To deliver effective and efficient, local government services that benefit our citizens, our businesses, our environment and our future.

CITY OF VERNON

AGENDA

Advisory Planning Committee

Wednesday, September 3, 2025, 4:00 p.m.

CITY HALL COUNCIL CHAMBER

3400 30 Street, Vernon BC

Pages

1. CALL TO ORDER

   As Chair of the City of Vernon's Advisory Planning Committee, and in the spirit of this gathering, I recognize the City of Vernon is located in the traditional territory of the Syilx people of the Okanagan Nation.

2. AGENDA

   THAT the Advisory Planning Committee Meeting Agenda of September 3, 2025 be adopted.

3. ADOPTION OF MINUTES 3

   THAT the Advisory Planning Committee Meeting Minutes of July 15, 2025 be adopted.

4. UNFINISHED BUSINESS

5. NEW BUSINESS

5.a Zoning Amendment Application for 8734 Okanagan Landing Road

THAT the Advisory Planning Committee recommends that Council support Zoning Application ZON00420 to rezone Lot 1, Sec. 14, TP 13, ODYD, Plan EPP37864, Except Plan EPP130210 (8734 Okanagan Landing Road) as follows:

- The portion of the property located west of Okanagan Landing Road from AGRS – Agriculture and Rural: Small Block (Non-ALR) to PANS – Parks and Natural Spaces; and
- The portion of the property located east of Okanagan Landing Road from AGRS – Agriculture and Rural: Small Block (Non-ALR) to MUS – Multi-Unit: Small Scale

as outlined in the report titled “Zoning Amendment Application for 8734 Okanagan Landing Road” dated September 3, 2025;

AND FURTHER, that the Advisory Planning Committee recommends that Council’s support of ZON00420 be subject to:

a. Registration of a geotechnical covenant on title, as recommended in the Geotechnical Services Report, by Tetra Tech, dated June 6, 2023 (Attachment 4) to protect the public from rockfall hazards; and

b. Provision of a hydraulic model confirming that the existing local water infrastructure meets Greater Vernon Water flow requirements.

AND FURTHER, that the Advisory Planning Committee recommends that Council require the Owner, in accordance with Covenant CB1018546, to dedicate the portion of the property west of Okanagan Landing Road to the City of Vernon for public lake access (beach), with registration on the title of Lot 1, Sec. 14, TP 13, ODYD, Plan EPP37864, Except Plan EPP130210 (8734 Okanagan Landing Road) by October 14, 2026.

6. INFORMATION ITEMS

6.a Staff Liaison Update

The Staff Liaison will update the Committee on the progress of previous considered applications.

7. NEXT MEETING

The next meeting for the Advisory Planning Committee is scheduled for September 16, 2025 at 4:00 pm.

8. CLOSE OF MEETING

CITY OF VERNON

MINUTES OF THE ADVISORY PLANNING COMMITTEE

July 15, 2025, 4:00 p.m.
CITY HALL COUNCIL CHAMBER
3400 30 Street, Vernon BC

Members Present:	C. Ishoy, Community at Large M. Jarman, Community at Large C. Neville, Community at Large E. Stranks, Community at Large H. Nahal, Community at Large M. Lupien, Community at Large J. Kirkham, Community at Large J. Hart, Community at Large M. Gaudreau, Community at Large
Members Absent:	K. Hengel, Community at Large K. Lammie, Community at Large S. Chatterton, Community at Large
Administration Present:	M. Austin, Senior Planner K. Stogneff, Committee Clerk P. Weeber, Chief Administrative Officer R. Nuriel, General Manager, City Planning T. Barton, Director, Planning and Community Services L. Korolchuk, Manager, Current Planning T. Atwood, Manager, Community Planning & Sustainability M. Faucher, Senior Planner C. Wiltsie, Senior Planner
Also Present:	Mayor Cumming Councillor Durning

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1. CALL TO ORDER

The meeting was called to order at 4:03 pm.

As Chair of the City of Vernon's Advisory Planning Committee, and in the spirit of this gathering, I recognize the City of Vernon is located in the traditional territory of the Syilx people of the Okanagan Nation.

2. AGENDA

Moved by: M. Lupien, Community at Large
Seconded by: J. Kirkham, Community at Large

THAT the Advisory Planning Committee Meeting Agenda of July 15, 2025 be adopted.

CARRIED

3. ADOPTION OF MINUTES

Moved by: M. Jarman, Community at Large
Seconded by: E. Stranks, Community at Large

THAT the Advisory Planning Committee Meeting Minutes of May 27, 2025 be adopted.

CARRIED

4. UNFINISHED BUSINESS

5. NEW BUSINESS

5.a Draft Official Community Plan

R. Nuriel presented the draft Official Community Plan to the Advisory Planning Committee.

M. Gaudreau left the meeting at 4:10 pm.

J. Hart left the meeting at 5:18 pm.

6. INFORMATION ITEMS

7. NEXT MEETING

The next meeting for the Advisory Planning Committee is scheduled for August 12, 2025 at 4:00 pm.

8. CLOSE OF MEETING

The meeting of the Advisory Planning Committee adjourned at 5:32 pm.

Chair

THE CORPORATION OF THE CITY OF VERNON
REPORT TO ADVISORY PLANNING COMMITTEE

SUBMITTED BY: Michelle Austin, Senior Planner

APC MEETING DATE: September 3, 2025
REPORT DATE: September 3, 2025
FILE: 3360-20 (ZON00420)

SUBJECT: Zoning Amendment Application for 8734 Okanagan Landing Road

PURPOSE:

The purpose of this report is to present a Zoning Amendment application for 8734 Okanagan Landing Road to facilitate a subdivision for small-scale multi-unit housing. The Advisory Planning Committee is asked to review the proposal and provide a recommendation to Council.

RECOMMENDATION:

THAT the Advisory Planning Committee recommends that Council support Zoning Application ZON00420 to rezone Lot 1, Sec. 14, TP 13, ODYD, Plan EPP37864, Except Plan EPP130210 (8734 Okanagan Landing Road) as follows:

- The portion of the property located west of Okanagan Landing Road from AGRS – Agriculture and Rural: Small Block (Non-ALR) to PANS – Parks and Natural Spaces; and
- The portion of the property located east of Okanagan Landing Road from AGRS – Agriculture and Rural: Small Block (Non-ALR) to MUS – Multi-Unit: Small Scale

as outlined in the report titled "Zoning Amendment Application for 8734 Okanagan Landing Road" dated September 3, 2025;

AND FURTHER, that the Advisory Planning Committee recommends that Council's support of ZON00420 be subject to:

a) Registration of a geotechnical covenant on title, as recommended in the Geotechnical Services Report, by Tetra Tech, dated June 6, 2023 (Attachment 4) to protect the public from rockfall hazards; and
b) Provision of a hydraulic model confirming that the existing local water infrastructure meets Greater Vernon Water flow requirements.

AND FURTHER, that the Advisory Planning Committee recommends that Council require the Owner, in accordance with Covenant CB1018546, to dedicate the portion of the property west of Okanagan Landing Road to the City of Vernon for public lake access (beach), with registration on the title of Lot 1, Sec. 14, TP 13, ODYD, Plan EPP37864, Except Plan EPP130210 (8734 Okanagan Landing Road) by October 14, 2026.

ALTERNATIVES & IMPLICATIONS:

1. THAT the Advisory Planning Committee recommends that Council not support Zoning Application ZON00420 to rezone Lot 1, Sec. 14, TP 13, ODYD, Plan EPP37864, Except Plan EPP130210 (8734 Okanagan Landing Road) as follows:

    - The portion of the property located west of Okanagan Landing Road from AGRS – Agriculture and Rural: Small Block (Non-ALR) to PANS – Parks and Natural Spaces; and

- The portion of the property located east of Okanagan Landing Road from AGRS – Agriculture and Rural: Small Block (Non-ALR) to MUS – Multi-Unit: Small Scale.

as outlined in the report titled "Zoning Amendment Application for 8734 Okanagan Landing Road" dated September 3, 2025.
Note: The alternative does not support rezoning and would prevent the proposal from moving forward. Under the current zoning, the property could be subdivided into a maximum of two lots, each allowing one dwelling, one secondary suite, and one accessory dwelling.

ANALYSIS:

A. Rationale:

1. Administration supports the zoning amendment application for the following reasons:

- The property has been planned for residential use since 1994 and supports ground-oriented housing such as single-family homes, duplexes, and townhouses.
- The proposed housing types fit the intent of the current land use designation.
- Water and sewer services are already available at the site.
- Past City decisions—like extending services to nearby areas—indicated long-term plans for residential development here.
- The proposal includes community benefits like public lake access and a safer road connection to Okanagan Landing Road.
- The lot sizes proposed (600–1,000 m²) are more in line with nearby properties and create a smoother transition in density.
- The City needs more housing to meet provincial targets, and this project would help increase supply.

B. Overview:

2. The subject property is located at 8734 Okanagan Landing Road, about 9 km from downtown Vernon (Figures 1 & 2). The site is 4.62 hectares (11.41 acres) in size and gently slopes toward Okanagan Lake. It is surrounded by a mix of residential, rural, and parkland uses, with public beach access to the west and natural open space to the east (Attachment 1).

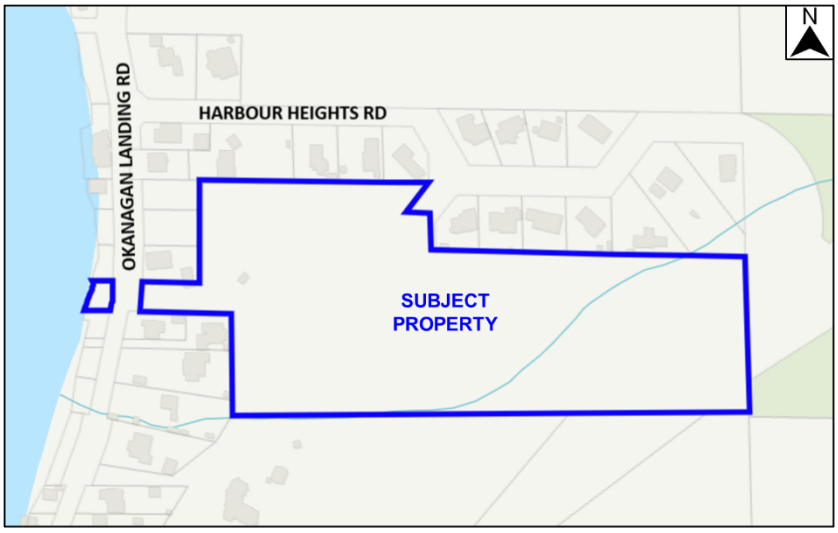

Figure 1: Property Location Map

3. The property is currently zoned Agriculture and Rural: Small Block (Non-ALR) (AGRS). The application (Attachment 2) proposes to rezone the lakefront portion west of Okanagan Landing Road to Parks and Natural Spaces (PANS), and the portion east of the road to Multi-Unit: Small Scale (MUS) to allow a residential subdivision for small-scale multi-unit housing. The conceptual plan (Attachment 3) shows a fee-simple subdivision with municipal roads, with lots generally between 600 m² and 1,000 m². The proposal includes a new public road connecting Okanagan Landing Road to Harbour Heights Road and a new public lake access (Attachments 2 & 3).

4. The property is located within several Development Permit (DP) areas, including Environmental Management, Slopes, and Fire Interface. To address these requirements, the applicant has submitted an Environmental Impact Assessment, a Geotechnical and Hillside Study, and a Wildfire Plan. These reports would guide future development and support the required DP applications before subdivision. Summaries of each report are included in the Rezoning Application Report (Attachment 2).

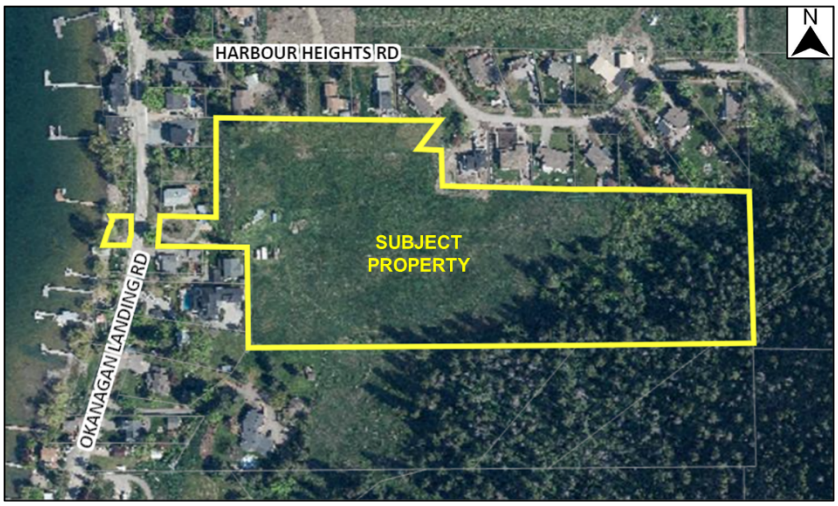

Figure 2: Aerial View of Property

C. Policy Analysis:

5. The Regional Growth Strategy (RGS), adopted in 2011, designates the subject property as part of the Rural Protection Area, which is intended to support low-density rural uses such as agriculture, conservation, and large-lot residential development (typically 1 hectare or more). These areas are generally not serviced by community water or sewer and are not intended for urban growth. This property is fully serviced with both community water and sewer, which is not consistent with the intent of the Rural Protection Area designation. Additionally, the RGS does not reflect recent changes in provincial housing legislation aimed at increasing housing supply.

6. The property has been designated Residential Low Density (RLD) in the OCP since it was incorporated into the City in 1994. Key OCP policies relevant to this property include:

   - RLD supports single-family homes, duplexes, semi-detached homes, and row housing, with a maximum density of 30 units per hectare. It is intended to maintain low-density housing.
   - The proposed MUS zone aligns with the RLD designation in terms of housing types but allows higher density. Since the City adopted Zoning Bylaw 6000, MUS is now the lowest-density residential zone and is the best fit among the available options.
   - Broader OCP policies discourage new development in rural areas. Section 5.1 directs growth to the City Centre and neighbourhood plan areas, while Section 5.8 discourages low-density greenfield subdivisions.

   While the proposed zoning aligns with the housing types and general density supported by the OCP, it does not fully align with the OCP's growth management strategy. However, the current OCP does not reflect recent changes to provincial housing legislation that aim to increase housing supply.

7. Past land use decisions—such as extending water service to the Sunset Properties and sewer service to the Outback—along with the property's residential designation, reflect the City's long-standing intent for low-density residential use in this area. Although the proposal is greenfield rather than infill, additional housing is needed to address urgent housing needs and required housing targets.

8. ARGS & MUS Comparison:

   - The AGRS and MUS zones are designed for different types of development. The AGRS zone is intended for rural and agricultural uses on larger lots with limited services. In contrast, the MUS zone allows for small-scale multi-unit housing, such as townhouses and row housing, on smaller,

fully serviced lots. It supports higher density, smaller lot sizes, reduced setbacks, and greater site coverage.

- The subdivision potential also varies greatly. Under the AGRS zone, the minimum lot size is 2 hectares, which means this property could be split into two lots, each allowing one house, one secondary suite, and one accessory dwelling. Under the MUS zone, the minimum lot size is 250 m², and up to four units are allowed per lot. After subtracting the lakefront, road reserve, and internal road area, the site could theoretically support up to 118 lots and approximately 473 units. However, it is unlikely that the site would be developed to this full capacity.
- The owner is proposing a lower density development with lot sizes between 600 and 1,000 m². This would allow for about 37 lots and up to 148 units at full buildout—still a significant increase, but more in line with surrounding properties, which are mostly over 1,000 m². As required by Provincial legislation, the City must permit at least four units on any lot over 280 m² and cannot restrict this. However, the actual number of units will depend on future market demand. It is reasonable to expect that many lots would be developed with single-family homes and suites, resulting in a lower overall density of about 74 units.

9. Table 1 below indicates the surrounding zoning, and land uses.

	Zoning	Actual Use
North	MUS – Multi-Unit: Small Scale	Single detached housing Harbour Heights Road
East	PANS – Parks and Natural Spaces	Road Reserve Natural Space (Crown Provincial)
South	AGRS – Agriculture & Rural: Small Block (Non-ALR) Road Reserve	Acreage
West	MUS	Single detached housing Okanagan Landing Road Lakefront properties

Table 1: Surrounding Properties – Zoning & Actual Use

10. Servicing: Detailed servicing will be addressed at the subdivision stage, but the following high-level information outlines the expected approach:

    - Water and Sewer: Existing water and sewer mains are available along Okanagan Landing Road. The development would connect to these services, with full design details to be confirmed during subdivision.
    - Roads: The owner is proposing two access points: a new tee intersection on Okanagan Landing Road as the primary access, and a secondary connection to Harbour Heights Road through an existing stub road. The new Okanagan Landing Road intersection is intended to be safer and more efficient than the current access via Harbour Heights. Most traffic is expected to use the internal road network and exit through the new Okanagan Landing Road intersection to improve safety and connectivity.

11. Lake Access:

    Lake access was secured through a covenant CB1018546 registered on title at the time of a previous subdivision. The covenant requires the land be transferred to the City either upon a future subdivision or within one year of the City's request and prohibits further subdivision until

the transfer occurs. Administration recommends initiating the one-year notice period now and completing the dedication as part of this application. This would allow the transfer to take place by October 14, 2026.

12. Geotechnical Services Report, by Tetra Tech, dated June 6, 2023 (Attachment 4): The geotechnical report recommends a covenant to restrict development in areas with identified rockfall hazards on the eastern portion of the property. The covenant would prevent construction in moderate to high-risk areas unless further geotechnical assessment and mitigation measures are completed. Its purpose is to protect public safety and reduce geotechnical risks in steep, sloped areas of the site.

D. Attachments:

Attachment 1 – Photos
Attachment 2 – Rezoning Application Report
Attachment 3 – Concept Roads & Lots Layout
Attachment 4 – Geotechnical Services Report

E. Council's Strategic Plan Alignment:

- ☐ Governance & Organizational Excellence
- ☐ Recreation, Parks & Natural Areas
- ☐ Environmental Leadership
- ☒ Livability
- ☐ Vibrancy
- ☐ Not Applicable

F. Relevant Policy/Bylaws/Resolutions:

- OCP Bylaw 5470
- Zoning Bylaw 6000

BUDGET/RESOURCE IMPLICATIONS:

N/A

FINANCIAL IMPLICATIONS:

☒ None ☐ Budget Previously Approved ☐ New Budget Request
(Finance Review Required)

Prepared by:

x Michelle Austin
Michelle Austin
Senior Planner

Approved for submission to APC:

Lydia Korolchuk, Manager
Current Planning

Date: Aug 28-25

REVIEWED WITH

☐ Corporate Services	☐ Operations	☒ Current Planning
☐ Bylaw Compliance	☐ Public Works/Airport	☒ Long Range Planning & Sustainability
☐ Real Estate	☐ Facilities	☐ Building & Licensing
☐ RCMP	☐ Utilities	☒ Engineering Development Services
☐ Fire & Rescue Services	☐ Recreation Services	☐ Infrastructure Management
☐ Human Resources	☐ Parks	☒ Transportation
☐ Financial Services		☐ Economic Development & Tourism
☒ COMMITTEE: APC (Sept. 3-25)		
☐ OTHER:		

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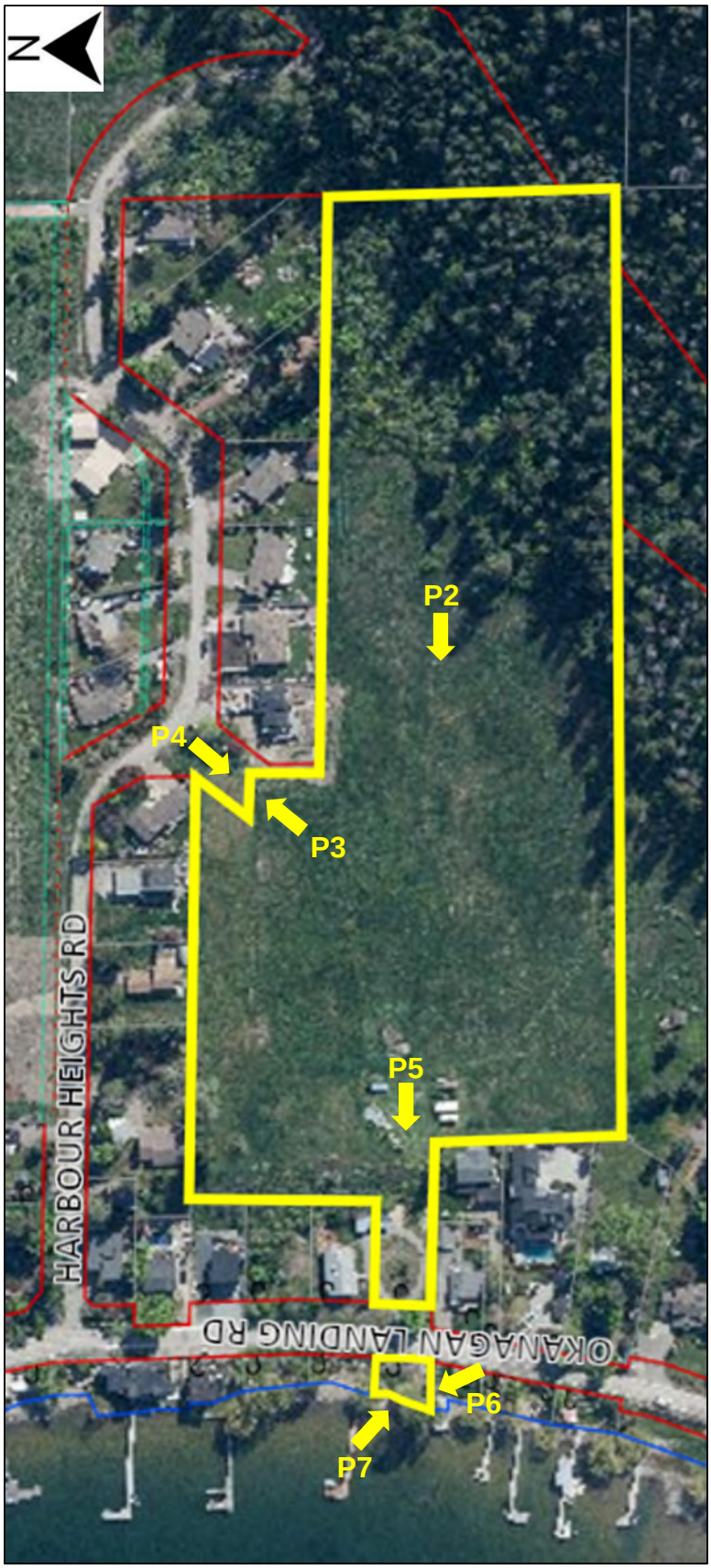


Photo 1 – Photo locations/directions

Photo 2 – View (facing west) of property

Photo 3 – View (facing northeast) of proposed access to Harbour Heights Road

Photo 4 – View (facing southwest) of proposed access from Harbour Heights Road

Photo 5 – View (facing west) of proposed access to Okanagan Landing Road

Photo 6 – View (facing northwest) of public beach access

Photo 7 – View (facing southeast) of public beach access

8734 Okanagan Landing Road, Vernon, BC

Rezoning Application Report

Originally submitted: February 23, 2024
Resubmitted under Bylaw 6000: May 5, 2025

Prepared by:
Michael & Kathleen Nolan, with
Development Team Members

Contents

Appendices

1. Development Application

This application is revised and submitted under Zoning Bylaw #6000 (2024). The content is generally the same as the application submitted under Bylaw #5000 in February 2024, other than updating the zoning designations to be consistent with Bylaw #6000.

In 2024, in response to the Province's 'Bill 44 - Housing Statutes (Residential Development) Amendment Act', the City of Vernon updated the Zoning Bylaw and its zoning designations. This application was in process and put on hold at that time, hence some of the supporting reports herein contain references to the prior zoning designations.

This application for rezoning follows a Pre-Application Meeting with staff from several City departments on February 2, 2023. The purposes of the meeting were to familiarize staff with the property, discuss community planning objectives and zoning options, and to review the Applicants' vision for the development. The resulting Development Application Form and Pre-Application Meeting Summary are contained in Appendix A. This application report and attachments fulfil the requirements set out in the Development Application Form.

2. Property Description

2.1 Description

The subject property is located on the east shore of Okanagan Lake about 9 km from city centre. The property slopes gently to the SW, transitioning from forest to grassland to lakefront.

Jurisdiction:	City of Vernon
Civic Address:	8734 Okanagan Landing Road, Vernon, BC V1H 1J7
P.I.D.:	029-373-379
Legal Description:	Rem Lot 1 Sec 14 Tp 13 ODYD Plan EPP37864, Exc Plan EPP130210
Area:	4.62 ha (11.4 ac)
ALR:	Non-ALR
OCP Designation:	RLD Residential Low Density
Current Zoning:	AGRS Agricultural & Rural: Small Block (Non-ALR)

Property Location

2.2 Site Plans

Appendix B contains the following site plans:

- legal survey plans;
- orthophoto and topography; and
- sketch plan showing current lot features.

2.3 State of Title Certificate

Appendix C contains a current title certificate.

Summary of Charges on Title

Three Sec 219 Restrictive Covenants are registered on the title of the subject property ("the Lands"). A brief discussion follows each, indicating how the charges relate to this application.

Covenant CA3899145 in favour of the City of Vernon. Provides a Road Reserve Area of 0.649 ha for a contemplated 'Bench Row Road to Eastside Road Connector' as set out in the OCP 25 Year Master Transportation Plan. Road Reserve area is shown on Plan EPP37865.

> This area is generally undevelopable due to its steep slope, wildfire and potential rockfall hazard. It was intended by the City that that this covenant area would dedicated as Road with future subdivision of the Lands. However, City staff indicated during the pre-application meeting that the proposed Bench Row Rd to Eastside Rd Connector is unlikely to be included in an updated OCP and Transportation Plan. Alternatively then, the covenant could be discharged and the area could comprise large rear yards of a subdivision development, or potentially part of a park dedication given its proximity to Truman Dagnus Locheed Park.

Covenant CB1018546 in favour of the City of Vernon. Prohibits future subdivision of the Lands until a 20m wide public lake access is dedicated to the City. Dedication area is shown on Plan EPP130248.

> This area can be designated as Lake Access either during subdivision of the Lands, or on notice by the City. Ideally, the lake access would provide a community amenity through lakeshore improvements and title transfer as part of the park dedication requirements for a future subdivision of the Lands.

Covenant CB1018549 in favour of the City of Vernon. Prohibits future subdivision of the Lands until roads and drainage works fronting Lots 1 and 2 Plan EPP130210 (8724 and 8730 Okanagan Landing Road) as outlined in PLR SUB00831 are completed or security is provided.

> These works would be designed and constructed concurrent with future improvements to Ok Landing Rd as part of subdivision of the Lands.

There are no other non-financial charges.

2.4 Site Disclosure Statement

Appendix D contains a Site Disclosure Statement. The subject property has not been used for any Contaminated Sites Regulation Schedule 2 activities.

2.5 Okanagan Landing Neighbourhood

The orthophoto in Appendix B illustrates the semi-rural nature of the property, and the linear form of development along the Okanagan Lake foreshore from the Vernon Yacht Club to Ellison Provincial Park. The linear form has developed over time as lakefront residential housing has followed the topographical constraints imposed by the lacustrine terrace immediately SE of the lakeshore, and steep rocky bluffs further SE of that. Two notable rural residential clusters or communities exist along this hillside landform - Harbour Heights and Sunset Properties.

The subject property is bounded as follows:

- on the west by Okanagan Lake and Ok Landing Rd, and by six low density MUS-zoned single family residential lakefront lots adjacent;
- on the east by forested, steep rocky bluffs and Truman Dagnus Locheed Park;
- on the south by a single AGRS-zoned large rural residential lot; and
- on the north by the Harbour Heights Road MUS-zoned low density residential neighbourhood, with the rear yards of 10 lots adjacent.

The Okanagan Landing east shore area has a rural residential feel, with higher density redevelopment occurring moving NE to SW along the lakefront.

In the more immediate area of the subject property there are two relatively distinct neighbourhood styles:

- Lakefront Linear Neighbourhood - Along Ok Landing Rd itself, the residential development is quite linear, with most residences situated on the lake side of the road. Most residents have only two immediate neighbours, one on each side. Pedestrian and cycling use of Ok Landing Rd is quite limited due to the narrow shoulders and lack of sidewalks. Many of the properties are seasonal use summer ‘second homes’.

- Harbour Heights Neighbourhood – The Harbour Heights subdivision was developed in the late 1960s under the jurisdiction of the BC Ministry of Highways. It is named after a small private boat harbour that once existed at 8719 Ok Landing Rd, just south of the Harbour Heights Rd intersection. Today, the neighbourhood consists of about 20 MUS-zoned single family residential properties, mostly occupied by permanent, year-round residents. Although Harbour Heights Rd is narrow and without shoulders or sidewalks, vehicle speeds and traffic volumes are low, hence the road is safe for local pedestrian use.

3. Regulatory Context

3.1 Official Community Plan

Since at least 1994, i.e., when the area was amalgamated into the City of Vernon, community plans have designated the subject property as future residential low density.

Compliance with OCP objectives and specific Development Permit Areas is described later in this report.

3.2 Zoning

The property is currently mixed-zoned:

- the majority of the land is designated AGRS – Agricultural & Rural: Small Block (Non-ALR), and
- in 2023 the area nearest Okanagan Lake was designated as R6 – Lakeshore Residential, then in 2024 to MUS with adoption of Bylaw #6000.

At 4.6 ha, the property is legally non-compliant with the AGRS minimum lot size of 4.94 ha.

3.3 Zoning Analysis

The Zoning Analysis Table is attached in Appendix A. The table is completed to the extent possible at this stage of development, i.e., at the rezoning stage the lot layout and future building particulars have yet to be determined. To the Applicants' knowledge this application is in full compliance with the requirements of the Zoning Bylaw for the MUS designation.

3.4 Development Permits

This application responds to the development permit requirements in the OCP and as set out during the Pre-Application Meeting. Generally, the property is situated within the Hillside Residential & Agricultural Development District (OCP Map 14). The specific DP areas include:

- Fire Interface Area (Map 11, Interface Areas 2 & 3);
- Hillside Residential & Agricultural Area (Map 14);
- Environmental Management Area (Medium Status Conservation Value area, Map 15);
- Riparian Area / Flood Hazard Area (OCP Map Schedule FH1).

Response to these development objectives is described in later sections.

4. Development Vision

4.1 Vision

The high-level development goals are to:

- respect the natural surroundings, i.e., the lake, hillside and forest;
- build a 'neighbourhood', well-integrated with Harbour Heights, by providing a mix of housing types, local amenities, improving local infrastructure services, and to the extent practical to preserve existing lake views; and
- meet green development goals by fostering an environmentally friendly development and energy-efficient homes.

The development vision supports several of the OCP's Guiding Principles, as follows:

Guiding Principle	Supporting Development Concepts
Foster prosperity for people	- Encourage work-from-home situations. - Encourage an open, caring neighbourhood, with mixed-age mentoring opportunities.
Protect and preserve green spaces and sensitive areas	- Protect the upper forest area; possibly amalgamate part with the Park. - Provide animal pathways and their access to the lake. - Improve habitat at the lakefront. - 'Firesmart' the existing forest interface area.
Ensure housing meets the need of the whole community	- Encourage a variety of housing types, from 'young family affordable' to 'luxury retirement'. - Look to match demand and gaps in existing inventory.
Create a culture of sustainability	- Encourage solar power and energy efficient homes. - Provide internal walkways and bikeways. - Encourage natural and FireSmart building materials and native planting.
Create strong, compact and complete neighbourhoods	- Encourage housing that is attractive to a range of ages. - Possibly incorporate a playground and community garden. - Incorporate linkages to the Harbour Hts neighbourhood.
Provide alternative transportation	- Provide connecting walking pathways to the lake, Harbour Heights and the Park. - Provide bike parking near the lake.
A youth-friendly city	- Provide lake access for swimming, small watercraft and paddleboards.

4.2 Form of Development

The rezoning to MUS is proposed to facilitate development of residential development of the property. To illustrate this, we have provided a potential development layout showing a fee-simple subdivision with municipal roads, shown in Appendix E. The density shown is intended to be reflective and respectful of the adjacent Harbour Heights Rd residential subdivision; proposed lots are in the 600 to 1,000 m^2 range, with some larger lots in the steeper area.

The primary driver for a fee-simple arrangement is the need for a new public road connecting Ok Landing Rd to upper Harbour Heights Rd. The new public road would be used by properties outside the subject development's boundaries, in preference to use of the Harbour Heights Rd – Ok Landing Rd intersection.

All proposed roads and lots shown in the conceptual development layout conform to the City of Vernon Zoning and Subdivision Development Bylaws.

The following sections provide a conceptual development layout, and the assessments on which to create a more detailed development plan if needed as the application proceeds.

5. Conceptual Layout and Community Benefits

5.1 Conceptual Roads and Lot Layout

The subject site has road frontage on both Ok Landing Rd and Harbour Heights Rd. It is apparent from the Harbour Heights subdivision layout that from the 1960s the subdivision approving authority (then BC Ministry of Highways) foresaw future residential development of the subject lands and required a road connection to the subject lands.

Appendix E contains a conceptual layout for a future development. The final layout would be subject to City review, actual zoning designation and terms, and subdivision requirements.

This application has named the internal roads for ease of reference in this report. While it is recognized that the City has road naming authority, the road names herein, or similar, are encouraged as they reflect the historic harbour mentioned above, and to help integrate the new development with the existing Harbour Heights neighbourhood.

5.2 Local Community Benefits

This development vision and concepts would provide a variety of community benefits.

- **Traffic Safety Improvements** – The proposed roads layout creates an alternative public road access to Ok Landing Rd for Harbour Heights Road traffic. Existing grades on lower Harbour Heights Rd are 20% or greater, ending in a steep tee intersection with poor intersection sight lines and sight distances at Ok Landing Rd. The current situation is unsafe, requires priority snow clearing attention, and the lack of intersection vertical transition presents access restrictions for heavy equipment and long loads.

- Road grades within the proposed development are maximum 12%, conforming with bylaw design requirements, and the design Ok Landing Rd intersection would be much safer than the existing situation. Refer to the road profiles in Appendix E. Traffic safety benefits are further discussed in the Traffic Assessment later in this report.

- **Preservation of Lake Views** – Preservation of existing lake views will be important to Harbour Heights Rd residents. As the subject land slopes away from the adjacent homes on Harbour Heights Rd, purposeful design of new roads, lots and buildings in the development area can maintain much of the lake views from the existing homes, particularly from second storey decks. A view analysis could be completed during subdivision design.

- **Lake Access Opportunity** – A new public lake access is proposed where the subject land meets Okanagan Lake. It is proposed that the lake access be designed and constructed as an integral part of future subdivision works. To respect existing neighbours' enjoyment of their properties it is proposed that the lake access be designed without a dock, and limitation to its capacity. This would supplement the existing nearby public lake accesses at 8697, 8797 and 8835 (boat launch) Ok Landing Rd.

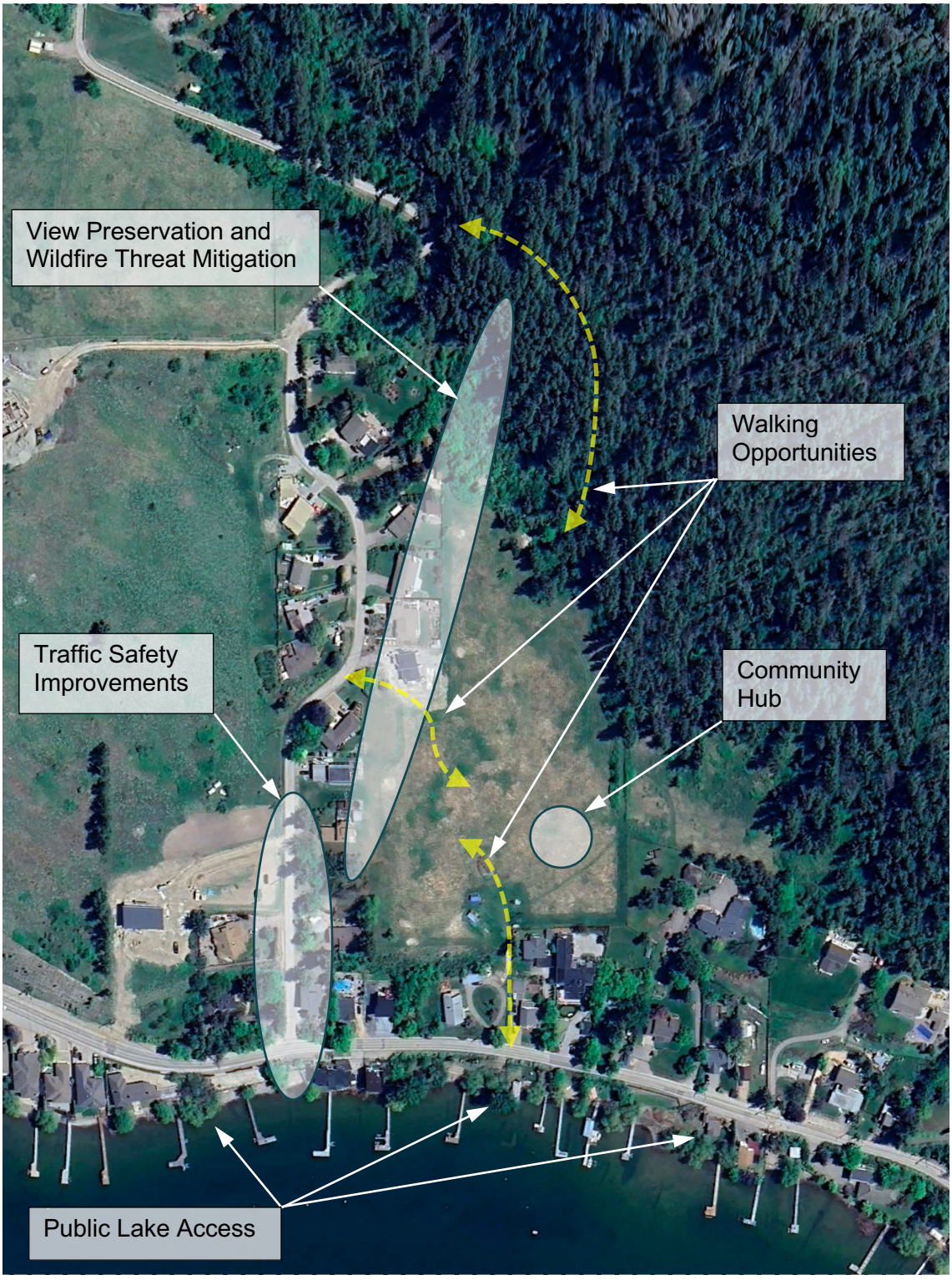
- **Local Walking Opportunity** – There is an opportunity to provide walking paths on the perimeter of the upper forested area with future connection to Truman Dagnus Locheed Park. It is recommended that these be designed and secured at the time of a future subdivision. Further, the new streets and intersections could be made pedestrian- and biking-friendly compared to existing Harbour Heights Rd and Ok Landing Rd conditions.

- **Wildfire Mitigation** – Proximity of the existing forest creates fire safety concerns for the Harbour Heights neighbourhood and City fire officials. Neighbours have expressed concerns about fire spread from the native grassland and forested areas. Implementing the recommendations of the Wildfire Threat Assessment & Mitigation Report (Appendix I) can help mitigate this risk.

- **A Community Hub** – The proposed development could include a local neighbourhood hub consisting of a small playground, covered shelter and community garden. The intent is to *build community*, and provide a safe place where young and old can meet, teach and play. As a future fee simple subdivision is proposed, this hub would best be a City-owned (park) asset, potentially situated on public road where proposed Lot 31 is shown.

The proposed local lake access, pathways and community hub amenities could form all or part of the future development's park dedication.

The figure on the next page illustrates how some of the development concepts shown in the above table could be implemented.



Local Community Benefits

6. Environmental Context

6.1 Environmental Impact Assessment

An Environmental Impact Assessment is contained in Appendix F (Western Water Associates Ltd., October 1, 2021).

The following key findings and recommendations relate to this application.

a) The land is situated within a medium conservation status Environmental Management Area (EMA).
b) The land comprises three distinct landforms: a riparian corridor, a mid-bench moderately sloped grassland area, and an upper steep forested area.
c) The assessment scope includes waterbodies, fish habitat, vegetation and wildlife.
d) Two waterbodies are of interest: Okanagan Lake, and a provincially mapped watercourse shown located NE to SW through the mid-bench area. This assessment concluded that the latter is in fact a shallow draw with no physical evidence of surface water, or vegetation or soils typical of a watercourse, hence the RAPR does not apply.
e) Recommendations include detailed species at risk surveys prior to subdivision, a lakefront riparian planting plan, invasive plant control and spill management plans during any future construction phase.

6.2 RAPR Assessment

A Riparian Areas Protection Regulation: Assessment Report is contained in Appendix G (Western Water Associates Ltd., July 21, 2022). As required, this assessment report has been reviewed and approved by the Province. It is noted that the foreshore area described in the RAPR Assessment has subsequently been subdivided, and the subject lands comprise only the southernmost 20 m of the 68 m of foreshore covered in the riparian assessment.

The following key findings and recommendations relate to this application.

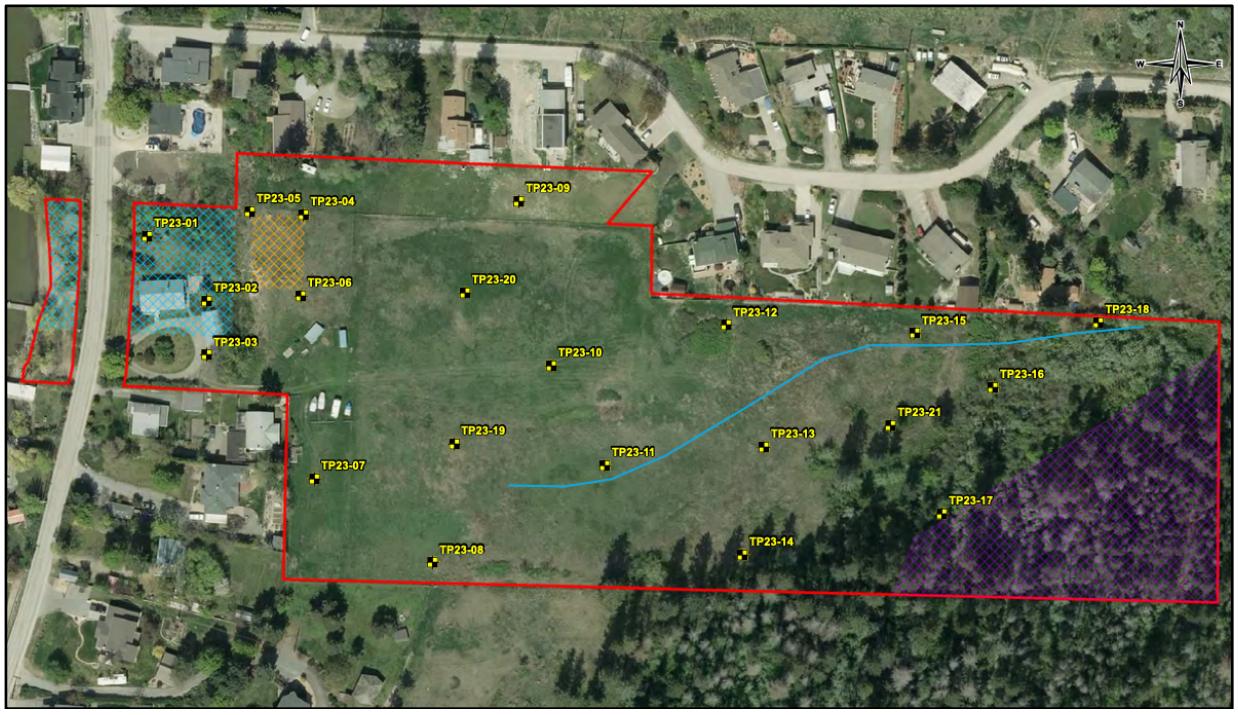
a) The entire 20 m wide land area west of Ok Landing Rd, and Ok Landing Rd itself, are situated within the riparian assessment area (RAA).
b) There are some red-listed trees and shrubs present within the RAA.
c) Floodplain and SPEA concerns are minimal as there is no development planned in the SPEA or floodplain areas.
d) The foreshore is not located within the mapped area for shore spawning kokanee, nor identified as native mussel habitat.
e) The foreshore is mapped as a red zone for foreshore plants.
f) Future subdivision development should include a foreshore plant survey and mitigation plan, a sediment control plan, and intermittent environmental monitoring during construction of future upland roadworks.

7. Geotechnical & Hillside Context

A geotechnical, hillside development and risk assessment was completed. Refer to the Geotechnical Services Report for Future Subdivision (Tetra Tech Canada Inc., June 6, 2023) contained in Appendix H. The scope of work included three parts: a 'phase 1' addressing a two-lot residential subdivision adjacent to Okanagan Lake; 'phase 2' a proposed new house build on the subject lands; and 'phase 3' rezoning and subdivision of the 4.6 ha remainder parcel. The 'phase 3' investigations are relevant to this application. The results of the assessment are presented in two parts below, addressing the geotechnical/soils conditions and hillside/slope risk assessment, respectively.

7.1 Soils Investigation

The soils investigation consisted of twenty-one (21) test pits, excavated throughout the property as shown below.



Test Pit Locations

Key findings were:

a) The surficial geology of the site is consistent with Geological Survey of Canada mapping: a veneer of lacustrine deposits generally less than 3 m thick consisting of silt with minor clay and sand; overlying morainal deposits consisting of till with minor sand, gravel and silt; overlying older, unconsolidated pre-Fraser glacial and non-glacial sediments (Tetra Tech report Sec 4.3).

b) Soil stratigraphy generally consist of three layers (TT report Sec 4.3):
   - topsoil to a depth of 0.3 to 0.6 m; overlying
   - clay or silt with varying levels of plasticity and thickness; in some areas overlying
   - a dense to very dense silty sand and gravel till layer.

c) No groundwater or surface water was encountered or observed (TT report Sec 4.4).

d) Referring to the 'mapped watercourse' crossing the property, "the test pits located within and near the mapped watercourse … did not exhibit any features that would normally be associated with a watercourse, such as stratified deposits or a significantly different soil profile." (TT report Sec 4.4).

The geotechnical report provides recommendations for engineering design and construction period activities, including:

- site preparation and material reuse;
- permanent cut and fill slopes and temporary excavations;
- slope setbacks and clearances;
- drainage and soil permeability;
- pavement design; and
- geotechnical construction monitoring.

In terms of drainage and permeability of the native soils and their suitability for on-lot and on-site infiltration, Tetra Tech estimated that the hydraulic conductivity (*k*) of the native clay or silt soils is in the range of 10^{-10} m/s to 10^{-8} m/s (TT report Sec 8.4). Accordingly, on-site infiltration should be avoided due to the limited permeability of the clay soils.

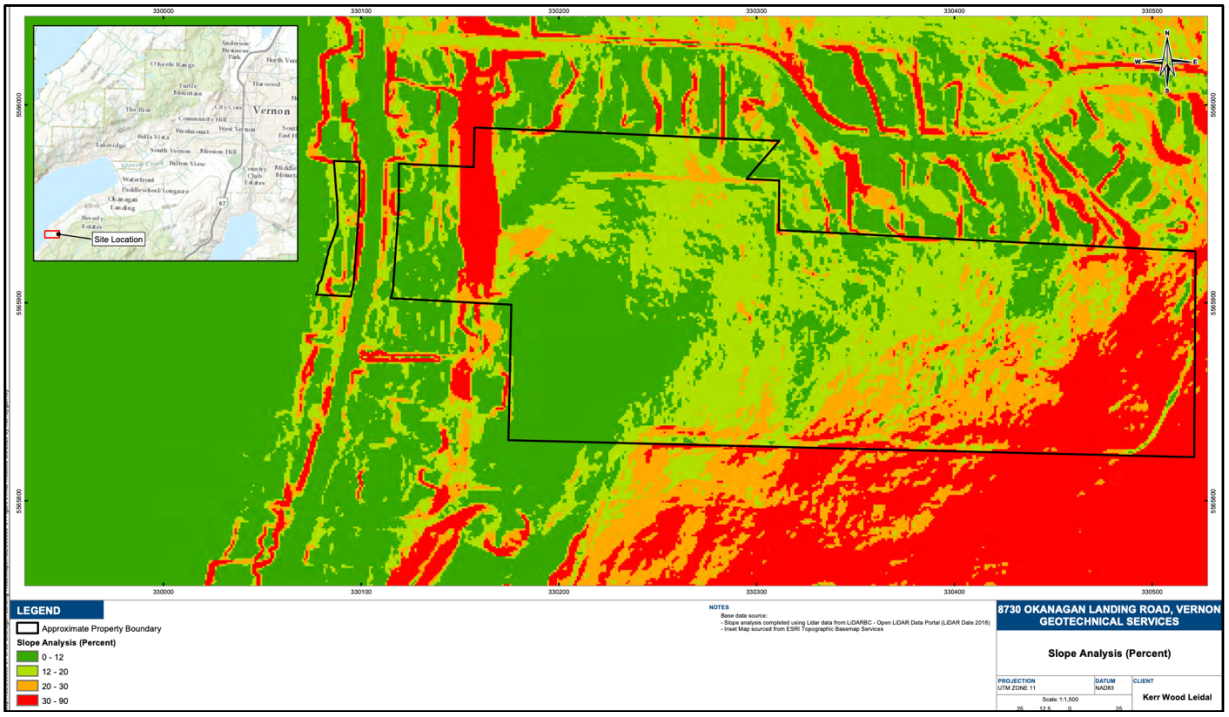
Other sections of the geotechnical report provide recommendations related to house building, such as bearing capacity, slabs-on-grade, excavations, slope setback and clearance, house roof leaders and other drainage and permeability considerations.

7.2 Hillside and Risk Assessment

In terms of topography, Section 4.1 of the TT geotechnical report describes the property as having several distinct sloped areas from west to east:

- a relatively flat (0%-5% slope) lower bench nearest the lake;
- a separating short steep (~30%) lacustrine slope face;
- a grassy field (0% to 30%) for most of the property; and
- an upper treed forest land (5% to ≥30%).

A Slope Analysis is contained as Figure 3 in the geotechnical report and is copied below.

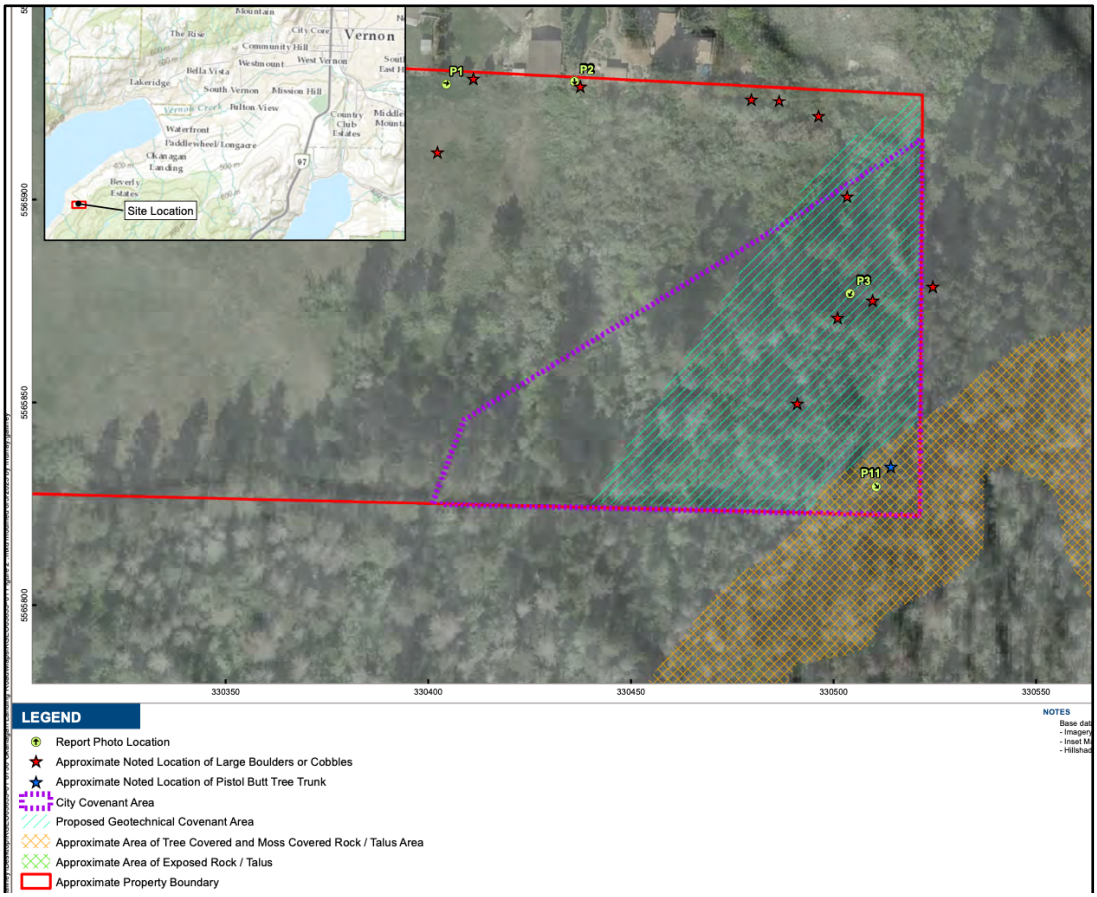


Slope Analysis

Section 5 of the TT geotechnical report provides a Hillside Study as required in the City's Hillside Guidelines. In terms of potential geohazards, note is made of the steep rock face and talus slope area located within Truman Dagnus Locheed Park, offsite and immediately east of the subject property.

Key findings were:

a) Reference is made to the City road reserve no-build covenant area, as it relates to the same general area of rockfall hazard identified in the geotechnical report.
b) There were no obvious signs or evidence of previous natural landslides in the area, or on the property, or on the talus slopes/rockfaces to the east of the property. Given site observations "the risk of natural landslide is considered to be very low to low" (from TT report Sec 5.0).
c) A rockfall risk is identified within an area at the eastern part of the property (generally consistent with the City's road reserve covenant area), consisting of areas identified as Zones 1 to 3 representing increasing risk of rockfall hazard. Zone 3 is offsite, east of the subject property. It is recommended that a geotechnical no-build covenant area be established on the east part of the property, see Figure 2 in the geotechnical report and the excerpt copied below. It is further recommended that a more detailed geotechnical and rockfall hazard assessment be conducted to further identify the covenant area boundary and rockfall hazard mitigation recommendations. This more detailed assessment, to better delineate the covenant area and protective works, would be completed as part of a future subdivision design and approval.



Hillside Study – Proposed Geotechnical Covenant Area

8. Wildfire Plan and Covenant

The subject property is located within the Fire Interface Area identified in the OCP (OCP Map 11, Interface Areas 2 & 3). Accordingly, a Wildfire Threat Assessment & Mitigation Report has been completed and is contained in Appendix I (Forsite Forest Management Specialists, November 6, 2023).

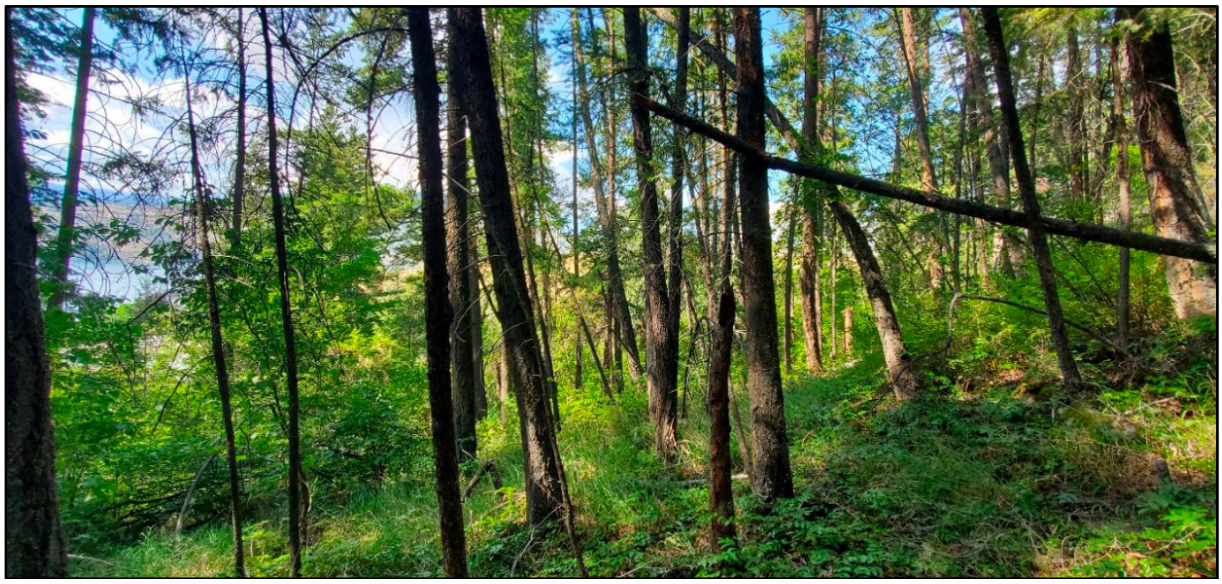
Portions of the property are situated within Fire Interface Area Zones 2 and 3 as follows:

- Interface Area 2 - ~3.2 ha - lower elevation lakefront and mid-grassland area, with average slope of ~11% to the west; and
- Interface Area 3 – 1.3 ha upper elevation forested area, consisting of ~0.4 ha of small deciduous medium-height shrubs, ~0.9 ha of fir second growth forest and standing dead beetle kill.

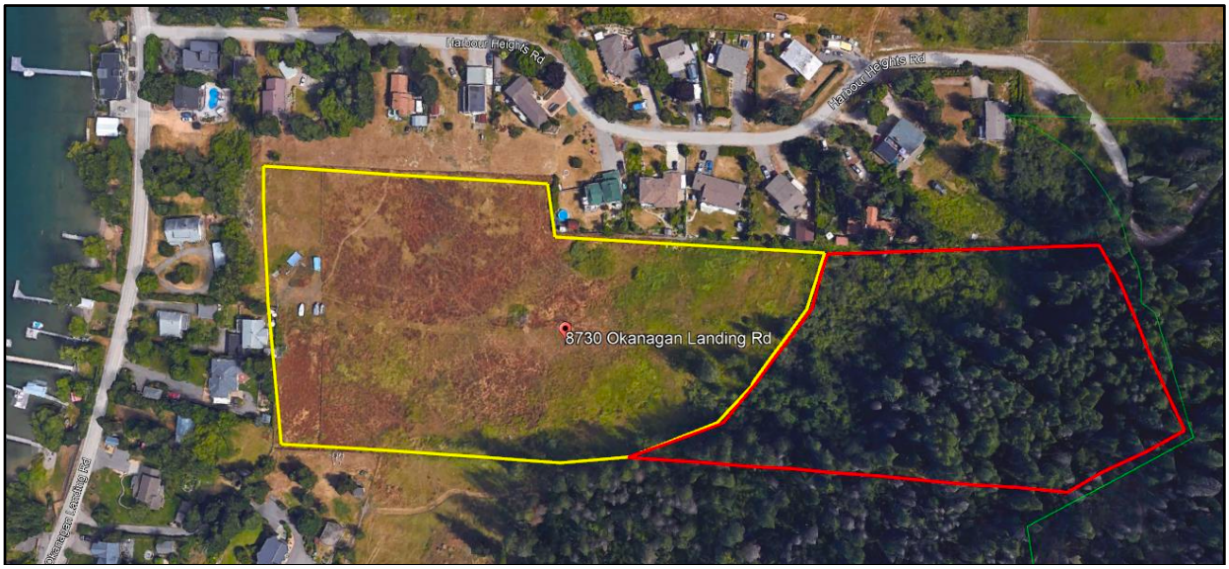
The wildfire assessment also notes that the 0.9 ha second growth forested area includes the ~0.65 ha triangular area covenanted by the City for future road.

Photos from the wildfire assessment show the typical vegetation in the Zone 2 and 3 areas, as shown in the following photos.

Typical Grassland Area (Area 2)



Typical Forested Area (Area 3)



Development would occur in the grassland (yellow) and forested (red) areas shown.

The wildfire report provides specific recommendations for:

a) subdivision area building sites - site preparation and construction;
b) forest area - fuel hazard abatement; and
c) a restrictive covenant on all lands – for buildings and structural materials, landscaping vegetation, setback clearing and treatment areas near the forest, and other best practices.

Appendix I contains a typical wildfire covenant, presently registered on the subject property, with similar to be registered on future property titles within the development area.

9. Stormwater Management

As a hillside development, stormwater management (i.e., rainfall and snowmelt runoff, subsurface drainage and discharge to the receiving environment) are important development considerations.

Surface water runoff collected by the upland offsite portion of the NE to SW draw crossing the property is largely intercepted by the Harbour Heights Rd ditches and diverted to an Okanagan Lake outfall. Other upslope surface and shallow subsurface water sources known on the property are shown in the following figure. Future subdivision infrastructure will intercept and direct runoff and shallow seepage to a new Okanagan Lake outfall.

The following points discuss the sources and how they would be addressed in a stormwater management plan and subdivision infrastructure design.

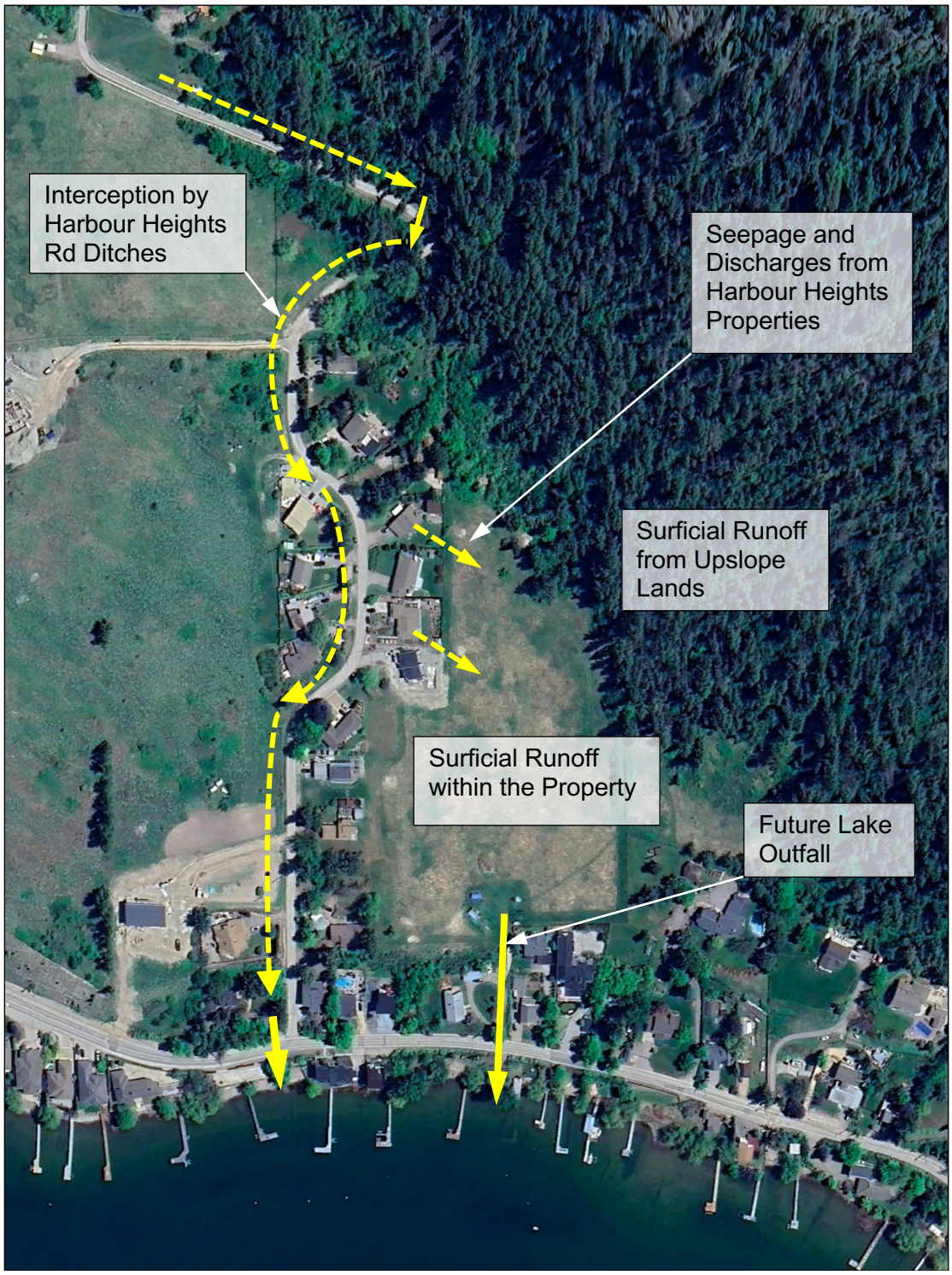
- Surficial Runoff from Upslope Lands – Appendix J contains topographical mapping showing the contributing surface watershed areas. The upslope lands are forested and stable with natural shrub and grass vegetation. There are no areas of concentrated runoff from the upslope lands to the property. Infrastructure works to intercept and collect this runoff should not be required.

- Seepage and Discharges from Harbour Heights Rd Properties – Experience on the property has shown that during extreme precipitation years (1997 and 2017 notably) there is shallow subsurface seepage crossing the rear boundaries of the adjacent Harbour Heights Rd properties. The source of this flow is likely the road ditch. Historically, some of the adjacent Harbour Heights residential properties direct piped water from impervious surfaces, basement sump pumps and hot tubs downslope across their rear property boundaries. A shallow capture and collection system should be considered along this boundary during subdivision design.

- Surficial Runoff within the Property – During future subdivision construction, stormwater management works should collect and capture surface runoff to prevent movement of sediments to the lake.

Future subdivision stormwater collection works would collect water from on-lot footing drains, impervious surfaces and local roads. A new outfall would be constructed under Ok Landing Rd to Okanagan Lake.

As mentioned in the Geotechnical Section 7.1 above, due to the impervious nature of the native clay and silt soils (very low infiltration rate, swelling), on-site stormwater infiltration should generally be avoided.



Stormwater Runoff and Shallow Seepage Routes

10. Roads and Traffic Assessment

This section discusses several road and traffic considerations and provides recommendations for future changes. Appendix K contains a figure showing existing speed limits and traffic calming measures on Ok Landing Rd, and a table showing traffic count data collected in February 2023.

10.1 Okanagan Landing Rd - Current Function

Near the proposed development this is a two-lane asphalt road with intermittent bike lanes on the asphalt shoulders. Drainage is by shallow ditches, occasional cross-culverts to lake outfalls. There is occasional street lighting. Longitudinal grades are quite flat. It is classified as a 'Collector Road' in the Master Transportation Plan. The figure in Appendix K shows the current speed limit signage and two local traffic calming measures. The posted speed limit in the vicinity of the development varies from 30 km/h to 50 km/h. *Traffic* sightlines along the road are generally acceptable, however, driver awareness of *pedestrians* crossing or walking along the road is poor in some areas.

A traffic count conducted in February 2023 (winter, mid-week) indicated *peak one-way* traffic volumes of 20 vehicles per 15-minute interval occurring between 7:30-8:30am and 4:30-6:00pm. Traffic consisted of work commuters, schoolchildren deliveries and resident mid-day routine trips to town, and construction-related vehicles. The summer traffic rate is estimated to be about double the February rate as seasonal summer residents arrive and school-related trips decrease. A 2025 summer traffic count is recommended to confirm this estimate and will be conducted during a July 2025 weekend. Results will be forwarded to the City.

10.2 Harbour Heights Road - Current Function

This is a dead end, two-lane simple asphalt road serving about 20 properties. Speed limit is 30 km/hr. Drainage is by ditches, with occasional driveway- and cross-culverts leading to a lake outfall. There is no street lighting except at the intersection with Ok Landing Rd. The road grade is steep – a longitudinal section taken using Google Earth Pro indicates 20% to 25% grade near the Ok Landing Rd intersection. It is classified as a 'Local Road' in the Master Transportation Plan. (The current City of Vernon bylaws limit longitudinal design grade to 12% for Local Roads.) Turning movements accessing and egressing Harbour Heights Rd are difficult for heavy vehicles and long/low loads as there is no level holding zone or vertical transition onto Harbour Heights Rd. This is evidenced by the deep gouging of the asphalt on Ok Landing Rd due to long/low loads scraping during entry and ascent.

Both the left and right sightlines are restricted for vehicles departing Harbour Heights Rd to Ok Landing Rd .

During the traffic count in February 2023 Harbour Heights Rd serviced 21 single-family residences, including 2 homes under construction (with related construction traffic).

The February 2023 traffic count (winter, mid-week) indicated *peak one-way* traffic volumes of 2 vehicles per 15-minute interval occurring between 7:30-8:30am and 4:00-5:30pm. The summer traffic rates are expected to be similar to that in winter.

Due to the steep grade of Harbour Heights Rd it requires priority winter plowing and sanding. Winter access and egress can be difficult for residents, waste management and emergency response vehicles.

10.3 Proposed Bench Row Rd to Eastside Rd Extension

This proposed two-lane Collector Road is identified in the Master Transportation Plan (Section 6.2.2 Development-Led and -Funded Road Projects, Table 5, Figure 2). This extension has been seen by roads planners as a means to "provide an alternative route enabling a reduction in traffic on Ok Landing Rd". According to City staff during the pre-application meeting however, recent investigations have questioned the physical feasibility, construction cost and its potential to facilitate urban sprawl.

It is this proposed future road that prompted the City to establish the road reserve no-build covenant on the upper easterly part of the subject property. It is recommended that the rezoning application consider two options – that the road reserve remains in place and the land is dedicated as City Road or Park, or that the road reserve is removed and the land used for residential rear yards, shared trail or nature reserve purposes.

10.4 Proposed Internal Local Roads

The plan in Appendix E shows a simple, functional internal road design that provides the critical new connection between Ok Landing Rd and Harbour Heights Rd. This road (Harbour Wynd) has a design grade of 8% to 12% throughout, with flatter grades at intersections. For traffic safety, noise reduction and energy efficiency there would not be any stops between Ok Landing Rd and Harbour Heights Rd. The two cul-de-sac roads shown (Harbour Close and Harbour View) have grades up to 12% with flatter grades at the cul-de-sacs, with stop signs where they meet Harbour Wynd. As Local Roads, it is recommended that the speed limit is set at 30 km/hr, consistent with current traffic speed on Harbour Heights Rd.

There are two locations to consider providing road access to lands beyond:

- The road end of Harbour Close is shown to abut the common property line of two adjacent properties 8660 and 8680 Harbour Heights Rd. This would give these two properties relief from the steep section of Harbour Heights Rd should they wish to build driveways to the cul-de-sac, or these lot owners may wish to access Harbour Close for future subdivision of their lots. Sanitary sewer service could be made available to these adjacent lots.

- Road dedication could be made through to the large property on the south boundary (8778 Ok Landing Rd) via a southerly extension of Harbour Wynd through where proposed Lot 31 is shown. The only purpose for this access would be for future rezoning and subdivision development of 8778, however, the development feasibility of the parcel is not straightforward given the steep topography, and the vertical and

horizontal constraints imposed by the proposed Bench Row to Eastside Rd Extension (refer to the topographic mapping in Appendix B, and the slope analysis in the Geotechnical Report - Figure 3). The feasibility of development of 8778, and physical complexities of converging sidehill roads, should be assessed before requiring a road access to the south boundary.

10.5 Proposed New Okanagan Landing Rd Intersection

The proposed new intersection would likely be a typical tee intersection, with substantially improved vehicle holding and vertical transition compared to the current Harbour Heights Rd intersection. Preliminary horizontal and vertical intersection design is shown in Appendix E. Recently a section of the development entrance Road 'A' (i.e., Harbour Wynd) was constructed to design grade, and it can be compared to Harbour Heights Rd. Two lake parking stalls dedicated to the lake access could be included at the intersection.

Given the traffic count data on Harbour Heights Rd, it is unlikely that a southbound left turn lane or road widening would be warranted on Okanagan Landing Rd. A preliminary estimate of summer peak traffic volume at this intersection on buildout indicates about 10 vehicles per 15-minute peak period, executing either southbound left turn in or westbound right turn out movements[1]. A proper traffic impact analysis would be completed as part of the subdivision design; however estimates herein indicate that a southbound left turn lane and right-out northbound widening are likely not warranted. For comparison, tee intersections with Ok Landing Rd at the Mandalay condos (7922 Ok Landing Rd ~ 28 units) and Sunset Properties (9200 block Ok Landing Rd at Kokanee Rd ~ 65 units) experience insignificant interruption of Ok Landing Rd through-traffic.

There is a requirement to complete Ok Landing Rd widening and drainage improvements along the 8724, 8730 and 8724 frontages upon subdivision of the subject lands.

Should the development proceed to subdivision, it is recommended that the City consider extending the limits of the 30 km/hr zone on Ok Landing Rd to Harbour Heights Rd.

10.6 Harbour Heights Rd – Recommendations

At the February 2, 2023 Pre-Application Meeting, staff asked the Applicant to consider road and traffic safety improvements for Harbour Heights Rd. The Applicant has reviewed the situation, and discussed options with several residents with driveways accessing lower Harbour Heights Rd, as well as with a current City of Vernon snowplow operator.

There are essentially two options to relieve the current situation: regrade Harbour Heights Rd or close the lower portion of Harbour Heights Rd. It is likely not feasible, practical or cost-effective to regrade the Harbour Heights Rd intersection to flatten the longitudinal grade to

[1] To approximate the peak summer intersection traffic: (February 2023 was 2 vehicles per 15 minute peak period at HHts Rd) x (17 HHts lots +35 new lots tributary to the new intersection) / (21 HHts lots) x (2 for summer increase) = a peak ~10 vehicles per 15 minute period.

anywhere near the bylaw grade of 12%. Closing the lower portion of the road removes road access to several existing properties.

The following options can be considered:

a) Leave Harbour Heights Rd in operation as is, as there are 4 to 8 driveways accessing the lower part of the road without alternative access, and these properties need waste pickup, snowplowing and emergency services.
b) In the future, encourage residents east of about 8660 to use the new Harbour Wynd to access Ok Landing Rd. Of the current 21 properties on Harbour Heights Rd, this would leave about 4 properties using the Ok Landing Rd – Harbour Heights Rd intersection, and about 17 using the new Harbour Wynd access.
c) In the future, restrict heavy vehicles and long loads from entering Harbour Heights Rd.
d) The City could work with the landowners (8690 and 8708) to improve the traffic sightlines or westbound right and left turns on to Ok Landing Rd by trimming or removing vegetation and other obstacles.

11. Infrastructure Servicing

The development site is fully serviced on its Okanagan Landing Rd boundary. A future subdivision on the property would be serviced by municipal and private utilities in conformance with the Subdivision and Development Servicing Bylaw. The Ok Landing Rd area saw significant upgrades for water and sewer services following area annexation in 1994. This section describes the servicing approach.

11.1 City- and GVW-owned Infrastructure

Water Supply & Fire Protection – A large diameter municipal trunk water main was installed in Ok Landing Rd in 1999. Record drawings indicate that the fronting section of water main is 350 mm (14”) diameter, pressure class 250 (psi) ductile iron pipe. The property is wholly located within the 431 m pressure zone (to be confirmed with GVW) which provides adequate water pressure and fireflow supply throughout a future subdivision development.

The water distribution system would tie into the water system in Harbour Heights Rd at the time of subdivision, providing an increased level of service for those properties.

Sanitary Sewer – Municipal sanitary sewer piping was installed in Ok Landing Rd in 2006. Record drawings indicate three mains on the frontage: 200 mm PVC, 250 mm PVC and a 75 mm polyethylene low pressure sewer forcemain. Connection details for a future subdivision would be determined at the design stage, however this will likely involve a traditional gravity system tying into one of the large sewer mains in Ok Landing Rd.

The sanitary sewer system could provide a gravity connection to service the upper Harbour Heights Rd properties. Other arrangements could be designed at the time of a future subdivision development.

Stormwater – As discussed in Section 9, future development would have a traditional stormwater collection system with a new outfall discharge to Okanagan Lake.

11.2 Shallow Utilities

Contact has been made with BC Hydro, Fortis Gas, Telus and Shaw Cable. Each has confirmed adequate capacity to service a future subdivision with underground services.

12. Closure

We trust that the information provided herein meets the needs of the City of Vernon, referral agencies and neighbouring property owners.

Respectfully submitted,

Michael and Kathleen Nolan
8730 Okanagan Landing Road
Vernon, BC V1H 1J7

ATTACHMENT 3

SAVED 2025/04/30, 4:26 PM

Paper Size = ANSI D
A1 Full Size, this border measures 520 mm x 800 mm

0 50 100 millimetres

OKANAGAN LANDING ROAD

HARBOUR HEIGHTS ROAD

OKANAGAN LAKE

HARBOUR CLOSE

HARBOUR WYND

HARBOUR VIEW

Lot 1
Lot 2
Lot 3
Lot 4
Lot 5
Lot 6
Lot 7
Lot 8
Lot 9
Lot 10
Lot 11
Lot 12
Lot 13
Lot 14
Lot 15
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Lot 25
Lot 26
Lot 27
Lot 28
Lot 29
Lot 30
Lot 31
Lot 32
Lot 33
Lot 34
Lot 35
Lot 36
Lot 37

Lot 31 - potential public road to lands south, or interim community garden / playground

ZONING LEGEND
- MUS LOTS
- ROAD DEDICATION

ZONING LOT INFO:
MULTI UNIT SMALL SCALE (MUS)
CLASS 4 DENSITY USE
- MIN INTERIOR LOT WIDTH = 14.0m
- MIN EXTERIOR LOT WIDTH = 20.0m
- MIN LOT AREA = 500m²
- MIN SETBACK FRONT YARD = 4.0m
- MIN SETBACK HOUSING BASED = 1.5m
- MIN SETBACK NON-HOUSING BASED = 3.0m

NOTE:

ALL LOTS AND ROADS SHOWN ARE IN GENERAL CONFORMANCE WITH CITY OF VERNON ZONING BYLAW #6000 AND SUBDIVISION & DEVELOPMENT SERVICING BYLAW #3843

SITE PLAN - REZONING
Scale 1:750

KERR WOOD LEIDAL
consulting engineers

0 10 (1:750) 40m

POTENTIAL ROADS AND LOTS LAYOUT
8730 OKANAGAN LANDING ROAD
MUS ZONING

P:\4300-4399\4377-001\01-Drawings\5_Figures\Rezoning Development Option 1.dwg

TETRA TECH

June 6, 2023

ISSUED FOR USE
FILE: 704-ENG.KGEO03853-01
Email: BVanCalsteren@kwl.ca

Kerr Wood Leidal
202, 3334 - 30 Avenue
Vernon, BC V1T 2C8

Attention: Bruce VanCalsteren

Subject: Geotechnical Services Report for Proposed Development at 8730 Okanagan Landing Road, Vernon, BC

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) have been retained by Kerr Wood Leidal (the Client) to provide geotechnical services for a proposed development at 8730 Okanagan Landing Road (Legal description; Lot 1 Plan EPP 37864 Section 14 Township 13 Osoyoos Division Yale District) in Vernon, BC (herein referred to as "the property").

Based on the information provided and discussions with the client, we understand that the proposed development will be undertaken in three phases, which can be seen in Figure 1, attached to this report.

- Phase 1 would include rezoning of the lakefront portion of the property from A2 to R6 and subdividing off two residential lots from the main property.
- Phase 2 would include building of a single residential home and access driveway on the upper slope above the existing house on the main property.
- Phase 3 would include rezoning of the remaining ~4.9 ha of the main property and creation of a multi-lot subdivision.

The existing lot has one house built on it, while the rest of the lot is vacant grassland that turns into forested land on the east side of the property. Supplied information from the Client is attached in Appendix A.

Tetra Tech has been requested to undertake geotechnical assessment of the site and provide geotechnical design and hillside development recommendations, as per City of Vernon's Development Application Form, as well as the City of Vernon's Engineering Development Servicing Report (10/05/2022).

This report presents the findings of our current subsurface exploration, outlines the outcomes of our analyses, and provides geotechnical recommendations for the proposed development.

2.0 FIELDWORK AND LAB TESTING

Fieldwork included a subsurface exploration as well as a walkover site reconnaissance mapping to inform the hillside study portion of the geotechnical investigation.

Tetra Tech Canada Inc.
150, 1715 Dickson Avenue
Kelowna, BC V1Y 9G6 CANADA
Tel 250.862.4832 Fax 250.862.2941

The subsurface exploration of the proposed area was undertaken on April 27 and 28, 2023 and included testpit excavation using a Kubota U48-S excavator provided by the Client. Testpit locations were selected to provide an understanding of the subsurface soils for all three phases of the proposed development. A total of 21 testpits were excavated to a maximum depth of 3.2 m. The approximate testpit locations are shown in the attached Figure 1.

Site walkover reconnaissance mapping was undertaken on April 28, 2023, and included surficial mapping of geomorphic features and observations to inform the hillside study.

A geotechnical engineer from Tetra Tech was present to supervise testpit excavations, collect soil samples, log the soil stratigraphy, and complete the site walkover reconnaissance mapping for the hillside study. Detailed testpit logs are provided in Appendix B. Testpit geographic coordinates and completed depths are summarized in Table 2-1.

Table 2-1: Summary of Testpit Location Details

ID	Completed Depth (m)	Easting[1] (m NAD83)	Northing[1] (m NAD83)	Elevation[2] (m)
TP23-01	2.7	330124	5565958	347
TP23-02	1.7	330146	5565934	349
TP23-03	1.9	330146	5565914	349
TP23-04	3.0	330182	5565966	361
TP23-05	3.0	330162	5565967	359
TP23-06	3.2	330181	5565936	360
TP23-07	2.6	330186	5565868	354
TP23-08	2.2	330230	5565837	356
TP23-09	2.8	330262	5565971	366
TP23-10	2.8	330274	5565910	362
TP23-11	2.3	330294	5565873	363
TP23-12	2.9	330339	5565925	371
TP23-13	2.4	330353	5565880	370
TP23-14	2.4	330345	5565840	373
TP23-15	2.9	330409	5565922	378
TP23-16	2.4	330438	5565902	382
TP23-17	3.0	330419	5565855	385
TP23-18	2.8	330477	5565926	386
TP23-19	1.6	330238	5565881	357
TP23-20	3.0	330242	5565937	360
TP23-21	2.8	330400	5565888	377

Notes:
1 – NAD = North American Datum 1983, Zone 11; Coordinate positions estimated from GIS Data and handheld GPS.
2 – Elevations estimated from City of Vernon 1m Contours dated 2016.

3.0 LABORATORY TESTING

Disturbed soil samples collected during the subsurface exploration were sent to our laboratory for classification testing that included Atterberg limits, moisture contents, hydrometer gradation and sieve gradation analysis. A summary of the laboratory test results is presented in Table 3-1 and are also attached in Appendix C.

Table 3-1: Summary of Laboratory Test Results

Sample Depth (m)	Sample Depth (m)	Moisture Content %	USCS[1]	Particle Size Distribution (%)				Atterberg Limits (%)		
				Fines		Sand	Gravel	LL	PL	PI
				Clay	Silt					
TP23-02; DS1	1.2 – 1.3	7.1	-	15		31	54	-	-	-
TP23-04; DS2	1.4 – 1.5	38.6	CH	-	-	-	-	74	24	50
TP23-04; DS3	1.9 – 2.0	39.9	-	-	-	-	-	-	-	-
TP23-04; DS4	2.3 – 2.4	38.6	-	-	-	-	-	-	-	-
TP23-04; DS5	2.9 – 3.0	41.2	CI	-	-	-	-	48	28	20
TP23-06; DS2	1.2 – 1.3	61.1	CL-CH	-	-	-	-	51	26	25
TP23-06; DS3	1.7 – 1.8	36.4	-	-	-	-	-	-	-	-
TP23-06; DS4	2.1 – 2.2	39.8	-	-	-	-	-	-	-	-
TP23-06; DS5	2.5 – 2.6	38.1	-	-	-	-	-	-	-	-
TP23-06; DS6	2.9 – 3.0	39.7	-	-	-	-	-	-	-	-
TP23-07; DS2	1.2 – 1.3	12.5	CI	-	-	-	-	32	18	14
TP23-10; DS3	2.3 – 2.4	19.3	-	40	51	9	0	-	-	-
TP23-12; DS2	1.8 – 1.9	39.2	-	-	-	-	-	-	-	-
TP23-12; DS3	2.5 – 2.6	40.4	CI-CH	-	-	-	-	51	26	25
TP23-15; DS1	0.8 – 0.9	36.2	ML	-	-	-	-	39	28	11
TP23-15; DS2	2.0 – 2.1	31.0	-	-	-	-	-	-	-	-
TP23-15; DS3	2.8 – 2.9	32.4	CH	-	-	-	-	64	30	34
TP23-16; DS1	0.5 – 0.6	37.3	-	-	-	-	-	-	-	-
TP23-16; DS2	1.9 – 2.0	26.3	-	-	-	-	-	-	-	-
TP23-17; DS3	2.4 – 2.5	5.2	-	27		42	31	-	-	-
TP23-18; DS2	1.1 – 1.2	27.3	MH	-	-	-	-	58	36	22
TP23-20; DS1	0.9 – 1.0	25.2	-	85		15	0	-	-	-
TP23-21; DS1	0.6 – 0.7	33.2	-	-	-	-	-	-	-	-
TP23-21; DS2	1.9 – 2.0	28.9	-	-	-	-	-	-	-	-

Notes: 1 – USCS represents Unified Soil Classification System nomenclature.

4.0 SITE CONDITIONS

4.1 Site Description

The property is split into two main areas: a lower bench, and an upper slope. There is a short but somewhat steep (>30%) slope that separates the lower bench and upper slope (see Figure 3). The lower bench is where the current house, driveway, garage, and landscape yards are situated. The upper slope is a large grassy field that eventually turns into treed forestland on the east side of the property. The Property generally slopes from east to west, from greater than 30° (60%) slopes on the east side of the property down to between approximately 0° and 5° (0-10%) slopes on the west side of the property (see Figure 3).

4.2 Site Geology

The geological map for the area, Geological Survey of Canada Map 1392A (R.J. Fulton et al. 1963-65), indicates that the property has the following surficial geology:

- A thin veneer of lacustrine deposits generally less than 10 feet thick consisting of silt with minor clay and sand overlying.
- Morainal deposits consisting of till with minor sand, gravel, and silt overlying.
- Older, unconsolidated pre-Fraser glacial and non-glacial sediments consisting of sand, silt, gravel, and till deposited prior to the last ice advance.

The soil conditions encountered during the fieldwork are generally consistent with the information from the surficial geology map, as both the lacustrine deposits and Fraser glaciation morainal deposits were present in the testpits completed.

4.3 Soil Stratigraphy

The soil profile at the site generally consists of the following layers:

- **Topsoil:** This uppermost layer comprises rootlets and organic matter. It extends from the surface to a depth ranging between 0.3 and 0.6 m.
- **Clay or Silt:** Beneath the topsoil, there exists a layer of clay or silt with varying levels of plasticity depending on depth and location. These clays and silts are typically stiff, moist, and exhibit a color range from grey to brown. It is worth noting that this layer was absent in testpits TP23-01, TP23-02, and TP23-03. It is also worth noting that the moisture content in the clay appears to be higher on the west side of the property.
- **Silty sand and gravel till layer:** In the lower elevation testpits and beyond the treeline at the south/southeast of the property, a layer of silty sand and gravel till was encountered. This layer starts at a depth ranging from 0.6 to 2.0 m below the surface and extends to the bottom of the testpit. The deposits in this layer were observed to be dense to very dense, and their color varied from light/dark brown to grey.

4.4 Groundwater and Surface Water

No groundwater or surface water was encountered in any of the testpits completed or observed at any location during our fieldwork.

Based on the information provided in Western Water Associates 2021 Environmental Impact Assessment Report (WWA, 2021), a "*mapped watercourse runs for 330 m from the northeast to the southwest corner of the upper slope. It reportedly has not flowed since it has been observed starting in 1965 the watercourse behaves as a shallow seepage observed in 1997 and 2017 (winters of particularly heavy snowfall). In these years the water course reportedly temporarily seeped for a few weeks during freshet, and, in 2017 only, temporarily pooled on the surface and seeped to ground, and did not directly flow into Okanagan Lake. It does not have an identifiable channel boundary or any other characteristics of a surface water tributary*." The mapped watercourse location from the WWA report can be seen in Figure 1 attached to this report.

It is also worth noting that from the Engineering Development Servicing Report issued by the City of Vernon for this property on 10/05/2022, the "*Provincial Fresh Water Atlas (FWA) mapping indicates a stream running southwest from the northeast corner of the lot*."

The testpits located within and near the mapped watercourse from the WWA report, such as TP23-18, TP23-15, and TP23-11, did not exhibit any features that would normally be associated with a watercourse, such as stratified deposits or a significantly different soil profile. Tetra Tech did not observe any surficial water or groundwater during our investigation. However, localized or seasonal groundwater and surface water may be encountered during construction. For the purposes of this report and our analysis, we assumed no groundwater influence on the underlying stratigraphy.

5.0 HILLSIDE STUDY

The City of Vernon Hillside Guidelines (CoV, 2008) requires a hillside study on slopes with an angle of 12% or greater for a minimum horizontal distance of 10 meters. Figure 3 shows the results of slope angle analysis based on publicly available Lidar data from 2018 and shows that much of the site contains slopes over 12%, so a hillside study has been undertaken.

There is an existing City of Vernon covenant area on the east side of the property that we understand may be used for future City roadworks. The covenant restricts any building development within the covenant area. The location of the City of Vernon covenant area can be seen in Figures 1 and 2 attached to this report.

Observations regarding steep slopes and potential geohazards made during the hillside study walkover are presented below. Photos of the recorded site observations are attached to this report. Photo locations and mapped features are shown in Figure 2. Key observations include:

- Large boulders were noted on the east side of the property (see Photos 1, 2, 3 and Figure 2). These boulders were noted to be moss-covered. Considering the location of these boulders relative to the cliffs to the east of the property, it is likely that most of these boulders are glacial erratic. It is possible that boulders near P3 on Figure 2 are associated with historical rockfall runout.
- There were no obvious boulder strike marks on the side of any of the trees observed.
- There were two different trees with pistol butt shaped tree trunks noted (see Photo 5 and Figure 2). Pistol butt trunks can be an indication of slope instability. However, due to the lack of evidence of any other landsliding, these pistol butt trees are more likely due to being pushed over while they were juveniles (possibly due to either boulder strikes, snowfall, windfall, hit by another falling tree, or earthworks construction).
- There were two main talus slope areas: one with exposed rock and little to minor moss/vegetation coverage (see Photos 8, 9 ,10 and Figure 2), and the other was a larger area with some tree coverage that had more moss/vegetation on the rock (see Photos 4, 6, 7, 11 and Figure 2). The typical slope of these talus slope areas

ranged between approximately 30 and 40 degrees and rock size was generally between 150 and 600 mm with occasional metric sized boulders. It is worth noting that these talus slopes, and the rock cliffs above them, are to the east of the 8730 Okanagan Landing Road property and are located within the neighbouring Truman Dagnus Locheed Park, except for a small portion of tree covered and moss-covered rock area that exists in the southeast corner of the property (see Figure 2).

- Groundwater seepage was not noted at any location on the Property and was not noted in any neighbouring areas. There were no obvious drainage paths noted.
- There were no obvious signs or evidence of previous natural landslides in the area, on the property, or on the talus slopes/rockfaces to the east of the property. Given site observations the risk of natural landslides across the site is considered to be very low to low.

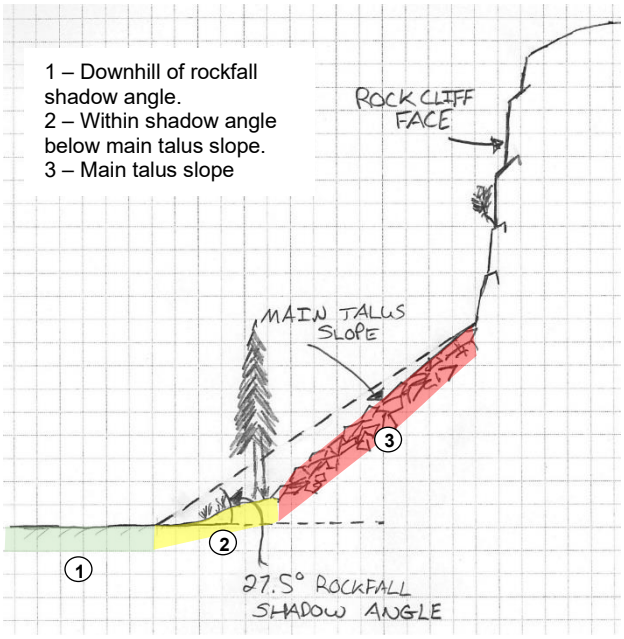
Given the materials observed on-site and our understanding of the proposed development, it is our assessment that the existing slopes are considered to be reasonably stable, and the only slope stability hazard currently noted at the site is associated with rockfall at the eastern end of the property. This is discussed further in the next section.

5.1 Rockfall

Rockfall risk was evaluated based on-site observations, EGBC's Landslide Assessments in British Columbia professional practice guidelines, as well as establishment of a rockfall shadow angle as described in Evans and Hunger (1993). Evans and Hunger describe a rockfall shadow angle as the angle between the distal limit of expected rockfall from a cliff face and the top of the talus slope below that cliff face. Their study of 16 talus slopes around the province of BC found that a rockfall shadow angle of 27.5° provides a reasonable approximation of rockfall limits.

Using this rockfall shadow angle we have established three main risk zones at the site that are shown in Sketch 1 below and include:

- Downhill of the rockfall shadow angle.
- Between the downhill limit of the rockfall shadow angle and the main talus slope.
- Between the main talus slope and the existing cliffs.



Sketch 1: Conceptual Cross-Section Showing Three Main Rockfall Risk Zones

Using the three rockfall risk zones outlined above, assessment of rockfall likelihood at the site is as follows:

- Given that the observed slopes have only been exposed since the end of the last glaciation we have assumed that Zone 1, areas outside the rockfall shadow angle in a downslope direction, have a rockfall impact likelihood of > 1/2,500 years.
- Observations on-site show that minor rockfall is likely ongoing but that it is usually contained within the limits of the main talus slope. We have therefore assumed a likelihood of possible to unlikely; 1/500 to 1/2,500 years for Zone 2, between the downslope limit of the rockfall shadow angle and the main talus slope.
- There are large mature trees within a large area of the talus slope suggesting that although rockfall impact is common within the main talus slope, an individual area could pass a significant amount of time with being impacted. We have assigned a likelihood of rockfall impact for Zone 3, within the main talus slope, of almost certain to likely; 1/1 to 1/500 years.

Assessment of rockfall consequence at the site is as follows:

- **Zone 1** – the consequence of rockfall impact in this area would, in the worst case, likely be <$100K damage with a remote possibility of serious injury or even a fatality. This area is deemed to be low risk and acceptable without requirements for further investigation or protection measures.
- **Zone 2** – consequences would likely be <$100K damage with a possibility of minor to serious injury and remote risk of fatality. This area is deemed to be medium risk and considered tolerable for uninhabited or non-emergency infrastructure. Where residential buildings or portions of residential buildings fall within this area, it is recommended that rockfall protection measures be constructed to reduce the risk or additional, more detailed study of rockfall risk above individual sites must be considered.
- **Zone 3** – consequences would likely be <$1M damage with a possibility of serious injury and fatality. This area is deemed to be high risk and is considered unacceptable and a “no-build” zone unless additional rockfall risk assessment occurs coupled with installation of rockfall protection measures.

Zone 3 mostly occurs to the east of the property boundary and can be seen in Figure 2 with the orange and green cross hatches. Zone 2 extends approximately to the end of the proposed geotechnical covenant area, which is also shown in Figure 2. Tetra Tech recommends a geotechnical covenant be placed in the eastern area of the property to restrict any development within rockfall risk Zones 2 or 3 unless supported by more detailed geotechnical and rockfall hazard assessment. The geotechnical covenant area mostly overlaps with the existing City of Vernon covenant area (Figure 2), which is a “no-build” zone due to the possibility of a future City road in this location. Given the preliminary nature of the rockfall assessment, the covenant shown in Figure 2 is considered conservative in size.

6.0 PHASE 1 GEOTECHNICAL ASSESSMENT

6.1 General

Based on our understanding of the proposed development and the observed site geology, Tetra Tech considers that from a geotechnical perspective, the land is suitable for the use intended, subject to the conditions and recommendations presented in this report.

6.2 Site Preparation and Material Reuse

Within the footprint of all buildings and roadways it is recommended that all topsoil, as well as any potential soft silt or clay layers, be stripped to expose dense till deposits or other suitable subgrade. Based on encountered site conditions, approximate depth of site stripping is anticipated to be approximately 0.5 to 0.6 m.

The extent of removal for overburden layers will depend upon the foundation depth and structure type. As such, despite removal of all deleterious materials, additional sub-excavation may be required to reach required grade elevation. If sub-excavation is required it should, as a general rule for preliminary planning, extend horizontally beyond the building footings for a distance of at least 1H:1V in every direction. The requirements and extent of sub-excavation must be confirmed and deemed competent on the site by Tetra Tech personnel during the site preparation.

Following site stripping, the following recommendations must be followed within the footprint of all buildings and roadways:

- The geotechnical engineer or their representative must review the exposed subgrade after site grading.
- Compaction of the excavated base must be performed using a smooth drum vibratory roller on sand and gravel soils to achieve 100% Standard Proctor Maximum Dry Density (SPMDD).
- In areas where sub-excavation is required, backfilling must be carried out with approved structural fill material with less than 8% fines content, compacted to 100% SPMDD or tested through proof-rolling.

It is important to note that any silt or clay materials found on-site are not considered suitable for reuse as structural fill. However, native sand and gravel materials can be utilized as general backfill.

6.3 Bearing Capacity

Based on the local freezing index, as per Climate Atlas (2023), frost penetration depth for City of Vernon was calculated to be 0.9 m. Foundation elements must be placed at or below this depth to ensure adequate protection from frost.

We have assumed that the proposed footings may consist of concrete strip footings with minimum widths of 0.45 m and isolated pad footings with minimum widths of 0.9 m. The bearing soils at each footing excavation must be inspected and approved by qualified geotechnical personnel prior to concrete placement. Foundation preparation must include the following:

- Underneath foundation footprint, sub-excavate native soils to expose the native till sand and gravel deposits. Sub-excavated base must be reviewed by the geotechnical engineer or their representative.
- The subgrade base must be compacted using a smooth drum roller on all sand and gravel soils to achieve 100% SPMDD or until deemed competent.
- If backfill is required, place approved structural fill material compacted to 100% SPMDD or proof-roll tested.

Based on the above assumptions and the foundation preparation, it is our assessment that a factored ultimate limit state (ULS) geotechnical bearing resistance of 150 kPa with Serviceability Limit State (SLS) bearing pressure of 100 kPa may be applicable.

A Geotechnical Resistance Factor (Φ) of 0.5 was used to calculate the factored ultimate limit state (ULS) geotechnical resistance in accordance with Section 8 of the Canadian Foundation Engineering Manual (CFEM 2006).

6.4 Slab-on-Grade Floors

Interior slab-on-grade floors should be founded on a minimum 150 mm thick layer of 25 mm minus crushed gravel, overlying structural fill approved by a geotechnical engineer. Slab-on-grade floors shall be designed in accordance with the 2018 BCBC regarding damp proofing, waterproofing, and soil gas control.

6.5 Excavations and Backfill

6.5.1 Permanent Cut and Fill Soil Slopes

Tetra Tech recommends that permanent cut and fill slopes in soils shall not be graded steeper than a 2H:1V (horizontal: vertical). Permanent fill slopes shall be over-built and then trimmed back to the recommended inclination before recompacting the slope. Permanent slopes shall be vegetated with native grasses and pocket planted shrubs immediately after construction to prevent surface erosion.

6.5.2 Temporary Excavation

Based on the soil conditions encountered in the testpits within the project area, Tetra Tech recommends a maximum temporary soil cut slope angle of 1H:1V (horizontal: vertical) up to a maximum height of 1.2 m. Shallower soil cuts may be required depending on the excavation height.

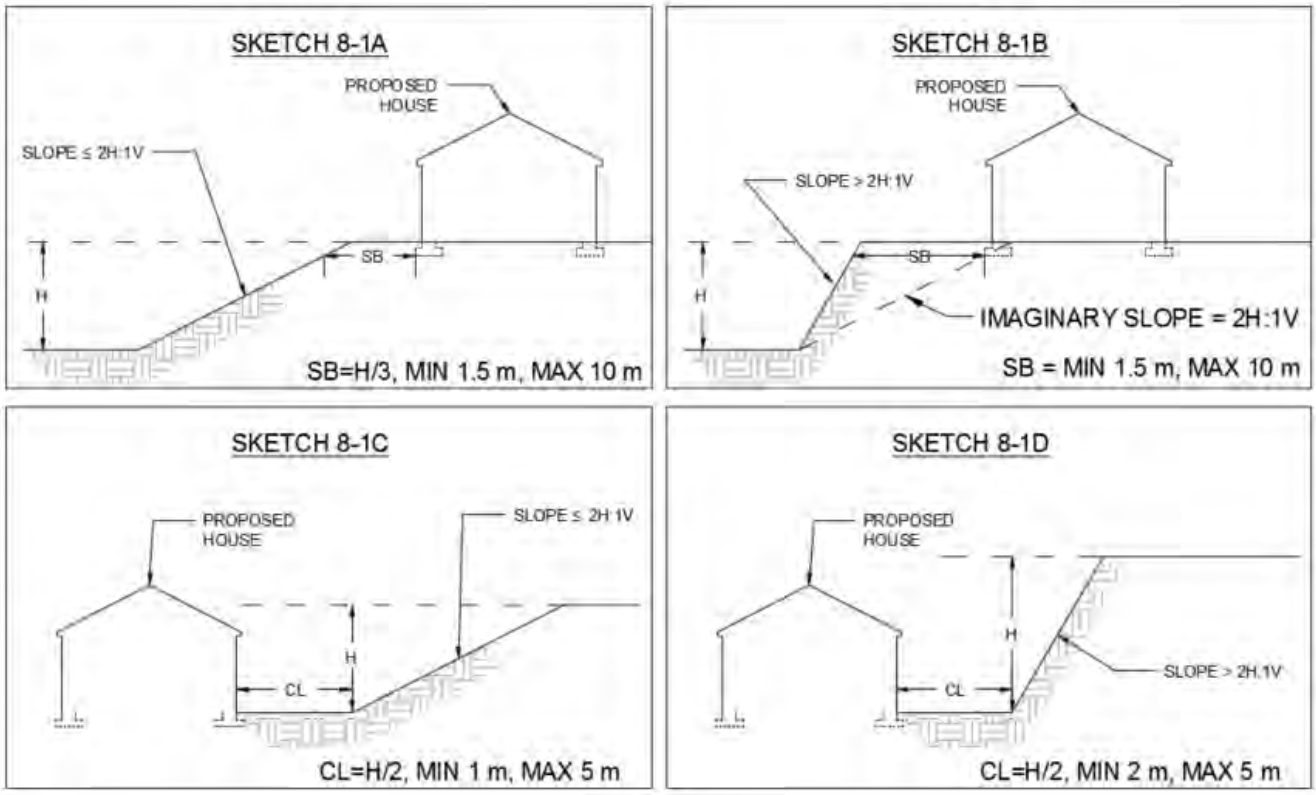
Temporary excavation work must be carried out in accordance with the requirements specified by WorkSafe BC Occupational Health & Safety Regulation, Part 20. Flatter excavations may be required if soil sloughing, groundwater seepage, or loose soils are encountered. A geotechnical engineer shall review any excavation greater than 1.2 m.

6.5.3 Slope Set-Back and Clearance

The slope between the lower bench area and the upper sloped area is approximately 27° (50%) and up to 10 m high (see Figure 3). Once the house locations for the proposed two new lots are known, Tetra Tech must revisit the site to do a more detailed analysis on the slope between the lower bench and the upper slope area.

However, for preliminary planning, general set-back and clearance recommendations are shown graphically in Sketch 8-1 below and include:

- Where a soil slope below a property is equal to or shallower than 2H:1V, the set-back distance between the outer edge of the foundation and the soil slope should be at least the height of the slope divided by 3 (see Sketch 8-1A) but no less than 1.5 m with no need to be greater than 10 m.
- Where a soil slope below a property is steeper than 2H:1V, the set-back should be such that an imaginary line between the outer edge of the foundation and the toe of the slope has an angle of 2H:1V or less (see Sketch 8-1B). In addition, the set-back distance between the outer edge of the foundation and the soil slope should be no less than 1.5 m horizontally from the face of the slope with no need to be greater than 10 m.
- Where a soil slope above a property is equal to or shallower than 2H:1V, the clearance from the edge of the house to the toe of the slope should be equal to the height of the slope divided by 2 (see Sketch 8-1C) but clearance should not be less than 1 m with no need to be greater than 5 m.
- Where a soil slope above a property is steeper than 2H:1V, the clearance from the edge of the house to the toe of the slope should be equal to the height of the slope divided by 2 (see Sketch 8-1D) but no less than 1 m with no need to be greater than 5 m.
- Other set-back and clearance distances for soil slopes may be possible but will require approval from a geotechnical engineer.
- If there are soil slopes above or below a property that are shallower than 3H:1V, then there are no set-back or clearance recommendations and construction elements can extent right to the toe or crest of slopes.



Sketch 8-1: Illustration Showing Set-back and Clearance Distance for Soil Slopes

6.6 Drainage and Permeability

Based on the Engineering Development Servicing Report from the City of Vernon on 10/05/2022, there are no storm sewer mains that exist in the area. Hydraulic conductivity (*k*) of the native sand and gravel till soils has been preliminarily estimated to range between 10^{-8} m/s to10^{-6} m/s. A factor of safety of 2 should be applied to the lower bound of the hydraulic conductivity estimated above to allow for siltation of the infiltration system.

Tetra Tech recommends that prior to detailed design, the preliminary hydraulic conductivity rates be confirmed in the field in accordance with ASTM D3385-18 “Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer” or another approved method.

Tetra Tech recommends that the site is graded with a gradient of at least 1-2% along the preferred direction and away from buildings. Tetra Tech also recommends that a perimeter foundation drainage system be designed around the proposed structures. The perimeter foundation drainage system should be constructed with rigid perforated PVC piping with a minimum diameter of 100 mm surrounded by a minimum 300 mm of clear drain rock. The drain rock should be wrapped in non-woven geotextile such as Nilex 4510 or an approved equivalent by the geotechnical engineer.

6.7 Construction Monitoring

The recommendations presented in this report assume that Tetra Tech will be retained to provide field review during construction, to confirm that soil conditions encountered are consistent with our design assumptions, and work is carried out in general accordance with the intent of our recommendations.

Full-time monitoring by experienced geotechnical/materials personnel will be required to ensure footing base is comprised of clean, free draining material and to monitor the compaction of all granular materials placed with in situ density testing. The gradation of all materials used in construction must be tested and approved by the geotechnical engineer prior to construction.

7.0 PHASE 2 GEOTECHNICAL ASSESSMENT

7.1 General

Based on our understanding of the proposed development and the observed site geology, Tetra Tech considers that from a geotechnical perspective, the land is suitable for the use intended, subject to the conditions and recommendations presented in this report.

7.2 Site Preparation and Material Reuse

A geotechnical consideration in site preparation for this phase of the development is the risk of expansive soils. Expansive clay soils undergo volume changes upon wetting and/or drying. Swelling, or an increase in volume, occurs when the moisture content of an unsaturated expansive soil increases. Conversely, shrinking and an associated decrease in volume occurs when the moisture content decreases. Change in moisture content could happen naturally with seasonal fluctuations in water content, presence of interbedded sand lenses or because of constructing buildings that may block the natural evaporation pathways within the upper portion of the ground. Unless there is sufficient weight to restrain the swelling pressure, the soil can expand in volume and heave the building.

Therefore, within the footprint of all buildings and roadways it is recommended that all topsoil, as well as any soft silt or clay and desiccated or partially desiccated clay layers, be stripped to expose stiff to very stiff non-desiccated clay materials.

The extent of stripping will also depend upon the preferred foundation depth and structure type. As such, despite removal of all deleterious materials, additional sub-excavation may be required to reach required grade elevation. Excavation should, as a general for planning, extend horizontally beyond the building footings for a distance of at least 1H:1V in every direction. The requirements and extent of sub-excavation is to be confirmed and deemed competent on the site by Tetra Tech personnel during the site preparation.

Following site stripping, the following recommendations must be followed for within the footprint of all buildings and roadways:

- The geotechnical engineer or their representative must review the exposed subgrade after site grading.
- The excavated base must be protected from further drying or wetting to avoid any desiccation or heaving of the expansive materials. The moisture change in the soil may cause the soil to swell and heave over time. Care should also be taken to restrict equipment movement on native clay so as to avoid subgrade rutting/pumping

and strength loss. If excavated base is noted to be excessively moist or desiccated, further sub-excavation will be required to minimize heave potential. A geotechnical engineer must inspect the excavated base prior to compaction to determine if sub-excavation is required.

- Excavated base must be compacted using a sheep-foot roller on all clay materials to a minimum 98% Standard Proctor Maximum Dry Density (SPMDD).
- For sub-excavated areas, backfill using approved granular pit run with fines content less than 12%. Backfill must be compacted to a minimum 100% SPMDD.

It is important to note that the silt and clay materials found on-site are not considered suitable for reuse as structural fill. However, native sand and gravel materials can be utilized as general backfill.

7.3 Bearing Capacity

Based on the local freezing index, as per Climate Atlas (2023), frost penetration depth for City of Vernon was calculated to be 0.9 m. Foundation elements should be placed at or below this depth to ensure adequate protection from frost.

We have assumed that the proposed footings may consist of concrete strip footings with minimum widths of 0.45 m and isolated pad footings with minimum widths of 0.9 m. The bearing soils at each footing excavation should be inspected and approved by qualified geotechnical personnel prior to concrete placement. Foundation preparation should include the following:

- Excavate all very soft, soft, or firm, or desiccated/partially desiccated clay, until stiff non-desiccated clay is encountered. The subgrade at the bottom of the excavation shall be deemed competent by the geotechnical engineer.
- The bottom of the excavation should be sloped at a minimum grade of 2% and a drainage system should be installed at the bottom of the excavation and daylighted to facilitate gravity water flow discharge away from footings and off-site.
- Place a layer of high strength non-woven geotextile such as Nilex 4504 or equivalent at prepared excavation base. Geotextile should extend to a distance of 2H:1V from footing footprint and should have a minimum overlap of 600 mm.
- Backfill over geotextile using nominal 8”-10” blast rock in lifts not exceeding 450 mm up to 300 mm below footing elevation. Each blast rock lift should be compacted using a minimum 1000 lb plate packer.
- Backfill underneath footings with approved 75 mm structural fill compacted to 100% SPMDD. The degree of compaction of each lift should be determined by conducting visual monitoring during placement of each lift(s).
- Excavation around poured footings should be backfilled with free draining granular material to 0.9 m below ground surface. The whole perimeter of buildings should then be capped with 0.9 m thick layer of moisture-conditioned clay cut from site and compacted in 200 mm lifts with a sheep-foot roller to 98% SPMDD. The free draining fill should be separated from the surrounding native and capping clay using a non-woven geotextile.

Based on the above assumptions and the foundation preparation, it is our assessment that a factored ultimate limit state (ULS) geotechnical bearing resistance of 150 kPa with Serviceability Limit State (SLS) bearing pressure of 100 kPa may be applicable.

A Geotechnical Resistance Factor (Φ) of 0.5 was used to calculate the factored ultimate limit state (ULS) geotechnical resistance in accordance with Section 8 of the Canadian Foundation Engineering Manual (CFEM 2006).

7.4 Slab-on-Grade Floors

Interior slab-on-grade floors should be founded on a minimum 150 mm thick layer of 25 mm minus crushed gravel, overlying structural fill approved by a geotechnical engineer. Slab-on-grade floors shall be designed in accordance with the 2018 BCBC regarding damp proofing, waterproofing, and soil gas control.

7.5 Excavations

7.5.1 Permanent Cut and Fill Soil Slopes

Tetra Tech recommends that permanent cut and fill slopes in soils shall not be graded steeper than a 2H:1V (horizontal: vertical). Permanent fill slopes shall be over-built and then trimmed back to the recommended inclination before recompacting the slope. Permanent slopes shall be vegetated with native grasses and pocket planted shrubs immediately after construction to prevent surface erosion.

7.5.2 Temporary Excavation

Based on the soil conditions encountered in the testpits within the project area, Tetra Tech recommends a maximum temporary soil cut slope angle of 1H:1V (horizontal: vertical) up to a maximum height of 1.2 m. Shallower soil cuts may be required depending on the excavation height.

Temporary excavation work should be carried out in accordance with the requirements specified by WorkSafe BC Occupational Health & Safety Regulation, Part 20. Flatter excavations may be required if soil sloughing, groundwater seepage, or loose soils are encountered. A geotechnical engineer shall review any excavation greater than 1.2 m.

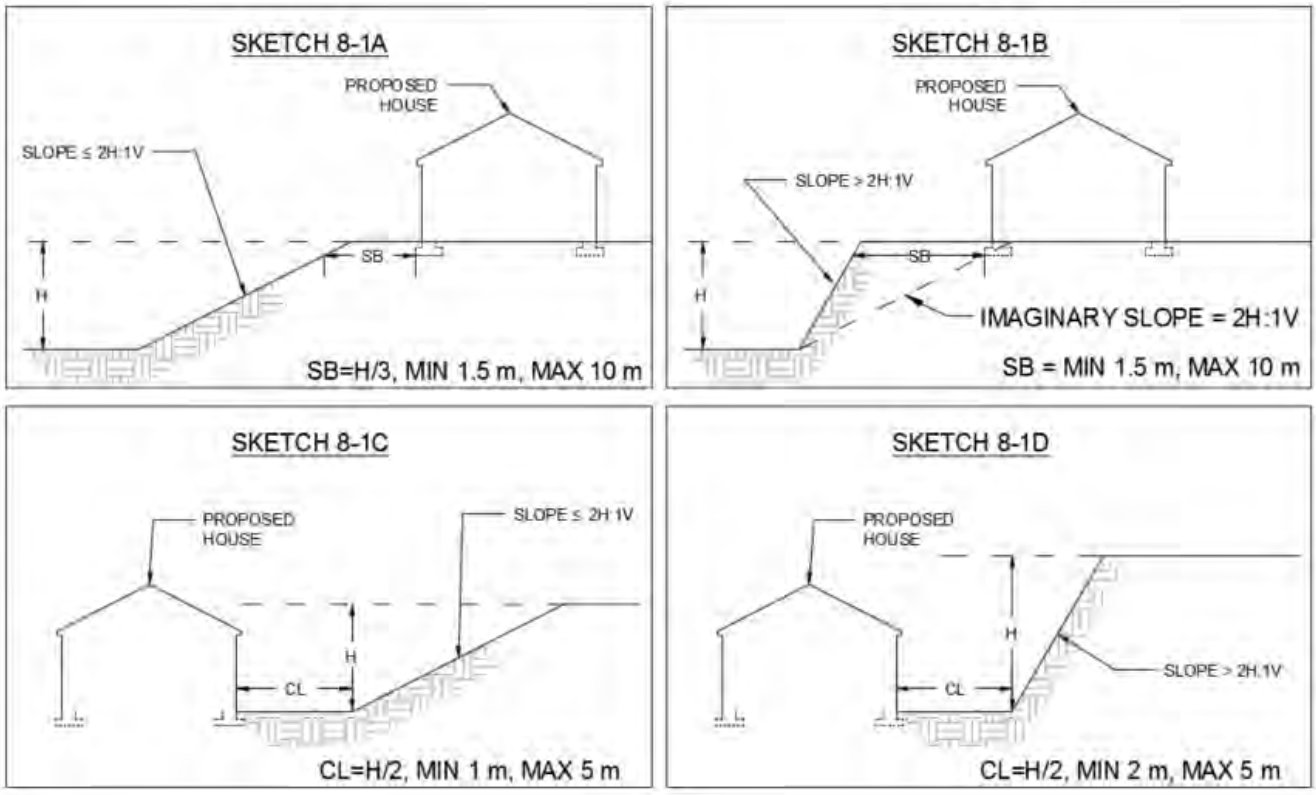
7.5.3 Slope Set-Back and Clearance

The slope between the lower bench area and the upper sloped area is approximately 27° and up to 10 m high (see Figure 3). Once the location for the new proposed house is known, Tetra Tech must revisit the site to do a more detailed analysis on the slope between the lower bench and the upper slope area.

However, for preliminary planning, general set-back and clearance recommendations for permanent soils slope angles are shown graphically in Sketch 8-1 below and includes:

- Where a soil slope below a property is equal to or shallower than 2H:1V, the set-back distance between the outer edge of the foundation and the soil slope should be at least the height of the slope divided by 3 (see Sketch 9-1A) but no less than 1.5 m with no need to be greater than 10 m.
- Where a soil slope below a property is steeper than 2H:1V, the set-back should be such that an imaginary line between the outer edge of the foundation and the toe of the slope has an angle of 2H:1V or less (see Sketch 8-1B). In addition, the set-back distance between the outer edge of the foundation and the soil slope should be no less than 1.5 m horizontally from the face of the slope with no need to be greater than 10 m.

- Where a soil slope above a property is equal to or shallower than 2H:1V, the clearance from the edge of the house to the toe of the slope should be equal to the height of the slope divided by 2 (see Sketch 8-1C) but clearance should not be less than 1 m with no need to be greater than 5 m.
- Where a soil slope above a property is steeper than 2H:1V, the clearance from the edge of the house to the toe of the slope should be equal to the height of the slope divided by 2 (see Sketch 8-1D) but no less than 1 m with no need to be greater than 5 m.
- Other set-back and clearance distances for soil slopes may be possible but will require approval from a geotechnical engineer.
- If there are soil slopes above or below a property that are shallower than 3H:1V, then there are no set-back or clearance recommendations and construction elements can extent right to the toe or crest of slopes.



Sketch 8-1: Illustration Showing Set-back and Clearance Distance for Soil Slopes

7.6 Drainage and Permeability

Based on the Engineering Development Servicing Report from the City of Vernon on 10/05/2022, there are no storm sewer mains that exist in the area. Hydraulic conductivity (*k*) of the native clay soils has been preliminarily estimated to range between 10^{-10} m/s to10^{-8} m/s. A factor of safety of 2 should be applied to the lower bound of the hydraulic conductivity estimated above to allow for siltation of the infiltration system.

Tetra Tech recommends that prior to detailed design, the preliminary hydraulic conductivity rates be confirmed in the field in accordance with ASTM D3385-18 “Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer” or another approved method.

Tetra Tech recommends that the site is graded with a gradient of at least 1-2% along the preferred direction and away from buildings. Tetra Tech also recommends that a perimeter foundation drainage system be designed around the proposed structure. The perimeter foundation drainage system should be constructed with rigid perforated PVC piping with a minimum diameter of 100 mm surrounded by a minimum 300 mm of clear drain rock. The drain rock should be wrapped in non-woven geotextile such as Nilex 4510 or an approved equivalent by the geotechnical engineer.

7.7 Construction Monitoring

The recommendations presented in this report assume that Tetra Tech will be retained to provide field review during construction, to confirm that soil conditions encountered are consistent with our design assumptions, and work is carried out in general accordance with the intent of our recommendations.

Full-time monitoring by experienced geotechnical/materials personnel will be required to ensure footing base is comprised of clean, free draining material and to monitor the compaction of all granular materials placed with in situ density testing. The gradation of all materials used in construction must be tested and approved by the geotechnical engineer prior to construction.

8.0 PHASE 3 GEOTECHNICAL ASSESSMENT

8.1 General

Based on our understanding of the proposed development and the observed site geology, Tetra Tech considers that from a geotechnical perspective, the land is suitable for the use intended, subject to the conditions and recommendations presented in this report.

8.2 Site Preparation and Material Reuse

A geotechnical consideration in site preparation for this phase of the development is the risk of expansive soils. Expansive clay soils undergo volume changes upon wetting and/or drying. Swelling, or an increase in volume, occurs when the moisture content of an unsaturated expansive soil increases. Conversely, shrinking and an associated decrease in volume occurs when the moisture content decreases. Change in moisture content could happen naturally with seasonal fluctuations in water content, presence of interbedded sand lenses or because of constructing buildings that may block the natural evaporation pathways within the upper portion of the ground. Unless there is sufficient weight to restrain the swelling pressure, the soil can expand in volume and heave the building.

The area where swelling soils may regularly change in volume with periodic changes in moisture is defined as the “Active Zone”. Based on laboratory test results and observed soil conditions on the site, the active zone is estimated, on average, to be potentially more than 2.4 m below ground surface and the moisture content at which no swelling would occur is estimated to be approximately 45%. Any proposed structure would be required to be founded on materials below this active zone and at moisture contents higher than the above. Swelling potential was analyzed based on empirical correlations from soil index properties (Kayabali, 2014) obtained from Atterberg Limits tests.

Within the footprint of all buildings and roadways it is recommended that all topsoil, as well as any soft silt, partially desiccated or desiccated clay layers, be stripped to expose dense till deposits, stiff clay deposits, or other suitable

subgrade. Based on encountered site conditions, approximate depth of site stripping is anticipated to vary between approximately 0.5 to 1.2 m.

The extent of removal for overburden layers will depend upon the preferred foundation depth and structure type. As such, despite removal of all deleterious materials, additional sub-excavation may be required to reach required grade elevation. It is very likely that excavation for buildings will need to go at least minimum 2.0 – 2.5 m in depth due to expansive soil issues. More information can be provided regarding building foundation preparation once a detailed site plan is available. Excavation should, as a general rule for planning, extend horizontally beyond the building footings for a distance of at least 1H:1V in every direction. The requirements and extent of sub-excavation must be confirmed and deemed competent on the site by Tetra Tech personnel during the site preparation.

Following site stripping, the following recommendations must be followed:

- The geotechnical engineer or their representative must review the exposed subgrade after site grading.
- Where clay is the exposed subgrade, the excavated base must be protected from further drying or wetting to avoid any desiccation or heaving of the expansive materials. The moisture change in the soil may cause the soil to swell and heave over time. Care should also be taken to restrict equipment movement on native clay so as to avoid subgrade rutting/pumping and strength loss. If excavated base is noted to be excessively moist or desiccated, further sub-excavation will be required to minimize heave potential. A geotechnical engineer must inspect the excavated clay base prior to compaction to determine if sub-excavation is required.
- Where clay is encountered, excavated base should be compacted using a sheep-foot roller to a minimum 98% Standard Proctor Maximum Dry Density (SPMDD).
- On till or sand and gravel subgrade, compaction of the excavated base should be performed using a smooth drum vibratory roller to achieve 100% Standard Proctor Maximum Dry Density (SPMDD).
- In areas where sub-excavation is required, backfilling must be carried out with approved structural fill material with less than 8% fines content, compacted to 100% SPMDD or tested through proof-rolling.

It is important to note that the silt and clay materials found on-site are not considered suitable for reuse as structural fill. However, native sand and gravel materials can be utilized as general backfill.

8.3 Excavations and Backfill

8.3.1 Permanent Cut and Fill Soil Slopes

Tetra Tech recommends that permanent cut and fill slopes in soils not be graded steeper than a 2H:1V (horizontal: vertical). Permanent fill slopes shall be over-built and then trimmed back to the recommended inclination before recompacting the slope. Permanent slopes shall be vegetated with native grasses and pocket planted shrubs immediately after construction to prevent surface erosion.

8.3.2 Temporary Excavation

Based on the soil conditions encountered in the testpits within the project area, Tetra Tech recommends a maximum temporary soil cut slope angle of 1H:1V (horizontal: vertical) up to a maximum height of 1.2 m. Shallower soil cuts may be required depending on the excavation height.

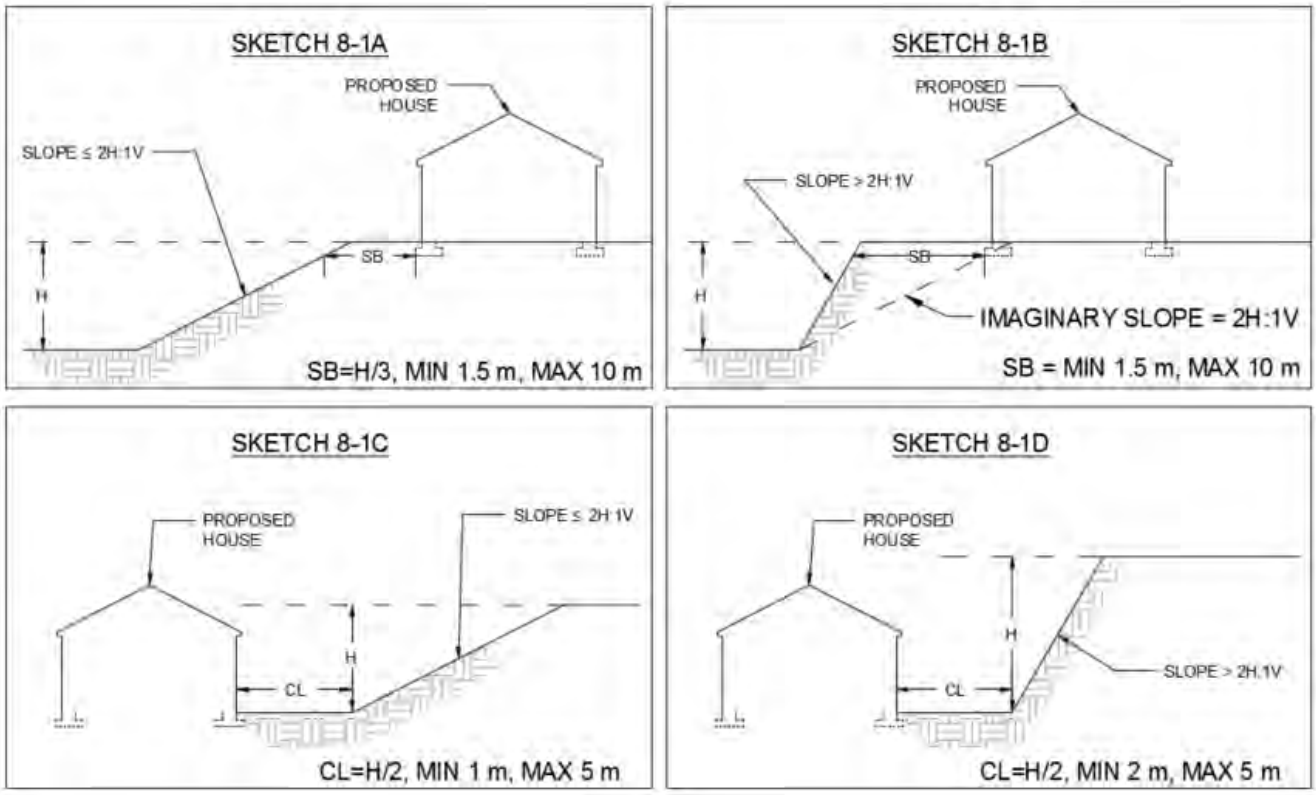
Temporary excavation work should be carried out in accordance with the requirements specified by WorkSafe BC Occupational Health & Safety Regulation, Part 20. Flatter excavations may be required if soil sloughing,

groundwater seepage, or loose soils are encountered. A geotechnical engineer shall review any excavation greater than 1.2 m.

8.3.3 Slope Set-Back and Clearance

General set-back and clearance recommendations for permanent soils slope angles for preliminary planning purposes are shown graphically in Sketch 8-1 below and include:

- Where a soil slope below a property is equal to or shallower than 2H:1V, the set-back distance between the outer edge of the foundation and the soil slope should be at least the height of the slope divided by 3 (see Sketch 8-1A) but no less than 1.5 m with no need to be greater than 10 m.
- Where a soil slope below a property is steeper than 2H:1V, the set-back should be such that an imaginary line between the outer edge of the foundation and the toe of the slope has an angle of 2H:1V or less (see Sketch 8-1B). In addition, the set-back distance between the outer edge of the foundation and the soil slope should be no less than 1.5 m horizontally from the face of the slope with no need to be greater than 10 m.
- Where a soil slope above a property is equal to or shallower than 2H:1V, the clearance from the edge of the house to the toe of the slope should be equal to the height of the slope divided by 2 (see Sketch 8-1C) but clearance should not be less than 1 m with no need to be greater than 5 m.
- Where a soil slope above a property is steeper than 2H:1V, the clearance from the edge of the house to the toe of the slope should be equal to the height of the slope divided by 2 (see Sketch 8-1D) but no less than 1 m with no need to be greater than 5 m.
- Other set-back and clearance distances for soil slopes may be possible but will require approval from a geotechnical engineer.
- If there are soil slopes above or below a property that are shallower than 3H:1V, then there are no set-back or clearance recommendations and construction elements can extent right to the toe or crest of slopes.



Sketch 8-1: Illustration Showing Set-back and Clearance Distance for Soil Slopes

8.4 Drainage and Permeability

Based on the Engineering Development Servicing Report from the City of Vernon on 10/05/2022, there are no storm sewer mains that exist in the area. Hydraulic conductivity (*k*) of the native clay or silt soils has been preliminarily estimated to range between 10^{-10} m/s to10^{-8} m/s. Hydraulic conductivity (*k*) of the native sand and gravel till soils has been preliminarily estimated to range between 10^{-8} m/s to10^{-6} m/s. A factor of safety of 2 should be applied to the lower bound of the hydraulic conductivity estimated above to allow for siltation of the infiltration system.

Tetra Tech recommends that prior to detailed design, the preliminary hydraulic conductivity rates be confirmed in the field in accordance with ASTM D3385-18 “Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer” or another approved method.

Tetra Tech recommends that the site is graded with a gradient of at least 1-2% along the preferred direction and away from buildings. Tetra Tech also recommends that a perimeter foundation drainage system be designed around the proposed structures. The perimeter foundation drainage system should be constructed with rigid perforated PVC piping with a minimum diameter of 100 mm surrounded by a minimum 300 mm of clear drain rock. The drain rock should be wrapped in non-woven geotextile such as Nilex 4510 or an approved equivalent by the geotechnical engineer.

8.5 Pavement Design

Following the site preparation, the subgrade preparation should include:

- Excavated subgrade should be compacted using a smooth drum roller on till or sand and gravel soils to minimum of 100% SPMDD or proof-roll tested. Clay and silt soils should be compacted using a sheep-foot roller to a minimum 98% Standard Proctor Maximum Dry Density (SPMDD).
- Where soft or weak layers exist (such as soft clay), place a layer of granular pit run with fines content less than 12% compacted to 100% SPMDD and 2% of optimum moisture content.
- Failing areas should be remediated and retested following appropriate replacement treatment to confirm subgrade stability.
- Water pooling and/or excessive rutting from trucks should be avoided to prevent subgrade degradation and loss of strength.

Given the above subgrade preparation is undertaken, an in situ CBR of 8% can be assumed for pavement design for a design life of 15 years. Table 8-1 below presents the minimum thicknesses for the pavement section for residential roads within the proposed development.

Table 8-1: Recommended Pavement Section for Residential Roads

Structural Component	Recommended Minimum Thickness
Asphalt	75 mm
Crushed Gravel Base Course	100 mm
Gravel Sub-base Course	200 mm

Sub-base and base materials should be compacted to a minimum of 100% SPMDD, respectively, and within 2% of optimum moisture content. We recommend that the actual compaction of all granular materials placed should be confirmed with in situ density testing.

Good drainage provisions will optimize pavement performance. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum grade of two percent) to provide effective surface drainage towards a ditch and/or catch-basins. Surface water should not be allowed to pond adjacent to the outside edges of pavement areas.

8.6 Construction Monitoring

The recommendations presented in this report assume that Tetra Tech will be retained to provide field review during construction, to confirm that soil conditions encountered are consistent with our design assumptions, and work is carried out in general accordance with the intent of our recommendations.

Full-time monitoring by experienced geotechnical/materials personnel will be required to ensure footing base is comprised of clean, free draining material and to monitor the compaction of all granular materials placed with in situ density testing. The gradation of all materials used in construction must be tested and approved by the geotechnical engineer prior to construction.

9.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Kerr Wood Leidal and their agents. Tetra Tech Canada Inc. (operating as 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 Kerr Wood Leidal, 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 D or Contractual Terms and Conditions executed by both parties.

10.0 CLOSURE

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

Respectfully Submitted,
Tetra Tech Canada Inc.

Prepared by:
Chris Stuart, EIT
Geotechnical Engineer
Direct Line: 250.309.3652
chris.stuart@tetratech.com

Prepared by:
Murray Gaffney, EIT
Project Engineer
Direct Line: 778.940.1213
murray.gaffney@tetratech.com

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA G. MARTINEZ #29412
JUNE 6, 2023

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
PERMIT NUMBER: 1001972

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA S. W. GREENE # 50076
June 6, 2023

Reviewed by:
German Martinez, P.Eng.
Senior Geotechnical Engineer
Direct Line: 778.940.1224
german.Martinez@tetratech.com

/sa

Hillside Study and Geohazard Sections

Reviewed by:
Shane Greene, P.Eng.
Geotechnical Engineer
Direct Line: 778.940.1205
shane.greene@tetratech.com

REFERENCES

BCBC, 2018. British Columbia Building Code, Office of Housing and Construction Services, Province of British Columbia and National Research Council.

Burt G. Look, 2007. Handbook of Geotechnical Investigation and Design Tables 2007. 356 p.

Climate Atlas (2023). https://climateatlas.ca/map/canada/fdd_baseline#z=7&lat=51.51&lng=-117.03&city=377. Climate Atlas of Canada. Accessed May 19, 2023.

CFME, 2006. Canadian Foundation Engineering Manual; 4th edition. Canadian Geotechnical Society. 488 p.

Evans, S. and O. Hungr. 1993. The Assessment of Rockfall Hazard at the Base of Talus Slopes. Canadian Geotechnical Journal, 1995, Vol 30, Issue 4: 620-636.

Fulton, R.J. 1963-65. Surficial Geology, Vernon, British Columbia map 1392A. Geological Survey of Canada. Scale 1:126,720.

Kayabali, 2014. Estimation of Swelling Pressure using Simple Soil Indices, Bulletin of the Mineral Research and Exploration. Kamil Kayabali and Ozgur Yaldiz, University of Ankara.

Vijayvergiya, V.N., O.I. Ghazzaly, 1973. Prediction of swelling potential for natural clays, Proceedings of the 3rd International Conference on Expansive Soils, Vol 1, pp. 227 – 236.

Western Water Associates, 2021. FINAL 8730 Okanagan Landing Road Rezoning Environmental Impact Assessment. October 1, 2021.

FIGURE

LEGEND

- Approximate Testpit Location
- Approximate Location of Mapped Watercourse (WWA 2021)
- City Covenant Area
- Approximate Location of Subdivision of Two Lots from the Existing Lot (Phase 1)
- Approximate Location of Proposed House (Phase 2)
- Approximate Property Boundary

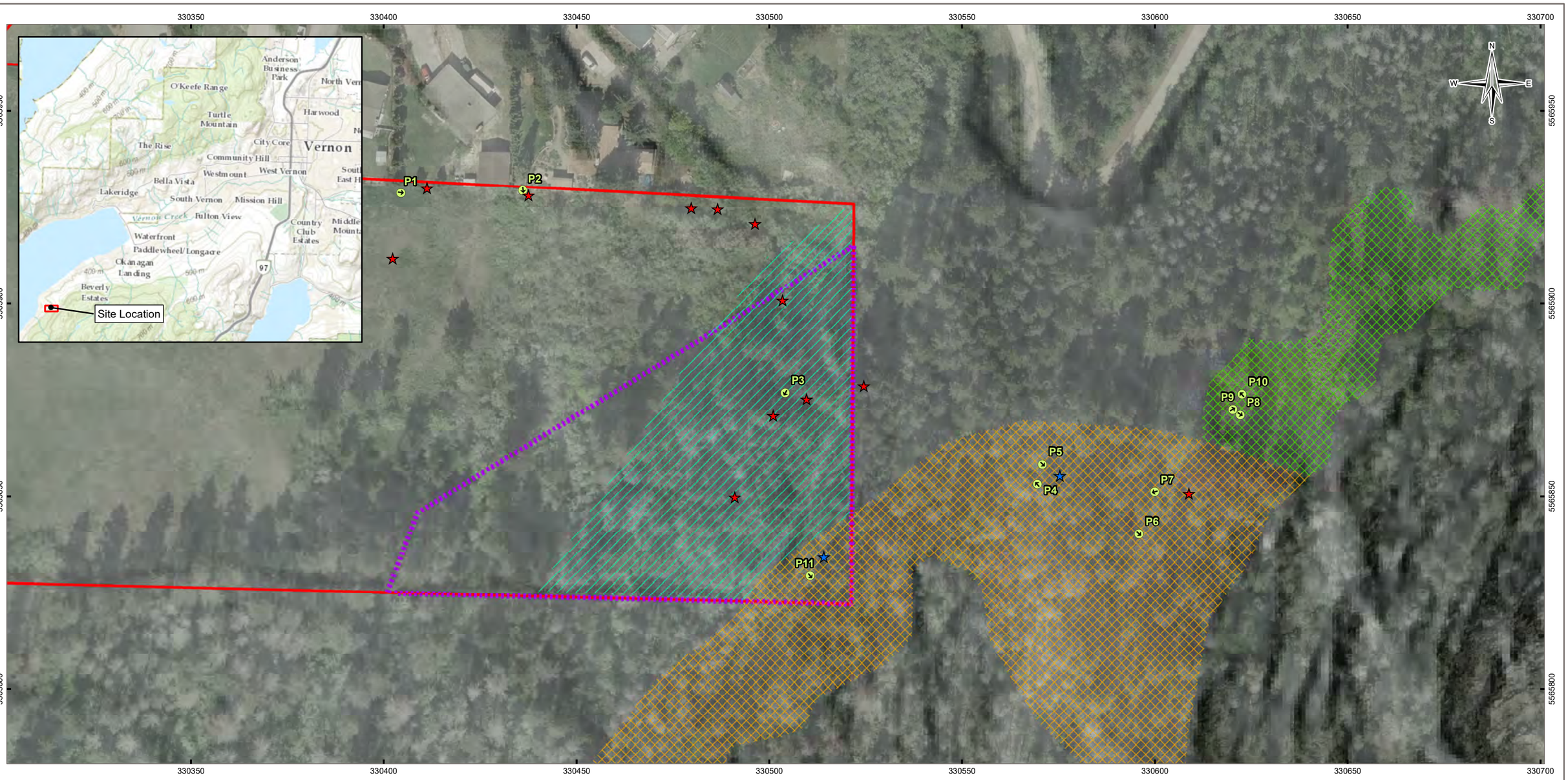
NOTES
Base data source:
- Imagery provided by City of Vernon 2016
- Site Plan overlay provided by client
- Inset Map sourced from ESRI Topographic Basemap Services

STATUS
ISSUED FOR USE

8730 OKANAGAN LANDING ROAD, VERNON
GEOTECHNICAL SERVICES

Testpit Location Plan

PROJECTION UTM ZONE 11	**DATUM** NAD83	**CLIENT** Kerr Wood Leidal	
Scale: 1:1,500 — 25 12.5 0 25 Metres			
FILE NO. KGEO03853-01 Figure 1.mxd		TETRA TECH	
OFFICE Kelowna	**DWN** MG / **CKD** SL / **APVD** GM / **REV** 0		**Figure 1**
DATE June 5, 2023	**PROJECT NO.** ENG.KGEO03853-01		



LEGEND

- Report Photo Location
- Approximate Noted Location of Large Boulders or Cobbles
- Approximate Noted Location of Pistol Butt Tree Trunk
- City Covenant Area
- Proposed Geotechnical Covenant Area
- Approximate Area of Tree Covered and Moss Covered Rock / Talus Area
- Approximate Area of Exposed Rock / Talus
- Approximate Property Boundary

NOTES

Base data source:
- Imagery provided by City of Vernon 2016
- Inset Map sourced from ESRI Topographic Basemap Services
- Hillshade sourced from LiDAR BC - Open LiDAR Data Portal (LiDAR Date is 2018)

STATUS
ISSUED FOR USE

8730 OKANAGAN LANDING ROAD, VERNON GEOTECHNICAL SERVICES

Hillside Study Photo Location and Notes

PROJECTION	DATUM	CLIENT
UTM ZONE 11	NAD83	Kerr Wood Leidal

Scale: 1:1,000
20 10 0 20
Metres

TETRA TECH

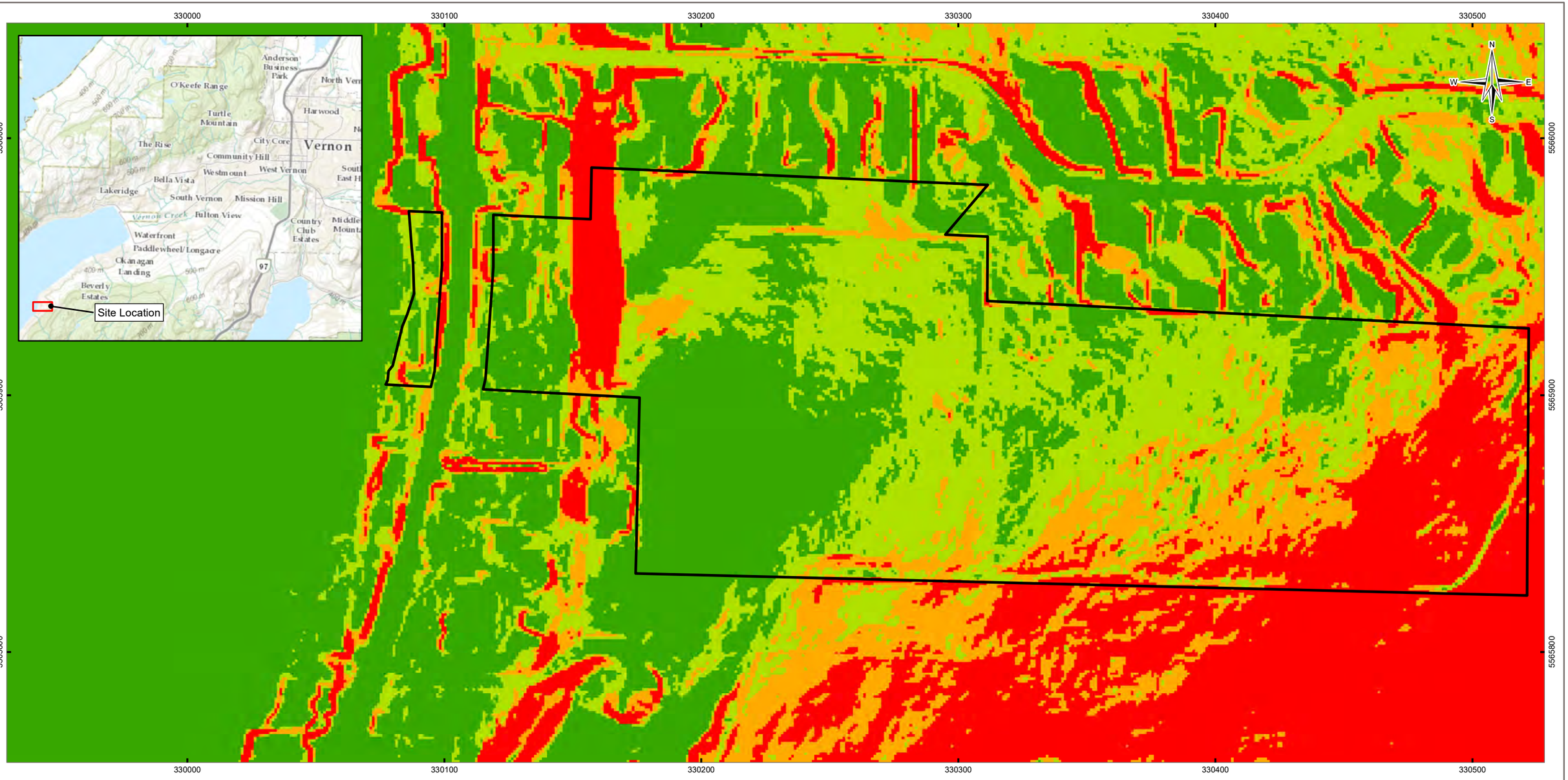
FILE NO. KGEO03853-01 Figure 2 .mxd

OFFICE	DWN	CKD	APVD	REV
Kelowna	MG	SL	SG	0

DATE	PROJECT NO.
June 5, 2023	ENG.KGEO03853-01

Figure 2

C:\Users\murray.gaffney\Desktop\KGEO03853-01 8730 Okanagan Landing Road\Maps\KGEO03853-01 Figure 2 .mxd modified 6/5/2023 by murray.gaffney



LEGEND

- Approximate Property Boundary

Slope Analysis (Percent)

- 0 - 12
- 12 - 20
- 20 - 30
- 30 - 90

NOTES

Base data source:
- Slope analysis completed using Lidar data from LiDARBC - Open LiDAR Data Portal (LiDAR Date 2018)
- Inset Map sourced from ESRI Topographic Basemap Services

STATUS
ISSUED FOR USE

8730 OKANAGAN LANDING ROAD, VERNON GEOTECHNICAL SERVICES

Slope Analysis (Percent)

PROJECTION UTM ZONE 11	**DATUM** NAD83	**CLIENT** Kerr Wood Leidal
Scale: 1:1,500 — 25 12.5 0 25 Metres		TETRA TECH
FILE NO. KGEO03853-01 Figure 3.mxd		
OFFICE Kelowna	**DWN** MG / **CKD** SL / **APVD** GM / **REV** 0	**Figure 3**
DATE June 5, 2023	**PROJECT NO.** ENG.KGEO03853-01	

C:\Users\murray.gaffney\Desktop\KGEO03853-01 8730 Okanagan Landing Road\Maps\KGEO03853-01 Figure 3.mxd modified 6/5/2023 by murray.gaffney

PHOTOGRAPHS

Photo 1: Looking east at a boulder that was moved during the testpit investigation. The landowner said that this boulder was moved during construction of the houses to the left of this photo. (April 28, 2023).

Photo 2: Looking south at a boulder located on the property. (April 28, 2023).

Photo 3: Looking south towards a boulder that was observed on the property. (April 28, 2023).

Photo 4: Looking NW down towards a moss-covered area of rock and talus. The slope in this photo is between 30-40 degrees. Photo taken from Truman Dagnus Locheed Park. (April 28, 2023).

Photo 5: Looking east up towards a rock and talus slope. A tree butt was noted in this location. Photo taken from Truman Dagnus Locheed Park. (April 28, 2023).

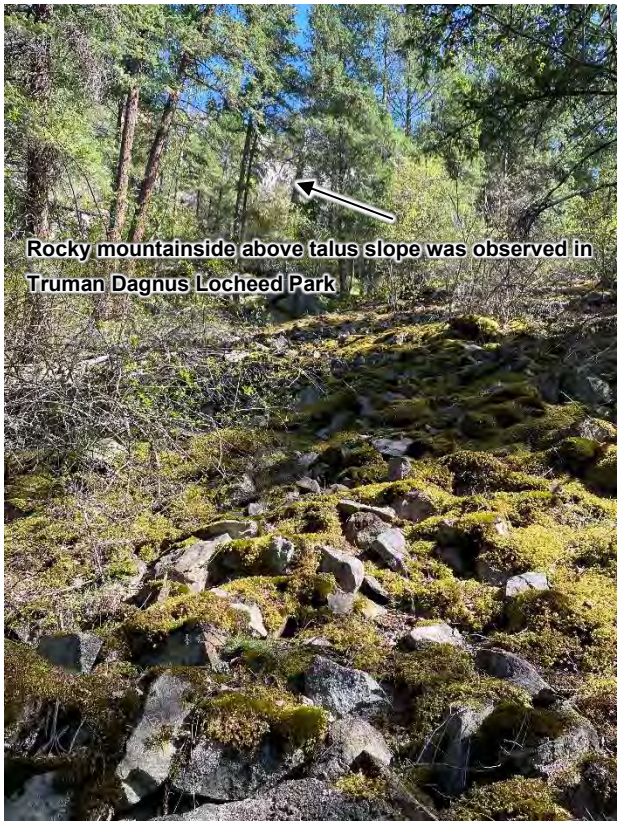


Photo 6: Looking east up at a moss-covered rock/talus slope and at a rocky mountainside above the slope. The slope in this photo is between approximately 30-40 degrees. Photo taken from Truman Dagnus Locheed Park. (April 28, 2023).

Photo 7: Looking SW at a moss-covered rock/talus slope. iPad used as a reference. The slope in this photo ranges between approximately 30-40 degrees. Photo taken from Truman Dagnus Locheed Park. (April 28, 2023).

Photo 8: Looking east up at an area of exposed rock and talus, as well as the rocky mountainside that was observed above the slope. Photo taken from Truman Dagnus Locheed Park. (April 28, 2023).

Photo 9: Looking north across at an area of exposed rock/talus. Photo taken from Truman Dagnus Locheed Park. (April 28, 2023).

Photo 10: Looking west down at an area of exposed rock/talus. Photo taken from Truman Dagnus Locheed Park. (April 28, 2023).

Photo 11: Looking SE up at an area of vegetated and moss-covered rock/talus. This area was densely vegetated which made further observation difficult - however from orthophotos and hill shade it appears that there are likely rock outcrops above this talus slope. (April 28, 2023).

APPENDIX A

SUPPLIED INFORMATION

APPENDIX B

TESTPIT LOGS

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-01**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 347 m
Vernon, BC	UTM: 330124 E; 5565958 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	SCALA PENETROMETER: Blow Per 50 mm Penetration	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0											3 6 9 12	Post-Peak ◇ Peak 10 20 30 40; Plastic Limit Moisture Content Liquid Limit 20 40 60 80	347
	Testpitting		SILT AND SAND (TOPSOIL), some gravel, brown, damp, loose, brown; rootlets throughout										
			GRAVEL, sandy, some silt (TILL), occasional cobbles and boulders to 400 mm, damp to moist, dense, grey/green, fine to coarse sand and gravel, subrounded gravel			DS1							
1													346
						DS2							
2													345
			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours										
3													344
4													343

TETRA TECH

Contractor: Private	Completion Depth: 2.7 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed by: MG	Page 1 of 1

TP23-01

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-02**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 349 m
Vernon, BC	UTM: 330146 E; 5565934 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Field Vane (kPa) / Plastic Limit / Moisture Content / Liquid Limit	Elevation (m)
0											Post-Peak ◇ Peak; 10 20 30 40; Plastic Limit / Moisture Content / Liquid Limit; 20 40 60 80	349
	Testpitting		SILT AND SAND (TOPSOIL), some gravel, brown, damp, loose, brown; rootlets throughout									
			GRAVEL, sandy, some silt (TILL), occasional cobbles, damp to moist, dense, grey/green, fine to coarse sand and gravel, subrounded gravel									
1												348
						DS1	54	31		15	●	
			END OF TESTPIT - Refusal on very dense till - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours									
2												347
3												346
4												345

TETRA TECH

Contractor: Private	Completion Depth: 1.7 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed by: MG	Page 1 of 1

TP23-02

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-03**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 349 m
Vernon, BC	UTM: 330146 E; 5565914 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Clay (%)	SCALA PENETROMETER: Blow Per 50 mm Penetration	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0											3 6 9 12	Post-Peak Peak 10 20 30 40; Plastic Limit Moisture Content Liquid Limit 20 40 60 80	349
	Testpitting		SILT AND SAND (TOPSOIL), some gravel, brown, damp, loose, brown; rootlets throughout										
			GRAVEL, sandy, some silt (TILL), occasional cobbles and boulders to 500 mm, damp to moist, compact, grey/green, fine to coarse sand and gravel, subrounded gravel			DS1							
1			- becomes dense @ 1.1 m										348
			END OF TESTPIT - Refusal on very dense till - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours										
2													347
3													346
4													345

TETRA TECH

Contractor: Private	Completion Depth: 1.9 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed by: MG	Page 1 of 1

TP23-03

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-04**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 361 m
Vernon, BC	UTM: 330182 E; 5565966 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Laboratory USCS	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Elevation (m)
0	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown									361
			CLAY, moist, firm, medium to high plastic, brown				DS1					
1												360
			-becomes stiff at 1.3 m		CH		DS2					
							DS3					
2												359
							DS4					
					CI		DS5					
3			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours									358
4												357

SCALA PENETROMETER: Blow Per 50 mm Penetration (3, 6, 9, 12)

Field Vane (kPa): Post-Peak, Peak (10, 20, 30, 40)

Plastic Limit, Moisture Content, Liquid Limit (20, 40, 60, 80)

TETRA TECH

Contractor: Private	Completion Depth: 3 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed by: MG	Page 1 of 1

TP23-04

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-05**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 359 m
Vernon, BC	UTM: 330162 E; 5565967 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Field Vane (kPa) Post-Peak / Peak; Plastic Limit / Moisture Content / Liquid Limit	Elevation (m)
0											Field Vane (kPa) Post-Peak ◇ Peak ◆ 10 20 30 40; Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	359
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown									
			CLAY, damp to moist, firm to stiff, high plastic, light grey/brown									
						DS1						
1												358
						DS2						
			- becomes brown, moist @ 1.9 m									
2						DS3						357
						DS4						
3			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours									356
4												355

TETRA TECH

Contractor: Private	Completion Depth: 3 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed by: KG	Page 1 of 1

TP23-05

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-06**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 360 m
Vernon, BC	UTM: 330181 E; 5565936 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Laboratory USCS	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Clay (%)	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0													360
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown										
			CLAY, moist, firm to stiff, medium to high plastic, brown				DS1						
1					CI-CH		DS2						359
							DS3						
2							DS4						358
							DS5						
3							DS6						357
			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours										
4													356

Field Vane (kPa): Post-Peak ◇ / Peak ◆ — 10 20 30 40

Plastic Limit / Moisture Content / Liquid Limit — 20 40 60 80

TETRA TECH

Contractor: Private	Completion Depth: 3.2 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed by: KG	Page 1 of 1

TP23-06

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-07**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 354 m
Vernon, BC	UTM: 330186 E; 5565868 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Laboratory USCS	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	SCALA PENETROMETER: Blow Per 50 mm Penetration	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0												3 6 9 12	Post-Peak / Peak 10 20 30 40; 20 40 60 80	354
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown											
			SILT and SAND, some clay, damp, firm, non-plastic to low plastic, grey/brown				DS1							
1			CLAY, dry to damp, stiff to very stiff, medium plastic, light grey/brown		CI		DS2							353
			- lens of grey/orange silty sand											
			CLAY, damp to moist, stiff to very stiff, medium to high plastic, grey/brown				DS3							
2														352
							DS4							
			END OF TESTPIT - Refusal on hard clay - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours											
3														351
4														350

TETRA TECH

Contractor: Private	Completion Depth: 2.6 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed by: AG	Page 1 of 1

TP23-07

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-08**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 356 m
Vernon, BC	UTM: 330230 E; 5565837 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Field Vane (kPa) Post-Peak / Peak; Plastic Limit / Moisture Content / Liquid Limit	Elevation (m)
0											Field Vane (kPa) Post-Peak ◇ Peak ◆ 10 20 30 40; Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	356
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown									
			SAND and SILT, trace to some gravel, trace clay, damp, compact, fine to coarse sand and gravel, subrounded gravel			DS1						
1			CLAY, damp to moist, stiff, high plastic, grey/brown									355
			SAND and GRAVEL, some silt (TILL), occasional boulders to 600 mm, damp, dense to very dense, fine to coarse sand and gravel, subangular to subrounded gravel, grey/green sand, orange gravel			DS2						
2												354
			END OF TESTPIT - Refusal on very dense till - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours									
3												353
4												352

TETRA TECH

Contractor: Private	Completion Depth: 2.2 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed by: KG	Page 1 of 1

TP23-08

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-09**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 366 m
Vernon, BC	UTM: 330262 E; 5565971 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	SCALA PENETROMETER: Blow Per 50 mm Penetration	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0											3 6 9 12	Post-Peak 10 20 30 40 Peak; Plastic Limit 20 Moisture Content 40 60 Liquid Limit 80	366
			SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout										
			SILT, some sand, some clay, moist, firm, low plastic, brown, rootlets			DS1							
1													365
	Testpitting		CLAY, moist, stiff, high plastic, brown			DS2							
2													364
						DS3							
			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours										
3													363
4													362

TETRA TECH

Contractor: Private	Completion Depth: 2.8 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed by: AG	Page 1 of 1

TP23-09

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-10**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 362 m
Vernon, BC	UTM: 330274 E; 5565910 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0											Post-Peak ◇ Peak; 10 20 30 40; Plastic Limit, Moisture Content, Liquid Limit; 20 40 60 80	362
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout									
			SAND and SILT, some clay, moist, loose to complact, brown, fine to coarse sand			DS1						
1												361
			CLAY, silty, trace sand, moist, stiff, high plastic, brown			DS2						
2												360
						DS3	0	9	51	40		
			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours									
3												359
4												358

TETRA TECH

Contractor: Private	Completion Depth: 2.8 m
Equipment Type: Kubota U48-S	Start Date: April 28, 2023
Logged By: CS	Completion Date: April 28, 2023
Reviewed By: MC	Page 1 of 1

TP23-10

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-11**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 363 m
Vernon, BC	UTM: 330294 E; 5565873 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	SCALA PENETROMETER: Blow Per 50 mm Penetration	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0											3 6 9 12	Post-Peak Peak 10 20 30 40; Plastic Limit Moisture Content Liquid Limit 20 40 60 80	363
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown										
			CLAY, moist, stiff, high plastic, brown			DS1							
1													362
			SAND and GRAVEL, some silt (TILL), damp, dense, green/grey, fine to coarse sand and gravel, subrounded gravel			DS2							
2													361
			END OF TESTPIT - Refusal on very dense till - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours										
3													360
4													359

TETRA TECH

Contractor: Private	Completion Depth: 2.3 m
Equipment Type: Kubota U48-S	Start Date: April 28, 2023
Logged By: CS	Completion Date: April 28, 2023
Reviewed By: MC	Page 1 of 1

TP23-11

Testpit No: **TP23-12**

Kerr Wood Leidal Associates Ltd

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 371 m
Vernon, BC	UTM: 330339 E; 5565925 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Laboratory USCS	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%)	Silt (%)	Clay (%)	Field Vane (kPa) Post-Peak / Peak; Plastic Limit / Moisture Content / Liquid Limit	Elevation (m)
0														371
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout											
			CLAY, moist, stiff, medium to high plastic, brown				DS1							
1														370
							DS2							
2														369
					CI-CH		DS3							
3			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours											368
4														367

Field Vane (kPa): Post-Peak ◇ / Peak ◆ — 10 20 30 40

Plastic Limit / Moisture Content / Liquid Limit — 20 40 60 80

TETRA TECH

Contractor: Private	Completion Depth: 2.9 m
Equipment Type: Kubota U48-S	Start Date: April 28, 2023
Logged By: CS	Completion Date: April 28, 2023
Reviewed By: MC	Page 1 of 1

TP23-12

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-13**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 370 m
Vernon, BC	UTM: 330353 E; 5565880 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	SCALA PENETROMETER: Blow Per 50 mm Penetration	Field Vane (kPa): Post-Peak / Peak	Plastic Limit / Moisture Content / Liquid Limit	Elevation (m)
0											3 6 9 12	10 20 30 40	20 40 60 80	370
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown, rootlets throughout											
			SAND and SILT, some clay, damp, loose, brown, fine to coarse sand											
			SAND and GRAVEL, some silt, some clay (TILL), damp, compact to dense, grey/green			DS1								
1														369
2						DS2								368
			END OF TESTPIT - Refusal on very dense till - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours											
3														367
4														366

TETRA TECH

Contractor: Private	Completion Depth: 2.4 m
Equipment Type: Kubota U48-S	Start Date: April 28, 2023
Logged By: CS	Completion Date: April 28, 2023
Reviewed By: MC	Page 1 of 1

TP23-13

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-14**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 373 m
Vernon, BC	UTM: 330345 E; 5565840 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Field Vane (kPa) Post-Peak / Peak; Plastic Limit / Moisture Content / Liquid Limit	Elevation (m)
0											Field Vane (kPa) Post-Peak ◇ Peak ◆ 10 20 30 40; Plastic Limit Moisture Content Liquid Limit 20 40 60 80	373
			SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout									
			SAND and SILT, trace to some gravel, damp, dense, brown, fine to coarse sand, fine gravel			DS1						
1	Testpitting		SAND and GRAVEL, some silt (TILL), occasional boulders to 400 mm, damp, dense, green/grey, fine to coarse sand and gravel, subangular to subrounded gravel			DS2						372
2												371
			END OF TESTPIT - Refusal on very dense till - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours									
3												370
4												369

TETRA TECH

Contractor: Private	Completion Depth: 2.4 m
Equipment Type: Kubota U48-S	Start Date: April 28, 2023
Logged By: CS	Completion Date: April 28, 2023
Reviewed By: MC	Page 1 of 1

TP23-14

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-15**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 378 m
Vernon, BC	UTM: 330409 E; 5565922 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Laboratory USCS	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Elevation (m)
0	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown									378
			SILT, moist, stiff, low plastic, grey/brown		ML		DS1					
1												377
			CLAY, moist, stiff, high plastic, grey/brown				DS2					
2												376
					CH		DS3					
3			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours									375
4												374

SCALA PENETROMETER: Blow Per 50 mm Penetration (3, 6, 9, 12)

Field Vane (kPa): Post-Peak / Peak (10, 20, 30, 40)

Plastic Limit / Moisture Content / Liquid Limit (20, 40, 60, 80)

TETRA TECH

Contractor: Private	Completion Depth: 2.9 m
Equipment Type: Kubota U48-S	Start Date: April 28, 2023
Logged By: CS	Completion Date: April 28, 2023
Reviewed By: MC	Page 1 of 1

TP23-15

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-16**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 382 m
Vernon, BC	UTM: 330438 E; 5565902 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	SCALA PENETROMETER: Blow Per 50 mm Penetration	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0											3 6 9 12	Post-Peak ◇ Peak 10 20 30 40; Plastic Limit Moisture Content Liquid Limit 20 40 60 80	382
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout										
			CLAY, trace to some gravel, occasional boulders to 400 mm, damp to moist, stiff, high plastic, grey, fine to coarse subrounded gravel			DS1							
1													381
						DS2							
2													380
			END OF TESTPIT - Refusal on hard clay and gravel - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours										
3													379
4													378

TETRA TECH

Contractor: Private	Completion Depth: 2.4 m
Equipment Type: Kubota U48-S	Start Date: April 28, 2023
Logged By: CS	Completion Date: April 28, 2023
Reviewed By: MG	Page 1 of 1

TP23-16

Testpit No: **TP23-17**

Kerr Wood Leidal Associates Ltd

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 385 m
Vernon, BC	UTM: 330419 E; 5565855 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0											Post-Peak 10 20 30 40 Peak; Plastic Limit 20 40 60 80 Liquid Limit	385
			SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout									
			GRAVEL and SAND, trace to some silt, some cobbles, some boulders to 800 mm, dry to damp, compact, brown, fine to coarse sand and gravel, subangular to subrounded gravel			DS1						
1												384
	Testpitting		CLAY, gravelly, occasional cobbles, damp, stiff, high plastic, grey			DS2						
2												383
			SAND, gravelly, silty (TILL), damp, dense, grey/green, sine to coarse sand and gravel, subrounded gravel			DS3	31	42	27		●	
3												382
			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours									
4												381

Contractor: Private	Completion Depth: 3 m
Equipment Type: Kubota U48-S	Start Date: April 28, 2023
Logged By: CS	Completion Date: April 28, 2023
Reviewed By: MC	Page 1 of 1

TETRA TECH

TP23-17

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-18**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 386 m
Vernon, BC	UTM: 330477 E; 5565926 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Laboratory USCS	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0												Post-Peak / Peak: 10 20 30 40; Plastic Limit / Moisture Content / Liquid Limit: 20 40 60 80	386
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout										
			SAND, gravelly, silty, damp, compact, brown, fine to coarse sand and gravel, subangular gravel				DS1						
1			SILT, clayey, some gravel to gravelly, occasional boulders to 800 mm, damp, stiff, high plastic, grey, fine to carse subangular gravel		MH		DS2						385
2													384
			SAND and GRAVEL, some silt (TILL), damp, dense, grey/green, fine to coarse sand and gravel, subrounded gravel				DS3						
3			END OF TESTPIT - Refusal on very dense till - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours										383
4													382

TETRA TECH

Contractor: Private	Completion Depth: 2.8 m
Equipment Type: Kubota U48-S	Start Date: April 28, 2023
Logged By: CS	Completion Date: April 28, 2023
Reviewed By: MC	Page 1 of 1

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-19**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 357 m
Vernon, BC	UTM: 330238 E; 5565881 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	SCALA PENETROMETER: Blow Per 50 mm Penetration	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0											3 6 9 12	Post-Peak ◇ Peak 10 20 30 40; Plastic Limit / Moisture Content / Liquid Limit 20 40 60 80	357
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout										
			SILT and SAND, some clay, moist, firm, non-plastic to low plastic, light brown			DS1							
1													356
			SAND and GRAVEL, some sitl (TILL), damp, very dense, grey sand, grey and orange gravel, fine to coarse sand and gravel, subangular to subrounded gravel			DS2							
			END OF TESTPIT - Refusal on very dense till - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours										
2													355
3													354
4													353

TETRA TECH

Contractor: Private	Completion Depth: 1.6 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed By: MG	Page 1 of 1

TP23-19

Testpit No: **TP23-20**

Kerr Wood Leidal Associates Ltd

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 360 m
Vernon, BC	UTM: 330242 E; 5565937 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0											Post-Peak / Peak; 10 20 30 40; Plastic Limit / Moisture Content / Liquid Limit; 20 40 60 80	360
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout									
			SILT, some sand, trace clay, damp, loose, brown, fine to coarse sand									
1					DS1		0	15	85			359
			CLAY, damp to moist, stiff to very stiff, high plastic, brown		DS2							
					DS3							
2												358
					DS4							
			- lens of fine, light grey sand from 2.6 - 2.7 m									
3												357
			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours									
4												356

TETRA TECH

Contractor: Private	Completion Depth: 3 m
Equipment Type: Kubota U48-S	Start Date: April 27, 2023
Logged By: CS	Completion Date: April 27, 2023
Reviewed By: MC	Page 1 of 1

TP23-20

Kerr Wood Leidal Associates Ltd

Testpit No: **TP23-21**

Project: 8730 Okanagan Landing Road	Project No: 704-ENG.KGEO03853-01
Location: 8730 Okanagan Landing Road	Ground Elev: 377 m
Vernon, BC	UTM: 330400 E; 5565888 N; Z 11

Depth (m)	Method	Core Diameter (mm)	Soil Description	Graphical Representation	Sample Type	Sample Number	Particle Size Distribution: Gravel (%)	Sand (%)	Silt & Clay (%): Silt (%)	Silt & Clay (%): Clay (%)	SCALA PENETROMETER: Blow Per 50 mm Penetration	Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit	Elevation (m)
0											3 6 9 12	Post-Peak 10 20 30 Peak 40; Plastic Limit 20; Moisture Content 40 60; Liquid Limit 80	377
	Testpitting		SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout										
			CLAY, gravelly, occasional cobbles to 200 mm, damp to moist, stiff, high plastic, brown/grey, fine to coarse gravel			DS1							
1													376
						DS2							
2													375
			SAND and SILT, some play, damp to moist, dense, brown, fine to coarse sand										
			END OF TESTPIT - Excavator limit reached - Coordinates estimated from handheld GPS and GIS data - Elevations estimated from City of Vernon 1m Contours										
3													374
4													373

TETRA TECH

Contractor: Private	Completion Depth: 2.8 m
Equipment Type: Kubota U48-S	Start Date: April 28, 2023
Logged By: CS	Completion Date: April 28, 2023
Reviewed By: MG	Page 1 of 1

TP23-21

APPENDIX C

LABORATORY TESTING RESULTS

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	8730 Okanagan Landing Road, Geotechnical Services	Sample No.:	KS-10381
Project No.:	ENG.KGEO03853-01	Date Tested:	May 8, 2023
Client:	Kerr Wood Leidal Associates Ltd.	Tested By:	JB
Address:	8730 Okanagan Landing Road, Vernon, B.C.	Page:	1 of 1

T.P. Number	Depth (m)	Moisture Content (%)	Visual Description of Soil
23-02, DS1	1.2 - 1.3	7.1	
23-04, DS2	1.4 - 1.5	38.6	
23-04, DS3	1.9 - 2.0	39.9	
23-04, DS4	2.3 - 2.4	38.6	
23-04, DS5	2.9 - 3.0	41.2	
23-06, DS2	1.2 - 1.3	61.1	
23-06, DS3	1.7 - 1.8	36.4	
23-06, DS4	2.1 - 2.2	39.8	
23-06, DS5	2.5 - 2.6	38.1	
23-06, DS6	2.9 - 3.0	39.7	
23-07, DS2	1.2 - 1.3	12.5	
23-10, DS3	2.3 - 2.4	19.3	
23-12, DS2	1.8 - 1.9	39.2	
23-12, DS3	2.5 - 2.6	40.4	
23-15, DS1	0.8 - 0.9	36.2	
23-15, DS2	2.0 - 2.1	31.0	
23-15, DS3	2.8 - 2.9	32.4	
23-16, DS1	0.5 - 0.6	37.3	
23-16, DS2	1.9 - 2.0	26.3	
23-18, DS2	1.1 - 1.2	27.3	
23-21, DS1	0.6 - 0.7	33.2	
23-21, DS2	1.9 - 2.0	28.9	

Reviewed By: _____ C.Tech.

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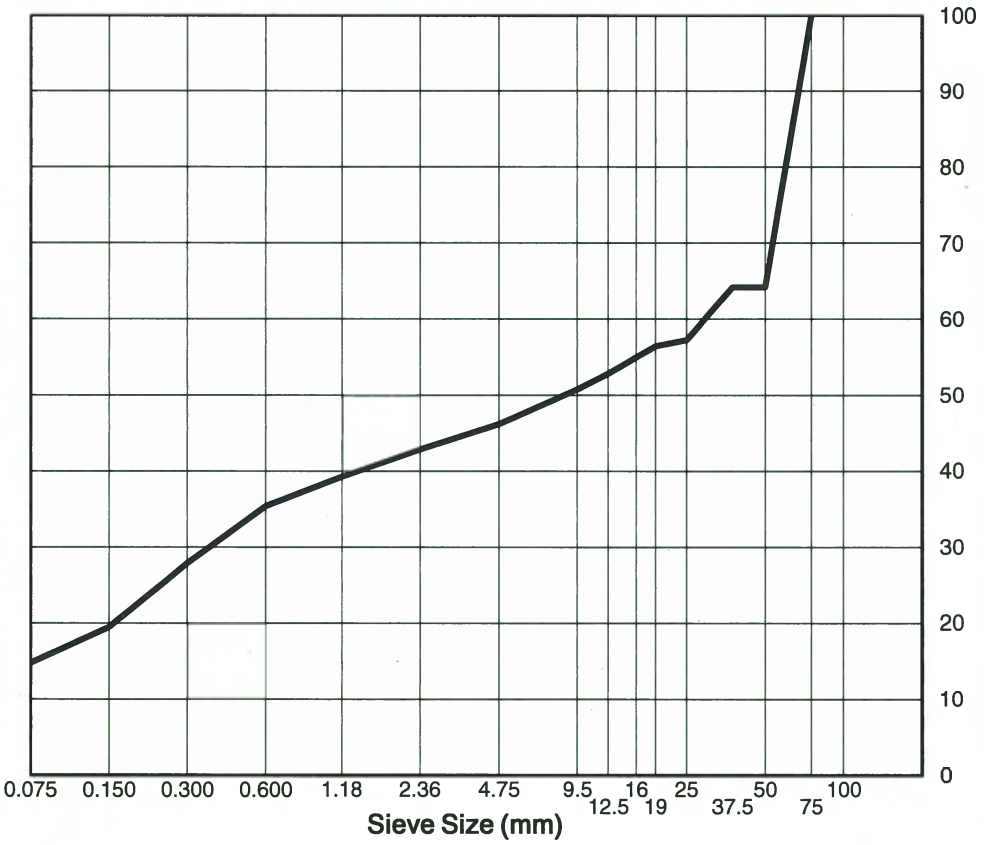
SIEVE ANALYSIS REPORT

Washed Sieve: ASTM C136 and C117

Project No.:	ENG.KGEO03853-01	Sample No.:	KS-10382
Project:	8730 Okanagan Landing Road, Geotechnical Services	Date Sampled:	April 27, 2023
		Sampled by:	CS
Client:	Kerr Wood Leidal Associates Ltd.	Date Tested:	May 9, 2023
Attention:	See e-mail distribution	Tested by:	JB Office: Kelowna
Email:	See e-mail distribution	Moisture Content (as received):	7.0%
Description:	75 mm (-) GRAVEL, sandy, some silt	No. Crushed Faces:	One (1) or Two (2)
Source:	N/A	By particle mass:	
Depth:	1.2 - 1.3 m		
Sample Location:	TP23-02, DS1		
Specification:	N/A		

Sieve Size	Percent Passing
75	100
50	64
37.5	64
25	57
19	56
12.5	53
9.5	51
4.75	46
2.36	43
1.18	39
0.600	35
0.300	28
0.150	19
0.075	14.8



Remarks:

Reviewed By: _____ C.Tech.

TETRA TECH

SIEVE ANALYSIS REPORT

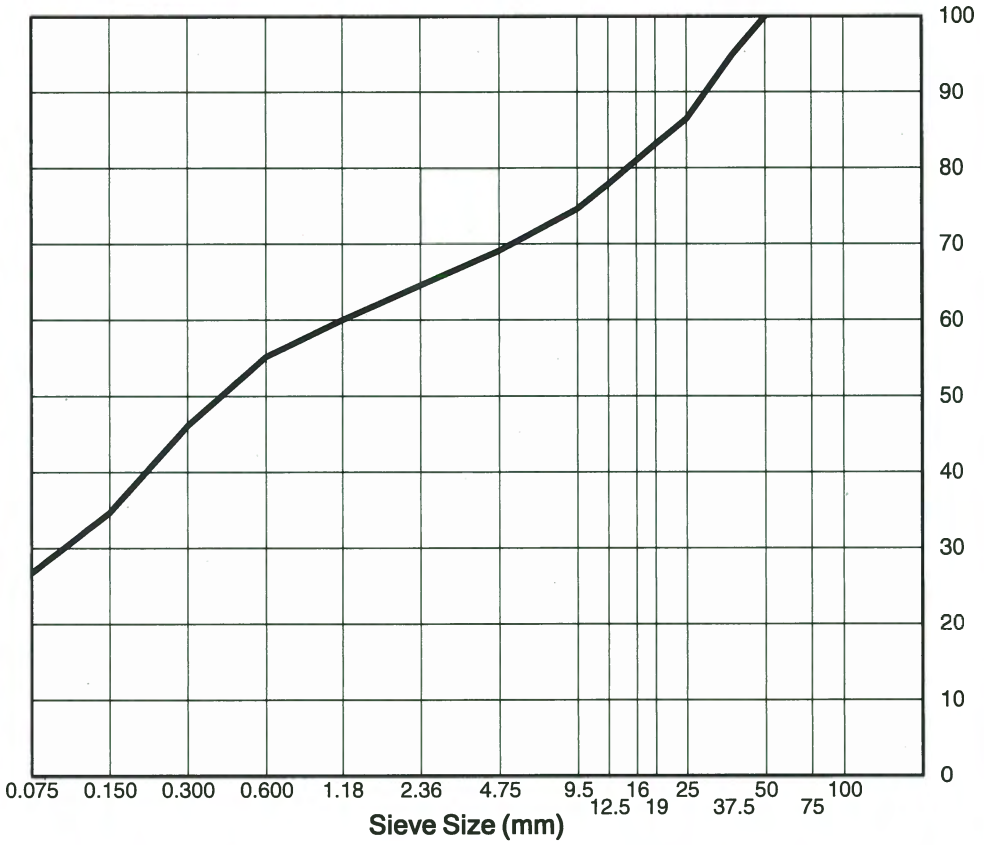
Washed Sieve: ASTM C136 and C117

Project No.:	ENG.KGEO03853-01	Sample No.:	KS-10383
Project:	8730 Okanagan Landing Road, Geotechnical Services	Date Sampled:	April 28, 2023
		Sampled by:	CS
Client:	Kerr Wood Leidal Associates Ltd.	Date Tested:	May 9, 2023
Attention:	See e-mail distribution	Tested by:	JB Office: Kelowna
Email:	See e-mail distribution	Moisture Content (as received):	5.2%
Description:	50 mm (-) SAND, gravelly, silty	No. Crushed Faces:	One (1) or Two (2)
Source:	N/A	By particle mass:	
Depth:	2.4 - 2.5 m		

Sample Location: TP23-17, DS3

Specification: N/A

Sieve Size	Percent Passing
50	100
37.5	95
25	86
19	83
12.5	78
9.5	75
4.75	69
2.36	65
1.18	60
0.600	55
0.300	46
0.150	35
0.075	26.7



Remarks:

Reviewed By: _____ C.Tech.

TETRA TECH

SIEVE ANALYSIS REPORT

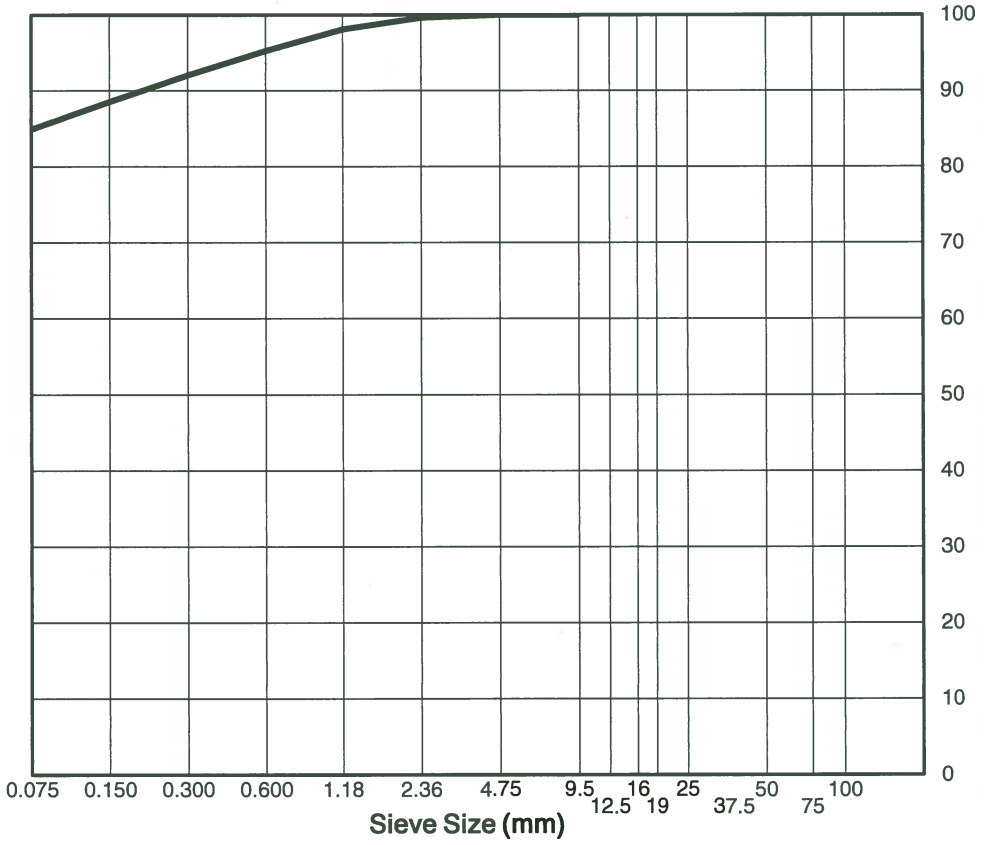
Washed Sieve: ASTM C136 and C117

Project No.:	ENG.KGEO03853-01	Sample No.:	KS-10384
Project:	8730 Okanagan Landing Road, Geotechnical Services	Date Sampled:	April 27, 2023
		Sampled by:	CS
Client:	Kerr Wood Leidal Associates Ltd.	Date Tested:	May 9, 2023
Attention:	See e-mail distribution	Tested by:	JB Office: Kelowna
Email:	See e-mail distribution	Moisture Content (as received):	25.2%
Description:	9.5 mm (-) SILT, some sand	No. Crushed Faces:	One (1) or Two (2)
Source:	N/A	By particle mass:	
Depth:	0.9 - 1.0 m		

Sample Location: TP23-20, DS1

Specification: N/A

Sieve Size	Percent Passing
9.5	100
4.75	100
2.36	100
1.18	98
0.600	95
0.300	92
0.150	89
0.075	84.9



Remarks:

Reviewed By: _____ C.Tech.

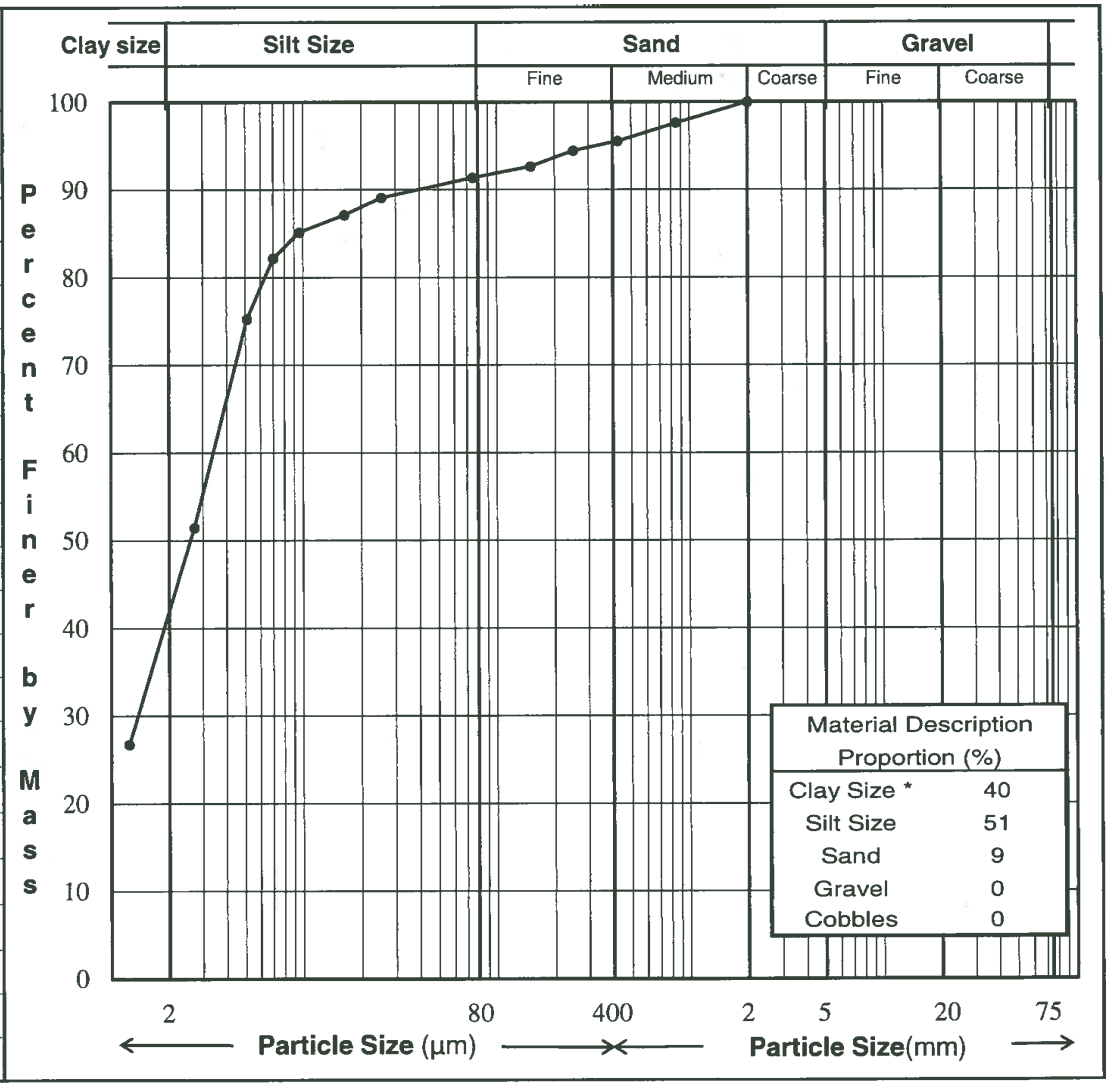
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D7928

Project:	8730 Okanagan Landing Road, Geotechnical Services	Sample No.:	KS-10385
Client:	Kerr Wood Leidal Associates Ltd.	Borehole/ TP:	TP23-10, DS3
Project No.:	ENG.KGEO03853-01	Depth:	2.3 -2.4 m
Location:	Vernon, B.C.	Date Tested	May 10, 2023
Description **:	SILT, clayey, trace sand	Tested By:	CP

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
38 mm	
25 mm	
19 mm	
13 mm	
10 mm	
5 mm	
2 mm	100
850 µm	98
425 µm	96
250 µm	94
150 µm	93
75 µm	91
25 µm	89
16 µm	87
10 µm	85
7 µm	82
5 µm	75
3 µm	51
1 µm	27



Remarks: * The description is behaviour based & subject to Tetra Tech Canada description protocols.

Reviewed By:

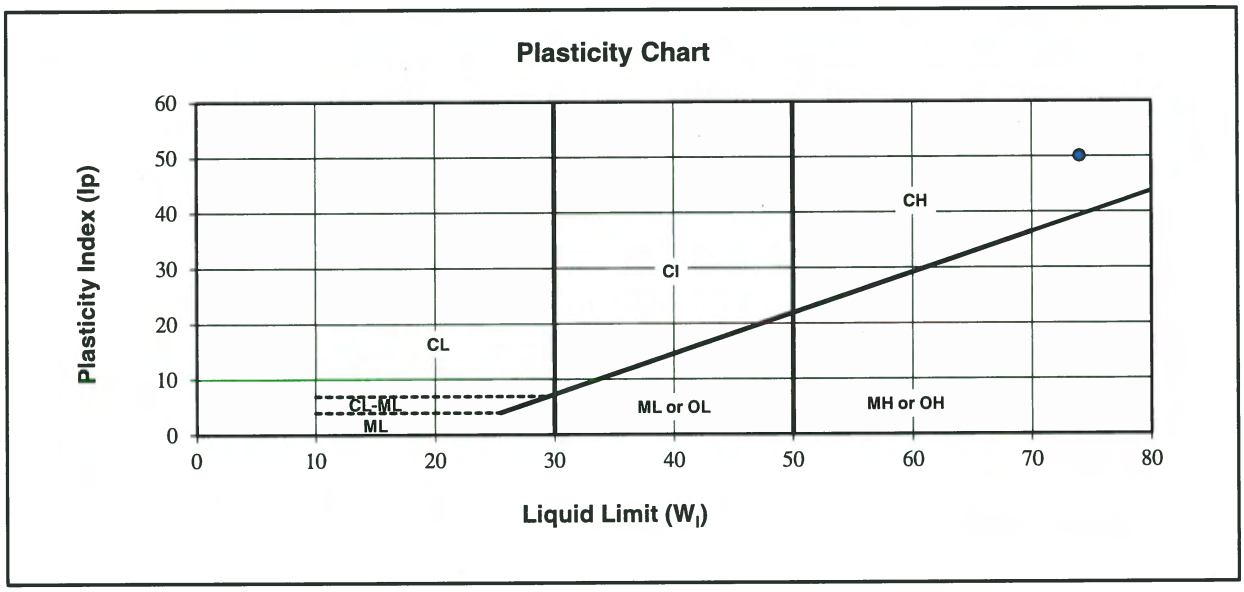
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	8730 Okanagan Landing Road, Geotechnical Services	Sample Number:	KS-10386
		Sample Location:	TP23-04, DS2
Project No:	ENG.KGEO03853-01	Depth:	1.4 - 1.5 m
Client:	Kerr Wood Leidal Associates Ltd.	Sampled By:	CS Tested By: JB
Attention:	See e-mail distribution	Date Sampled:	April 27-28, 2023
Email:	See e-mail distribution	Date Tested:	May 9, 2023

Sample Description: CLAY, High Plasticity (CH)



Liquid Limit (W_1) :	74	Natural Moisture (%)	38.6
Plastic Limit :	24	Soil Plasticity:	High
Plasticity Index (Ip) :	50	Mod.USCS Symbol:	CH

Remarks:

Reviewed By: _____ C.Tech.

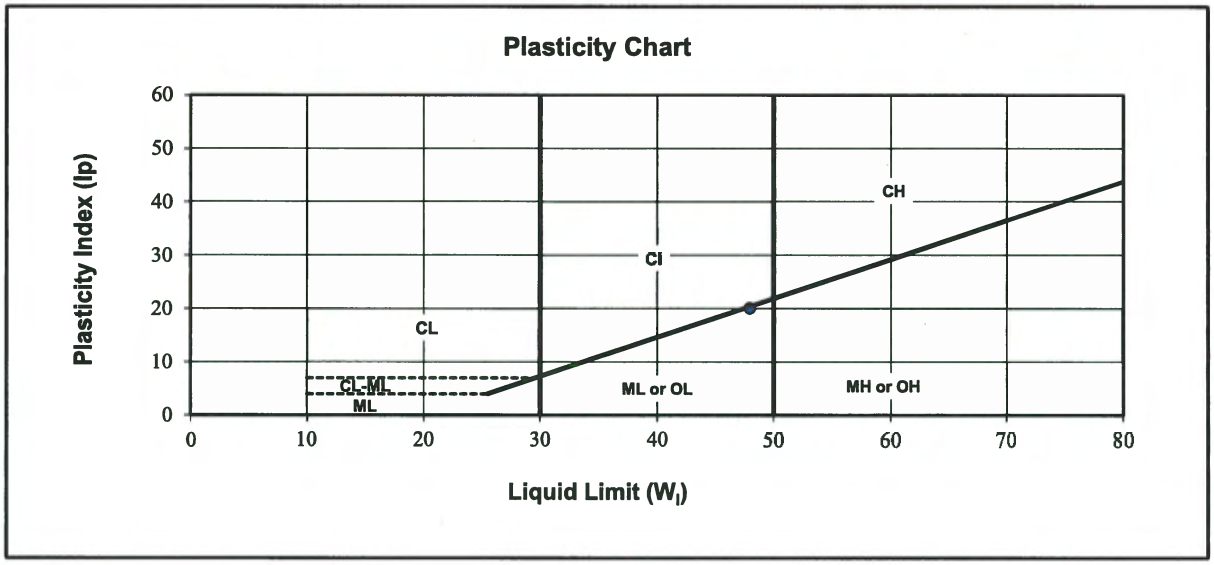
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	8730 Okanagan Landing Road, Geotechnical Services	Sample Number:	KS-10387
		Sample Location:	TP23-04, DS5
Project No:	ENG.KGEO03853-01	Depth:	2.9 - 3.0 m
Client:	Kerr Wood Leidal Associates Ltd.	Sampled By:	CS Tested By: CS
Attention:	See e-mail distribution	Date Sampled:	April 27-28, 2023
Email:	See e-mail distribution	Date Tested:	May 8, 2023

Sample Description: CLAY, Medium Plasticity (CI)



Liquid Limit (W_1):	48	Natural Moisture (%)	41.2
Plastic Limit :	28	Soil Plasticity:	Medium
Plasticity Index (Ip) :	20	Mod.USCS Symbol:	CI

Remarks:

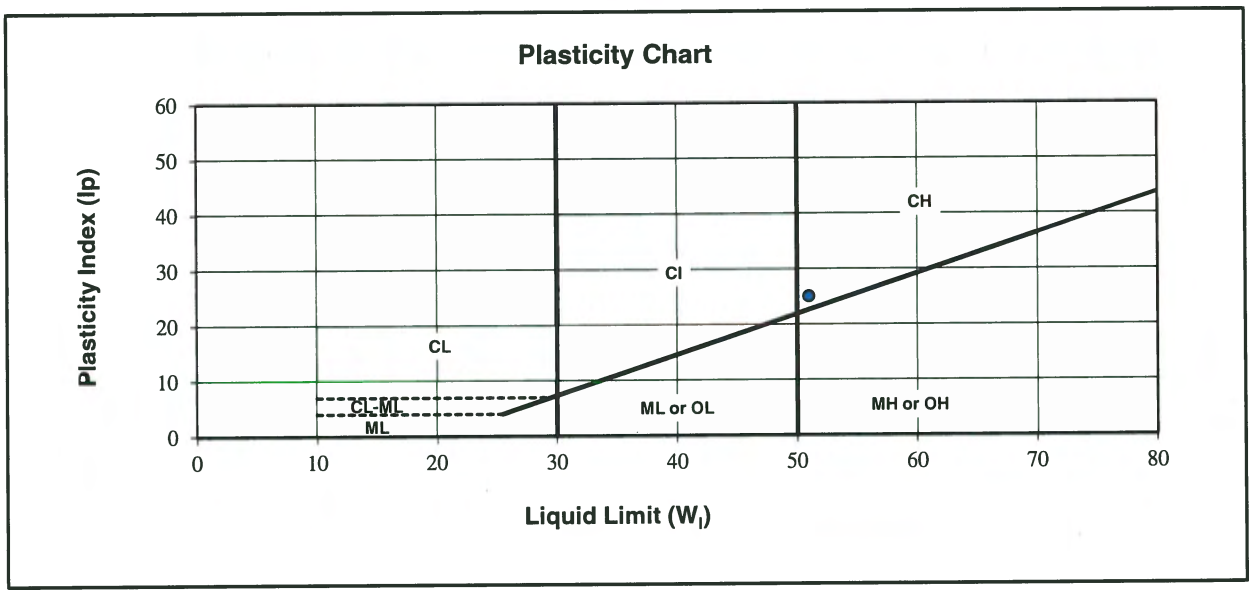
Reviewed By: C.Tech.

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	8730 Okanagan Landing Road, Geotechnical Services	Sample Number:	KS-10388
Project No:	ENG.KGEO03853-01	Sample Location:	TP23-06, DS2
Client:	Kerr Wood Leidal Associates Ltd.	Depth:	1.2 - 1.3 m
Attention:	See e-mail distribution	Sampled By:	CS Tested By: JB
Email:	See e-mail distribution	Date Sampled:	April 27-28, 2023
		Date Tested:	May 9, 2023

Sample Description: CLAY, Medium to High Plasticity (CI-CH)



Liquid Limit (W_1) :	51	Natural Moisture (%)	61.1
Plastic Limit :	26	Soil Plasticity:	Medium to High
Plasticity Index (Ip) :	25	Mod.USCS Symbol:	CI-CH

Remarks:

Reviewed By: C.Tech.

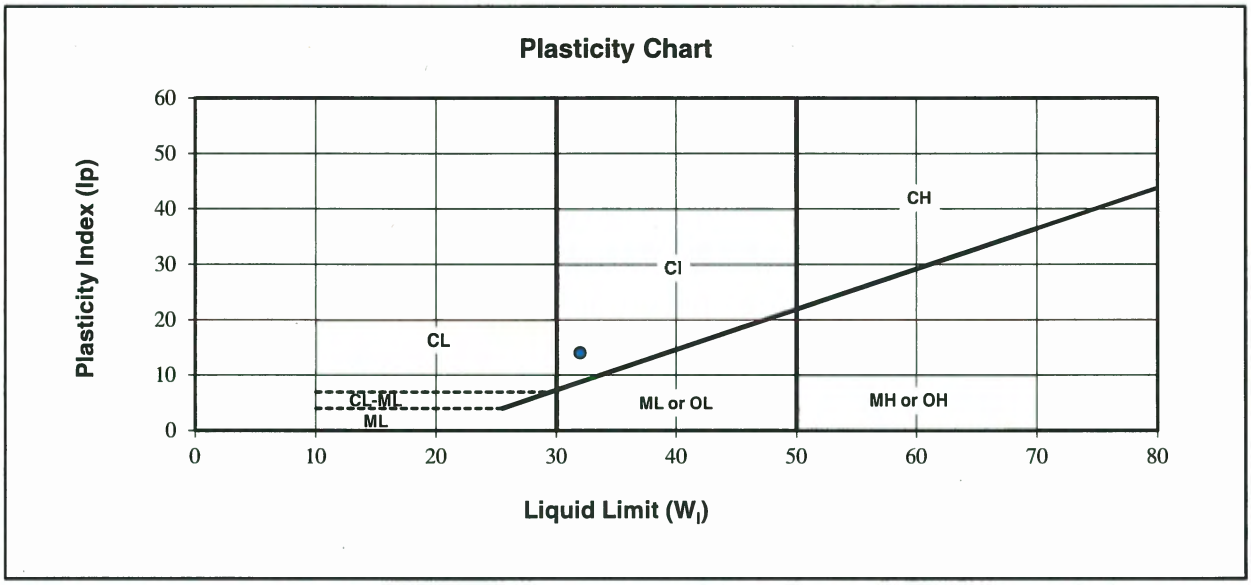
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	8730 Okanagan Landing Road, Geotechnical Services	Sample Number:	KS-10389
		Sample Location:	TP23-07, DS2
Project No:	ENG.KGEO03853-01	Depth:	1.2 - 1.3 m
Client:	Kerr Wood Leidal Associates Ltd.	Sampled By:	CS Tested By: JB
Attention:	See e-mail distribution	Date Sampled:	April 27-28, 2023
Email:	See e-mail distribution	Date Tested:	May 9, 2023

Sample Description: CLAY, Medium Plasticity (CI)



Liquid Limit ($W_{1)}$:	32	Natural Moisture (%)	12.5
Plastic Limit :	18	Soil Plasticity:	Medium
Plasticity Index (Ip) :	14	Mod.USCS Symbol:	CI

Remarks:

Reviewed By: _____ C.Tech.

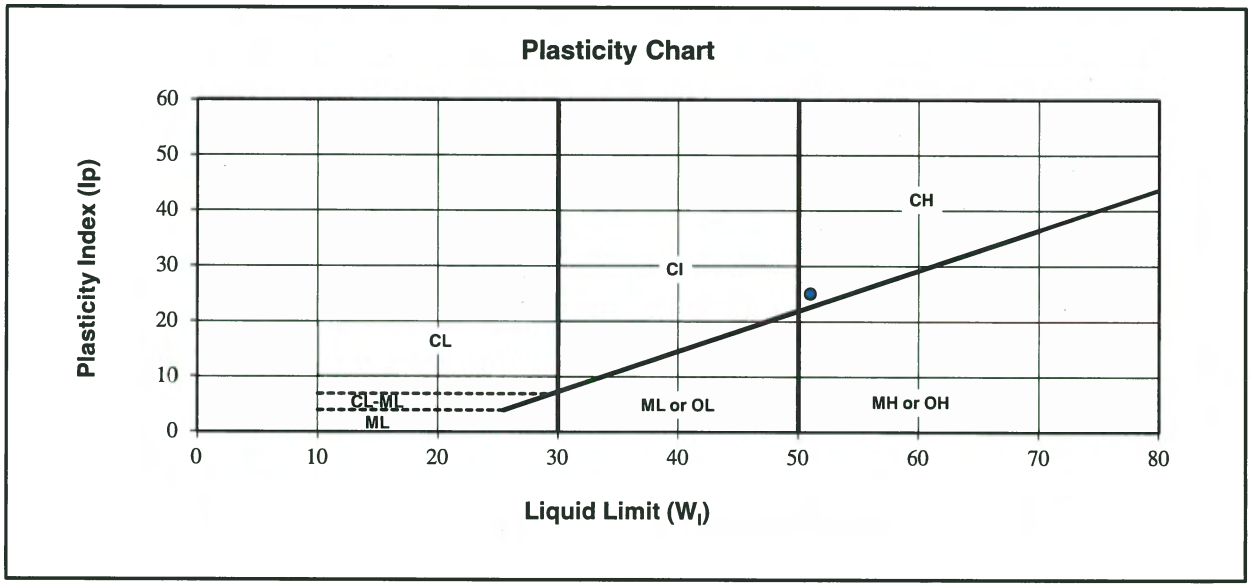
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	8730 Okanagan Landing Road, Geotechnical Services	Sample Number:	KS-10390
		Sample Location:	TP23-12, DS3
Project No:	ENG.KGEO03853-01	Depth:	2.5 - 2.6 m
Client:	Kerr Wood Leidal Associates Ltd.	Sampled By:	CS Tested By: CS
Attention:	See e-mail distribution	Date Sampled:	April 27-28, 2023
Email:	See e-mail distribution	Date Tested:	May 9, 2023

Sample Description: CLAY, Medium to High Plasticity (CI-CH)



Liquid Limit ($W_{1)}$:	51	Natural Moisture (%)	40.4
Plastic Limit :	26	Soil Plasticity:	Medium to High
Plasticity Index (Ip) :	25	Mod.USCS Symbol:	CI-CH

Remarks:

Reviewed By: _____ C.Tech.

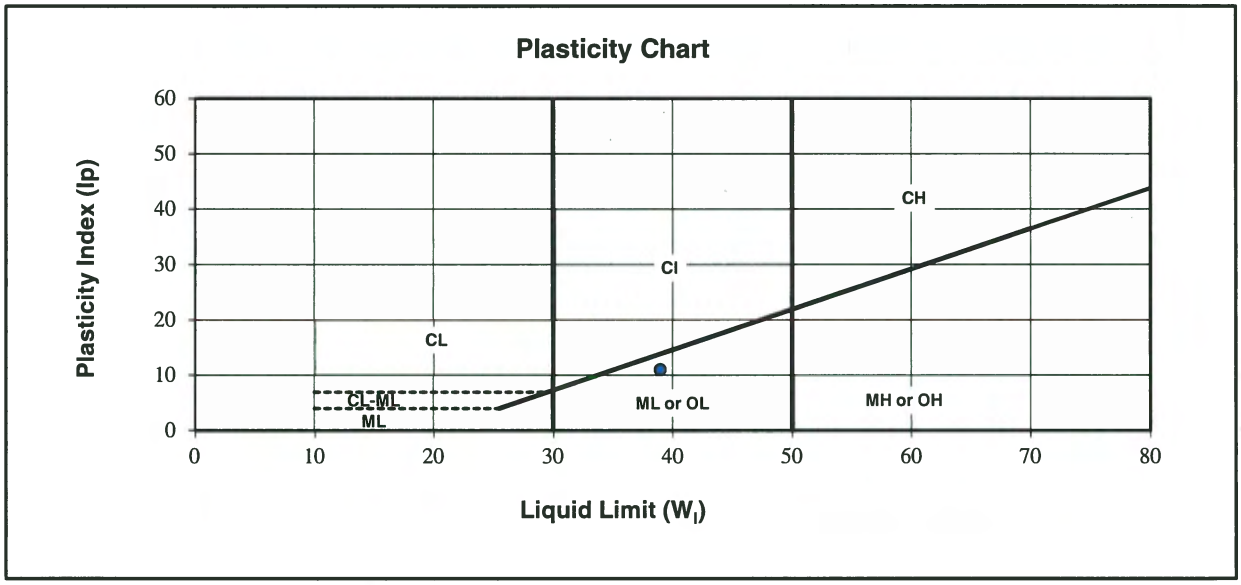
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	8730 Okanagan Landing Road, Geotechnical Services	Sample Number:	KS-10391
		Sample Location:	TP23-15, DS1
Project No:	ENG.KGEO03853-01	Depth:	0.8 - 0.9 m
Client:	Kerr Wood Leidal Associates Ltd.	Sampled By:	CS Tested By: JB
Attention:	See e-mail distribution	Date Sampled:	April 27-28, 2023
Email:	See e-mail distribution	Date Tested:	May 9, 2023

Sample Description: SILT, Low Plasticity (ML)



Liquid Limit ($W_{1)}$:	39	Natural Moisture (%)	36.2
Plastic Limit :	28	Soil Plasticity:	Low
Plasticity Index (Ip) :	11	Mod.USCS Symbol:	ML

Remarks:

Reviewed By: _____ C.Tech.

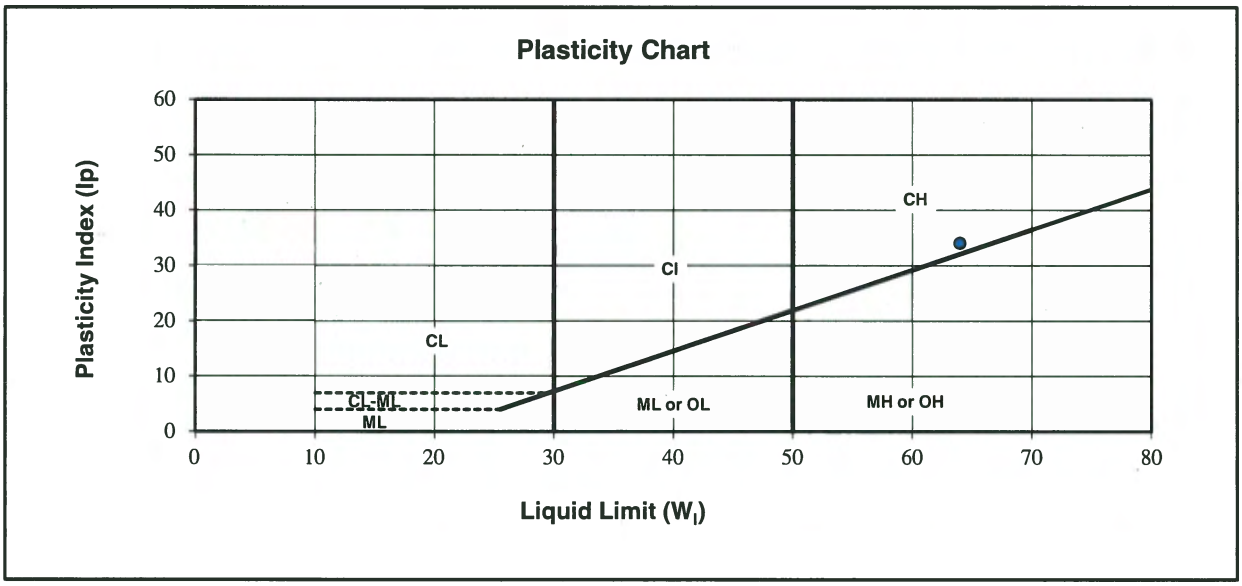
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	8730 Okanagan Landing Road, Geotechnical Services	Sample Number:	KS-10392
		Sample Location:	TP23-15, DS3
Project No:	ENG.KGEO03853-01	Depth:	2.8 - 2.9 m
Client:	Kerr Wood Leidal Associates Ltd.	Sampled By:	CS Tested By: CS
Attention:	See e-mail distribution	Date Sampled:	April 27-28, 2023
Email:	See e-mail distribution	Date Tested:	May 8, 2023

Sample Description: CLAY, High Plasticity (CH)



Liquid Limit ($W_{1)}$:	64	Natural Moisture (%)	32.4
Plastic Limit :	30	Soil Plasticity:	High
Plasticity Index (Ip) :	34	Mod.USCS Symbol:	CH

Remarks:

Reviewed By: _____ C.Tech.

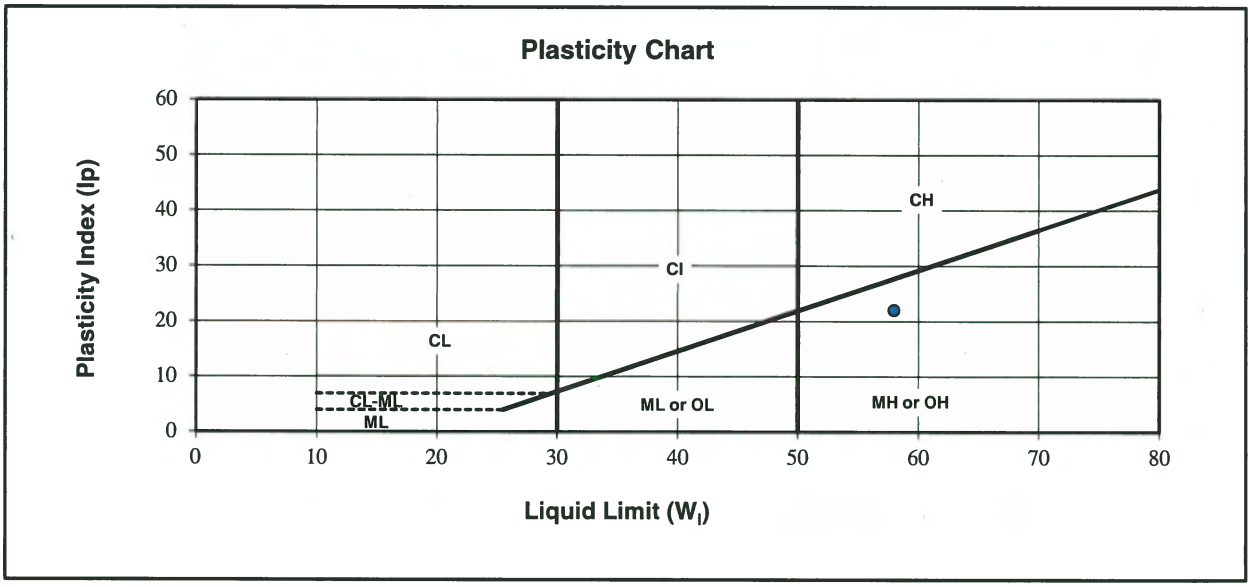
TETRA TECH

ATTERBERG LIMITS TEST REPORT

ASTM D4318

Project:	8730 Okanagan Landing Road, Geotechnical Services	Sample Number:	KS-10393
		Sample Location:	TP23-18, DS2
Project No:	ENG.KGEO03853-01	Depth:	1.1 - 1.2 m
Client:	Kerr Wood Leidal Associates Ltd.	Sampled By:	CS Tested By: CS
Attention:	See e-mail distribution	Date Sampled:	April 27-28, 2023
Email:	See e-mail distribution	Date Tested:	May 8, 2023

Sample Description: SILT, High Plasticity (MH)



Liquid Limit ($W_{1)}$:	58	Natural Moisture (%)	27.3
Plastic Limit :	36	Soil Plasticity:	High
Plasticity Index (Ip) :	22	Mod.USCS Symbol:	MH

Remarks:

Reviewed By: C.Tech.

TETRA TECH

APPENDIX D

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

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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

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. Where temporary or permanent drainage systems are installed within or around a structure, these systems must protect the structure from loss of ground due to mechanisms such as internal erosion and must be designed so as to assure continued satisfactory performance of the drains. Specific design details regarding the geotechnical aspects of such systems (e.g. bedding material, surrounding soil, soil cover, geotextile type) should be reviewed by the geotechnical engineer to confirm the performance of the system is consistent with the conditions used in the geotechnical design.

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.