GEOTECHNICAL REPORT

FKC Grays Harbor
North Thornton Street and Sumner Avenue
Aberdeen, Washington

Project No. T-8215

Terra Associates, Inc.

Prepared for:

PCI HealthDev
Dallas, Texas

October 9, 2019

TERRA ASSOCIATES, Inc.
Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

October 9, 2019
Project No. T-8215

Mr. Alan Morris
PCI HealthDev
12655 N Central Expressway, Suite 200
Dallas, Texas 75243

Subject: Geotechnical Report
FKC Grays Harbor
North Thornton Street and Sumner Avenue
Aberdeen, Washington

Dear Mr. Morris:

As requested, we have conducted a geotechnical engineering study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

In general, soil conditions we observed at the test borings consisted of approximately two to six inches of topsoil overlying approximately three and one-half to four and one-half feet of very loose to loose inorganic fill composed of silty sand to sandy silty with varying gravel content overlying alluvial sediments composed of very soft to soft silt with varying amounts of sand to the termination of the test borings. The soils are generally moist to wet. There were two exceptions to this general condition. At Test Borings B-5 and B-6, we observed the native soils immediately under the topsoil layer. At Test Boring B-2, we observed three and one-half feet of loose, organic fill material overlying the native soils. We also observed tree logs during drilling of Test Borings B-2 and B-5 between depths of about four to ten feet. The deeper CPT data indicates these alluvial sediments are present to the 60-foot depth explored. The relative density of the deeper alluvial sand and silty sand layers increased to the medium dense to dense range. The groundwater was generally observed at depths ranging from two to seven and one-half feet below existing site grades.

In our opinion, the soil conditions we observed at the site will be suitable for support of the proposed development, provided the recommendations presented in this report are incorporated into project design and construction.

We trust the information provided in the attached report is sufficient for your current needs. If you have any questions or need additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

10-9-19

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Theodore J. Schepper, P.E.
President

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1.0 PROJECT DESCRIPTION

Based on review of a conceptual site plan prepared by Pagone + Associates, dated April 24, 2019, the project will consist of redeveloping the northern portion of the site with a single-story medical building and paved parking with additional paved parking constructed on the southern portion of the site. Based on existing site grades, we would expect grading to establish the building and exterior pavement elevations will be minor with cuts and fills generally ranging between one and five feet.

The structure is expected to be a one-story, wood- or metal-framed building constructed with slab-on-grade floor. Foundation loads should be relatively light in the range of 2 to 4 kips per foot for bearing walls and 50 to 75 kips for isolated columns.

The recommendations contained in the following sections of this report are based on the above design features. If actual features vary or changes are made, we should review them in order to modify our recommendations, as required. We should review the final design drawings and specifications to verify that our recommendations have been properly interpreted and incorporated into project design.

2.0 SCOPE OF WORK

Our work was completed in accordance with our authorized proposal, dated August 19, 2019. Accordingly, on September 11, 2019, we explored subsurface conditions at the site by drilling 6 test borings to a maximum depth of 26.5 feet below current site grades. On September 12, 2019, In-Situ Engineering, under subcontract with Terra Associates, Inc., performed 4 cone penetration tests (CPTs) to a maximum depth of about 60 feet below existing surface grades.

Using this data along with results of laboratory testing, we performed analyses to develop geotechnical recommendations for project design and construction. Specifically, this report addresses the following:

- Soil and groundwater conditions
- Seismic site class and liquefaction assessment
- Site preparation and grading
- Surcharge
- Excavations
- Foundations

- Slab-on-grade floors
- Drainage
- Infiltration feasibility
- Utilities
- Pavements

It should be noted that recommendations outlined in this report regarding drainage are associated with soil strength, design earth pressures, erosion, and stability. Design and performance issues with respect to moisture as it relates to the structure environment are beyond Terra Associates' purview. A building envelope specialist or contractor should be consulted to address these issues, as needed.

3.0 SITE CONDITIONS

3.1 Surface

The project site is an assemblage of several tax parcels totaling about 1.3 acres of land located at North Thornton Street and Sumner Avenue in Aberdeen, Washington. The approximate site location is shown on Figure 1.

The tax parcels are separated by an east to west alley access. Parcels north of the alley are developed with wood-framed single-family homes. The eastern parcel of the four tax parcels south of the alley is also developed with a single-story wood-framed structure. The remaining parcels are vacant. The site is relatively flat with areas outside of the buildings opened and grass covered.

3.2 Subsurface

In general, soil conditions we observed at the test borings consisted of approximately two to six inches of topsoil overlying approximately three and one-half to four and one-half feet of very loose to loose inorganic fill composed of silty sand to sandy silt with varying gravel content overlying alluvial sediments composed of very soft to soft silt with varying amounts of sand to the termination of the test borings. The soils are generally moist to wet. There were two exceptions to this general condition. At Test Borings B-5 and B-6, we observed the native soils immediately under the topsoil layer. At Test Boring B-2, we observed three and one-half feet of loose, organic fill material overlying the native soils. We also observed tree logs during drilling of Test Borings B-2 and B-5 between depths of about four to ten feet. The CPT data indicates these alluvial sediments are present to the 60-foot depth explored. The soft alluvial sediments are present to approximately 30 feet below current site grades. The relative density of the deeper alluvial sand and silty sand layers increased to the medium dense to dense range.

The *Geologic map of the Humptulips quadrangle and adjacent areas, Grays Harbor County, Washington* by W.W. Rau (1986), shows the site soils mapped as Quaternary deposits (Qd). The native soils observed in the test borings and CPTs are generally consistent with this geologic mapping

The preceding discussion is intended to be a brief review of the soil conditions observed at the site. More detailed descriptions are presented on the Test Boring and CPT Logs attached in Appendix A.

3.3 Groundwater

We observed groundwater in all of the test borings between four and one-half and seven and one-half feet below current site grades. We performed two pore water dissipation tests at CPT-1 and CPT-3. The test results indicate the static groundwater level to be located at depths ranging from two to three feet below existing site grades. Based on the groundwater observed and our experience in the area, we expect that the groundwater observed is a part of the regional groundwater table for the area. Fluctuations in the static groundwater level will occur seasonally. We would expect this groundwater to be present year-round with heavy groundwater seepage in the winter/spring months.

4.0 SEISMIC

Based on soil conditions noted in the subsurface explorations and our knowledge of the area geology, per Chapter 16 of the 2018 International Building Code (IBC), site class “E” should be used in structural design.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations. Liquefaction mainly affects geologically recent deposits of fine-grained sands underlying the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction; thus, eliminating the soil’s strength.

We completed a liquefaction analysis using the computer program LiquefyPro published by CivilTech Corporation. The analysis was completed using a ground acceleration value of 0.791g, which is the ASCE 7-16 site-modified peak ground acceleration value (PGA_M) determined using the map-based online ground motion parameter calculator at https://seismicmaps.org/ for Latitude 46.975665ºN and Longitude 123.834218ºW. The results of the liquefaction analysis are attached in Appendix B.

The results of our analysis indicate soil liquefaction could occur during the design earthquake event. Analysis indicates that liquefaction could result in total settlements ranging from 2 ¼ to 3 ¾ inches, one-half of which would likely be differential in nature. In our opinion, this amount of settlement would not structurally impact the building but would result in damage of a cosmetic nature. If the owner is not willing to accept the risk of cosmetic building damage requiring repair should liquefaction induced settlements occur, the foundations would need to be supported on ground improved using stone columns to mitigate soil liquefaction settlements below the building foundations.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

Based on our study, in our opinion, development of the site as proposed is feasible from a geotechnical engineering standpoint. The primary geotechnical concern at the site is the presence of compressible soil strata susceptible to consolidation under static dead loads imposed by the structure. If unmitigated, compression of these soft soils under project loads would result in unacceptable levels of differential settlement. To mitigate the potential for post-construction settlement due to this consolidation, we recommend surcharging the building location. Surcharging will involve placing five feet of surcharge fill above the finished floor grade and allowing settlements to occur under this load before building construction is initiated. In our opinion, surcharging of paved parking areas will also be necessary. Surcharging of paved areas should consist of a minimum of 24-inch surcharge fill placed above finished grade. As an alternative to this system, ground improvement using vibrated stone columns or rammed aggregate piers could be considered.

The existing very loose, inorganic fill material observed in Test Borings B-1, B-3, and B-4 will need to be scarified and recompacted in accordance with the recommendations outlined below. The loose, organic fill material observed in Test Boring B-2 will need to be removed from below all building elements and grade restored with new structural fill. The lateral extent of the recompaction and overexcavation will need to be determined in the field during grading.

Most of the soils encountered at the site contain a significant amount of soil fines and will be difficult to compact as structural fill when too wet. The ability to use native soil from site excavations as structural fill will depend on its moisture content and the prevailing weather conditions at the time of construction. If grading activities will take place during winter, the owner should be prepared to import free-drainage granular material for use as structural fill and backfill. Alternatively, stabilizing the moisture in the native and existing fill soils with cement or lime can be considered.

Detailed recommendations regarding these issues and other geotechnical design considerations are provided in the following sections. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 Site Preparation and Grading

To prepare the site for construction, all vegetation and organic surface soils, and other deleterious material should be stripped and removed from the site. Surface stripping depths of approximately two to six inches should be expected to remove the organic surface soils. Soil containing organic material will not be suitable for use as structural fill but may be used for limited depths in nonstructural areas. Demolition of existing structures should include removal of existing foundations and floor slabs and abandoned buried utilities. Abandoned utility pipes that fall outside of new building areas can be left in place provided they are sealed to prevent intrusion of groundwater seepage and soil.

Excavation depths of up to four feet should be expected in the vicinity of Test Boring B-2. The lateral extent of the overexcavation should be determined in the field during grading.

Once stripping and demolition operations are complete, cut and fill operations can be initiated to establish desired building grades. Prior to placing fill, all exposed bearing surfaces should be observed by a representative of Terra Associates, Inc. to verify soil conditions are as expected and suitable for support of new fill or building elements. Our representative may request a proofroll using heavy rubber-tired equipment to determine if any isolated soft and yielding areas are present. If excessively yielding areas are observed, and they cannot be stabilized in place by compaction, the affected soils should be excavated and removed to firm bearing and grade restored with new structural fill. If the depth of excavation to remove unstable soils is excessive, the use of geotextile fabrics, such as Mirafi 500X, or an equivalent fabric, can be used in conjunction with clean granular structural fill. Our experience has shown that, in general, a minimum of 18 inches of a clean, granular structural fill place and compacted over the geotextile fabric should establish a stable bearing surface

The native alluvial soils will not be suitable for immediate support of building elements. All building footings should obtain support on a minimum of two feet of granular structural fill that replaces the existing alluvial soils or existing fill material. The fill should extend laterally from the edge of footing a minimum distance of two feet. Slab-on-grade floors should be supported on a minimum of 12 inches of granular fill material that replaces the existing native and fill soils.

Our study indicates that the existing fills and native soils contain a sufficient percentage of fines, silt and clay size particles, that will make them difficult to compact as structural fill if they are too wet or too dry. Accordingly, the ability to use these native soils from site excavations as structural fill will depend on their moisture content and the prevailing weather conditions when site grading activities take place. Soils that are too wet to properly compact could be dried by aeration during dry weather conditions or mixed with an additive such as cement or lime to stabilize the soil and facilitate compaction. If an additive is used, additional Best Management Practices (BMPs) for its use will need to be incorporated into the Temporary Erosion and Sedimentation Control plan (TESC) for the project.

If grading activities are planned during the wet winter months, or if they are initiated during the summer and extend into fall and winter, the contractor should be prepared to import wet weather structural fill. For this purpose, we recommend importing a granular soil that meets the following grading requirements:

U.S. Sieve Size	**Percent Passing**
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

*Based on the 3/4-inch fraction.

Prior to use, Terra Associates, Inc. should examine and test all materials to be imported to the site for use as structural fill.

Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-698 (Standard Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this ASTM standard. In nonstructural areas, the degree of compaction can be reduced to 90 percent.

Surcharge Program

The surcharge program discussed above will consist of placing fill material over the building footprint and paved parking areas to pre-consolidate the compressible soils. The amount and rate of settlement is monitored, and once primary settlements have occurred, the surcharge is removed. For this procedure, we recommend placing a minimum of five feet of surcharge fill in the building area above the finished floor grade. The surcharge fill should extend a minimum of five feet beyond the outside edge of the perimeter building footing. Paved parking areas should be surcharged with a minimum 24-inch fill placed above the finished elevation. The surcharge fill does not need to meet any special requirements other than having a minimum in place unit weight of 120 pounds per cubic foot (pcf). However, it would be advisable to use a good quality structural fill for use in raising grades in other portions of the site, such as parking and driveway areas, if necessary.

We estimate that total settlement under the building surcharge fill will be in the range of 14 to 20 inches. Total settlement under the pavement surcharge fill is estimated in the range of four to six inches. It is estimated that 90 percent of the consolidation settlement will occur in about 6 to 8 weeks following full application of the surcharge.

To evaluate the amount of settlement and the time rate of movement, the surcharge program should be monitored by installing settlement markers. The settlement markers should be installed on the existing grade prior to placing any fill. Once installed, elevations of both the fill height and marker should be taken daily until the full height of the surcharge is in place. Once fully surcharged, readings should continue weekly until the anticipated settlements have occurred. Monitoring data should be forwarded to us within two days after it is obtained for review and comment. A typical settlement marker detail is shown on Figure 3.

It is critical that the grading contractor recognize the importance of the settlement marker installations. All efforts must be made to protect the markers from damage during fill placement. It is difficult, if not impossible, to evaluate the progress of the surcharge program if the markers are damaged or destroyed by construction equipment. If the markers are impacted, it may be necessary to install new markers and extend the surcharging time period in order to ensure that settlements have ceased and building construction can begin.

5.3 Excavations

All excavations at the site associated with confined spaces, such as those for utility construction, must be completed in accordance with local, state, or federal requirements. Based on current Washington Industrial Safety and Health Act (WISHA) regulations, soils observed at the project site would be classified as Type C soils.

For properly dewatered excavations more than 4 feet, but less than 20 feet in depth, the side slopes should be laid back at an inclination no steeper than 1.5:1 (Horizontal:Vertical). If there is insufficient space to complete the excavations in this manner, or if excavations greater than 20 feet in depth are planned, temporary shoring to support the excavations may be required. Properly designed and installed shoring trench boxes can be used to support utility trench excavations where required.

Groundwater should be anticipated within excavations extending below depths of about two feet below existing surface grades. Excavations extending below this depth will likely encounter groundwater with volumes and flow rates sufficient to require some level of dewatering. Shallow excavations that do not extend more than two to three feet below the groundwater table can likely be dewatered by conventional sump-pumping procedures along with a system of collection trenches. Deeper excavations will require dewatering by closely spaced well points. This will be an especially critical consideration for any deep excavations such for lift stations and sanitary sewer tie-ins.

This information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Terra Associates, Inc. assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

5.4 Foundations

As discussed earlier, the soils underlying the existing fill are compressible and, in our opinion, will not be suitable for immediate support of conventional spread footing foundations for the expected building loads. Therefore, following a successful surcharge program, we recommend supporting the buildings on conventional spread footing foundations bearing on a minimum of two feet of granular structural fill that replaces the existing soils. As an alternative to this system ground improvement using vibrated stone columns or rammed aggregate piers could be considered.

Spread Footings

Following a successful surcharge program, the buildings may be supported on conventional spread footing foundations bearing on a minimum of two feet of granular structural fill. Foundations exposed to the weather should bear at a minimum depth of 1.5 feet below adjacent grades for frost protection. Interior foundations can be supported at any convenient depth below the floor slab, provided immediate support is obtained on a minimum of two feet of granular structural fill.

We recommend designing foundations for a net allowable bearing capacity of 2,000 psf. For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used. Following successful completion of the surcharge program with the expected building loads and this bearing stress applied, total and differential settlements due to static loading should not exceed one-inch and one-half inch, respectively.

For designing foundations to resist lateral loads, a base friction coefficient of 0.30 can be used. Passive earth pressures acting on the sides of the footings can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 300 pcf. We do not recommend including the upper 12 inches of soil in this computation because it can be affected by weather or disturbed by future grading activity. This value assumes the foundation will be backfilled with structural fill, as described in Section 5.2 of this report. The values recommended include a safety factor of 1.5.

Ground Improvement

As an alternative to surcharging, building foundations can be supported on improved ground using vibrated stone columns or rammed aggregate piers. This method creates highly densified columns of graded aggregate that would extend through the upper softer soils into the underlying medium dense to dense silty sand and sand layers. Because of the methods used to construct the columns, some improvement of the adjacent soils is also realized. Moreover, these methods can provide liquefaction mitigation by providing drainage paths and reduced pore pressures during ground shaking, and by constructing stiff, non-liquefiable inclusions in the soils. Once constructed, conventional spread footing foundations can be designed to bear immediately above the stone column.

These ground improvement techniques are typically completed on a design/build approach with both design and construction completed by a specialty contractor. We can assist in contracting and selecting the specialty contractor, if desired.

5.5 Slab-on-Grade Floors

Slab-on-grade floors should be supported on a minimum of 12 inches of granular structural fill that replaces the existing soils. Immediately below the floor slab, we recommend placing a four-inch thick capillary break layer composed of clean, coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and to aid in uniform curing of the concrete slab. It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will not be effective in assisting uniform curing of the slab and can actually serve as a water supply for moisture bleeding through the slab, potentially affecting floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained. We recommend floor designers and contractors refer to the current American Concrete Institute (ACI) Manual of Concrete Practice for further information regarding vapor barrier installation below slab-on-grade floors.

With subgrade prepared as recommended, for design of the floor slab for storage rack loading and lift truck vehicle traffic, a subgrade modulus of 80 pounds per square inch per inch of deflection (pci) can be used.

5.6 Infiltration Feasibility

Based on our study, it is our opinion that subsurface conditions are generally not favorable for infiltration of site stormwater. The native soils observed at the site contain a high percentage of soil fines that would impede any downward migration of site stormwater. In addition, the presence of shallow groundwater would further impede the downward migration of stormwater. Even low impact development (LID) techniques would likely fill up and overtop during rain events and cause minor local flooding.

5.7 Drainage

Surface

Final exterior grades should promote free and positive drainage away from the site at all times. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building areas. We recommend providing a positive drainage gradient away from the building perimeters. If this gradient cannot be provided, surface water should be collected adjacent to the structures and disposed to appropriate storm facilities.

Subsurface

In our opinion, with floor slabs at or elevated above the adjacent exterior grade, and positive drainage away from the structure maintained, in our opinion, installation of conventional perimeter foundation drains would not be necessary for the industrial grade building.

If positive drainage away from the building perimeters is not provided or where landscaping is completed adjacent the buildings, we recommend installing a continuous drain along the outside lower edge of the perimeter building foundations. The drains can be laid to grade at an invert elevation equivalent to the bottom of footing grade. The drains can consist of four-inch diameter perforated PVC pipe that is enveloped in washed ½- to ¾-inch gravel-sized drainage aggregate. The aggregate should extend six inches above and to the sides of the pipe. The foundation drains and roof downspouts should be tightlined separately to an approved point of controlled discharge. All drains should be provided with cleanouts at easily accessible locations. These cleanouts should be serviced at least once each year.

5.8 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) or local jurisdictional requirements. At minimum, trench backfill should be placed and compacted as structural fill as described in Section 5.2 of this report. As noted, soils excavated on-site should generally be suitable for use as backfill material during dry weather. However, the native site soils are fine grained and moisture sensitive. Therefore, moisture conditioning may be necessary to facilitate proper compaction. If utility construction takes place during the winter, it may be necessary to import suitable wet weather fill for utility trench backfilling.

The utility contractor should also be prepared for encountering unstable soft alluvial soils below the pipe invert elevations. If not removed from below the pipe and replaced with crushed rock or additional bedding material, pipe deflections may occur as a result of the soil yielding and compressing in response to loading imposed during trench backfilling. The need to overexcavate and stabilize the pipe foundation before backfilling should be evaluated by observation and testing during construction.

5.9 Pavements

Pavement subgrade should be prepared as described in the Section 5.2 of this report. Regardless of the degree of relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. The subgrade should be proofrolled with heavy rubber-tire construction equipment such as a loaded 10-yard dump truck to verify this condition.

The pavement design section is dependent upon the supporting capability of the subgrade soils and the traffic conditions to which it will be subjected. For access, with traffic consisting mainly of light passenger vehicles with only occasional heavy traffic, and with a stable subgrade prepared as recommended, we recommend the following pavement sections:

- Two inches of hot mix asphalt (HMA) over six inches of crushed rock base (CRB)
- Full depth four inches of HMA over prepared subgrade

The paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for ½-inch class HMA and CRB.

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability. For optimum pavement performance, we recommend surface drainage gradients of at least two percent. Some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

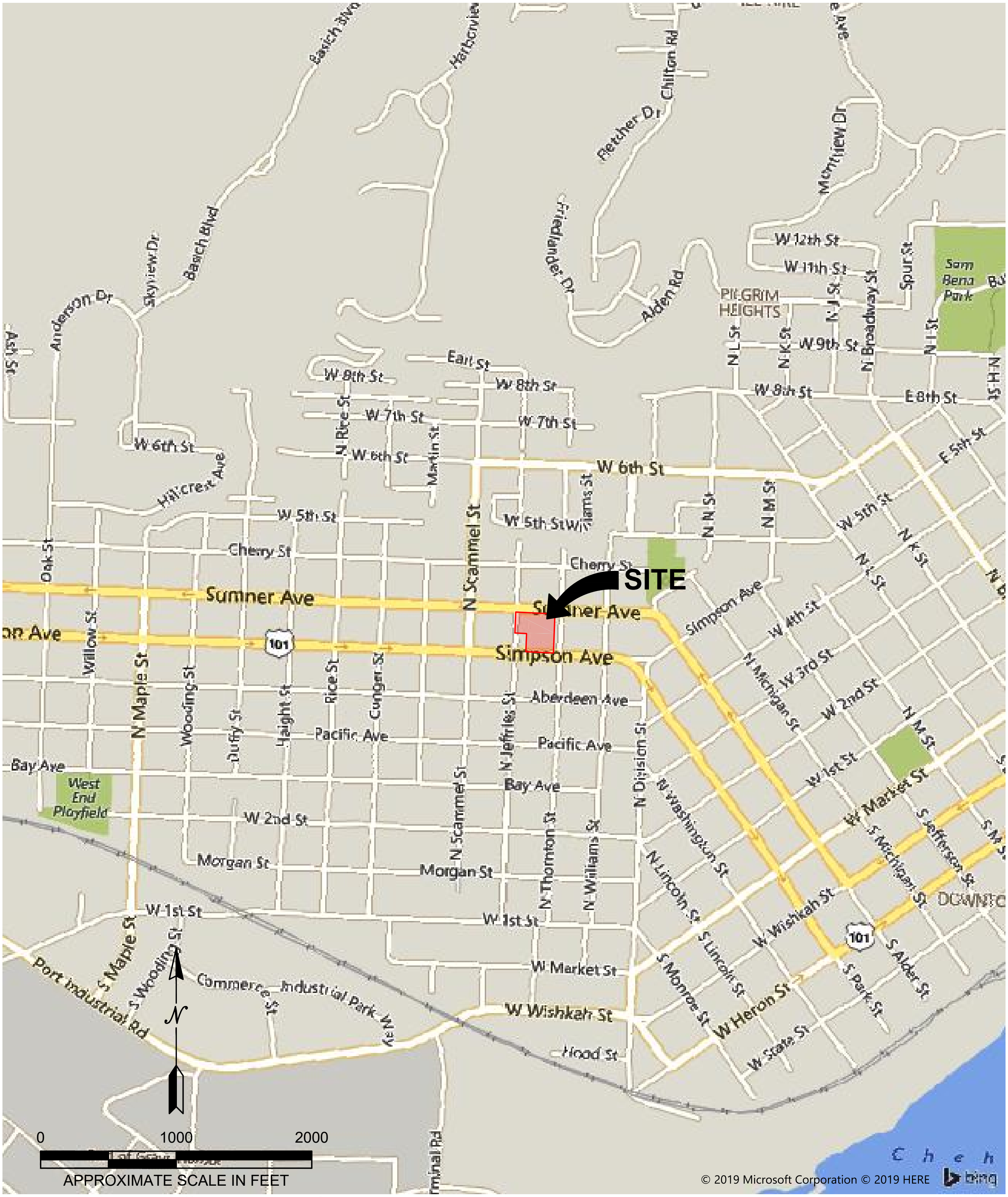
6.0 ADDITIONAL SERVICES

Terra Associates, Inc. should review project designs and specifications to verify that earthwork and foundation recommendations have been properly interpreted and incorporated into project design. We should also provide geotechnical services during construction to observe compliance with our design concepts, specifications, and recommendations. This will allow for expedient design changes if subsurface conditions differ from those anticipated prior to the start of construction.

7.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made. This report is the copyrighted property of Terra Associates, Inc. and is intended for specific application to the FKC Grays Harbor project in Aberdeen, Washington. This report is for the exclusive use of PCI HealthDev and their authorized representatives.

The analyses and recommendations presented in this report are based on data obtained from the subsurface explorations completed on-site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, Terra Associates, Inc. should be requested to reevaluate the recommendations in this report prior to proceeding with construction.



REFERENCE: https://www.bing.com/maps

ACCESSED 10/8/19

Terra Associates, Inc.

Consultants in Geotechnical Engineering
Geology and
Environmental Earth Sciences

VICINITY MAP
FKC GRAYS HARBOR
ABERDEEN, WASHINGTON

Proj.No. T-8215	Date: OCT 2019	Figure 1

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NOTE:

THIS SITE PLAN IS SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.

REFERENCE: SITE PLAN PROVIDED BY https://www.bing.com/maps.

LEGEND:

◐ APPROXIMATE BORING LOCATION

⊕ APPROXIMATE CONE PENETRATION TEST LOCATION

0 50 100

APPROXIMATE SCALE IN FEET

N

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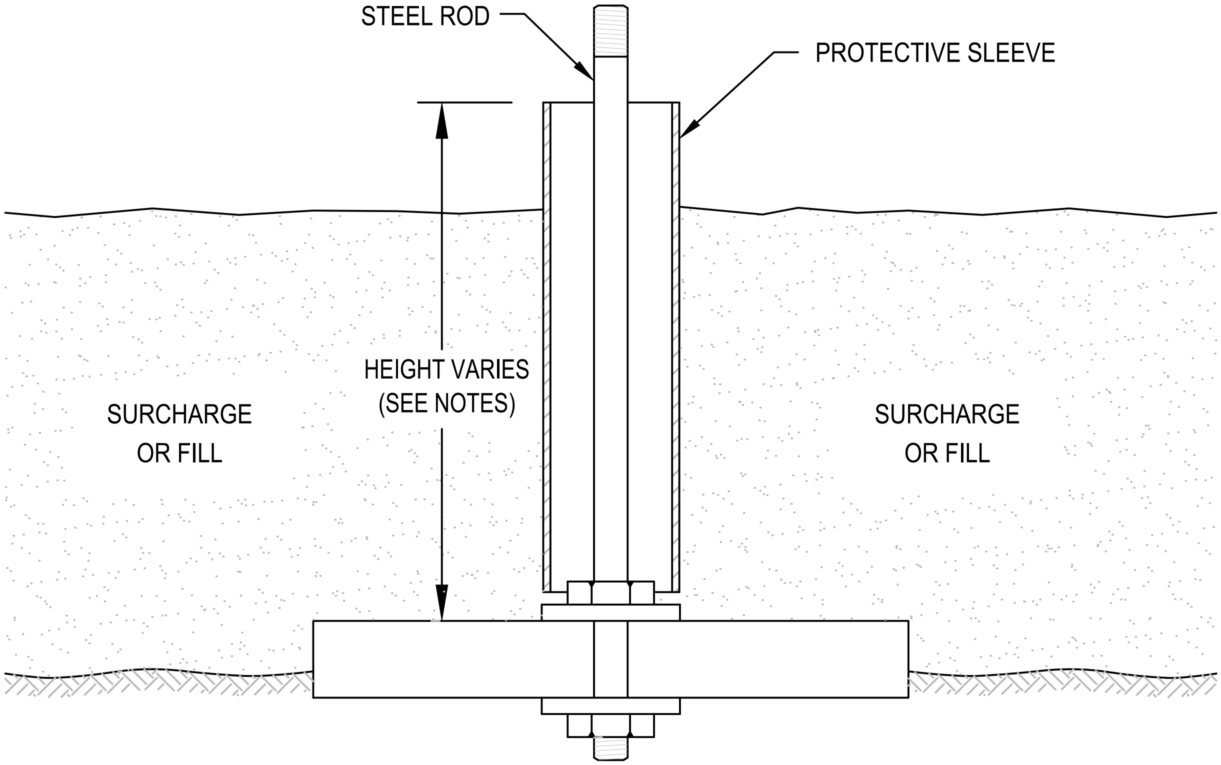
Environmental Earth Sciences

EXPLORATION LOCATION PLAN
FKC GRAYS HARBOR
ABERDEEN, WASHINGTON

Proj.No. T-8215 | Date: OCT 2019 | Figure 2



NOT TO SCALE

NOTES:

1. BASE CONSISTS OF 3/4" THICK, 2'x2' PLYWOOD WITH CENTER DRILLED 5/8" DIAMETER HOLE.
2. BEDDING MATERIAL, IF REQUIRED, SHOULD CONSIST OF CLEAN COARSE SAND.
3. MARKER ROD IS 1/2" DIAMETER STEEL ROD THREADED AT BOTH ENDS.
4. MARKER ROD IS ATTACHED TO BASE BY NUT AND WASHER ON EACH SIDE OF BASE.
5. PROTECTIVE SLEEVE SURROUNDING MARKER ROD SHOULD CONSIST OF 2" DIAMETER PLASTIC TUBING. SLEEVE IS NOT ATTACHED TO ROD OR BASE.
6. ADDITIONAL SECTIONS OF STEEL ROD CAN BE CONNECTED WITH THREADED COUPLINGS.
7. ADDITIONAL SECTIONS OF PLASTIC PROTECTIVE SLEEVE CAN BE CONNECTED WITH PRESS-FIT PLASTIC COUPLINGS.
8. STEEL MARKER ROD SHOULD EXTEND AT LEAST 6" ABOVE TOP OF PLASTIC PROTECTIVE SLEEVE.
9. PLASTIC PROTECTIVE SLEEVE SHOULD EXTEND AT LEAST 1" ABOVE TOP OF FILL SURFACE.

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Associates, Inc.
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Geology and
Environmental Earth Sciences

SETTLEMENT MARKER DETAIL
FKC GRAYS HARBOR
ABERDEEN, WASHINGTON

Proj.No. T-8215	Date: OCT 2019	Figure 3

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

FKC Grays Harbor
Aberdeen, Washington

On September 11, 2019, we completed our site exploration by observing soil and groundwater conditions at 6 test borings. The test borings were drilled to a maximum depth of approximately 26.5 feet below existing site grades. Test boring locations were determined in the field by measuring from existing site features and using GPS coordinates from Google Earth. The approximate location of the test borings is shown on the attached Exploration Location Plan, Figure 2. Test Boring Logs are attached as Figures A-2 through A-7.

A geotechnical engineer from our office conducted the field exploration. Our representative classified the soil conditions encountered, maintained a log of each test boring, obtained representative soil samples, and recorded water levels observed during excavation. During drilling, soil samples were obtained in general accordance with ASTM Test Designation D-1586. Using this procedure, a 2-inch (outside diameter) split barrel sampler is driven into the ground 18 inches using a 140-pound hammer free falling a height of 30 inches. The number of blows required to drive the sampler 12 inches after an initial 6-inch set is referred to as the Standard Penetration Resistance value or N value. This is an index related to the consistency of cohesive soils and relative density of cohesionless materials. N values obtained for each sampling interval are recorded on the Test Boring Logs, Figures A-2 through A-7. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described on Figure A-1.

Representative soil samples obtained from the test borings were placed in sealed plastic bags and taken to our laboratory for further examination and testing. The moisture content of selected samples was measured and is reported on the corresponding Test Boring Logs. Grain size analyses were also performed on select samples. The results are shown on Figures A-8 and A-9.

On September 12, 2019, InSitu Engineering, under subcontract with Terra Associates, Inc. conducted 4 electric CPTs at locations selected by Terra Associates, Inc. which are shown on Figure 2. The CPTs were advanced to a maximum depth of 60 feet below the surface. The CPT is an instrumented approximately 1 ½-inch diameter cone that is pushed into the ground at a constant rate. During advancement, continuous measurements are made of the resistance to penetration of the cone and the friction of the outer surface of the sleeve. The cone is also equipped with a porous filter and a pressure transducer for measuring groundwater or pore water pressure generated. Measurements of tip and sleeve frictional resistance, pore pressure, and interpreted soil conditions are summarized in graphical form on the attached CPT Logs.

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS More than 50% material larger than No. 200 sieve size	**GRAVELS** More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, sands with gravel, little or no fines.
			SP	Poorly-graded sands, sands with gravel, little or no fines.
		Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS More than 50% material smaller than No. 200 sieve size	**SILTS AND CLAYS** Liquid Limit is less than 50%		ML	Inorganic silts, rock flour, clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity. (Lean clay)
			OL	Organic silts and organic clays of low plasticity.
	SILTS AND CLAYS Liquid Limit is greater than 50%		MH	Inorganic silts, elastic.
			CH	Inorganic clays of high plasticity. (Fat clay)
			OH	Organic clays of high plasticity.
HIGHLY ORGANIC SOILS			PT	Peat.

DEFINITION OF TERMS AND SYMBOLS

COHESIONLESS

Density	Standard Penetration Resistance in Blows/Foot
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

COHESIVE

Consistancy	Standard Penetration Resistance in Blows/Foot
Very Soft	0-2
Soft	2-4
Medium Stiff	4-8
Stiff	8-16
Very Stiff	16-32
Hard	>32

⌶	2" OUTSIDE DIAMETER SPILT SPOON SAMPLER
Ⅱ	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
▼	WATER LEVEL (Date)
Tr	TORVANE READINGS, tsf
Pp	PENETROMETER READING, tsf
DD	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot

Terra Associates, Inc.
Consultants in Geotechnical Engineering
Geology and
Environmental Earth Sciences

UNIFIED SOIL CLASSIFICATION SYSTEM
FKC GRAYS HARBOR
ABERDEEN, WASHINGTON

Proj.No. T-8215 | Date: OCT 2019 | Figure A-1

LOG OF BORING NO. B-1

Figure No. A-2

Project: FKC Grays Harbor **Project No:** T-8215 **Date Drilled:** September 11, 2019

Client: PCI HealthDev **Driller:** Boretec **Logged By:** HM

Location: Aberdeen, Washington **Depth to Groundwater:** 5.5 Feet **Approx. Elev:** N/A

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot 10 30 50	Moisture Content (%)
0					
		(4 inches of Topsoil) Fill: Brown silty SAND with gravel, fine to coarse sand, fine gravel, moist, scattered organics. (SM)	Very Loose	2	15.7
		*At 5 feet observed minor amounts of wood debris.			
▼ 5		Gray SILT with sand to SILT, fine sand, wet, minor wood fragments. (ML)	Very Soft	1	86.1
				1	83.6
		*At 9 feet observed 0.5-foot thick layer of PEAT.			185.4
10				1	93
			Soft	2	60.3
15				3	48.6
20			Very Soft	1	71.2
25				1	67.6
		Test boring terminated at 26.5 feet. Groundwater observed at 5.5 feet during drilling.			
30					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. B-2

Figure No. A-3

Project: FKC Grays Harbor **Project No:** T-8215 **Date Drilled:** September 11, 2019

Client: PCI HealthDev **Driller:** Boretec **Logged By:** HM

Location: Aberdeen, Washington **Depth to Groundwater:** 7.5 Feet **Approx. Elev:** N/A

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot 10 30 50	Moisture Content (%)
0					
		(4 inches of Topsoil) Fill: Brown silty SAND with gravel, fine to coarse sand, fine gravel, moist, heavy organic inclusions and wood debris within bottom 2 feet. (SM)	Loose		16.2
	I			9	250.5
5	I	Gray SILT with sand to SILT, fine sand, wet, observed tree logs within upper 3 feet. (ML)	Soft	2	
▼	I			1	124.8
		*At 9 feet observed minor to heavy amounts of wood debris.	Very Soft		
10	I			1	110.2
	I			2	69.8
15	I		Soft	2	54.1
20	I		Very Soft	1	67.3
		*At 22 feet observed minor amounts of wood debris.			
25	I		Soft	2	67.1
		Test boring terminated at 26.5 feet. Groundwater observed at 7.5 feet during drilling.			
30					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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Environmental Earth Sciences

LOG OF BORING NO. B-3

Figure No. A-4

Project: FKC Grays Harbor **Project No:** T-8215 **Date Drilled:** September 11, 2019

Client: PCI HealthDev **Driller:** Boretec **Logged By:** HM

Location: Aberdeen, Washington **Depth to Groundwater:** 4.5 Feet **Approx. Elev:** N/A

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot (10 30 50)	Moisture Content (%)
0		(5 inches of Topsoil) Fill: Brown to black silty SAND to sandy SILT, fine to medium sand, moist, minor pieces of broken glass and plastic observed at 4 feet. (SM/ML)			
	├		Very Loose		47.1
	│			● 3	
	┴				128.1
▼					
5	├	Gray SILT with sand to SILT, fine sand, wet, minor wood debris. (ML)		● 1	92.4
	┴		Very Soft		
				● 1	
	├				69.8
	┴				
10	├		Soft	● 2	75.3
		*At 11 feet observed heavy amounts of wood debris.			
	┴	Test boring terminated at 11.5 feet. Groundwater observed at 4.5 feet during drilling.			
15					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. B-4

Figure No. A-5

Project: FKC Grays Harbor **Project No:** T-8215 **Date Drilled:** September 11, 2019

Client: PCI HealthDev **Driller:** Boretec **Logged By:** HM

Location: Aberdeen, Washington **Depth to Groundwater:** 5 Feet **Approx. Elev:** N/A

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot 10 30 50	Moisture Content (%)
0		(6 inches of Topsoil) Fill: Brown silty SAND to sandy SILT, fine, medium sand, moist, few gravel, scattered organics. (SM/ML)	Very Loose		
	┃				55.1
				● 4	
▼ 5	┃	Brown to gray sandy SILT to SILT, fine sand, wet, minor to moderate wood debris within upper 5 feet. (ML)	Very Soft	● 1	119
				● 1	
	┃				90
10	┃		Soft	● 3	71.3
		Test boring terminated at 11.5 feet. Groundwater observed at 5 feet during drilling.			
15					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. B-5

Figure No. A-6

Project: FKC Grays Harbor **Project No:** T-8215 **Date Drilled:** September 11, 2019

Client: PCI HealthDev **Driller:** Boretec **Logged By:** HM

Location: Aberdeen, Washington **Depth to Groundwater:** 6.5 Feet **Approx. Elev:** N/A

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot 10 30 50	Moisture Content (%)
0					
		(2 inches of Topsoil) Brown-gray SILT with sand to SILT, fine sand, moist to wet. (ML)	Soft		
				2	
5			Very Soft	1	
▼		*At depths ranging from 6.5 feet to 9 feet observed scattered wood fragments.			
				1	
					66
		*At 10 feet observed tree logs.	Soft		
10				2	91.2
		Test boring terminated at 11.5 feet. Groundwater observed at 6.5 feet during drilling.			
15					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. B-6

Figure No. A-7

Project: FKC Grays Harbor **Project No:** T-8215 **Date Drilled:** September 11, 2019

Client: PCI HealthDev **Driller:** Boretec **Logged By:** HM

Location: Aberdeen, Washington **Depth to Groundwater:** 5 Feet **Approx. Elev:** N/A

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot 10 30 50	Moisture Content (%)
0		(3 inches of crushed spalls) Brown to gray SILT with sand to SILT, fine sand, moist to wet, minor to heavy amounts of wood debris. (ML)	Soft		
	I			● 4	
▼ 5	I		Very Soft	● 1	75.4
	I			● 1	78.4
10	I		Soft	● 2	69.9
		Test boring terminated at 11.5 feet. Groundwater observed at 5 feet during drilling.			
15					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

Terra Associates, Inc.
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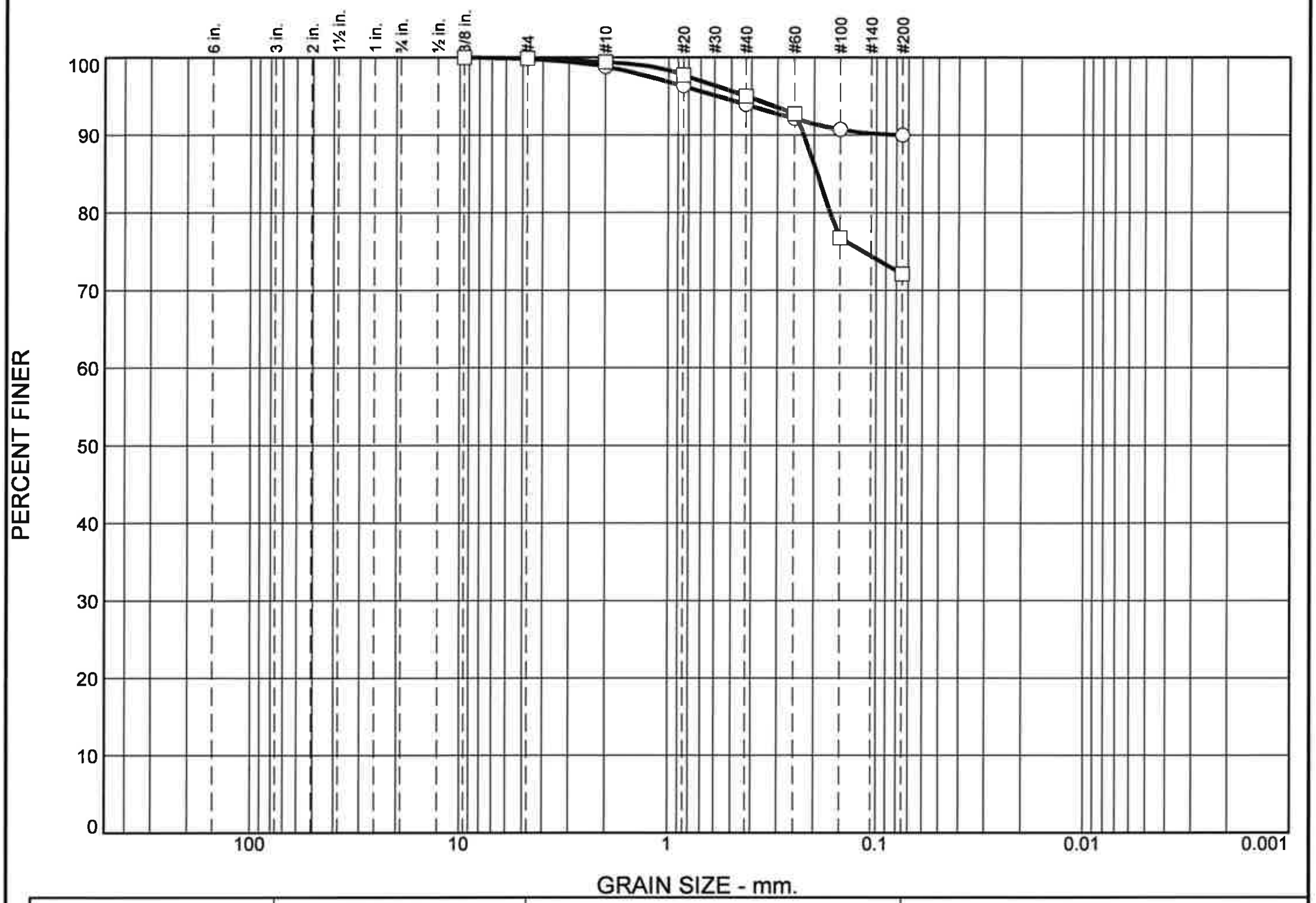
Geology and
Environmental Earth Sciences

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.2	1.0	4.9	3.9	90.0	
☐	0.0	0.0	0.1	0.5	4.4	22.9	72.1	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										
☐			0.1934							

Material Description	USCS	AASHTO
○ SILT	ML	
☐ SILT with sand	ML	

Project No. T-8215 **Client:** PCI HealthDev

Project: FKC Grays Harbor

Aberdeen, WA

○ **Location:** B-1 **Depth:** -7.5 feet **Sample Number:** 3

☐ **Location:** B-1 **Depth:** -15 feet **Sample Number:** 6

Remarks:

○Tested on September 25, 2019

☐Tested on September 25, 2019

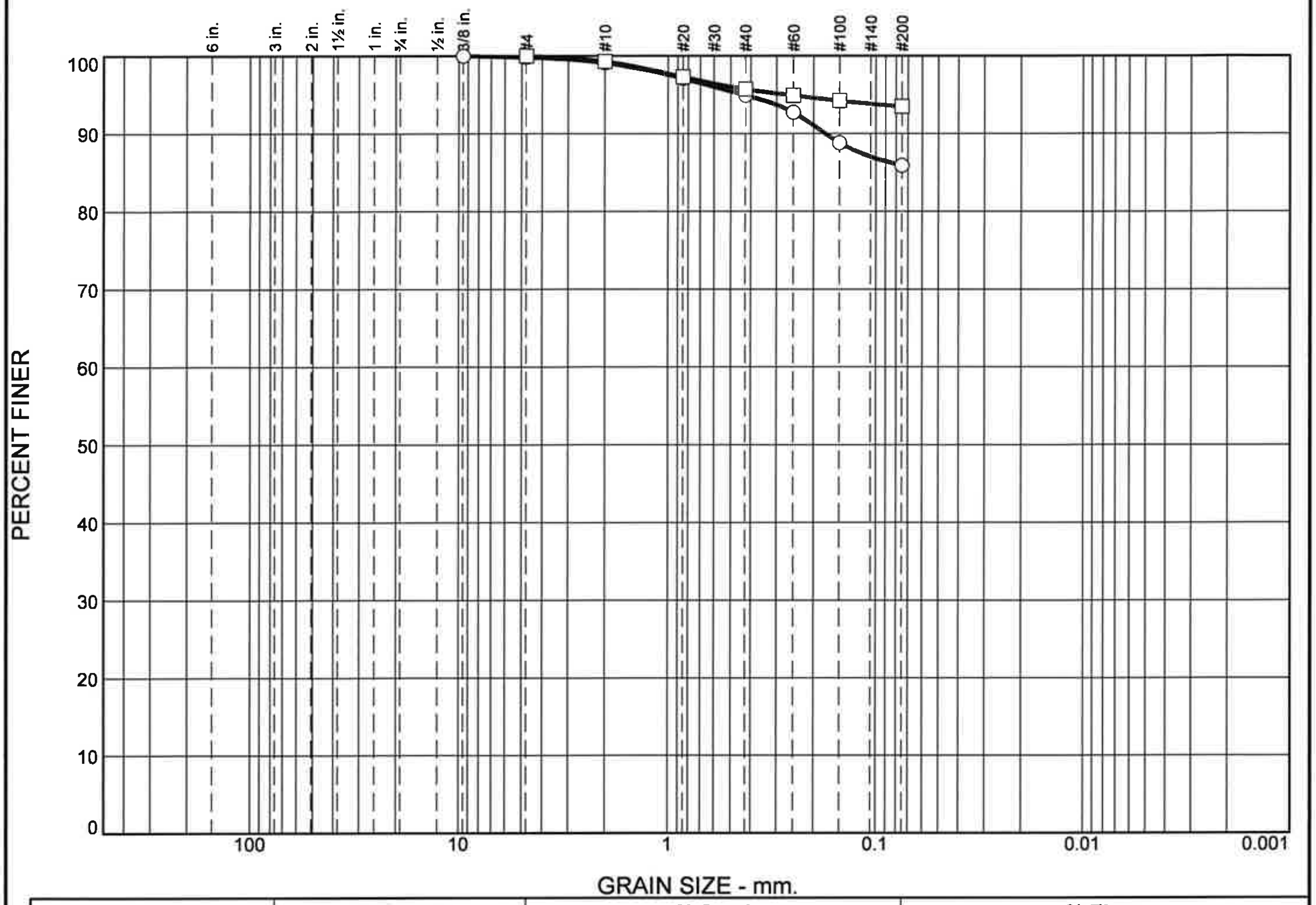
Terra Associates, Inc.

Kirkland, WA

Figure A-8

Tested By: FQ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.2	0.7	4.2	9.0	85.9	
□	0.0	0.0	0.0	0.7	3.6	2.2	93.5	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○										
□										

Material Description	USCS	AASHTO
○ SILT	ML	
□ SILT	ML	

Project No. T-8215 **Client:** PCI HealthDev

Project: FKC Grays Harbor

Aberdeen, WA

○ **Location:** B-2 **Depth:** -12.5 feet **Sample Number:** 5

□ **Location:** B-5 **Depth:** -7.5 feet **Sample Number:** 3

Remarks:

○Tested on September 25, 2019

□Tested on September 25, 2019

Terra Associates, Inc.

Kirkland, WA

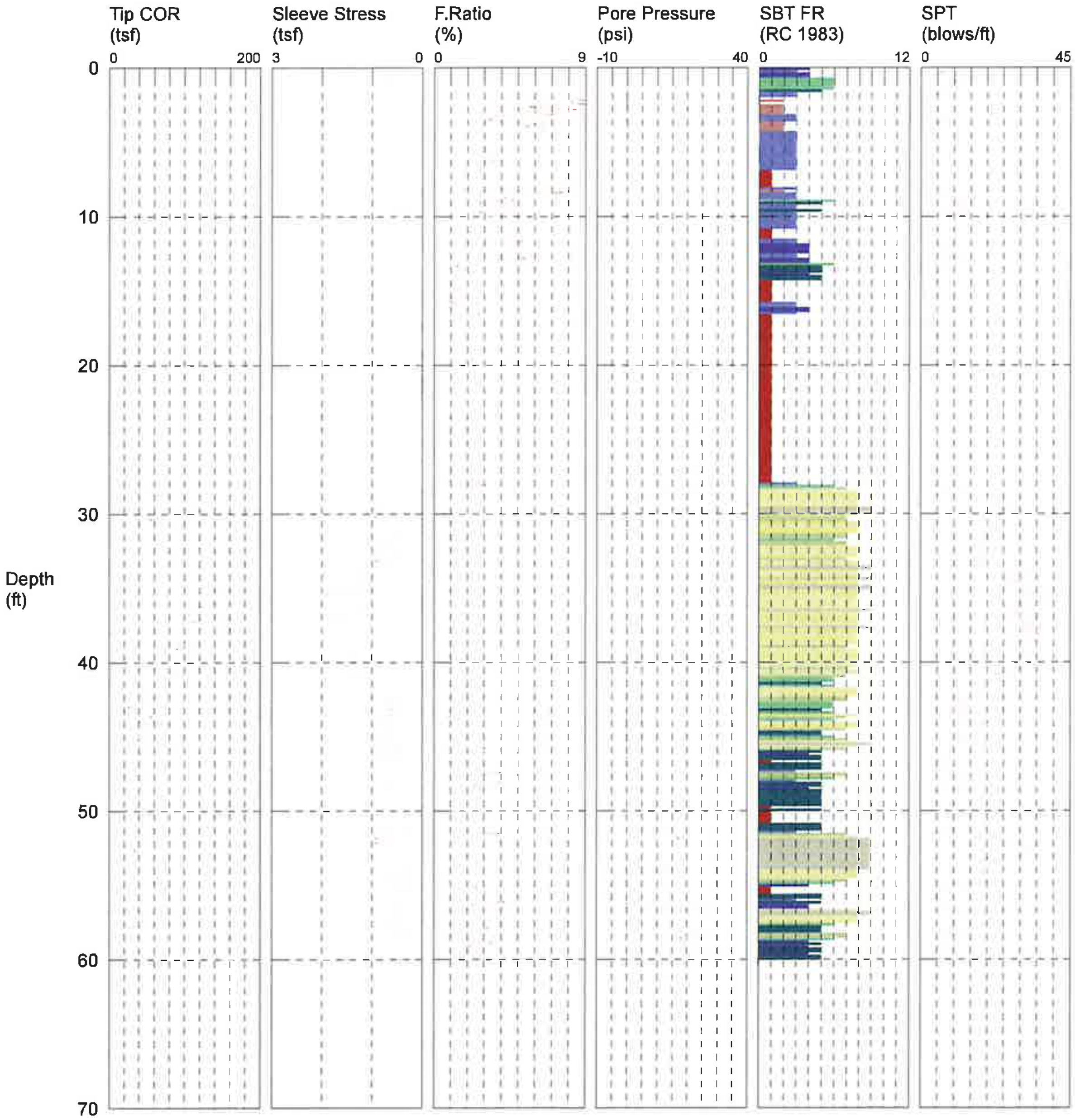
Figure A-9

Tested By: FQ

CPT-01

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Asso
LOCATION: Aberdeen
JOB NUMBER: T-8215
TEST DATE: 9/12/2019 7:33:05 AM

OPERATOR: Okbay
CONE ID: DDG1263
PREDRILL : N/A
BACKFILL: Bentonite Chips
SURFACE PATCH: N/A



TOTAL DEPTH: 60.367 ft

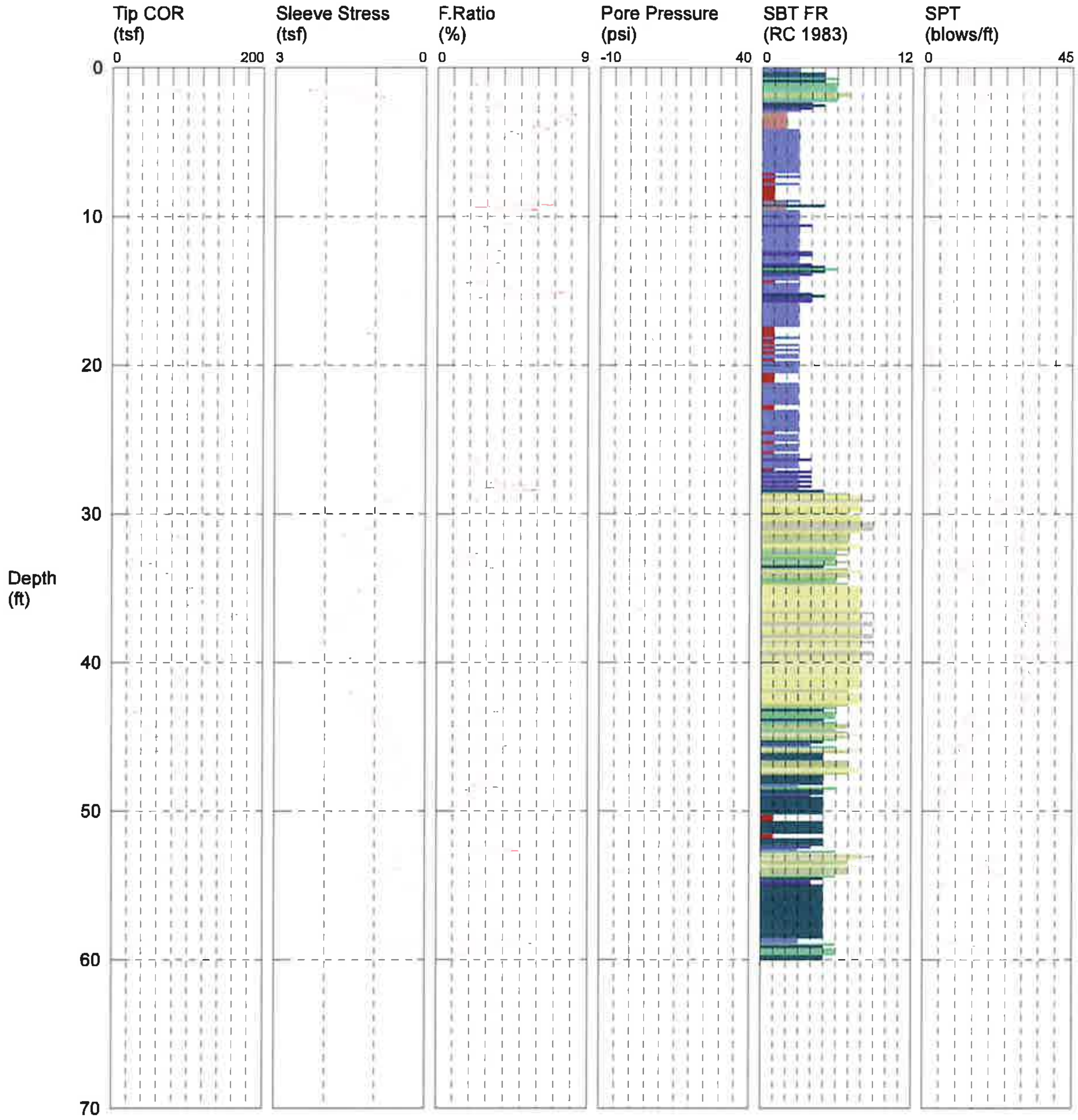
🟥 1 sensitive fine grained
🟥 2 organic material
🟦 3 clay
🟪 4 silty clay to clay
🟦 5 clayey silt to silty clay
🟩 6 sandy silt to clayey silt
🟩 7 silty sand to sandy silt
🟨 8 sand to silty sand
⬜ 9 sand
🟫 10 gravelly sand to sand
⬜ 11 very stiff fine grained (*)
⬛ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

CPT-02

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Asso
LOCATION: Aberdeen
JOB NUMBER: T-8215
TEST DATE: 9/12/2019 8:44:46 AM

OPERATOR: Okbay
CONE ID: DDG1263
PREDRILL : N/A
BACKFILL: Bentonite Chips
SURFACE PATCH: N/A



TOTAL DEPTH: 60.367 ft

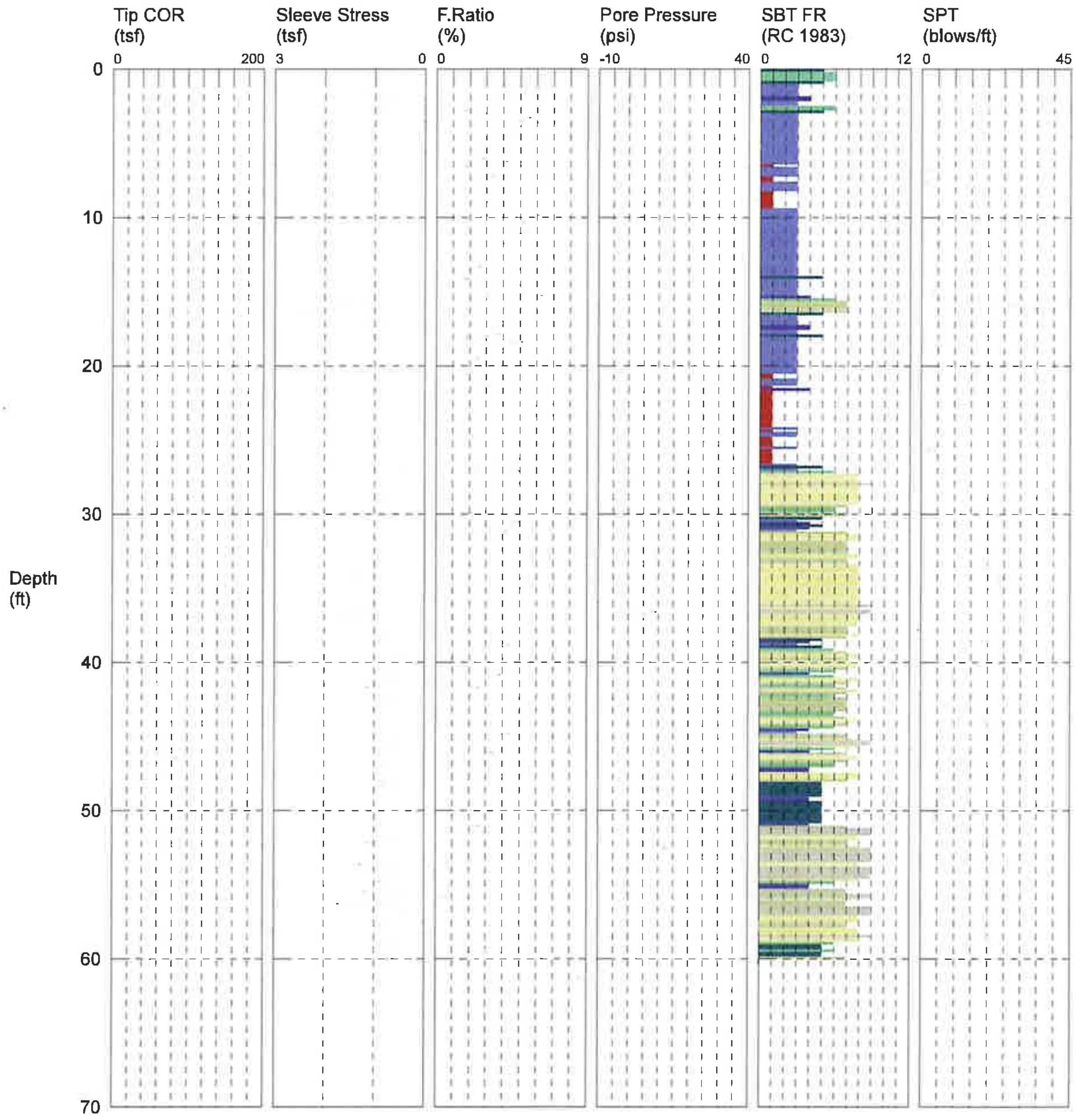
🟥 1 sensitive fine grained
🟫 2 organic material
🟦 3 clay
🟪 4 silty clay to clay
🟦 5 clayey silt to silty clay
🟩 6 sandy silt to clayey silt
🟩 7 silty sand to sandy silt
🟨 8 sand to silty sand
⬜ 9 sand
🟧 10 gravelly sand to sand
⬜ 11 very stiff fine grained (*)
⬛ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

CPT-03

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Asso
LOCATION: Aberdeen
JOB NUMBER: T-8215
TEST DATE: 9/12/2019 9:48:43 AM

OPERATOR: Okbay
CONE ID: DDG1263
PREDRILL : N/A
BACKFILL: Bentonite Chips
SURFACE PATCH: N/A



TOTAL DEPTH: 60.367 ft

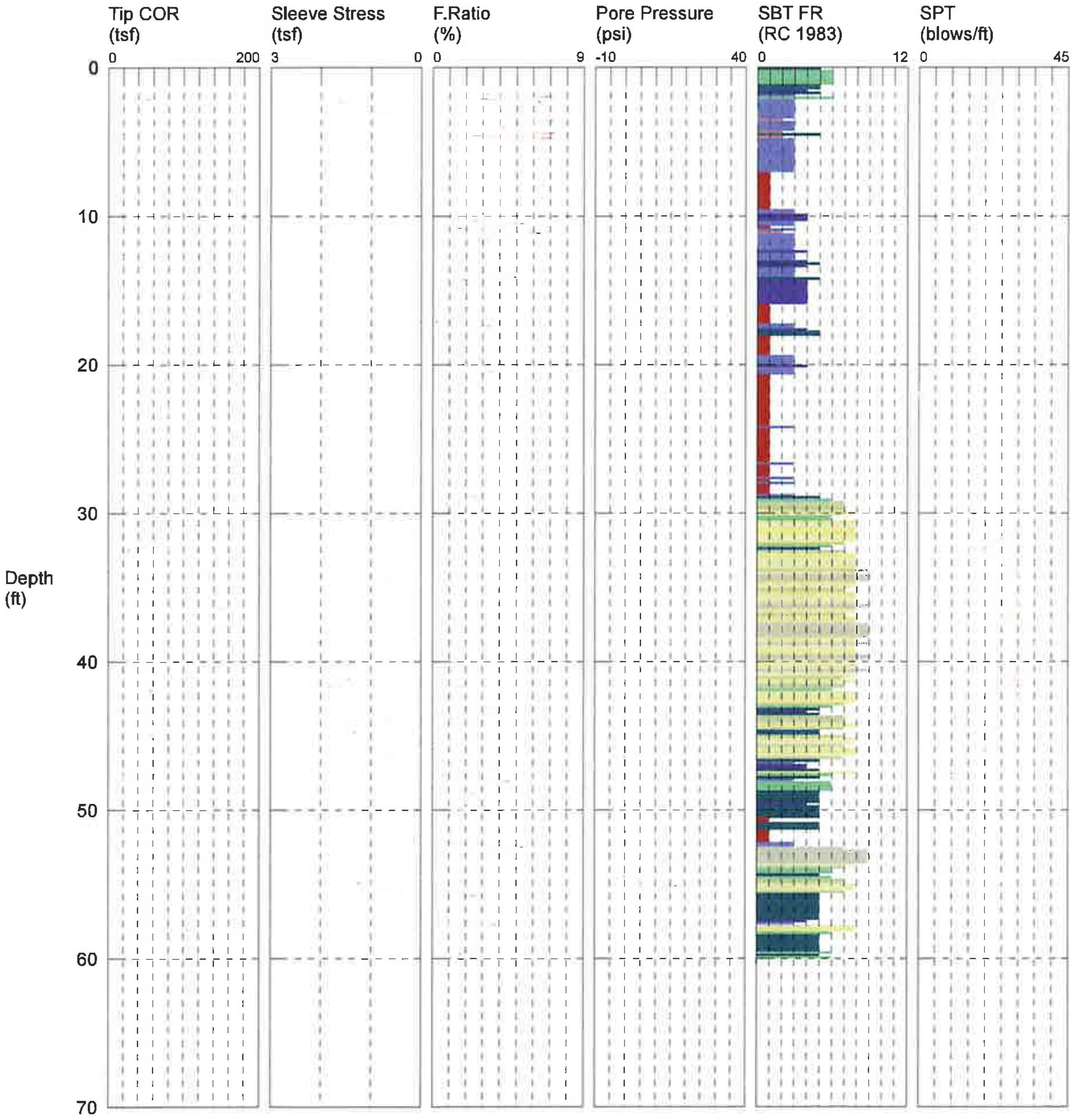
🟥 1 sensitive fine grained
🟫 2 organic material
🟦 3 clay
🟪 4 silty clay to clay
🟦 5 clayey silt to silty clay
🟩 6 sandy silt to clayey silt
🟩 7 silty sand to sandy silt
🟨 8 sand to silty sand
⬜ 9 sand
🟧 10 gravelly sand to sand
⬜ 11 very stiff fine grained (*)
⬛ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

CPT-04

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Asso
LOCATION: Aberdeen
JOB NUMBER: T-8215
TEST DATE: 9/12/2019 11:03:16 AM

OPERATOR: Okbay
CONE ID: DDG1263
PREDRILL : N/A
BACKFILL: Bentonite Chips
SURFACE PATCH: N/A



TOTAL DEPTH: 60.367 ft

■ 1 sensitive fine grained
■ 2 organic material
■ 3 clay

■ 4 silty clay to clay
■ 5 clayey silt to silty clay
■ 6 sandy silt to clayey silt

■ 7 silty sand to sandy silt
■ 8 sand to silty sand
■ 9 sand

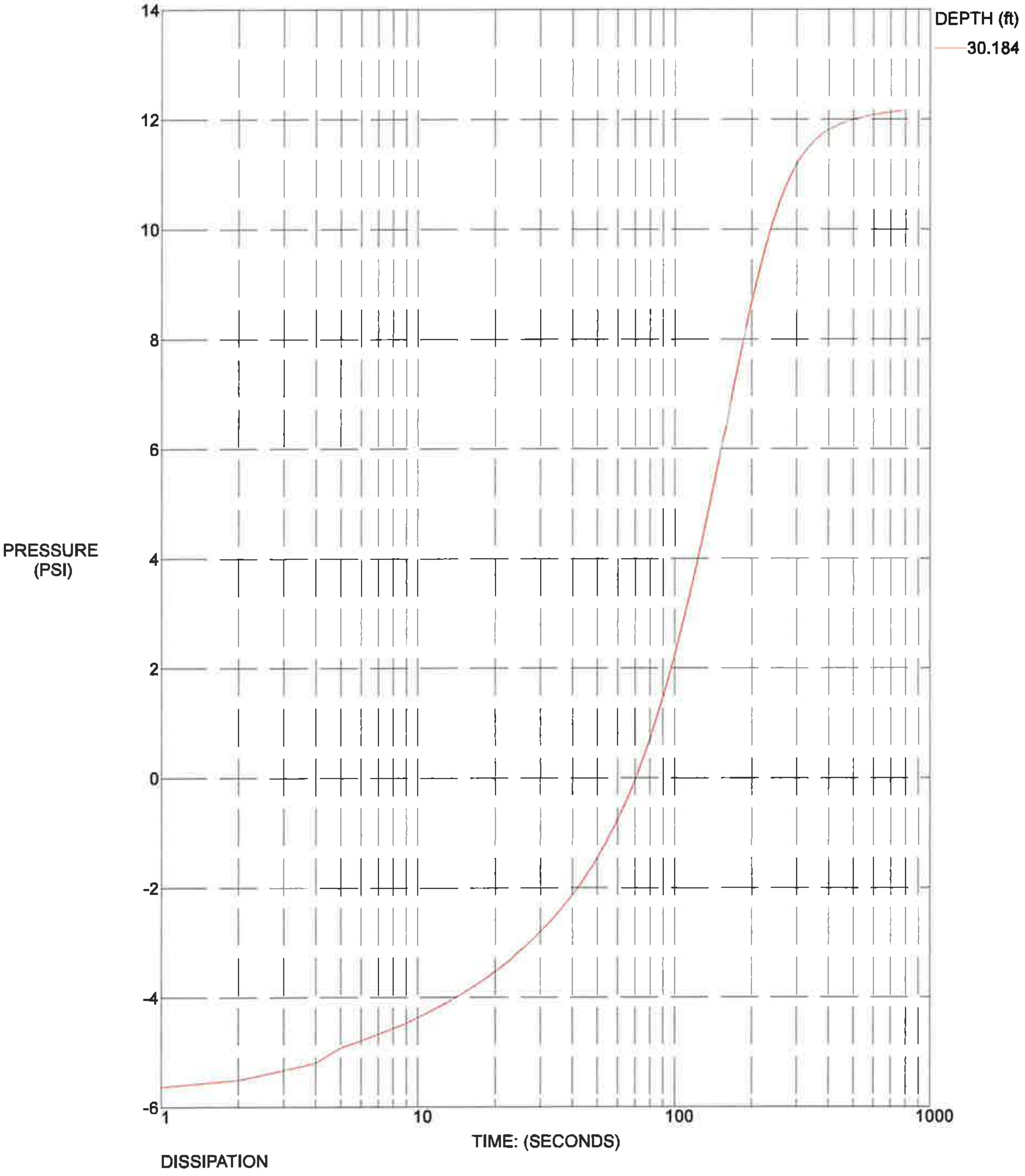
■ 10 gravelly sand to sand
■ 11 very stiff fine grained (*)
■ 12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

CPT - 01

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Asso
LOCATION: Aberdeen
JOB NUMBER: T-8215
TEST DATE:

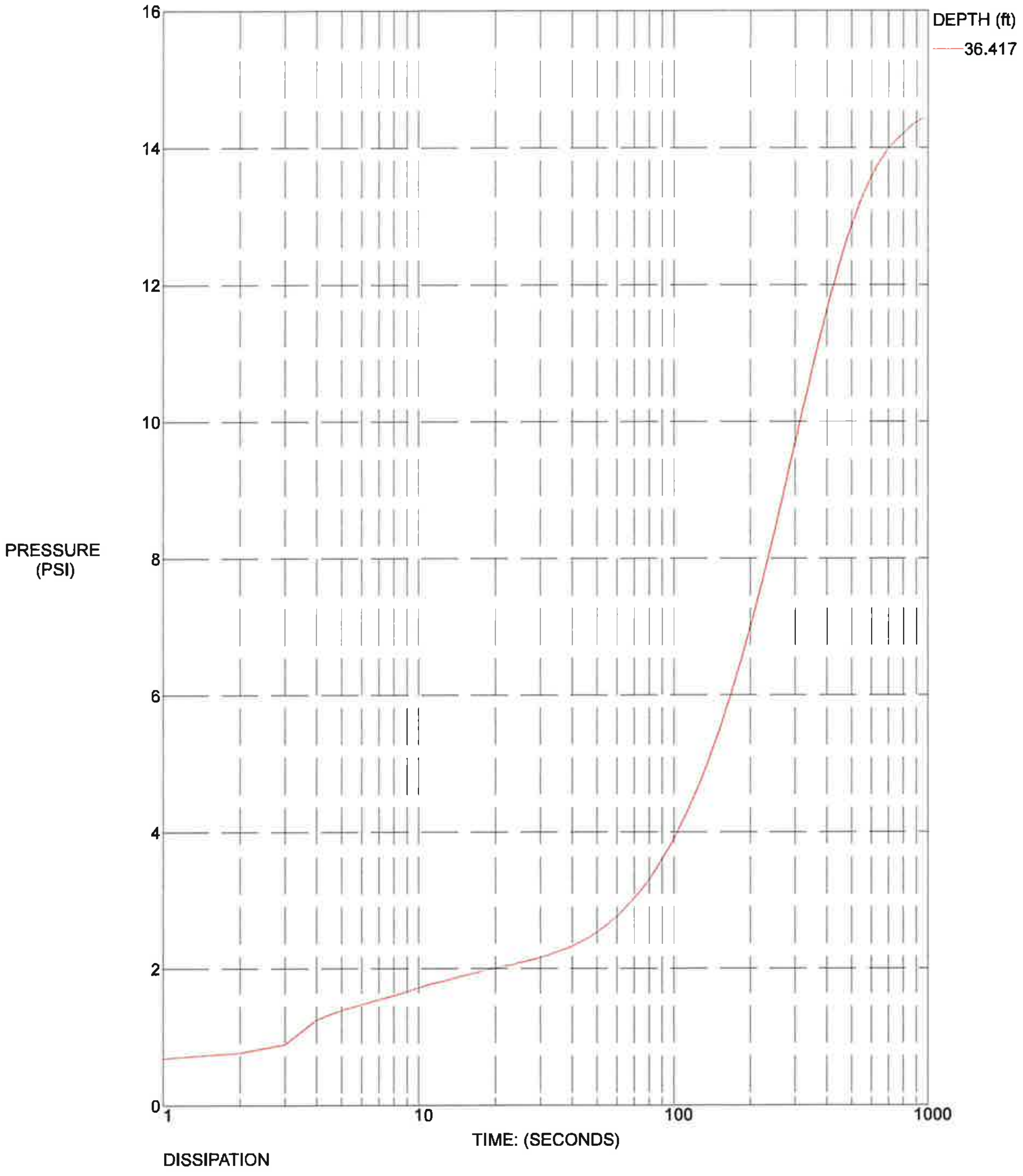
OPERATOR: Okbay
CONE ID: DDG1263
PREDRILL : N/A
BACKFILL: Bentonite Chips
SURFACE PATCH: N/A



CPT - 03

CPT CONTRACTOR: In Situ Engineering
CUSTOMER: Terra Asso
LOCATION: Aberdeen
JOB NUMBER: T-8215
TEST DATE:

OPERATOR: Okbay
CONE ID: DDG1263
PREDRILL : N/A
BACKFILL: Bentonite Chips
SURFACE PATCH: N/A



APPENDIX B

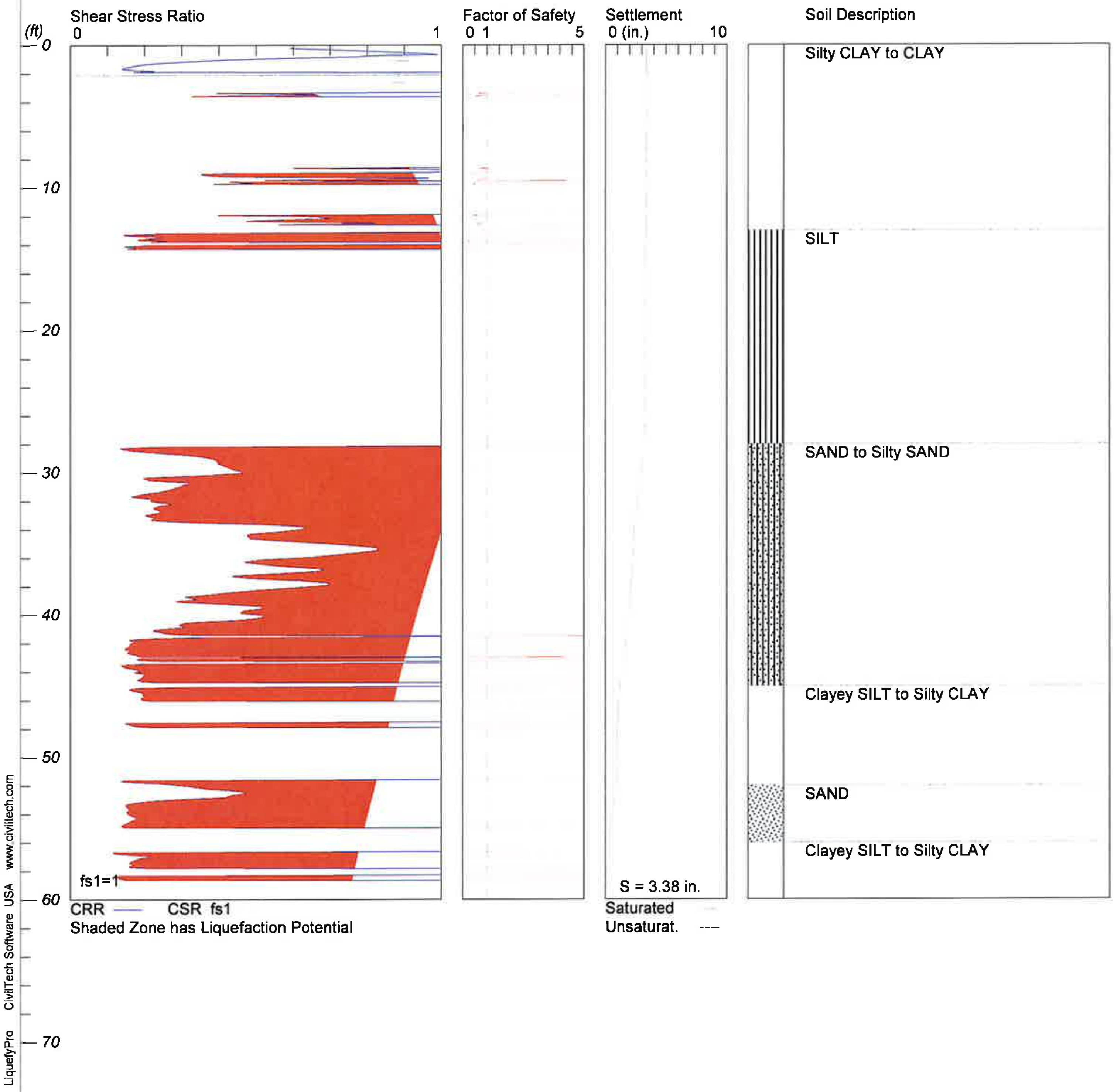
LIQUEFACTION ANALYSIS

LIQUEFACTION ANALYSIS

FKC Grays Harbor

Hole No.=CPT-01 Water Depth=2.1 ft

Magnitude=7
Acceleration=0.791g

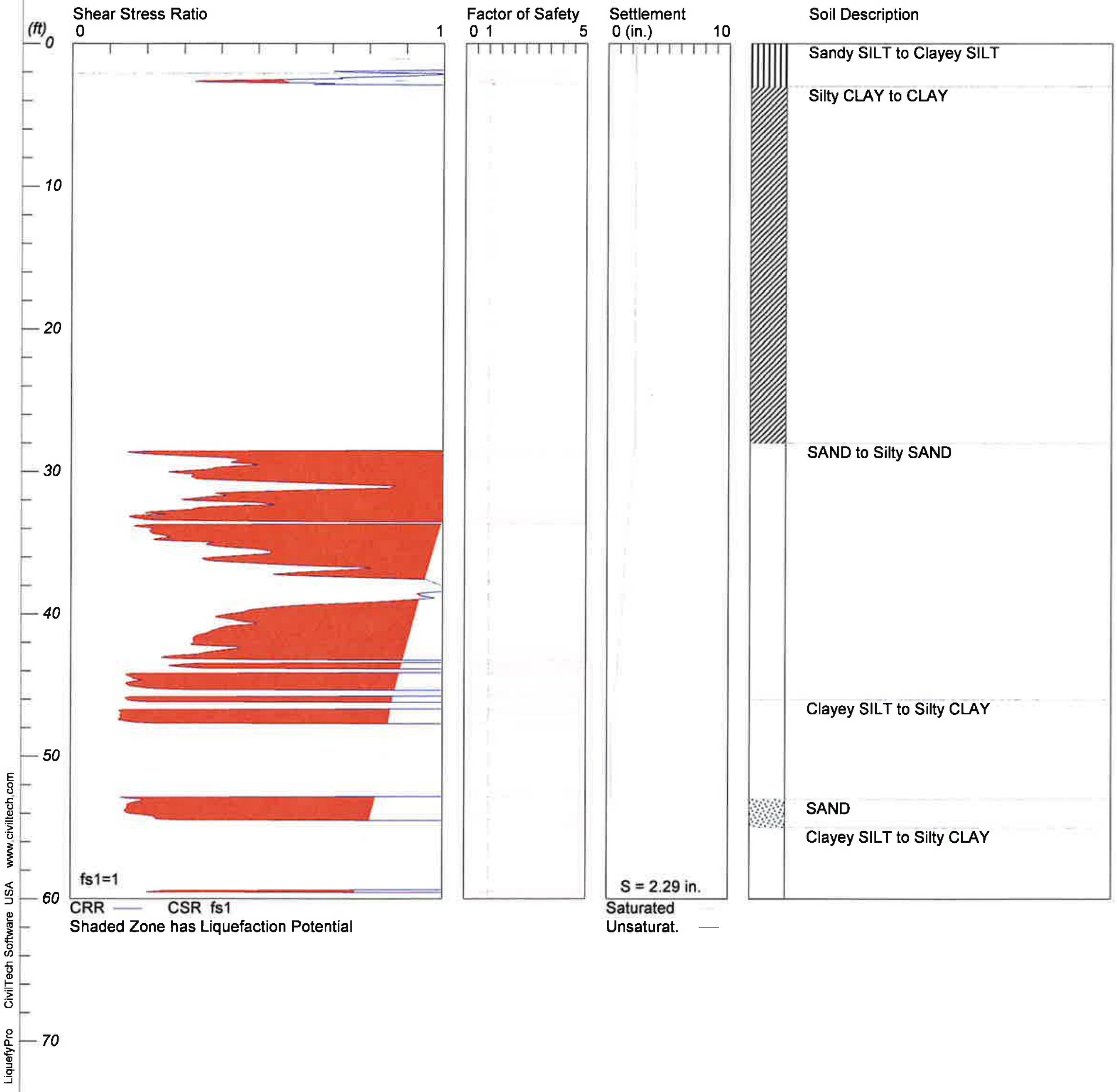


LIQUEFACTION ANALYSIS

FKC Grays Harbor

Hole No.=CPT-02   Water Depth=2.1 ft

Magnitude=7
Acceleration=0.791g



CivilTech Corporation

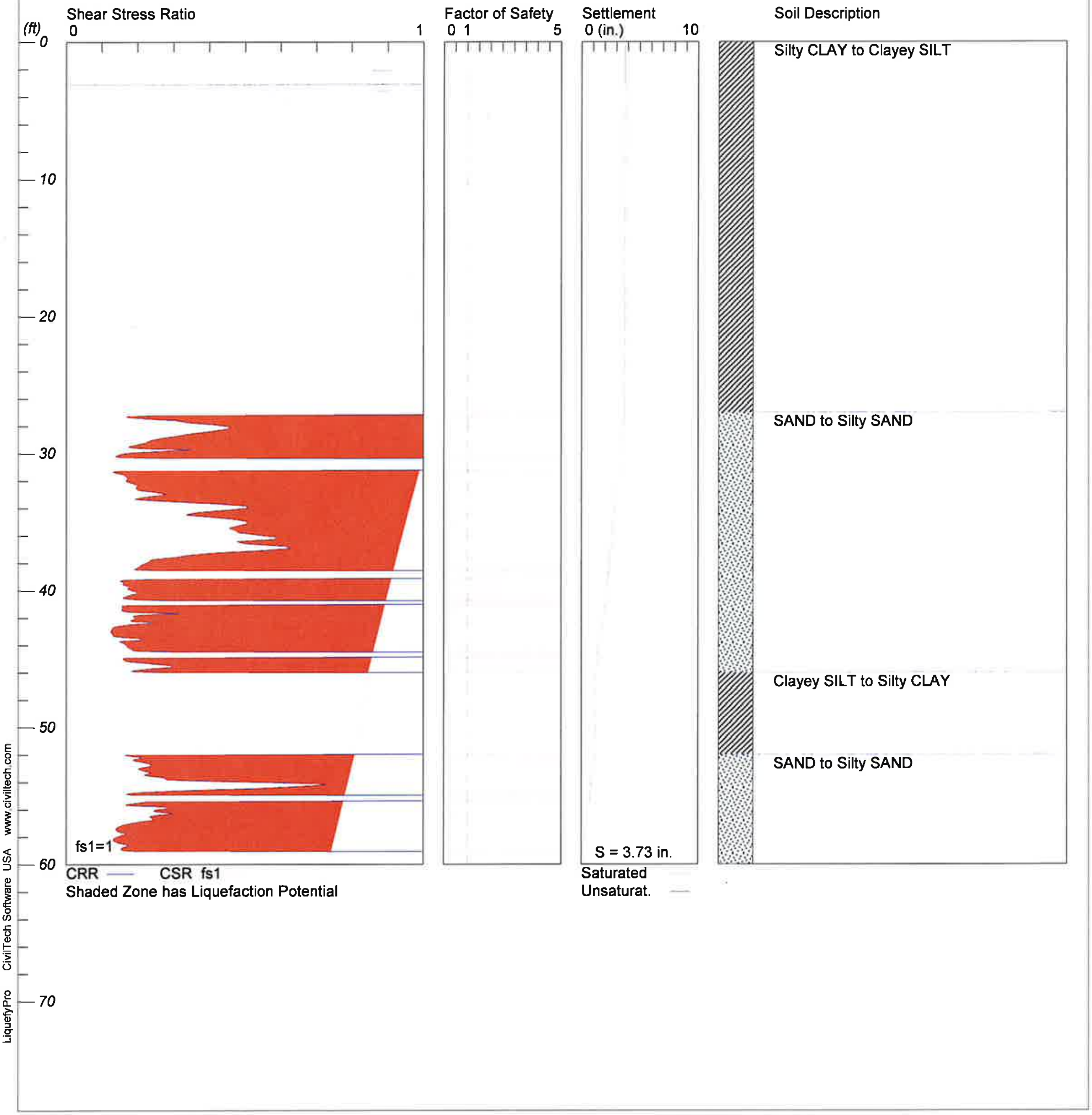
Plate A-2

LIQUEFACTION ANALYSIS

FKC Grays Harbor

Hole No.=CPT-03 ***Water Depth=3.1 ft*** ***Magnitude=7***

Acceleration=0.791g



LIQUEFACTION ANALYSIS

FKC Grays Harbor

Hole No.=CPT-04   Water Depth=2.1 ft

Magnitude=7
Acceleration=0.791g