TETRA TECH

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Kerr Wood Leidal
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**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.

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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.

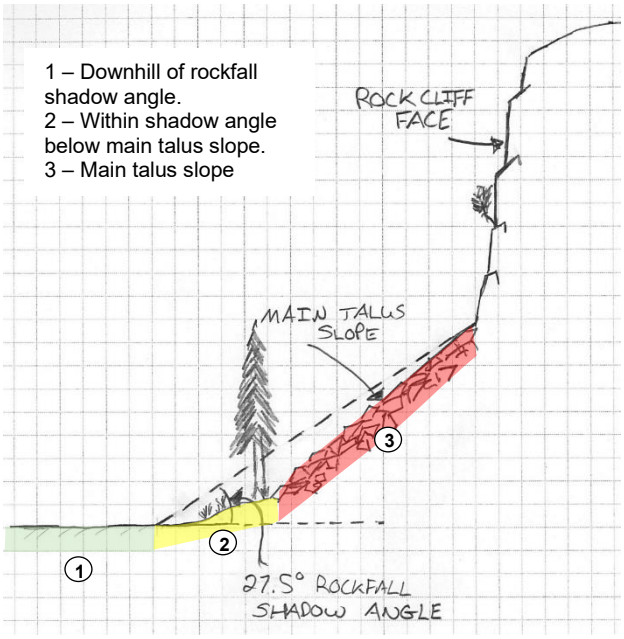
Given the materials observed on-site and our understanding of the proposed development, it is our assessment that the existing slopes are considered to be reasonably stable, and the only slope stability hazard currently noted at the site is associated with rockfall at the eastern end of the property.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

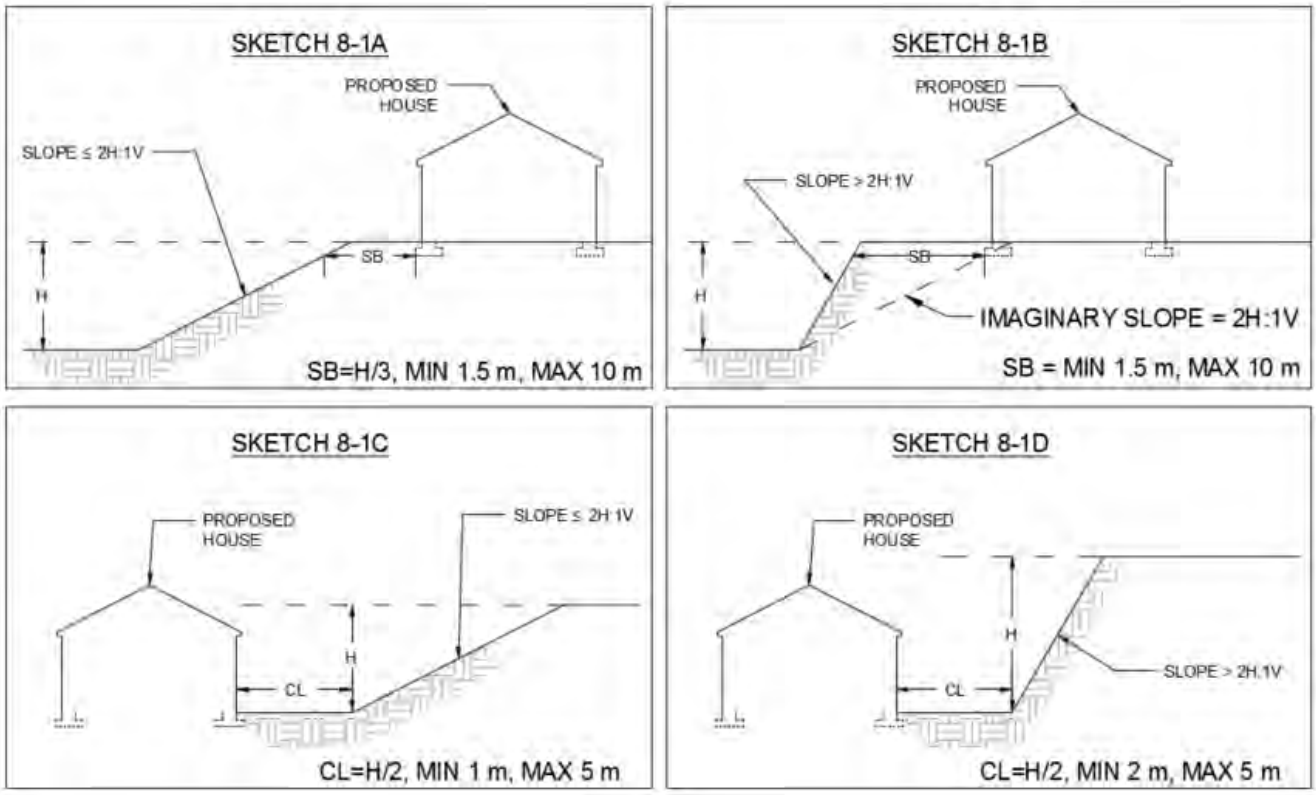
Temporary excavation work must be carried out in accordance with the requirements specified by WorkSafe BC Occupational Health & Safety Regulation, Part 20. Flatter excavations may be required if soil sloughing, groundwater seepage, or loose soils are encountered. A geotechnical engineer shall review 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 to$10^{-6}$ 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.

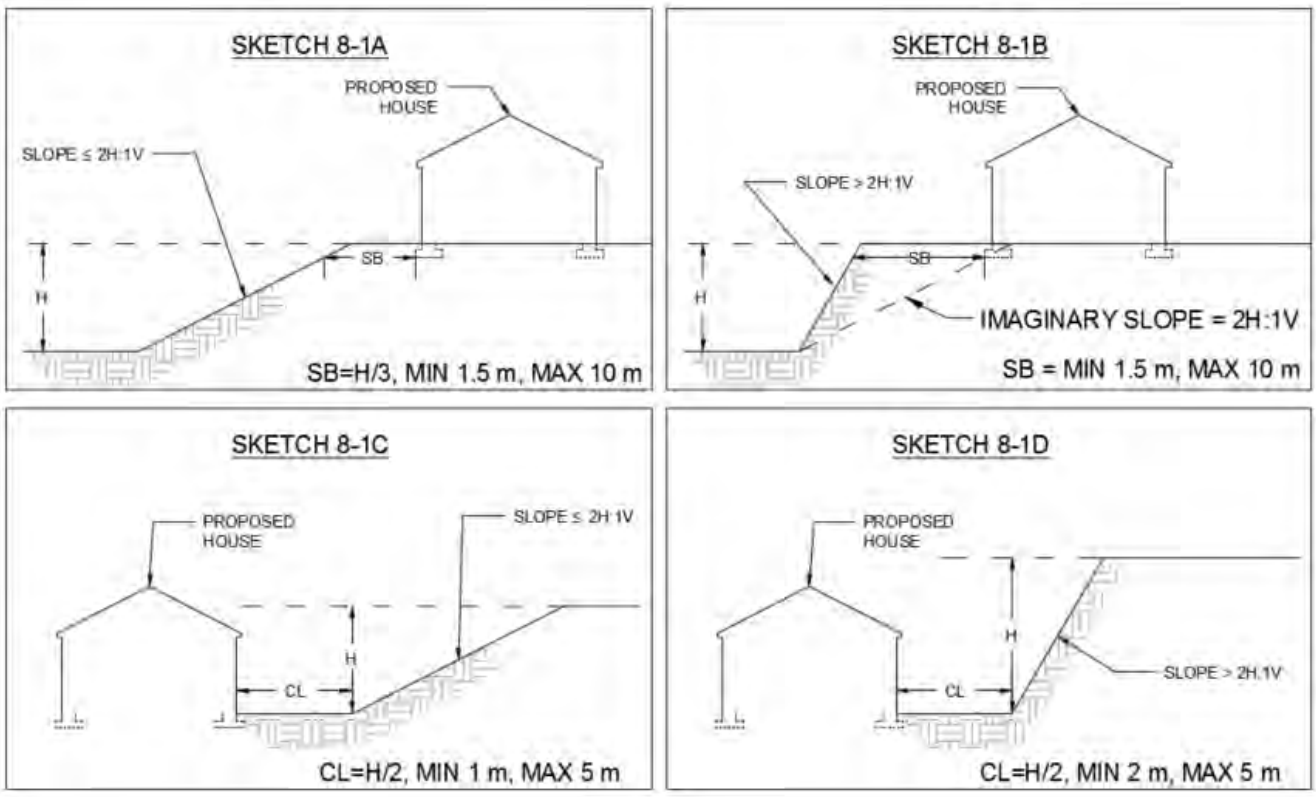
### 7.5.3 Slope Set-Back and Clearance

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 to$10^{-8}$ 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.

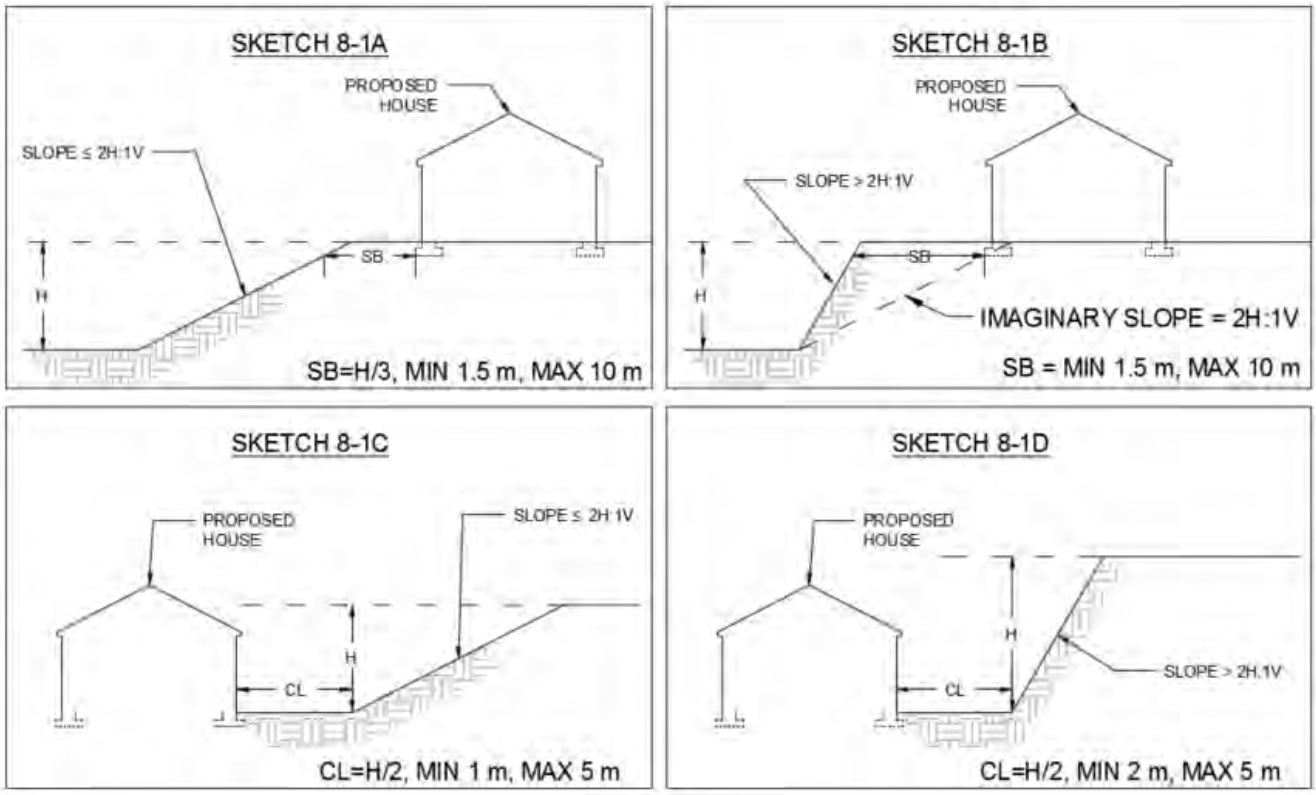
Temporary excavation work should be carried out in accordance with the requirements specified by WorkSafe BC Occupational Health & Safety Regulation, Part 20. Flatter excavations may be required if soil sloughing,

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 to$10^{-8}$ m/s. Hydraulic conductivity (*k*) of the native sand and gravel till soils has been preliminarily estimated to range between $10^{-8}$ m/s to$10^{-6}$ 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.



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Hillside Study and Geohazard Sections

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# REFERENCES

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# FIGURE

Figure 1 Testpit Location Plan
Figure 2 Hillside Study Photo Location and Notes
Figure 3 Slope Analysis (Percent)


## 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

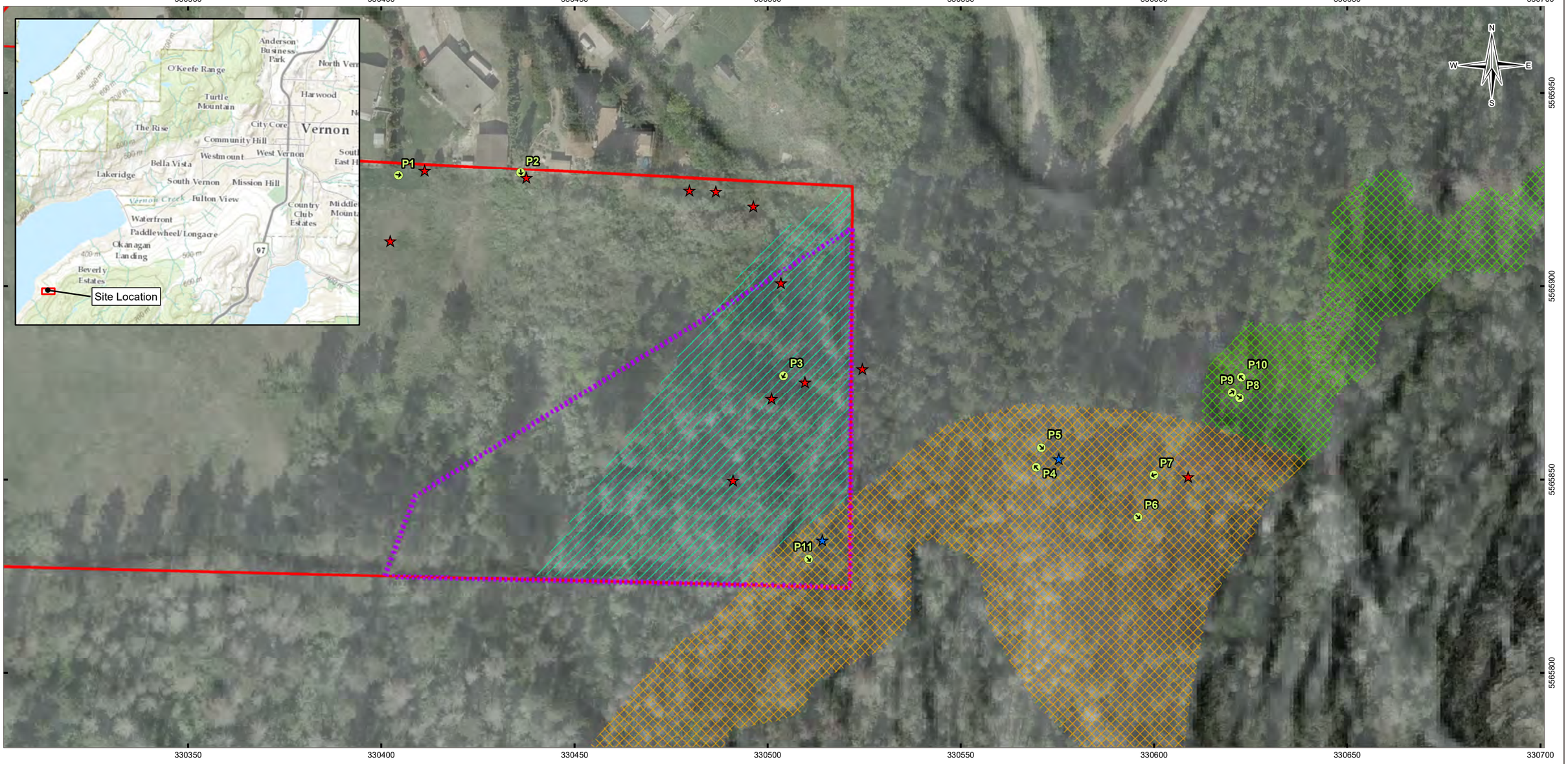
**STATUS**
ISSUED FOR USE

# 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 | | |

C:\Users\murray.gaffney\Desktop\KGEO03853-01 8730 Okanagan Landing Road\Maps\KGEO03853-01 Figure 1.mxd modified 6/5/2023 by murray.gaffney




## 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

**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 |

TETRA TECH

**Figure 2**

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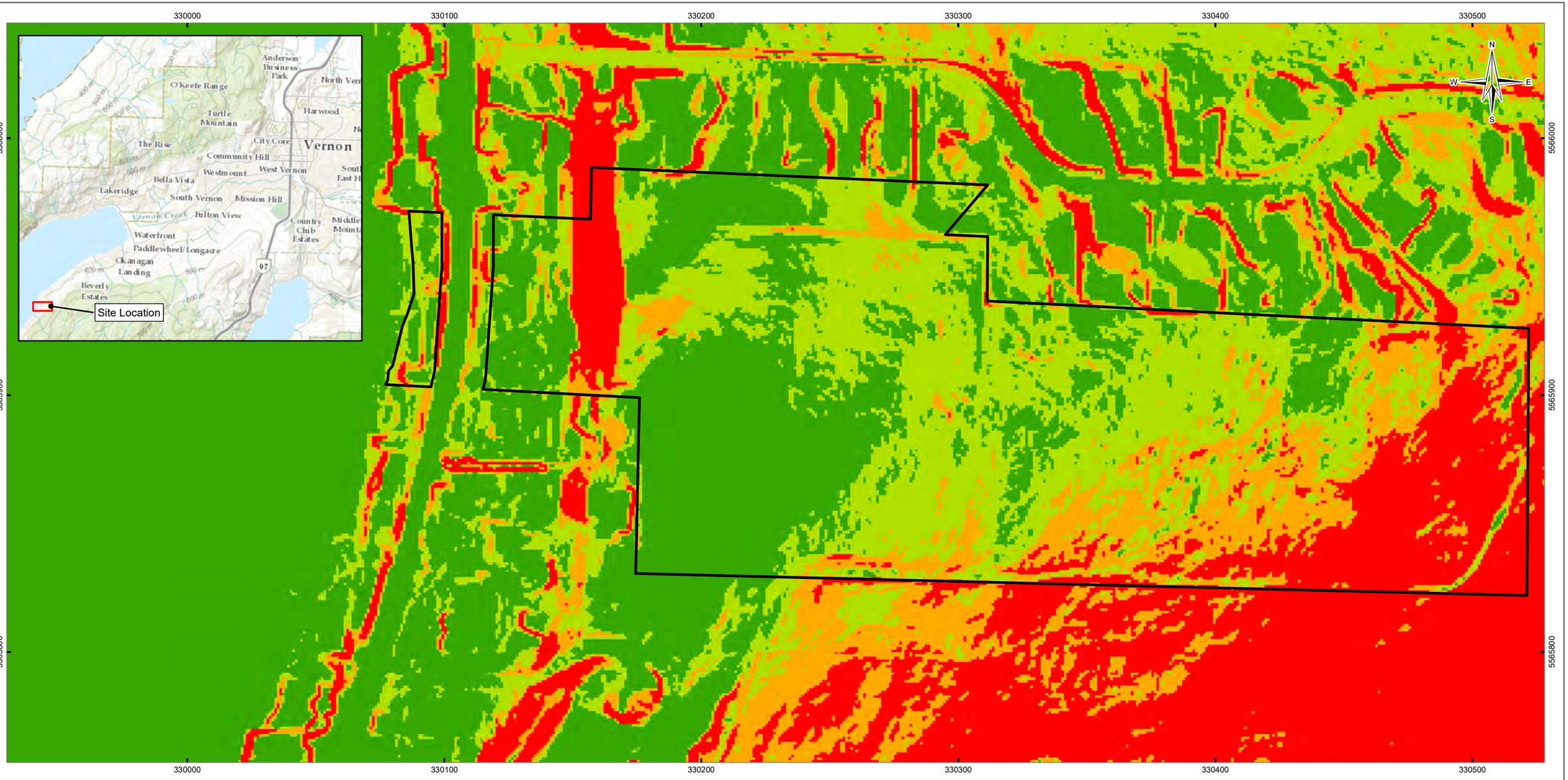



## LEGEND

- 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).

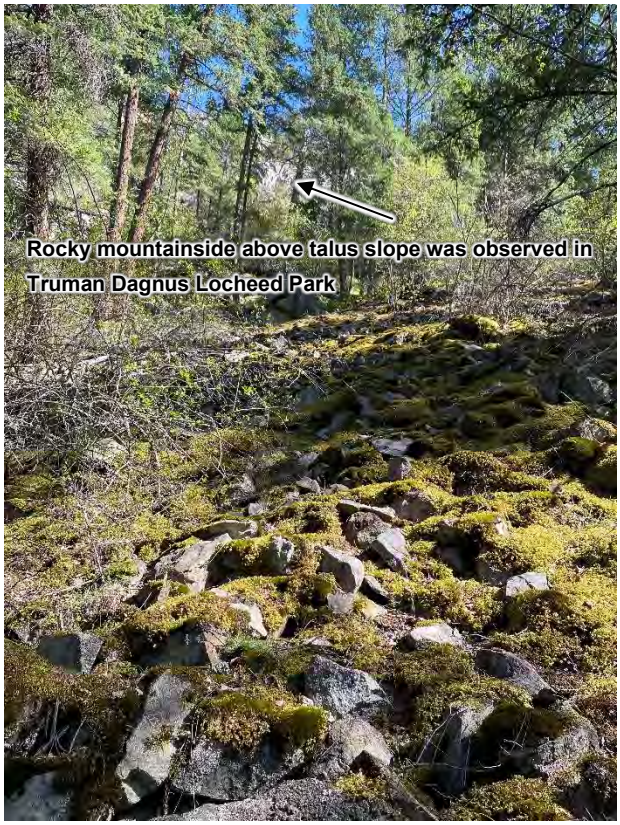



**Photo 6:** Looking east up at a moss-covered rock/talus slope and at a rocky mountainside above the slope. The slope in this photo is between approximately 30-40 degrees. Photo taken from Truman Dagnus Locheed Park. (April 28, 2023).


**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 (%) | 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<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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 (%) | 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<br>- Refusal on very dense till<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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<br>- Refusal on very dense till<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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 (%) | 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; 20 40 60 80 | 361 |
| | Testpitting | | SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown | | | | | | | | | | | |
| | | | 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<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- Elevations estimated from City of Vernon 1m Contours | | | | | | | | | | | 358 |
| 4 | | | | | | | | | | | | | | 357 |

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<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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: MG | 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 (%) | Particle Size Distribution: Sand (%) | Particle Size Distribution: Silt & Clay (%) | Particle Size Distribution: Silt (%) | Particle Size Distribution: Clay (%) | Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit | Elevation (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown | | | | | | | | | | | 360 |
| | | | CLAY, moist, firm to stiff, medium to high plastic, brown | | | | DS1 | | | | | | | |
| 1 | Testpitting | | | | CI-CH | | DS2 | | | | | | | 359 |
| | | | | | | | DS3 | | | | | | | |
| 2 | | | | | | | DS4 | | | | | | | 358 |
| | | | | | | | DS5 | | | | | | | |
| 3 | | | | | | | DS6 | | | | | | | 357 |
| | | | END OF TESTPIT<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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: MG | 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; Plastic Limit / Moisture Content / Liquid Limit 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 | | | | | | | | | | | |
| 2 | | | | | | | DS3 | | | | | | | 352 |
| | | | | | | | DS4 | | | | | | | |
| | | | END OF TESTPIT<br>- Refusal on hard clay<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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: MG | 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 (10 20 30 40); Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80) | Elevation (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | | | | 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<br>- Refusal on very dense till<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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: MG | 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 |
| | Testpitting | | 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 | | | CLAY, moist, stiff, high plastic, brown | | | | | | | | | | 365 |
| | | | | | | DS2 | | | | | | | |
| 2 | | | | | | | | | | | | | 364 |
| | | | | | | DS3 | | | | | | | |
| 3 | | | END OF TESTPIT<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- Elevations estimated from City of Vernon 1m Contours | | | | | | | | | | 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: MG | 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<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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: MG | 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 10 20 30 40 Peak; Plastic Limit 20 Moisture Content 40 60 Liquid Limit 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<br>- Refusal on very dense till<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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: MG | Page 1 of 1 |

# TP23-11

# Kerr Wood Leidal Associates Ltd

# Testpit No: **TP23-12**

| | |
|---|---|
| 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<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- Elevations estimated from City of Vernon 1m Contours | | | | | | | | | | | 368 |
| 4 | | | | | | | | | | | | | | 367 |

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: MG | 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) / 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 | 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<br>- Refusal on very dense till<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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: MG | 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 (10 20 30 40); Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80) | Elevation (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | | | | 373 |
| | Testpitting | | 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 | | | 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<br>- Refusal on very dense till<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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: MG | 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 (%) | 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 |
| 2 | | | CLAY, moist, stiff, high plastic, grey/brown | | | | DS2 | | | | | | 376 |
| | | | | | CH | | DS3 | | | | | | |
| 3 | | | END OF TESTPIT<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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: MG | 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<br>- Refusal on hard clay and gravel<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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

# Kerr Wood Leidal Associates Ltd

# Testpit No: **TP23-17**

| | |
|---|---|
| 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 Moisture Content Liquid Limit 20 40 60 80 | 385 |
| | Testpitting | | 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 |
| | | | 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<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- Elevations estimated from City of Vernon 1m Contours | | | | | | | | | |
| 4 | | | | | | | | | | | | 381 |

TETRA TECH

| | |
|---|---|
| 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: MG | Page 1 of 1 |

# 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 (%) | Particle Size Distribution: Sand (%) | Particle Size Distribution: Silt & Clay (%) | Particle Size Distribution: Silt (%) | Particle Size Distribution: Clay (%) | Field Vane (kPa) / Plastic Limit, Moisture Content, Liquid Limit | Elevation (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Testpitting | | SILT AND SAND (TOPSOIL), trace gravel, brown, damp, loose, brown; rootlets throughout | | | | | | | | | | | 386 |
| | | | 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<br>- Refusal on very dense till<br>- Coordinates estimated from handheld GPS and GIS data<br>- Elevations estimated from City of Vernon 1m Contours | | | | | | | | | | | 383 |
| 4 | | | | | | | | | | | | | | 382 |

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: 2.8 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 |

# 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<br>- Refusal on very dense till<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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

# Kerr Wood Leidal Associates Ltd

# Testpit No: **TP23-20**

| | |
|---|---|
| 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 ◇ 10 20 30 40 ◆ Peak; Plastic Limit 20 40 60 80 Liquid Limit | 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<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- 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: MG | 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 | 20 40 60 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<br>- Excavator limit reached<br>- Coordinates estimated from handheld GPS and GIS data<br>- Elevations estimated from City of Vernon 1m Contours | | | | | | | | | | |
| 3 | | | | | | | | | | | | | 374 |
| 4 | | | | | | | | | | | | | 373 |

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

Plastic Limit — Moisture Content — Liquid Limit

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.



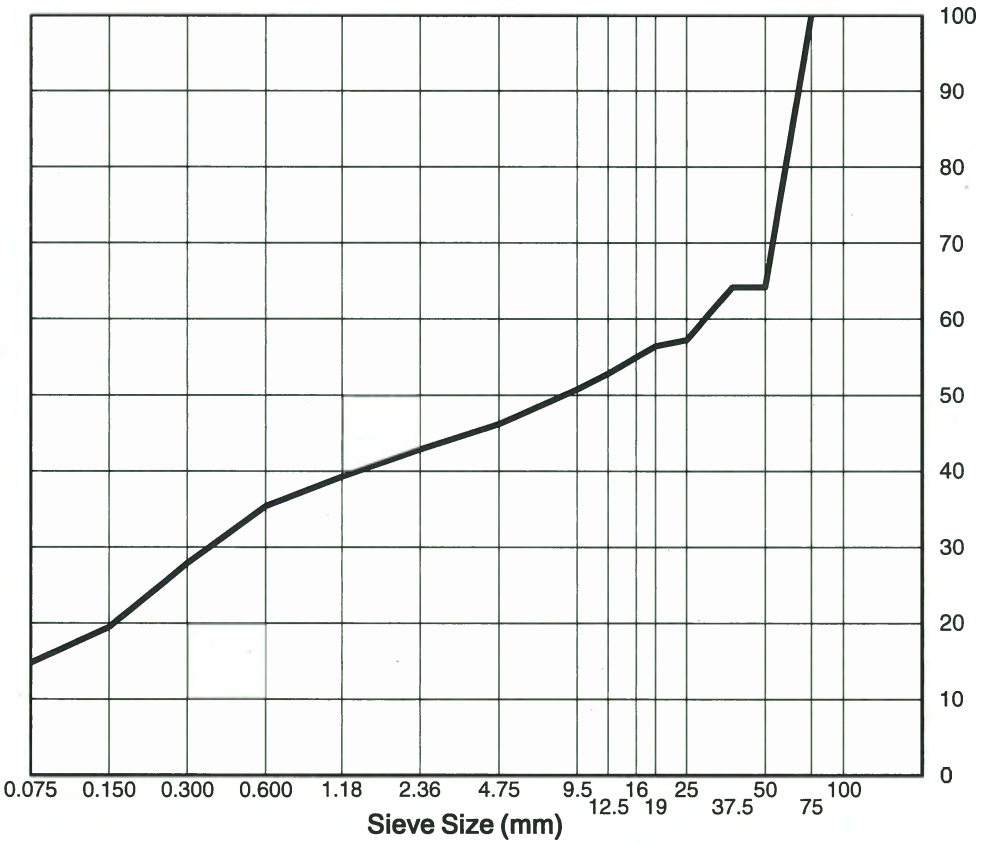
TETRA TECH

# 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

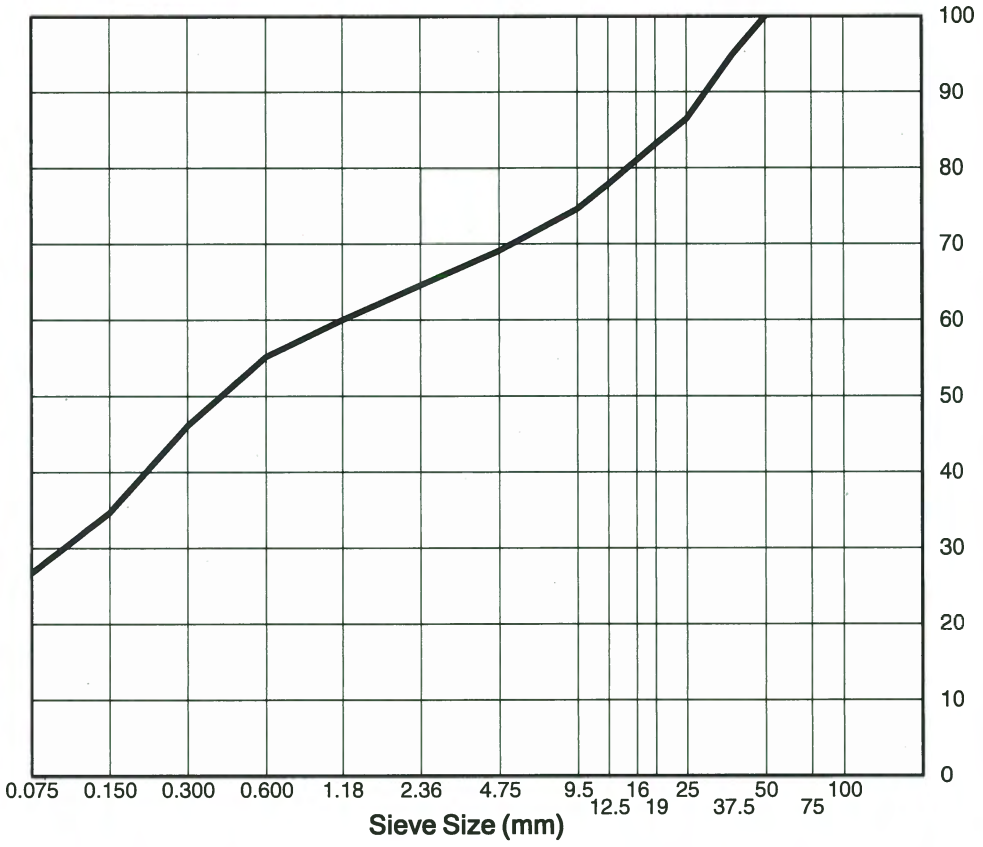
Washed Sieve: ASTM C136 and C117

| | | | |
|---|---|---|---|
| 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.



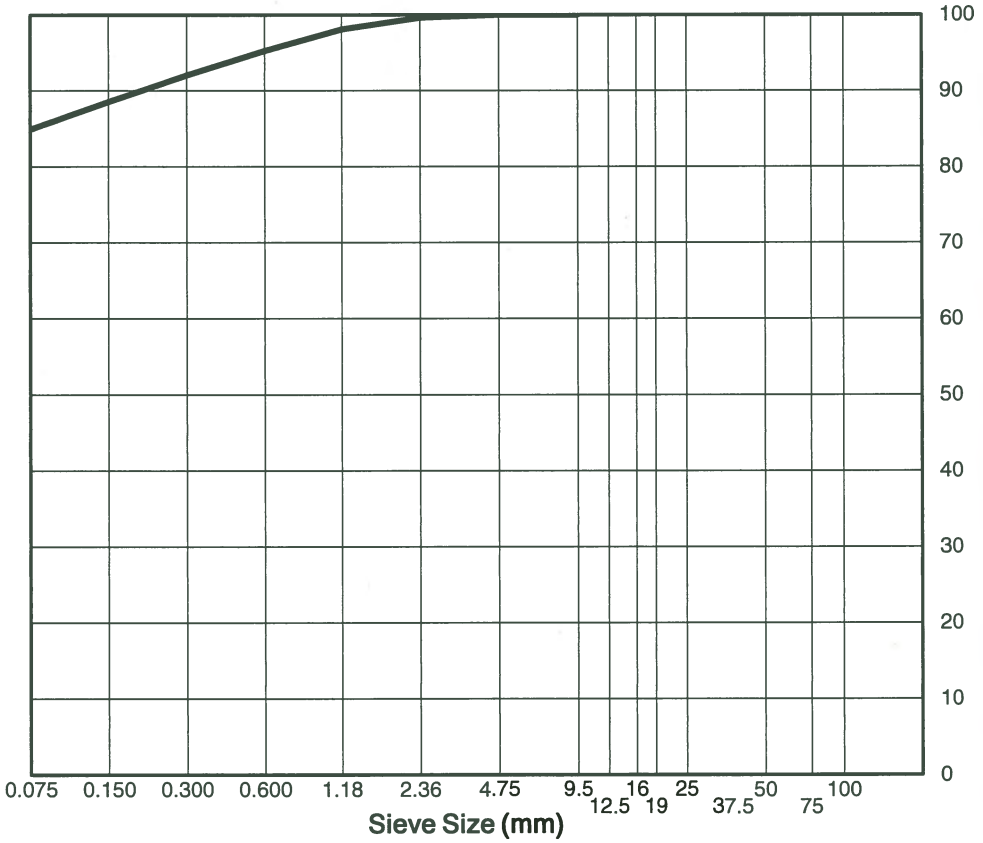
TETRA TECH

# 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.



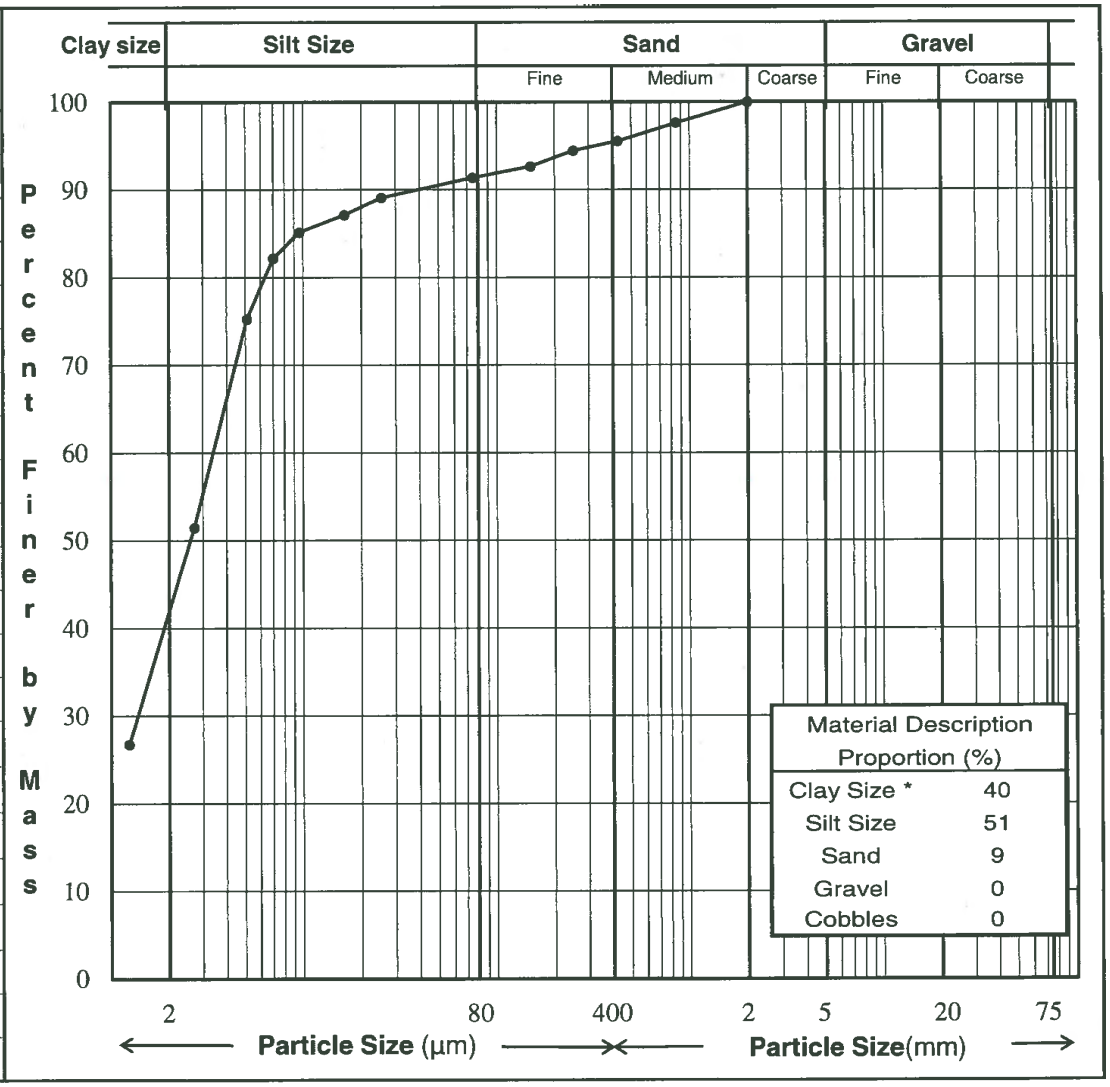
TETRA TECH

# 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:**



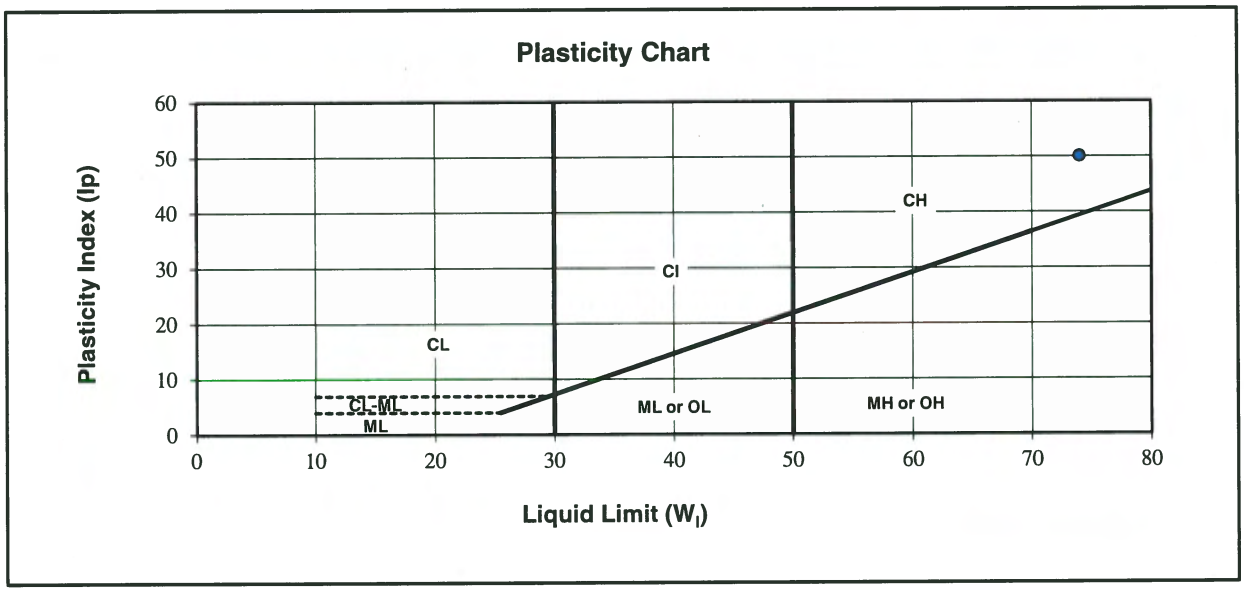
TETRA TECH

# 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.



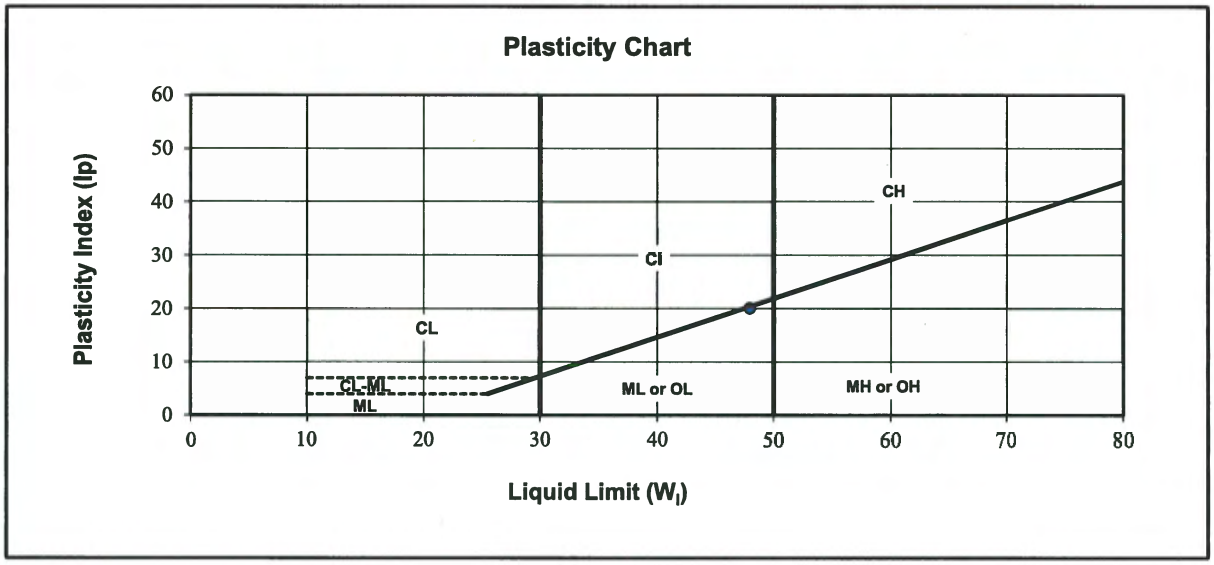
TETRA TECH

# 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.



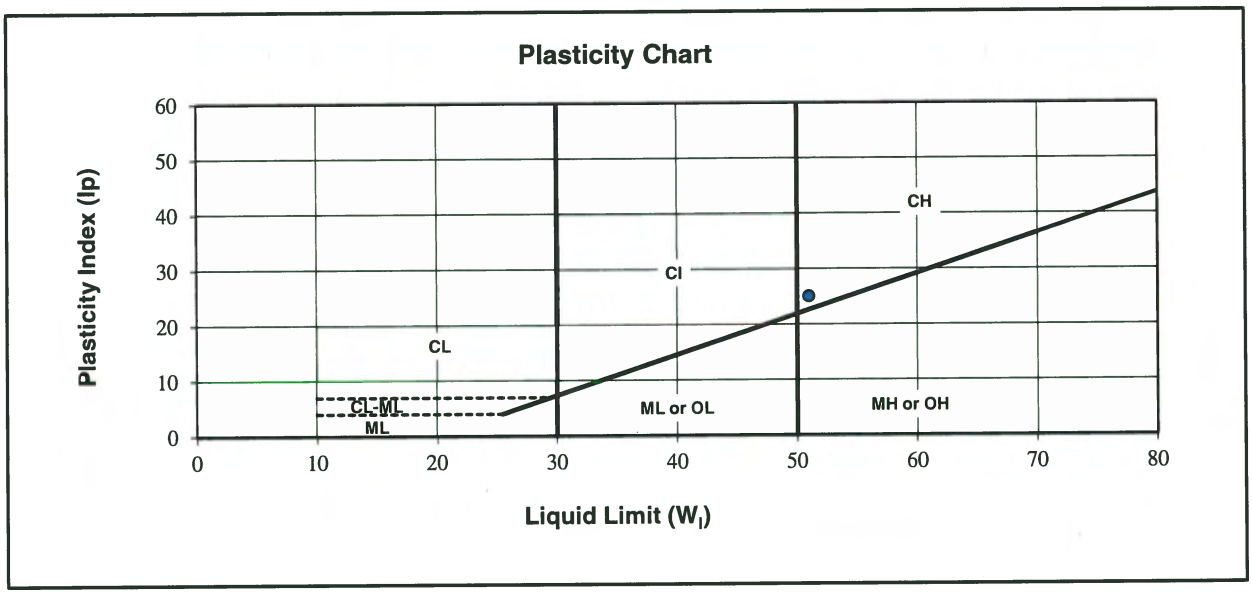
TETRA TECH

# 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 |
| Email: | See e-mail distribution | Tested By: | JB |
| | | 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.



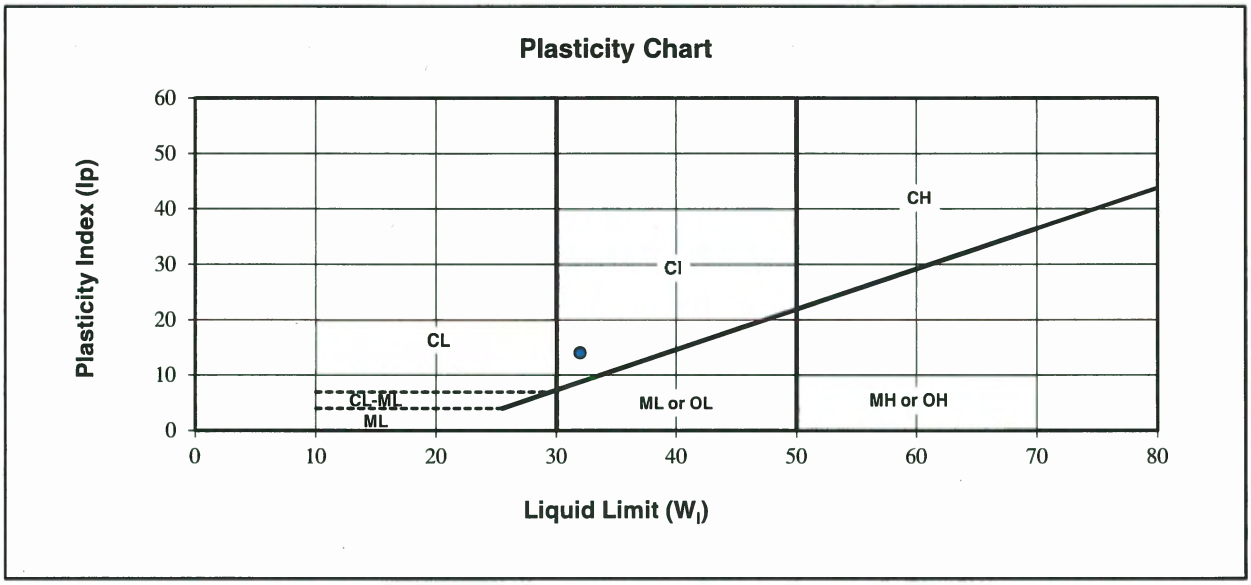
TETRA TECH

# 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.



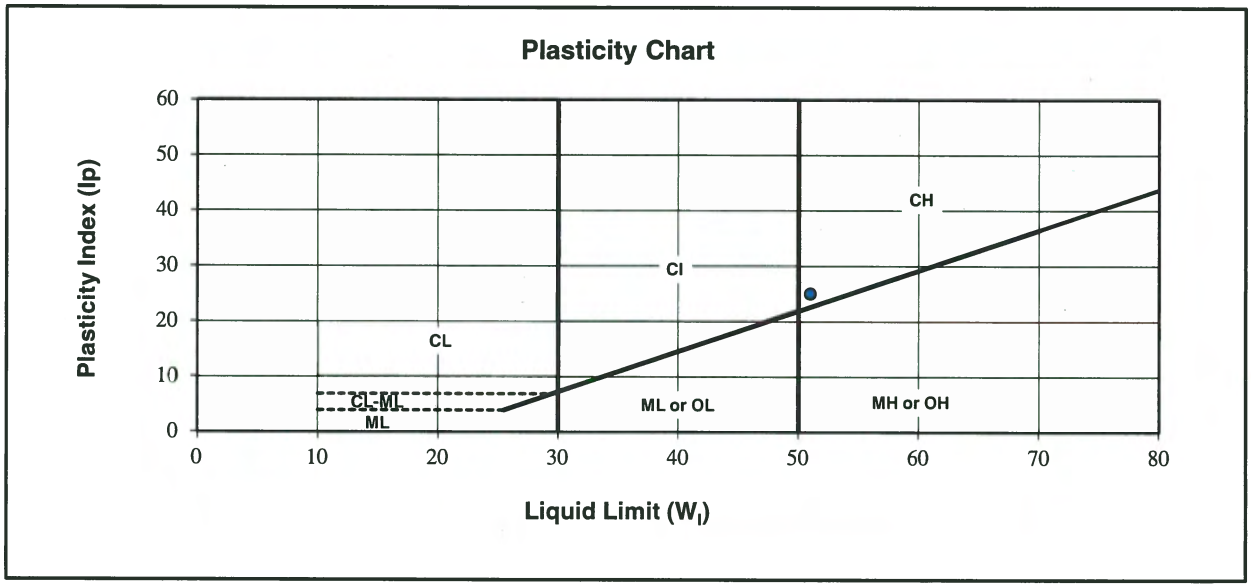
TETRA TECH

# 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.



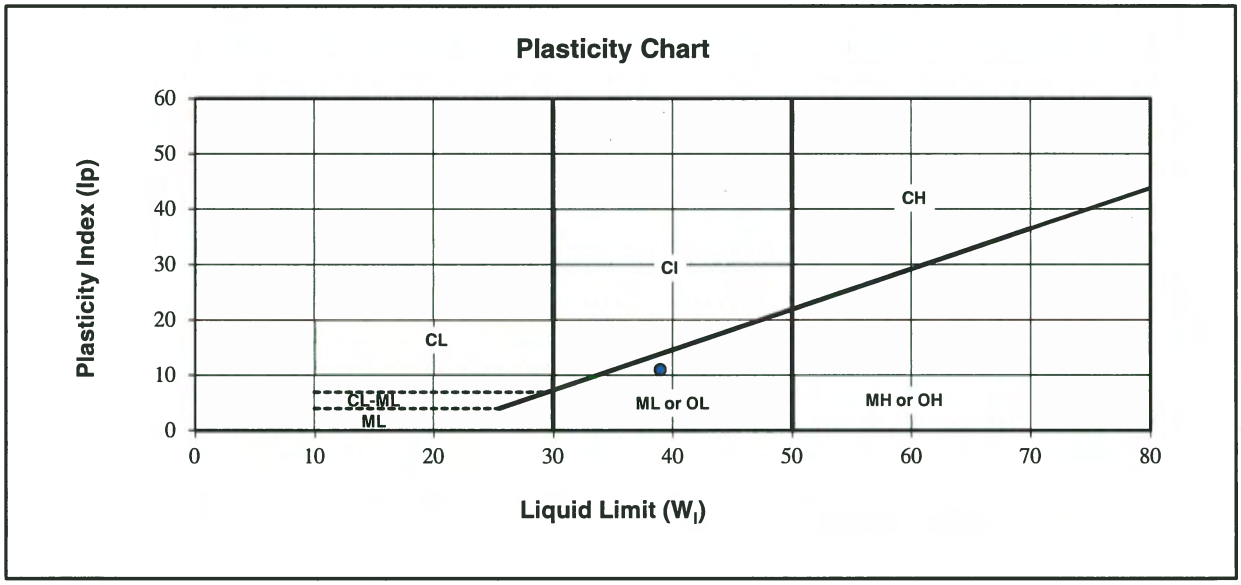
TETRA TECH

# 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.



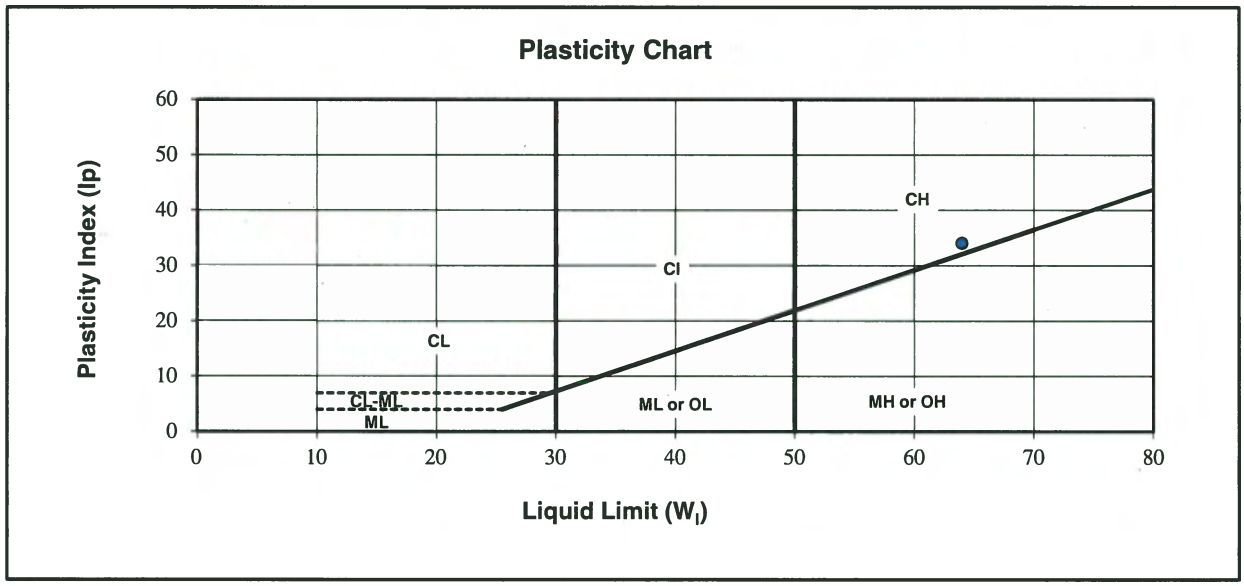
TETRA TECH

# 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.



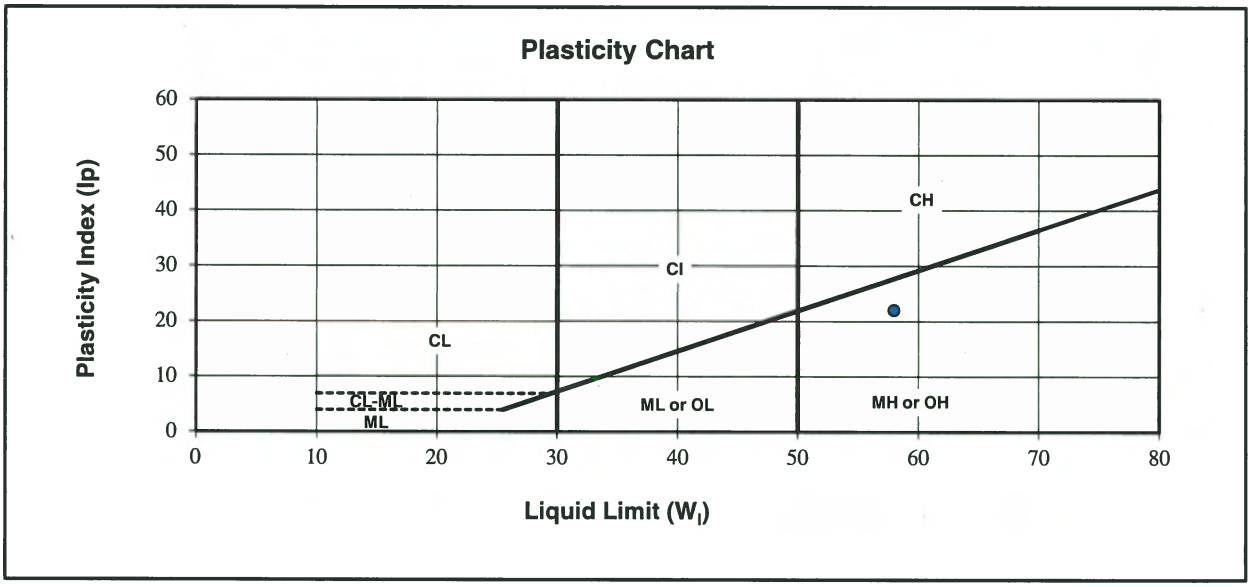
TETRA TECH

# 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

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

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

Any unauthorized use of the Professional Document is at the sole risk of the user. TETRA TECH accepts no responsibility whatsoever for any loss or damage where such loss or damage is alleged to be or, is in fact, caused by the unauthorized use of the Professional Document.

Where TETRA TECH has expressly authorized the use of the Professional Document by a third party (an "Authorized Party"), consideration for such authorization is the Authorized Party's acceptance of these Limitations on Use of this Document as well as any limitations on liability contained in the Contract with the Client (all of which is collectively termed the "Limitations on Liability"). The Authorized Party should carefully review both these Limitations on Use of this Document and the Contract prior to making any use of the Professional Document. Any use made of the Professional Document by an Authorized Party constitutes the Authorized Party's express acceptance of, and agreement to, the Limitations on Liability.

The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

### 1.2 ALTERNATIVE DOCUMENT FORMAT

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

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

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

### 1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

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

### 1.4 DISCLOSURE OF INFORMATION BY CLIENT

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

### 1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

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

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

### 1.6 GENERAL LIMITATIONS OF DOCUMENT

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

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

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

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

### 1.7 ENVIRONMENTAL AND REGULATORY ISSUES

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

### 1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

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

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

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

### 1.9 LOGS OF TESTHOLES

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

### 1.10 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

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

### 1.11 PROTECTION OF EXPOSED GROUND

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

### 1.12 SUPPORT OF ADJACENT GROUND AND STRUCTURES

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

### 1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

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

### 1.14 OBSERVATIONS DURING CONSTRUCTION

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

### 1.15 DRAINAGE SYSTEMS

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.