10 92587

June 3, 2010

Mr. Scott Raber
P. O. Box 755
Kingston, Washington 98346

Subject: Limited Geotechnical Engineering Evaluation
Raber Property Lot A
Olney Avenue
Port Orchard, Washington

Dear Mr. Raber:

EnviroSound Consulting Inc. (ESC) has prepared this letter report to present our findings and limited geotechnical recommendations for the proposed development of a single family residence for the property located at 1000 Olney Avenue (Tax Parcel Identification Number 4538-010-004-0305). Our scope of services included discussion of preliminary project details with representatives of Mr. Raber, shallow subsurface exploration with four test pit excavations, limited engineering analyses and preparation of this letter report. The focus of this report is for Lot A of the three proposed lots.

Proposed Construction

Based on our discussions, we understand that the proposed development is to consist of the removal of the SFR currently on the lot and dividing the parcel into three lots. Lot A will be developed with a single story wood frame building with standard foundation design. A preliminary sketch provided by AES Engineering is attached as Figure 2.

Site Conditions

The subject property consists of one parcel located in Section 25 Township 24N Range 1E as shown on the Vicinity Map (Figure 1). Access to the subject property is provided by a driveway off of Olney Avenue. At the time of the site visit the site was developed with a modular home in the process of being demolished and associated landscaping. Lot A is bordered by an access driveway to the north, Lot B to the south, Olney Avenue to the east and a forested slope to the west. At the time of the site visit the majority of the site (slope area) was forested with a mixture of young and mature trees and an understory of ferns. The eastern portion of the parcel consists of a relatively level plateau area that had been cleared, and vegetated with grass, landscaping and scattered trees. The topography of the site in general slopes toward the west with a steeply descending slope to the west as shown in the Vicinity Map. An asphalt driveway which provides access to adjacent SFR's parallels the subject property boundaries to the north.

Geologic Setting

The subject site lies within the central Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved with a depositional and erosional history including at least four separate glacial advance/retreats. The Puget Lowland is bounded on the west by the Olympic Mountains and on the east by the Cascade Range. The lowland is filled with glacial and nonglacial sediments consisting of interbedded gravel, sand, silt, till, and peat lenses.

The Washington Division of Geology and Earth Resource (WDGER), Geologic Map of Washington - Northwest Quadrant, dated 2002, indicates that the site is mapped as Alluvium (Qa) and Glacial Till (Qgt). Alluvium is described as sorted combinations of silt, sand, and gravel deposited in streambeds and alluvial fans. Glacial till is an unsorted, unstratified, highly compacted mixture of clay, silt, sand, gravel, and boulders deposited by glacial ice.

The Geologic map of surficial deposits in the Seattle 30' by 60' quadrangle, Washington Map by Yount et al., dated 1993 indicates the site is mapped near a contact of Vashon recessional outwash (Qvr) and Vashon till (Qvt). Vashon recessional outwash is a complex of poorly to moderately sorted and stratified gravel and sand with minor amounts of silt and clay. Vashon till is described similarly to glacial till above.

The United States Department of Agriculture (USDA) Soil Survey of Kitsap County Area, Washington, information indicates the following soil types exist on the project site:

- Indianola loamy sand, (6 – 15% slopes)

USDA Soil Survey Name	**19- Indianola loamy sand, 6 – 15 percent slopes**
Typical Profile	*0 to 7 inches:* Loamy sand *7 to 29 inches:* Loamy sand *29 to 60 inches:* Sand
Origination	Sandy Glacial outwash
Drainage	Excessively drained
Permeability	Rapid
Surface Runoff	Medium
Erosion Hazard	Moderate

Field Exploration and Subsurface Soils

The eastern portion of the parcel is a plateau sloping gently toward the west. The western portion of the parcel is a relatively steep forested slope. There was no visible evidence of erosion or slope failure on the subject parcel or adjoining parcels during our site visit.

Four exploratory test pits were excavated by a mini trackhoe provided by the client on April 13, 2010. The test pits were excavated between the vegetation buffer and building setback and in the building

footprint (See Figure 2) and logged by a representative of ESC. Test pit TP-1 was excavated in the building footprint of Lot C. Test pits TP-2 through TP-4 were excavated along the building setback of Lot C, Lot B and Lot A, respectively. Samples were obtained from the test pits for additional review and for laboratory testing. In general, the subsurface soils consisted of topsoil and silty Sand. For more complete information see the attached test pit logs and laboratory test data.

Groundwater was not encountered in the test pits. Water table elevations can fluctuate with time. Groundwater levels are typically influenced by seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors.

CONCLUSIONS

Based on the findings of this investigation, it is our opinion that the proposed SFR and attached garage may be constructed on the site. The proposed SFR will need to be founded in the medium dense Sand encountered in test pit TP-4 (approximately 2.5 feet below existing grade).

It is our opinion that the construction of the proposed SFR within the 15-foot building set-back will not adversely impact the stability of the slope. In addition it is feasible for the homeowners to maintain a yard within the 25-foot top of slope setback without over saturation of the yard area.

Slope Stability

Based on topographic information provided by Kitsap County GIS mapping, the hillside adjacent to the proposed residence varies between elevation 50 feet and approximately 110 feet (Olney Road). Overall the slope is estimated to be roughly 34 degrees (measured from the horizontal). Test pit explorations in the area of the proposed residence, near the top of the slope indicate the presence of medium dense soil near the ground surface (within the upper 6 to 7 feet). Given the steepness of the slope and the associated vegetation the slope has assumed its natural angle of repose.

The proposed siting of the residence places it behind a 26 degree line projected up from the toe of the slope. In our opinion, the 26 degree projection should provide a stable long-term slope angle given the soil and groundwater conditions observed at this site. Some surficial movements could occur; however, if the recommendations for development are followed, any surficial movements should they occur should not impact the proposed residence.

Foundations

The proposed construction may be founded on a shallow foundation system bearing in the medium dense silty, sand. Topsoil and soft or loose soil should be removed from foundation excavations. Continuous or isolated footings may be designed for a net allowable bearing pressure of 2,000 pounds per square foot (psf). An increase of 1/3 may be applied to the allowable bearing pressure value for short duration loads, such as those associated with wind and seismic conditions.

Footing excavations should be observed by a representative of the geotechnical engineer to verify that the foundations will bear on suitable material. If topsoil or loose native soils are observed within foundation excavations, these materials should be removed and/or re-compacted, depending on the depth and nature

of the material. The extent of overexcavation and/or re-compaction should be based on the geotechnical engineer's representative's recommendations during construction monitoring.

Footings should have adequate embedment for local frost penetration requirements. In the area of this project, the minimum depths are typically 18 inches for exterior footings and 12 inches for interior footings. We recommend that the footings be a minimum of 12 inches wide, regardless of the design foundation pressures. Footings should be located a minimum of 5 feet from any adjacent, descending slope. The distance is to be measured horizontally at the base of the footing.

Total foundation settlements should be less than ¾ of an inch for footings that are constructed as recommended. Differential settlement across a distance of 20 feet should be less than ¾ inch. The majority of the settlement is expected to occur at the time of construction or soon after. Greater than expected post-construction settlement can occur if foundation subgrade soils become saturated.

Lateral footing displacement can be resisted by friction along the base of the foundation and passive pressure acting against the appropriate footing faces. We recommend an allowable friction factor of 0.40 and an allowable passive pressure of 300 psf. These values include a factor of safety of 1.5 for the allowable friction factor and 2.0 for the allowable equivalent fluid passive pressure. Note that the allowable passive pressure assumes that the foundations are located in the dense sand.

Drainage

Runoff from buildings and impervious surfaces should be directed into an appropriately designed stormwater disposal system. Design of stormwater disposal systems is primarily the responsibility of a civil engineer. Based on the soils encountered in the test pits, we anticipate that infiltration may be used at the site.

A perimeter footing drain should be installed around the SFR and the garage at a depth equal to the bottom of the footing. This drain should consist of a minimum 4-inch diameter perforated rigid pipe (with perforations placed down) with a minimum thickness of 6 inches of pea gravel around the pipe. The backfill soils within 1 foot of the foundation wall should consist of free-draining sand and gravel material. This drainage system should be designed to transport water away from the residence and discharge into an appropriate area.

Lateral Earth Pressures

We understand that shallow below grade walls may be included in the proposed construction. Lateral pressures will be exerted on below grade (basement) and retaining walls by backfill soils, surcharge loads, and hydrostatic pressures caused by groundwater. Lateral earth pressures on walls depend upon the type of wall, type of backfill material and allowable wall movements. For walls that are restrained at the top, lateral earth pressures should be estimated for an "at rest" condition. For walls that are free to rotate away from the retained soil, lateral earth pressures should be estimated for an "active" earth pressure. For walls that are compressing the retained soil, lateral earth pressures should be estimated for a "passive" earth pressure. Recommended lateral earth pressures coefficients are provided in the following tables along with equivalent fluid pressures. These pressures are calculated assuming a moist unit weight for the

backfill soil of 130 pounds per cubic foot (pcf) and an angle of internal friction of 35 degrees, as would be typical for compacted sand backfill soil.

Lateral Earth Pressures, no slope above or below the wall					
"Active" Condition		"At Rest" Condition		"Passive" Condition	
Coefficient (Ka)	Equivalent Fluid Unit Weight (pcf)	Coefficient (Ko)	Equivalent Fluid Unit Weight (pcf)	Coefficient (Kp)	Equivalent Fluid Unit Weight (pcf)
0.27	35	0.43	56	1.85	242

Lateral Earth Pressures, 2H:1V slope above or below the wall					
"Active" Condition		"At Rest" Condition		"Passive" Condition	
Coefficient (Ka)	Equivalent Fluid Unit Weight (pcf)	Coefficient (Ko)	Equivalent Fluid Unit Weight (pcf)	Coefficient (Kp)	Equivalent Fluid Unit Weight (pcf)
0.39	51	0.62	81	0.72	94

The recommended equivalent fluid unit weights do not include hydrostatic pressure due to groundwater accumulated behind walls. The recommended fluid pressures in the first table assume a horizontal ground surface above and below the wall and do not include seismic loading, or any surcharge due to nearby loading from structures, equipment or traffic. The recommended fluid pressures in the second table assume a 2H:1V slope above the wall for the active and at rest cases and a 2H:1V slope below the wall for the passive case. Therefore, for a wall with a 2H:1V slope below it, the active or at-rest pressures from the first table should be used with the passive pressures from the second table. In both tables the passive pressures have been reduced by a factor of 2 to limit wall translation.

The potential seismic force on the wall can be modeled as a uniform pressure (in pounds per square feet-psf) on the back of the wall equal to 7 times the height of the wall (in feet) if there is no slope above the wall. For a wall with a 2H:1V slope above, the potential seismic force should be increased to 14 times the height of the wall. The units for this pressure are pounds per square feet.

Continuous drains with cleanouts should be installed at the base of retaining walls to prevent the buildup of hydrostatic pressure behind the structure. These drains should consist of a minimum 4-inch diameter perforated rigid pipe (with perforations placed down) with a minimum thickness of 6 inches of pea gravel around the pipe. The backfill soils within 1 foot of the walls should consist of free-draining sand and gravel material. This drainage system should be designed to transport water away from the structure and discharge into an appropriate area.

Infiltration Trench

A grain size distribution test was performed on one sample from test pit TP-4 to estimate the USDA Textural Classification of the soils encountered. The test result indicates that the site soils at approximately 4 feet in depth are primarily "Loamy Sand" under the USDA textural classification system.

Based on the results of the test pit and laboratory testing, it appears that the infiltration rates for "Loamy Sand" are likely to be the most appropriate for design. The short term infiltration rate given for Loamy Sand in the SWMM is 8 inches per hour. The Kitsap SWDM indicates a short term infiltration rate for Loamy Sand of 15 minutes per inch. Note the different units for the two design manuals and that the Kitsap Manual consistently gives a higher infiltration rate. The placement of the trench in the upper area of the vegetative setback will minimize any significant impact on the overall stability of the slope.

Erosion Control

The soils on the slope may erode in the disturbed state or under conditions of channelized water flow. Therefore, best management practices for erosion control including silt fences, hay bales, etc. should be used to prevent sediment from leaving the site and entering storm water sewer systems or surface waters. Water should not be allowed to flow over the slope in a concentrated manner. Stripping of vegetation on the steep slopes should be limited to the extent possible for the proposed construction. We further recommend that vegetation be replanted on the slopes as soon as practical following completion of grading.

The Washington State Department of Ecology (DOE) has three publications, which may be helpful in developing long-term slope vegetation maintenance/protection and landscape plans:

- "Slope Stabilization and Erosion Control Using Vegetation: A Manual of Practice for Coastal Property Owners", May 1993, Publication 93-30.
- "Vegetation Management: A Guide for Puget Sound Bluff Property Owners", May 1993, Publication 93-31.
- "Surface Water and Ground Water on Coastal Bluffs: A Guide for Puget Sound Property Owners", June 1995, Publication 95-107.

Although the slope on the property is not a "bluff" the preceding publications have a great deal of general information regarding plants, steep slopes and the use of vegetation to stabilize soil.

Temporary Slopes

It is our opinion that the soils encountered in the test pits (except for the upper 3 feet) are a Type B material as defined by the Washington Industrial Safety and Health Act's (WISHA) regulations on excavation, trenching and shoring. Temporary slopes excavated in Type B material should be inclined no steeper than 1H:1V (horizontal: vertical). A representative of our firm should evaluate temporary slopes to verify that they are appropriate for the soils encountered during construction. In areas where it is not possible to maintain the recommended slopes due to space constraints, temporary shoring may be required. Shoring would need to be properly designed by an engineer.

The Contractor should be familiar with applicable local, state, and federal safety regulations, including the current WISHA regulations on excavation, trenching and shoring. Construction site safety is the sole responsibility of the contractor, who shall also be solely responsible for the means, methods and sequencing of construction operations. ESC is providing this information only as a service to our client. Under no circumstances should the information provided above be interpreted to mean that ESC is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

The soils to be penetrated by any proposed excavations may be variable. ESC's preliminary classifications are based on the materials encountered in the test pits. The Contractor should continually classify the soils that are encountered as excavation work progresses with respect to the WISHA system.

Structural Fill

The majority of the on site soils will likely be suitable for use as structural fill. If the earthwork is to take place during the normally wet period of the year, excavations in the sands should not be left open for any significant length of time. Imported structural fill should consist of well-graded gravel and/or sand with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve).

Structural fill should be placed in loose lifts no more than 12 inches thick, moisture conditioned as necessary (moisture content of soil should be within 2 percent of optimum moisture) and the material should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D-1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. Note that, although in place density testing of fill is frequently used as the primary criterion for acceptance of fill, it should not be the only criterion. If, in the judgment of the geotechnical engineer or his representative, placed fill is not suitable it should be rejected regardless of in place density test results. As an example, fill that is compacted wet of the optimum moisture content may exhibit "pumping" behavior even if in place density test results indicate greater than 95 percent compaction has been achieved. In such a situation, the fill should be removed and replaced with drier material.

Limitations

We have prepared this letter based on standard practices, currently used in this area at the time of preparation. The conclusions are based on the observations made during the site visit. A limited subsurface exploration program was performed. The information presented in this letter was collected and interpreted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty, expressed or implied, including (but not limited to) any warranty of merchantability or fitness for a particular use has been made. Should you have any questions or concerns, which have not been addressed, or if we may be of additional assistance, please call our office at (360) 698-5950.

Sincerely,

Shawn E. Williams, LEG.
Senior Engineering Geologist

State of Washington
Engineering Geologist
2208
Licensed Geologist

Shawn E. Williams
6-3-10

Michael J. Wolczko, P.E.
Sound Geotechnical PLLC.

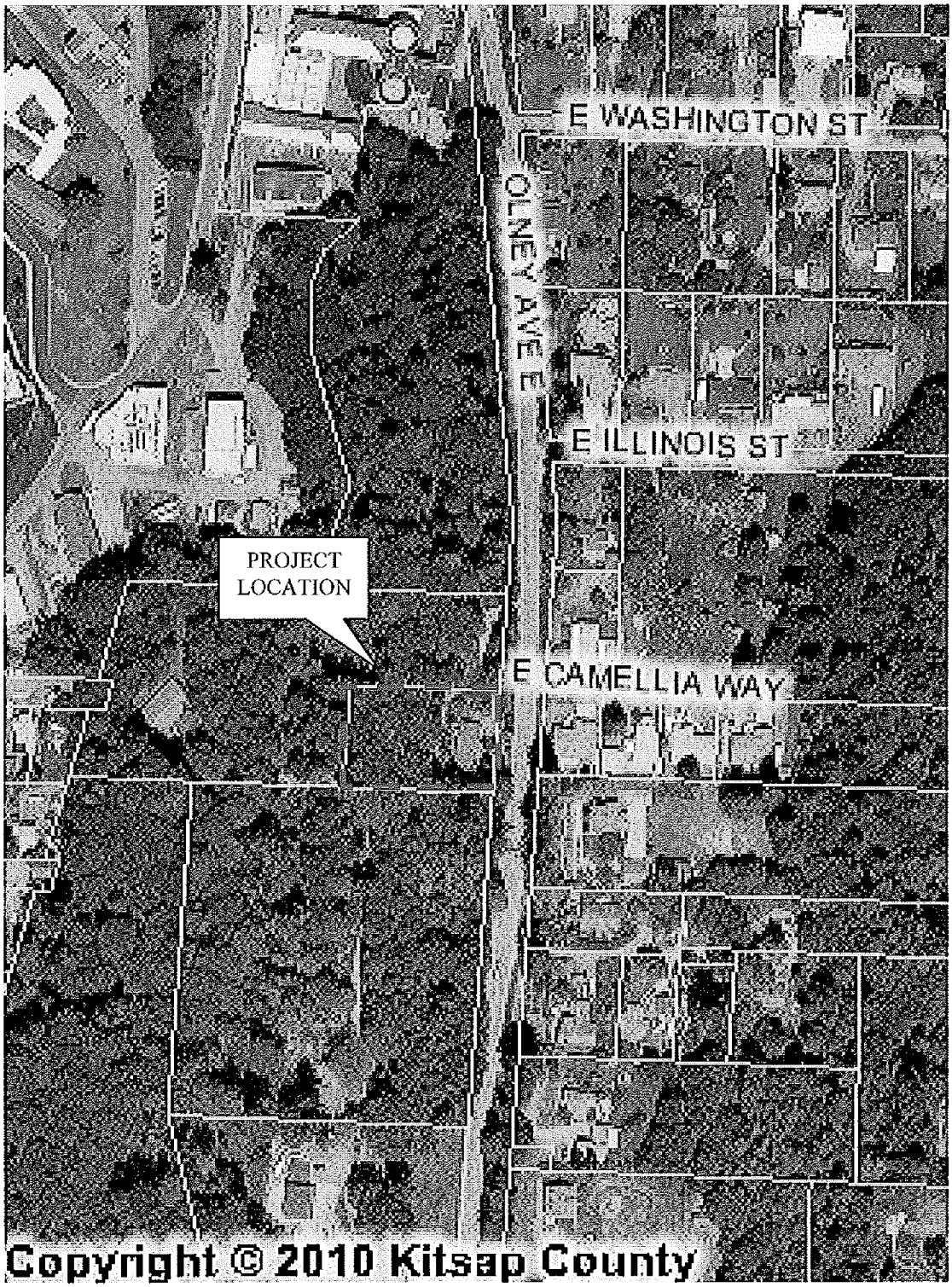
MICHAEL JOHN WOLCZKO
STATE OF WASHINGTON
31276
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 6/7/2011

6/3/2010

Attachments:

Figure 1 – Vicinity Map
Figure 2 – Site Plan

Appendix A – Test Pit Logs



ENVIROSOUND CONSULTING, INC.
3388 Byron Street NW Ste 200
Silverdale, WA 98383
360-698-5950

FIGURE 1. Site Vicinity Map
Project Name: Olney Road Slope
Location: Port Orchard, Washington
Client: Mr. Scott Raber
Date: 02/11/2010

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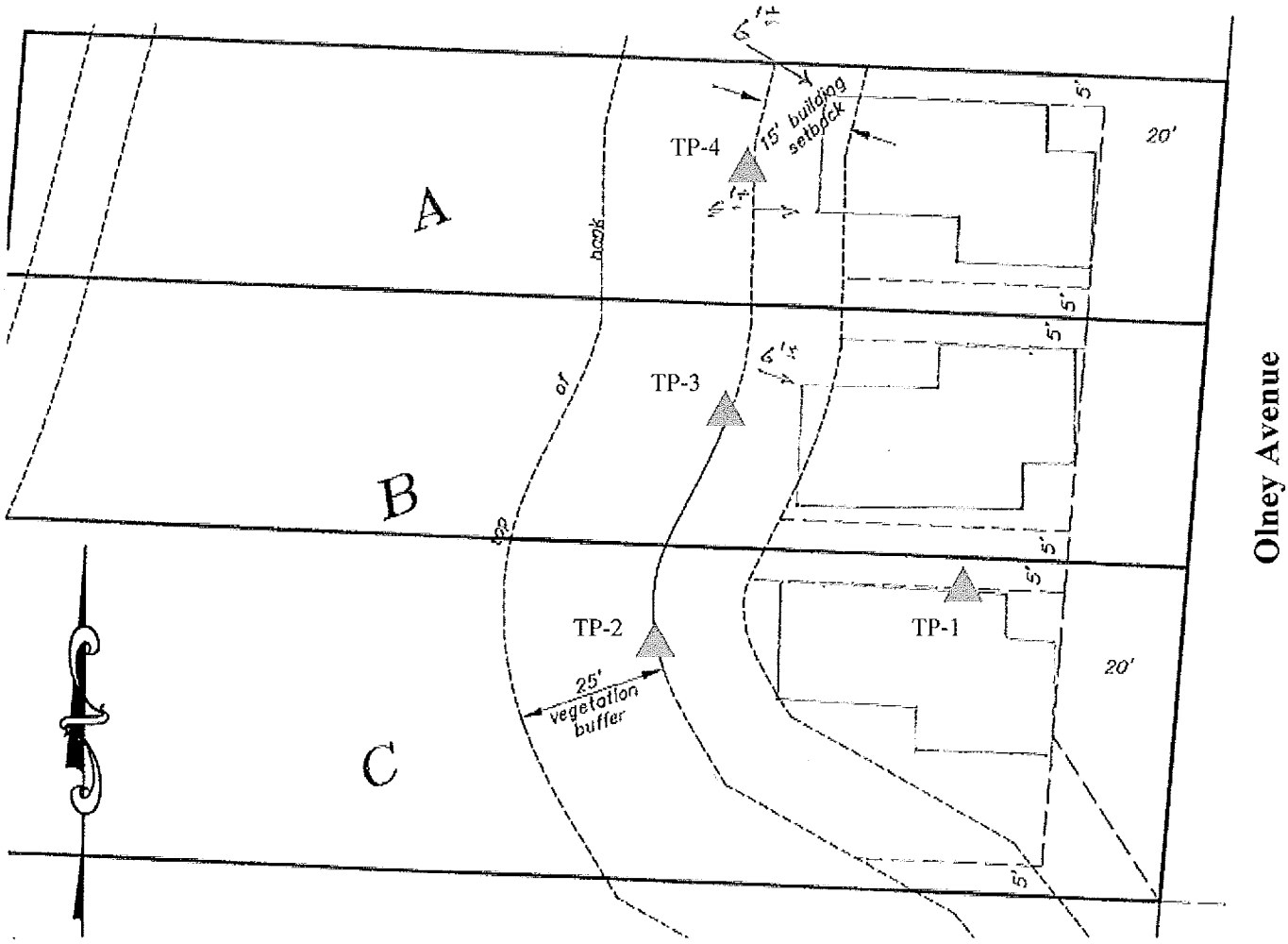

▲ **Approximate Test Pit locations**

Map adapted from figure provided by AES.

EnviroSound Consulting

FIGURE 2 Test Pit Location Map
Project Name: Raber Lots- Olney Ave
Location: Port Orchard, Washington
Project: ESC10-G011
Client: Mr. Scott Raber
Date: April 2010

TEST PIT TP- 1

Project Name: Raber Lots- Lot C
Client: Mr. Scott Raber
Project Number: ESC10-G011

Test Pit Elevation: @ 105'
Test Pit Location: upper plateau- Lot C
Depth to Groundwater: none encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-6" Brown, sandy SILT, moist 6" – 1.5' Tan, sandy SILT, moist, rootlets, medium dense 1.5' – 6.0' Gray slightly silty SAND (fine – medium) compact, trace silt seams	S-1	Grab	2.5	
5		6.0 – 7.0' Gray, silty fine SAND, compact, higher moisture content				
		TD 7.0' No sloughing No seepage				
10						
15						

Excavation Contractor: Ron Thomas
Excavation Equipment: Track hoe
Operator: Ron

Excavation Date: 04/13/10
ESC Representative: SEW

TEST PIT TP- 2

Project Name: Raber Lots- Lot C
Client: Mr. Scott Raber
Project Number: ESC10-G011

Test Pit Elevation: @ 98'
Test Pit Location: Lot C. 21' from top of slope
Depth to Groundwater: none encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-6" Dark brown sandy SILT, topsoil, moist, scattered roots 6" – 3' mottled tan and gray, fine to medium silty SAND, moist, medium dense				
		3' – 9' Gray-brown, medium dense, very silty SAND, (fine), moisture increases with depth	S-1	Grab	2.0	
5			S-2	Grab	4.0	
10		TD 9.0' No sloughing No seepage				
15						

Excavation Contractor: Ron Thomas
Excavation Equipment: Track hoe
Operator: Ron

Excavation Date: 04/13/10
ESC Representative: SEW
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TEST PIT TP- 3

Project Name: Raber Lots- Lot B
Client: Mr. Scott Raber
Project Number: ESC10-G011

Test Pit Elevation: @ 98'
Test Pit Location: Lot B, 18' from top of slope
Depth to Groundwater: none encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-6" dark brown topsoil, rootlets, moist 6" – 3.0' mottled tan-gray, fine to medium silty SAND, medium dense				
5		3.0 – 5.0' interbedded SAND with sandy-Silt, moist, compact 4.0' – 7.0' mottled tan and gray, sandy SILT, very moist, some oxide staining	S-1	Grab	4.0	
10		TD 7.0' No sloughing No seepage				
15						

Excavation Contractor: Ron Thomas
Excavation Equipment: Track hoe
Operator: Ron

Excavation Date: 04/13/10
ESC Representative: SEW
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TEST PIT TP- 4

Project Name: Raber Lots- Lot A
Client: Mr. Scott Raber
Project Number: ESC10-G011

Test Pit Elevation: @ 98'
Test Pit Location: Lot A
Depth to Groundwater: none encountered

DEPTH (FT.)	USGS Classification	VISUAL PHYSICAL DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE DEPTH (FT.)	LABORATORY TESTING RESULTS FOR SAMPLE
0		0-6" Dark brown, topsoil, sandy SILT, moist, rootlets 6" – 1.5' brownish-gray, sandy fine SILT, moist, compact, trace roots 1.5' – 3.0' gray, slightly silty, medium SAND, medium dense, moist				
		3.0' – 7.0' tan and gray, sandy SILT, compact, increased moisture with depth, at 4.5' scattered roots	S-1	Grab	3.0	
5						
		TD 7.0' No sloughing No seepage				
10						
15						

Excavation Contractor: Ron Thomas
Excavation Equipment: Track hoe
Operator: Ron

Excavation Date: 04/13/10
ESC Representative: SEW