GEOTECHNICAL REPORT

Buchan 9118
4215 Mercerwood Drive
Mercerwood, Washington

Project No. T-8528

Terra Associates, Inc.

Prepared for:

William E. Buchan, Inc.
Bellevue, Washington

June 9, 2021

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

June 9, 2021
Project No. T-8528

Mr. Greg Nelson
William E. Buchan, Inc.
2630 – 116th Avenue NE, #100
Bellevue, Washington 98004

Subject: Geotechnical Report
Buchan 9118
4215 Mercerwood Drive
Mercer Island, Washington

Dear Mr. Nelson:

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.

Our field exploration indicates the site is generally underlain by approximately two inches of topsoil overlying one foot of medium dense sand with silt and gravel possible fill material over soft to hard silt with varying sand and gravel contents to the termination of the test borings. We did not observe any groundwater during our exploration.

In our opinion, the native soils on 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.

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Staff Engineer

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Geotechnical Report
Buchan 9118
4215 Mercerwood Drive
Mercer Island, Washington

1.0 PROJECT DESCRIPTION

The project consists of redeveloping the site with a new single-family residence, associated access, and utilities. Based on existing topography and preliminary site plan prepared by William E Buchan, Inc. dated March 22, 2021, we would expect grading to be minor, with cuts and fills between one and five feet.

We expect the residential building constructed on the lot will be a two- to- three-story wood-framed building constructed over a crawlspace with an attached garage constructed at-grade. Structural loading should be relatively light, with bearing walls carrying loads of 2 to 3 kips per foot and isolated columns carrying maximum loads of 30 to 40 kips.

The recommendations in the following sections of this report are based on our understanding of the preceding design features. We should review design drawings as they become available to verify our recommendations have been properly interpreted and to supplement them, if required.

2.0 SCOPE OF WORK

Our work was completed in accordance with our proposal dated April 9, 2021. On April 26, 2021, we observed soil and groundwater conditions at two soil test borings drilled to maximum depths of approximately 20 feet below existing grades. Using the information obtained from the subsurface exploration, we performed analyses to develop geotechnical recommendations for project design and construction.

Specifically, this report addresses the following:

- Soil and groundwater conditions.
- Geologic Hazards per the City of Mercer Island Municipal Code.
- Seismic Site Class per the current International Building Code (IBC).
- Site preparation and grading.
- Relative Slope Stability.
- Excavations.
- Foundation support.
- Slab-on-grade floors.
- Lateral earth pressures for below-grade walls.
- Drainage.
- Utilities.
- Pavements.

It should be noted, 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, Inc.'s purview. A building envelope specialist or contactor should be consulted to address these issues, as needed.

3.0 SITE CONDITIONS

3.1 Surface

The site is a single residential tax parcel totaling about 0.36 acres located at 4215 Mercerwood Drive in Mercer Island, Washington. The approximate site location is shown on Figure 1.

The site is currently developed with a single-family residence with associated access and landscaping. Vegetation on the site consists of grass lawn with several landscaped shrubs and small-sized trees throughout the property. Site topography consists of a slight slope that descends from the north to the south-southwest with an overall relief of approximately 13 feet.

3.2 Subsurface

In general, the soil conditions at the site consist of approximately two inches of topsoil overlying one foot of medium dense, possible fill material consisting of sand with silt and gravel over soft to hard silt with varying sand and gravel contents to the termination of the test borings. The exception to this general condition was observed at Test Boring B-2, where possible fill material consisting of soft to stiff silt containing occasional charcoal fragments was observed underlying the upper granular, possible fill material.

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 Glacial Till (Qt). This mapped description is consistent with the native stiff to hard silt soils we observed at the test boring locations.

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

3.3 Groundwater

We did not observe groundwater seepage in either of the test borings. However, mottling was observed in both test borings within the silt deposits below the upper possible fills and where interbedded sand seams were observed. This mottling indicates the presence of perched groundwater throughout the site. The occurrence of shallow perched groundwater is typical for sites underlain by fine-grained soils. We expect perched groundwater levels and flow rates will fluctuate seasonally and will typically reach their highest levels during and shortly following the wet winter months (October through May).

3.4 Geologic Hazards

Section 19.07.160.A of the Mercer Island City Code (MICC) defined geologically hazardous areas as "…lands that are susceptible to erosion, landslides, seismic events, or other factors as identified by WAC 365-190-120." We have evaluated the site below for the presence of erosion hazard areas, landslide hazard areas, and seismic hazard areas.

3.4.1 Erosion Hazard Areas

Section 19.16.010 of the MICC defines erosion hazard areas as "Those areas greater than 15 percent slopes 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 onsite are classified as Kitsap silt loam, 8 to 15 percent slopes by the United States Department of Agriculture Natural Resources Conservation Service (NRCS). Across the site, with the existing slope gradients, these soils will have a severe potential for erosion when exposed. Therefore, the site meets the above criteria for an erosion hazard area as defined by the MICC.

Implementation of temporary and permanent Best Management Practices (BMPs) for preventing and controlling erosion will be required and will mitigate the erosion hazard. At 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 is securely anchored to the ground surface or straw mulch.
- Establish permanent cover by seeding, in conjunction with a mulch cover or appropriate hydroseeding, over exposed areas that will not be disturbed for a period of 30 days or more.

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 onsite sediment retention for collected runoff.

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

3.4.2 Landslide Hazard Areas

Section 19.16.010 of the MICC defines landslide hazard areas as “Those areas subject to landslides based on a combination of geologic, topographic, and hydrogeologic factors, including:

1. Areas of historic failures;
2. Areas with all three of the following characteristics:
    a. Slopes steeper than 15 percent; and
    b. Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and
    c. Springs or ground water seepage;
3. Any 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; or
5. Steep Slope. Any slope of 40 percent of greater calculated by measuring the vertical rise over any 30-foot horizontal run.”

While the site does not meet any of the above conditions, the site is mapped as ‘Potential Slide Area’ on *Mercer Island Landslide Hazard Assessment* Map dated April 2009. The western slope descending from the north to south with a vertical relief of approximately 8 feet at a grade of approximately 32 percent is of particular concern. In accordance with the City requirements, we have completed a slope stability analysis. The analysis and results are in Section 4.3 of this report.

3.4.3 Seismic Hazard Areas

Section 19.16.010 of the MICC defines seismic hazard areas 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 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.

The site is currently mapped on the *Mercer Island Seismic Hazard Assessment* Map, dated April 2009, as a known or suspect seismic hazard area with a moderate potential for seismically induced ground failures. However, based on the soil and groundwater conditions we observed, it is our opinion that the risk for soil liquefaction occurring at the site is negligible due to the relative density of the soils and amount of cohesive material that would be sufficient to resist the cyclical loading of a seismic event. In addition, our analysis of the site’s slopes indicate the site slopes would remain stable during a seismic event. Therefore, in our opinion, the site would not be considered a seismic hazard area as defined by the MICC.

Based on soil conditions observed in the test pits and our knowledge of the area geology, per Chapter 16 of the 2018 International Building Code (IBC), Site Class “D” should be used in structural design.

3.5 City of Mercer Island Critical Area Requirement

Per Section 19.307.160.B.3 of the MICC, “An evaluation of site-specific subsurface conditions demonstrates that the proposed development is not located in a landslide hazard area or seismic hazard area.”

Based on the site topography, the soil and groundwater conditions, and the analysis completed below, in our opinion, the site is not located within a landslide hazard area or a seismic hazard area. Therefore, the proposed project can be constructed as designed without negatively impacting the project site or adjacent properties.

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 residential building can be supported on conventional spread footings bearing on competent native soils or competent existing fill soils observed below the organic surface horizon or on structural fill placed and compacted above the existing fill and native soils. Pavement and floor slabs can be similarly supported.

The native soils encountered at the site contain a sufficient amount of soil fines that will make them difficult to compact as structural fill when too wet. The ability to use the native soils from site excavations as structural fill will depend on its moisture content and the prevailing weather conditions at the time of construction.

Any development within the upper four feet should consider the presence of soft silt soils observed in Test Boring B-2. These materials would not be suitable bearing surfaces and should be replaced with new structural fill. The need for overexcavation and recompaction or replacement should be determined by observations in the field during grading.

The following sections provide detailed recommendations regarding the preceding issues and other geotechnical design 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, organic surface soils, and other deleterious material should be stripped and removed from the site. Surface stripping depths of two inches should be expected to remove the organic surface soils and vegetation. In the developed portions of the site, demolition of existing structures should include removal of existing foundations and buried asphalt and abandonment of underground septic systems and other 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. Organic topsoil will not be suitable for use as structural fill but may be used for limited depths in nonstructural areas.

As described above, in the vicinity of Test Boring B-2, the upper four feet of soft silt soils will require removal of the material if present within a planned development area. We recommend the soils be removed to expose the underlying medium stiff to stiff, native silts. Once removed, we recommend restoring the grade, if necessary, with structural fill meeting requirements for wet weather structural fill as discussed in the following paragraphs.

Once clearing and stripping 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, 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.

The native soils encountered at the site contain a sufficient amount of soil fines that will make them difficult to compact as structural fill when too wet or too dry. The ability to use 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 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, cement kiln dust (CKD), 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 3/4-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 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-1557 (Modified 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 Relative Slope Stability

The western portion of the proposed development will include developing near the crest of the western slope with a concrete patio. In accordance with the City of Mercer Island requirements, we have completed a slope stability analysis to determine the effects of the new building loading on the existing slope. The analysis was performed at the 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 pseudostatic (seismic) conditions. A horizontal acceleration of 0.36g was used in the pseudostatic analysis to simulate slope performance under earthquake loading. This value 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 (IBC).

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)
Soft to medium stiff SILT	100	28	200
Stiff to hard SILT	110	30	500
Structural Fill	125	32	50

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’	5.62 (Seismic FS = 1.88)	4.36 (Seismic FS = 1.84)

Based on our analysis, the existing slope is stable in its current condition and post construction the factors of safety remain above engineering standards of 1.5 for static and 1.1 for pseudostatic. Therefore, based on the City of Mercer Island requirements, the proposed structure can be constructed as shown without impacting the site or adjacent properties. The results of our analysis are attached in Appendix B.

4.4 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 upper granular soils and soft silts would be classified as Type C soil. The underlying unweathered native silts would be classified as Type B 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. Side slopes in Type B soils can be laid back at a slope inclination of 1:1 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.

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.

4.5 Foundation Support

The residential building may be supported on conventional spread footing foundations bearing on competent native soils, existing medium dense fills, or on structural fills placed above competent soils. Foundation subgrade should be prepared as recommended in Section 4.2 of this report. Perimeter foundations exposed to the weather should bear a minimum depth of 1.5 feet below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab.

As noted above, foundations located in the vicinity of Test Boring B-2 will likely require some over excavation and replacement.

Foundations can be dimensioned 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. With structural loading as anticipated and this bearing stress applied, estimated total settlements are less than one-half inch.

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 existing fill, 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.

4.6 Slab-on-Grade Floors

Slab-on-grade floors may be supported on subgrade prepared as recommended in Section 4.2 of this report. 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, 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.

4.7 Lateral Earth Pressures for Below-Grade Walls

The magnitude of earth pressure development on below-grade 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, wall drainage must also be installed. A typical recommended 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 35 pounds per cubic foot (pcf). For restrained walls, an additional uniform load of 100 psf should be added to the 35 pcf. To account for typical traffic surcharge loading, the walls can be designed for an additional imaginary height of two feet (two-foot soil surcharge). 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 4.5 of this report.

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 perimeter. If this gradient cannot be provided, surface water should be collected adjacent to the structures and directed to appropriate storm facilities.

Subsurface

We recommend installing perimeter foundation drains adjacent to 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 the local jurisdictional specifications. At a minimum, trench backfill should be placed and compacted as structural fill as described in Section 4.2 of this report. As noted, most native soils excavated on the site should be suitable for use as backfill material during dry weather conditions. However, if utility construction takes place during the wet winter months, it will likely be necessary to import suitable wet weather fill for utility trench backfilling.

4.10 Pavements

Pavement subgrades should be prepared as described in the Section 4.2 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-tired 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 residential 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 four inches of Crushed Rock Base (CRB)
- Three and one-half inches of full depth HMA

The paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for half-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.

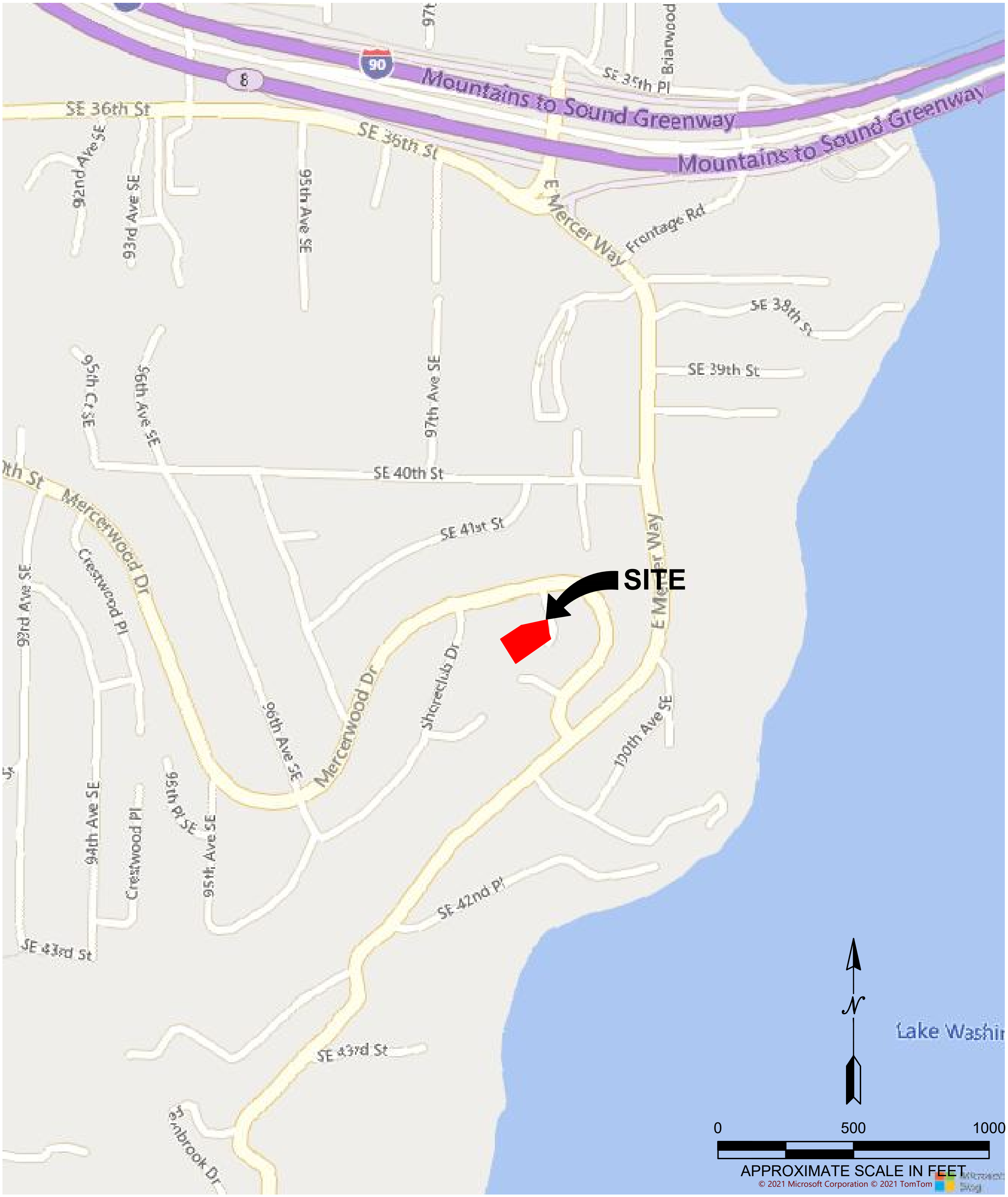
5.0 ADDITIONAL SERVICES

Terra Associates, Inc. should review the final design drawings and specifications in order to verify 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 Buchan 9118 project in Mercer Island, Washington. This report is for the exclusive use of William E. Buchan, Inc., and their authorized representatives.

The analyses and recommendations presented in this report are based on data obtained from the subsurface explorations completed onsite. 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 4/30/2021

Terra Associates, Inc.

Consultants in Geotechnical Engineering
Geology and
Environmental Earth Sciences

VICINITY MAP
BUCHAN 9118
MERCER ISLAND, WASHINGTON

Proj.No. T-8528	Date:JUNE 2021	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 BING MAPS.

LEGEND:

- ◐ APPROXIMATE BORING LOCATION
- ◣ ◢ APPROXIMATE CROSS SECTION LOCATION

0 20 40

APPROXIMATE SCALE IN FEET

N

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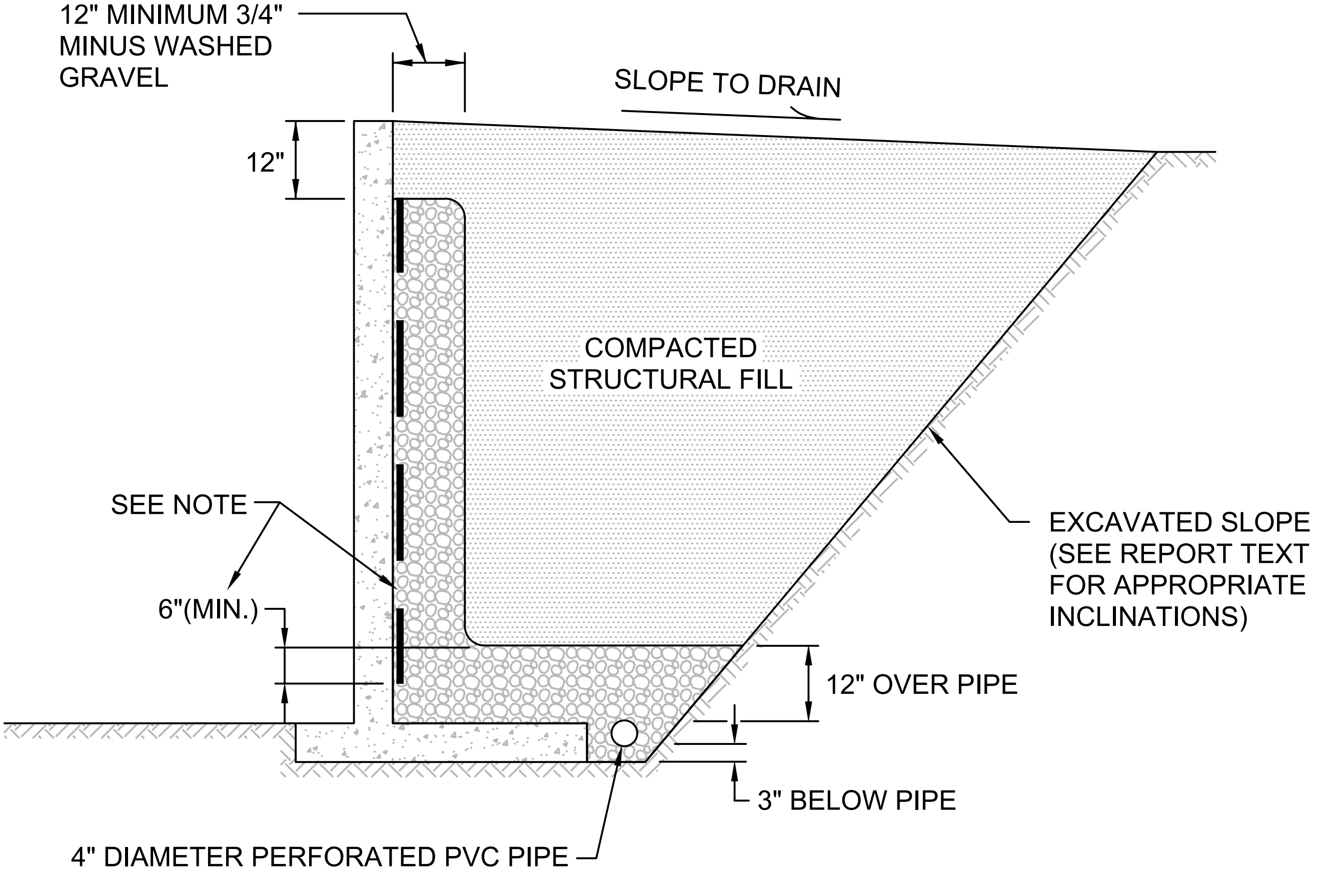
EXPLORATION LOCATION PLAN
BUCHAN 9118
MERCER ISLAND, WASHINGTON

Proj.No. T-8528	Date:JUNE 2021	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
BUCHAN 9118
MERCER ISLAND, WASHINGTON

Proj.No. T-8528	Date:JUNE 2021	Figure 3

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

Buchan 9118
Mercer Island, Washington

On April 26, 2021, we completed our site exploration by observing soil and groundwater conditions at two test borings drilled to maximum depths of approximately 20 feet below existing site grades. Test boring locations were determined in the field by measurements 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 attached as Figures A-2 and A-3.

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, 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

I	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
BUCHAN 9118
MERCER ISLAND, WASHINGTON

Proj.No. T-8528 | Date:JUNE 2021 | Figure A-1

LOG OF BORING NO. B-1

Figure No. A-2

Project: Buchan 9118 **Project No:** T-8528 **Date Drilled:** April 26, 2021

Client: William E. Buchan, Inc. **Driller:** Boretec **Logged By:** MJX

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

Depth (ft)	Soil Description	Consistency/ Relative Density	SPT (N) Blows / foot 10 30 50	Moisture Content (%)
0	(2-inches organic TOPSOIL)	medium dense		
	FILL?: Brown SAND with silt and gravel, fine to coarse sand, fine gravel, moist. (SP-SM)	soft	2	25.7
	Brown sandy SILT, fine to medium sand, moist, mottled, occasional gravel. (ML)			
5		medium stiff	8	25.5
		very stiff	16	27.7
	Gray SILT, moist, mottled, trace fine sand. (ML)			21.4
10			23	23.1
	*frequent interbedded coarse sand and fine silty sand seams below approximately 12.5 feet.	hard	32	20.7
15			35	20.0
20			66/12"	16.2
	Test boring terminated at approximately 20 feet. No groundwater seepage observed.			
25				

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: Buchan 9118 **Project No:** T-8528 **Date Drilled:** April 26, 2021

Client: William E. Buchan, Inc. **Driller:** Boretec **Logged By:** MJX

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

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows / foot 10 30 50	Moisture Content (%)
0		(2-inches organic TOPSOIL)	medium dense		
		FILL?: Brown SAND with silt and gravel, fine to coarse sand, fine gravel, moist. (SP-SM)	soft	2	23.1
		FILL?: Gray SILT, moist, mottled, trace sand, occasional organic, occasional charcoal fragment. (ML)			
5			stiff	11	27.2
		Gray SILT, moist, mottled, occasional gravel. (ML)			21.1
		*Sample contained interbedded coarse sand seams		16	20.4
			very stiff		
10				19	22.4
		Gray sandy SILT, fine to medium sand, moist, occasional gravel. (ML)			13.9
			dense/hard	41	15.9
		Gray SILT with sand, fine sand, moist. (ML)	very stiff		
15				20	22.6
			hard		
20				50/6"	18.9
		Test boring terminated at approximately 20 feet. No groundwater seepage observed.			
25					

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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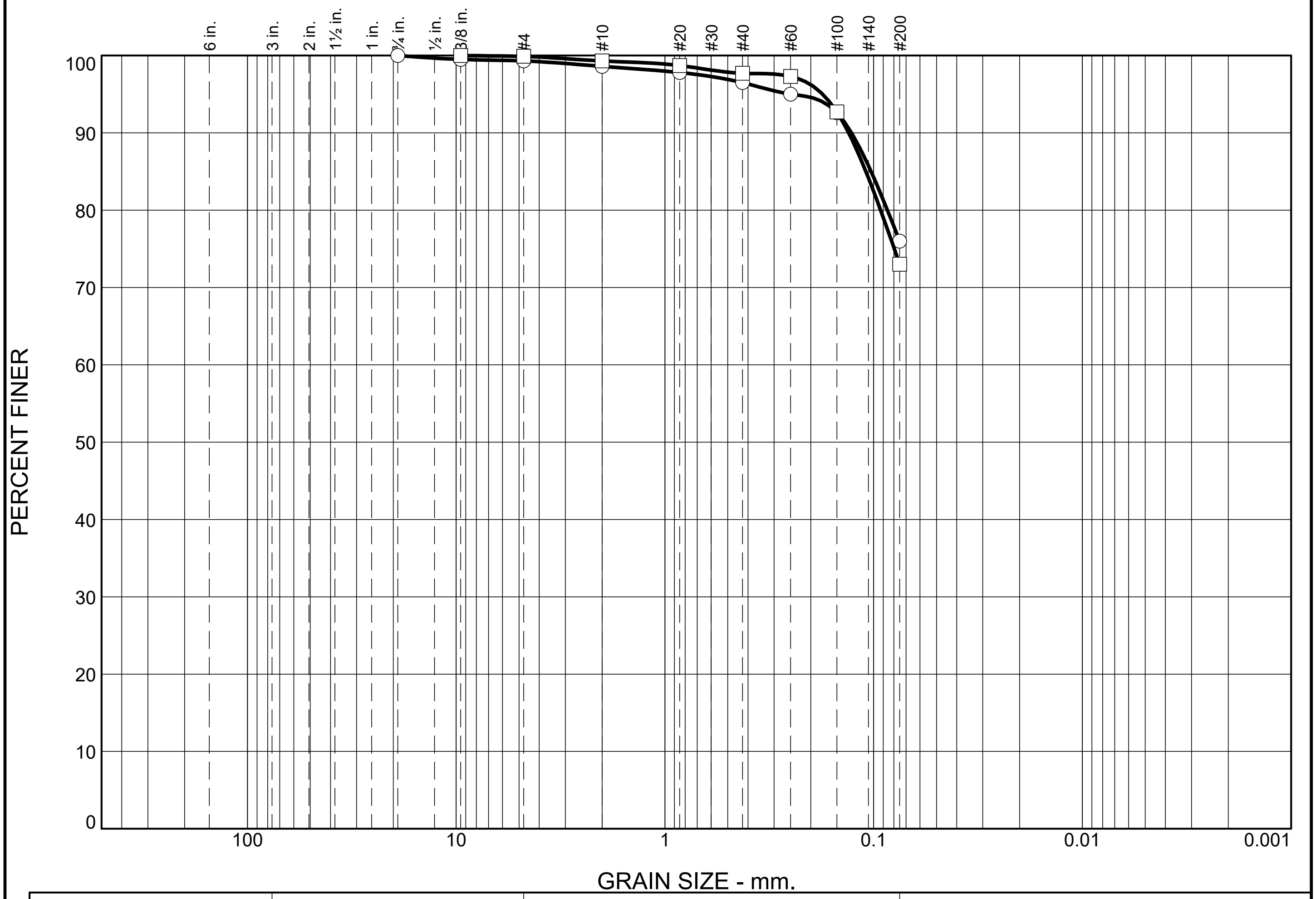
Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.7	0.7	2.1	20.5	76.0	
□	0.0	0.0	0.1	0.6	1.6	24.7	73.0	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1029							
□			0.1089							

Material Description	USCS	AASHTO
○ sandy SILT	ML	
□ sandy SILT	ML	

Project No. T-8528 **Client:** William E. Buchan, Inc.

Project: Buchan 9118

○ **Location:** Test Boring B-1 **Depth:** 5 ft **Sample Number:** 2

□ **Location:** Test Boring B-2 **Depth:** 12.5 ft **Sample Number:** 7

Remarks:

○Tested on May 5, 2021

□Tested on May 5, 2021

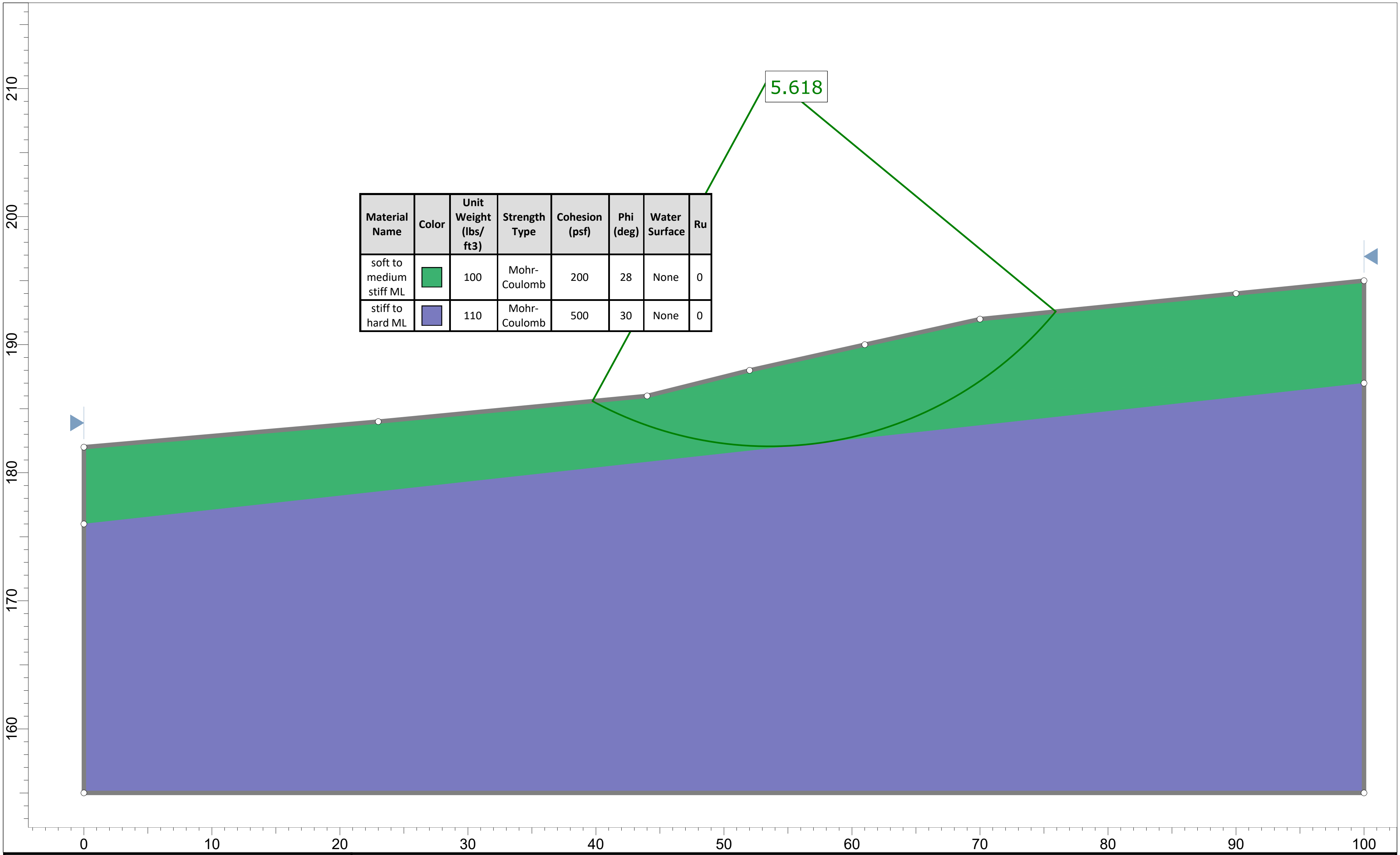
Terra Associates, Inc.

Kirkland, WA

Figure A-4

Tested By: FQ

APPENDIX B
SLIDE OUTPUT

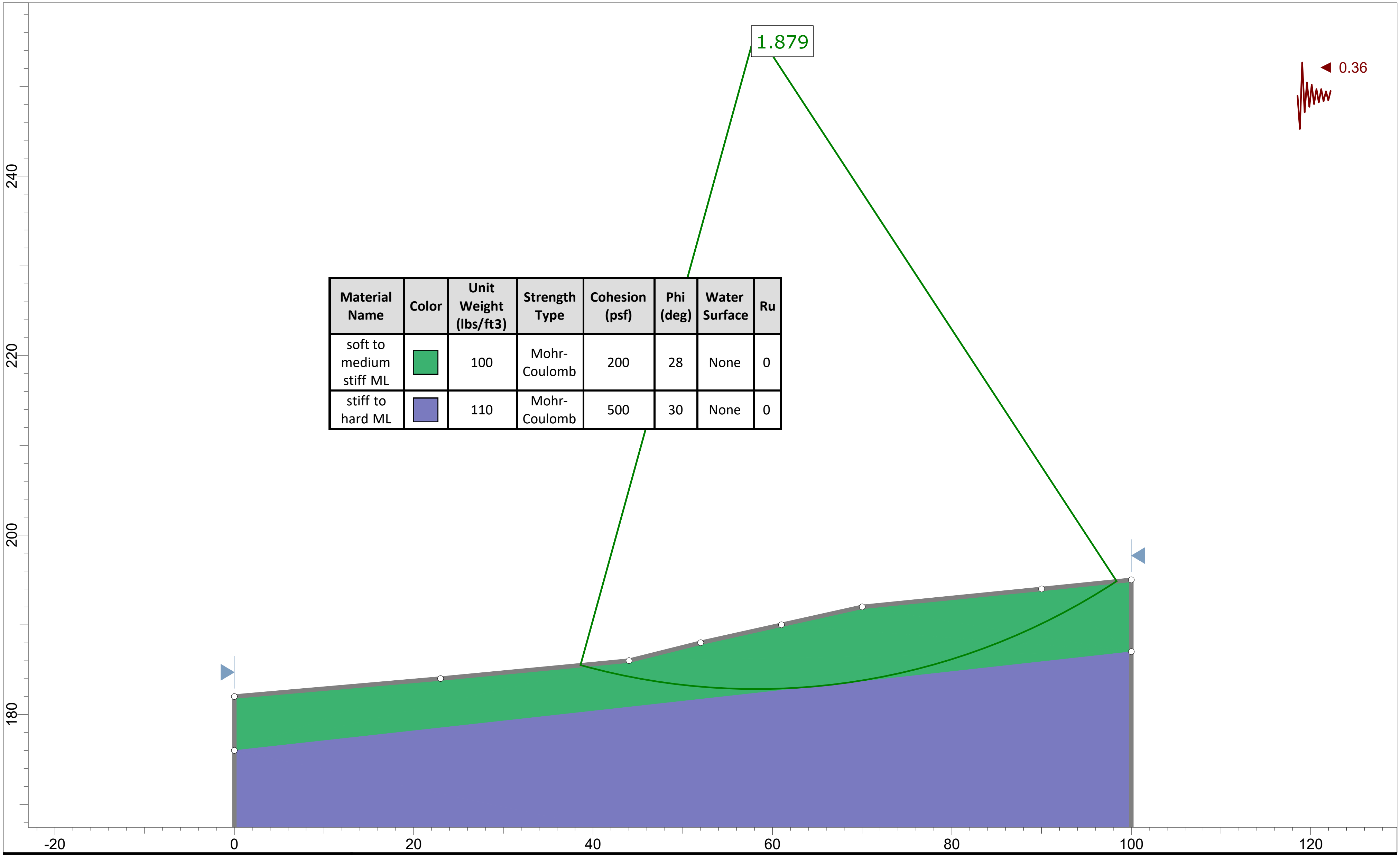


Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
soft to medium stiff ML	🟩	100	Mohr-Coulomb	200	28	None	0
stiff to hard ML	🟪	110	Mohr-Coulomb	500	30	None	0

rocscience

SLIDEINTERPRET 9.008

Project	SLIDE - An Interactive Slope Stability Program		
Group	Existing - Static	*Scenario*	Master Scenario
Drawn By	MJX	*Company*	Terra Associates, Inc.
Date	4/26/2021, 3:12:50 PM	*File Name*	A-A' revised.slmd

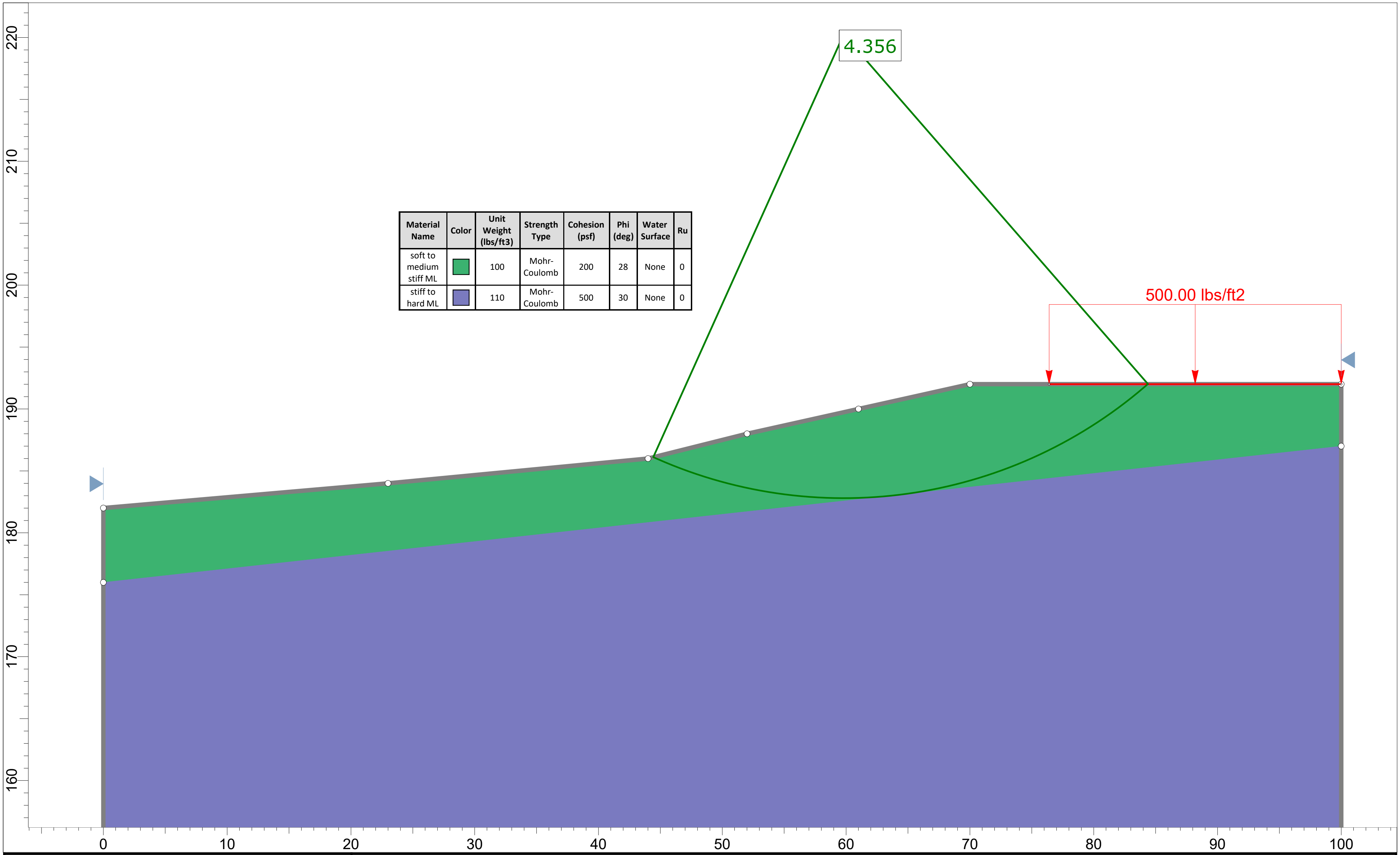


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
soft to medium stiff ML	🟩	100	Mohr-Coulomb	200	28	None	0
stiff to hard ML	🟪	110	Mohr-Coulomb	500	30	None	0

rocscience

SLIDEINTERPRET 9.008

Project	SLIDE - An Interactive Slope Stability Program		
Group	Existing - Static	*Scenario*	Existing - Sesimic
Drawn By	MJX	*Company*	Terra Associates, Inc.
Date	4/26/2021, 3:12:50 PM	*File Name*	A-A' revised.slmd

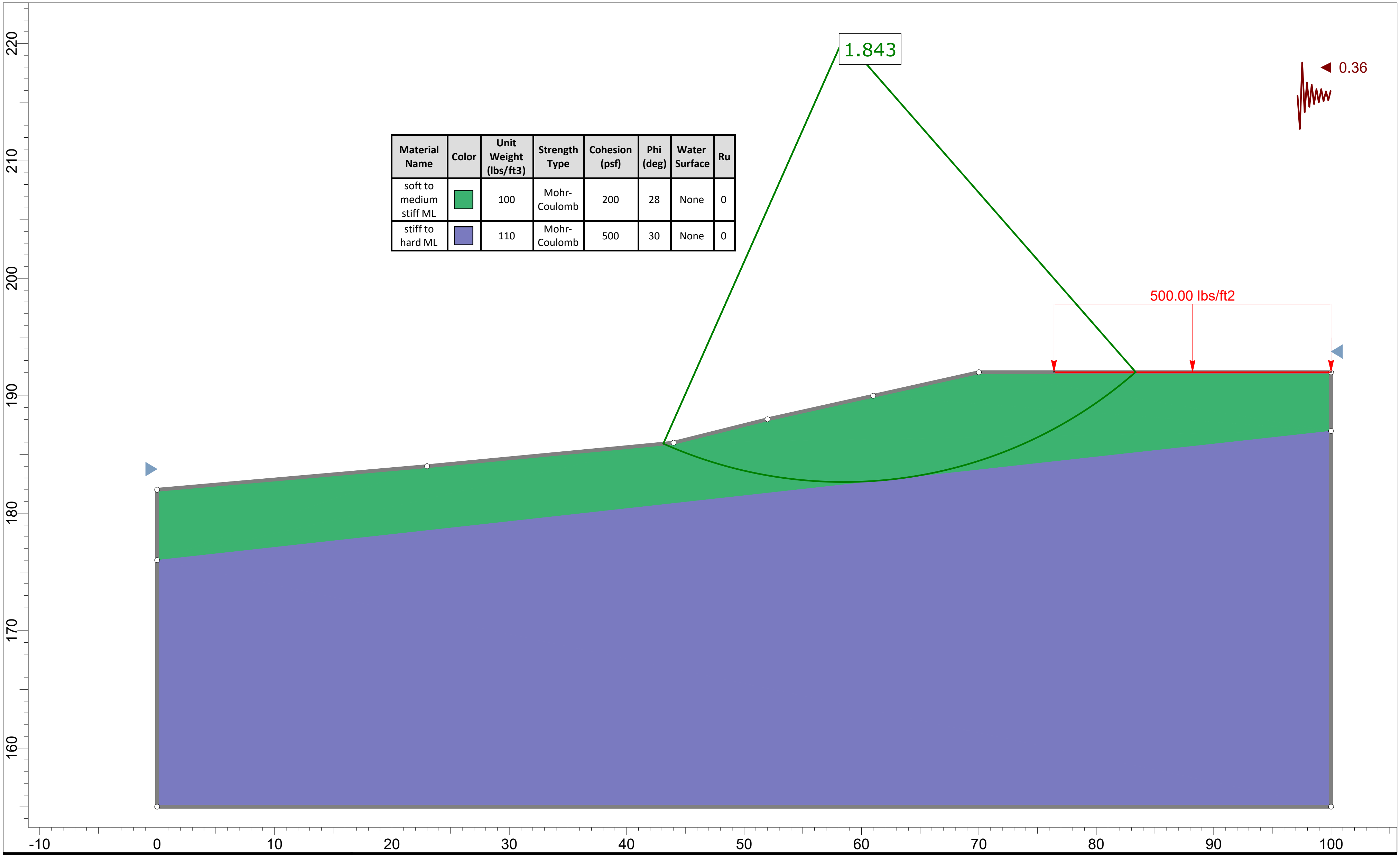


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
soft to medium stiff ML	🟩	100	Mohr-Coulomb	200	28	None	0
stiff to hard ML	🟪	110	Mohr-Coulomb	500	30	None	0

rocscience

SLIDEINTERPRET 9.008

Project	SLIDE - An Interactive Slope Stability Program		
Group	Post Construction	*Scenario*	Master Scenario
Drawn By	MJX	*Company*	Terra Associates, Inc.
Date	4/26/2021, 3:12:50 PM	*File Name*	A-A' revised.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
soft to medium stiff ML	🟩	100	Mohr-Coulomb	200	28	None	0
stiff to hard ML	🟪	110	Mohr-Coulomb	500	30	None	0

rocscience

SLIDEINTERPRET 9.008

Project	SLIDE - An Interactive Slope Stability Program

Group	Post Construction	*Scenario*	Post Construction - Sesimic
Drawn By	MJX	*Company*	Terra Associates, Inc.
Date	4/26/2021, 3:12:50 PM	*File Name*	A-A' revised.slmd