GeoEngineers

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Memorandum

To:	Robert W. Droll, PLA, ASLA (RWD Landscape Architecture)
From:	AF Amanda Fickeisen, LG, Sean W. Cool, PE SWC
Date:	October 26, 2022
File:	0925-019-00
Subject:	Memorandum - Geotechnical Considerations Strawberry Fields Athletic Complex - Field #2 Turf Conversion Marysville, Washington

INTRODUCTION

This memorandum presents a summary of GeoEngineers, Inc.'s (GeoEngineers) geotechnical considerations to support replacement of the existing sod field surfacing with a new synthetic turf surface for Field #2 of the City of Marysville Strawberry Fields Athletic Complex in Marysville, Washington. The project location is shown on the Figure 1, Vicinity Map. We understand that the field complex has an existing drain system with 4-inch-diameter pipes at 15 feet on-center with unknown functionality; this system will be left in place. The new construction will include stripping existing sod, placing a flat geocomposite underdrain over the subgrade, placement of 6 inches of granular field fill within a containment curb surrounding the field, and new synthetic turf. The underdrain will slope to an 8-inch corrugated pipe and outlet to the existing detention basin to the south of the site.

The purpose of our geotechnical engineering services was to explore subsurface conditions at the site as a basis for evaluating the existing shallow soil profile and groundwater conditions in Field #2. Our scope of work is described in our services agreement dated April 18, 2022 and authorized via notice to proceed on July 11, 2022. The scope of our services completed for the project included completing two test pits and two hand augers, completing limited lab testing, discussing site observations and recommendations on the suitability of the proposed turf section and preparing this geotechnical considerations memorandum.

SITE CONDITIONS

Surface Conditions

The project site is located at Strawberry Fields Athletic Complex in Marysville, Washington. The site is bounded by 152nd Street NE to the north, Pearson Drilling to the west and the Strawberry Fields Trail System to the south and east. The field complex is located nearby a residential neighborhood. The fields are relatively level and vegetated with manicured lawn/sod. An access way with bleachers and lights are located in between Field #2 and the field to the east.

Subsurface Conditions

Soil Conditions

Subsurface soil conditions were evaluated by completing two hand augers (HA-1 and HA-2) to depths of 5.5 and 5.3 feet below the existing ground surface (bgs), respectively. Two test pits (TP-1 and TP-2) were also completed to depths of 6 feet bgs on August 3, 2022 using a mini excavator. All explorations were completed at the approximate locations shown on the Figure 2, Site Plan attached to this memo. The explorations were

continuously monitored by a geotechnical engineer from our firm who examined and classified the soil encountered, obtained representative soil samples and maintained a detailed log of the explorations. Soil encountered during the explorations were classified in general accordance with ASTM International (ASTM) D 2488 and the classification chart listed on Figure 3, Key to Exploration Logs. The logs of the explorations are presented on Figures 4 through 7, Logs of Explorations. The results of laboratory sieve analyses from four representative soil samples collected within the depth of exploration are presented on Figure A-8, Sieve Analysis Results.

In general, subsurface soil conditions in both the test pits and hand augers consisted of 1 to 3 inches of sod overlying a loose brown medium to coarse sandy fill to a depth of approximately 1-foot bgs. A subsequent layer of fill consisting of medium dense gray-brown to gray-blue poorly graded fine to medium sand with silt to silty sand was found to depths ranging from approximately 1.5 to 3 feet bgs. Underlying the fill, an organic rich layer consisting of dark brown sandy silt to silt with sand was encountered, interpreted to be a relict topsoil layer. The relict topsoil ranged from 6 to 12 inches in thickness. Soil interpreted to be native Vashon Drift glacial recessional outwash was encountered underlying the relict topsoil to the full depth explored, ranging from 5.3 to 6 feet.

Groundwater Conditions

Groundwater seepage was encountered ranging from 5 to 6 feet in all explorations at the time of our site exploration in early August. Groundwater is often perched within sand and gravel fill layers overlying layers of fine-grained (silt and clay) fill and native undifferentiated glacial soils. We do not anticipate turf conversion will encounter significant perched groundwater if the work is done during the dry season, but perched groundwater could occur at and above the fill and native soil contact during the wet season. Groundwater conditions should be expected to fluctuate based on season, precipitation and other factors.

GEOTECHNICAL CONSIDERATIONS

Based on our site observations, it is our opinion that the site conditions are suitable for the proposed improvements with proper planning and construction practices. We provide the following general geotechnical considerations.

Site Preparation and Earthwork

In general, site preparation will include stripping the sod from the existing Field #2 area, placing a flat underdrain on the subgrade and placing 6 inches of new granular field fill material within a 6-inch containment curb surrounding the field. We recommend evaluation of the field subgrade after stripping to identify excessively soft/loose areas that may require overexcavation and replacement prior to placement of the turf section.

The existing granular fill will provide some protection to the subgrade during dry weather, but the underlying relict topsoil layer and other fine-grained soils may be subject to degradation from repeated heavy traffic even during dry weather. Accordingly, we recommend that site preparation and other earthwork be completed with low ground pressure track-mounted equipment to protect the subgrade from disturbance, or other considerations for vehicle/equipment routing if/where heavy wheeled vehicles will be used.

On-Site Soils

Near-surface on-site soil consist of fine to medium sand with variable silt content and density. Portions of the on-site soils, specifically the upper granular fill layers and native outwash sand with lower fines content (SP and SP-SM) may be suitable for use as general structural fill for site grading but may not meet specific gradation requirements for use within the turf section or drainage. If used, the soil should be free of excessive silt/clay, organic matter, oversized material and moisture conditioned as necessary for compaction. Because of the variable silt content, this material will likely be unsuitable as fill material if the soil is too wet to achieve satisfactory compaction, and moisture-conditioning by drying back the material may be required. If the material cannot be properly moisture conditioned, we recommend using imported material for fill.

A relict topsoil layer was observed between depths of approximately 1.5 to 3.5 feet bgs and extending up to 4 feet bgs. Any organic rich fill soils and relict topsoil layer will not be suitable for reuse and will require separation/segregation from other primarily granular soils if they are to be used for site grading.

Stormwater Drainage Considerations

Relatively shallow groundwater was encountered below the site as shallow as 5 feet bgs in early August, and groundwater elevations would be expected to be higher during the winter and spring. Additionally, the relict topsoil layer and other finer-grained soil deposits likely limit rates of vertical infiltration below the site. Although the upper granular site soils may provide an infiltration rate on the order of 0.5 to 2 inches per hour when unsaturated, the underlying organic relict topsoil and fine-grained glacial soil layers, combined with shallow groundwater conditions, could significantly reduce effective infiltration rates during the wet season, likely less than 0.1 to 0.25 inches per hour, and possibly significantly less than this value.

As noted, the existing drainage system consisting of buried piping with unknown functionality that will be left in place. Accordingly, new drainage provisions should be provided to maintain field function during the wet season. We understand that stormwater drainage will be managed using an underdrain system sloping towards an 8-inch slotted corrugated pipe. The corrugated pipe will drain to the detention basin located south of the site. The new system does not rely on infiltration of the underlying soils.

Wet Weather Earthwork

The upper soils at the site and the granular field fill material to be used are moderately susceptible to disturbance from construction traffic when excessively wet. The underlying relict topsoil layer is highly susceptible to disturbance even during moderately wet weather. If feasible, we recommend that the field improvements be constructed during the drier summer months to reduce extra costs and delays associated with wet weather earthwork.

If earthwork will occur during wet weather conditions and construction schedule cannot be adjusted, it may be necessary to use light-weight track-mounted equipment, load removed material into trucks supported on gravel haul roads, use gravel working pads and employ other methods to reduce ground disturbance. The contractor should be responsible to protect the subgrade during construction reflective of their proposed means and methods, and anticipated time of year for construction.

LIMITATIONS

We have prepared this limited design memorandum for the RWD Landscape Architecture, for the City of Marysville Strawberry Athletic Fields Turf Conversion project. RWD Landscape Architecture may distribute copies of this report to its authorized agents and regulatory agencies as may be required for the Project.

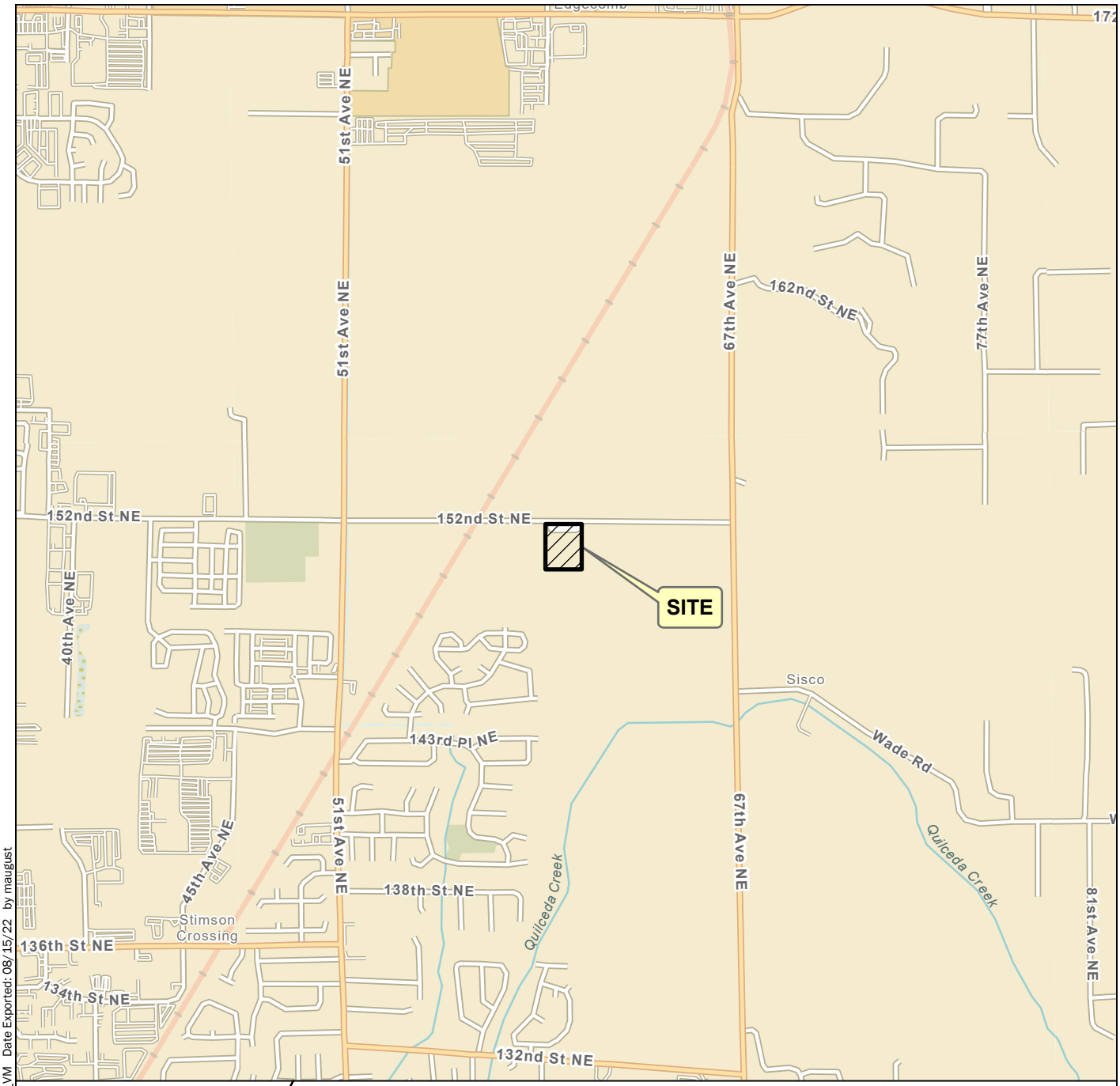
Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices for geotechnical engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty, express or implied, applies to the services or this report.

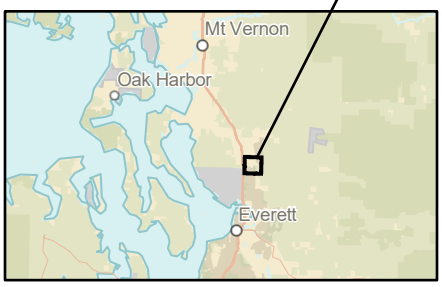
Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments should be considered a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

PU:AF2:SWC:tlm

Attachments:
Figure 1. Vicinity Map
Figure 2. Site Plan
Figure 3. Key to Exploration Logs
Figures 4 through 7. Logs of Explorations
Figure 8. Sieve Analysis Results

One copy submitted electronically





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2,000 0 2,000

Feet

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI

Projection: NAD 1983 UTM Zone 10N

Vicinity Map

Strawberry Fields Turf Conversion
Marysville, Washington

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Figure 1

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Legend

- Approximate Test Pit Location and Identification
- Approximate Hand Auger Location and Identification

100 0 100

Feet

N W E S

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Bing Maps.

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

Site Plan

Strawberry Fields Turf Conversion
Marysville, Washington

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Figure 2

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SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
	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% RETAINED ON NO. 200 SIEVE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
	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, ROCK FLOUR, 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% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel / Dames & Moore (D&M)

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point lead test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
UU	Unconsolidated undrained triaxial compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

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Figure 3

Date Excavated	8/3/2022	Total Depth (ft)	6	Logged By PU Checked By AF2	Excavator Equipment CAT 402 mini excavator 305.5E2	See "Remarks" section for groundwater observed Caving not observed
Surface Elevation (ft) Vertical Datum	Undetermined			Easting (X) Northing (Y)	Coordinate System Horizontal Datum	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	Approximately 1½ inches of sod			
					SP	Brown medium to coarse sand with gravel (loose, moist) (fill)			
	1		1 MC; SA				7	5	
					SP-SM	Dark gray fine to medium sand with silt (medium dense to dense, moist) (fill)			
	2		2		TS	Dark brown sandy silt with rootlets (dense, dry) (former native surface/relict topsoil)			
	3		3		CL	Gray-brown with iron staining silty sandy clay with occasional rootlets (dense, moist) (glaciomarine drift)			
	4		4 MC		SM	Blue-gray silty fine sand, iron staining (dense, moist) (glacial outwash)	20		
	5		5			Sand grades to fine to medium			
	6								Slow groundwater seepage observed at 5.8 feet

Notes: See Figure 3 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on . Vertical approximated based on .

Log of Test Pit TP-1

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Project: Strawberry Fields Turf Conversion
Project Location: Marysville, Washington
Project Number: 0925-019-00

Figure 4
Sheet 1 of 1

Date Excavated	8/3/2022	Total Depth (ft)	6	Logged By PU Checked By AF2	Excavator Equipment CAT 402 mini excavator 305.5E2	See "Remarks" section for groundwater observed Caving not observed
Surface Elevation (ft) Vertical Datum	Undetermined			Easting (X) Northing (Y)	Coordinate System Horizontal Datum	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	Approximately 3 inches of sod			
			1		SP-SM	Brown fine to coarse sand with silt (loose, moist) (fill/pitrun)			
			2 MC; SA		SP-SM	Dark gray fine to medium sand with silt (dense, moist) (fill)	11	6	
	1				SM	Gray-blue silty fine to medium sand with interbedded silty clay (dense, moist)			
	2		3						
	3				TS	Dark brown silt with sand and organic matter (stiff, moist) (relict topsoil)			
			4		SM	Gray to blue-gray silty fine to medium sand (dense, moist) (glacial outwash)			
	4								
			5			Increased moisture content at 5 feet			Slow groundwater seepage observed at 5 feet
	5								
			6			Decreased silt content at 6 feet			
	6								

Notes: See Figure 3 for explanation of symbols.
The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on . Vertical approximated based on .

Log of Test Pit TP-2

GeoEngineers

Project: Strawberry Fields Turf Conversion
Project Location: Marysville, Washington
Project Number: 0925-019-00

Figure 5
Sheet 1 of 1

Date Excavated	8/3/2022	Total Depth (ft)	5.5	Logged By PU Checked By AF2	Excavator Equipment Shovel/hand auger	See "Remarks" section for groundwater observed Caving not observed
Surface Elevation (ft) Vertical Datum	Undetermined	Easting (X) Northing (Y)		Coordinate System Horizontal Datum		

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	Approximately 1½ inches of sod			
			1 MC		SP	Brown fine to medium sand with occasional gravel (loose, moist) (fill)	13		
	1								
			2 MC; SA		SP-SM	Gray-brown fine to medium sand with silt and occasional fine gravel (dense, moist) (fill)	17	18	
	2				SM	Brown silty fine sand (medium dense, moist) (fill)			
			3						
					ML/TS	Dark brown sandy silt with organic matter (stiff, moist) (relict topsoil)			
	3		4						
			5		ML	Blue-gray clayey sandy silt (stiff, moist) (reworked glaciomarine drift)			
	4				SP-SM	Gray to brown fine to medium sand with silt (medium dense to dense, moist) (glacial outwash)			
			6						
	5		7		SM	Brown silty fine to medium sand with gravel (dense, wet)			Slow groundwater observed at 5.3 feet

Notes: See Figure 3 for explanation of symbols.
The depths on the hand-augered boring logs are based on an average of measurements across the hand-auger and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on . Vertical approximated based on .

Log of Hand Auger HA-1

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Project: Strawberry Fields Turf Conversion
Project Location: Marysville, Washington
Project Number: 0925-019-00

Figure 6
Sheet 1 of 1

Date Excavated	8/3/2022	Total Depth (ft)	5.25	Logged By PU Checked By AF2	Excavator Equipment Shovel/hand auger	See "Remarks" section for groundwater observed Caving not observed
Surface Elevation (ft) Vertical Datum	Undetermined			Easting (X) Northing (Y)		Coordinate System Horizontal Datum

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
					SOD	Approximately 2 inches of sod			
			1		SP-SM	Brown fine to medium sand with silt and gravel (loose, moist) (fill)			
	1				SP-SM	Dark gray fine to medium sand with silt and occasional fine gravel (loose to medium dense, moist)			
			2						
	2				ML	Dark gray to dark brown sandy silt with occasional organic matter (medium dense, moist)			
			3						
	3				TS	Dark brown silt with sand, clay and organic matter (rootlets) (stiff, moist) (relict topsoil)			
			4 MC; %F				39	57	
	4				SM	Light bluish gray silty fine to medium sand (dense, moist) (glacial outwash)			
			5 MC; SA				19	26	
	5		6						Slow groundwater seepage observed at 5 feet

Notes: See Figure 3 for explanation of symbols.
The depths on the hand-augered boring logs are based on an average of measurements across the hand-auger and should be considered accurate to ½ foot.
Coordinates Data Source: Horizontal approximated based on . Vertical approximated based on .

Log of Hand Auger HA-2

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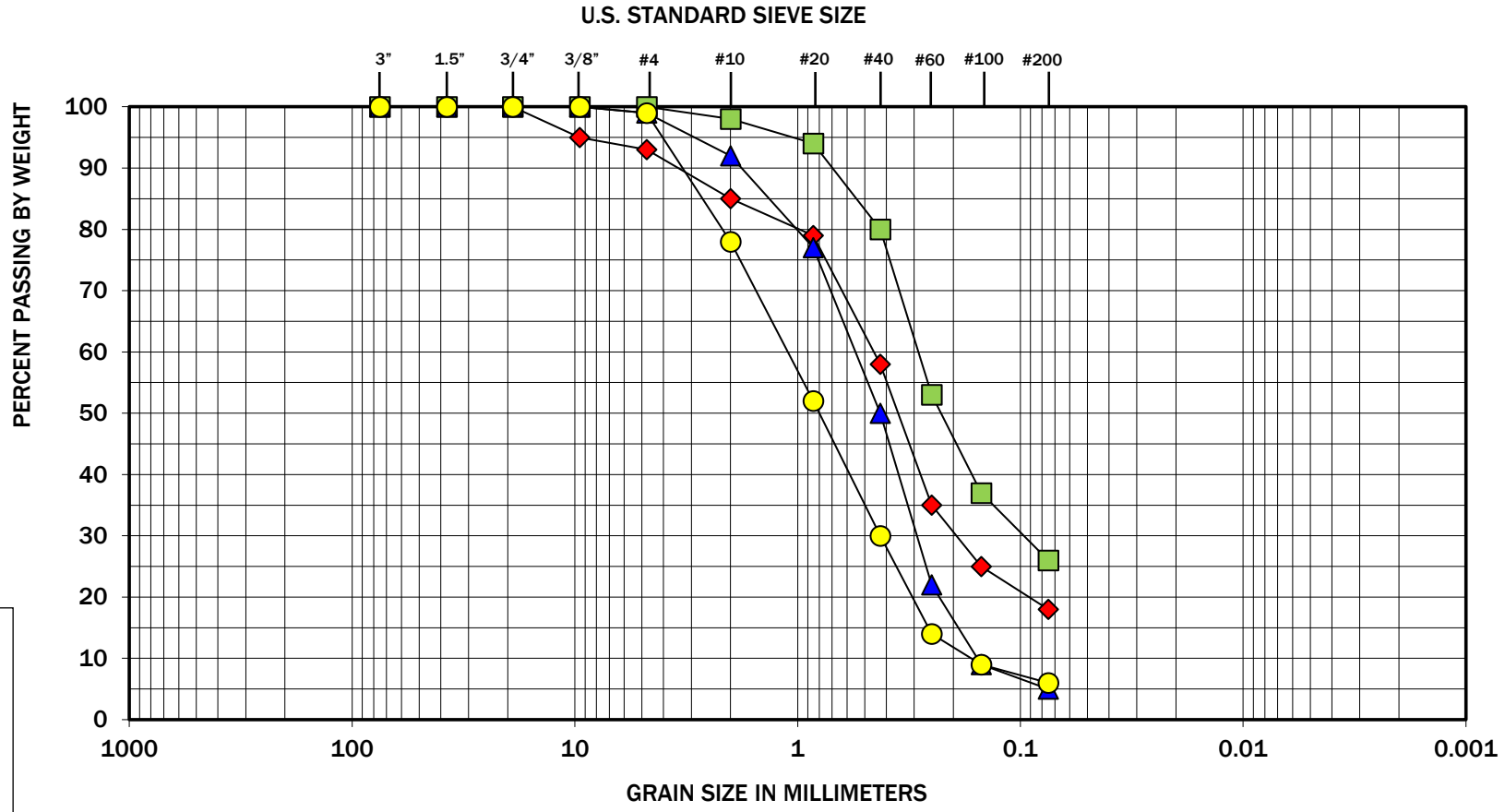
Project: Strawberry Fields Turf Conversion
Project Location: Marysville, Washington
Project Number: 0925-019-00

Figure 7
Sheet 1 of 1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	HA-1	1.5	17	Silty sand with gravel (SM)
■	HA-2	4.5	19	Silty sand (SM)
▲	TP-1	0.8	7	Poorly graded sand with silt (SP-SM)
●	TP-2	1.0	11	Poorly graded sand with silt (SP-SM)

The grain size analysis results were obtained in general accordance with ASTM D 6913. GeoEngineers 17425 NE Union Hill Road Ste 250, Redmond, WA 98052

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Strawberry Fields Turf Conversion
City of Marysville

Sieve Analysis Results

Figure A-8