GEOTECHNICAL REPORT

Pilchuck Landing
Smokey Point Boulevard
Marysville, Washington

Project No. T-5675

Terra Associates, Inc.

Prepared for:

Opus Northwest, LLC
Bellevue, Washington

March 2, 2005

TERRA ASSOCIATES, Inc.

Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

March 2, 2005
Project No. T-5675

Mr. Dick Wooden
Opus Northwest, LLC
915 – 118th Avenue SE, Suite 300
Bellevue, Washington 98005

Subject: Geotechnical Report
Pilchuck Landing
Smokey Point Boulevard
Marysville, Washington

Dear Mr. Wooden:

As requested, we have completed a geotechnical study for the subject project. The purpose of our study was to explore the subsurface soil and groundwater conditions and develop geotechnical engineering recommendations for project design and construction.

Our field exploration indicates that the site is generally underlain by loose to medium dense outwash soils. Groundwater was observed at depths of two to six feet below existing grade. In our opinion, the native soils on the site will be suitable for the proposed development, provided the recommendations presented in this report are incorporated into project design and construction.

We trust this information is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

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Geotechnical Report
Pilchuck Landing
Smokey Point Boulevard
Marysville, Washington

1.0 PROJECT DESCRIPTION

The approximately 40-acre assemblage of parcels is located between the Interstate 5 (I-5) corridor and Smokey Point Boulevard, north of 156th Street NE, in Marysville, Washington. As we understand, the north end of the site will be developed with an automotive dealership with service bays and a motorcycle sales company who will have a test track. The remaining southern site area will be developed with retail stores, with the possibility of a large "big box" anchor store. Structures will be single-story to two-story buildings constructed with pre-cast tilt up wall panels or CMU block. We expect floors will be constructed at grade at an elevation at or near existing site grades. Dock-high access may be provided at a few locations.

The recommendations contained in the following sections of this report are based upon our understanding of these design features. If actual features vary or changes are made, we should review them in order to modify our recommendations, as required. We should review final design drawings and specifications to verify that our recommendations have been properly interpreted and incorporated into project design.

2.0 SCOPE OF WORK

Our work was completed in accordance with our authorized proposal dated January 31, 2005. On February 11, 2005, we excavated 12 test pits to depths ranging from 8 to 10 feet below existing surface grades. In addition, we subcontracted with Northwest Cone Exploration to perform 6 Cone Penetration Tests (CPTs) to a maximum depth of 40 feet. Using the information obtained from these subsurface explorations, we developed geotechnical recommendations for project design and construction. Specifically, this report addresses the following:

- Soil and groundwater conditions
- Seismic
- Site preparation and grading
- Excavations
- Foundations
- Slab-on-grade support
- Earth pressure parameters for retaining wall design
- Drainage
- Utilities
- Pavements

It should be noted that recommendations outlined in this report regarding drainage are associated with soil strength, design earth pressures, erosion and stability. Design and performance issues with respect to moisture as it relates to the structure environment (i.e., humidity, mildew, mold) is beyond Terra Associates' purview. A building envelope specialist or contactor should be consulted to address these issues as needed.

3.0 SITE CONDITIONS

3.1 Surface

The project site is located west of Smokey Point Boulevard, and east of I-5 in Marysville, Washington. The approximate location of the site is shown on Figure 1. We were provided with a preliminary site development plan by Opus NW, dated December 16, 2005. Figure 2 is based on this site plan.

Currently, the southern portion of the site is occupied with several structures associated with the Marysville Livestock Auction (MLA). An approximately 400-foot long, 150-wide pond is located along the west property line, west of the MLA facilities. The northern one-half of the site is primarily open agricultural fields with two single-family residential structures. The site is relatively open with few trees, with the exception of a thick grove of trees south of the residence near the northwest property corner. The site lies within the Stilliquamish River flood plain.

3.2 Soils

In general, underlying a thin sod cover, the CPT and test pit explorations indicate the site is underlain with glacial outwash sediments. The soils encountered in the test pits consisted of loose to medium dense, fine- to coarse-grained sand with varying amounts of silt and gravel. The sands were generally moist in the upper two to six feet, and wet to water-bearing below that depth. Below this upper horizon, layers of medium dense silty sand grading to dense sand are predominant to the 40-foot termination depth of the CPTs. Interbedded thin layers of silt and sandy silt were also indicated in this lower soil profile. Shallow surface fills also composed of silty sand were observed at Test Pits TP-11 and TP-12 to depths of two to three feet in the southern developed portion of the site.

The *Geologic Map of the Arlington West Quadrangle, Snohomish County, Washington*, by James P. Minard (1985), maps the soils in the vicinity of the site belonging to the Marysville Sand Member (Qvrm) of the Vashon recessional outwash. These soils are classified as well-drained sand with fine gravel. The soils we observed in the test pits, and indicated by the CPTs, are consistent with the mapped description.

The preceding discussion is intended as a general review of the soil conditions encountered. For more complete descriptions, please refer to the Test Pit and CPT Logs attached in Appendix A.

3.3 Groundwater

At the time of our exploration, the static groundwater table was indicated at a depth of about four to six feet below existing surface grades. We installed slotted, two-inch diameter PVC pipes in six of the test pits to allow for monitoring groundwater levels. Water level readings at these wells obtained on February 23, 2005, indicated a static water level at a depth of about three feet. Fluctuations in the static groundwater level will occur seasonally, and will reach maximum levels during and shortly following the wet winter months.

4.0 GEOLOGIC HAZARDS

4.1 Seismic

Based on the results of our field exploration and our knowledge of the area geology, per Chapter 16 of the 2003 International Building Code (IBC), Site Class "C" should be used in structural design.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations. Liquefaction mainly affects geologically recent deposits of loose, fine-grained sand and silty sand underlying the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction; thus, eliminating the soil's strength.

As described earlier, our subsurface exploration indicates that the soils at the site consist of glacial recessional outwash sands. The static groundwater table is shallow, residing at a depth of about three feet below current surface elevations. CPT data indicates that the outwash sand layers below the water table exhibit relative densities in the medium dense to very dense range. Due to the dense nature of the sand formation, analysis indicates it will be resistant to liquefaction during a design magnitude earthquake. Based on analysis, in our opinion, the risk for soil liquefaction to occur at the site and its associated hazard are low.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

Based on our study, there are no geotechnical conditions that would preclude development of the site as planned. The primary geotechnical consideration for site design and building construction is the shallow groundwater table. To reduce impacts associated with the shallow water table, building grades should be designed as high as practical. At minimum, finished floor and pavement grades should be at or near existing site elevations. Below-grade structures will need to be designed to account for hydrostatic pressures, or provided with adequate drainage to prevent hydrostatic loading. Dewatering by well point or deep pump wells will be necessary to facilitate excavations for installation of below-grade structures and utilities. The need for and extent of dewatering will depend on the depth of the structure or utility and the time of year construction will occur. The groundwater table will likely recede to a depth of five to six feet below current site elevations during the normally dry summer season.

Buildings can be supported on conventional spread footings bearing on competent native soils below the surface layer of organic topsoil and sod. Alternatively, if required by desired final building elevations, structural fill placed and compacted above these native soils can be used to support the building foundations. Floor slabs and pavements can be similarly supported.

The near-surface native soils encountered at the site to a depth of about five feet contain a sufficient amount of soil fines that will make them difficult to compact as structural fill when too wet or dry. The ability to use the upper native soils from site excavations as structural fill will depend on its moisture content and the prevailing weather conditions at the time of construction. The earthwork contractor should be prepared to dry the native soils by aeration during the normally dry summer season to facilitate compaction as structural fill. Alternatively, stabilizing the moisture in the native soil with cement kiln dust (CKD), cement, or lime can be considered. In general, the native outwash below the upper five-foot soil horizon is relatively free of fines and could be used during most weather conditions as structural fill or backfill.

The following sections provide detailed recommendations regarding these issues and other geotechnical design considerations. These recommendations should be incorporated into the final design drawings and construction specifications.

5.2 Site Preparation and Grading

To prepare the site for construction, all vegetation, organic surface soils, and other deleterious materials should be stripped and removed from the site. Surface stripping depths of about 12 inches should be expected to remove the sod/organic topsoil layer in the northern open field areas. In the developed MLA portion of the site, removal of surface organic materials will be required in the livestock holding areas. Stripped vegetation debris should be removed from the site. Organic topsoil will not be suitable for use as structural fill but may be used for limited depths in non-structural areas or for landscaping purposes.

Demolition of existing structures should include removal of all foundations from below areas of new construction. Depending on final building grades, it may be possible to leave floor slabs and pavement in place provided it is fractured or broken up in place prior to filling over. Existing site utilities that are abandoned should be removed from below new foundation construction. Elsewhere, the abandoned pipes can be left in place provided they are plugged or sealed to prevent water and soil intrusion.

Once clearing and grubbing operations are complete, grading to establish desired building grades can be initiated. In order to achieve proper compaction of the building fill, the native subgrade must be in a relatively stable condition. If excessively soft and yielding subgrade is observed and it cannot be stabilized in place by aeration and compaction, stabilizing by the use of an additive, such as cement, CKD, or lime will need to be considered. Alternatively, the unstable soils can be excavated and replaced with clean granular structural fill. Typically, stabilization of soft yielding soils that, because of excess moisture cannot be stabilized in place, requires amending or otherwise removing and replacing affected soils to a depth of 12 to 18 inches.

To construct suitable support for pavements, we recommend constructing a soil cement base (SCB) using the native soils. Based on our experience, native soils should be blended with Type I Portland cement at a rate of .75 pounds per square foot of surface area per inch of depth, moisture conditioned as necessary, and then compacted as structural fill. The soil cement should be tested to determine its compressive strength. A minimum 28-day compressive strength of 200 pounds per square inch (psi) is recommended. Recommended thickness of the SCB is discussed in the pavement section.

If grading activities are planned during the wet winter months, and the on-site soils become too wet to achieve adequate compaction, the owner or contractor should be prepared to treat soils with CKD, lime, or cement, or import wet weather structural fill. For wet weather structural fill, we recommend importing a granular soil that meets the following grading requirements:

U.S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

*Based on the 3/4-inch fraction.

Prior to use, Terra Associates, Inc., should examine and test all materials to be imported to the site for use as structural fill. If the building subgrade is constructed using native soils and will be exposed during wet weather, it would be advisable to place 12 inches of this granular structural fill on the building pad to prevent deterioration of the floor subgrade.

Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-698 (Standard Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this same ASTM standard. In non-structural areas, or for backfill in utility trenches below a depth of 4 feet, the degree of compaction can be reduced to 90 percent.

5.3 Excavations

All excavations at the site associated with confined spaces, such as utility trenches and lower building levels, must be completed in accordance with local, state, or federal requirements. Based on current Occupational Safety and Health Administration (OSHA) regulations, soils found on the project site would be classified as Group C soils.

For properly dewatered excavations more than 4 feet but less than 20 feet in depth, the side slopes should be laid back at a minimum slope inclination of 1.5:1 (Horizontal:Vertical). If there is insufficient room to complete the excavations in this manner, or if excavations greater than 20 feet in depth are planned, using temporary shoring to support the excavations may need to be considered. Utility trench sidewalls can be supported by a properly designed and installed shoring trench box.

Groundwater should be anticipated within excavations extending to depths of three feet and greater below existing surface grades. For excavations below six feet, the volume of water and rate of flow into the excavation may be significant, and dewatering of the excavations will be necessary. Shallow excavations that do not extend more than one to two feet below the groundwater table can likely be dewatered by conventional sump pumping procedures, along with a system of collection trenches. Deeper excavation will require dewatering by well points or isolated deep-pump wells. The utility subcontractor should be prepared to implement excavation dewatering by well point or deep-pump wells, as needed. This will be an especially critical consideration for deep utility excavations that will likely be required to tie into existing utilities along Smokey Point Boulevard.

This information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that Terra Associates, Inc., assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

5.4 Foundations

The buildings may be supported on conventional spread footing foundations bearing on competent native soils or on structural fill placed above competent native soils. Foundation subgrade should be prepared as recommended in Section 5.2 of this report. Perimeter foundations exposed to the weather should bear at a minimum depth of 1.5 feet below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab.

Foundations supported on undisturbed bearing surfaces composed of native soil or structural fill can be dimensioned for a net allowable bearing capacity of 2,000 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used. With structural loading as anticipated and these bearing stresses applied, estimated total foundation settlement ranges from one-half to one inch.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the sides of the footings can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 300 pounds per cubic foot (pcf). We do not recommend including the upper 12 inches of soil in this computation because it can be affected by weather or disturbed by future grading activity. This value assumes the foundation will be backfilled with structural fill, as described in Section 5.2 of this report. The values recommended include a safety factor of 1.5.

5.5 Retaining Walls

The magnitude of earth pressure development on retaining walls will partly depend on the quality of backfill. We recommend placing and compacting wall backfill as structural fill. To guard against the buildup of hydrostatic pressure, wall drainage must also be installed. A typical wall drainage detail is attached as Figure 3.

With granular backfill placed and compacted as recommended and drainage properly installed, we recommend designing unrestrained retaining walls for an active earth pressure equivalent to a fluid weighing 35 pcf. For restrained conditions, an additional uniform pressure equivalent to 100 psf should be applied and included in the wall loading calculations. For below-grade walls, such as utility vaults, if it is not possible to effectively drain the walls, they should be designed to support an equivalent fluid weight of 90 pcf. When required, to account for traffic surcharge, the walls should be designed for an additional height of two feet.

Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 5.5 of this report.

5.6 Slab-on-Grade Floors

Slabs-on-grade may be supported on the subgrade prepared as recommended in Section 5.2 of this report. Immediately below the floor slab, we recommend placing a four-inch thick capillary break layer composed of coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and aid in uniform curing of the concrete slab. It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will be ineffective in assisting in uniform curing of the slab and can actually serve as a water supply for moisture transmission through the slab, and affecting floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained.

Other methods are available for preventing or reducing water vapor transmission through the slab. We recommend consulting with building envelope specialist or contractor for additional assistance regarding this issue.

5.7 Drainage

Surface

Final exterior grades should promote free and positive drainage away from the site at all times. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building areas. We recommend providing a gradient of at least three percent for a minimum distance of ten feet from the building perimeters, except in paved locations. In paved locations, a minimum gradient of two percent should be provided, unless provisions are included for collection and disposal of surface water adjacent to the structure.

Subsurface

In our opinion, with pavement surfaces extending up to the building perimeter and surface drainage controlled by positive sloping away from the building, or by storm sewer installations, perimeter foundation drains would not be required.

5.8 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Associates (APWA) specifications. As a minimum, trench backfill should be placed and compacted as structural fill as described in Section 5.2 of this report. At the time of our study, the soil's moisture content was above optimum; therefore, drying back or other means to condition the material will probably be necessary to facilitate proper compaction. If utility construction takes place during the winter, it may be necessary to import suitable wet weather fill for utility trench backfilling. Also, due to the high groundwater table, any trench excavation deeper than four feet will likely require dewatering.

Hydrostatic uplift forces will need to be considered for below-grade structures, such as utility vaults or buried tanks. For design, the groundwater table should be assumed equivalent to existing surface grade. Resistance to uplift will be provided by the weight of the structure itself and the weight of the backfill soil. For backfill that is compacted to structural fill requirements, a soil unit weight of 115 pcf can be used.

5.9 Pavements

In order to prepare a stable subgrade and pavement base, we recommend using a soil cement application as discussed in Section 5.2 of this report. The cement should be blended uniformly with the native soil, with the mixture also moisture conditioned as necessary. The soil cement moisture should be within –1 to +2 percent of optimum, as determined by ASTM Test Designation D-698 (Standard Proctor) prior to compaction. Once blended and conditioned, the soil cement should be compacted to a minimum of 95 percent of its maximum dry density, as determined by this ASTM standard. The soil cement should achieve a minimum 28-day compressive strength of 200 pounds per square inch (psi).

Initial compaction of the soil cement should be accomplished with a sheep's foot compactor. Once compacted, rough grading can be completed with final compaction achieved using a steel-drum roller. Compaction and rough grading should be completed within a three-hour time period following application and blending of the cement with the soil.

After grading and compaction, traffic on the soil cement base should be kept at a minimum for at least three days to allow the base to cure and gain its initial compressive strength. Pavement construction should then be completed shortly following this initial curing period. During this time period, and up to when pavement surfaces are constructed, the SCB must be kept moist and not allowed to dry excessively. If needed, maintaining a moist surface by watering with a water truck is recommended. If the soil cement base will not be paved over following initial curing, and traffic will traverse the base, we recommend placing a two-inch thick layer of crushed rock over the SCB to reduce surface degradation.

Quality control during construction of the soil cement base should include verifications of the following:

- Cement application rate
- Thickness
- Moisture and compaction
- Compressive strength

A minimum of three test specimens from the same soil cement sample should be prepared for compressive strength testing for each day's construction.

We expect traffic at the facility will consist of cars and light trucks, along with occasional heavy traffic in the form of tractor-trailer rigs. For design considerations, we have assumed traffic in parking and in car/light truck access pavement areas can be represented by an 18-kip Equivalent Single Axle Loading (ESAL) of 50,000 over a 20-year design life. For heavy traffic pavement areas, we have assumed and ESAL of 300,000 would be representative of the expected loading. These ESALs represent loading equivalent to 3 and 18, loaded (80,000 pound GVW) tractor-trailer rigs traversing the pavement daily in each area, respectively.

Based on these traffic loading assumptions, we recommend the following pavement sections be constructed:

Light traffic and parking:

- Three inches of asphalt concrete (AC) over eight inches of SCB

Heavy traffic:

- Three inches of AC over 12 inches of SCB

Asphalt concrete should meet the requirements for ½-inch HMA mix, as outlined in Washington State Department of Transportation's (WSDOT) standard specifications. Asphalt-treated base and crushed rock base should also meet WSDOT requirements.

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability. For optimum pavement performance, we recommend surface drainage gradients of at least two percent. Some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

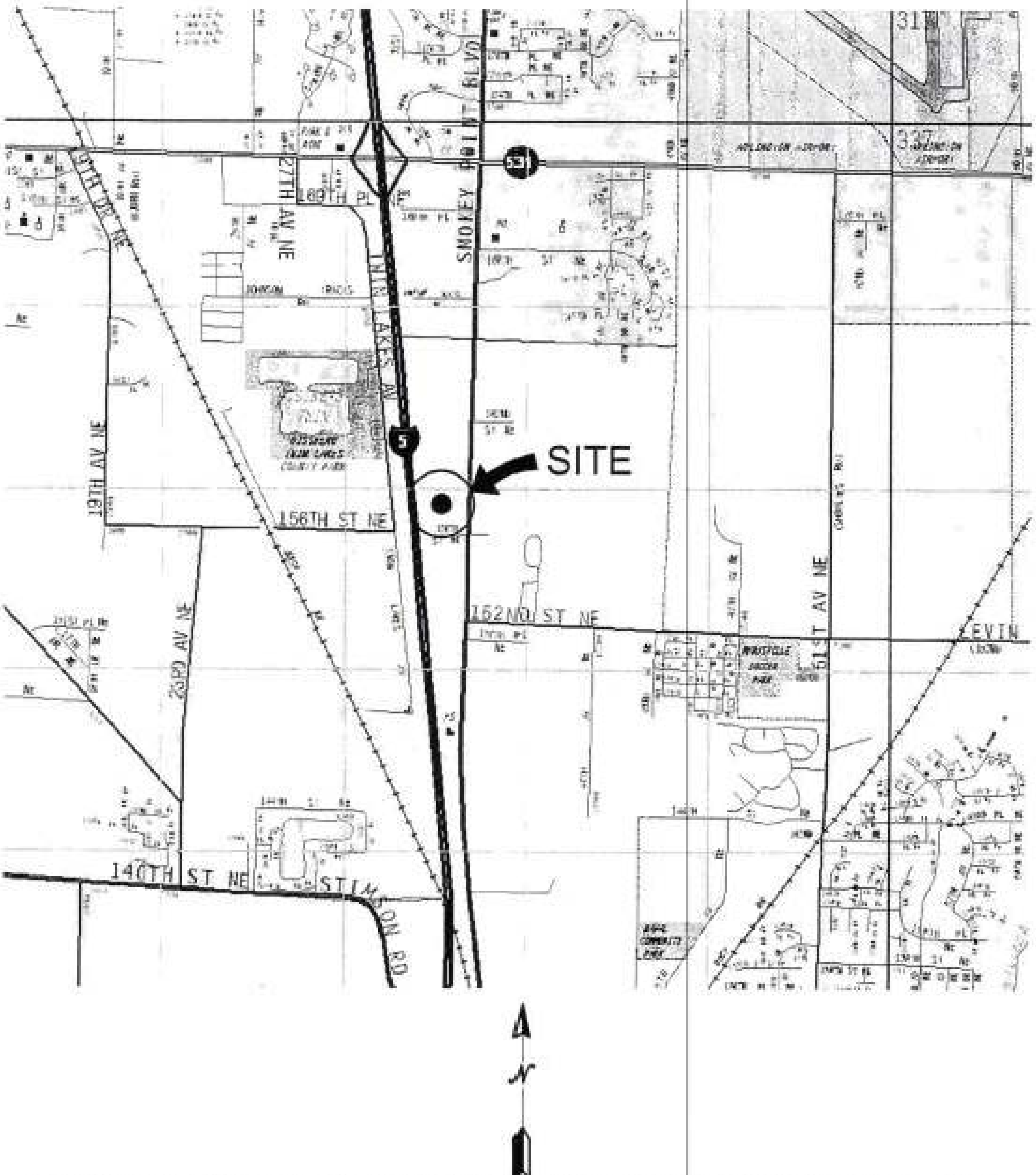
6.0 ADDITIONAL SERVICES

Terra Associates, Inc., should review final designs and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and implemented into project design. We should also provide geotechnical services during construction in order to observe compliance with the design concepts, specifications, and recommendations. This will allow for design changes if subsurface conditions differ from those anticipated prior to the start of construction.

7.0 LIMITATIONS

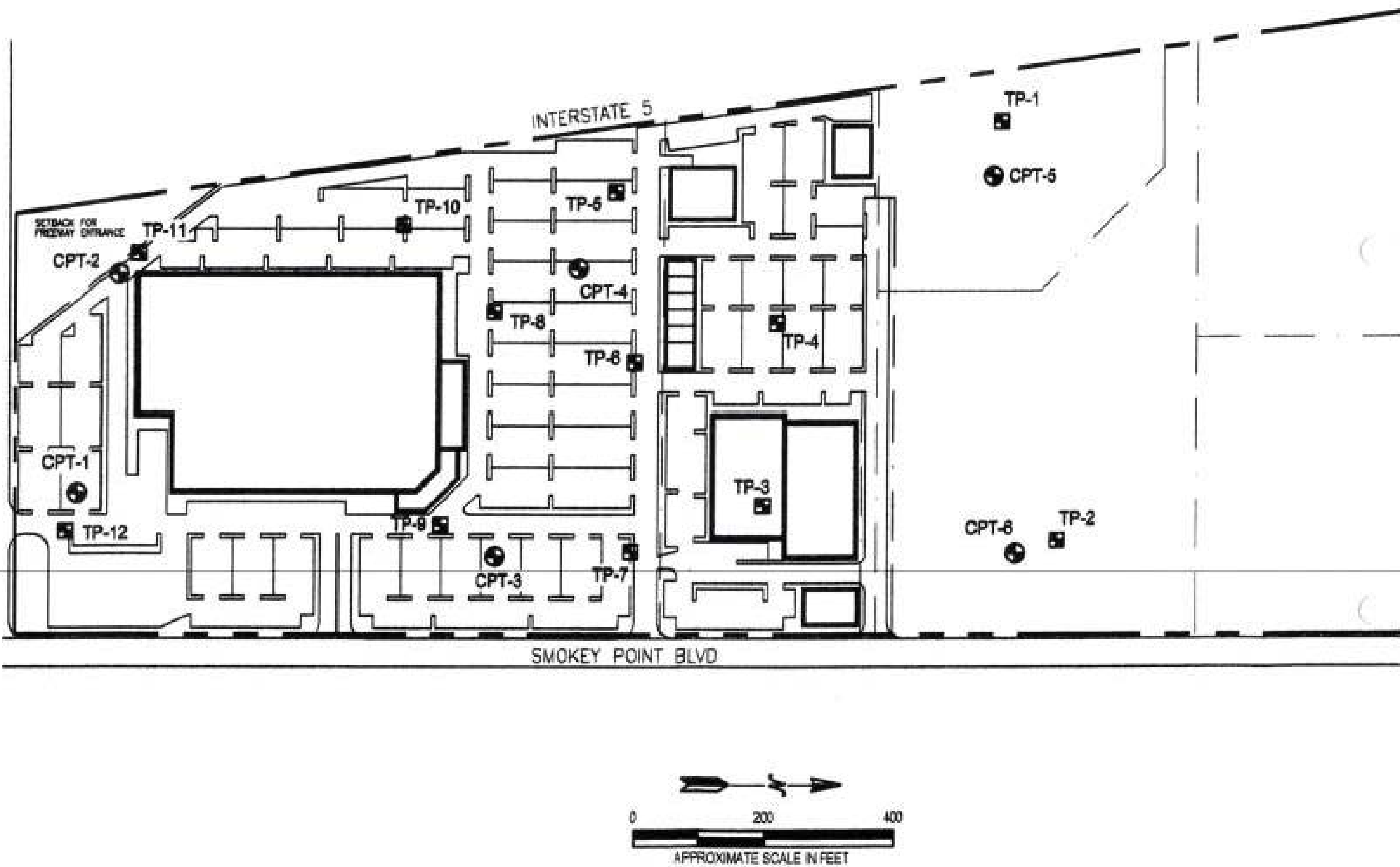
This report is the property of Terra Associates, Inc., and was prepared in accordance with generally accepted geotechnical engineering practices. This report is intended for specific application to the Pilchuck Landing project in Marysville, Washington, and for the exclusive use of Opus NW, LLC and their authorized representatives. No other warranty, expressed or implied, is made.

The analyses and recommendations presented in this report are based upon data obtained from the test pits excavated on-site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, Terra Associates, Inc., should be requested to reevaluate the recommendations in this report prior to proceeding with construction.



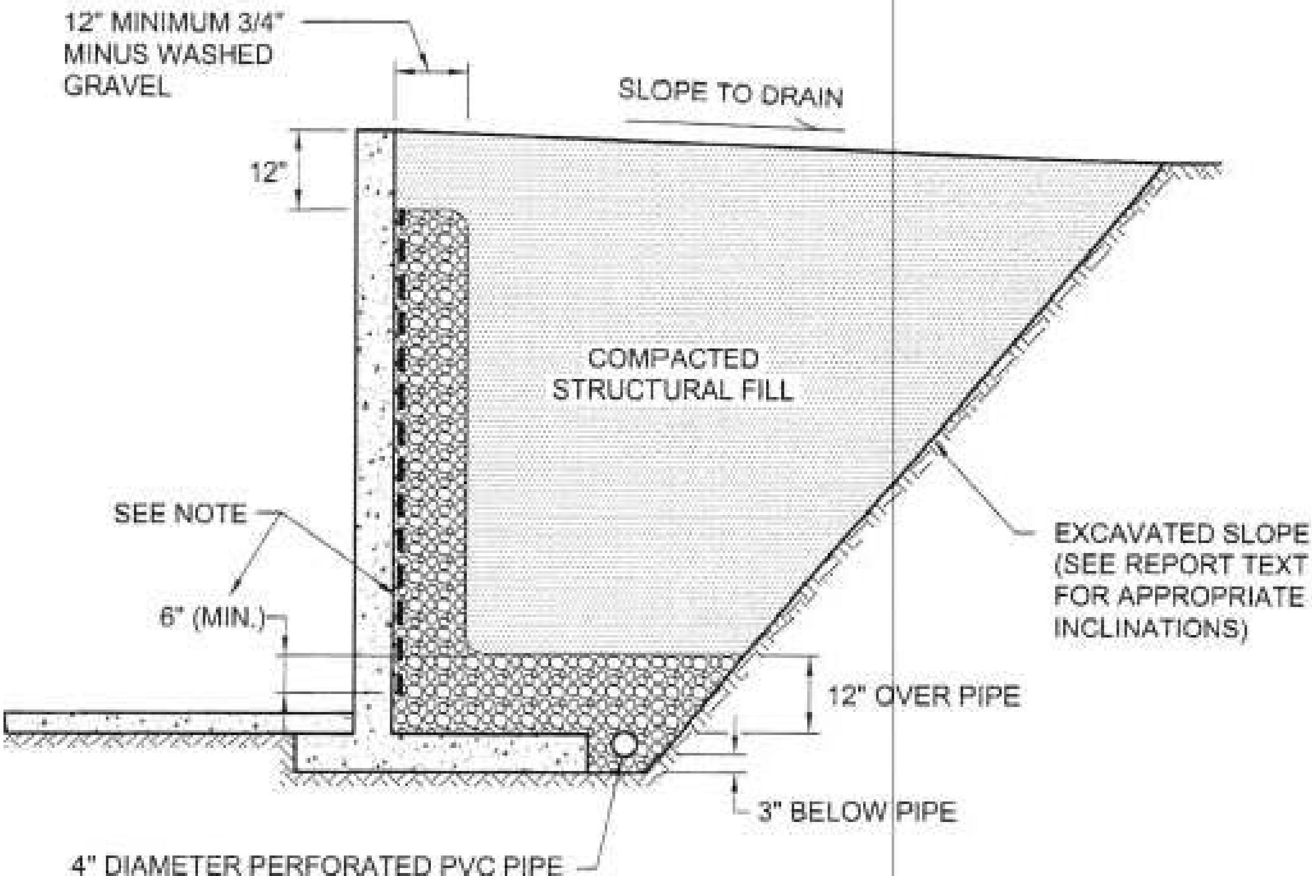
REFERENCE: THOMAS GUIDE, CD-ROM, KING/PIERCE/SNOHOMISH COUNTIES, 2004   NOT TO SCALE

Terra Associates, Inc. Consultants in Geotechnical Engineering Geology and Environmental Earth Sciences	VICINITY MAP PILCHUCK LANDING MARYSVILLE, WASHINGTON		
	Proj. No. T-5675	Date MAR 2005	Figure 1



INTERSTATE 5
SMOKEY POINT BLVD
SETBACK FOR FREEWAY ENTRANCE
TP-1
CPT-5
TP-2
CPT-6
TP-3
TP-4
TP-5
CPT-4
TP-8
TP-6
TP-7
CPT-3
TP-9
TP-10
TP-11
CPT-2
CPT-1
TP-12
0
200
400
APPROXIMATE SCALE IN FEET

LEGEND:



NOT TO SCALE

NOTE:

MIRADRAIN G100N PREFABRICATED DRAINAGE PANELS OR SIMILAR PRODUCT CAN BE SUBSTITUTED FOR THE 12-INCH WIDE GRAVEL DRAIN BEHIND WALL. DRAINAGE PANELS SHOULD EXTEND A MINIMUM OF SIX INCHES INTO 12-INCH THICK DRAINAGE GRAVEL LAYER OVER PERFORATED DRAIN PIPE.

Terra Associates, Inc. Consultants in Geotechnical Engineering Geology and Environmental Earth Sciences	TYPICAL WALL DRAINAGE DETAIL PILCHUCK LANDING MARYSVILLE, WASHINGTON		
	Proj. No. T-5675	Date MAR 2005	Figure 3

APPENDIX A
FIELD EXPLORATION

Pilchuck Landing
Marysville, Washington

On February 11, 2005, we performed our field exploration using a rubber-tired backhoe. We explored subsurface soil conditions at the site by excavating 12 test pits to a maximum depth of 10 feet below existing surface grades. On February 16, 2005, we also explored subsurface conditions at the site by performing six CPTs. Northwest Cone Exploration (NWC) under subcontract with Terra Associates, Inc. performed the CPTs at locations selected by Terra Associates, Inc. The CPTs were advanced to depths of 40 feet below the surface. The CPT and test pit locations were determined in the field by pacing measurements from existing site features. The approximate CPT and test pit locations are shown on Figure 2.

In the CPT, an instrumented approximately 1 ½-inch diameter cone is pushed into the ground at a constant rate. During advancement, continuous measurements are made of the resistance to penetration of the cone and the friction of the outer surface of a sleeve. The cone is also equipped with a porous filter and a pressure transducer for measuring groundwater or pore water pressure generated. Measurements of tip and sleeve frictional resistance, pore pressure, and interpreted soil conditions are summarized in graphical form on the attached CPT logs.

An engineering geologist from our office observed the test pit excavations and classified the soil conditions encountered, maintained a log of each test pit, obtained representative soil samples, and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described on Figure A-1. The test pit logs are presented on Figures A-2 through A-7.

Representative soil samples obtained from the test pits were placed in closed containers and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the Test Pit Logs. Grain size analyses were performed on six of the samples, the results of which are shown on Figures A-8 through A-10.

MAJOR DIVISIONS				LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	More than 50% material larger than No. 200 sieve size	GRAVELS More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
			Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
		SANDS More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines.
				SP	Poorly-graded sands or gravelly sands, little or no fines.
			Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines.
				SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS	More than 50% material smaller than No. 200 sieve size	SILTS AND CLAYS Liquid limit is less than 50%		ML	Inorganic silts, rock flour, clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity, (lean clay).
				OL	Organic silts and organic clays of low plasticity.
		SILTS AND CLAYS Liquid limit is greater than 50%		MH	Inorganic silts, elastic.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of high plasticity.
HIGHLY ORGANIC SOILS				PT	Peat.

DEFINITION OF TERMS AND SYMBOLS

COHESIONLESS

Density	Standard Penetration Resistance in Blows/Foot
Very loose	0-4
Loose	4-10
Medium dense	10-30
Dense	30-50
Very dense	>50

COHESIVE

Consistency	Standard Penetration Resistance in Blows/Foot
Very soft	0-2
Soft	2-4
Medium stiff	4-8
Stiff	8-16
Very stiff	16-32
Hard	>32

Symbol	Definition
I	2" OUTSIDE DIAMETER SPLIT SPOON SAMPLER
I	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
▼	WATER LEVEL (DATE)
Tr	TORVANE READINGS, tsf
Pp	PENETROMETER READING, tsf
DD	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot

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Environmental Earth Sciences

UNIFIED SOIL CLASSIFICATION SYSTEM
PILCHUCK LANDING
MARYSVILLE, WASHINGTON

Proj. No. T-5675 | Date MAR 2005 | Figure A-1

Test Pit No. TP-1

Logged by: DPL

Date: 2/11/05

Approximate Elev.

Depth (ft.)	Soil Description	Moisture Content (%)	
0	(6 inches TOPSOIL/SOD) Reddish-brown silty SAND, fine grained, loose to medium dense, moist to wet. (SM)	23.5	
	Grayish-brown to gray silty SAND to SAND with silt, fine grained, medium dense, moist. (SM/SP)	23.0	
5	Gray SAND, fine to coarse grained, medium dense, wet. (SP)	21.8 19.4	▼
10	Test pit terminated at 9 feet. Moderate groundwater seepage observed at 6 feet. Test pit sidewalls easily caved. 2-inch slotted pvc standpipe installed.		
15			

Test Pit No. TP-2

Logged by: DPL

Date: 2/11/05

Approximate Elev.

Depth (ft.)	Soil Description	Moisture Content (%)	
0	(12 inches TOPSOIL/SOD)		
	Reddish-brown silty SAND, fine grained, medium dense, moist. (SM)	18.4 21.8	
5	Grayish-brown to gray SAND with silt to clean SAND, fine grained, medium dense, moist to wet. (SP)	25.3 23.6 24.3	▼
10	Test pit terminated at 10 feet. Moderate groundwater seepage observed at 6.5 feet. Test pit sidewalls easily caved.		
15			

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TEST PIT LOGS
PILCHUCK LANDING
MARYSVILLE, WASHINGTON

Proj. No. T-5675	Date MAR 2005	Figure A-2

Test Pit No. TP-3

Logged by: DPL

Approximate Elev.

Date: 2/11/05

Soil Description	Moisture Content (%)	
(12 inches TOPSOIL/SOD)		
Reddish-brown silty SAND, fine grained, medium dense, moist. (SM)	25.6	
Grayish-brown to gray SAND with silt, fine grained, medium dense, moist. (SM/SP)	25.3 20.7	▼
Gray SAND, fine to coarse grained, trace gravel, medium desne, wet. (SP)	23.4 21.3	

Depth (ft.): 0, 5, 10, 15

Test pit terminated at 10 feet.
Moderate groundwater seepage observed at 6 feet.
Test pit sidewalls easily caved.

Test Pit No. TP-4

Logged by: DPL

Approximate Elev.

Date: 2/11/05

Soil Description	Moisture Content (%)	
(12 inches TOPSOIL/SOD)		
Reddish-brown silty SAND, fine grained, medium dense, moist to wet. (SM)		
Gray SAND with some silt, fine grained, medium dense, wet. (SP)	22.4 23.1	▼
Gray SAND with gravel, fine to coarse grained, medium dense, wet. (SP)	14.5	

Depth (ft.): 0, 5, 10, 15

Test pit terminated at 10 feet.
Moderate groundwater seepage observed at 6 feet.
Test pit sidewalls easily caved.
2-inch slotted pvc standpipe installed.

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PILCHUCK LANDING
MARYSVILLE, WASHINGTON

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Test Pit No. TP-5

Logged by: DPL

Approximate Elev.

Date: 2/11/05

Depth (ft.)	Soil Description	Moisture Content (%)	
0	(12 inches TOPSOIL/SOD)		
	Reddish-brown silty SAND, fine grained, medium dense, wet. (SM)		
	Grayish-brown sandy clayey SILT, medium stiff, wet. (ML)	27.4	
	Reddish-brown sandy clayey SILT, soft, wet. (ML)	43.7	▼
5	Gray SAND, fine grained, medium dense, wet. (SP)	26.3	
	Gray SAND with gravel, fine to coarse grained, medium dense, wet. (SP)	13.7	
10	Test pit terminated at 8 feet. Moderate groundwater seepage observed at 4.5 feet. Test pit sidewalls easily caved.		
15			

Test Pit No. TP-6

Logged by: DPL

Approximate Elev.

Date: 2/11/05

Depth (ft.)	Soil Description	Moisture Content (%)	
0	(12 inches TOPSOIL/SOD)		
	Reddish-brown silty SAND, fine grained, medium dense, moist to wet. (SM)	29.1	
5	Gray SAND, fine grained, medium dense, moist. (SP)	21.8	▼
	Gray SAND with some gravel, fine to coarse grained, medium dense, wet. (SP)	19.9	
10	Test pit terminated at 10 feet. Moderate to heavy groundwater seepage observed at 6 feet. Test pit sidewalls easily caved.		
15			

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TEST PIT LOGS
PILCHUCK LANDING
MARYSVILLE, WASHINGTON

Proj. No. T-5675	Date MAR 2005	Figure A-4

Test Pit No. TP-7

Logged by: DPL

Approximate Elev.

Date: 2/11/05

Depth (ft.)	Soil Description	Moisture Content (%)	
0	(12 inches TOPSOIL/SOD)		
	Reddish-brown silty SAND, fine grained, medium dense, moist. (SM)	15.2	
	Gray SAND, fine grained, medium dense, moist. (SP)	21.5	
5		25.6	▼
	Trace coarse sand grains below 8 feet.	24.7	
10	Test pit terminated at 10 feet. Moderate groundwater seepage observed at 6.5 feet. Test pit sidewalls easily caved. 2-inch slottted pvc standpipe installed.		
15			

Test Pit No. TP-8

Logged by: DPL

Approximate Elev.

Date: 2/11/05

Depth (ft.)	Soil Description	Moisture Content (%)	
0	(12 inches TOPSOIL/SOD)		
	Reddish-brown silty SAND, fine grained, medium dense, moist. (SM)	20.1	
	Grayish-brown to gray SAND with silt to clean SAND, fine grained, medium dense, moist to wet. (SP)	20.4	▼
5	Trace gravel and coarse sand grairs below 6 feet.	15.9	
		19.2	
10	Test pit terminated at 9 feet. Moderate groundwater seepage observed at 5 feet. Test pit sidewalls easily caved. 2-inch slotted pvc standpipe installed.		
15			

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TEST PIT LOGS
PILCHUCK LANDING
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Test Pit No. TP-9

Logged by: DPL

Date: 2/11/05

Approximate Elev.

Depth (ft.)	Soil Description	Moisture Content (%)	
0–1	(12 inches TOPSOIL/SOD)		
1–5	Brown to reddish-brown silty SAND fine grained, medium dense, moist to wet. (SM)	19.8 28.2	
5–10	Gray SAND, fine grained, medium dense, trace gravel below 7 feet, moist to wet. (SP)	20.1 23.9	▼

Test pit terminated at 10 feet.
Moderate groundwater seepage observed at 5.5 feet.
Test pit sidwalls easily caved.

Test Pit No. TP-10

Logged by: DPL

Date: 2/11/05

Approximate Elev.

Depth (ft.)	Soil Description	Moisture Content (%)	
0–1	(12 inches TOPSOIL/SOD)		
1–2	Reddish-brown silty SAND, fine grained, medium dense, wet. (SM)		
2–4	Grayish-brown to gray silty SAND to SAND with silt, fine grained, medium dense, moist. (SM)	17.1	▼
4–10	Gray SAND, fine grained, medium dense, trace gravel, fine to coarse grained below 8 feet, moist to wet. (SP)	20.9 23.7 20.2	

Test pit terminated at 10 feet.
Moderate groundwater seepage observed at 4.5 feet.
Test pit sidewalls easily caved.
2-inch slotted pvc standpipe installed.

Test Pit No. TP-11

Logged by: DPL

Date: 2/11/05

Approximate Elev.

Depth (ft.)	Soil Description	Moisture Content (%)	
0	FILL: brown to dark brown silty sand with some gravel, loose, wet. (6 inches TOPSOIL layer at 1.5 to 2 feet)		
	Bluish-gray silty SAND, fine grained, medium dense, moist. (SM)	22.7	
5	Brown silty SAND, fine grained, medium dense, wet. (SM)	29.8	
	Gray SAND, fine to coarse grained, trace gravel, medium dense, wet. (SP)	22.5 14.6	▼
10			

Test pit terminated at 10 feet.
Moderate groundwater seepage observed at 6.5 feet.
Test pit sidewalls easily caved.
2-inch slotted pvc standpipe installed.

15

Test Pit No. TP-12

Logged by: DPL

Date: 2/11/05

Approximate Elev.

Depth (ft.)	Soil Description	Moisture Content (%)	
0	FILL: gray silty sandy gravel, fine grained, medium dense, moist.		
	FILL: brown to tan brown silty sand, fine grained, medium dense, moist.	15.9	
	Reddish-brown silty SAND, fine grained, iron stained, medium dense, wet. (SP)	43.4	▼
5	Gray SAND, fine to coarse grained, medium dense, moist to wet. (SP)	15.9	

Test pit terminated at 8 feet.
Heavy groundwater seepage observed at 4 feet.
Test pit sidewalls easily caved.

10

15

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TEST PIT LOGS
PILCHUCK LANDING
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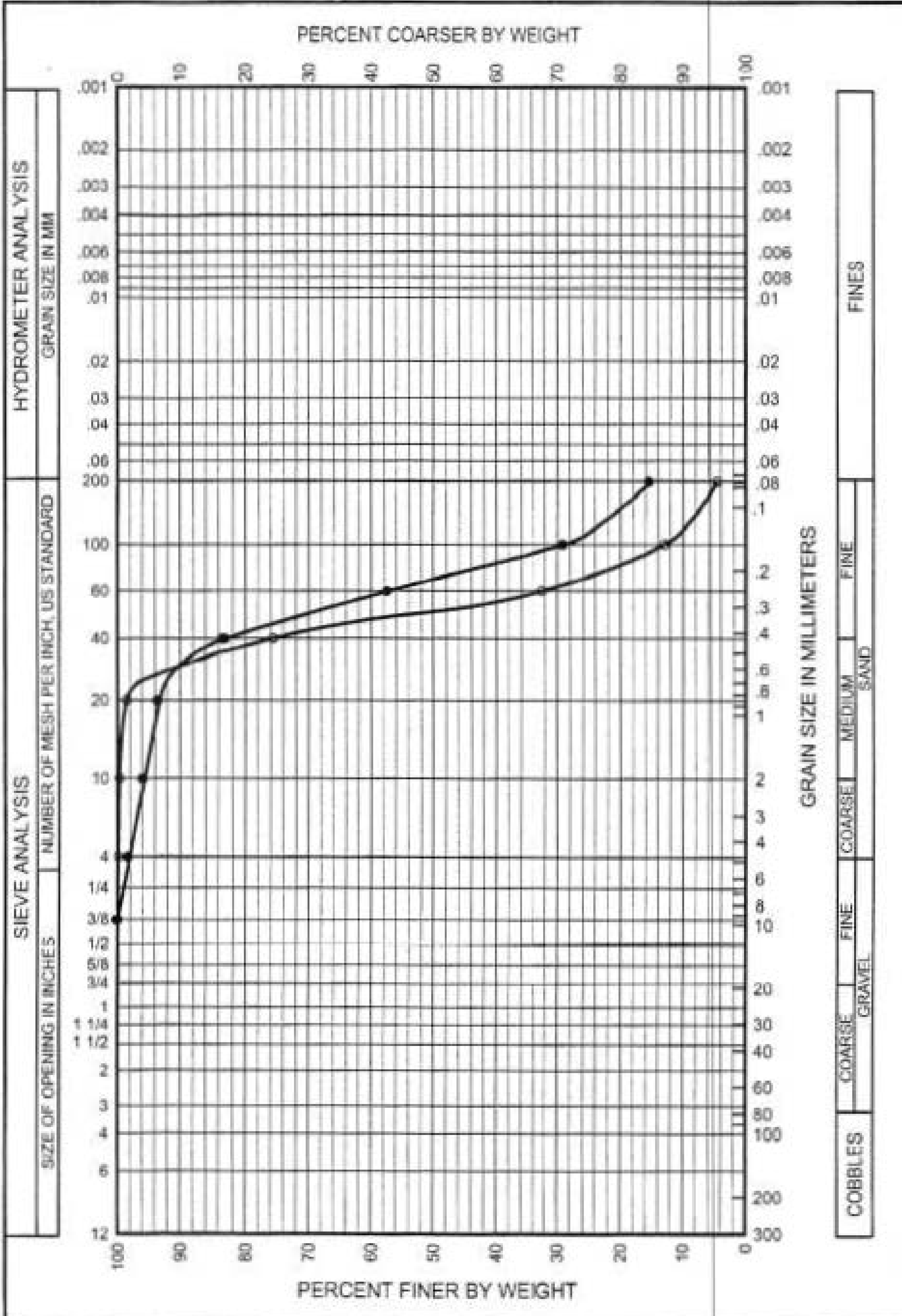
Proj. No. T-5675 | Date MAR 2005 | Figure A-7



Key	Exploration Number	Depth (ft.)	USCS	Description	Moisture Content (%)	LL	PL
●	TP-1	2.0	SM	silty SAND	23.5		
○	TP-1	6.0	SP	SAND	21.8		

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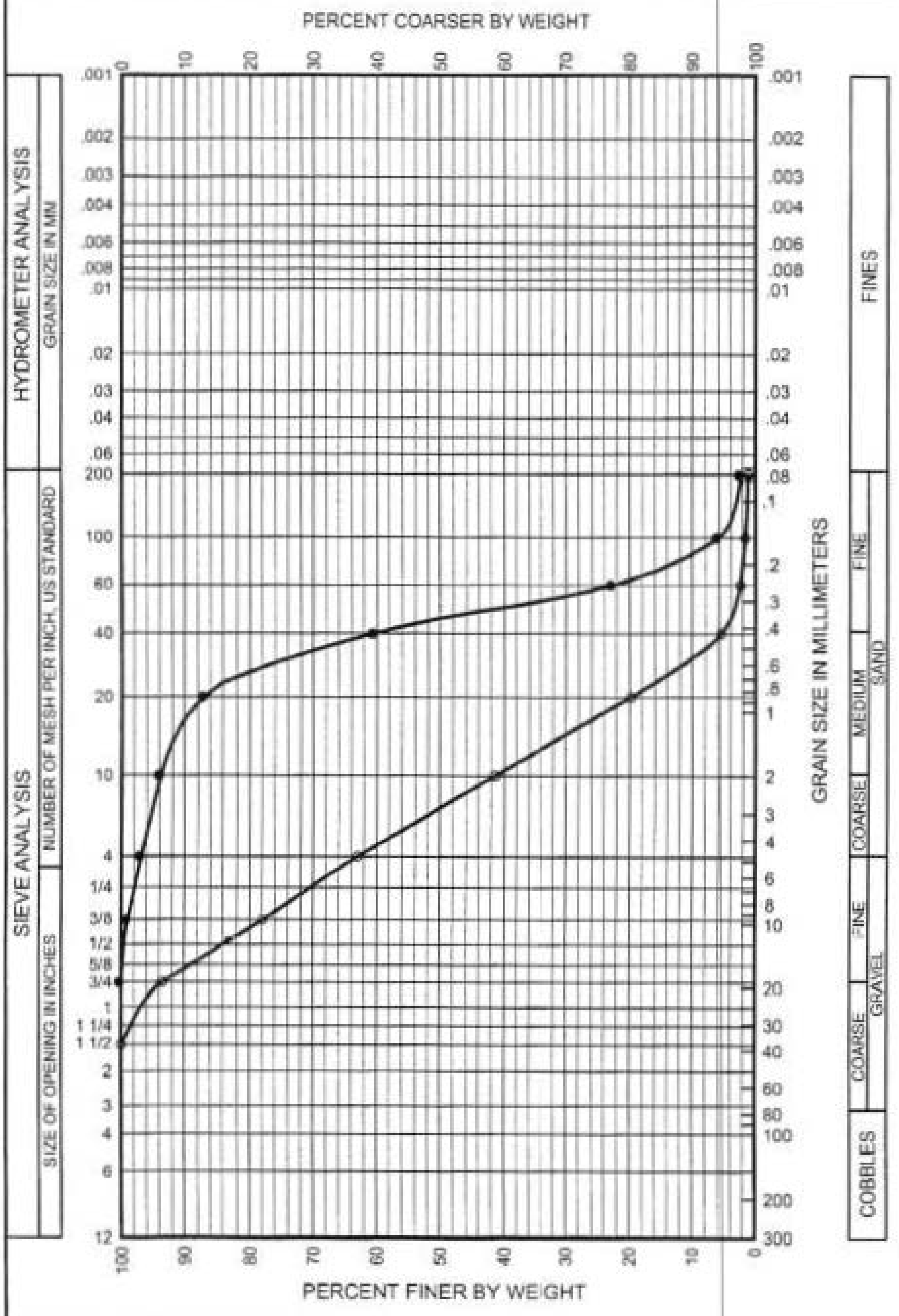
GRAIN SIZE ANALYSIS
PILCHUCK LANDING
MARYSVILLE, WASHINGTON

Proj. No. T-5675	Date MAR 2005	Figure A-8



Key	Exploration Number	Depth (ft.)	USCS	Description	Moisture Content (%)	LL	PL
●	TP-3	5.0	SP	SAND	20.7		
○	TP-5	7.0	SP	SAND with gravel	13.7		

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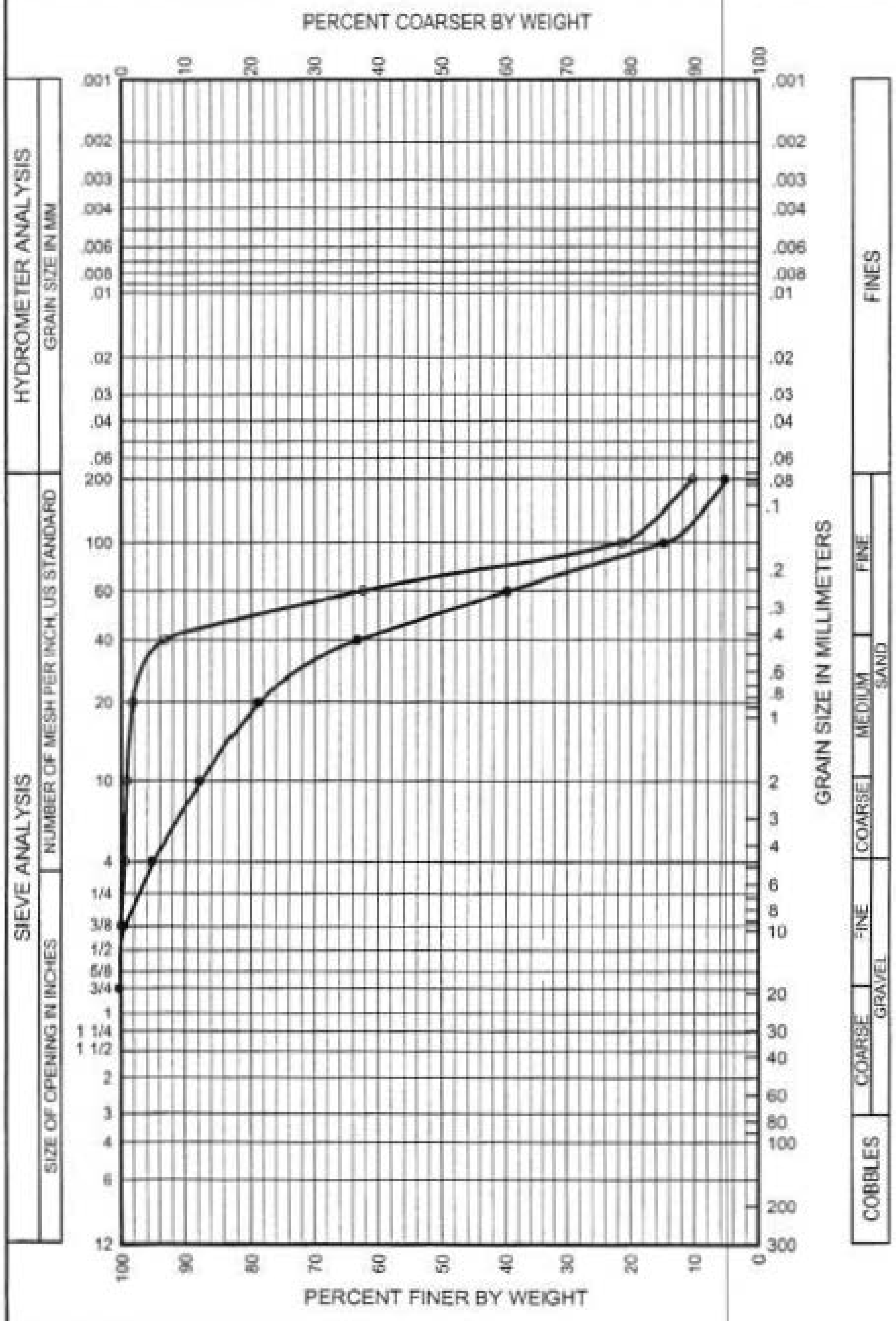
GRAIN SIZE ANALYSIS
PILCHUCK LANDING
MARYSVILLE, WASHINGTON

Proj. No. T-5675 | Date MAR 2005 | Figure A-9



Key	Exploration Number	Depth (ft.)	USCS	Description	Moisture Content (%)	LL	PL
●	TP-9	5.5	SP	SAND with gravel	20.1		
○	TP-11	5.0	SP-SM	SAND with silt	29.8		

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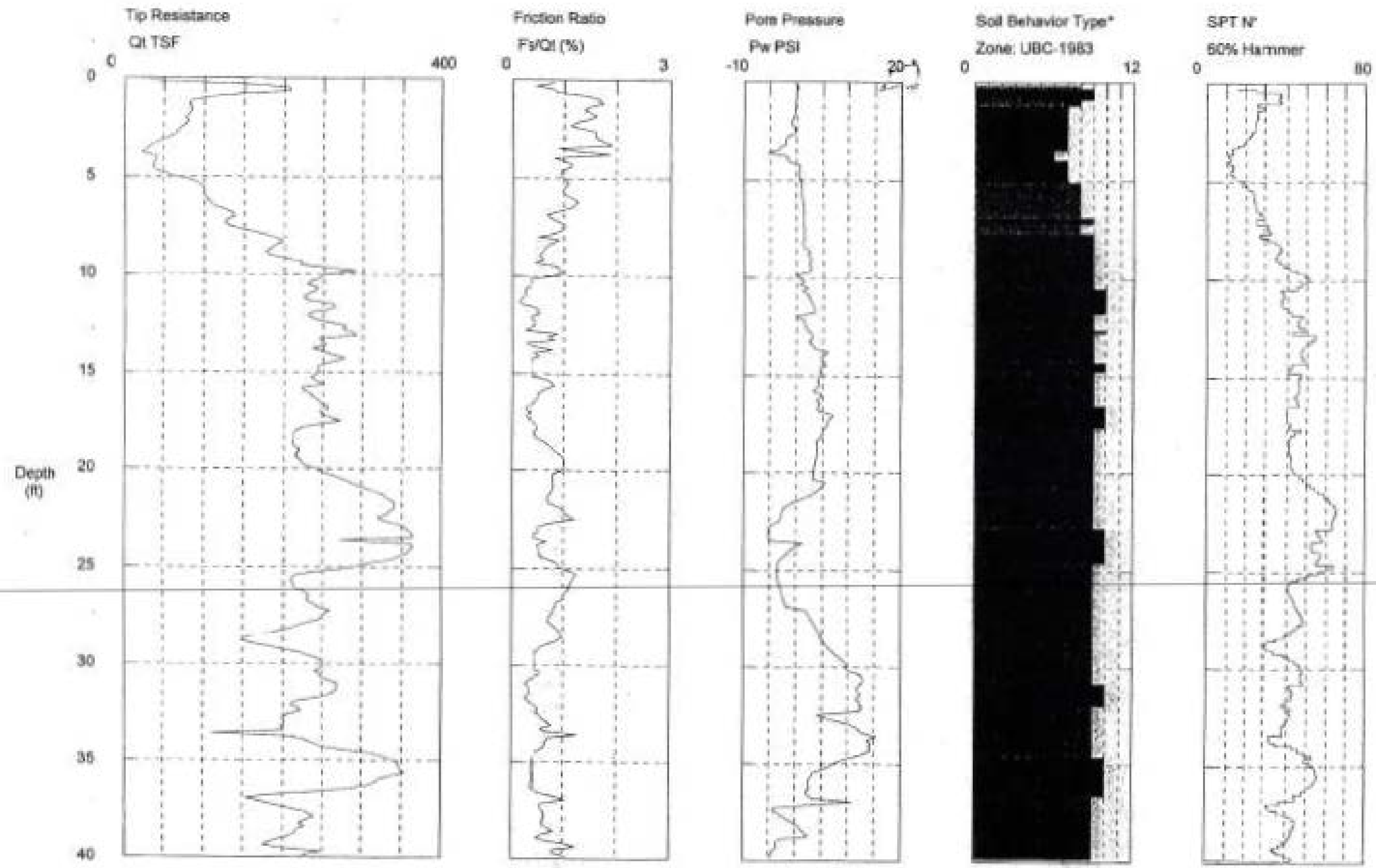
GRAIN SIZE ANALYSIS
PILCHUCK LANDING
MARYSVILLE, WASHINGTON

Proj. No. T-5675	Date MAR 2005	Figure A-10

Terra Associates

Operator: Brown
Sounding: CPT2005-01
Core Used: DSG0851

CPT Date/Time: 2/16/2005 2:38:52 PM
Location: Pilchuck Landing
Job Number: T-5675



Maximum Depth = 40.19 feet

Depth Increment = 0.164 feet

- 1 sensitive fine grained
- 2 organic material
- 3 clay
- 4 silty clay to clay
- 5 clayey silt to silty clay
- 6 sandy silt to clayey silt
- 7 silty sand to sandy silt
- 8 sand to silty sand
- 9 sand
- 10 gravelly sand to sand
- 11 very stiff fine grained (*)
- 12 sand to clayey sand (*)

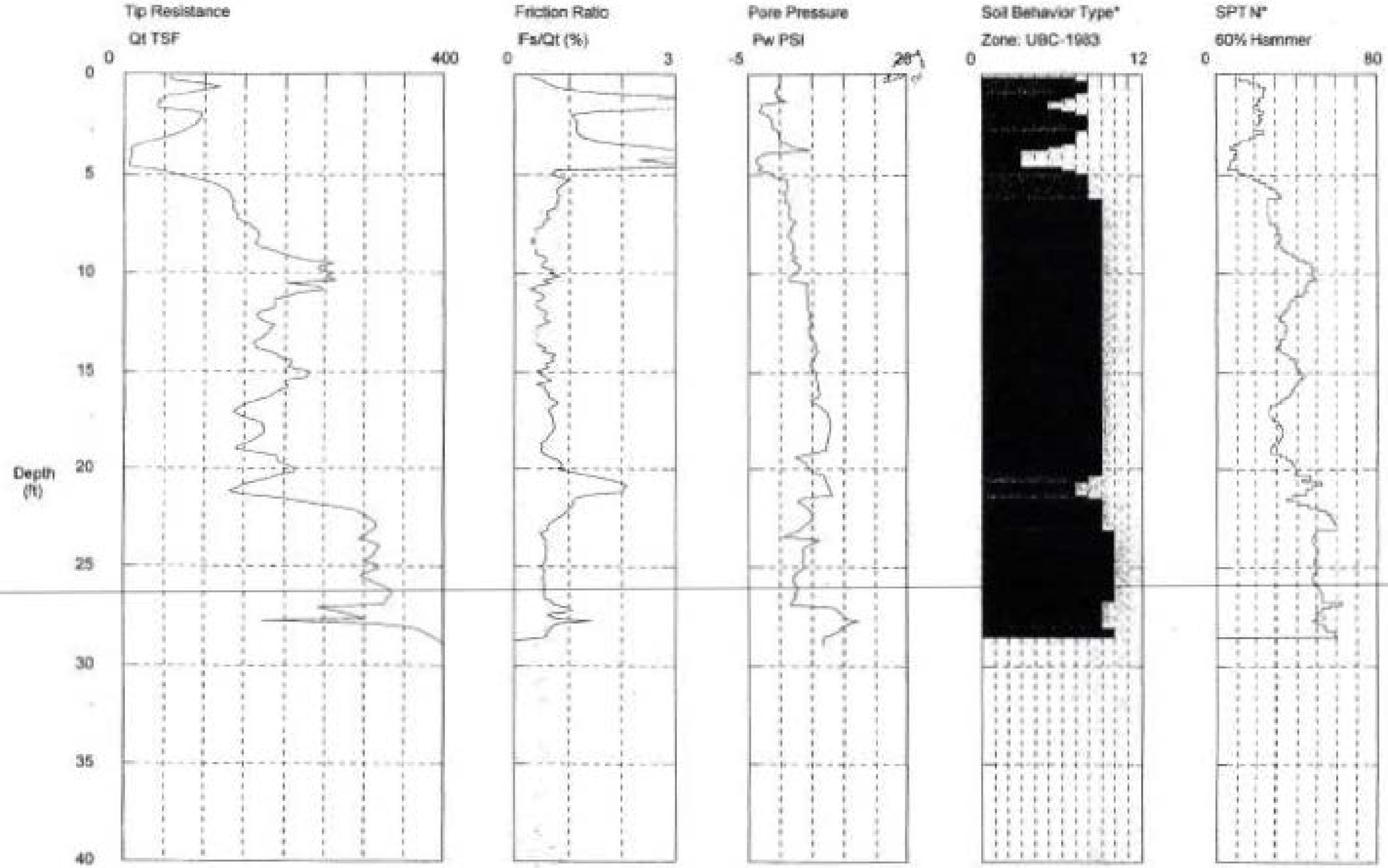
*Soil behavior type and SPT based on data from UBC-1983

Northwest Cone Exploration

Terra Associates

Operator: Brown
Sounding: CPT-02
Cone Used: DSG0851

CPT Date/Time: 2/16/2005 3:15:44 PM
Location: Pilchuck Landing
Job Number: T-5675



Maximum Depth = 28.90 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

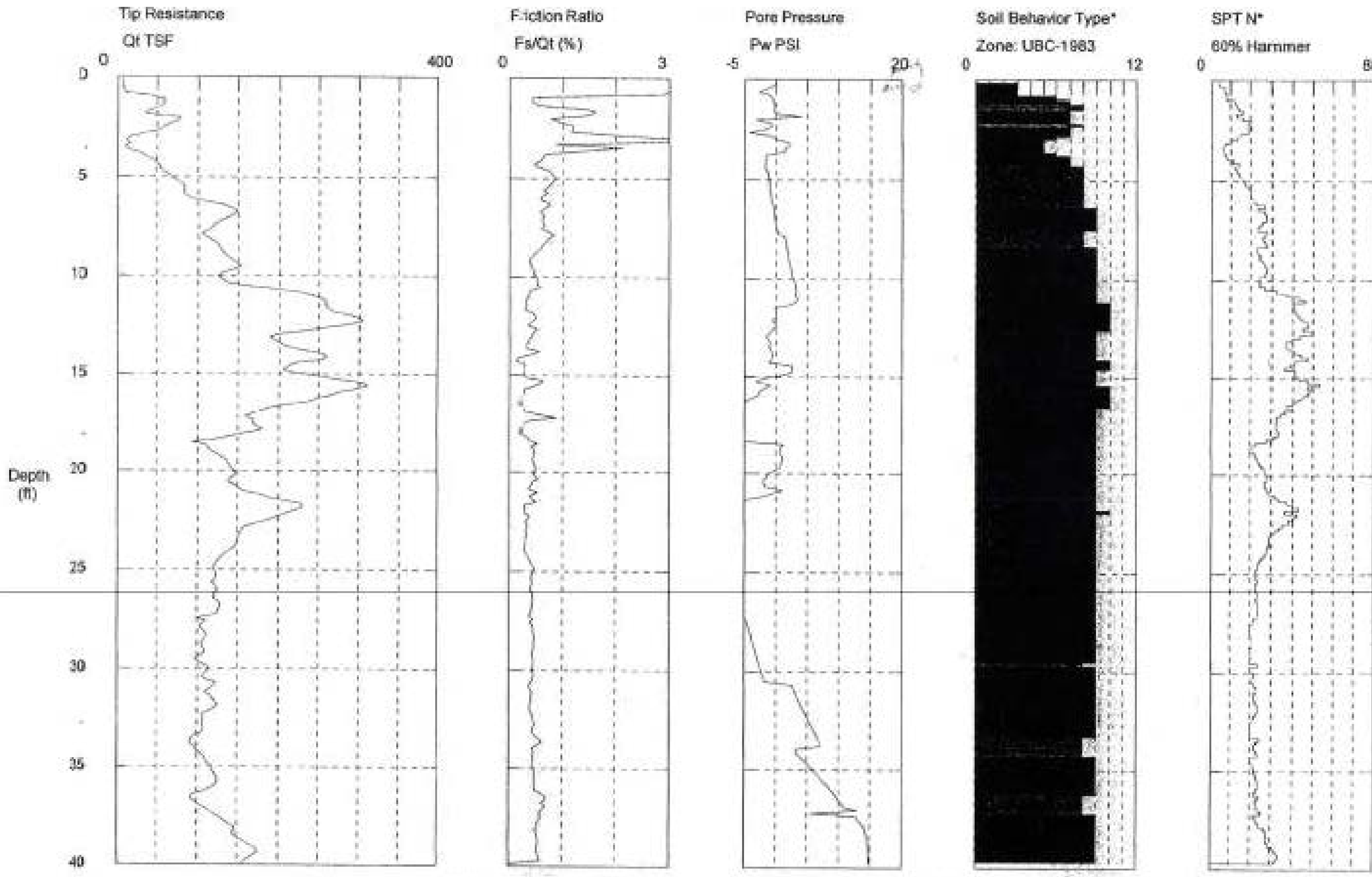
Instrument refused at 29 feet due to tip resistance
Northwest Cone Exploration

*Soil behavior type and SPT based on data from UBC-1983

Terra Associates

Operator: Brown
Sounding: CPT-03
Cone Used: DSG0708

CPT Date/Time: 2/18/2005 1:55:40 PM
Location: Pilchuck Landing
Job Number: T-5675



Maximum Depth = 40.03 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

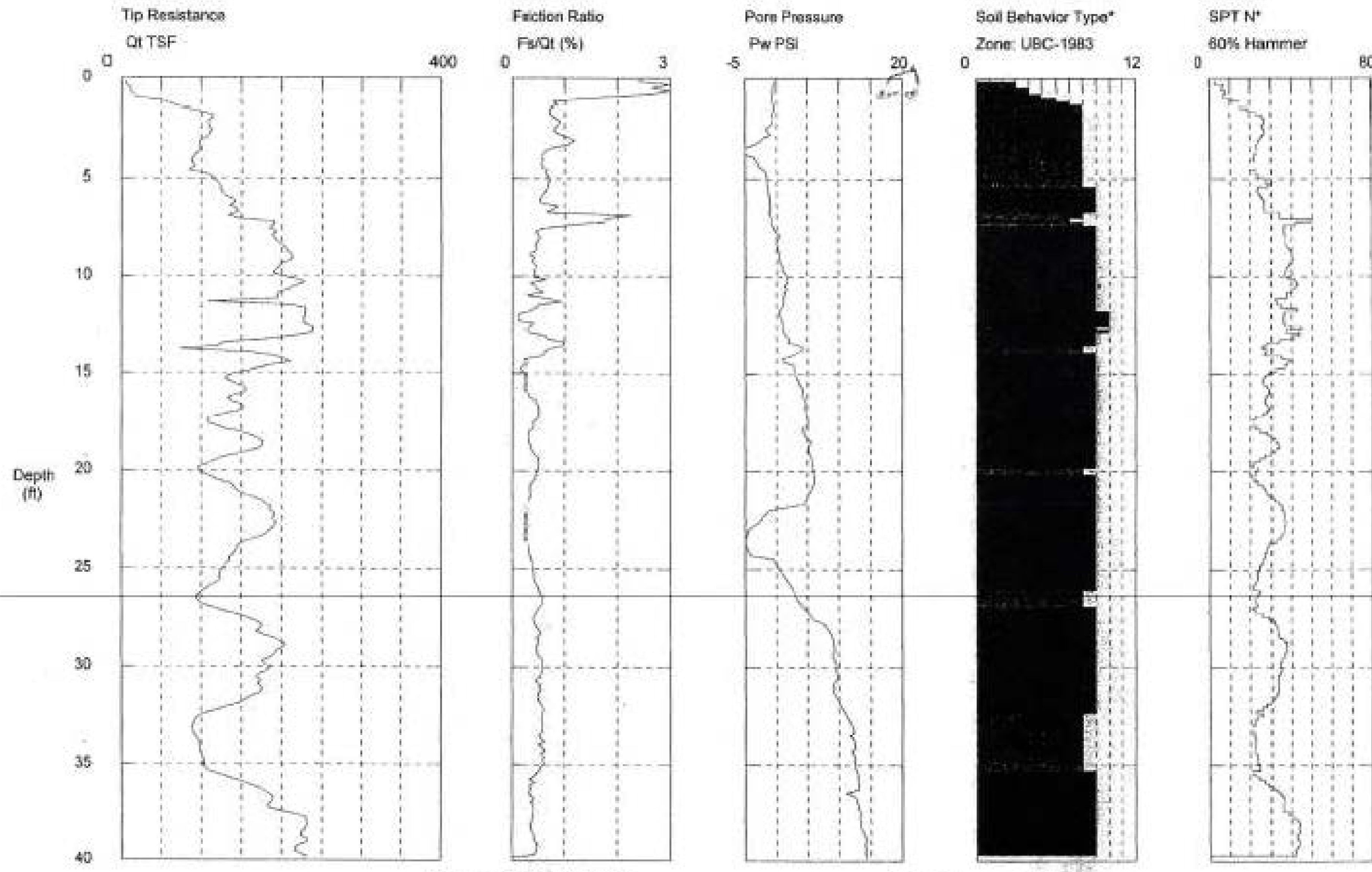
*Soil behavior type and SPT based on data from UBC-1983

Northwest Cone Exploration

Terra Associates

Operator: Brown
Sounding: CPT-04
Core Used: DSG0708

CPT Date/Time: 2/18/2005 1:25:45 PM
Location: Pilchuck Landing
Job Number: T-5675



Maximum Depth = 40.03 feet

Depth Increment = 0.164 feet

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

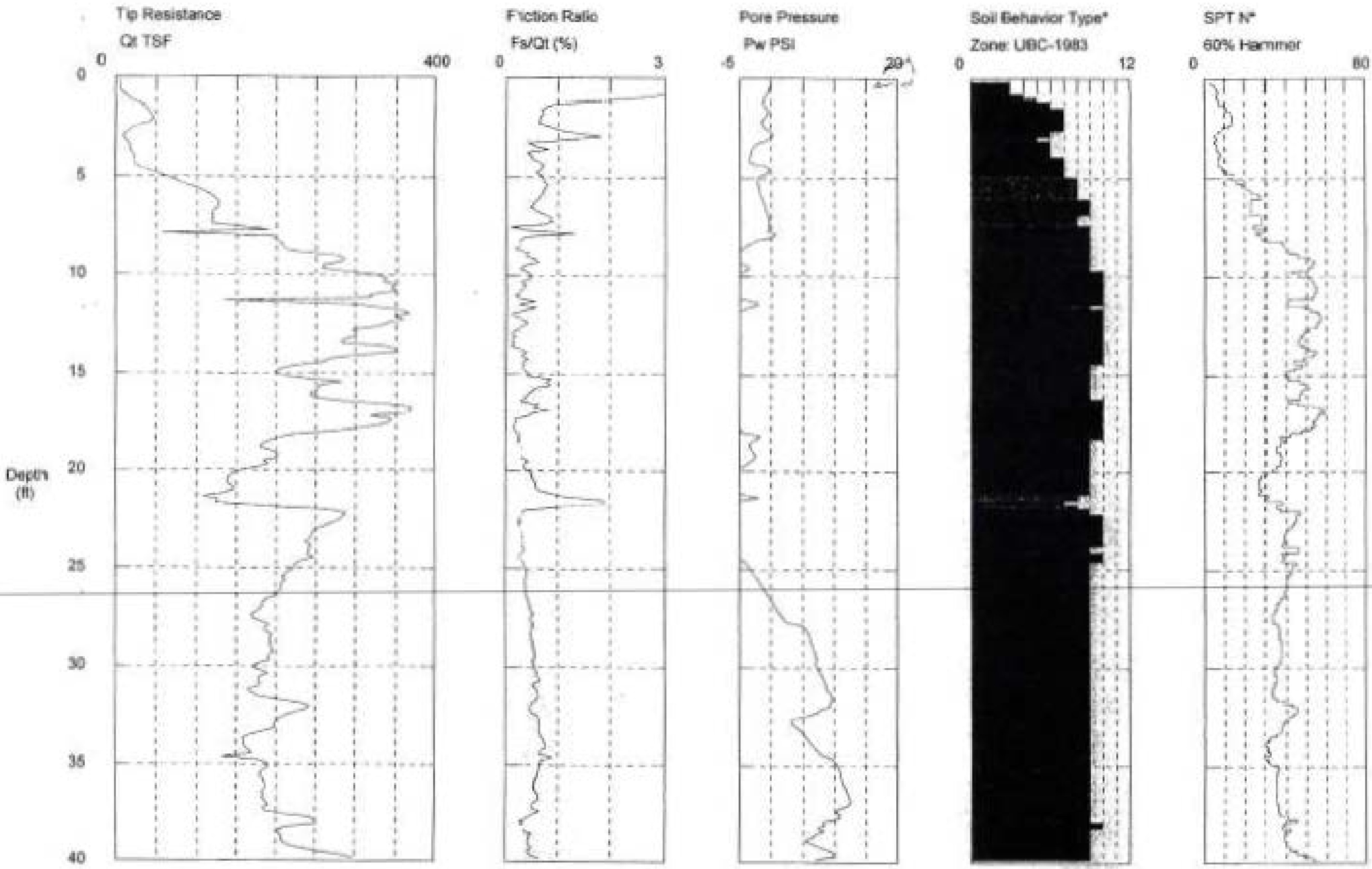
*Soil behavior type and SPT based on data from UBC-1983

Northwest Cone Exploration

Terra Associates

Operator: Brown
Sounding: CPT-05
Cone Used: DSG0708

CPT Date/Time: 2/18/2005 12:34:53 PM
Location: Pilchuck Landing
Job Number: T-5675



Maximum Depth = 41.17 feet

Depth Increment = 0.164 feet

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

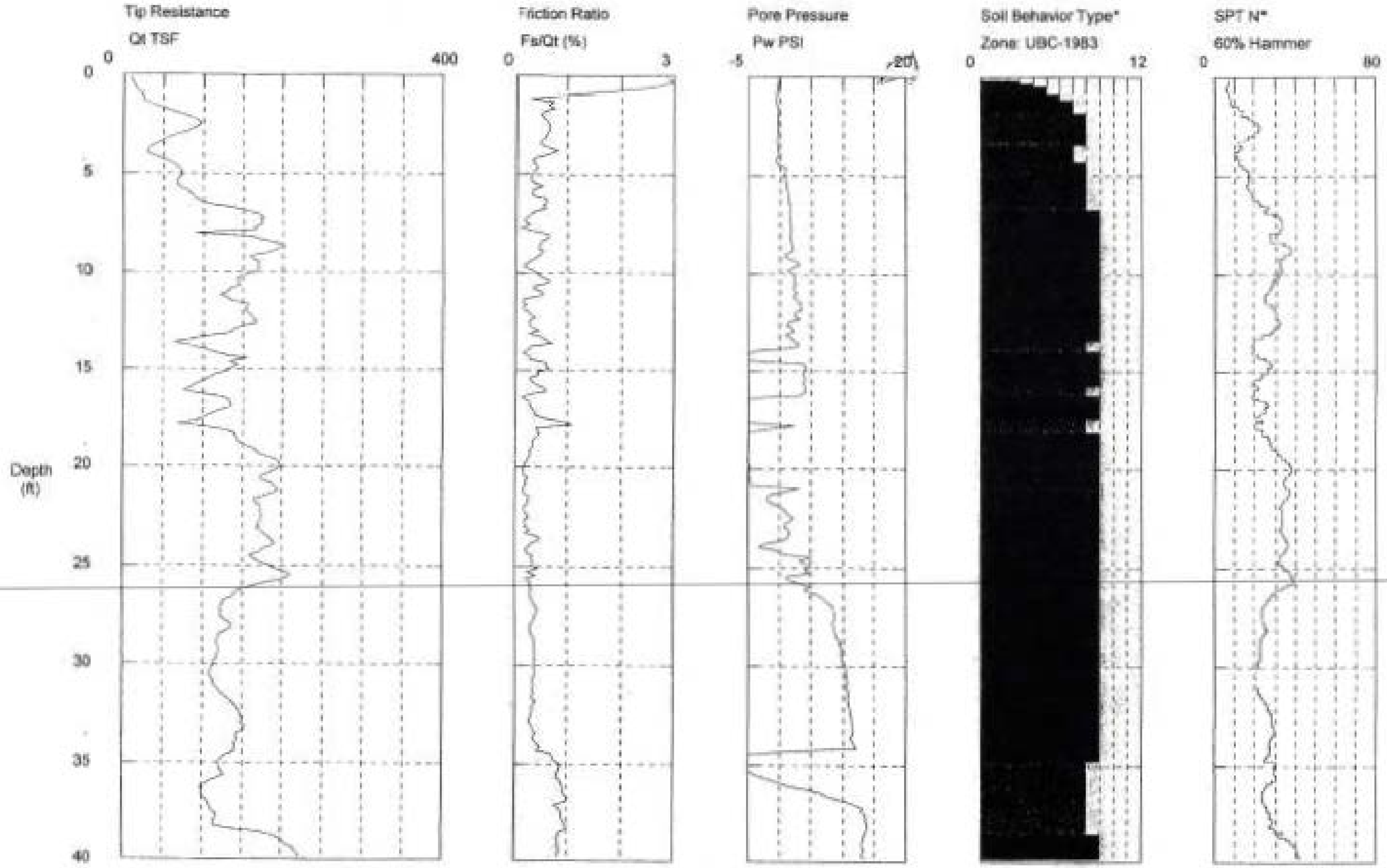
*Soil behavior type and SPT based on data from UBC-1983

Northwest Cone Exploration

Terra Associates

Operator: Brown
Sounding: CPT-06
Cone Used: DSG0708

CPT Date/Time: 2/18/2005 11:57:42 AM
Location: Pilchuck Landing
Job Number: T-5675



Maximum Depth = 40.35 feet

Depth Increment = 0.164 feet

■ 1 sensitive fine grained
■ 2 organic material
■ 3 clay
■ 4 silty clay to clay
■ 5 clayey silt to silty clay
■ 6 sandy silt to clayey silt
■ 7 silty sand to sandy silt
■ 8 sand to silty sand
■ 9 sand
■ 10 gravelly sand to sand
■ 11 very stiff fine grained (*)
■ 12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

Northwest Cone Exploration