GEOTECHNICAL REPORT

Cheshire Short Plat
7615 East Mercer Way
Mercer Island, Washington

Project No. T-8264

Terra Associates, Inc.

Prepared for:

Mr. Derek Cheshire
Mercer Island, Washington

May 12, 2020
Revised August 5, 2022

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

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Project No. T-8264

Mr. Derek Cheshire
7615 East Mercer Way
Mercer Island, Washington 98040

Subject: Geotechnical Report
Cheshire Short Plat
7615 East Mercer Way
Mercer Island, Washington

Dear Mr. Cheshire:

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, the soil conditions observed in the test boring consists of approximately 4 feet of dense fill material overlying 7 to 13 feet of medium dense to dense silty sand over medium dense to dense silt to the termination of the test borings. An approximately four-foot layer of sand with gravel was observed at a depth of 15 feet in Test Boring B-2. Groundwater seepage and wet soils were observed at depths of 7.5 to 25 feet below current site grades.

In our opinion, the soil conditions 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 presented in this report is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

8-5-2022

Carolyn S. Decker, P.E.
President

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1.0 PROJECT DESCRIPTION

The project consists of constructing a residential structure in the northeast corner of the existing tax parcel. The site is developed with a single-family residence and an accessory dwelling unit in the eastern portion of the site. The focus of this report is the northeast, undeveloped portion of the site. Based on the site plan prepared by CORE Design dated January 2020, the structure will be located in the approximate center of the new building lot with access from SE 76th Street. With finish floor elevations of 122 feet and 112 feet, grading will consist of cuts and fills from one to ten feet.

The structure constructed on the lot is expected to be two- to three- story building framed over a crawl space. Foundation loads should be relatively light, in the range of 4 to 6 kips per foot for bearing walls and 50 to 75 kips for isolated columns.

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

2.0 SCOPE OF WORK

On June 27, 2022, we observed soil and groundwater conditions at 2 test borings drilling to depths of 30 and 40 feet below current site grades. Using this data along with 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 criteria per the current International Building Code (IBC).
- Geologic hazards per the City of Mercer Island Municipal Code.
- Site preparation and grading.
- Relative slope stability.
- Excavations
- Foundation support.

- Floor slab-on-grade support.
- Lateral earth pressures on below-grade walls.
- Drainage
- Utilities

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 consists of a single tax parcel totaling approximately 2 acres located at 7615 East Mercer Way in Mercer Island, Washington. The approximate site location is shown on Figure 1.

The site is currently developed with a single-family residence, an accessory dwelling unit, and associated access and landscaping in the eastern half of the site. The western half of the site is a steep slope that is covered with a moderate forest and associated understory. The focus of our study is the northeast corner of the site where the new development is proposed. Site topography in this portion of the site consists of a slope that descends from the west to the east with an overall relief of approximately 26 feet.

3.2 Subsurface

In general, the soil conditions at the site consisted of approximately 4 feet of dense fill material overlying 7 to 13 feet of medium dense to dense silty sand over medium dense to dense silt to the termination of the test borings. An approximately four-foot layer of sand with gravel was observed at a depth of 15 feet in Test Boring B-2.

The *Preliminary Geologic Map of Seattle and Vicinity, Washington,* by H.H. Waldron, B.A. Leisch, D.R. Mullineaux, and D.R. Crandell (1961) maps the site as pre-fraser glacial drift (Qgpc). This mapped description is consistent with the native soils observed in the test borings.

The preceding discussion is intended to be a general review of the soil conditions encountered. For more detailed descriptions, please refer to the Test Boring Logs in Appendix A. The approximate location of the Test Borings is shown on Figure 2.

3.3 Groundwater

Groundwater seepage and wet soils were noted at approximately 7.5 to 25 feet below current site grades within the sandier soils.

3.4 Geologic Hazards/Critical Areas Report

We evaluated site conditions for the presence of geologic hazards including erosion hazard areas, landslide hazard areas, and seismic hazard areas. In addition, we have reviewed Section 19.07.110 of the Mercer Island Municipal Code, Critical Area Study. Our findings are presented below.

3.4.1 Erosion Hazard Areas

Section 19.16.010 of the Mercer Island Municipal Code (MIMC) defines an erosion hazard as "areas greater than 15 percent slope and subject to a severe risk of erosion due to wind, rain, water, slope, and other natural agents including those soil types and/or areas identified by the U.S. Department of Agriculture's Natural Resources Conservation Service as having a "severe" or "very severe" rill and inter-rill erosion hazard."

The soils observed on-site are classified as Kitsap Silt Loam, 15 to 30 percent slopes (KpD) by the United States Department of Agriculture Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service. With the existing slope gradients, these soils will have a severe potential for erosion when exposed. Therefore, the site is categorized as an erosion hazard area per the MIMC.

Implementation of temporary and permanent Best Management Practices (BMPs) for preventing and controlling erosion will be required and will mitigate the erosion hazard. As a minimum, we recommend implementing the following erosion and sediment control BMPs prior to, during, and immediately following construction activities at the site.

Prevention

- Limit site clearing and grading activities to the relatively dry months (typically May through September).
- Limit disturbance to areas where construction is imminent.
- Locate temporary stockpiles of excavated soils no closer than ten feet from the crest of the slope.
- Provide temporary cover for cut slopes and soil stockpiles during periods of inactivity. Temporary cover may consist of durable plastic sheeting that is securely anchored to the ground surface or straw mulch.
- Establish permanent cover over exposed areas that will not be disturbed for a period of 30 days or more by seeding, in conjunction with a mulch cover or appropriate hydroseeding.

Containment

- Install a silt fence along site margins and downslope of areas that will be disturbed. The silt fence should be in place before clearing and grading is initiated.
- Intercept surface water flow and route the flow away from the slope to a stabilized discharge point. Surface water must not discharge at the top or onto the face of the steep slope.
- Provide on-site sediment retention for collected runoff.

The contractor should perform daily review and maintenance of all erosion and sedimentation control measures at the site.

3.4.2 Landslide Hazard Areas

Section 19.16.010 of the MIMC defines a landslide hazard as "areas subject to landslides based on a combination of geologic, topographic, and hydrologic factors, including:

1. Areas of historic failures.

2. Areas with all three of the following characteristics:

    a. Slopes steeper than 15 percent.

    b. Hillsides intersecting geologic contacts with relatively permeable sediment overlying a relatively impermeable sediment or bedrock.

    c. Springs or groundwater seepage.

3. Areas that have shown evidence of past movement or that are underlain or covered by mass wastage debris from past movements.

4. Areas potentially unstable because of rapid stream incision and stream bank erosion.

5. Steep Slope. Any slope of 40 percent or greater calculated by measuring the vertical rise over any 30-foot horizontal run."

None of these conditions exist on the site. Therefore, the site is not a landslide hazard as defined by the MIMC.

We completed a slope stability analysis through the site to determine if the proposed construction can alter the area without causing instability. Our analysis was completed at a location designated as Cross-Section A-A' using the computer program Slide 2. The approximate cross-section location is shown on Figure 2.

Our analysis considered both static and the pseudostatic (seismic) conditions. A horizontal acceleration of 0.31g was used in the pseudostatic analysis to simulate slope performance under earthquake loading. This acceleration is equal to one-half of the peak horizontal ground acceleration with a two percent in 50-year probability of exceedance as defined by the 2018 International Building Code. A groundwater table was also modeled.

Based on our field exploration, laboratory testing, and previous experience with similar soil types, we chose the following parameters for our analysis:

Table 1 – Slope Stability Analysis Soil Parameters

Soil Type	Unit Weight (pcf)	Friction Angle (Degrees)	Cohesion (psf)
Medium Dense SM	120	35	100
Medium Dense SP-SM	120	28	0
Medium Stiff ML	110	28	700
Stiff ML	110	28	1500

The results of our slope stability analysis, as shown by the lowest safety factors for each condition, are presented in the following table:

Table 2 – Slope Stability Analysis Results

Cross Section	Minimum Safety Factors	
	Existing Conditions	***Post Construction***
A-A'	2.52 (Seismic FS = 1.07)	1.70 (Seismic FS = 1.16)

Based on our analysis, the proposed project will increase the overall stability of the site and thereby the development has been designed so that the risk to the site and adjacent property is mitigated such that the site is determined to be safe. Therefore, per Section 19.07.160.3.b of the MICI and our opinion, the site can be constructed, as proposed. The results of our analysis are attached in Appendix B.

Per Section 19.07.110.C. of the MIMC "the critical area study requirement may be waived or modified if the applicant demonstrates that the development proposed will not have an impact on the critical area or its buffer in a manner contrary to the purposed and requirements of this chapter". The purpose of the critical area study from a geotechnical perspective is to determine if and how proposed construction will impact a geologic hazard. The geologic hazard present at this proposed site is the blocky soils that have been outlined on the borings logs. The presence of landslide debris typically indicates past instability. Therefore, a slope stability analysis should be completed based on the proposed construction. Based on the analysis completed above, the proposed construction will increase the overall stability of the site. Therefore, the critical area study should be waived as the proposed developed will not have a negative impact on the critical area or its buffer.

If the proposed project changes, this analysis should be reviewed to determine if any additional analysis is required for the project.

3.4.3 Seismic Hazard Areas

Section 19.16.010 of the MIMC defines a seismic hazard area as "areas subject to severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement, soil liquefaction or surface faulting."

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 sand that is below 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 0.62g, which is the ground acceleration for the maximum considered earthquake (MCE) for an earthquake with a 2,500 return-period. The value was determined using the U.S. Geological Survey (USGS) web-based Unified Hazard Tool.

The results of our analysis indicate soil liquefaction could occur during the design earthquake event, resulting in total settlements approaching approximately 2.8 inches, with one-half of that settlement likely being differential in nature. Results of the analysis are attached to in Appendix C.

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 in the event of seismic-induced settlements occur, foundations would need to be supported on ground improved with stone columns or rammed aggregate piers. Based on our experience with similar sites and structures, structural design elements are also available to mitigate potential damage caused by the seismic-related soil settlements.

3.5 Seismic Design Parameters

Due to the site soils being subject to liquefaction, per the current International Building Code (IBC), the subsurface conditions would be assigned site class “F”, which would require performing a site-specific seismic analysis to determine seismic forces for structural design. However, the current IBC allows for using code derived seismic values for the soil conditions indicated if the building’s fundamental period is equal to or less than 0.5 seconds. We expect the single-family residence will fall into this category. In this case, based on soil conditions encountered and our knowledge of the area geology, site class “E” can be used to determine seismic design forces.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 General

Based on our study, there are no geotechnical considerations that would preclude development of the site, as currently planned. The structure can be supported on conventional spread footings bearing on competent inorganic native soils or on new structural fill placed and compacted above the competent soils. Floor slabs can be similarly supported.

The native soils encountered contain a sufficient amount of soil fines and will be difficult to compact as structural fill when too wet. The ability to use these native soils 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 clean granular material for use as structural fill and backfill.

The following sections provide detailed recommendations regarding the preceding issues and other geotechnical design and construction considerations. These recommendations should be incorporated into the final design drawings and construction specifications.

4.2 Site Preparation and Grading

To prepare the site for construction, all vegetation and organic surface soils should be stripped and removed from below the new construction/remodeling areas. Soil containing organic material will not be suitable for use as structural fill but may be used for limited depths in nonstructural areas.

Once stripping operations are complete, cut and fill operations can be initiated to establish desired 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 building foundations or placement of structural fill. If unsuitable yielding areas are observed, they should be cut to firm bearing soil and filled to grade with structural fill. If depth of excavation to remove unstable soils is excessive, use of geotextile fabric such as Mirafi 500X or equivalent in conjunction with structural fill can be considered in order to limit the depth of removal. Our experience has shown that, in general, a minimum of 18 inches of a clean, granular structural fill placed and compacted over the geotextile fabric should establish a stable bearing surface.

Our study indicates that the site soils contain a sufficient percentage of fines, silt size particles that will make them difficult to compact as structural fill if they are too wet or too dry. The ability to use the native soils as structural fill will depend on their moisture content and the prevailing weather conditions when site grading activities take place. If wet soils are encountered, the contractor will need to dry the soils by aeration during dry weather conditions. Alternatively, the use of an additive such as Portland cement or lime to stabilize the soil moisture can be considered. If the soil is amended, additional Best Management Practices (BMPs) addressing the potential for elevated pH levels will need to be included in the Storm Water Pollution Prevention Program (SWPPP) prepared with the Temporary Erosion and Sedimentation Control (TESC) plan.

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 owner 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 ¾-inch fraction.

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

Structural fill should be placed in uniform loose layers not exceeding 6 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.

4.3 Excavations

All excavations at the site associated with confined spaces, such as utility trenches, must be completed in accordance with local, state, and federal requirements. Based on regulations outlined in the Washington Industrial Safety and Health Act (WISHA), the on-site soils would be classified as Type C soil.

Accordingly, temporary excavations in Type C soils should have their slopes laid back at an inclination of 1.5:1 (Horizontal: Vertical) or flatter, from the toe to the crest of the slope. All exposed temporary slope faces that will remain open for an extended period of time should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation.

Groundwater should be expected for excavations that extend ten feet below current site grades. The volume of water could be significant and may need to be dewatered depending on the final configuration of the grades. The contractor should be prepared to implement active dewatering for any excavation that extends 15 feet below current site grades.

The above 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 general contractor.

4.4 Foundation Support

The building may be supported on conventional isolated or continuous footing foundations bearing on competent native soils or new structural fills placed above competent soils. Foundation subgrades should be prepared as recommended in Section 4.2 of this report. Perimeter foundations exposed to the weather should be at a minimum depth of 18 inches below final exterior grades. Interior foundations can be constructed at any convenient depth below the floor slab.

We recommend designing foundations supported on competent material for a net allowable bearing capacity of 2,000 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used in design. With the anticipated loads and this bearing stress applied, building settlements should be less than one-half inch total and one-quarter inch differential.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the side of the footing and buried portion of the foundation stem wall can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 300 pcf. We recommend not including the upper 12 inches of soil in this computation because they can be affected by weather or disturbed by future grading activity. This value assumes the foundation will be constructed neat against competent native soil or backfilled with structural fill as described in Section 4.2 of this report. The values recommended include a safety factor of 1.5.

4.5 Floor Slab-on-Grade

Slab-on-grade floors may be supported on a subgrade as recommended in Section 4.2. 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 five 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.

4.6 Lateral Earth Pressures on Below-Grade Walls

The magnitude of earth pressure development on retaining walls will partly depend on the quality of the wall backfill. We recommend placing and compacting wall backfill as structural fill as described in Section 4.2 of this report. To guard against hydrostatic pressure development, drainage must be installed behind the wall. A typical wall drainage detail is shown on Figure 3.

With wall backfill placed and compacted as recommended, and drainage properly installed, we recommend designing unrestrained walls for an active earth pressure equivalent to a fluid weighing 40 pounds per cubic foot (pcf). For restrained walls, an additional uniform load of 100 psf should be added to the 40 pcf. For evaluation of wall performance under seismic loading, a uniform pressure equivalent to 8H psf, where H is the height of the below-grade portion of the wall should be applied in addition to the static lateral earth pressure. These values assume a horizontal backfill condition and that no other surcharge loading, sloping embankments, or adjacent buildings will act on the wall. If such conditions exist, then the imposed loading must be included in the wall design. Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 4.4 of this report.

4.7 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. Even low impact development (LID) techniques would likely fill up and overtop during rain events and cause minor local flooding. Based on these soil conditions, it is our opinion that the stormwater should be managed using a conventional system.

4.8 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

We recommend installing perimeter foundation drains adjacent to exterior shallow 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 pea gravel-sized drainage aggregate. The aggregate should extend six inches above and to the sides of the pipe. Roof and foundation drains should be tightlined separately to the storm drains. All drains should be provided with cleanouts at easily accessible locations.

4.9 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 4.2 of this report. As noted, soils excavated on-site should generally be suitable for use as backfill material during dry weather. However, the 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.

5.0 ADDITIONAL SERVICES

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

6.0 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 Cheshire Short Plat project in Mercer Island, Washington. This report is for the exclusive use of Mr. Derek Cheshire and his authorized representatives.

The analyses and recommendations present 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.

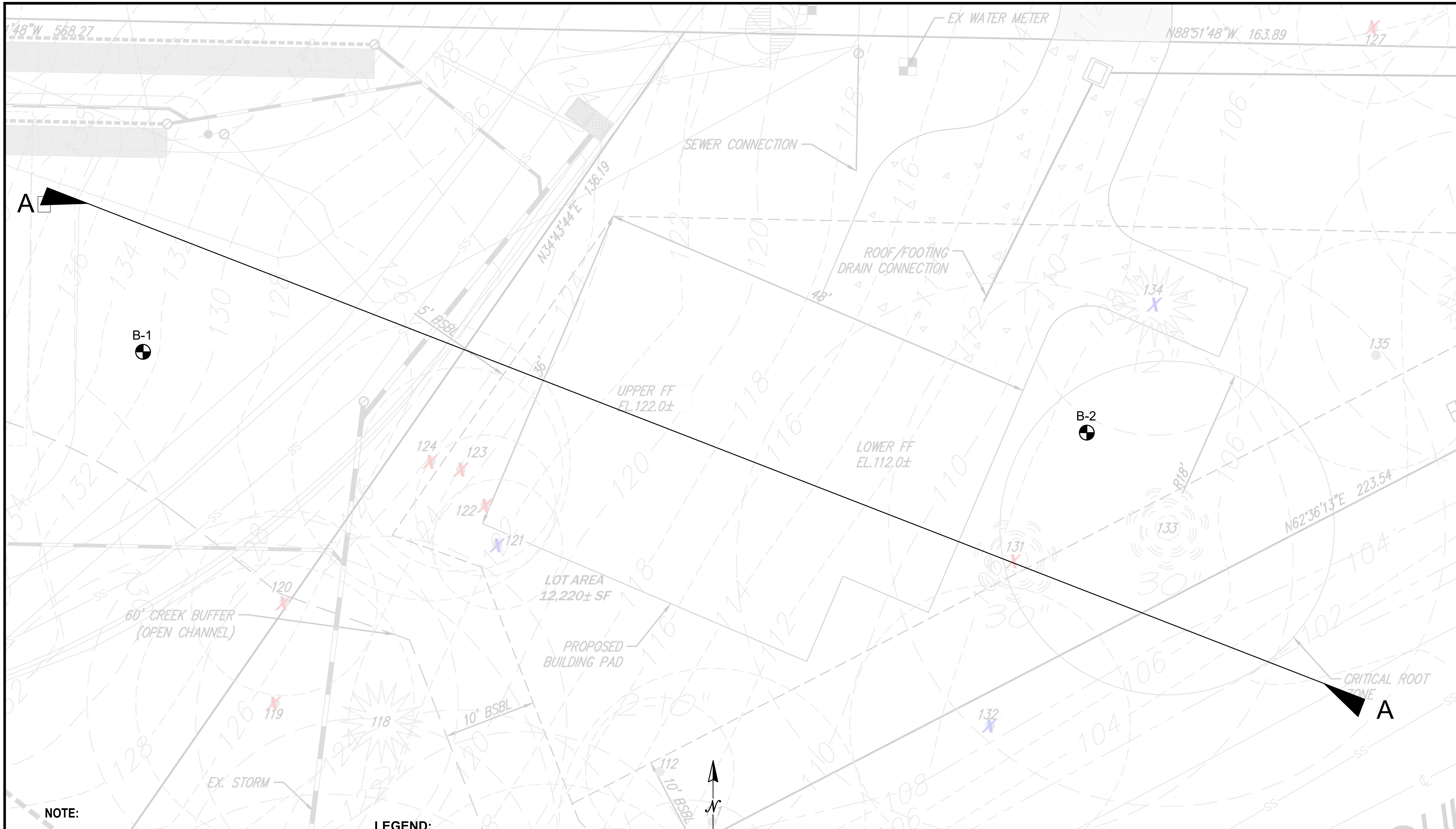
REFERENCE: https://www.bing.com/maps

ACCESSED 5/12/2020

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

VICINITY MAP
CHESHIRTE SHORT PLAT
MERCER ISLAND, WASHINGTON

Proj.No. T-8264	Date: AUG 2022	Figure 1



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 CORE DESIGN.

LEGEND:

- APPROXIMATE BORING LOCATION
- APPROXIMATE CROSS SECTION LOCATION

0 20 40

APPROXIMATE SCALE IN FEET

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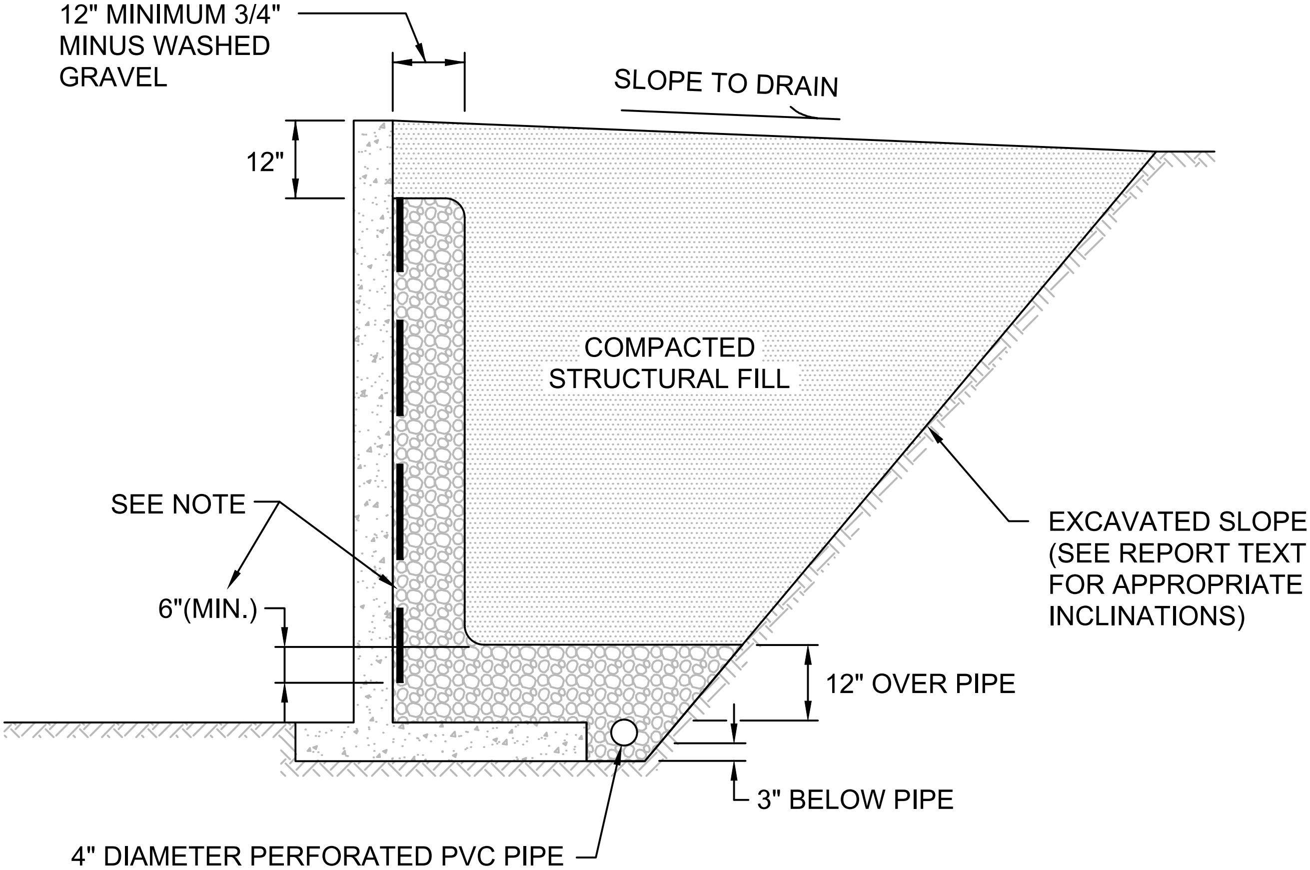
EXPLORATION LOCATION PLAN
CHESHIRE SHORT PLAT
MERCER ISLAND, WASHINGTON

Proj.No. T-8264	Date: AUG 2022	Figure 2



NOT TO SCALE

NOTE:

MIRADRAIN G100N PREFABRICATED DRAINAGE PANELS OR SIMILAR PRODUCT CAN BE SUBSTITUTED FOR THE 12-INCH WIDE GRAVEL DRAIN BEHIND WALL. DRAINAGE PANELS SHOULD EXTEND A MINIMUM OF SIX INCHES INTO 12-INCH THICK DRAINAGE GRAVEL LAYER OVER PERFORATED DRAIN PIPE.

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TYPICAL WALL DRAINAGE DETAIL
CHESHIRE SHORT PLAT
MERCER ISLAND, WASHINGTON

Proj.No. T-8264	Date: AUG 2022	Figure 3

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

Cheshire Short Plat
Mercer Island, Washington

On June 27, 2022, we completed our site exploration by observing soil conditions at 2 test borings drilled to depths of approximately 30 to 40 feet below existing site grades. Test boring locations were determined in the field by measuring from existing site features. The approximate location of the test borings is shown on the attached Exploration Location Plan, Figure 2. Test Boring Logs are presented on Figures A-2 and A-3.

An engineering geologist 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 drilling. During drilling, continuous soil samples were obtained during drilling in general accordance with ASTM Test Designation D-6914. Using this procedure, an eight-inch (outside diameter) hollow coring barrel is vibrated into the subsurface at five-foot intervals. A five-foot, continuous section of soil is then emptied into a sampling bag. In addition, Standard Penetration Test (SPT) soil samples were obtained every five-feet 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 from 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 and A-3. 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 Figure A-4.

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

Symbol	Definition
I	2" OUTSIDE DIAMETER SPILT SPOON SAMPLER
‖	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
CHESHIRE SHORT PLAT
MERCER ISLAND, WASHINGTON

Proj.No. T-8264	Date: AUG 2022	Figure A-1

LOG OF BORING NO. 1

Figure No. A-2

Project: Cheshire Short Plat **Project No:** T-8264 **Date Drilled:** June 27, 2022

Client: Mr. Derek Cheshire **Driller:** Boretec **Logged By:** JCS

Location: Mercer Island, Washington **Depth to Groundwater:** 12.5 ft, 25 ft **Approx. Elev:** NA

Depth (ft)	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot	Moisture Content (%)
0–4.5	Fill: Brown silty GRAVEL with sand, fine to coarse gravel, fine to coarse sand, moist. (GM)	Dense	35	6.8
4.5–7.5	Gray-brown silty SAND with gravel, fine sand, fine to coarse gravel, moist. (SM) (Possible fill)	Dense	30	6.6
7.5–10.5	Brown to gray-brown silty SAND with gravel, fine sand, fine to coarse gravel, dry to moist. (SM/SP-SM)	Medium Dense	21	5.7
		Dense	39	5.0
10.5–14	Gray silty SAND with gravel, fine sand, fine to coarse gravel, moist (wet below 12.5 feet). (SM)		16	32.0
14–17.5	Gray clayey SILT, moist, scattered randomly-oriented, iron-oxide stained fractures. (ML) (Pp=4.5 tons/sf) (LL=49, PI=15)	Very Stiff	23	28.4
17.5–21.5	Gray SILT to SILT with sand, fine sand, trace of fine to coarse gravel, moist, nonplastic to low plasticity, trace of brown silty sand pockets, scattered blocky zones. (ML)	Medium Dense / Dense	37	28.3
21.5–41.5	Gray SILT, moist, nonplastic to low plasticity. (ML)	Medium Dense		
25	- Wet with scattered blocky zones below 25 feet.		20	34.3
30	- Scattered high-angle sheared seams with hard, angular silt/clay clasts between 30 and 36.5 feet. (LL=30. PI=4)		12	33.6
35			14	33.5
40			21	30.2
41.5	Boring terminated at 41.5 feet. Groundwater encountered between 12.5 and 12.6 feet and below 25 feet.			

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. 2

Figure No. A-3

Project: Cheshire Short Plat **Project No:** T-8264 **Date Drilled:** June 27, 2022

Client: Mr. Derek Cheshire **Driller:** Boretec **Logged By:** JCS

Location: Mercer Island, Washington **Depth to Groundwater:** 7.5 ft **Approx. Elev:** NA

Depth (ft)	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot	Moisture Content (%)
2.5	No sample recovery at 2.5 feet.	Medium Dense	16	
5	Brown silty SAND with gravel, fine to medium sand, fine to coarse gravel, moist to wet (wet below 7.5 feet). (SM)	Medium Dense	14	13.0
7.5		Medium Dense	15	13.3
10	No sample recovery at 10 feet.	Medium Dense	19	
12.5	Gray silty SAND with gravel, fine sand, fine to coarse gravel, wet. (SM)	Medium Dense	12	17.8
15	Gray SAND with gravel, fine to coarse sand, fine to coarse gravel, wet. (SP)	Medium Dense	10	13.7
20	Gray SILT, moist to wet, nonplastic to low plasticity. (ML)	Medium Dense	19	30.5
25	- Wet with scattered blocky zones between 25 and 26.5 feet. (LL=29, PI=3)	Loose	9	32.5
30		Medium Dense	24	31.4
31.5	Boring terminated at 31.5 feet. Groundwater encountered below 7.5 feet			

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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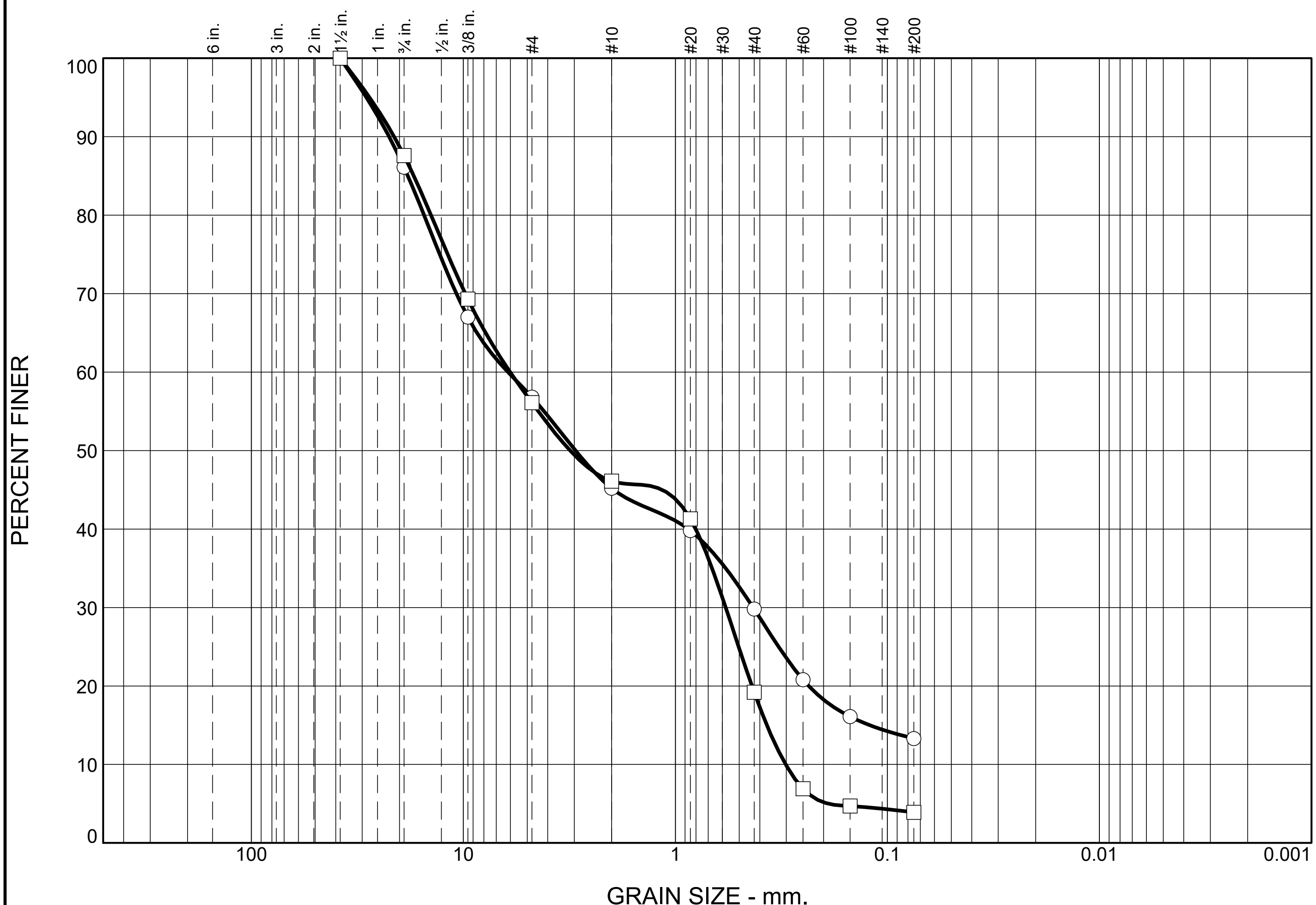
Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	13.9	29.3	11.6	15.4	16.5	13.3	
□	0.0	12.4	31.5	10.0	26.9	15.3	3.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			18.2740	6.1594	2.9592	0.4298	0.1212			
□			17.1334	6.0179	3.1361	0.5789	0.3702	0.3018	0.18	19.94

Material Description	USCS	AASHTO
○ silty SAND with gravel	SM	
□ SAND with gravel	SP	

Project No. T-8264 **Client:** Derek Cheshire

Project: Cheshire Short Plat

Mercer Island, Washington

○ **Location:** B-1 **Depth:** 7.5'

□ **Location:** B-2 **Depth:** 15'

Remarks:

○ Tested July 6, 2022

□ Tested July 6, 2022

Terra Associates, Inc.

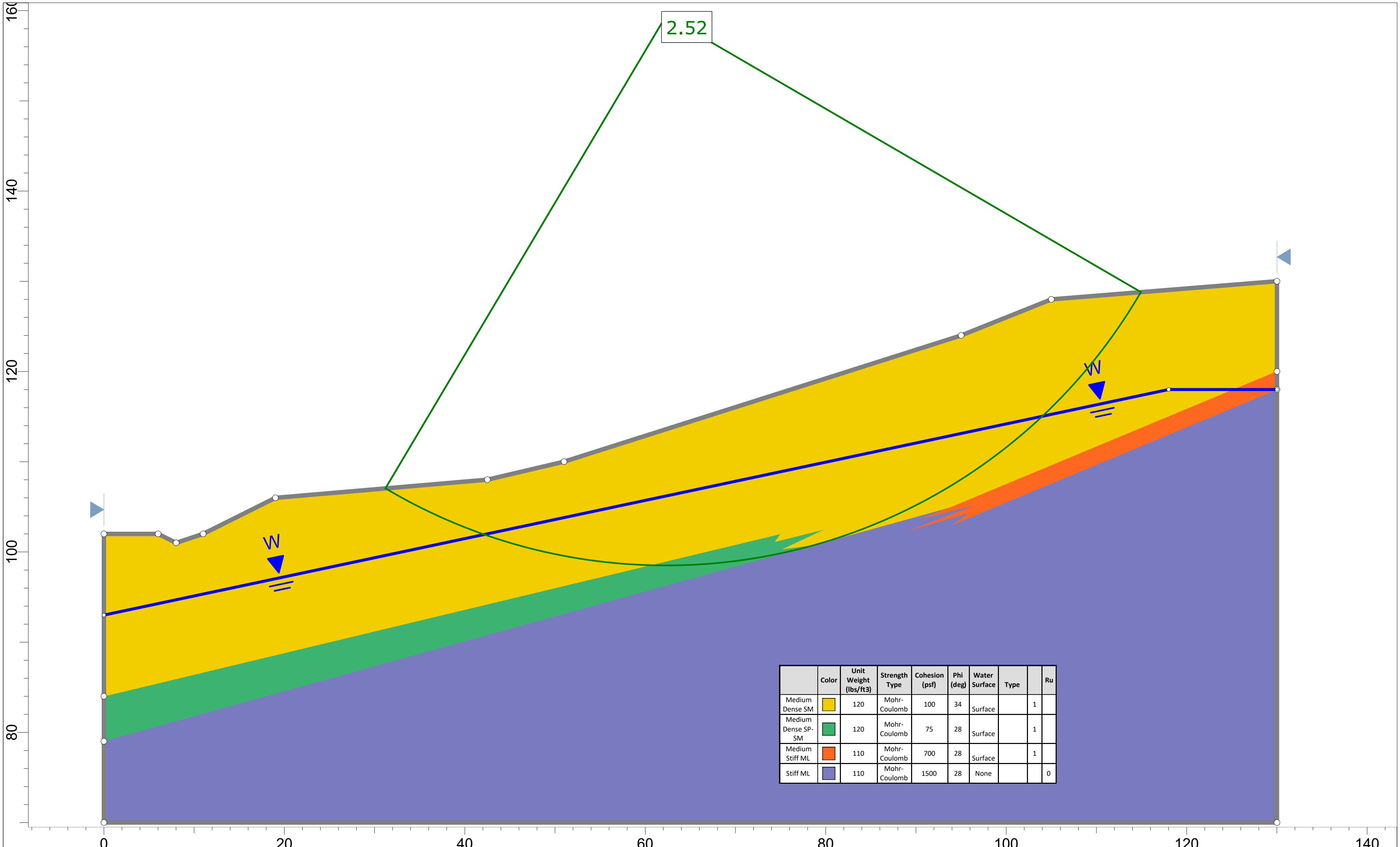
Kirkland, WA

Figure A-4

Tested By: KJ

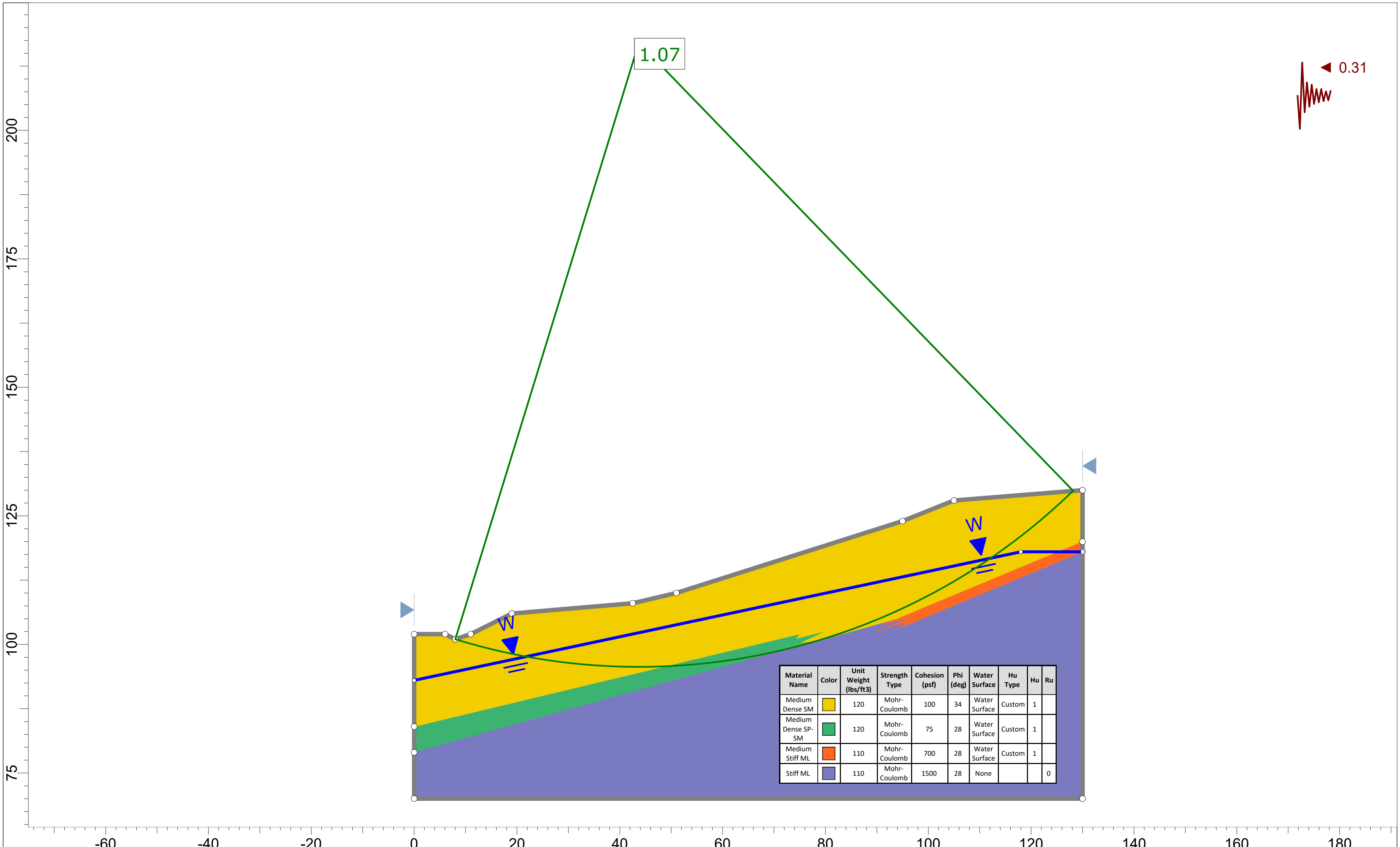
APPENDIX B

RELATIVE SLOPE STABILITY RESULTS



	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Type		Ru
Medium Dense SM		120	Mohr-Coulomb	100	34	Surface		1	
Medium Dense SP-SM		120	Mohr-Coulomb	75	28	Surface		1	
Medium Stiff ML		110	Mohr-Coulomb	700	28	Surface		1	
Stiff ML		110	Mohr-Coulomb	1500	28	None			0

rocscience	*Project* Cheshire Short Plat		
	Group Existing Conditions	*Scenario* Master Scenario	
	Drawn By C. Decker	*Company* Terra Associates, Inc.	
SLIDEINTERPRET 9.008	*Date* August 5, 2022	*File Name* Cross Section A-A' August 2022.slmd	

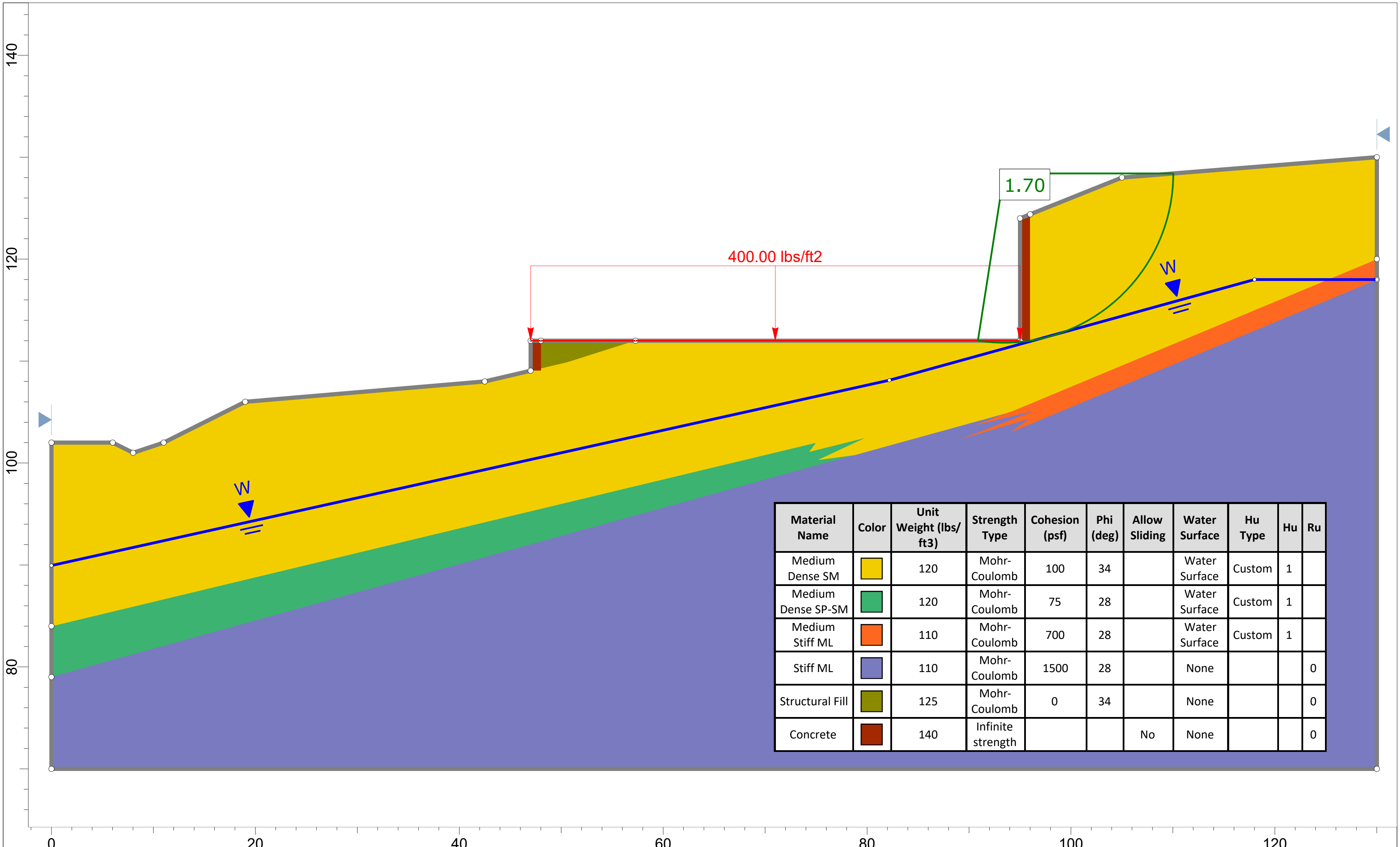


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu	Ru
Medium Dense SM		120	Mohr-Coulomb	100	34	Water Surface	Custom	1	
Medium Dense SP-SM		120	Mohr-Coulomb	75	28	Water Surface	Custom	1	
Medium Stiff ML		110	Mohr-Coulomb	700	28	Water Surface	Custom	1	
Stiff ML		110	Mohr-Coulomb	1500	28	None			0

rocscience

SLIDEINTERPRET 9.008

Project	Cheshire Short Plat
Group	Existing Conditions
Scenario	Seismic
Drawn By	C. Decker
Company	Terra Associates, Inc.
Date	August 5, 2022
File Name	Cross Section A-A' August 2022.slmd

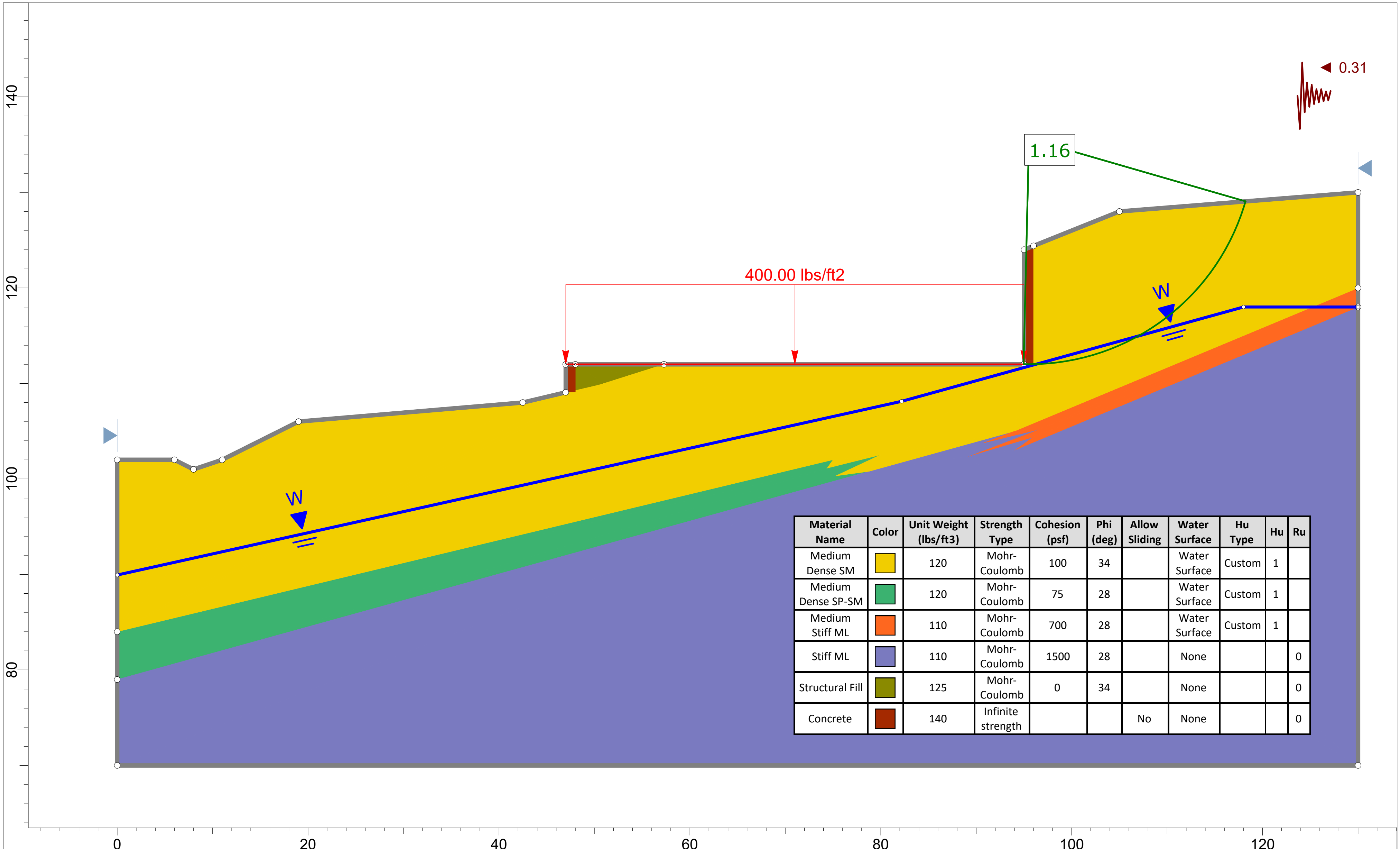


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu	Ru
Medium Dense SM		120	Mohr-Coulomb	100	34		Water Surface	Custom	1	
Medium Dense SP-SM		120	Mohr-Coulomb	75	28		Water Surface	Custom	1	
Medium Stiff ML		110	Mohr-Coulomb	700	28		Water Surface	Custom	1	
Stiff ML		110	Mohr-Coulomb	1500	28		None			0
Structural Fill		125	Mohr-Coulomb	0	34		None			0
Concrete		140	Infinite strength			No	None			0

rocscience

SLIDEINTERPRET 9.008

Project	Cheshire Short Plat		
Group	Post Construction	*Scenario*	Master Scenario
Drawn By	C. Decker	*Company*	Terra Associates, Inc.
Date	August 5, 2022	*File Name*	Cross Section A-A' August 2022.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Allow Sliding	Water Surface	Hu Type	Hu	Ru
Medium Dense SM		120	Mohr-Coulomb	100	34		Water Surface	Custom	1	
Medium Dense SP-SM		120	Mohr-Coulomb	75	28		Water Surface	Custom	1	
Medium Stiff ML		110	Mohr-Coulomb	700	28		Water Surface	Custom	1	
Stiff ML		110	Mohr-Coulomb	1500	28		None			0
Structural Fill		125	Mohr-Coulomb	0	34		None			0
Concrete		140	Infinite strength			No	None			0

rocscience

SLIDEINTERPRET 9.008

Project	Cheshire Short Plat		
Group	Post Construction	*Scenario*	Seismic
Drawn By	C. Decker	*Company*	Terra Associates, Inc.
Date	August 5, 2022	*File Name*	Cross Section A-A' August 2022.slmd

APPENDIX C

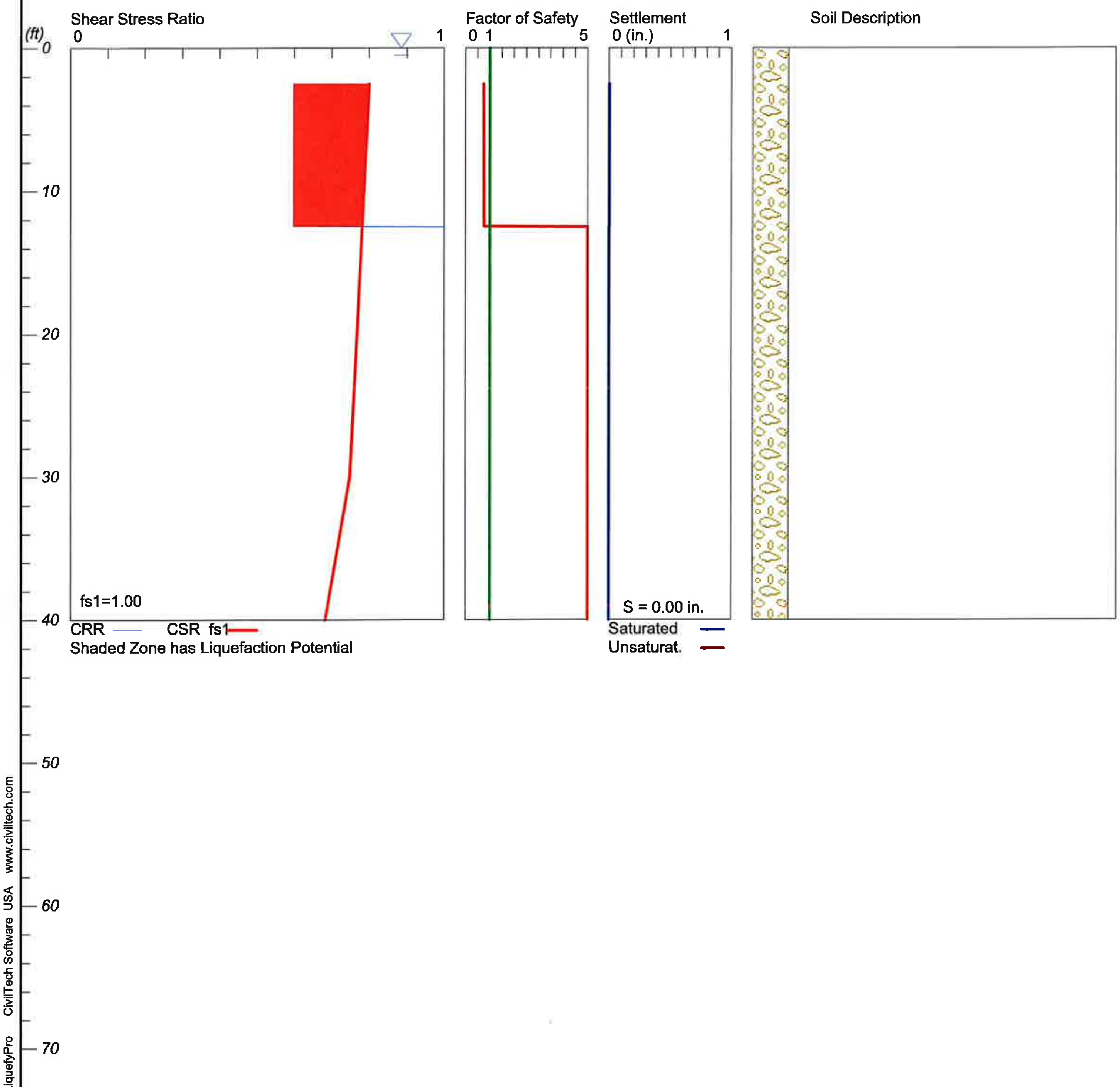
LIQUEFACTION RESULTS

LIQUEFACTION ANALYSIS

Mercer Island Short Plat

Hole No.=B-1

Magnitude=7
Acceleration=0.62g



LIQUEFACTION ANALYSIS

Mercer Island Short Plat

Hole No.=B-2   Water Depth=5 ft

Magnitude=7
Acceleration=0.62g