December 26, 2019
ES-7056

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

Mr. Navdeep Gill
22403 – 94th Avenue South
Kent, Washington 98031

Subject: **Preliminary Geotechnical Evaluation**
14030 Southeast 187th Street
King County (Renton), Washington

Reference: D.R. Mullineaux
Geologic Map of the Renton Quadrangle, King County, Washington, 1965

United States Department of Agriculture (USDA)
Natural Resources Conservation Service
Online Web Soil Survey (WSS) resource

King County Flood Control District, Washington
Liquefaction Susceptibility Map for King County, May 2010

King County, Washington
Title 21A of the King County Code

Greetings, Mr. Gill:

Earth Solutions NW, LLC (ESNW) has prepared this evaluation letter providing preliminary geotechnical recommendations for your proposed project. This letter was prepared in general accordance with the scope of services outlined in our proposal dated November 7, 2019 and approved by you.

Project Description

Although unspecified at the time of this letter production, we anticipate the site will be redeveloped into a residential short plat. Specific building plans were not available for review; however, we anticipate any such residence to be two to three stories in height and constructed utilizing relatively lightly loaded wood framing supported on a conventional foundation system. Perimeter footing loads will likely be 1 to 2 kips per lineal foot. Slab-on-grade loading is anticipated to be approximately 150 pounds per square foot (psf).

If the design assumptions outlined above are incorrect or change, ESNW should be contacted to review the recommendations provided in this letter. This letter has been prepared for the exclusive use of Mr. Navdeep Gill and his representatives. A warranty is neither expressed nor implied. The recommendations and conclusions provided in this letter are professional opinions 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. Variations in the soil and groundwater conditions encountered at the test pit locations may exist and may not be encountered until construction.

Surface Conditions

The subject site is located directly northeast of the Southeast 187th Street and 140th Avenue Southeast intersection, in the Renton area of unincorporated King County, Washington. The approximate location of the subject site is illustrated on Plate 1 (Vicinity Map).

The site is bordered to the north and east by residential development and forested growth, to the south by Southeast 187th Street, and to the west by 140th Avenue Southeast. The property is developed with a single-family residence and associated infrastructure improvements, of which are clustered within the southeast site corner. Topography forms a local depression near the central site area with a total, of about 20 feet of elevation change occurring within the property confines.

Subsurface Conditions

An ESNW representative observed, logged, and sampled four test pits, excavated with a mini-trackhoe and operator retained by our firm, within accessible site areas. The approximate locations of the test pits are depicted on Plate 2 (Test Pit Location Plan). Please refer to the attached logs for a more detailed description of subsurface conditions. Representative soil samples collected at the test pit locations were analyzed in accordance with Unified Soil Classification System (USCS) and USDA methods and procedures.

Topsoil and Fill

Topsoil was encountered within the upper approximate 4 to 12 inches of existing grades at the test pit locations. The topsoil was characterized by a dark brown hue, presence of fine organic material, and root intrusions within the horizon. Fill soil was not observed at the test pit locations, however, fill may be present within proximity to the existing structure and within areas of infrastructure improvements.

Native Soil

Underlying topsoil and fill, native soils were classified primarily as silty sand (USCS: SM) in a medium dense to very dense condition. In general, native soils were encountered in a moist condition, extending to the maximum exploration depth between five and eight feet below the existing ground surface (bgs), where refusal was met on very dense glacial till.

Geologic Setting

The referenced geologic map resource identifies the site as being underlain by ground moraine deposits (Qgt) as underlying the site and surrounding area. The ground moraine deposits are characterized as an unsorted mixture of sand, silty, clay, and gravel. The referenced WSS resource identifies soils of the Alderwood gravelly sandy loam series (Map Unit Symbol: AgB, AgC, and AgD) as underlying the site and surrounding areas. The Alderwood series is typically associated with ridge and hill landforms. Based on our field observations, native site soils are consistent with local geologic mapping and soil survey designations of glacial till.

Groundwater

Groundwater intrusions were not encountered during our November 2019 subsurface exploration. 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.

Critical Areas

Review of the King County iMap GIS database indicates soil in the central to northeastern site area may be erodible. Our review of readily accessible soil surveys, site topographic conditions, and King County Code (KCC) erosion hazard definition are provided in the following section.

Erosion Hazard Area

KCC 21A.06.415 defines an erosion hazard area as those underlain by soils subject to severe erosion when disturbed. Classification of erosion hazard soils can come form the USDA Soil Conservation Service, the 1990 Snoqualmie Pass Area Soil Survey, and/or the 1973 King County Soils Survey (KCSS). Review of the KCSS resource indicates that soils of the AgB and AgC series are characterized as having a slight to moderate potential. However, soils of the AgD series are considered to have a severe erosion potential.

In addition, where present on slopes of 15 percent or greater, soils of the AgD series are considered to be an erosion hazard per the KCC. Based on available soil survey data, it appears the AgD soil series may be present to some extent within the more steeply inclined portions of the site. However, a site specific survey will be necessary to determine if 15 percent or greater slopes exist on the site. Based on visual observation, in our opinion, the northeastern site area is likely an erosion hazard, per soil survey and KCC designations.

In our opinion, potentially erodible soils that may exist on site can be adequate mitigated during construction through installation of temporary sediment and erosion control measures. These installations will need to be maintained throughout the course of construction to ensure proper function. Following construction, permanent landscaping should be installed, per the approved landscape architect plans.

Structural Fill

Structural fill is defined as compacted soil placed in structural subgrade, slab-on-grade, roadway, permanent slope, retaining wall, and utility trench backfill areas. The following recommendations are provided for soils intended for use as structural fill:

- Moisture content — At or slightly above optimum
- Relative compaction (minimum) — 95 percent (Modified Proctor)
- Loose lift thickness (maximum) — 12 inches

The on-site soil will not be suitable for use as structural fill unless the soil moisture content is no more than about 3 percent above the optimum level at the time of placement and compaction. If the on-site soil cannot achieve the above specifications, use of an imported structural fill material will likely be necessary. With respect to underground utility installations and backfill, local jurisdictions will likely dictate soil type(s) and compaction requirements.

Foundations

Single-family residences, with similar loading conditions as anticipated above, can be supported on conventional continuous and spread footing foundations bearing on competent native soil, recompacted native soil, or new structural fill placed directly on competent native soil. In general, competent soil bearing conditions for foundation support should be anticipated beginning at a depth of about two feet bgs. Where loose or unsuitable soil conditions are exposed at foundation subgrade elevations, compaction of soils to the specifications of structural fill, or overexcavation and replacement with suitable structural fill, will be necessary. Provided the foundations are supported as prescribed, the following criteria may be used for design:

- Allowable soil bearing capacity — 2,500 psf
- Passive earth pressure — 300 pcf (equivalent fluid)
- Coefficient of friction — 0.40

A one-third increase in the allowable soil bearing capacity may be assumed for short-term wind and seismic loading conditions. The above passive earth pressure and coefficient of 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. The majority of anticipated settlement should occur during construction, as dead loads are applied.

Seismic Design

The 2015 International Building Code recognizes the American Society of Civil Engineers (ASCE) for seismic site class definitions. 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.

The referenced liquefaction susceptibility map indicates the subject site possesses a very low liquefaction susceptibility. In our opinion, site soils are not liquefiable based on the medium dense to very dense native soil conditions.

Slab-on-Grade Floors

Slab-on-grade floors for the anticipated residential structures should be supported on a firm and unyielding subgrade. Unstable or yielding subgrade areas should be recompacted, or overexcavated and replaced with suitable structural fill, prior to slab construction. A capillary break consisting of at least four inches of free-draining crushed rock or gravel should be placed below each slab. The free-draining material should have a fines content of 5 percent or less (where the fines content is defined as the percent passing the Number 200 sieve, based on the minus three-quarter-inch fraction). In areas where slab moisture is undesirable, installation of a vapor barrier below the slab should be considered. If a vapor barrier is to be used, it should be a material specifically designed for use as a vapor barrier and installed in accordance with the specifications of the manufacturer.

Retaining Walls

Retaining walls must be designed to resist earth pressures and applicable surcharge loads. The following parameters may be used for design:

- Active earth pressure (unrestrained condition) — 35 pcf (equivalent fluid)
- At-rest earth pressure (restrained condition) — 55 pcf
- Traffic surcharge (passenger vehicles) — 70 psf (rectangular distribution)*
- Passive earth pressure — 300 pcf (equivalent fluid)
- Coefficient of friction — 0.40
- Seismic surcharge — 6H psf**

* *Where applicable*
** *Where H equals the retained height (in feet)*

The above passive earth pressure and coefficient of friction values include a factor-of-safety of 1.5 and are based on a level backfill condition and level grade at the wall toe. Revised design values will be necessary if sloping grades are to be used above or below retaining walls. Additional surcharge loading from adjacent foundations, sloped backfill, or other relevant loads should be included in the retaining wall design.

Retaining walls should be backfilled with free-draining material that extends along the height of the wall and a distance of at least 18 inches behind the wall. The upper 12 inches of the wall backfill may consist of a less permeable soil, if desired. A sheet drain may also be considered in lieu of a free-draining backfill section. A perforated drainpipe should be placed along the base of the wall and connected to an approved discharge location. If drainage is not provided, hydrostatic pressures should be included in the wall design.

Drainage

Perched groundwater seepage should be anticipated in site excavations particularly in the winter, spring and early summer months. Temporary measures to control surface water runoff and groundwater during construction would likely involve interceptor trenches, interceptor swales, and sumps. ESNW should be consulted during earthwork activities to both identify areas of seepage and provide recommendations to reduce the potential for seepage-related instability.

Finish grades must be designed to direct surface drain water away from structures and slopes. Water must not be allowed to pond adjacent to structures or slopes. In our opinion, foundation drains should be installed along building perimeter footings.

Infiltration Feasibility

As indicated in the *Subsurface* section of this letter, native soils encountered during our fieldwork were characterized primarily as glacial till deposits. Given the dense in-situ conditions, it is our opinion that full or large-scale infiltration is infeasible from a geotechnical standpoint. The native geologic setting would likely impede the long-term performance and intended function of an infiltration facility.

Additional Services

ESNW should have an opportunity to review final project plans with respect to the preliminary geotechnical recommendations provided in this letter. ESNW should also be retained to provide testing, observation, and other consultation services during construction.

We trust this evaluation meets your current needs. If you have questions regarding the content of this letter, or require additional information, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

12/26/19

Chase G. Halsen
Senior Staff Geologist

Kyle R. Campbell, P.E.
Principal Engineer

Attachments: Plate 1 – Vicinity Map
Plate 2 – Test Pit Location Plan
Test Pit Logs
Grain Size Distribution

Reference:
King County, Washington
OpenStreetMap.org

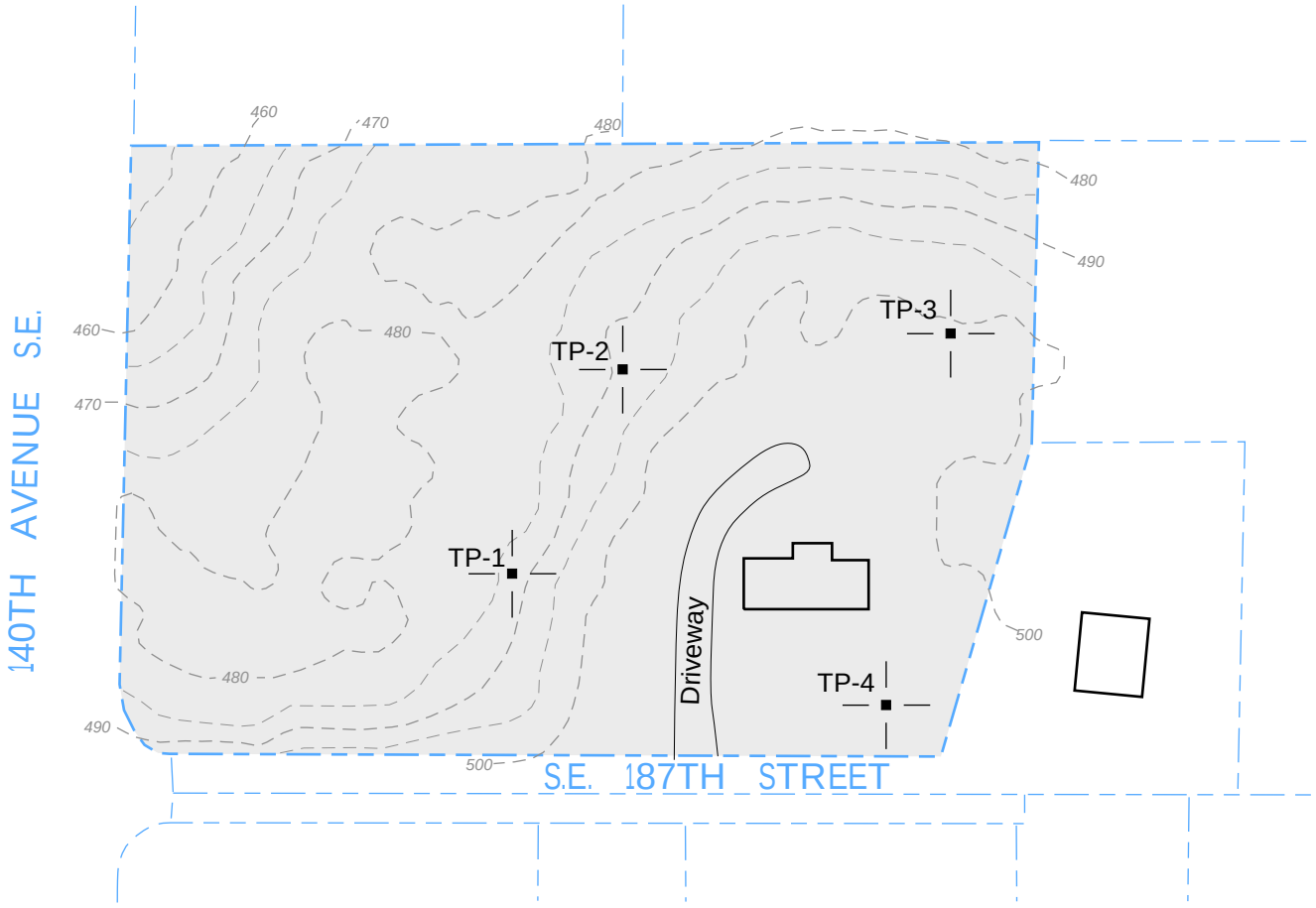
NORTH

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.

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

Vicinity Map
SE 187th Property
King County (Renton), Washington

Drwn. MRS	Date 12/20/2019	Proj. No. 7056
Checked CGH	Date Dec. 2019	Plate 1



LEGEND

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-7056, Nov. 2019

Subject Site

Existing Building

NORTH

NOT - TO - SCALE

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.

Earth Solutions NW LLC

Geotechnical Engineering, Construction Observation/Testing and Environmental Services

Test Pit Location Plan
SE 187th Property
King County (Renton), Washington

Drwn. MRS	Date 12/20/2019	Proj. No. 7056
Checked CGH	Date Dec. 2019	Plate 2

Earth Solutions NW LLC

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	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
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	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
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	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
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
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Redmond, Washington 98052
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Fax: 425-449-4711

TEST PIT NUMBER TP-1

PROJECT NUMBER ES-7056 **PROJECT NAME** SE 187th Property

DATE STARTED 11/19/19 **COMPLETED** 11/19/19 **GROUND ELEVATION** 487 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD **AT TIME OF EXCAVATION** ---

LOGGED BY CGH **CHECKED BY** SSR **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 6": brush **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0			TPSL		0.5 Dark brown TOPSOIL, root intrusions to 3'	486.5
					Tan silty SAND with gravel, medium dense, moist	
		MC = 10.00%				
		MC = 5.90% Fines = 15.50%	SM		-becomes gray, dense to very dense [USDA Classification: gravelly sandy LOAM] -trace cobbles	
5		MC = 5.80%			5.0	482.0
					Test pit terminated at 5.0 feet below existing grade due to refusal in very dense glacial till. No groundwater encountered during excavation. No caving observed. Bottom of test pit at 5.0 feet.	

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TEST PIT NUMBER TP-2

PROJECT NUMBER ES-7056 **PROJECT NAME** SE 187th Property

DATE STARTED 11/19/19 **COMPLETED** 11/19/19 **GROUND ELEVATION** 492 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD **AT TIME OF EXCAVATION** ---

LOGGED BY CGH **CHECKED BY** SSR **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 8": brush **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, root intrusions to 2'
				0.6	491.4
					Tan silty SAND with gravel, medium dense, moist
		MC = 9.00%			
			SM		-becomes gray, dense
		MC = 5.90%			-becomes very dense, moderately cemented
5					
		MC = 7.30% Fines = 18.80%		6.0	[USDA Classification: gravelly coarse sandy LOAM]
					486.0
					Test pit terminated at 6.0 feet below existing grade due to refusal in very dense glacial till. No groundwater encountered during excavation. No caving observed.
					Bottom of test pit at 6.0 feet.

Earth Solutions NW
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TEST PIT NUMBER TP-3

PROJECT NUMBER ES-7056 **PROJECT NAME** SE 187th Property

DATE STARTED 11/19/19 **COMPLETED** 11/19/19 **GROUND ELEVATION** 500 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD **AT TIME OF EXCAVATION** ---

LOGGED BY CGH **CHECKED BY** SSR **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 4": brush **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL	0.3	Dark brown TOPSOIL 499.7
		MC = 11.70% Fines = 17.70%			Brown silty SAND with gravel, medium dense, moist -root intrusions to 4'
					-becomes gray, dense [USDA Classification: gravelly sandy LOAM]
			SM		
5					-moderate iron oxide staining, becomes very dense -moderately cemented
		MC = 10.00%		7.0	-increased sand content 493.0
					Test pit terminated at 7.0 feet below existing grade due to refusal in very dense glacial till. No groundwater encountered during excavation. No caving observed. Bottom of test pit at 7.0 feet.

Earth Solutions NW
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TEST PIT NUMBER TP-4

PROJECT NUMBER ES-7056 **PROJECT NAME** SE 187th Property

DATE STARTED 11/19/19 **COMPLETED** 11/19/19 **GROUND ELEVATION** 500 ft **TEST PIT SIZE**

EXCAVATION CONTRACTOR NW Excavating **GROUND WATER LEVELS:**

EXCAVATION METHOD **AT TIME OF EXCAVATION** ---

LOGGED BY CGH **CHECKED BY** SSR **AT END OF EXCAVATION** ---

NOTES Depth of Topsoil & Sod 12": grass **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0			TPSL		Dark brown TOPSOIL, root intrusions to 2'
				1.0	499.0
					Brown silty SAND with gravel, medium dense, moist
		MC = 15.60%			-becomes gray, dense
5		MC = 6.70%	SM		-increased sand content, becomes very dense
					-silt interbedding
					-moderate iron oxide staining
		MC = 11.60% Fines = 30.60%		8.0	[USDA Classification: gravelly sandy LOAM] 492.0
					Test pit terminated at 8.0 feet below existing grade due to refusal in very dense glacial till. No groundwater encountered during excavation. No caving observed. Bottom of test pit at 8.0 feet.

Earth Solutions NW, LLC
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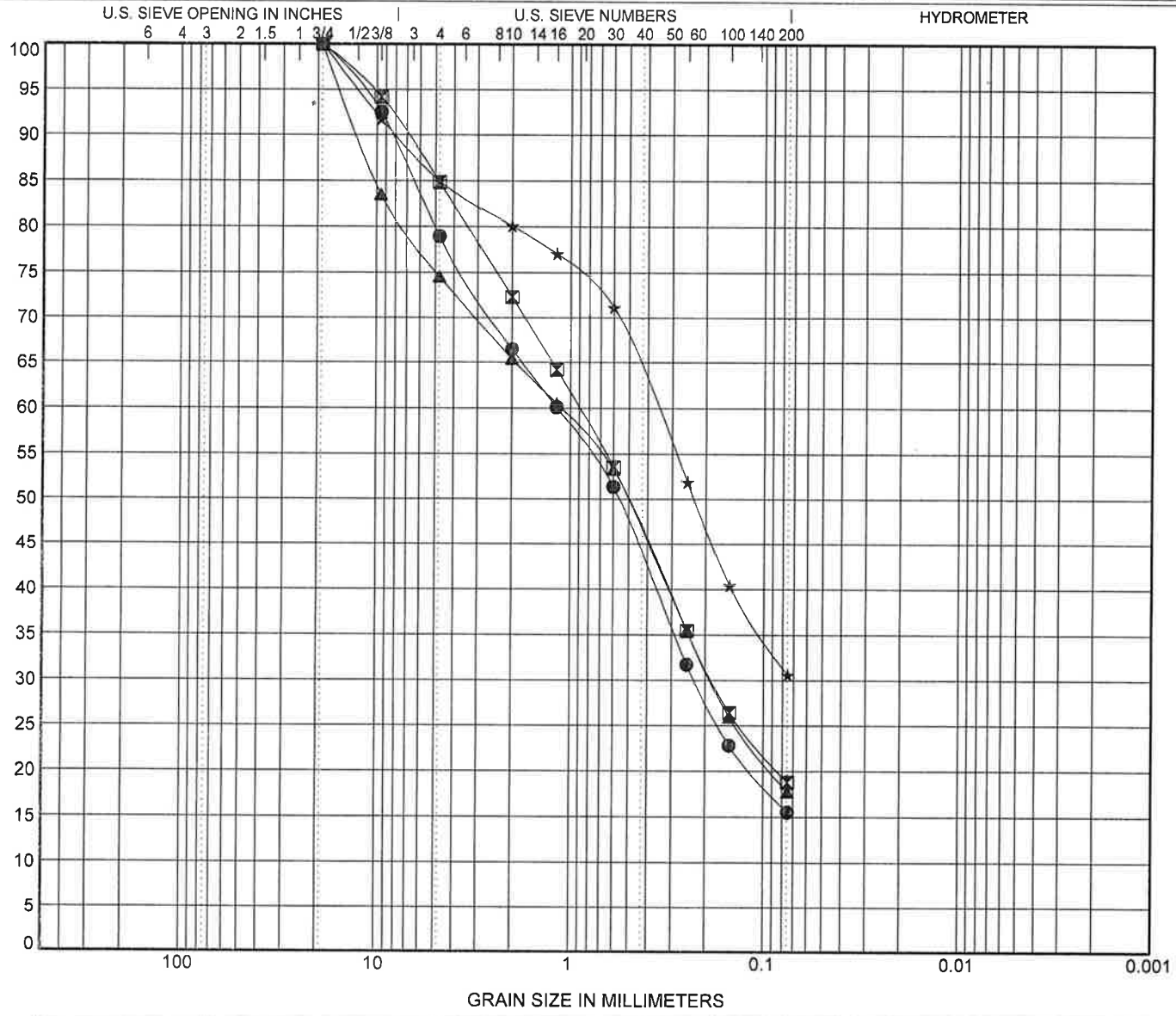
GRAIN SIZE DISTRIBUTION

PROJECT NUMBER ES-7056 **PROJECT NAME** SE 187th Property



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	Cc	Cu
● TP-01	3.00ft.	USDA: Gray Gravelly Sandy Loam. USCS: SM with Gravel.		
⊠ TP-02	6.00ft.	USDA: Gray Gravelly Coarse Sandy Loam. USCS: SM with Gravel.		
▲ TP-03	2.00ft.	USDA: Gray Gravelly Sandy Loam. USCS: SM with Gravel.		
★ TP-04	8.00ft.	USDA: Gray Gravelly Sandy Loam. USCS: SM with Gravel.		

Specimen Identification		D100	D60	D30	D10	LL	PL	PI	%Silt	%Clay
● TP-01	3.0ft.	19	1.168	0.226					15.5	
⊠ TP-02	6.0ft.	19	0.903	0.184					18.8	
▲ TP-03	2.0ft.	19	1.123	0.186					17.7	
★ TP-04	8.0ft.	19	0.361						30.6	

GRAIN SIZE USDA ES-7056 SE 187TH PROPERTY.GPJ GINT US LAB.GDT 11/27/19