Geotechnical Engineering Services

Harbour Pointe Boulevard Widening Project
Mukilteo, Washington

for
City of Mukilteo

October 20, 2017

GeoEngineers

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Geotechnical Engineering Services

Harbour Pointe Boulevard Widening Project
Mukilteo, Washington

File No. 5790-004-00

October 20, 2017

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INTRODUCTION AND PROJECT UNDERSTANDING

GeoEngineers, Inc. (GeoEngineers) is pleased to present this geotechnical engineering report for the proposed roadway widening and signalization improvements to the Harbour Pointe Boulevard (HPB) corridor extending approximately 1,600 feet west of Mukilteo Speedway (Highway 525) to just past Cyrus Way in Mukilteo, Washington. The location of the site is shown in the Vicinity Map, Figure 1. Our services were completed in accordance with the Subconsultant Agreement provided by the client for the project, dated April 4, 2016.

We understand the City of Mukilteo (City) plans to make improvements that will include widening of the existing roadway and new signal installation. The alignment of the HPB loops around both commercial and residential development, intersecting Mukilteo Speedway at two locations. Proposed improvements will be completed at the south intersection, just south of Paine Field. Eastbound channelization on the boulevard will be reconfigured to make the through eastbound lane at SR 525 a combination through lane and right turn lane; thus, providing eastbound traffic two right turn lanes onto SR 525. A left turn phase and additional street lighting will also be added to the signal located at the intersection of SR 525. Left turn pockets with left turn sign phases will be added to all four legs at the intersection of Cyrus Way allowing left turn movements to be protected/permissive. An elevated, 8-foot wide shared use path and 5-foot wide planter strip will be constructed on the south side of the boulevard to complete the sidewalk and bike path gap that currently exists. Associated stormwater improvements will be constructed to provide mitigation for the new impacts and will include catch basins, wet-vaults and filtration systems. Improvements will extend a short distance north and south on Cyrus Way.

The purpose of our services was to explore subsurface soil and groundwater conditions along the identified roadway improvement corridor and provide recommendations for the specific improvement elements. Our scope of services for this portion of work included drilling 8 geotechnical borings and 1 hand-augered exploration, completing two Pilot Infiltration Tests (PITs), completing laboratory testing on the samples obtained from the borings, and providing geotechnical conclusions and preliminary recommendations for design and construction of the proposed improvements. Five of the geotechnical borings included cores through the existing asphalt pavement. Our conclusions and preliminary recommendations include earthwork, subgrade preparation, pavement design, and retaining walls. Our specific scope of services is described in "Exhibit A – Scope of Work, Phase 2" of the City of Mukilteo agreement number ST140005-1 for the Harbour Pointe Boulevard Widening Project.

SITE CONDITIONS

Surface Conditions

Within the proposed improvement area, HPB is a 4- to 5-lane asphalt concrete roadway with curb and gutter. Sidewalks are present to the north and along select portions of the south. There are no sidewalk or curb and gutter along Cyrus Way immediately south of HPB. Cyrus Way is a two-lane roadway with open ditches and occasional culverts at driveway and business entrances. Overall the terrain in the project vicinity slopes down to the north and west.

The properties along the roadway primarily consist of businesses and undeveloped vacant land. Mukilteo City Hall is located on the north side of the project alignment west of Cyrus Way. Businesses with associated driveway/parking areas and planter strips are present north of HPB. The undeveloped vacant land located

Subsurface Explorations

Subsurface soil and groundwater conditions were evaluated by drilling eight borings (B-1 through B-3 and C-1 through C-5) along the project alignment on July 25, 2016. The cores (C-1 through C-5 were completed within the paved roadway surface, and the remaining borings (B-1 through B-3) were completed in the right-of-way (ROW) outside of the paved roadway. The borings were completed using a track-mounted hollow-stem auger drill rig subcontracted to GeoEngineers, Inc. The borings were completed to depths ranging from about 8 to 20.5 feet below the existing ground surface (bgs). One additional shallow subsurface exploration (HA-1) completed with a probe rod and hand auger was conducted in an area south of HPB and west of Cyrus Way that was not accessible by the drill rig on July 25, 2016. The hand-augered boring was completed to refusal at a depth of 1.5 feet bgs. The approximate locations of the borings are shown in the Site and Exploration Plan, Figure 2. Details of the field exploration program, laboratory testing and boring logs are presented in Appendix A.

GeoEngineers also completed two small-scale PITs (PIT-1 and PIT-2) within the native shallow soil deposits to determine design infiltration rates based on guidance from the Department of Ecology (Ecology) Stormwater Management Manual for Wester Washington (SMMWW). A summary of the PIT procedures and results is presented in Appendix B.

Previous Explorations

In addition to the explorations we completed for this study, we reviewed the logs of two borings completed previously by others in the project vicinity. The previous explorations were advanced to depths between 13 and 18 feet. Logs of previous explorations are presented in Appendix C. The approximate locations of the borings are shown in the Site and Exploration Plan, Figure 2.

Subsurface Conditions

Pavement Conditions

Borings C-1 through C-5 were completed in the paved portion of HPB and Cyrus Way. The existing pavement section observed at the boring locations varied in thickness throughout the project area. We observed a limited thickness of gravel base underlying the asphalt surfacing in the borings, overlying either additional fill or native soil at each of the roadway boring locations. A summary of the observed pavement sections is provided in Table 1 below and the underlying soil conditions are described in the following section of this report.

TABLE 1. SUMMARY OF OBSERVED PAVEMENT COMPONENTS

Exploration	Location	Asphalt Concrete Thickness	Gravel Base
C-1	East outside lane of HPB	8 inches	~2 inches
C-2	East inside lane of HPB	6 inches	~2 inches
C-3	East outside lane of HPB	9 inches	~2 inches
C-4	South lane of Cyrus Way	6 inches	~1 inches
C-5	South lane of Cyrus Way	8 inches	~2 inches

In general, the CAO requires that a qualified professional assess the geologic hazards based on review of available information and field studies, evaluate the specific project proposal with respect to its relationship and impact on the hazard area and adjacent sites if appropriate, provide minimum buffers and setbacks and provide mitigation strategies where appropriate for specific geologic hazards. No liquefaction, erosion, or landslide hazards are identified in the area of the site and accordingly, mitigation is not necessary for these hazards.

CONCLUSIONS AND RECOMMENDATIONS

We conclude that the design of the new widened roadway and associated ROW improvements and infrastructure can be accomplished with conventional earthwork equipment and techniques. We have provided recommendations for a new pavement section based on the observed site conditions and existing pavement performance.

All procedures and materials should be in accordance with most recent Washington State Department of Transportation (WSDOT) *Standard Specifications* (hereafter referred to as WSDOT *Standard Specifications*), unless another version or specification is referenced.

The site soils have a high susceptibility to erosion when disturbed. Temporary erosion control measures should be used during construction depending on the water, location, soil type, and other factors. Temporary erosion protection (e.g., straw, plastic, or rolled erosion control products [RECP]) may be necessary to reduce sediment transport until vegetation is established or permanent surfacing applied. Appropriate best management practices should be incorporated into the temporary erosion and sediment control plan by the civil engineer.

Pavement Recommendations

As discussed, the existing pavement condition along HPB and along Cyrus Way north of HPB is generally in good condition with limited cracking or distress observed. Moderate to severe pavement distress (alligator, edge raveling, and longitudinal cracking) with observed along Cyrus Way just south of HPB. Cyrus Way was observed to be in fair condition with only occasional cracking beginning approximately 180 feet south of HPB and extending farther south.

Subgrade Preparation

We recommend that the subgrade soils in reconstructed pavement areas be prepared and evaluated as described in the "Earthwork" section of this report. We recommend that the subgrade be compacted to at least 95 percent of the maximum dry density (MDD) per ASTM D 1557 prior to placing pavement section materials. If the subgrade soils are loose or soft, it may be necessary to excavate the soils and replace them with structural fill. A layer of suitable woven geotextile fabric can be considered for placement over soft subgrade areas to limit the thickness of structural fill required to bridge soft, yielding areas. For this purpose, we recommend a woven geotextile with a minimum grab tensile strength (ASTM 4632) of at least 300 pounds.

As noted, organic soils were encountered at boring C-4 underlying the surficial fill. New asphalt could be placed over the existing fill and organic soil but it would be expected to have a reduced service life similar to the existing pavement. At a minimum, we recommend a woven geotextile or geogrid reinforcement be

New mast arm signal pole foundations should be sized in accordance with WSDOT Design Manual Exhibit 1330-11b. Luminaire pole foundations should be sized in accordance with WSDOT Standard Plan J.28.30.

We recommend that new signal pole foundations be designed using an allowable lateral bearing pressure of 2,500 pounds per square foot (psf). This allowable bearing pressure is based on data from all borings except C-4. Boring C-4 contained very soft soil resulting in a lateral bearing pressure of 700 psf if a signal pole will be located in this area. Additional explorations and/or revised recommendations may be required if the signal poles are not located near current exploration locations.

The allowable lateral bearing pressure applies only to relatively flat ground conditions. If sloping ground is present at the drilled shaft location, the depth of the drilled shaft should be adjusted in accordance with the methodology presented in Section 17.2.1 of the WSDOT GDM.

Luminaire or signal poles with large mast arms and/or with many signals and signs may be subjected to significant torsional loads on the shaft foundations from wind loading conditions. The torsional stability of the foundation should also be checked for these poles.

Drainage and Infiltration Considerations

Our scope of services for the planning phase of the project included an evaluation of the feasibility of stormwater infiltration as a low impact development (LID) design option. Where feasible, infiltration is the preferred low-impact means of handling stormwater. Two small-scale PITs were conducted at the project site as a basis for evaluating the long-term infiltration rate of near-surface soils. Details of the PIT evaluation and results of the are presented in our memorandum dated January 9, 2017 and are included in Appendix B of this report. In our opinion, the geologic soil profile at the site is relatively uniform, with a limited thickness of fill/weathered horizon overlying dense glacial till, and the two PITs are representative of the characteristic infiltration capacity at the site.

Based on our analysis of the two PITs performed at the site, it is our opinion that the on-site soils provide relatively low infiltration rates, with a recommended short-term infiltration rate of 0.10 inches per hour for the site glacial till soils, and a factored long-term design infiltration rate of about 0.036 inches per hour. Additionally, there is a potential for stormwater infiltration to result in perched groundwater conditions with lateral migration of excess infiltrated water. We understand that the combination of the low infiltration rate and potential for development of perched groundwater meets the SMMWW infeasibility criteria for infiltration, and that site stormwater management has been design with catch basins, wet vaults, and filtration systems.

Earthwork

Site Preparation

The proposed improvements will extend on the order of 20 feet south of the existing edge of pavement along HPB, and along the east and west side of Cyrus Way. The majority of this existing shoulder consists of undeveloped vacant land with areas that contain ditches and/or grass, shrubbery, and trees.

We recommend that any existing vegetation and topsoil be stripped from all proposed pavement, sidewalk, and retaining wall areas. We recommend a stripping depth of 3 inches for planning purposes. Greater stripping depths should be anticipated near heavy shrubs/brush areas and in the vicinity of tree roots. All

or stiff to hard native silty sand and sandy silt encountered at the site would be classified as "Type A" and require slope inclinations of 0.75H:1V or flatter.

The above regulations assume that surface loads such as construction equipment and storage loads will be kept a sufficient distance away from the top of the cut so that the stability of the excavation is not affected. Flatter slopes and/or shoring will be necessary for those portions of the excavations which are subjected to significant seepage in order to maintain the stability of the cut. Temporary slopes in wet/saturated sand will be susceptible to sloughing, raveling and "running" conditions. It should be expected that unsupported cut slopes will experience some sloughing and raveling if exposed to surface water. Berms, hay bales or other provisions should be installed along the top of the excavation to intercept surface runoff to reduce the potential for sloughing and erosion of cut slopes during wet weather.

In our opinion, the contractor will be in the best position to observe subsurface conditions continuously throughout the construction process and to respond to the soil and groundwater conditions. Construction site safety is generally the sole responsibility of the contractor, who also is solely responsible for the means, methods, and sequencing of the construction operations and choices regarding temporary excavations and shoring. Slope inclinations may need to be modified by the contractor if localized sloughing occurs or if seepage occurs. All dewatering, shoring and temporary slopes should conform to applicable local, state and federal safety regulations.

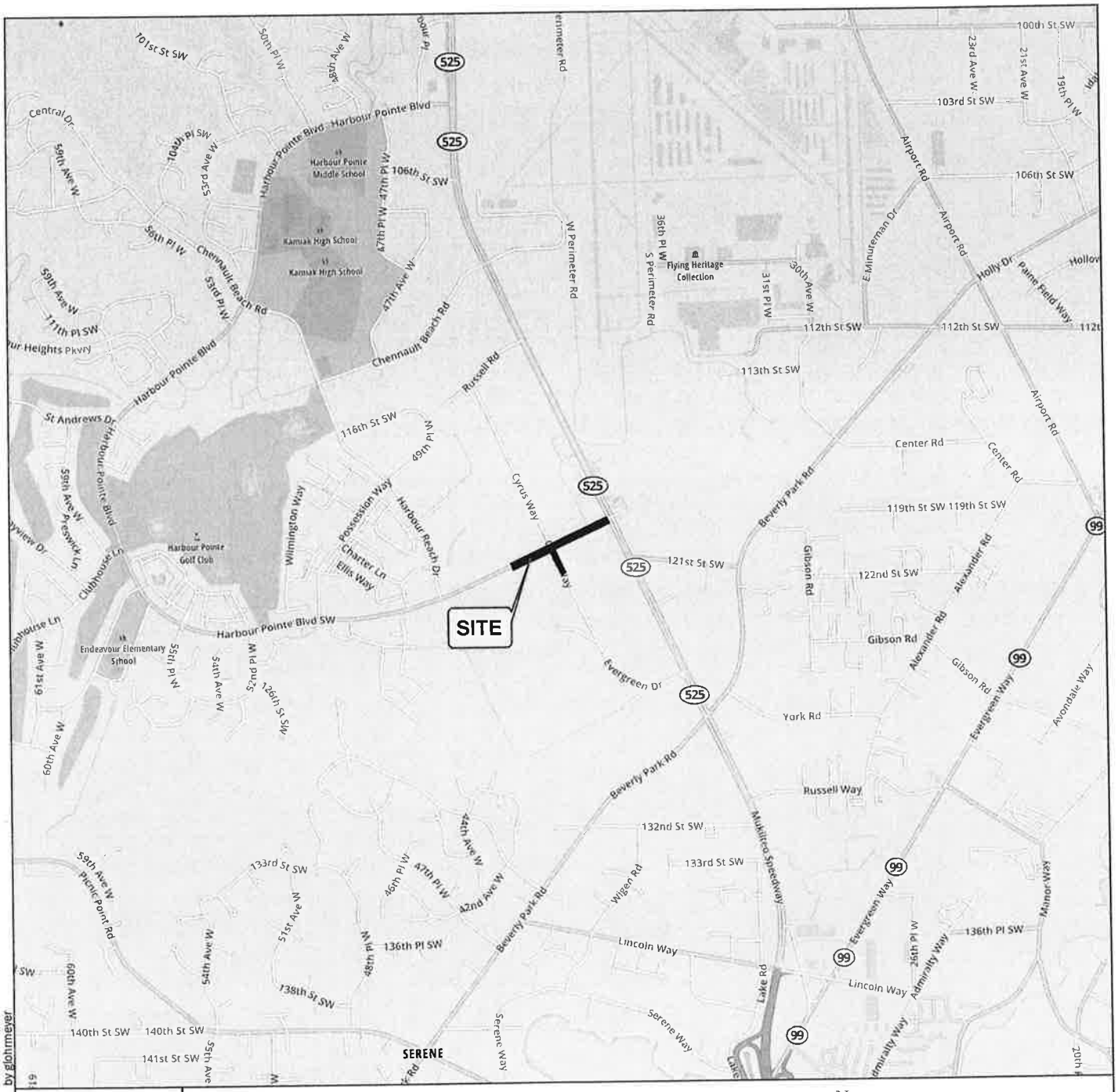
Structural Fill

General. We understand that the proposed roadway improvements will be constructed to match the existing roadway elevations, resulting in limited fill placement. Structural fill will be placed primarily to fill in the adjacent ditches, for backfill in overexcavation areas, backfilling behind retaining walls (if necessary) and to backfill stormwater features and utility trenches. Structural fill materials should be free of debris, organic contaminants and rocks or rock fragments larger than 6 inches or ½ the lift thickness, whichever is smaller.

All fill placed to support pavement, sidewalks, curbs, and gutters should be placed as structural fill. Structural fill should be placed in horizontal lifts and uniformly compacted. The appropriate lift thickness will depend on the material and the compaction equipment being used. Loose lift thicknesses of 8 to 12 inches are typical when using heavy self-propelled vibratory equipment. All excavations should be wide enough to accommodate the appropriate compaction equipment for the thickness of the fill. The structural fill should be compacted to at least 95 percent of the MDD in accordance with ASTM D 1557 within 2 feet of the ATB or granular base subgrade. A compaction standard of 90 percent may be used below this depth. We recommend sufficient monitoring of fill placement and in-place density tests to verify that adequate compaction is being achieved.

Use of On-site Soils for Structural Fill. Based on the samples collected from our explorations, the on-site soils include material with high fines content. These materials are moisture sensitive and can be difficult to compact to 95 percent of the MDD even at or near their optimum moisture content. Therefore, for planning purposes, we suggest that the on-site soils be considered unsuitable for use as structural fill except in deeper trenches where 90 percent compaction is acceptable.

Select Import Fill. Imported soil should conform to the recommendations provided in the "General" section above. We recommend using a select import fill: a sand and gravel with a fines content of less than 5 percent based on that portion passing the ¾-inch sieve. We generally recommend at least 30 percent



N
W E
S

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: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 10N

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Vicinity Map

Harbour Pointe Boulevard Widening Project
Mukilteo, Washington

GeoEngineers

Figure 1

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:
Aerial from Bing Imagery dated July, 2014.

N W E S

120 0 120
Feet

Legend

B-1	Boring by GeoEngineers, 2016
PIT-1	Test Pit by GeoEngineers, 2016
B-1-2001	Boring by CDM, 2001
TH-1-2-97	Boring by WSDOT, 1997
	Site Boundary

Site Plan

Harbour Pointe Boulevard Widening Project
Mukilteo, Washington

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Figure 2

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APPENDIX A
Field Explorations and Laboratory Testing

APPENDIX A
FIELD EXPLORATIONS AND LABORATORY TESTING

Field Explorations

Subsurface soil and groundwater conditions were evaluated on July 25, 2016, by completing 8 borings using a track-mounted hollow-stem auger drill rig subcontracted to GeoEngineers. The borings (B-1 through B-3 and C-1 through C-5) were completed to depths ranging from 8 to 20.5 feet bgs. The approximate locations of the borings are shown in the Site and Exploration Plan, Figure 2. The locations of the borings were determined by pacing from existing site features; therefore, the locations shown in Figure 2 should be considered approximate.

Disturbed soils samples were obtained using standard penetration test (SPT) methodology. This method involves driving a standard split spoon sampler a total of 18 inches using a 140-pound rope and cathead hammer free falling 30 inches. The number of blows required to drive the sampler the last 12 inches are recorded on the boring logs. The samples were placed in plastic bags to maintain the moisture content and transported back to our laboratory for analysis and testing.

The borings were continuously monitored by a geotechnical engineer from our firm who examined and classified the soils encountered, obtained representative soil samples, observed groundwater conditions and prepared a detailed log of each exploration. Soils encountered were classified visually in general accordance with ASTM D 2488-90, which is described in Figure A-1. An explanation of our boring log symbols is also shown in Figure A-1.

The logs of the borings are presented in Figures A-2 through A-10. The exploration logs are based on our interpretation of the field and laboratory data and indicate the various types of soils encountered. It also indicates the depths at which these soils or their characteristics change, although the change might actually be gradual. If the change occurred between samples in the boring, it was interpreted.

Laboratory Test Results

Soil samples obtained from the explorations were transported to our laboratory and examined to confirm or modify field classifications, as well as to evaluate index properties of the soil samples. Representative samples were selected for laboratory testing consisting of the determination of the moisture content. The tests were performed in general accordance with ASTM test methods or other applicable procedures.

Moisture content tests were completed in general accordance with ASTM D 2216 for representative samples obtained from the explorations. Grain size analyses were performed on selected samples in general accordance with ASTM D 6913 to determine the sample grain size distribution. The wet sieve analysis method was used to determine the percentage of soil greater than the U.S. No. 200 mesh sieve. The results of these tests are presented in the exploration logs at the depths at which the samples were obtained. The results of the sieve analysis are presented in Figure A-11.

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
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE			GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		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
	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE			SP	POORLY-GRADED SANDS, GRAVELLY SAND
		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
	TS	Topsoil/ Forest Duff/Sod

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
- 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.

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

A "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
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PP	Pocket penetrometer
PPM	Parts per million
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
NT	Not Tested

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 A-1

Rev. 02/16

Start Drilled 7/25/2016	End 7/25/2016	Total Depth (ft) 20.5	Logged By TKC Checked By MAG	Driller Boretec1, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) 541 Vertical Datum EGM96 Geoid			Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment EC55B Track Rig
Easting (X) 1283351 Northing (Y) 327546			System Datum WA State Plane,North NAD83 (feet)		Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft): None Observed
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample / Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
540	0	6		1 MC			SM	Brown silty fine to medium sand with gravel and roots (medium dense, moist) (fill)	4		
		17	86/11"	2 SA			ML/SM	Brownish gray sandy silt to silty sand with occasional gravel (hard/very dense, moist) (glacial till)	11	51	Difficult drilling
535	5	9	50/3"	3			SM	Brownish gray silty fine sand with occasional gravel (very dense, moist)			
530	10	9	50/3"	4 MC					9		
525	15	5	50/5"	5				Becomes gray			
	20	5	50/5"	6 MC					9		

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-1

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Project: Harbour Pointe Boulevard Widening
Project Location: Mukilteo, Washington
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Figure A-2
Sheet 1 of 1

Drilled	Start 7/25/2016	End 7/25/2016	Total Depth (ft)	20.5	Logged By TKC / Checked By MAG	Driller Boretec1, Inc.	Drilling Method	Hollow-Stem Auger
Surface Elevation (ft) / Vertical Datum	555 / EGM96 Geoid		Hammer Data	Rope & Cathead / 140 (lbs) / 30 (in) Drop		Drilling Equipment	EC55B Track Rig	
Easting (X) / Northing (Y)	1283590 / 327615		System Datum	WA State Plane, North / NAD83 (feet)		Groundwater: Date Measured	Depth to Water (ft)	Elevation (ft)
Notes:						None Observed		

Elevation (feet)	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample / Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						SM	Light brown silty fine sand with roots (loose, moist) (fill)			
		6		1							
		2	50/2"*	2			SM	Brown silty fine to medium sand with gravel (medium dense, moist) (weathered glacial till)			*Blow count overstated; sampler bouncing on rock
550	5	12	34*	3 MC					11		*Blow count overstated; broken rock in top of sampler
		16	86/10"	4			SM	Brown-gray silty fine sand with occasional gravel (very dense, moist) (glacial till)			
545	10	9	50/3"	5 MC					9		
540	15	9	50/3"	6							
535	20		50/5"	7							

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-2

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Project: Harbour Pointe Boulevard Widening
Project Location: Mukilteo, Washington
Project Number: 5790-004-00

Figure A-3
Sheet 1 of 1

Drilled	Start	End	Total Depth (ft)	Logged By	Checked By	Driller	Drilling Method
	7/25/2016	7/25/2016	20.5	TKC	MAG	Boretec1, Inc.	Hollow-Stem Auger

Surface Elevation (ft) / Vertical Datum	565 EGM96 Geoid	Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop
Drilling Equipment	EC55B Track Rig		
Easting (X) / Northing (Y)	1283948 / 327770	System Datum	WA State Plane,North NAD83 (feet)
Groundwater	Date Measured	Depth to Water (ft)	Elevation (ft)
		None Observed	

Notes:

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							SM	Brown silty fine to medium sand with occasional gravel (medium dense, moist) (fill)			
		6			1 MC					13		
		18	41		2			SM	Brown-gray with oxidation staining silty fine sand with gravel (dense, moist) (weathered glacial till)			
								SM	Brown-gray silty fine sand with occasional gravel (very dense, moist) (glacial till)			
560	5	5	50/5"		3 MC					9		Rock in top of sampler
		6	50/6"		4							
555	10	10	50/4"		5							
550	15	11	50/5"		6				Becomes moist to wet			
545	20	6	50/6"		7				Becomes gray			

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-3

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Project: Harbour Pointe Boulevard Widening
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Figure A-4
Sheet 1 of 1

Drilled Start 7/25/2016	End 7/25/2016	Total Depth (ft) 8	Logged By TKC / Checked By MAG	Driller Boretec1, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) 534 / Vertical Datum EGM96 Geoid			Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment EC55B Track Rig
Easting (X) 1283273 / Northing (Y) 327513			System Datum WA State Plane,North NAD83 (feet)		Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft): None Observed
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							AC	8 inches asphalt concrete			
								GP	2 inches gravel base			
		6			1			SM	Brown silty fine to medium sand with gravel (medium dense, moist) (fill)			
530		18	36		2 MC			SM	Brown-gray with oxidation staining silty fine sand with gravel (dense, moist) (weathered glacial till)	10		
	5	18	63		3			SM	Brown-gray silty fine sand with gravel (very dense, moist) (glacial till)			
		6	50/6"		4 MC					10		

Note: See Figure A-1 for explanation of symbols.

Log of Boring C-1

GeoEngineers

Project: Harbour Pointe Boulevard Widening
Project Location: Mukilteo, Washington
Project Number: 5790-004-00

Figure A-5
Sheet 1 of 1

Drilled Start 7/25/2016	End 7/25/2016	Total Depth (ft) 8.5	Logged By TKC / Checked By MAG	Driller Boretec1, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) 556 / Vertical Datum EGM96 Geoid			Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment EC55B Track Rig
Easting (X) 1283749 / Northing (Y) 327740			System Datum WA State Plane,North NAD83 (feet)		Groundwater: Date Measured / Depth to Water (ft) / Elevation (ft): None Observed
Notes:					

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							AC	6 inches asphalt concrete			
								GP	2 inches gravel base			
555		6			1 SA			SM	Brown silty fine to medium sand with gravel (medium dense, moist) (fill)	4	17	
		18	46		2 MC			SM	Brown-gray silty fine sand with gravel (dense, moist) (weathered glacial till)	12		
								SM	Brown-gray with slight oxidation staining silty fine sand with gravel (very dense, moist) (glacial till)			
	5	15	86/9"		3				1-inch seam of wet soil at 5½ feet			
550			50/4"		4							

Note: See Figure A-1 for explanation of symbols.

Log of Boring C-2

GeoEngineers

Project: Harbour Pointe Boulevard Widening
Project Location: Mukilteo, Washington
Project Number: 5790-004-00

Figure A-6
Sheet 1 of 1

Drilled Start 7/25/2016 End 7/25/2016	Total Depth (ft) 8.9	Logged By TKC Checked By MAG	Driller Boretec1, Inc.	Drilling Method Hollow-Stem Auger
Surface Elevation (ft) 566 Vertical Datum EGM96 Geoid		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment EC55B Track Rig
Easting (X) 1284148 Northing (Y) 327897		System Datum WA State Plane,North NAD83 (feet)		Groundwater Date Measured / Depth to Water (ft) / Elevation (ft): None Observed
Notes:				

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							AC	9 inches asphalt concrete			
565		6			1			GP	2 inches gravel base			
								SM	Dark brown silty fine to course sand with gravel and trace wood debris (medium dense, moist) (fill)			
		17	94/11"		2 MC			SM	Brown-gray with oxidation staining silty fine sand with gravel (very dense, moist) (weathered glacial till)	13		Rock in sampler tip
								SM	Brown-gray silty fine sand with gravel (very dense, moist) (glacial till)			
	5	16	60		3							
560									2 inch seam of wet soil at 6 feet			
								SM	Brown-gray silty fine to medium sand with gravel (very dense, moist to wet)			
		15	88/9"		4				½ lens of silt and clay			

Note: See Figure A-1 for explanation of symbols.

Log of Boring C-3

GeoEngineers

Project: Harbour Pointe Boulevard Widening
Project Location: Mukilteo, Washington
Project Number: 5790-004-00

Figure A-7
Sheet 1 of 1

Drilled	Start 7/25/2016	End 7/25/2016	Total Depth (ft)	14	Logged By TKC / Checked By MAG	Driller Boretec1, Inc.	Drilling Method	Hollow-Stem Auger
Surface Elevation (ft)	548		Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment	EC55B Track Rig	
Vertical Datum	EGM96 Geoid							
Easting (X)	1283525		System Datum	WA State Plane,North NAD83 (feet)		Groundwater	Depth to Water (ft)	Elevation (ft)
Northing (Y)	327532					Date Measured	See Remarks	
Notes:								

Elevation (feet)	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							AC	6 inches asphalt concrete			
								GP	1 inch gravel base			
		6			1			SM	Brown silty fine to medium sand with occasional gravel (medium dense, moist) (fill)			
545		5	3		2 MC			OL	Dark brown to black organic silt with sand, roots and trace wood debris (very soft to soft, moist to wet) (recessional deposits)	97		
	5	18	12		3			SM	Gray silty fine to medium sand with occasional gravel and fine roots (medium dense, wet)			Perched groundwater encountered at approximately 5.5 feet bgs during drilling
540		18	13		4A			SM	Gray silty fine sand with occasional gravel (medium dense, moist to wet) (weathered glacial till)			
					4B							
								SM	Gray silty fine sand with occasional gravel (dense to very dense, moist to wet) (glacial till)			
	10	18	40		5							
535		18	60		6				Becomes moist			

Note: See Figure A-1 for explanation of symbols.

Log of Boring C-4

GeoEngineers

Project: Harbour Pointe Boulevard Widening
Project Location: Mukilteo, Washington
Project Number: 5790-004-00

Figure A-8
Sheet 1 of 1

Drilled	Start 7/25/2016	End 7/25/2016	Total Depth (ft)	10.8	Logged By TKC / Checked By MAG	Driller Boretec1, Inc.	Drilling Method	Hollow-Stem Auger
Surface Elevation (ft)	552		Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment	EC55B Track Rig	
Vertical Datum	EGM96 Geoid							
Easting (X)	1283592		System Datum	WA State Plane,North NAD83 (feet)		Groundwater	Depth to Water (ft)	Elevation (ft)
Northing (Y)	327369					Date Measured		
Notes:						None Observed		

Elevation (feet)	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							AC	8 inches asphalt concrete			
		6			1			GP	2 inches gravel base			
								SM	Brown silty fine to medium sand with occasional gravel (medium dense, moist) (fill)			
550		18	72		2			SM	Gray-brown silty fine sand with gravel (very dense, moist) (glacial till)			
	5	12	50/6"		3							
545		0	50/1"		4							No recovery; sampler appeared to be hitting a rock
	10	8	50/2"		5							

Note: See Figure A-1 for explanation of symbols.

Log of Boring C-5

GeoEngineers

Project: Harbour Pointe Boulevard Widening
Project Location: Mukilteo, Washington
Project Number: 5790-004-00

Figure A-9
Sheet 1 of 1

Date Excavated 7/25/2016	Total Depth (ft) 1.5	Logged By TKC Checked By MAG	Excavator GeoEngineers, Inc.	Excavation Equipment Hand-Auger
Surface Elevation (ft) 551 Vertical Datum EGM96 Geoid		Easting (X) 1283419 Northing (Y) 327520		Coordinate System WA State Plane,North Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	Encountered Water	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
			1		SM		Brown silty fine sand with gravel and fine roots (loose, moist) (fill)			Probed 6 inches at surface
			2		SM		Light brown silty fine sand with gravel and occasional fine roots (dense, moist)			Probed 1 inch at ½ foot
550	1		3							Probed 1 inch at 1 foot
										Probed 1 inch at 1½ feet

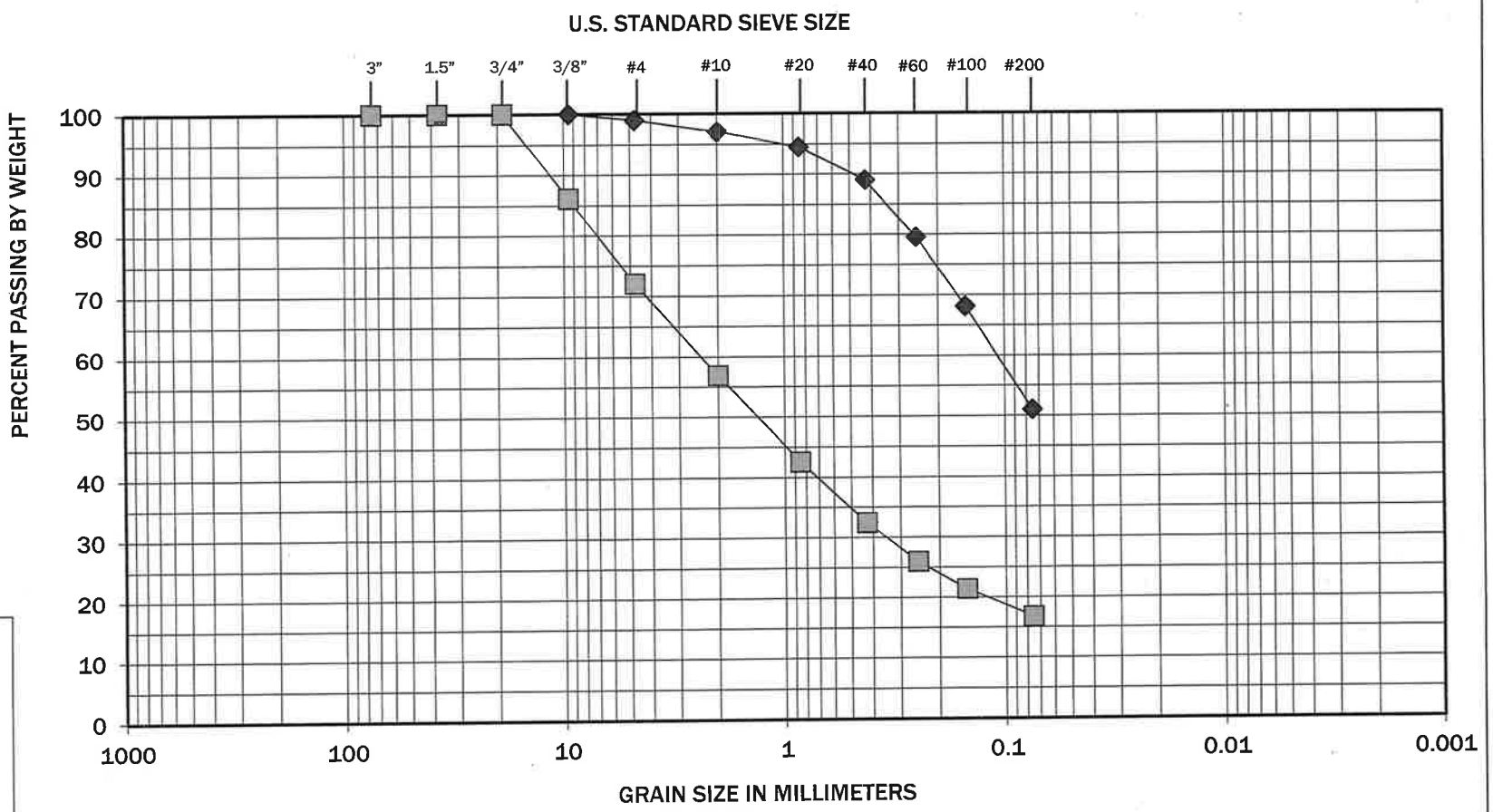
Notes: See Figure A-1 for explanation of symbols.
The depths on the hand-augered exploration logs are based on an average of measurements across the hand-auger and should be considered accurate to ½ foot.

Log of Hand-Auger HA-1

GeoEngineers

Project: Harbour Pointe Boulevard Widening
Project Location: Mukilteo, Washington
Project Number: 5790-004-00

Figure A-10
Sheet 1 of 1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	B-1	2.5	11	Sandy silt (ML)
■	C-2	1	4	Silty sand with gravel (SM)

Note: This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations, or generated by separate operations or processes.

The grain size analysis results were obtained in general accordance with ASTM D 6913.

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Harbour Pointe Boulevard Widening
Mukilteo, Washington

Sieve Analysis Results

Figure A-11

APPENDIX B
Pilot Infiltration Test Results

GeoEngineers

Memorandum

600 Dupont Street, Bellingham, Washington 98225, Telephone: 360.647.1510, Fax: 360.647.5044 www.geoengineers.com

To:	Shane Oden, PE (Tuttle Engineering and Management)
cc:	Challis Stringer (City of Mukilteo)
From:	Sean Cool, PE Deb Overbay, PE
Date:	January 9, 2017
File:	5790-004-00
Subject:	Pilot Infiltration Test (PIT) Results Harbour Pointe Boulevard Widening Mukilteo, Washington

INTRODUCTION

The purpose of this memorandum is to provide a summary of our infiltration testing results to support the design of stormwater infiltration facilities for the Harbour Pointe Boulevard Widening project in Mukilteo, Washington. The general project location is shown in the Vicinity Map, Figure 1. GeoEngineers previously completed a draft geotechnical engineering report for the site dated September 27, 2016. Our scope of work related to our previous services is described in our Subconsultant Agreement for the project dated October 5, 2015.

We understand that the proposed site development requires an evaluation of the feasibility infiltration as a low impact development (LID) design option. Infiltration facilities, if used for the project, would likely consist of shallow rain-garden type features rather than larger facilities or stormwater ponds. Accordingly, two small-scale Pilot Infiltration Tests (PITs) were conducted at the project site as a basis for evaluating the long-term infiltration rate of the near-surface site soils.

SUBSURFACE CONDITIONS

Detailed soil and groundwater conditions encountered at the site are described in our previous geotechnical engineering report, referenced above. Subsurface soil conditions encountered at the site generally consist of fill overlying weathered and unweathered glacial till. Two test pit excavations (PIT-1 and PIT-2) were excavated on November 10 and 11, 2016 at the approximate locations shown in the Site Plan, Figure 2. The test pits were advanced to maximum depths between about 7¾ and 8½ feet below ground surface (bgs) using a backhoe. The explorations were continuously monitored by an 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 in the borings was classified in general accordance with ASTM International (ASTM) D 2488 and the classification chart listed in Key to Exploration Logs, Figure 3. Logs of the explorations are presented in Figures 4 and 5. The results of laboratory sieve analyses from samples collected near the bottom of the PIT excavations are presented in Figure 6.

Test pit PIT-1 was initially excavated to a depth of approximately 4 feet for the PIT then continued to a depth of 7¾ feet after the test was completed. The soil encountered consisted of approximately 6 inches of topsoil, overlying approximately 2 feet of fill. The fill consists of loose to medium dense, dark brown, silty fine to medium

Graduated wood stakes (yard sticks) were driven into the floor of each PIT as visual references for monitoring water levels during testing. Piezoelectric pressure transducers were secured to the yard sticks to provide accurate water level records measured at thirty-second intervals throughout the duration of the tests. The following steps were completed during the testing:

- **Pre-Soak:** Initial filling in the test pits was done by measuring inflow and water level. The test pit was filled to a water depth of at least 1 foot for the pre-soaking period. The pre-soaking duration was reduced slightly from the typical 6 hours to about 5 hours because of limited daylight hours available after excavation and test set up and because of the minimal change in water level. During pre-soaking, the water level was maintained at approximately 1 foot above the bottom of the excavation and only refilled if necessary.
- **Steady State:** At the end of the pre-soak period, a steady state period is typically completed in which the water level at each PIT excavation is reestablished to a depth of approximately 1 foot, and then allowed to drain to a lower pre-determined level (approximately 2 inches lower than the initial level). The excavation is filled and drained in cycles. Because of the low infiltration rates for the site soils, the lower pre-determined level was not reached in either PIT during the length of the steady state period and no fill and drain cycling was completed.
- **Falling Head:** After the steady state period a falling head period was completed where water levels were measured as the excavation drained. In PIT-1 the lower head range was not met during the steady state period; therefore, no more water was added and continued water level measurements were recorded. The water level in PIT-2 was near the lower bound; therefore, water was added to reach the initial upper head range and the falling head measurements were recorded from that point.

The overall testing process took approximately 5½ to 6 hours with water levels measured continuously (every 30 seconds) in both test pits, as shown in the figures. At the conclusion of testing, water was bailed from the excavation as feasible and each PIT location was over-excavated an additional 4 to 4½ feet to characterize the soil profile and groundwater conditions below the base of the pit.

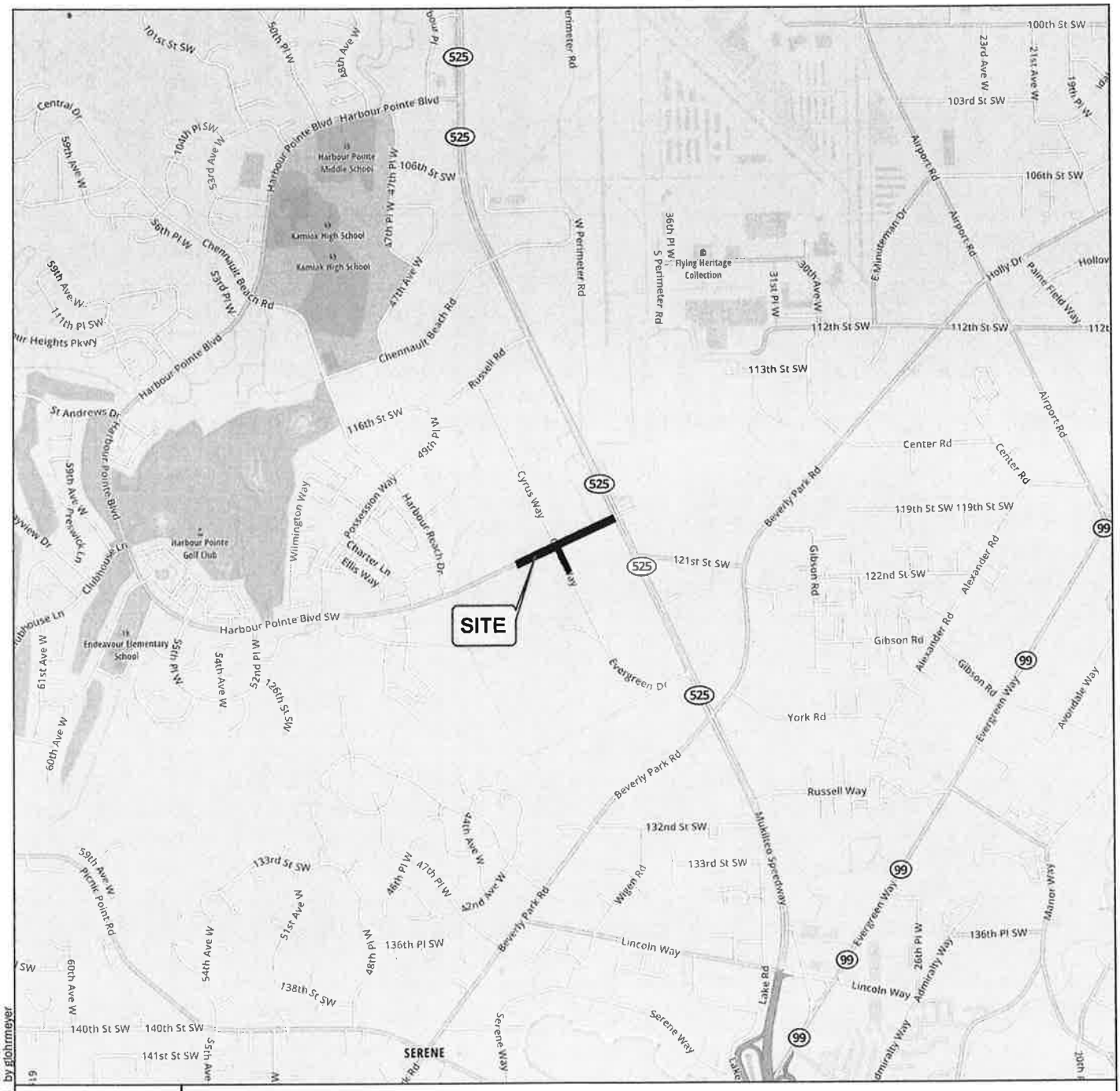
Infiltration Testing Results

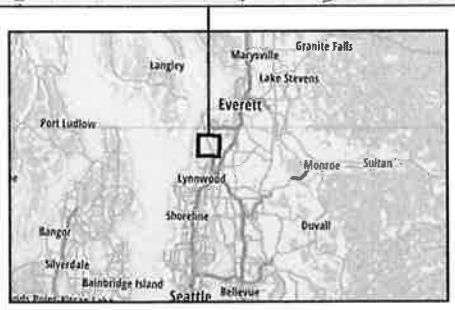
Figures 7 and 8 present plots of the water level in each PIT for the duration of the testing period and resulting initial "short-term" infiltration rate (or hydraulic conductivity rate, $K_{sat\text{-}initial}$) calculated during each stage of the PIT. Stages 1 and 2 were completed during the pre-soak and Stage 3 during the falling head period. Because the infiltration rate was low and multiple cycles of filling and draining were not completed for these tests, we recommend using the lowest recorded value for the test at the completion of soaking/end of falling head segment as the short-term infiltration rate. It should be noted in PIT-2, the data recorded after refilling the test pit excavation indicate the water level was increasing during a portion of the test segment, possibly due to slight seepage near the base of the PIT, and a higher infiltration rate was recorded at the end of the test period (Stage 3). In our opinion this final segment of infiltration should be ignored in determining the infiltration rate for this PIT. The test pit was filled slightly higher than during the initial stage and the slightly higher measured infiltration rate at the end of the test may represent lateral movement of water into the unsaturated weathered glacial till zone that was not pre-soaked.

and Guidelines for Use", which should be consulted for additional information pertaining to the use of this memorandum.

We appreciate the opportunity to work with you on this project. Please call if you have any questions regarding this memorandum.

Attachments:
Figure 1. Vicinity Map
Figure 2. Site Plan
Figure 3. Key to Exploration Logs
Figures 4 and 5. Logs of Test Pits
Figure 6. Sieve Analysis Results
Figures 7 and 8. Pilot Infiltration Test Results





N
W E
S

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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: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 10N

Vicinity Map

Harbour Pointe Boulevard Widening Project
Mukilteo, Washington

GeoEngineers

Figure 1

P:\5\5790004\GIS\5790004_F1_VicinityMap.mxd Date Exported: 08/17/16 by glohrmeyer

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:
Aerial from Bing Imagery dated July, 2014.

Legend

B-1	Boring by GeoEngineers, 2016
PIT-1	Test Pit by GeoEngineers, 2016
B-1-2001	Boring by CDM, 2001
TH-1-2-97	Boring by WSDOT, 1997
	Site Boundary

Site Plan

Harbour Pointe Boulevard Widening Project
Mukilteo, Washington

GEOENGINEERS

Figure 2

P:\5\5780004\CAD\00\1200 GeoTech\0578300400_F02_SitePlan.dwg TAB:F02 Date Exported: 12/16/16 - 14:15 by hmata

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 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
	TS	Topsoil/ Forest Duff/Sod

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

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.

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

A "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
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PP	Pocket penetrometer
PPM	Parts per million
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
NT	Not Tested

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 11/11/2016	Total Depth (ft) 7.75	Logged By MWB Checked By TKC	Excavator Kelly's Excavation, Inc.	Excavation Equipment Komatsu Backhoe
Surface Elevation (ft) 561 Vertical Datum EGM96 Geoid		Easting (X) 1283773 Northing (Y) 327725		Coordinate System WA State Plane,North Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
560	0				TS	Topsoil with grass/blackberry roots			
	1	☒	1		SM	Dark brown silty fine to medium sand with occasional gravel, fine roots (loose to medium dense, moist) (fill)			
559	2	☒	2		SM	Brown-gray silty fine to medium sand with gravel (medium dense, moist) (weathered glacial till)			
558	3								Water level at approximately 3 feet for PIT
					SM	Gray silty fine sand with occasional gravel (medium dense to very dense, moist) (glacial till)			
557	4	☒	3 SA				17	35	Bottom of PIT excavation at 4 feet
		☒	4 SA		SM	Gray silty fine sand (very dense, moist)	13	45	
556	5								
555	6								
554	7								
		☒	5						

Test pit completed at 7¾ feet
No groundwater seepage observed
No caving observed

Notes: See Figure A-1 for explanation of symbols.
The depths on the hand-augered exploration logs are based on an average of measurements across the hand-auger and should be considered accurate to ½ foot.

Log of Test Pit PIT-1

GeoEngineers

Project: Harbour Pointe Boulevard Widening
Project Location: Mukilteo, Washington
Project Number: 5790-004-00

Figure 4
Sheet 1 of 1

Date Excavated 11/10/2016	Total Depth (ft) 8.5	Logged By MWB Checked By TKC	Excavator Kelly's Excavation, Inc.	Excavation Equipment Komatsu Backhoe
Surface Elevation (ft) 546 Vertical Datum EGM96 Geoid		Easting (X) 1283418 Northing (Y) 327566		Coordinate System WA State Plane, North Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
545	1	☒	1		SM	Brown silty fine sand with occasional gravel, fine roots (loose to medium dense, moist) (fill)			
544	2	☒	2		SM	Gray-brown silty fine to medium sand with occasional gravel (medium dense, moist) (weathered glacial till)			
543	3				SM	Gray silty fine sand with gravel and cobbles up to 4 inches (very dense, moist) (glacial till)			Water level at approximately 3 feet for PIT
542	4	☒	3 SA				16	26	
		☒	4 SA			Wet sample at 4 feet at completion of PIT	17	23	Slight seepage observed at 4 feet Bottom of PIT excavation at 4 feet
541	5					Becomes moist			
540	6								
539	7								
538	8	☒	5						

Test pit completed at 8½ feet
No caving observed

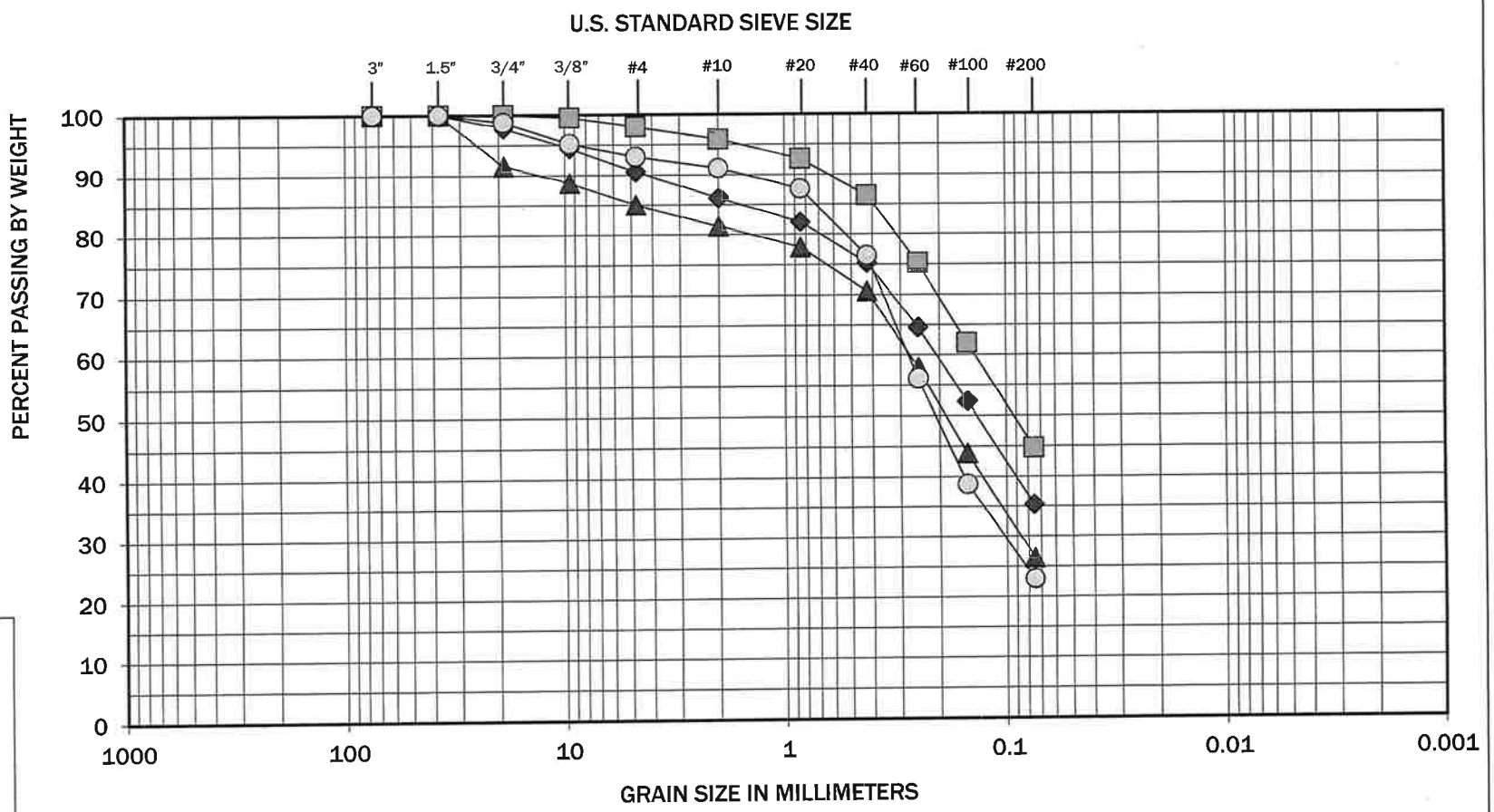
Notes: See Figure A-1 for explanation of symbols.
The depths on the hand-augered exploration logs are based on an average of measurements across the hand-auger and should be considered accurate to ½ foot.

Log of Test Pit PIT-2

GeoEngineers

Project: Harbour Pointe Boulevard Widening
Project Location: Mukilteo, Washington
Project Number: 5790-004-00

Figure 5
Sheet 1 of 1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Soil Description
◆	PIT-1	4	17	Silty fine to medium sand (SM)
■	PIT-1	4.5	13	Silty fine to medium sand (SM)
▲	PIT-2	3.75	16	Silty fine to medium sand (SM)
○	PIT-2	4	17	Silty fine to medium sand (SM)

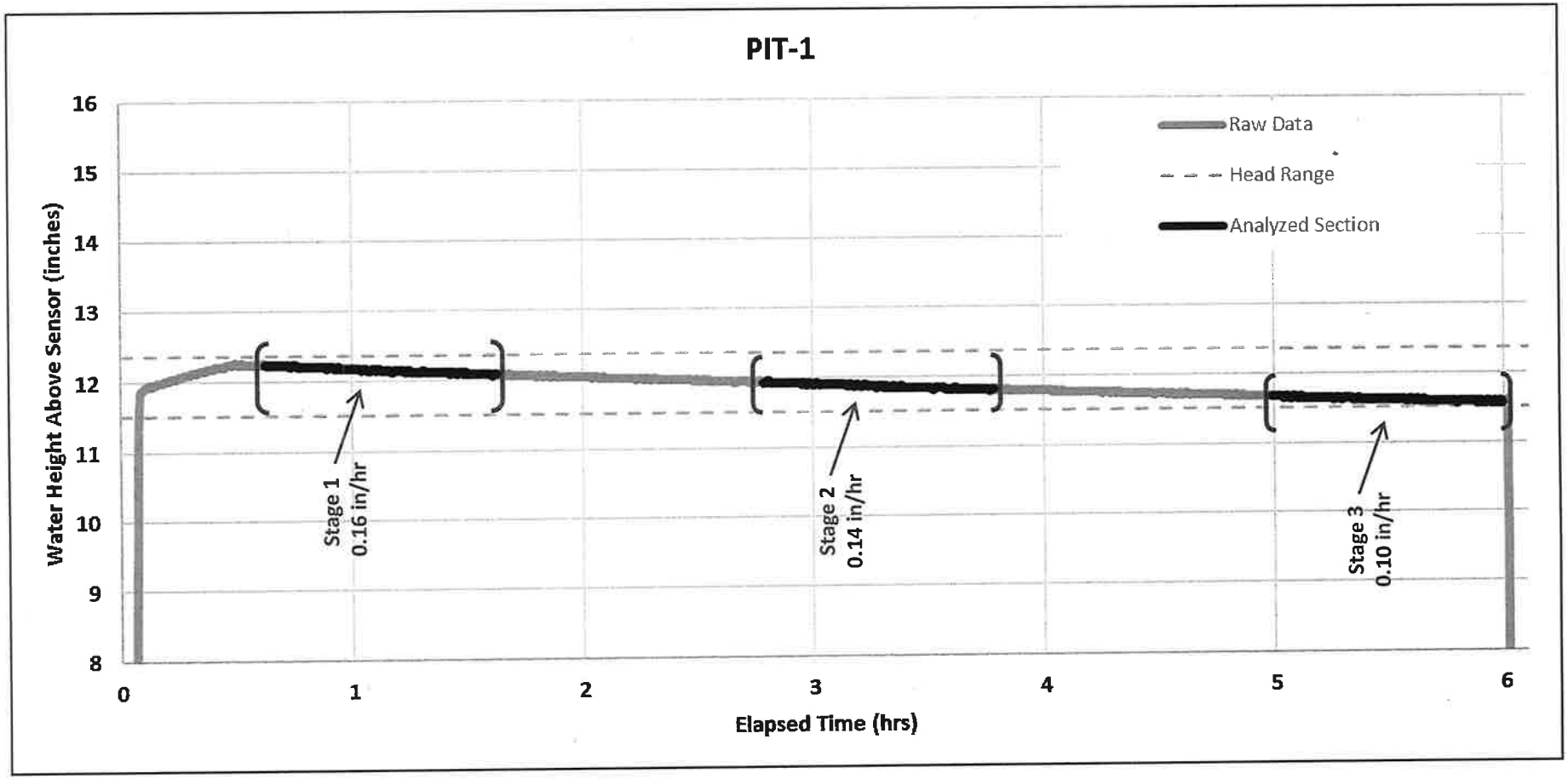
The grain size analysis results were obtained in general accordance with ASTM D 6913.

GeoEngineers

Figure 6

Harbour Pointe Boulevard Widening Project
Mukilteo, Washington

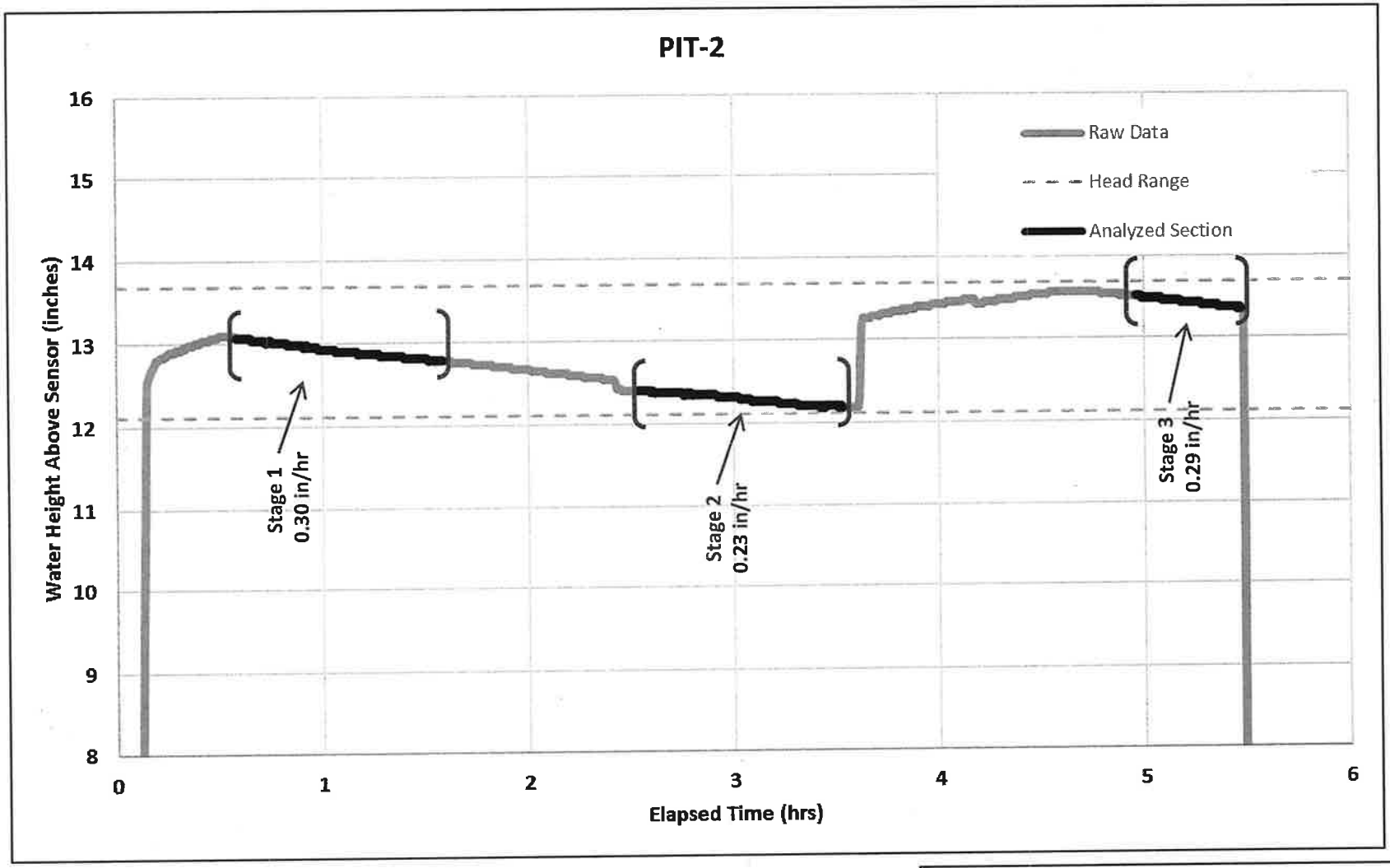
Sieve Analysis Results



Pilot Infiltration Test Results – PIT-1

Harbour Pointe Boulevard Widening
Mukilteo, Washington

GeoEngineers | **Figure 7**



Pilot Infiltration Test Results – PIT-2

Harbour Pointe Boulevard Widening
Mukilteo, Washington

GeoEngineers

Figure 8

LOG OF TEST BORING

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

S.R. 525 Section 132nd Street To Paine Field Boulevard Job No. OL-2299

Hole No. TH-1-2-97 For Signal Standards / System 2 Cont. Sec.

Station 6 + 845.9 Offset 17.7m Left Ground El. prox. Same as C/L

Type Of Boring Rotary Drill Diedrich D-25 Casing HQ Advancer W.T. El. - 8.6'

Inspector Brian M. Breck Starting Date 12\4\97 Sheet 1 of 1

DEPTH	BLOWS / FT.	PROFILE	SAMPLE #'s	DESCRIPTION OF MATERIAL
0				
	D - 1		4\6\4	Silty SAND with rounded and sub-rounded gravel and some organics ,
	10			(Wood) ,Loose ,Gray ,Moist ,Homogeneous. Recovered 1.0'
5				
	D - 2		18\31\42	Silty SAND with (embedded) Sub-angular and sub-angular gravel , (Till) ,
	73			Very dense ,Gray ,Moist ,Homogeneous. Recovered 1.2'
10				
	D - 3		28\50	Silty SAND with (embedded) Sub-angular and sub-angular gravel , (Till) ,
	50\0.5'			Very dense ,Gray ,Moist ,Homogeneous. Recovered 0.8'
15				
				End of test boring -- 12' Water table = - 8.6' Stations and offsets are estimates and were not surveyed.
20				

organic's silt's sand's gravel's

DOT
NW Region Form

Original to Materials Engineer
Copy to Bridge Engineer
Copy to District Administrator
Copy to _____

Other Tests	Sample No.	Moisture Content (%)	Dry Density (pcf)	PID (ppm) [reading/background]	Penetration Resistance (blows / 6 in.)	Depth (feet)	Sample	USCS	Symbol	DESCRIPTION	Elev. (feet)
						0		FILL		Gravel Drive / Fill.	
										TILL SANDY SILT with gravel (ML) Gray, moist, very dense, fine to coarse sand, fine gravel, slightly oxidized.	
	1				12 25 37	2					
						4					
MD	2	9.9	129.7			6				Becomes brownish gray with no visible oxidation.	
	3				25 50/4"	8		ML			
MD	4	9.7	124.8		21 50/5.5"	10				Becomes brown.	
	5				48 50/3"	12					
						14					
						16				SILT with sand (ML) Gray, moist, very hard, fine to medium sand.	
	6				34 50/3"	18		ML			
						20				Boring Terminated at 18.3 feet below ground surface. No Groundwater encountered. Boring Backfilled with Bentonite Chips.	
						22					
						24					

Location: SW Corner of Intersection
Surface Elevation:
Logged By: AJS

Drill Rig: Mobile B-59
Equipment/Hammer: HSA,SPT/140lb/DM/300lb
Date Completed: 7-27-01

City of Mukilteo
Intersection of Harbor Point Blvd/Cyrus Way
Mukilteo, Washington

Boring Log B1
Project No:

Figure: A-2
1 of 1

CDM Camp Dresser & McKee Inc.

BORING LOG MUK_INT.GPJ CDM_BLLV.GDT 7/30/01 REV. 1

APPENDIX D
Report Limitations and Guidelines for Use

APPENDIX D
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical Services are Performed for Specific Purposes, Persons and Projects

This report has been prepared for the exclusive use of City of Mukilteo Public Works, Tuttle Engineering and Management, and their authorized agents and for the Project(s) specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than the party to whom this report is addressed may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project, and its schedule and budget, our services have been executed in accordance with our the Subconsultant Agreement provided by the client for the project, dated April 4, 2016 and generally accepted geotechnical practices in this area at the time this report was prepared. We do not authorize, and will not be responsible for, the use of this report for any purposes or projects other than those identified in the report.

A Geotechnical Engineering or Geologic Report is based on a Unique Set of Project-Specific Factors

This report has been prepared for the Harbour Pointe Boulevard Widening Project located in Mukilteo, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

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1 Developed based on material provided by GBA, GeoProfessional Business Association; www.geoprofessional.org.

cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective means of managing the risks associated with unanticipated conditions. If another party performs field observation and confirms our expectations, the other party must take full responsibility for both the observations and recommendations. Please note, however, that another party would lack our project-specific knowledge and resources.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help reduce the risk of problems associated with unanticipated subsurface conditions, GeoEngineers recommends giving contractors the complete geotechnical engineering or geologic report, including these "Report Limitations and Guidelines for Use." When providing the report, you should preface it with a clearly written letter of transmittal that:

- advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and
- encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations,

Biological Evaluation No Effects Letter

Harbour Pointe Boulevard Widening Project
Mukilteo, Washington

for
City of Mukilteo Public Works

December 19, 2017

GeoEngineers

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