: 47% -SAND, silty, trace gravel, moist, brown.			SPT1	□		
	Solid Stem Auger		SAND, silty, trace gravel, dense, moist, brown; subrounded gravel up to 2.5 cm nominal diameter.			G5			
4									29
			Cobbles and Boulders						
			SAND, silty, trace gravel, stiff, moist, brown; subrounded gravel up to 2.5 cm nominal diameter.						
5									28
						G6			
6									27
			End of hole at 6.10 m. Target depth reached, dry at completion. Backfill with cutting.						
7									26
8									25
9									24
10									23

TETRA TECH

Contractor: DRILLWELL	Completion Depth: 6.1 m
Equipment Type: Truck-mounted Auger	Start Date: 2023 October 13
Logged By: OK	Completion Date: 2023 October 13
Reviewed By: AW	Page 1 of 1