Earth Solutions NW LLC
Geotechnical Engineering, Construction
Observation/Testing and Environmental Services

November 19, 2020
ES-6510.01

Mr. Amir and Mrs. Sarah Bastawrous
4909 East Mercer Way
Mercer Island, Washington 98040

Subject: **Geotechnical Evaluation**
Proposed Retaining Wall
4909 East Mercer Way
Mercer Island, Washington

Reference: Kathy G. Troost and Aaron P. Wisher
Geologic Map of Mercer Island, dated October 2006

Kathy G. Troost and Aaron P. Wisher
Mercer Island Erosion, Landslide, and Seismic Hazard Area Maps, dated April 2009

SCJ Studio Landscape Architecture
Permit Plans, revised November 2020

Swenson Fey Faget
Structural Calculations, revised November 10, 2020

Site Surveying, Inc.
Topographic Survey, dated May 21, 2018

Mercer Island City Code (MICC)

United States Department of Agriculture (USDA)
Online Web Soil Survey (WSS) Resource

Greetings, Mr. and Mrs. Bastawrous:

As requested, Earth Solutions NW, LLC (ESNW), has prepared this letter for the proposed retaining wall construction at the subject property. We performed our work in general accordance with the scope of services outlined in the Professional Services Agreement dated January 30, 2020, which was authorized by you on February 10, 2020. A summary of the soil and groundwater conditions observed during our fieldwork and geotechnical recommendations to aid with retaining wall design are provided in this letter.

Project Description

The subject site is located west of East Mercer Way, about 100 feet south of the intersection with East Mercer Highlands Drive, in Mercer Island, Washington. During construction of the single-family residence, several timber railroad-tie retaining walls ("timber walls") were installed without the benefit of toe embedment and drainage provisions. At least one timber wall, located approximately 20 feet south of the southeastern corner of the existing residence, has failed and is actively moving. The timber wall extends in a northeast-southwest direction and includes maximum exposed heights of about five feet. Based on our field observations, tension cracks are present behind the timber wall, and the wall is bulging, in part, due to loose fill placed during construction of the single-family residence. As such, it is proposed to remove the timber wall and a significant portion of the loose fill and construct a cast-in-place concrete retaining wall ("CIP wall").

The CIP wall will have a maximum height of six feet. Both steel W-piles and steel pipe piles will be installed underneath the CIP wall to provide adequate bearing support and for global stability purposes. About three feet of geofoam will be placed immediately behind the CIP wall drainage fill to reduce the lateral pressure on the CIP wall, and granular structural fill will be placed between the geofoam and the earth cut. At least eight inches of planting soil will be installed to cap the proposed wall construction and fill area. In general, a maximum temporary inclination of one-and-one-half horizontal to one vertical (1.5H:1V) will be used to install the proposed improvements; however, steeper temporary inclinations (such as 1H:1V) may be possible in areas of dense, undisturbed native soil, as recommended by ESNW at the time of construction.

The entirety of the site includes erosion, landslide, and seismic geologic hazard areas, as defined by the City of Mercer Island (City). Further discussion can be found in the *Geologically Hazardous Areas* section of this letter.

Subsurface Conditions

An ESNW representative observed, logged, and sampled three shallow borings, advanced at accessible locations near the area of the proposed retaining wall, on January 10, 2019 using hand tools. ESNW returned to the site on July 23, 2020, to advance two deeper borings using a drill rig and operators retained by our firm.

The approximate locations of the borings are depicted on Plate 2 (Subsurface Exploration Plan). Please refer to the attached boring logs for a more detailed description of subsurface conditions. Representative soil samples collected at the boring locations were evaluated in general accordance with Unified Soil Classification System (USCS) and USDA methods and procedures.

Fill

Fill was encountered at the boring locations to depths of roughly four to seven feet below the existing ground surface (bgs). The fill was characterized primarily as very soft to stiff silt with sand or sandy silt (USCS: ML) in a moist condition. Scattered organics and burnt wood fragments were observed in the fill.

Native Soil and Geologic Setting

Underlying the fill, native soil consisting of medium dense sandy silt (USCS: ML) and very dense silty sand (USCS: SM) was encountered at B-1 and B-2, beginning at a depth of about seven feet bgs. The native soil appeared consistent with Lawton clay deposits. Lawton clay (Qvlc) typically consists of laminated to massive clay-rich silt, which was deposited in lowland proglacial lakes during the Fraser glaciation. The material typically displays poor permeability characteristics and is prone to erosion. Lawton clay is commonly found along topographically lower areas of the Puget Sound and has historically been sensitive to localized and shallow failures in the greater Seattle area.

The referenced WSS resource identifies Kitsap silt loam (Map Unit Symbol: KpD) as the primary soil unit underlying the subject site and surrounding area. Kitsap series soils are associated with stratified silt deposited in lacustrine settings. Such material typically takes the landform of terraces and is commonly found along the margins of Mercer Island as steep slopes.

Groundwater

During our January 2019 and July 2020 subsurface explorations, groundwater seepage was not encountered at the boring locations. It is noted that seepage rates and elevations fluctuate depending on many factors, including precipitation duration and intensity, the time of year, and soil conditions. In general, groundwater flow rates are higher during the winter, spring, and early summer months.

Geologically Hazardous Areas

Based on our review of the MICC and the referenced hazard maps, the subject site and surrounding area are situated within erosion, landslide, and seismic hazard areas, as defined in MICC 19.16.010. While geologically hazardous areas are present on site and in the surrounding area, construction of the proposed retaining wall will stabilize the fill soils on site, which currently exacerbate the geologic hazard potential.

Erosion Hazard Areas

Erosion hazard areas are defined in MICC 19.16.010 as “those 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 USDA NRCS as having a ‘severe’ or ‘very severe’ rill and inter-rill erosion hazard”. Soils typically associated with rill and inter-rill erosion hazard include the Kitsap series, which is mapped on site. As such, it is our opinion the site lies within an erosion hazard area per the MICC definition.

The proposed improvements will help mitigate some of the risk associated with erosion hazard areas by removing the majority of loose fill present on site. As such, it is our opinion the project poses very low to low risk of erosion occurrence related to grading activity, provided that proper Best Management Practices (BMPs) are established and maintained during construction. Temporary approaches for controlling surface water runoff should be established prior to beginning earthwork activities. Further discussion on erosion control can be found in the *Temporary Erosion Control* section of this letter.

Landslide Hazard Areas

MICC 19.16.010 defines landslide hazard areas as "those areas subject to landslides based on a combination of geologic, topographic, and hydrologic factors", which includes:

- Areas of historic failures.
- Areas with all three of the following characteristics:
    - Slopes steeper than 15 percent.
    - Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock.
    - Springs or groundwater seepage.
- Areas that have shown evidence of past movement or that are underlain or covered by mass wastage debris from past movements.
- Areas potentially unstable because of rapid stream incision and stream bank erosion.
- Any slope of 40 percent or greater calculated by measuring the vertical rise over any 30-foot horizontal run.

Slopes greater than 40 percent are present on site, and as such, the site lies within a landslide hazard area per the MICC definition. Further discussion about how the proposed improvements will stabilize the site is provided in the *Statement of Risk & Plan Review* section below.

Seismic Hazard Areas

Seismic hazard areas are defined by MICC 19.16.010 as "those areas subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, or surface faulting". The area of the site proposed for development is largely underlain by fine-grained fill overlying native silt and silty sand. Because fine-grained soils are not typically susceptible to liquefaction, it is our opinion site susceptibility to liquefaction may be considered low. The relative density of native soils, as well as the absence of a uniformly established, shallow groundwater table, were the primary bases for this interpretation.

Alterations of Geologically Hazardous Areas

Per MICC 19.07.160(B)(2), alterations of landslide hazards areas, seismic hazard areas, and associated buffers may occur if the proposed alteration:

a. Will not adversely impact other critical areas.

b. Will not adversely impact the subject property or adjacent properties.

c. Will mitigate impacts to the geologically hazardous area, consistent with best-available science to the maximum extent reasonably possible, such that the site is determined to be safe.

d. Include the landscaping of all disturbed areas outside of building footprints and installation of hardscape prior to final inspection.

We offer the following evaluation of the proposed improvements, with respect to each criterion:

a. The proposed CIP wall and related grading improvements affect the mapped geologic hazards positively, such that the risks associated with each hazard (erosion, landslide, and seismic) are reduced in the proposed configuration. A significant portion of the existing, loose fill will be removed and replaced with an engineered wall system and structural fill. The steel W-piles and steel pipe piles used to provide foundation support for the CIP wall will also improve global slope stability.

b. The above analysis for “a” (for the subject property) is applicable to the discussion of potentially adversely impacting adjacent properties. Landslides and related earth movement are not anticipated as a result of the proposed improvements. Uncontrolled surface-water flows are expected to decrease because of drainage improvements to the slope and because collected stormwater will be tightlined to a nearby catch basin.

c. The proposed improvements have incorporated design recommendations from several consulting professionals, e.g., the project architect, geotechnical engineer, and structural engineer, based on best-available science and professional standards of the area, to the maximum extent reasonably possible.

d. The landscaping of all disturbed areas outside of building footprints and installation of all impervious surfaces is expected prior to final inspection.

Statement of Risk & Plan Review

Per MICC 19.07.160(B)(3), alterations of landslide hazards areas, seismic hazard areas, and associated buffers may occur if the conditions listed in MICC 19.07.160(B)(2) are satisfied and the geotechnical professional provides a statement of risk matching one of the following:

a. An evaluation of site-specific subsurface conditions demonstrates that the proposed development is not located in a landslide hazard area or seismic hazard area.

b. The landslide hazard area or seismic hazard area will be modified, or the development has been designed, so that the risk to the site and adjacent property is eliminated or mitigated, such that the site is determined to be safe.

c. Construction practices are proposed for the alteration that would render the development as safe as if it were not located in a geologically hazardous area and do not adversely impact adjacent properties.

d. The development is so minor as not to pose a threat to public health, safety, and welfare.

In our opinion, criterion “c” is met. The proposed improvements have been designed and reviewed by the project team, which includes the architect, geotechnical engineer, and structural engineer. The risks and hazards have been considered and accounted for in the design, which renders the development as safe as if it were not located in a geologically hazardous area. The proposed construction practices are designed to affect only the subject site and will not impact adjacent properties adversely.

Based on our review of the referenced permit plans, it is our opinion that all substantial geotechnical recommendations (including those provided in this letter) have been incorporated into the plans.

Temporary Erosion Control

It is recommended that silt fencing be placed along the clearing limits. Soil stockpiles should be covered or otherwise protected to reduce soil erosion. Soil stockpiles should be sited as far away as possible from the top of any slope, and ESNW should confirm stockpile siting during construction. Temporary approaches for controlling surface water runoff should be established prior to beginning earthwork activities. Site clearing should be performed only where necessary. Additional BMPs, as indicated on the plans, should be incorporated into construction activities.

Proposed Retaining Wall

The proposed CIP wall will have a maximum height of six feet. Both steel W-piles and steel pipe piles will be installed underneath the CIP wall to provide adequate bearing support and for global stability purposes. About three feet of geofoam will be placed immediately behind the CIP wall drainage fill to reduce the lateral pressure on the CIP wall, and granular structural fill will be placed between the geofoam and the earth cut. At least eight inches of planting soil will be installed to cap the proposed wall construction and fill area.

The CIP wall must be designed to resist earth pressures and applicable surcharge loads. Competent native soil suitable for foundation support will likely be encountered beginning at depths of about six to seven feet bgs across most of the site. To ensure sufficient end bearing is provided, pipe piles will be driven to refusal along portions of the base of the CIP wall, and W-piles will be installed to depths of at least 25 feet bgs. The new wall will include at least two feet of embedment along the wall toe.

The following parameters may be used for design of the CIP wall. The lateral earth pressures are expressed as equivalent fluid pressures.

- Active earth pressure (unrestrained condition) — 35 pcf (structural soil backfill)*
15 pcf (geofoam backfill)†
- Passive earth pressure — 250 pcf (level toe slope)
100 pcf (2H:1V toe slope)
- Coefficient of friction — 0.30
- Seismic surcharge — 6H psf‡

* *Where adequately compacted, clean crushed rock or suitable structural fill is placed as wall backfill*
† *Where at least three feet of geofoam, as measured laterally from the edge of the wall drainage backfill, is used*
‡ *Where H equals the retained height (in feet)*

A one-third increase in the allowable soil bearing capacity may be assumed for short-term wind and seismic loading conditions. The above passive pressure and friction values include a factor-of-safety of 1.5. With structural loading as expected, total settlement in the range of one inch and differential settlement of approximately one-half inch is anticipated. Most of the anticipated settlement should occur during construction when dead loads are applied.

The retaining wall should be backfilled with an 18-inch zone of free-draining material that extends along the back of the wall. Beyond the drainage fill, a three-foot-thick geofoam section should be installed along the entirety of the wall. Elsewhere, suitable structural fill, mechanically compacted to at least 95 percent of the laboratory maximum dry density (as determined by ASTM D1557), may be utilized as backfill. CIP wall construction and related earthwork activities should be observed and documented by ESNW during construction.

Steel Pipe Piles

A portion of the CIP wall will be supported on pipe piles driven to refusal in dense native soil. Based on the soil conditions encountered during our fieldwork, we anticipate competent native soil will be encountered beginning at depths of about six to seven feet bgs. Ultimately, pile lengths will be determined by final design grades and depths at which adequate refusal is achieved. As such, longer pile lengths may be required to achieve acceptable refusal criteria. In our opinion, the contractor should be prepared to drive piles in excess of 20 feet if site conditions require longer lengths to achieve refusal. Due to the encountered soil conditions, in our opinion, the pipe piles should consist of galvanized steel to reduce the potential for corrosion.

Where conventional installation machinery cannot access portions of the proposed building envelope, a 90-pound pneumatic jackhammer will likely be necessary for pipe pile installation. If utilized, the allowable axial load capacity listed below may be used for design:

- Pile diameter 2 inches
- Load capacity 3 tons*
- Refusal criteria 60 seconds per inch
- Pneumatic hammer 90 pounds

* *Including a factor-of-safety of at least 2.0*

With structural loading as expected, total settlement in the range of one-half inch and differential settlement of about one-quarter inch is anticipated. Most of the settlement should occur during construction when dead loads are applied. ESNW should evaluate the keyway of the proposed retaining wall during construction and prior to pipe pile installation. An ESNW representative should observe and document pile installation to confirm adequate refusal during pile installation.

Steel W-Piles

Most of the CIP wall will be supported by steel W-piles. Based on the results of global stability analysis (as summarized in the next section), the W-piles should extend at least 25 feet into the slope, as measured from the subgrade elevation of the CIP wall. At the option of the contractor and/or structural engineer, W8 X 31 or W12 X 26 piles are acceptable from a geotechnical standpoint.

Global Stability

A global stability analysis was completed to evaluate the feasibility of constructing the CIP wall and related grading improvements. The global stability analysis was completed using GeoStudio 2021 Slope/W modeling software. The stability analysis was completed to reflect both the temporary construction and proposed post-construction conditions. Existing and proposed site topography, as depicted on the referenced plans, was used in our models. Modeling parameters for soil properties were based on the conditions observed during our January 2019 and July 2020 field explorations.

The results of our analysis and the modeling parameters used in the analysis are attached to this letter. The analysis yielded factor-of-safety values of at least 1.1 for seismic conditions and 1.5 for static conditions in the post-construction configuration. In our opinion, the stability analysis demonstrates that the proposed CIP wall and related grading activities are feasible from a geotechnical standpoint.

Seismic Design

The 2015 International Building Code recognizes the American Society of Civil Engineers (ASCE) for seismic site class definitions. Based on the soil conditions encountered at the subject site, in accordance with Table 20.3-1 of the ASCE Minimum Design Loads for Buildings and Other Structures manual, Site Class D should be used for design.

Temporary Excavations and Permanent Slopes

Excavation activities are likely to expose very soft to stiff fill and/or stiff to very stiff native silt or silty sand. Based on the soil conditions observed at the boring locations, the following allowable temporary slope inclinations, as a function of horizontal to vertical (H:V) inclination, may be used. The applicable Federal Occupation Safety and Health Administration (OSHA) and Washington Industrial Safety and Health Act (WISHA) soil classifications are also provided:

- Areas containing groundwater seepage 1.5H:1V (Type C)
- Fill; loose to medium dense native soil 1.5H:1V (Type C)

Steeper temporary inclinations with dense, undisturbed native soil (such as 1H:1V) may be feasible but must be evaluated by ESNW on a case-by-case basis during construction. Permanent slopes should be planted with vegetation to enhance stability and to minimize erosion and should maintain a gradient of 2H:1V or flatter. An ESNW representative should observe temporary and permanent slopes to confirm the slope inclinations are suitable for the exposed soil conditions and to provide additional excavation and slope recommendations, as necessary.

Structural Fill

Structural fill placed and compacted as backfill for the proposed retaining wall during site grading activities should meet the following specifications and guidelines:

• Structural fill material	Granular soil*
• Moisture content	At or slightly above optimum†
• Relative compaction (minimum)	95 percent (Modified Proctor)
• Loose lift thickness (maximum)	12 inches

* *On-site soil should not be used as structural fill. Imported granular soil should contain less than 5 percent fines content, as confirmed by ESNW prior to acceptance as structural fill.*

† *Soil shall not be placed dry of optimum moisture content and should be evaluated by ESNW during construction.*

Areas of unsuitable material and debris should be removed from structural areas and replaced with structural fill. Topsoil and organic-rich soil is neither suitable for foundation support nor for use as structural fill but may be used in non-structural areas, if desired.

Drainage

Zones of perched groundwater seepage should be anticipated in site excavations depending on the time of year grading operations take place. Temporary measures to control surface water runoff during construction would likely involve passive elements such as interceptor trenches and sumps. ESNW should be consulted during preliminary grading to identify areas of seepage and to provide recommendations to reduce the potential for instability related to seepage effects, if necessary.

Limitations

This letter has been prepared for the exclusive use of Mr. Amir and Mrs. Sarah Bastawrous and their representatives. No warranty, express or implied, is made. This letter was prepared in a manner consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. If the assumptions outlined in this letter either change or are incorrect, ESNW must be contacted to review the recommendations and conclusions provided herein.

Variations in the soil and groundwater conditions observed at the boring locations may exist and may not become evident until construction. ESNW should reevaluate the conclusions provided in this letter if variations are encountered.

Additional Services

ESNW should be retained to provide testing and consultation services during the earthwork phase of construction. Provided that ESNW is retained to observe CIP wall construction and related grading activities, supplemental recommendations (where necessary, based on field conditions) can be provided.

We appreciate the opportunity to be of service and trust this letter meets your current needs. Please call if you have any questions or if we can be of further assistance.

Sincerely,

EARTH SOLUTIONS NW, LLC

11/19/2020

Keven D. Hoffmann, P.E.
Senior Project Manager

Attachments: Plate 1 – Vicinity Map
Plate 2 – Subsurface Exploration Plan
Boring and Hand Auger Boring Logs
Laboratory Grain Size Distributions
Slope/W Output

cc: SCJ Studio Landscape Architecture
Attention: Mr. Mark Garff, PLA (Email only)

Swenson Say Faget
Attention: Mr. Blaze Bresko, P.E., S.E. (Email only)

Reference:
King County, Washington
OpenStreetMap.org

NORTH

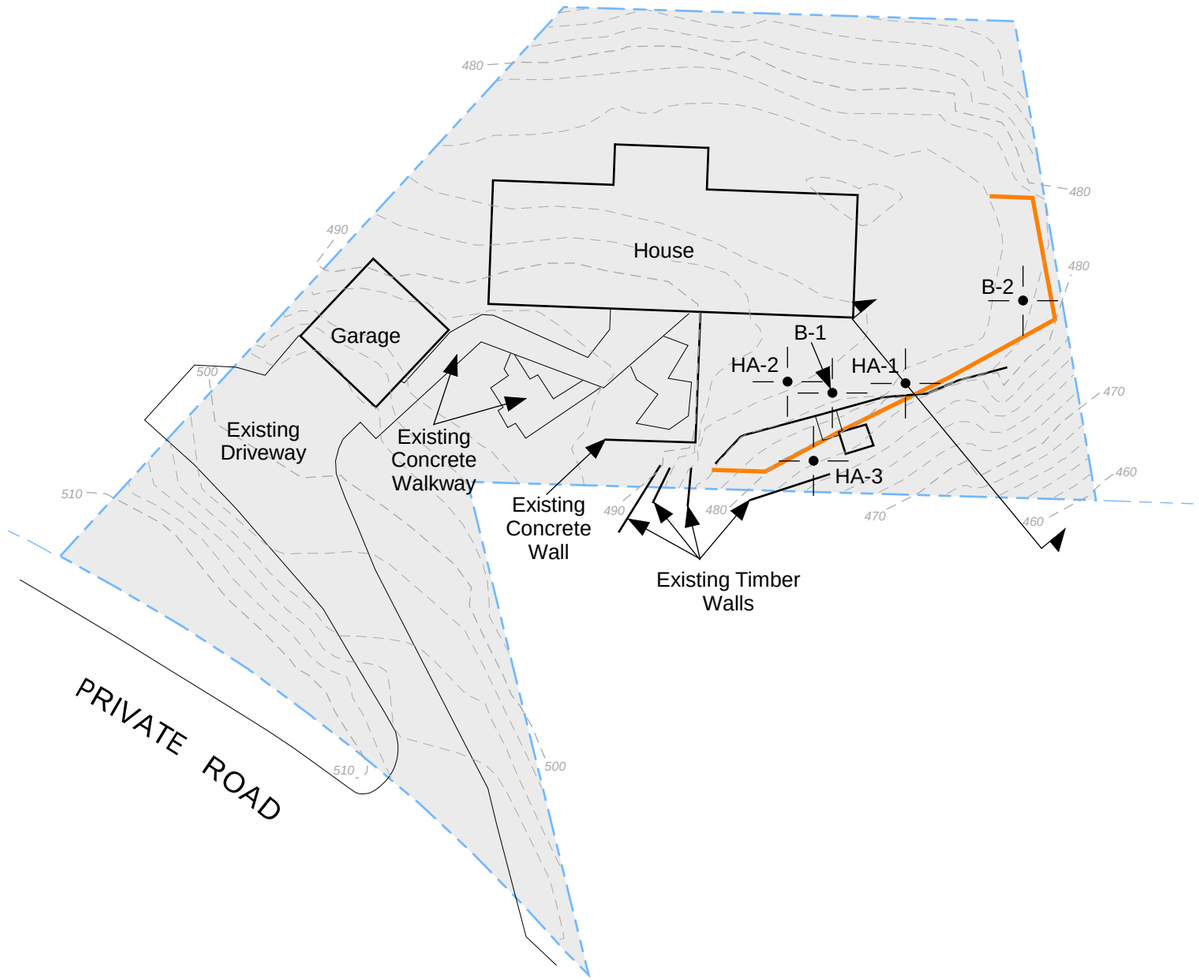
Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Vicinity Map
Maple Grove
Mercer Island, Washington

Drwn. MRS	Date 08/25/2020	Proj. No. 6510.01
Checked KDH	Date Aug. 2020	Plate 1

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.



LEGEND

B-1 — Approximate Location of ESNW Boring, Proj. No. ES-6510.01, July 2020

HA-1 — Approximate Location of ESNW Hand Auger Boring, Proj. No. ES-6510, Jan. 2019

Subject Site

Existing Building

Proposed Concrete Wall

Slope Stability Cross Section

NORTH

1"=30'

0 15 30 60

Scale in Feet

NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

Subsurface Exploration Plan
Maple Grove
Mercer Island, Washington

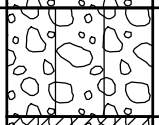
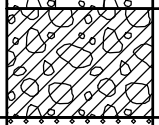
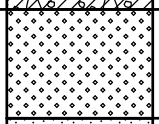
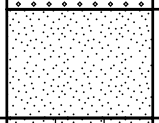
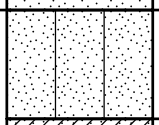
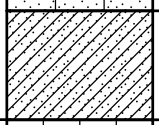
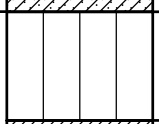
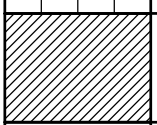
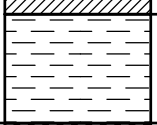
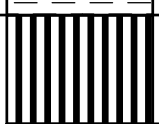
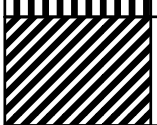
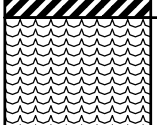
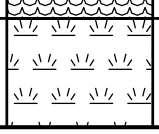
Earth Solutions NW LLC
Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Earth Solutions NW LLC

Drwn. By	MRS
Checked By	KDH
Date	11/17/2020
Proj. No.	6510.01
Plate	2

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO 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 (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

DUAL SYMBOLS are used to indicate borderline soil classifications.

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs.

Earth Solutions NW, LLC
15365 N.E. 90th Street, Suite 100
Redmond, Washington 98052
Telephone: 425-449-4704
Fax: 425-449-4711

BORING NUMBER B-1

PROJECT NUMBER ES-6510.01 **PROJECT NAME** Maple Grove

DATE STARTED 7/23/20 **COMPLETED** 7/23/20 **GROUND ELEVATION** _____ **HOLE SIZE** _____

DRILLING CONTRACTOR Geologic Drill Partners **GROUND WATER LEVELS:**

DRILLING METHOD HSA **AT TIME OF DRILLING** ---

LOGGED BY AZS **CHECKED BY** KDH **AT END OF DRILLING** ---

NOTES Surface Conditions: exposed soil **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					ML		Gray sandy SILT, very loose, moist (Fill)
							-trace organics
	SS	33	2-1-1 (2)	MC = 11.7% Fines = 68.0%			
5							-roots
	SS	22	5-4-5 (9)	MC = 17.1%			-becomes loose
							7.0
	SS	76	26-50/6"	MC = 5.1% Fines = 29.0%	SM		Gray silty SAND with gravel, very dense, damp
							[USDA Classification: gravelly sandy LOAM]
							8.5

Boring terminated at 8.5 feet below existing grade. No groundwater encountered during drilling. Boring backfilled with bentonite.

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BORING NUMBER B-2

PROJECT NUMBER ES-6510.01 **PROJECT NAME** Maple Grove
DATE STARTED 7/23/20 **COMPLETED** 7/23/20 **GROUND ELEVATION** _____ **HOLE SIZE** _____
DRILLING CONTRACTOR Geologic Drill Partners **GROUND WATER LEVELS:**
DRILLING METHOD HSA **AT TIME OF DRILLING** ---
LOGGED BY AZS **CHECKED BY** KDH **AT END OF DRILLING** ---
NOTES Surface Conditions: exposed soil **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0					ML		Gray sandy SILT, loose, moist (Fill)
	SS	50	4-4-5 (9)	MC = 12.5%			-trace roots
5	SS	33	4-3-2 (5)	MC = 16.4%			-roots
							7.0
	SS	78	5-5-12 (17)	MC = 5.3%	ML		Gray sandy SILT, medium dense, damp
10	SS	50	10-12-15 (27)	MC = 8.5% Fines = 60.8%			[USDA Classification: slightly gravelly LOAM]
							10.5

Boring terminated at 10.5 feet below existing grade. No groundwater encountered during drilling. Boring backfilled with bentonite.

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BORING NUMBER HA-1

PROJECT NUMBER ES-6510 **PROJECT NAME** Bastawrous SFR Deck

DATE STARTED 1/10/19 **COMPLETED** 1/10/19 **GROUND ELEVATION** 483 ft **HOLE SIZE**

DRILLING CONTRACTOR ESNW Rep **GROUND WATER LEVELS:**

DRILLING METHOD Hand Auger **AT TIME OF DRILLING** ---

LOGGED BY BST **CHECKED BY** KDH **AT END OF DRILLING** ---

NOTES Surface Conditions: bare soil **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0					Brown SILT with sand, very soft to soft, moist (Fill)	
					-scattered burnt wood fragments	
		MC = 20.9%	ML			
					-becomes medium stiff to stiff	
		MC = 20.8% Fines = 75.1%		4.0	[USDA Classification: slightly gravelly LOAM]	479.0
					Hand auger boring terminated at 4.0 feet below existing grade. No groundwater encountered during excavation. No caving observed.	

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BORING NUMBER HA-2

PROJECT NUMBER ES-6510 **PROJECT NAME** Bastawrous SFR Deck

DATE STARTED 1/10/19 **COMPLETED** 1/10/19 **GROUND ELEVATION** 488 ft **HOLE SIZE**

DRILLING CONTRACTOR ESNW Rep **GROUND WATER LEVELS:**

DRILLING METHOD Hand Auger **AT TIME OF DRILLING** ---

LOGGED BY BST **CHECKED BY** KDH **AT END OF DRILLING** ---

NOTES Surface Conditions: bare soil **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0						
		MC = 25.1%	ML		Brown to gray SILT with sand, soft to medium stiff, moist (Fill) -brick fragment -scattered burnt wood fragments	
3.5					-becomes stiff	484.5
3.8		MC = 10.7%	ML		Gray SILT, stiff, damp	484.3

Hand auger boring terminated at 3.75 feet below existing grade due to root obstruction.
No groundwater encountered during excavation. No caving observed.

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BORING NUMBER HA-3

PROJECT NUMBER ES-6510 **PROJECT NAME** Bastawrous SFR Deck

DATE STARTED 1/10/19 **COMPLETED** 1/10/19 **GROUND ELEVATION** 479 ft **HOLE SIZE**

DRILLING CONTRACTOR ESNW Rep **GROUND WATER LEVELS:**

DRILLING METHOD Hand Auger **AT TIME OF DRILLING** ---

LOGGED BY BST **CHECKED BY** KDH **AT END OF DRILLING** ---

NOTES Surface Conditions: brambles **AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0					Brown SILT, medium stiff, moist (Fill)	
		MC = 33.2%	ML		-scattered burnt wood fragments	
		MC = 10.9%			-becomes medium stiff to stiff, damp	
		MC = 14.6% Fines = 92.2%			[USDA Classification: slightly gravelly LOAM]	
				3.5	Hand auger boring terminated at 3.5 feet below existing grade. No groundwater encountered during excavation. No caving observed.	475.5

Earth Solutions NW, LLC
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Redmond, Washington 98052
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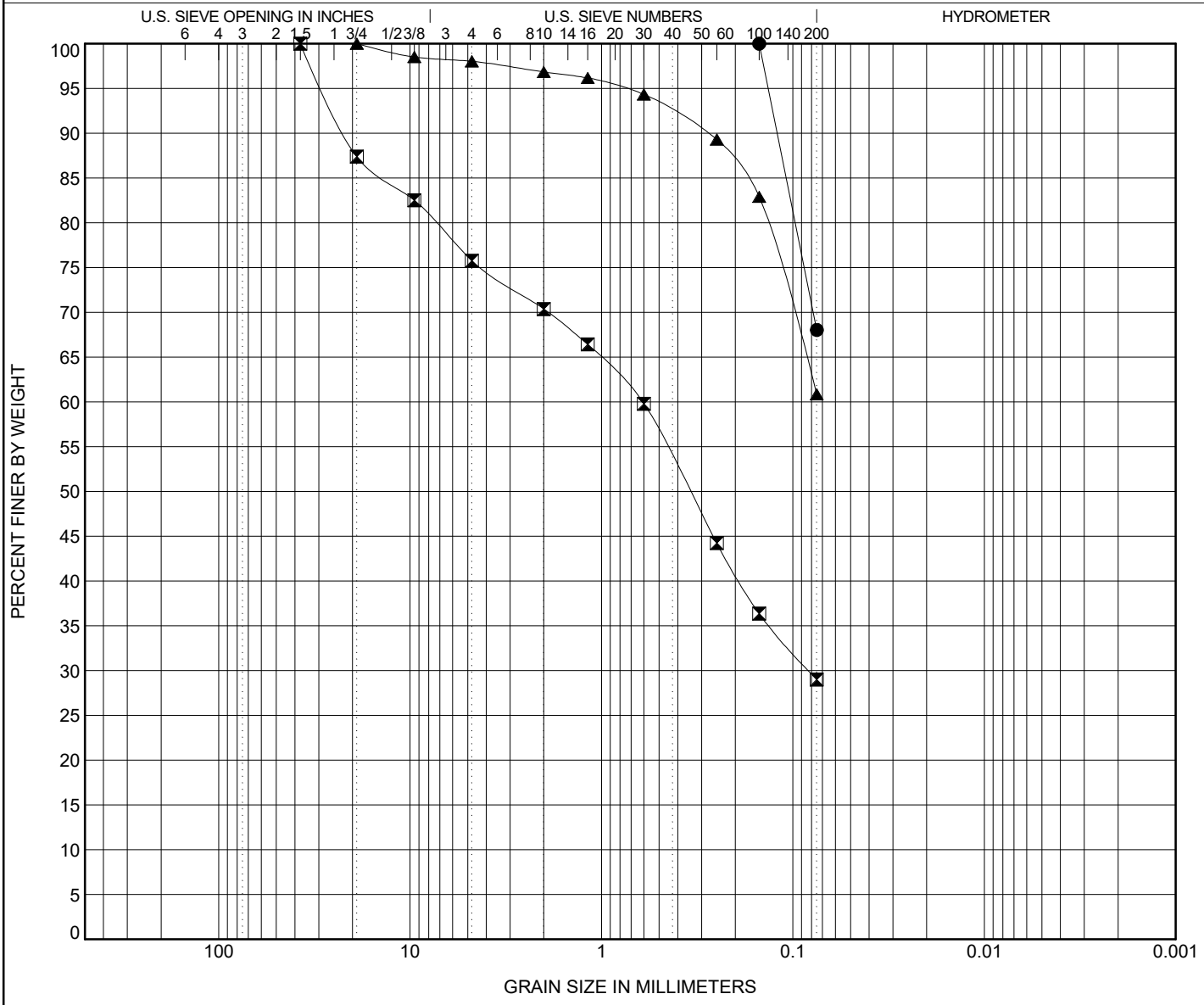
GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-6510.01 **PROJECT NAME** Maple Grove



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	Cc	Cu
●	**B-01**	**2.50ft.**			
⊠	**B-01**	**7.50ft.**	**USDA: Gray Gravelly Sandy Loam. USCS: SM with Gravel.**		
▲	**B-02**	**9.00ft.**	**USDA: Gray Slightly Gravelly Loam. USCS: Sandy ML.**		

	Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
●	**B-01**	**2.5ft.**	**0.15**							**68.0**	
⊠	**B-01**	**7.5ft.**	**37.5**	**0.612**	**0.082**					**29.0**	
▲	**B-02**	**9.0ft.**	**19**							**60.8**	

GRAIN SIZE USDA ES-6510.01 MAPLE GROVE.GPJ GINT US LAB.GDT 8/25/20

Earth Solutions NW, LLC
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Bellevue, WA 98005
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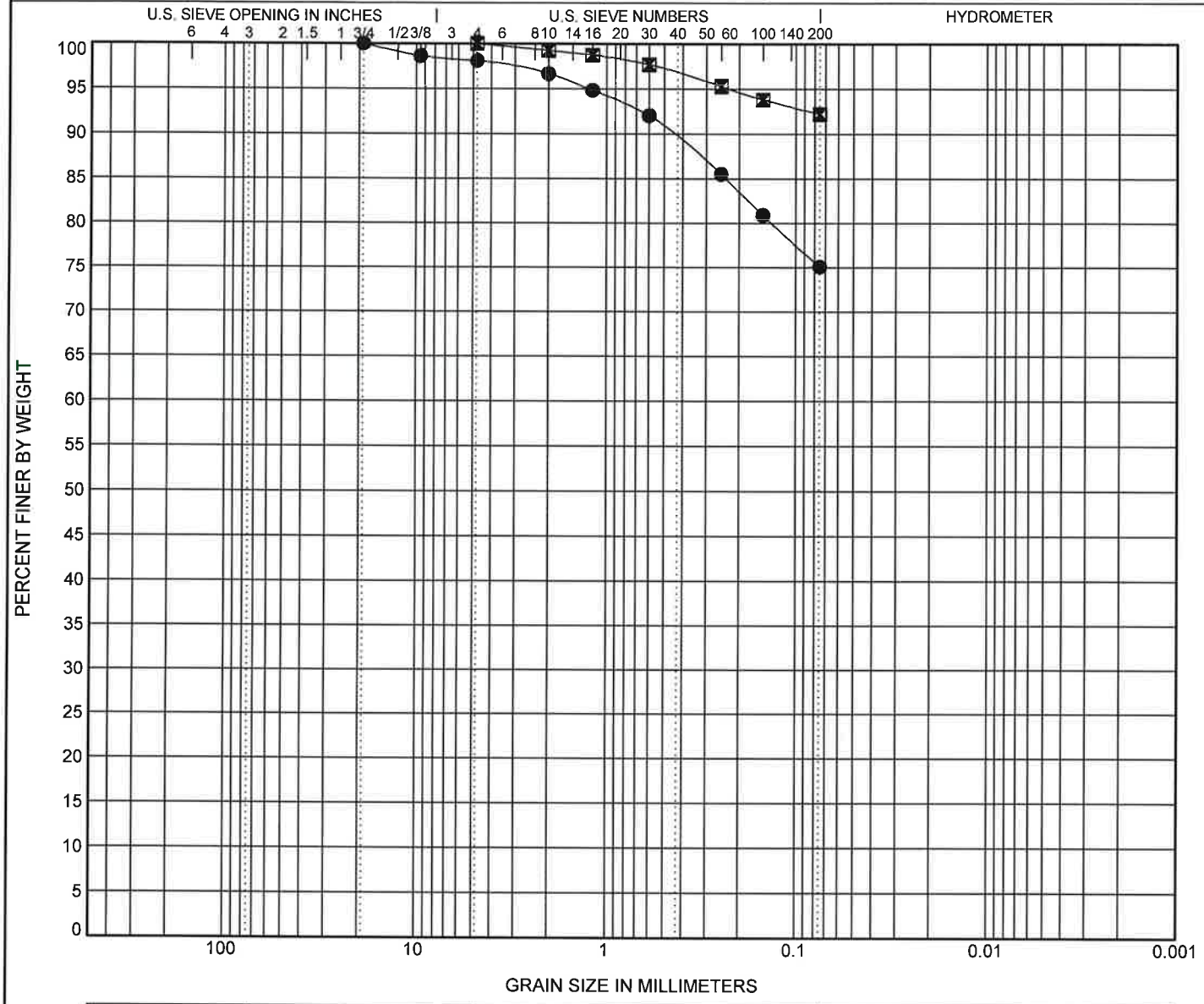
Fax: 425-449-4711

GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-6510 **PROJECT NAME** Bastowrous SFR Deck

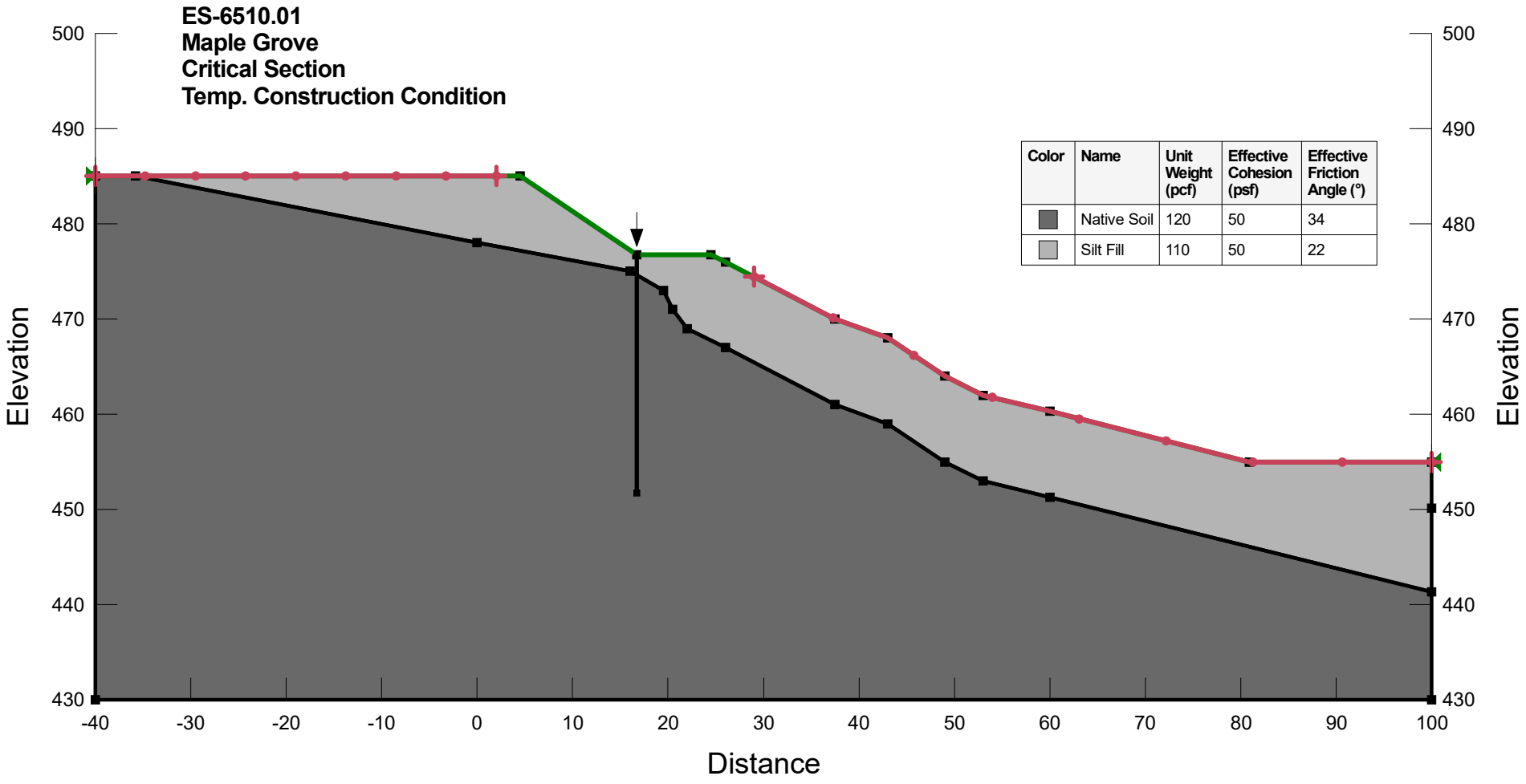


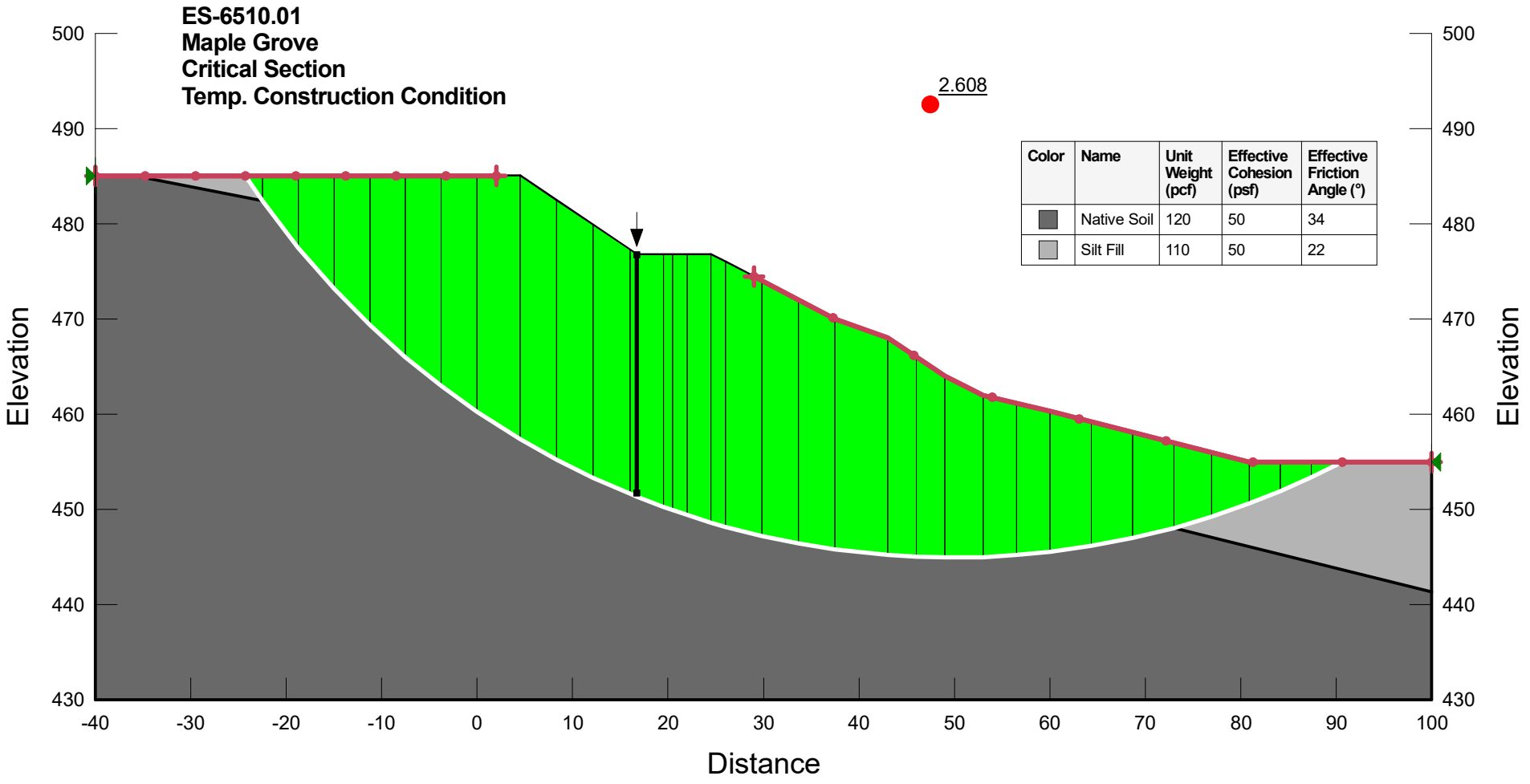
COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

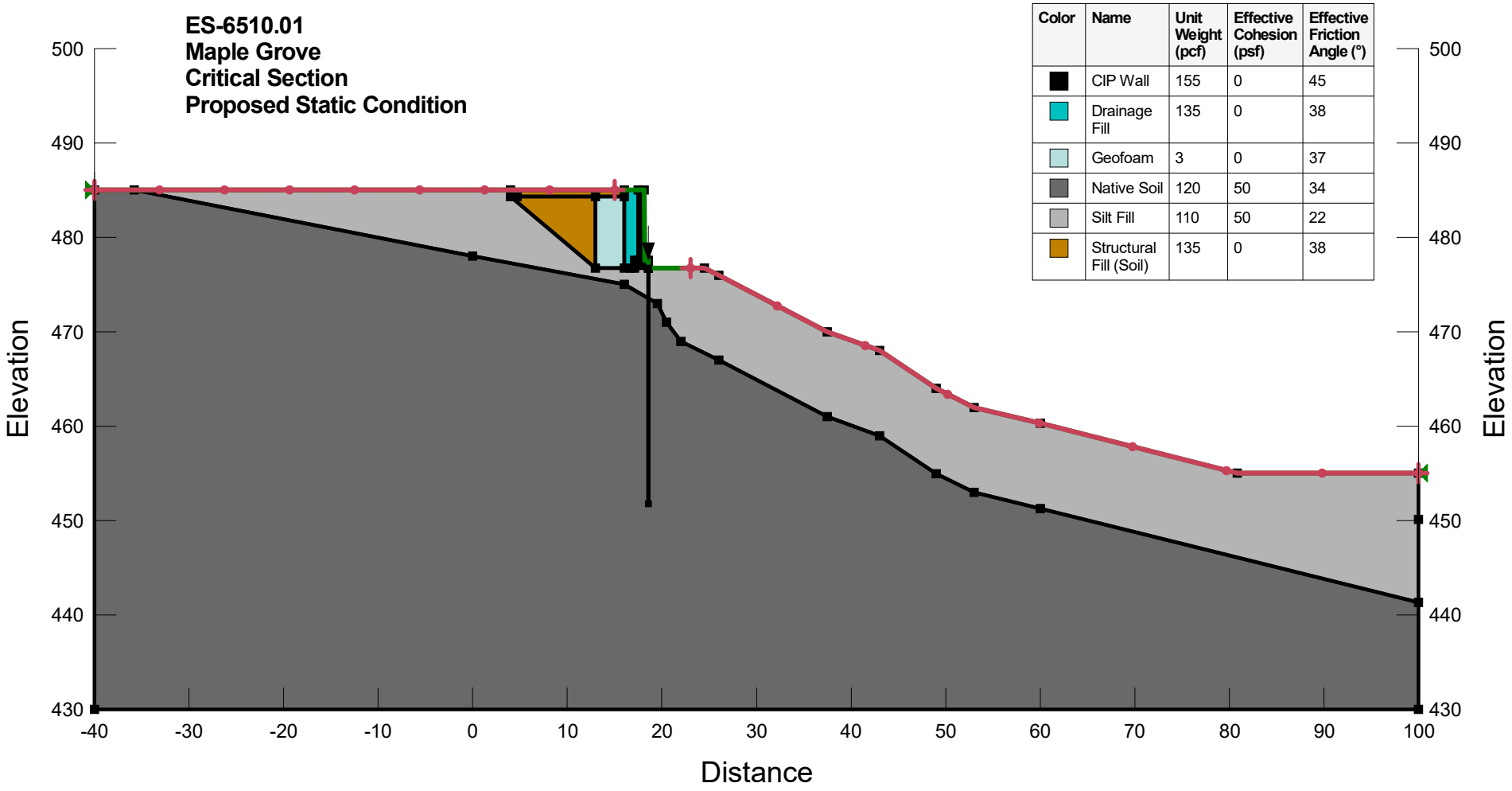
Specimen Identification		Classification	Cc	Cu
● HA-01	4.00ft.	**USDA: Brown Slightly Gravelly Loam. USCS: ML with Sand.**		
⊠ HA-03	3.50ft.	**USDA: Brown Slightly Gravelly Loam. USCS: ML.**		

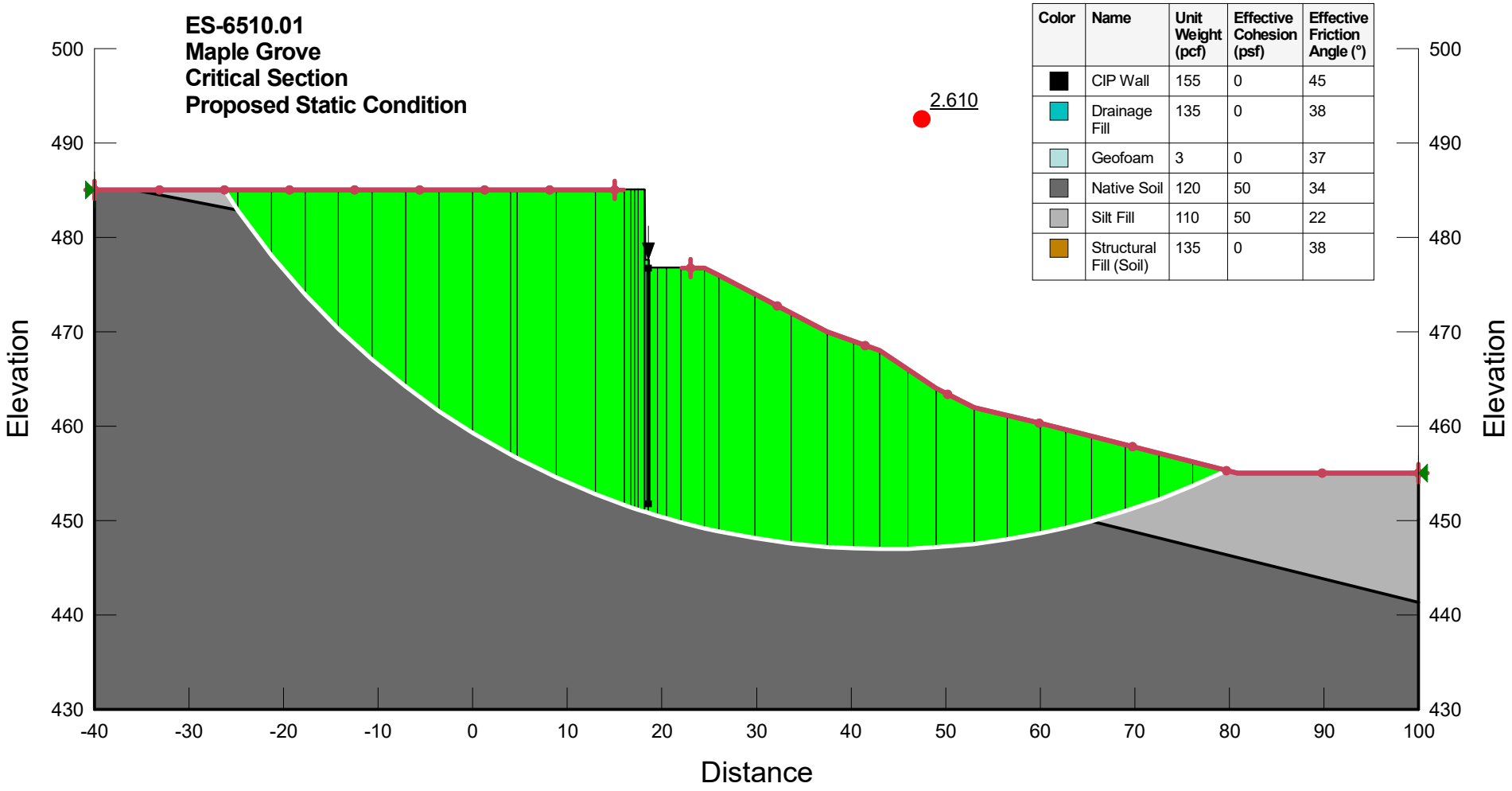
Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● HA-01	4.0ft.	19							75.1	
⊠ HA-03	3.5ft.	4.75							92.2	

GRAIN SIZE USDA ES-6510 PROPOSED DECK.GPJ GINT US LAB.GDT 1/14/19


ES-6510.01
Maple Grove
Critical Section
Temp. Construction Condition
Color
Name
Unit Weight (pcf)
Effective Cohesion (psf)
Effective Friction Angle (°)
Native Soil
120
50
34
Silt Fill
110
50
22
Elevation
Distance
500
490
480
470
460
450
440
430
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100


ES-6510.01
Maple Grove
Critical Section
Temp. Construction Condition
2.608
Color
Name
Unit Weight (pcf)
Effective Cohesion (psf)
Effective Friction Angle (°)
Native Soil
120
50
34
Silt Fill
110
50
22
Elevation
Distance
500
490
480
470
460
450
440
430
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100


ES-6510.01
Maple Grove
Critical Section
Proposed Static Condition
Color
Name
Unit Weight (pcf)
Effective Cohesion (psf)
Effective Friction Angle (°)
CIP Wall 155 0 45
Drainage Fill 135 0 38
Geofoam 3 0 37
Native Soil 120 50 34
Silt Fill 110 50 22
Structural Fill (Soil) 135 0 38
Elevation
500
490
480
470
460
450
440
430
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
Distance


ES-6510.01
Maple Grove
Critical Section
Proposed Static Condition
2.610
Color
Name
Unit Weight (pcf)
Effective Cohesion (psf)
Effective Friction Angle (°)
CIP Wall 155 0 45
Drainage Fill 135 0 38
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Native Soil 120 50 34
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Structural Fill (Soil) 135 0 38
Elevation
Distance
500
490
480
470
460
450
440
430
-40
-30
-20
-10
0
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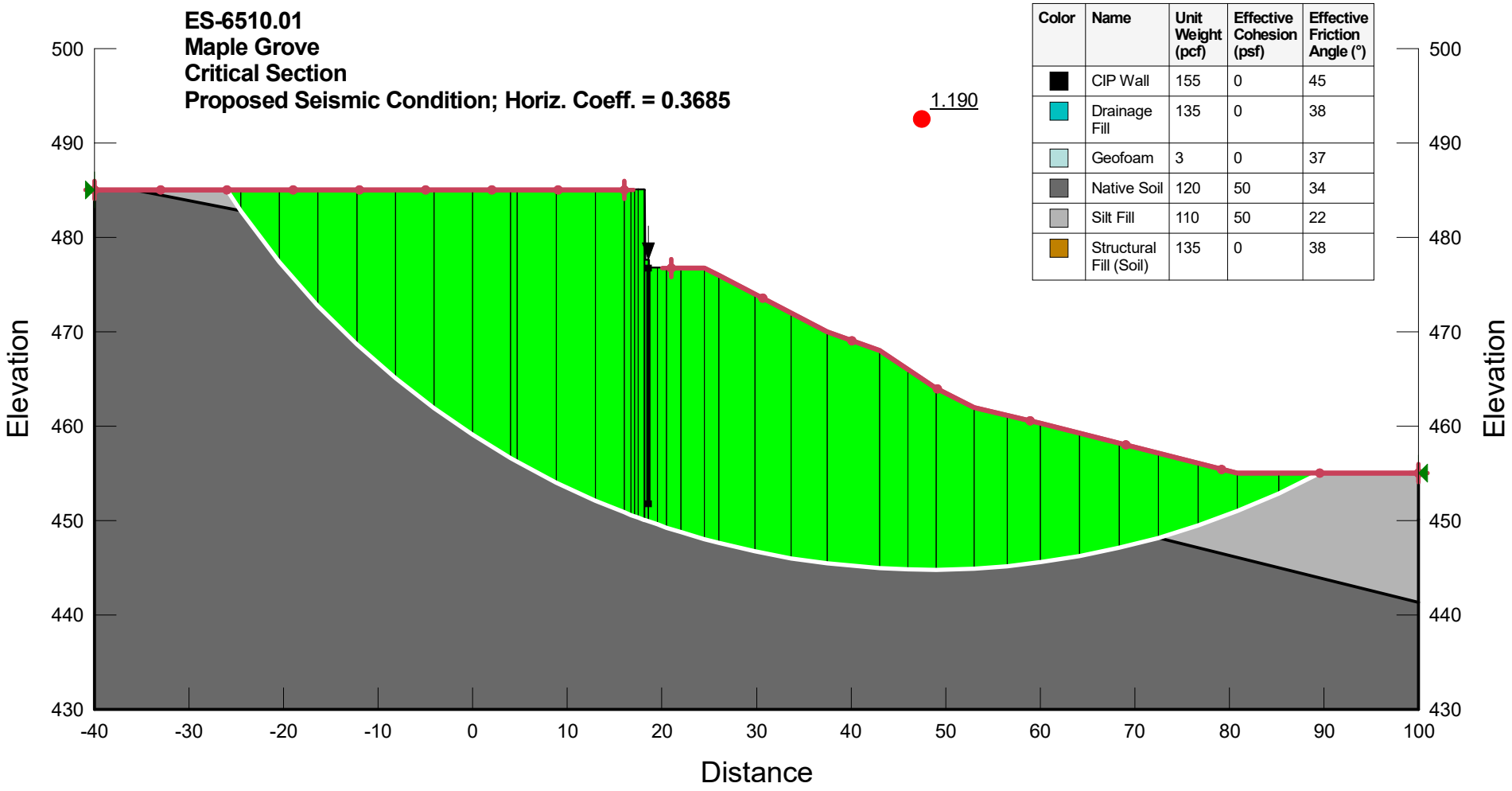
100


ES-6510.01
Maple Grove
Critical Section
Proposed Seismic Condition; Horiz. Coeff. = 0.3685
1.190
Color
Name
Unit Weight (pcf)
Effective Cohesion (psf)
Effective Friction Angle (°)
CIP Wall 155 0 45
Drainage Fill 135 0 38
Geofoam 3 0 37
Native Soil 120 50 34
Silt Fill 110 50 22
Structural Fill (Soil) 135 0 38
Elevation
Distance
500
490
480
470
460
450
440
430
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100

Temp. Construction Condition

File Information

File Version: 11.00
Title: Maple Grove
Created By: Keven Hoffmann
Last Edited By: Keven Hoffmann
Revision Number: 163
Date: 11/17/2020
Time: 05:00:06 PM
Tool Version: 11.0.0.21118
File Name: Maple Grove.gsz
Directory: C:\Users\keven.hoffmann\Dropbox\Keven's Inbox\Project Folders\6510\
Last Solved Date: 11/17/2020
Last Solved Time: 05:00:06 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Temp. Construction Condition

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions from: (none)
- Unit Weight of Water: 62.430189 pcf

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack Option: (none)

Distribution
- F of S Calculation Option: Constant

Advanced
- Geometry Settings
  - Minimum Slip Surface Depth: 0.1 ft
  - Number of Slices: 30
- Factor of Safety Convergence Settings
  - Maximum Number of Iterations: 100
  - Tolerable difference in F of S: 0.001
- Solution Settings
  - Search Method: Root Finder
  - Tolerable difference between starting and converged F of S: 3
  - Maximum iterations to calculate converged lambda: 20
  - Max Absolute Lambda: 2

Materials

Silt Fill

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Effective Cohesion: 50 psf
Effective Friction Angle: 22 °
Phi-B: 0 °

Native Soil

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 50 psf
Effective Friction Angle: 34 °
Phi-B: 0 °

Reinforcements

Stabilization Elements

Type: Pile
Shear Force: 50,000 lbf
Shear Force Reduction Factor: 1
Apply Shear: Parallel to Slip
Out-of-Plane Spacing: 1 ft

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (-40, 485) ft
Left-Zone Right Coordinate: (2, 485) ft
Left-Zone Increment: 8
Right Type: Range
Right-Zone Left Coordinate: (29, 474.43478) ft
Right-Zone Right Coordinate: (100, 455.00009) ft
Right-Zone Increment: 8
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-40, 485) ft
Right Coordinate: (100.00177, 455.00009) ft

Reinforcement Lines

Reinforcement Line 1

Reinforcement: Stabilization Elements
Lock to Ground Surface: Yes
Outside Point: (16.75521, 476.75802) ft
Inside Point: (16.75521, 451.75802) ft
Length: 25 ft
Orientation: -90 °
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft

Geometry

Name: H=6' Critical Section - Construction

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	26 ft	476 ft
Point 2	37.5 ft	470 ft
Point 3	43 ft	468 ft
Point 4	49 ft	464 ft
Point 5	53 ft	462 ft
Point 6	60 ft	460.3 ft
Point 7	0 ft	478 ft
Point 8	16 ft	475 ft

Point 9	19.5 ft	473 ft
Point 10	20.5 ft	471 ft
Point 11	22 ft	469 ft
Point 12	26 ft	467 ft
Point 13	37.5 ft	461 ft
Point 14	43 ft	459 ft
Point 15	49 ft	455 ft
Point 16	53 ft	453 ft
Point 17	60 ft	451.3 ft
Point 18	100 ft	450.14698 ft
Point 19	100 ft	441.3294 ft
Point 20	-40 ft	430 ft
Point 21	100 ft	430 ft
Point 22	-40 ft	485 ft
Point 23	-35.80618 ft	485 ft
Point 24	4.52841 ft	485 ft
Point 25	24.48687 ft	476.75657 ft
Point 26	16.75521 ft	476.75802 ft
Point 27	80.88012 ft	455.00009 ft
Point 28	100.00177 ft	455.00009 ft

Regions

	Material	Points	Area
Region 1	Silt Fill	6,5,4,3,2,1,25,26,24,23,7,8,9,10,11,12,13,14,15,16,17,19,18,28,27	984.91 ft²
Region 2	Native Soil	16,15,14,13,12,11,10,9,8,7,23,22,20,21,19,17	4,848.3 ft²

Slip Results

Slip Surfaces Analysed: 106 of 405 converged

Current Slip Surface

Slip Surface: 173
Factor of Safety: 2.608
Volume: 2,002.9336 ft³
Weight: 232,764.21 lbf
Resisting Moment: 14,378,500 lbf·ft
Activating Moment: 5,513,984.8 lbf·ft
Resisting Force: 149,455.44 lbf
Activating Force: 57,312.529 lbf
Slip Rank: 1 of 405 slip surfaces
Exit: (90.626433, 455.00009) ft
Entry: (-24.25, 485) ft
Radius: 88.321565 ft
Center: (49.712011, 533.27339) ft

Slip Slices

	X	Y	PWP	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Slice 1	-23.366522 ft	483.69768 ft	0 psf	37.295413 psf	50 psf	0 psf	Silt Fill
Slice 2	-20.609458 ft	479.92566 ft	0 psf	267.99263 psf	50 psf	0 psf	Native Soil
Slice 3	-16.862284 ft	475.30424 ft	0 psf	537.57385 psf	50 psf	0 psf	Native Soil
Slice 4	-13.115109 ft	471.25453 ft	0 psf	776.8798 psf	50 psf	0 psf	Native Soil
Slice 5	-9.3679353 ft	467.66926 ft	0 psf	994.0685 psf	50 psf	0 psf	Native Soil
Slice 6	-5.6207612 ft	464.47511 ft	0 psf	1,195.1606 psf	50 psf	0 psf	Native Soil
Slice 7	-1.8735871 ft	461.61939 ft	0 psf	1,384.6942 psf	50 psf	0 psf	Native Soil
Slice 8	2.264205 ft	458.82746 ft	0 psf	1,583.8167 psf	50 psf	0 psf	Native Soil
Slice 9	6.4403417 ft	456.30943 ft	0 psf	1,701.8614 psf	50 psf	0 psf	Native Soil
Slice 10	10.264205 ft	454.2797 ft	0 psf	1,715.5998 psf	50 psf	0 psf	Native Soil
Slice 11	14.088068 ft	452.48188 ft	0 psf	1,719.515 psf	50 psf	0 psf	Native Soil
Slice 12	16.377605 ft	451.48494 ft	0 psf	1,717.6174 psf	50 psf	0 psf	Native Soil
Slice 13	18.127605 ft	450.80543 ft	0 psf	1,768.4599 psf	50 psf	0 psf	Native Soil
Slice 14	20 ft	450.1012 ft	0 psf	1,836.8253 psf	50 psf	0 psf	Native Soil
Slice 15	21.25 ft	449.66726 ft	0 psf	1,876.2738 psf	50 psf	0 psf	Native Soil
Slice 16	23.243435 ft	449.0213 ft	0 psf	1,947.2607 psf	50 psf	0 psf	Native Soil

Slice 17	25.243435 ft	448.41251 ft	0 psf	1,995.8797 psf	50 psf	0 psf	Native Soil
Slice 18	27.916667 ft	447.70616 ft	0 psf	1,994.0127 psf	50 psf	0 psf	Native Soil
Slice 19	31.75 ft	446.81974 ft	0 psf	1,978.953 psf	50 psf	0 psf	Native Soil
Slice 20	35.583333 ft	446.11084 ft	0 psf	1,946.6488 psf	50 psf	0 psf	Native Soil
Slice 21	40.25 ft	445.50369 ft	0 psf	1,913.943 psf	50 psf	0 psf	Native Soil
Slice 22	44.5 ft	445.11855 ft	0 psf	1,845.8499 psf	50 psf	0 psf	Native Soil
Slice 23	47.5 ft	444.99228 ft	0 psf	1,726.4463 psf	50 psf	0 psf	Native Soil
Slice 24	51 ft	444.98387 ft	0 psf	1,592.5494 psf	50 psf	0 psf	Native Soil
Slice 25	54.75 ft	445.11305 ft	0 psf	1,487.8468 psf	50 psf	0 psf	Native Soil
Slice 26	58.25 ft	445.38306 ft	0 psf	1,409.0689 psf	50 psf	0 psf	Native Soil
Slice 27	62.160996 ft	445.86082 ft	0 psf	1,290.8961 psf	50 psf	0 psf	Native Soil
Slice 28	66.482989 ft	446.58666 ft	0 psf	1,126.2923 psf	50 psf	0 psf	Native Soil
Slice 29	70.804982 ft	447.53639 ft	0 psf	928.41651 psf	50 psf	0 psf	Native Soil
Slice 30	74.944514 ft	448.65804 ft	0 psf	410.28964 psf	50 psf	0 psf	Silt Fill
Slice 31	78.901585 ft	449.94108 ft	0 psf	290.32542 psf	50 psf	0 psf	Silt Fill
Slice 32	82.504505 ft	451.28381 ft	0 psf	193.37798 psf	50 psf	0 psf	Silt Fill
Slice 33	85.753276 ft	452.65974 ft	0 psf	121.58188 psf	50 psf	0 psf	Silt Fill
Slice 34	89.002047 ft	454.19304 ft	0 psf	44.167385 psf	50 psf	0 psf	Silt Fill

Proposed Seismic Condition; Horiz. Coeff. = 0.3685

File Information

File Version: 11.00
Title: Maple Grove
Created By: Keven Hoffmann
Last Edited By: Keven Hoffmann
Revision Number: 163
Date: 11/17/2020
Time: 05:00:06 PM
Tool Version: 11.0.0.21118
File Name: Maple Grove.gsz
Directory: C:\Users\keven.hoffmann\Dropbox\Keven's Inbox\Project Folders\6510\
Last Solved Date: 11/17/2020
Last Solved Time: 05:00:07 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Proposed Seismic Condition; Horiz. Coeff. = 0.3685

Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions from: (none)
- Unit Weight of Water: 62.430189 pcf

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack Option: (none)

Distribution
- F of S Calculation Option: Constant

Advanced
- Geometry Settings
  - Minimum Slip Surface Depth: 0.1 ft
  - Number of Slices: 30
- Factor of Safety Convergence Settings
  - Maximum Number of Iterations: 100
  - Tolerable difference in F of S: 0.001
- Solution Settings
  - Search Method: Root Finder
  - Tolerable difference between starting and converged F of S: 3
  - Maximum iterations to calculate converged lambda: 20
  - Max Absolute Lambda: 2

Materials

Silt Fill

Model: Mohr-Coulomb
Unit Weight: 110 pcf
Effective Cohesion: 50 psf
Effective Friction Angle: 22 °
Phi-B: 0 °

Native Soil

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Effective Cohesion: 50 psf
Effective Friction Angle: 34 °
Phi-B: 0 °

Drainage Fill

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 38 °
Phi-B: 0 °

Structural Fill (Soil)

Model: Mohr-Coulomb
Unit Weight: 135 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 38 °
Phi-B: 0 °

CIP Wall

Model: Mohr-Coulomb
Unit Weight: 155 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 45 °
Phi-B: 0 °

Geofoam

Model: Mohr-Coulomb
Unit Weight: 3 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 37 °
Phi-B: 0 °

Reinforcements

Stabilization Elements

Type: Pile
Shear Force: 50,000 lbf
Shear Force Reduction Factor: 1
Apply Shear: Parallel to Slip
Out-of-Plane Spacing: 1 ft

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (-40, 485) ft
Left-Zone Right Coordinate: (16, 485) ft
Left-Zone Increment: 8
Right Type: Range
Right-Zone Left Coordinate: (21, 476.75723) ft
Right-Zone Right Coordinate: (100, 455.00721) ft
Right-Zone Increment: 8
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (-40, 485) ft
Right Coordinate: (100.00655, 455.00721) ft

Seismic Coefficients

Horz Seismic Coef.: 0.3685

Reinforcement Lines

Reinforcement Line 1

Reinforcement: Stabilization Elements
Lock to Ground Surface: Yes
Outside Point: (18.590471, 476.76456) ft
Inside Point: (18.590471, 451.76456) ft
Length: 25 ft
Orientation: -90 °
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft

Geometry

Name: H=6' Critical Section - Proposed

Settings

View: 2D
Element Thickness: 1 ft

Points

	X	Y
Point 1	26 ft	476 ft
Point 2	37.5 ft	470 ft
Point 3	43 ft	468 ft
Point 4	49 ft	464 ft
Point 5	53 ft	462 ft
Point 6	60 ft	460.3 ft
Point 7	0 ft	478 ft
Point 8	16 ft	475 ft
Point 9	19.5 ft	473 ft
Point 10	20.5 ft	471 ft
Point 11	22 ft	469 ft
Point 12	26 ft	467 ft
Point 13	37.5 ft	461 ft
Point 14	43 ft	459 ft
Point 15	49 ft	455 ft
Point 16	53 ft	453 ft
Point 17	60 ft	451.3 ft
Point 18	100 ft	450.14698 ft
Point 19	100 ft	441.3294 ft
Point 20	-40 ft	430 ft
Point 21	100 ft	430 ft
Point 22	-40 ft	485 ft
Point 23	-35.80618 ft	485 ft
Point 24	24.48687 ft	476.75657 ft
Point 25	16.75521 ft	476.75802 ft
Point 26	17.5 ft	485 ft
Point 27	18.16 ft	485 ft
Point 28	17.08104 ft	476.75796 ft
Point 29	18.57698 ft	476.75768 ft
Point 30	17.08071 ft	477.58727 ft
Point 31	18.58104 ft	477.58661 ft
Point 32	18.16142 ft	477.58679 ft
Point 33	17.49934 ft	477.58708 ft
Point 34	16 ft	485 ft
Point 35	16 ft	476.75802 ft
Point 36	4 ft	485 ft
Point 37	16 ft	484.333 ft
Point 38	18.59055 ft	476.75768 ft
Point 39	13 ft	476.75802 ft
Point 40	13.00316 ft	484.33316 ft
Point 41	4 ft	484.333 ft
Point 42	4.72833 ft	484.33301 ft

Point 43	80.85208 ft	455.00721 ft
Point 44	100.00655 ft	455.00721 ft

Regions

	Material	Points	Area
Region 1	Silt Fill	6,5,4,3,2,1,24,38,29,28,25,35,39,41,36,23,7,8,9,10,11,12,13,14,15,16,17,19,18,44,43	964.4 ft²
Region 2	Native Soil	16,15,14,13,12,11,10,9,8,7,23,22,20,21,19,17	4,848.3 ft²
Region 3	CIP Wall	32,27,26,33,30,28,29,38,31	6.1481 ft²
Region 4	Drainage Fill	28,30,33,26,34,37,35,25	12.013 ft²
Region 5	Geofoam	39,35,37,40	22.713 ft²
Region 6	Structural Fill (Soil)	40,37,34,36,41,42	8.0031 ft²
Region 7	Structural Fill (Soil)	40,42,41,39	34.1 ft²

Slip Results

Slip Surfaces Analysed: 117 of 405 converged

Current Slip Surface

Slip Surface: 128
Factor of Safety: 1.190
Volume: 2,130.7786 ft³
Weight: 246,708.05 lbf
Resisting Moment: 14,500,764 lbf·ft
Activating Moment: 12,188,917 lbf·ft
Resisting Force: 153,114.78 lbf
Activating Force: 128,698.83 lbf
Slip Rank: 1 of 405 slip surfaces
Exit: (89.556247, 455.00721) ft
Entry: (-26, 485) ft
Radius: 88.708044 ft
Center: (48.263513, 533.51853) ft

Slip Slices

	X	Y	PWP	Frictional Strength	Cohesive Strength	Suction Strength	Base Material
Slice 1	-25.25466 ft	483.89575 ft	0 psf	15.546319 psf	50 psf	0 psf	Silt Fill
Slice 2	-22.466878 ft	480.08776 ft	0 psf	179.83084 psf	50 psf	0 psf	Native Soil
Slice 3	-18.381991 ft	475.05571 ft	0 psf	388.66329 psf	50 psf	0 psf	Native Soil
Slice 4	-14.297104 ft	470.69355 ft	0 psf	563.18153 psf	50 psf	0 psf	Native Soil
Slice 5	-10.212217 ft	466.86777 ft	0 psf	714.27029 psf	50 psf	0 psf	Native Soil
Slice 6	-6.1273302 ft	463.4895 ft	0 psf	850.88826 psf	50 psf	0 psf	Native Soil
Slice 7	-2.0424434 ft	460.49609 ft	0 psf	980.87031 psf	50 psf	0 psf	Native Soil
Slice 8	2 ft	457.86598 ft	0 psf	1,110.193 psf	50 psf	0 psf	Native Soil
Slice 9	4.364165 ft	456.43553 ft	0 psf	1,200.0324 psf	50 psf	0 psf	Native Soil
Slice 10	6.7962475 ft	455.13416 ft	0 psf	1,304.881 psf	50 psf	0 psf	Native Soil
Slice 11	10.932082 ft	453.08045 ft	0 psf	1,501.1406 psf	50 psf	0 psf	Native Soil
Slice 12	14.5 ft	451.50322 ft	0 psf	1,224.9763 psf	50 psf	0 psf	Native Soil
Slice 13	16.377605 ft	450.74026 ft	0 psf	1,772.8098 psf	50 psf	0 psf	Native Soil
Slice 14	16.918125 ft	450.53327 ft	0 psf	1,799.3309 psf	50 psf	0 psf	Native Soil
Slice 15	17.29052 ft	450.39368 ft	0 psf	1,825.7265 psf	50 psf	0 psf	Native Soil
Slice 16	17.83 ft	450.19509 ft	0 psf	1,923.4939 psf	50 psf	0 psf	Native Soil
Slice 17	18.16071 ft	450.07431 ft	0 psf	1,666.9849 psf	50 psf	0 psf	Native Soil
Slice 18	18.37123 ft	449.99896 ft	0 psf	1,402.9075 psf	50 psf	0 psf	Native Soil
Slice 19	18.585795 ft	449.92218 ft	0 psf	1,382.216 psf	50 psf	0 psf	Native Soil
Slice 20	19.045275 ft	449.76186 ft	0 psf	1,372.9351 psf	50 psf	0 psf	Native Soil
Slice 21	20 ft	449.43516 ft	0 psf	1,415.3616 psf	50 psf	0 psf	Native Soil
Slice 22	21.25 ft	449.0273 ft	0 psf	1,471.2681 psf	50 psf	0 psf	Native Soil
Slice 23	23.243435 ft	448.42192 ft	0 psf	1,573.4508 psf	50 psf	0 psf	Native Soil
Slice 24	25.243435 ft	447.85302 ft	0 psf	1,664.7771 psf	50 psf	0 psf	Native Soil
Slice 25	27.916667 ft	447.19793 ft	0 psf	1,741.2087 psf	50 psf	0 psf	Native Soil
Slice 26	31.75 ft	446.38291 ft	0 psf	1,857.7259 psf	50 psf	0 psf	Native Soil
Slice 27	35.583333 ft	445.74279 ft	0 psf	1,975.7524 psf	50 psf	0 psf	Native Soil
Slice 28	40.25 ft	445.21634 ft	0 psf	2,137.9887 psf	50 psf	0 psf	Native Soil
Slice 29	44.5 ft	444.90307 ft	0 psf	2,246.3645 psf	50 psf	0 psf	Native Soil

Slice 30	47.5 ft	444.82646 ft	0 psf	2,230.7612 psf	50 psf	0 psf	Native Soil
Slice 31	51 ft	444.87528 ft	0 psf	2,189.4022 psf	50 psf	0 psf	Native Soil
Slice 32	54.75 ft	445.06536 ft	0 psf	2,151.0248 psf	50 psf	0 psf	Native Soil
Slice 33	58.25 ft	445.392 ft	0 psf	2,096.3172 psf	50 psf	0 psf	Native Soil
Slice 34	62.082894 ft	445.9189 ft	0 psf	1,952.0947 psf	50 psf	0 psf	Native Soil
Slice 35	66.248681 ft	446.67887 ft	0 psf	1,702.9789 psf	50 psf	0 psf	Native Soil
Slice 36	70.414469 ft	447.64755 ft	0 psf	1,375.3795 psf	50 psf	0 psf	Native Soil
Slice 37	74.586042 ft	448.83407 ft	0 psf	499.25659 psf	50 psf	0 psf	Silt Fill
Slice 38	78.763401 ft	450.24833 ft	0 psf	340.35868 psf	50 psf	0 psf	Silt Fill
Slice 39	83.028122 ft	451.94069 ft	0 psf	196.82777 psf	50 psf	0 psf	Silt Fill
Slice 40	87.380205 ft	453.93761 ft	0 psf	73.19043 psf	50 psf	0 psf	Silt Fill