GEOTECHNICAL ENGINEERING STUDY
MERRILL RANCH
17301 38TH AVENUE COURT EAST
PIERCE COUNTY, WASHINGTON

November 14, 2006
Project No. E-12716

Prepared for
Alpha Development Corporation
10015 19th Avenue East
Tacoma, Washington 98445

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❑ Environmental Services ❑ Geotechnical Engineering ❑ Construction Materials Testing ❑ Special Inspections

November 14, 2006

Mr. Lee Allison
Alpha Development Corporation
10015 19th Avenue East
Tacoma, Washington 98445

Project No. E-12716

Dear Mr. Allison:

We are pleased to submit our report titled "Geotechnical Engineering Study, Merrill Ranch, 17301 38th Avenue Court East, Pierce County, Washington." This report presents the results of our field exploration, selective laboratory tests, and engineering analyses.

We appreciate this opportunity to have been of service to you. If you have any questions, or if we can be of further assistance, please call.

Respectfully submitted,

EARTH CONSULTING INCORPORATED

KRISTINA MARIE WELLER
STATE OF WASHINGTON
33182
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES 02-09-07

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GEOTECHNICAL ENGINEERING STUDY
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17301 38TH AVENUE COURT EAST
PIERCE COUNTY, WASHINGTON
E-12716

INTRODUCTION

General

This report presents the results of the geotechnical engineering study completed by Earth Consulting Incorporated. (ECI), for the proposed Merrill Ranch residential development, located at 17301 38th Avenue Court East, in unincorporated Pierce County, Washington. The general location of the site is shown on the "Vicinity Map," Plate 1.

The purpose of this study was to explore the subsurface conditions at the site and, based on the conditions encountered, to provide geotechnical engineering recommendations for developing the site with a new single-family residence development.

Project Description

The subject site is comprised of an approximately 22.71-acre, irregular-shaped residential tract located at 17301 38th Avenue Court East in unincorporated Pierce County, Washington. We understand it is planned to develop the site with up to 81 residential lots and associated arterial roadways.

Based on our experience with similar projects, we anticipate the residences will be two to three stories in height and will be of relatively lightly-loaded wood frame construction with slab-on-grade floors. We anticipate wall loads will be on the order of 2 to 3 kips per lineal foot and column loads will likely be in the range of 20 to 40 kips. We estimate slab-on-grade floor loads will be around 150 pounds per square foot (psf).

The site will be accessed by arterial roadways extending into the site from 176th Street East along the southern site perimeter and from 36th Avenue East along the western site perimeter. The arterial roadways will extend to the northern site perimeter for access to future developments to the north.

Stormwater runoff from the site is to be diverted to an infiltration facility in the northern portion of the property.

A grading plan was unavailable at the time of our study. Based on existing topography on a site plan provided by C.E.S. NW, Inc., we anticipate cuts and fills of less than 5 feet will be necessary to reach foundation and roadway subgrades throughout most of the site, while cuts up to 10 feet may be necessary along the eastern site perimeter.

SITE CONDITIONS

Surface

The subject site is comprised of an approximately 22.71-acre, irregular-shaped residential tract located at 17301 38th Avenue Court East in unincorporated Pierce County, Washington, as shown on Plate 1. The site is bordered to the north and east by single-family residences and undeveloped forest, to the south by single-family residences and 176th Street East, and to the west by single-family residences and 36th Avenue East.

The site topography is comprised of a relatively level bench area bordered to the east by a west-facing slope. The bench area slopes slightly west at gradients less than 5 percent. The slope descends approximately 30 feet in elevation from the eastern property line to the bench area at gradients of approximately 15 to 20 percent.

The bench area is primarily vegetated with grass and several small- to medium-diameter trees in the vicinity of the residences. The slope area is vegetated with medium- to large-diameter mixed pine and deciduous trees.

Subsurface

Subsurface conditions for the site and vicinity were evaluated by reviewing soil maps, geologic maps, and excavating ten test pits at the approximate locations shown on Plate 2.

Soil Map Review

Review of the USDA Soil Conservation Service (SCS) maps for Pierce County indicates that the bench area in the western portion of the site is underlain by Spanaway gravelly sandy loam (Map Unit 41A). Spanaway soils are characterized by slow surface runoff, moderately rapid permeability, and little erosion hazard potential. The slope area in the eastern portion of the site is underlain by Kapowsin gravelly loam, 15 to 30 percent slopes (Map Unit 19D). In Kapowsin soils with 15 to 30 percent slopes, the surface runoff is described as medium or rapid, with a moderate or severe erosion hazard.

Geologic Map Review

Review of the *Geologic Map of the South Half of the Tacoma Quadrangle, Washington* (Walsh, 1987) indicates the slope area in the eastern portion of the site is underlain by Vashon till (Map Unit Qdvt) deposited during the Vashon stade of the Frasier glaciation. The till consists of a compact, unsorted mixture of clay, silt, sand, and gravel. The bench area in the western portion of the site is underlain by Vashon Drift (Map Unit Qdv) comprised of stratified sand and gravel deposited during the recession of the Vashon glacier.

The contractor should be made aware that groundwater levels are not static. There will likely be fluctuations in the levels depending on the season, amount of rainfall, surface water runoff, and other factors. Generally, the water level is higher and seepage rates are greater in the wetter winter months (typically October through May). The contractor should be prepared to control groundwater if seepage is encountered in site excavations.

Laboratory Testing

Laboratory tests were conducted on representative soil samples to verify or modify the field soil classifications and to evaluate the general physical properties and engineering characteristics of the soil encountered. Visual field classifications were supplemented by grain-size analyses on representative soil samples. Moisture content tests were performed on all samples. The results of laboratory tests performed on specific samples are provided either at the appropriate sample depth on the individual test pit logs or on a separate data sheet contained in Appendix B. It is important to note that these test results may not accurately represent the overall in-situ soil conditions. Our geotechnical engineering recommendations are based on our interpretation of these test results and their use in guiding our engineering judgment. ECI cannot be responsible for the interpretation of these data by others.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our study, in our opinion, the site development is feasible from a geotechnical engineering standpoint, provided the recommendations contained in this report are followed. Building support may be provided using conventional spread and continuous footing foundation systems bearing on competent native soil or on structural fill used to modify existing site grades. Slab-on-grade floors may be similarly supported.

At the test pit locations, loose native granular soils were encountered to depths of 1.5 to 3 feet. At Test Pit TP-8, one foot of fill was encountered at the surface. If loose fill or native soil is encountered at construction subgrade elevations, it should be overexcavated and replaced with structural fill. It may be possible to reuse the existing loose soils provided they meet the requirements for structural fill.

This report has been prepared for specific application to this project only and in a manner consistent with that level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area. This report is for the exclusive use of Alpha Development Corporation and their representatives. No warranty, expressed or implied, is made. This report, in its entirety, should be included in the project contract documents for the information of the contractor.

Following the stripping operation and excavations necessary to achieve construction subgrade elevations, an ECI representative should observe the ground surface where structural fill, foundations, or slabs are to be placed. Soil in loose or soft areas, if recompacted and still excessively yielding, should be overexcavated and replaced with structural fill. The optional use of a geotextile fabric placed directly on the overexcavated surface may help to bridge unstable areas. ECI can provide recommendations for geotextiles, if necessary.

Structural Fill

Structural fill is defined as compacted fill placed under buildings, roadways, slabs, pavements, or other load-bearing areas. Structural fill under floor slabs and footings should be placed in horizontal lifts not exceeding 12 inches in loose thickness and compacted to a minimum of 90 percent of its laboratory maximum dry density determined in accordance with ASTM Test Designation D1557 (Modified Proctor). The fill materials should be placed at or near their optimum moisture content. Fill placed in roadway areas should also be placed in 12-inch-thick loose lifts and each lift compacted to 90 percent of maximum dry density, except the top 12 inches which should be compacted to 95 percent of maximum dry density per the same standard.

Based on the results of our laboratory tests, the on-site soils at the time of our exploration appeared to be near their optimum moisture content and should be suitable for use as structural fill. Laboratory testing indicates the outwash soils have between 1 and 11 percent fines passing the U.S. No. 200 sieve. However, based on field observations, the surficial soils and glacial till have well over 5 percent fines passing the U.S. No. 200 sieve. Soil with fines in excess of around 5 percent will degrade if exposed to excessive moisture, and compaction and grading will be difficult if the soil moisture increases significantly above its optimum level.

If the site soils are exposed to excessive moisture and cannot be adequately compacted, then it may be necessary to import a soil that can be compacted. During dry weather, non-organic, compactable granular soil with a maximum grain size of 4 inches can be used. Fill for use during wet weather should consist of a fairly well-graded granular material having a maximum grain size of 4 inches and no more than 5 percent fines passing the U.S. No. 200 sieve based on the minus 3/4-inch fraction.

Foundations

Based on the results of our study and provided our recommendations are followed, in our opinion, the future residences may be supported on conventional spread and continuous footing foundation systems bearing on competent native soil or on structural fill used to modify site grades.

If fill or loose native soil is encountered at construction subgrade elevations, it will be necessary to overexcavate the fill and loose soils and replace them with structural fill.

These values are based on horizontal backfill, and it is assumed that surcharges due to backfill slopes, hydrostatic pressures, traffic, structural loads, or other surcharge loads will not act on the wall. If such surcharges are to apply, they should be added to the above design lateral pressure. The passive pressure, friction coefficient, and allowable bearing capacity previously provided in the "Foundations" section of this study are applicable to retaining wall design.

To reduce the potential for hydrostatic forces building up behind the walls, free-standing retaining walls and the below-grade section of the foundation walls should be backfilled with free-draining material extending at least 18 inches behind the wall. The free-draining backfill should consist of pea gravel or washed rock with a fines content of less than 5 percent, based on the minus 3/4-inch fraction. A rigid, 4-inch-diameter, schedule 40, perforated PVC or SDR 35 drainpipe should be placed at the base of the wall and should be surrounded by a minimum of 1 cubic foot per lineal foot with pea gravel or washed rock. The pipe should be placed with the perforations in the down position. The remainder of the backfill should consist of structural fill.

Seismic Design Considerations

Earthquakes occur in the Puget Lowland with regularity; however, the majority of these events are of such low magnitude they are not detected without instruments. Large earthquakes do occur, as indicated by the 1949, 7.2 magnitude earthquake in the Olympia area and the 1965, 6.5 magnitude earthquake in the Midway area and the 2001, 6.8 magnitude earthquake in the Nisqually area.

There are three potential geologic hazards associated with a strong motion seismic event at this site: ground rupture, liquefaction, and ground motion response.

Ground Rupture

The strongest earthquakes in the Puget Lowland are widespread, subcrustal events, ranging in depth from 30 to 55 miles. Surface faulting from these deep events has not been documented to date. Therefore, it is our opinion that the risk of ground rupture at this site during a strong motion seismic event is negligible.

Liquefaction

Liquefaction is a phenomenon in which soils lose all shear strength for short periods of time during an earthquake. Groundshaking of sufficient duration results in the loss of grain- to grain-contact and rapid increase in pore water pressure, causing the soil to behave as a fluid. To have a potential for liquefaction, a soil must be cohesionless with a grain-size distribution of a specified range (generally sand and silt), it must be loose, it must be below the groundwater table, and it must be subject to sufficient magnitude and duration of groundshaking. The effects of liquefaction may be large total and/or differential settlement for structures founded in the liquefying soils.

Site Drainage

No groundwater seepage was encountered at the test pit locations to the maximum depth explored. Iron oxide staining was observed at 7 feet below grade in Test Pit TP-5, located in eastern portion of the site. The iron oxide staining at this location is likely indicative of the presence of seasonally perched groundwater.

If seepage is encountered during construction, the bottom of the excavation should be sloped to one or more, shallow sump pits. The collected water can then be pumped from these pits to a positive and permanent discharge. Depending on the magnitude of such seepage, it may also be necessary to interconnect the sump pits by a system of connector trenches.

During construction, the site must be graded such that surface water is directed away from construction areas. Water must not be allowed to stand in areas where foundations, slabs, or pavements are to be constructed or where structural fill will be placed. Loose soil surfaces should be sealed by compacting the surface to reduce the potential for moisture infiltration. Final site grades must allow for drainage away from the future residences. The ground should be sloped at a gradient of 3 percent for a distance of at least 10 feet away from the residences.

Footing drains should be installed around the perimeter of the residences at or just below the invert of the footing, with a gradient sufficient to initiate flow, as shown on the "Typical Footing Subdrain Detail," Plate 3. Under no circumstances should roof downspout drain lines be connected to the footing drain system. Roof downspouts must be separately tightlined to discharge. Cleanouts should be installed at strategic locations to allow for periodic maintenance of the footing drain and downspout tightline systems.

Utility Support and Backfill

The site soils should generally provide adequate support for utilities. Where loose soils or unstable conditions are encountered, remedial measures, such as overexcavating soft soils or compacting subgrade soils exposed in the trench bottom, may be required.

Utility trench backfill is a primary concern in reducing the potential for settlement along utility alignments, particularly in pavement areas. It is important that each section of utility line is adequately supported in the bedding material. The material should be hand tamped to provide support around the pipe haunches. Fill should be carefully placed and hand tamped to about 12 inches above the crown of the pipe before heavy compaction equipment is brought into use. The remainder of the trench backfill should be placed in lifts having a loose thickness of less than 12 inches.

Test Pits and Infiltration Tests Summary

Textural Analysis Results

Test Pit Location	Sample Depth (feet below grade)	USDA Classification	Hydrologic Soil Group	Depth to Groundwater (feet)	*Infiltration Rate (in/hr)	Measured Infiltration Rate (in/hr)
TP-1	5.5	Extremely gravelly coarse sand	A	>13'	60	33
	8.5	Extremely gravelly coarse sand	A		60	--
TP-6	4.5	Very gravelly coarse sand	A	>12'	60	156
	9	Extremely gravelly coarse sand	A		60	--
TP-8	5	Extremely gravelly coarse sand	A	>12'	60	813
	9	Extremely gravelly coarse sand	A		60	--

* Based on Table 6.3 of the Pierce County *Stormwater Management & Site Development Manual – 2005*

After completing the infiltration tests, Test Pits TP-1, TP-6, and TP-8 were extended a minimum of 5 feet below the infiltration test depth.

Infiltration Recommendations

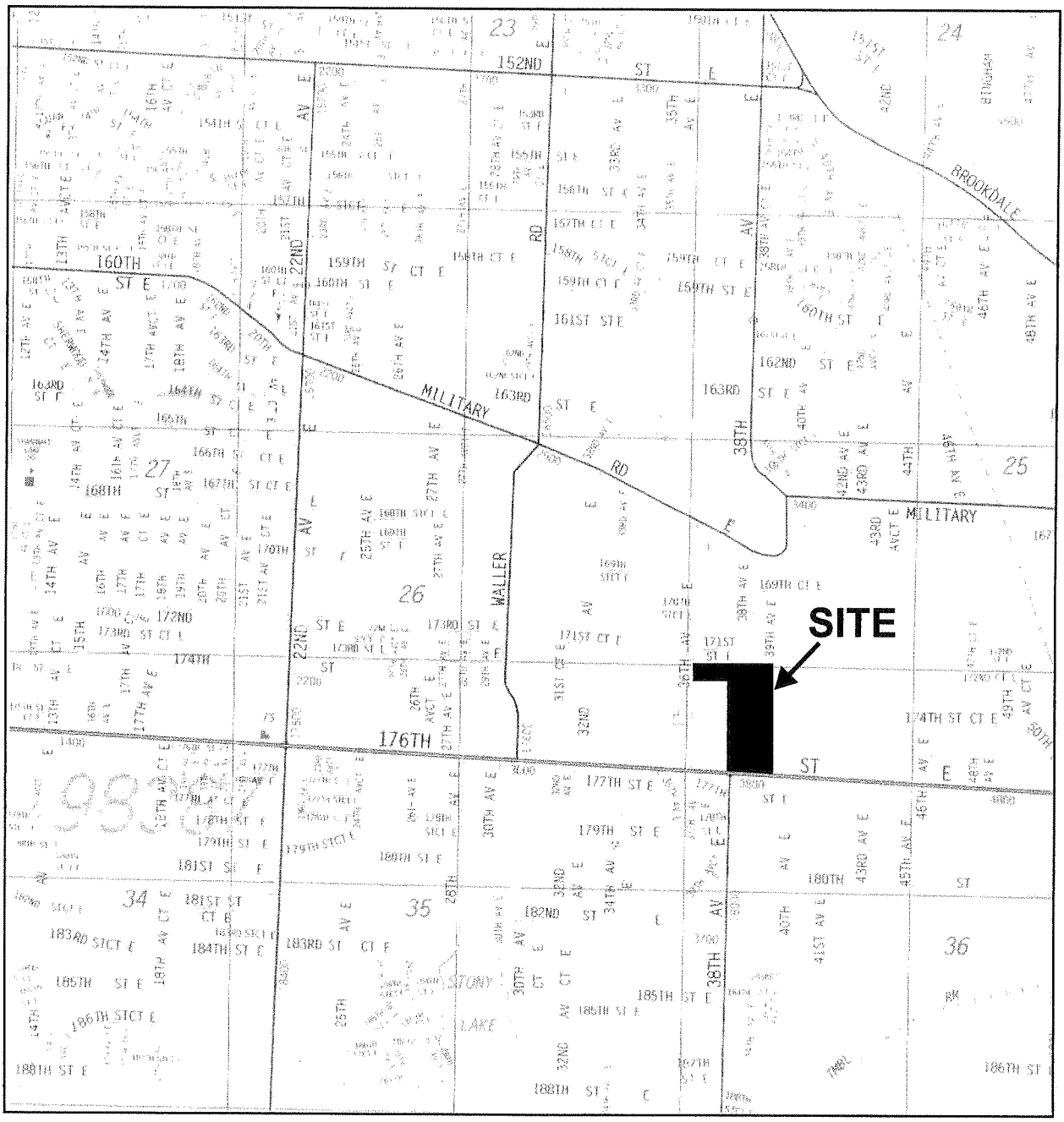
The measured field infiltration rates range from 33 inches per hour in Test Pit TP-1 to 813 inches per hour in Test Pit TP-8, with an average infiltration rate of 334 inches per hour.

Based on observed conditions and on our textural analyses of representative soils, the west and central portions of the site are underlain by extremely gravelly coarse sand and very gravelly coarse sand between 2 and 5 feet below grade and extending to the maximum exploration depth of 13 feet below grade.

The extremely gravelly loamy coarse sand and very gravelly coarse sand encountered in the test pits should be suitable for infiltration of stormwater runoff as planned. In our opinion, an infiltration rate of 60 inches per hour may be used for design. This rate does not include a factor-of-safety.

In accordance with Section 6.7.1 of the Pierce County *Stormwater Management & Site Development Manual – 2005*, a minimum of 3 feet of separation must be maintained between the bottom of the infiltration trench and underlying relatively impermeable layers and seasonal high groundwater levels provided above.

The infiltration capability of the encountered soils varies both horizontally and vertically. Due to this variability, a representative from ECI should observe the infiltration ponds during excavation to verify the soils encountered at the pond bottom elevation are as anticipated.



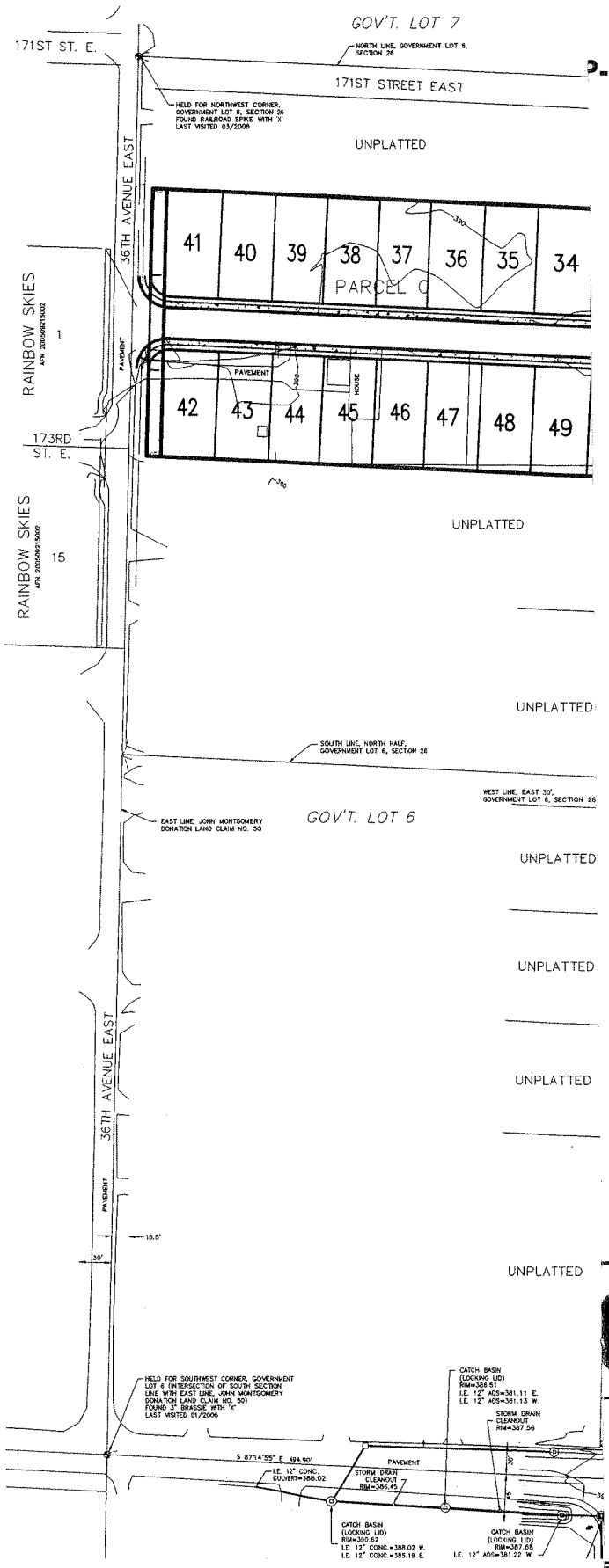
Reference:
Pierce County
Map 864
By The Thomas Guide
Dated 2006

NORTH

EARTH CONSULTING INCORPORATED

VICINITY MAP
MERRILL RANCH
PIERCE COUNTY, WASHINGTON

DRWN. DNM		PROJ. NO. 12716
CHKD. ELW	DATE 10/25/06	PLATE 1



LEGEND

Approximate location of ECI test pit, Project No. 12716, December 2005

NORTH

0 160

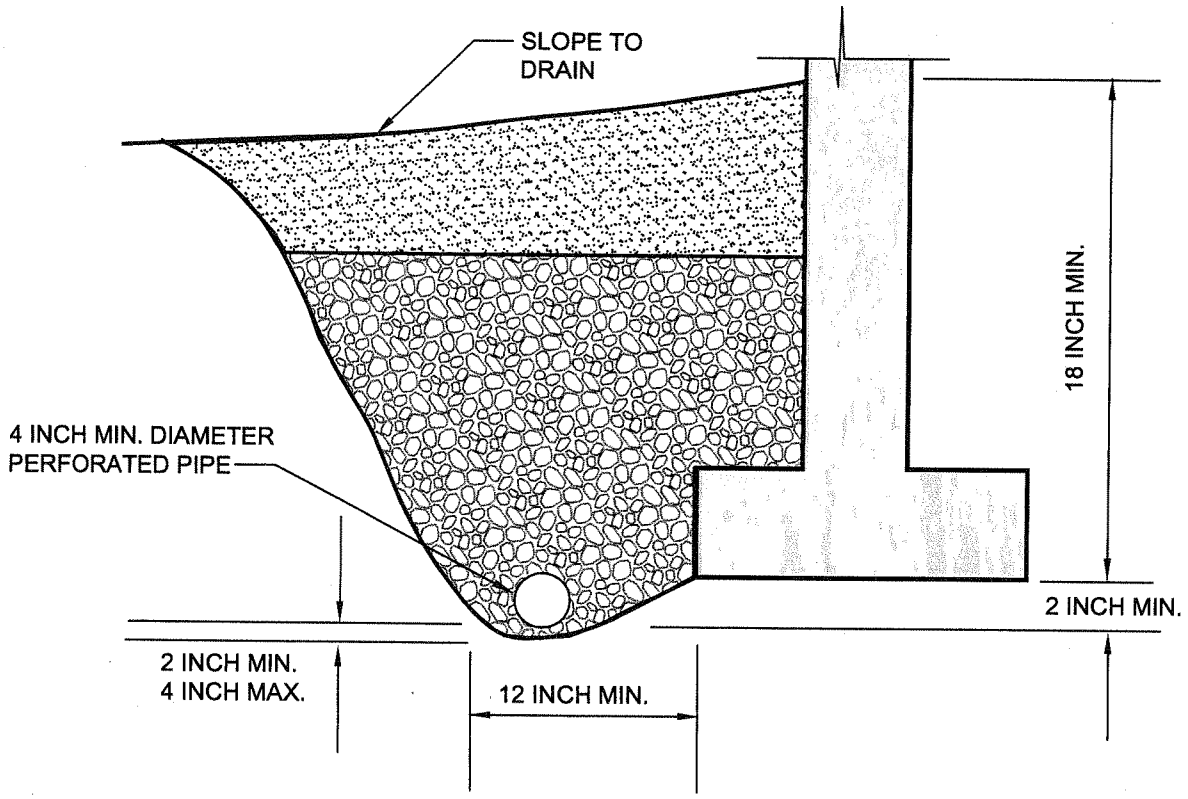
SCALE IN FEET

REFERENCE: C.E.S. NW INC., 4/19/06

Earth Consulting Incorporated

TEST PIT LOCATON PLAN
MERRILL RANCH
PIERCE COUNTY, WASHINGTON

DRWN. DNM		PROJ. NO. 12716
CHKD. ELW	DATE 10/25/06	PLATE 2



LEGEND

Surface seal; native soil or other low permeability material

Washed rock or pea gravel

Drain pipe; perforated or slotted rigid Schedule 40 PVC or SDR 35 pipe laid with perforations or slots facing down; tight jointed; with a positive gradient. Do not use flexible corrugated plastic pipe. Do not tie building downspout drains into footing lines.

SCHEMATIC ONLY - NOT TO SCALE
NOT A CONSTRUCTION DRAWING

Earth Consulting Incorporated

TYPICAL FOOTING SUBDRAIN DETAIL

MERRILL RANCH
PIERCE COUNTY, WASHINGTON

DRWN. DNM		PROJ. NO. 12716
CHKD. ELW	DATE 10/25/06	PLATE 3

APPENDIX A

FIELD EXPLORATION

E-12716

Earth Consulting Incorporated. (ECI) performed our test pit exploration on December 29, 2005. The subsurface conditions at the site were explored by excavating ten test pits to a maximum depth of 13 feet below existing grade. The test pits were excavated by Aikins' Excavating, subcontracted to ECI, using a tracked excavator.

The approximate test pit locations were determined by pacing from site features depicted on preliminary site plan provided by C.E.S. NW, Inc. The elevations were estimated from topographic lines depicted on the site plan. The locations and elevations of the test pits should be considered accurate only to the degree implied by the method used. These approximate locations are shown on Plate 2.

The field exploration was continuously monitored by a geologist from our firm, who classified the soils encountered, maintained a log of each test pit, obtained representative samples, and observed pertinent site features. All samples were visually classified in accordance with the Unified Soil Classification System that is presented on the "Legend," Plate A1. Logs of the test pits are presented on Plates A2 through A11. The final logs represent our interpretations of the field logs and the results of the laboratory tests on field samples. The stratification lines on the logs represent the approximate boundaries between soil types. In actuality, the transitions may be more gradual. Representative soil samples were collected and returned to our laboratory for further examination and testing.

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
Coarse-grained soils More than 50% material larger than No. 200 sieve size	Gravel and gravelly soils More than 50% coarse fraction retained on No. 4 Sieve	Clean gravels (little or no fines)		GW / gw	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP / gp	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		Gravels with fines (appreciable amount of fines)		GM / gm	Silty gravels, gravel-sand-silt mixtures
				GC / gc	Clayey gravels, gravel-sand-clay mixtures
	Sand and sandy soils More than 50% coarse fraction passing No. 4 Sieve	Clean sand (little or no fines)		SW / sw	Well-graded sands, gravelly sands, little or no fines
				SP / sp	Poorly-graded sands, gravelly sands, little or no fines
		Sands with fines (appreciable amount of fines)		SM / sm	Silty sands, sand-silt mixtures
				SC / sc	Clayey sands, sand-clay mixtures
Fine-grained soils More than 50% material smaller than No. 200 sieve size	Silts and clays	Liquid limit less than 50		ML / ml	Inorganic silts and very fine sands, rock flour, silty-clayey fine sands, clayey silts with slight plasticity
				CL / cl	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL / ol	Organic silts and organic silty clays of low plasticity
	Silts and clays	Liquid limit greater than 50		MH / mh	Inorganic silts, micaceous or diatomaceous fine sand or silty soils
				CH / ch	Inorganic clays of high plasticity, fat clays
				OH / oh	Organic clays of medium to high plasticity, organic silts
Highly organic soils				PT / pt	Peat, humus, swamp soils with high organic contents

Topsoil		Humus and duff layer
Fill		Highly variable constituents

The discussion in the text of this report is necessary for a proper understanding of the nature of the material presented in the attached logs. Dual symbols are used to indicate borderline soil classification.

C	TORVANE READING, tsf
qu	PENETROMETER READING, tsf
W	MOISTURE, % dry weight
P	SAMPLER PUSHED
*	SAMPLE NOT RECOVERED
pcf	DRY DENSITY, lb. per cubic ft.
LL	LIQUID LIMIT, %
PI	PLASTIC INDEX

2" O.D. SPLIT SPOON SAMPLER

2.4" I.D. RING OR SHELBY TUBE SAMPLER

WATER OBSERVATION WELL

DEPTH OF ENCOUNTERED GROUNDWATER DURING EXCAVATION

SUBSEQUENT GROUNDWATER LEVEL WITH DATE

Earth Consulting Incorporated

LEGEND - A1

Test Pit Log

Project Name: Merrill Ranch			Sheet 1 of 1
Job No. 12716	Logged by: SJS	Date: 12/29/05	Test Pit No.: TP-1
Excavation Contractor: Aikins' Excavating			Approx. Ground Surface Elevation: 395'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of topsoil and sod 6", grass
			1		SM	Brown silty SAND, loose, moist
			2			-becomes medium dense
	18.0		3			
			4			-moderate caving
			5		GP	Brown poorly graded GRAVEL with sand, medium dense, moist
	6.7		6			-infiltration rate at 5.5' of 33 inches/hour -2.4% fines
			7			
			8			-becomes wet
	9.4		9			-0.1% fines
			10			
			11			
			12			
	6.7		13			Test pit terminated at 13' below existing grade. No groundwater encountered during excavation.

Earth Consulting Incorporated

Test Pit Log
Merrill Ranch
Pierce County, Washington

Proj. No. 12716	Dwn. DNM	Date 10/25/06	Checked SJS	Date 10/25/06	Plate A2

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

BV TEST PIT LOG 12716.GPJ ECI.GDT 11/13/06

Test Pit Log

Project Name: Merrill Ranch			Sheet 1 of 1
Job No. 12716	Logged by: SJS	Date: 12/29/05	Test Pit No.: TP-3
Excavation Contractor: Aikins' Excavating			Approx. Ground Surface Elevation: 400'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of topsoil and sod 4", grass
			1		SM	Brown silty SAND, loose, moist
			2			
			3			-becomes medium dense
			4			
			5			
	17.6		6			
			7			
			8			-contains lenses of poorly graded sand
			9			
	14.9		10			
			11		GP	Gray poorly graded GRAVEL, medium dense, moist
			12			-light sloughing
						Test pit terminated at 12.5' below existing grade. No groundwater encountered during excavation.

Earth Consulting Incorporated

Test Pit Log
Merrill Ranch
Pierce County, Washington

Proj. No.	Dwn.	Date	Checked	Date	Plate
12716	DNM	10/25/06	SJS	10/25/06	A4

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

BV TEST PIT LOG 12716.GPJ ECI.GDT 11/13/06

Test Pit Log

Project Name: Merrill Ranch				Sheet 1 of 1
Job No. 12716	Logged by: SJS	Date: 12/29/05	Test Pit No.: TP-5	
Excavation Contractor: Aikins' Excavating			Approx. Ground Surface Elevation: 402'	
Notes:				

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions:
	13.1		1 2		SP-SM	Brown poorly graded SAND with silt and gravel, loose, moist -11.1% fines -becomes medium dense
	13.4		3 4 5 6 7 8		SM	Gray silty SAND with gravel, medium dense to dense, moist -iron oxide staining
	2.0		9 10		SP	Gray poorly graded SAND, medium dense, moist Test pit terminated at 10' below existing grade. No groundwater encountered during excavation.

Earth Consulting Incorporated

Test Pit Log
Merrill Ranch
Pierce County, Washington

Proj. No. 12716	Dwn. DNM	Date 10/25/06	Checked SJS	Date 10/25/06	Plate A6

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

BV TEST PIT LOG 12716.GPJ ECI.GDT 11/13/06

Test Pit Log

Project Name: Merrill Ranch				Sheet 1 of 1
Job No. 12716	Logged by: SJS	Date: 12/29/05	Test Pit No.: TP-7	
Excavation Contractor: Aikins' Excavating			Approx. Ground Surface Elevation: 393'	
Notes:				

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions:
	23.1		1–5		SM	Brown silty SAND, medium dense, moist
	4.2		5–8		GP	Gray poorly graded GRAVEL, medium dense, moist
						Test pit terminated at 8.5' below existing grade. No groundwater encountered during excavation.

Earth Consulting Incorporated

Test Pit Log
Merrill Ranch
Pierce County, Washington

Proj. No.	Dwn.	Date	Checked	Date	Plate
12716	DNM	10/25/06	SJS	10/25/06	A8

Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

BV TEST PIT LOG 12716.GPJ ECI.GDT 11/13/06

Test Pit Log

Project Name: Merrill Ranch			Sheet 1 of 1
Job No. 12716	Logged by: SJS	Date: 12/29/05	Test Pit No.: TP-9
Excavation Contractor: Aikins' Excavating			Approx. Ground Surface Elevation: 391'
Notes:			

General Notes	W (%)	Graphic Symbol	Depth Ft.	Sample	USCS Symbol	Surface Conditions: Depth of topsoil and sod 5", grass
			1		SM	Brown silty SAND, medium dense, moist
			2			
			3		SP	Gray poorly graded SAND, medium dense, moist
	8.8		4			
			5			
			6			
			7		GP	Gray poorly graded GRAVEL with sand, medium dense, moist
	3.7		8			
						Test pit terminated at 8.5' below existing grade. No groundwater encountered during excavation.

BV TEST PIT LOG 12716.GPJ ECI.GDT 11/13/06

Earth Consulting Incorporated

Test Pit Log
Merrill Ranch
Pierce County, Washington

Proj. No. 12716	Dwn. DNM	Date 10/25/06	Checked SJS	Date 10/25/06	Plate A10

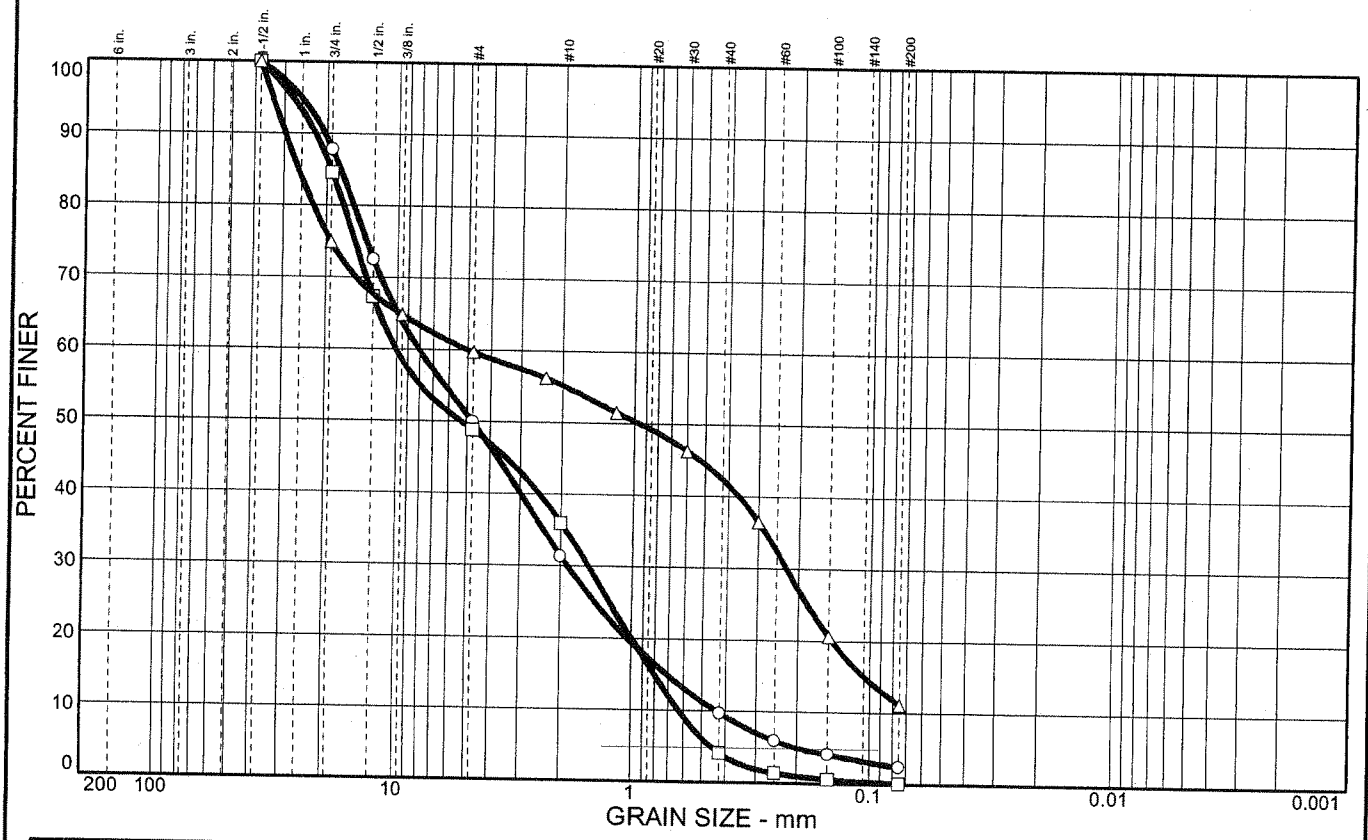
Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgment. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

APPENDIX B

LABORATORY TEST RESULTS

E-12716

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		50.0	47.6	2.4		GP			
□		51.1	48.8	0.1		GP			
△		40.3	48.6	11.1		SP-SM			

SIEVE inches size	PERCENT FINER ○	□	△
1.5	100.0	100.0	100.0
0.75	87.8	84.6	74.9
0.5	72.5	67.3	
3/8			64.8
	GRAIN SIZE		
D_{60}	8.06	10.1	5.00
D_{30}	1.87	1.52	0.226
D_{10}	0.440	0.631	
	COEFFICIENTS		
C_c	0.98	0.36	
C_u	18.34	15.99	

SIEVE number size	PERCENT FINER ○	□	△
#4	50.0	48.9	59.7
#8			56.2
#10	31.4	36.0	
#16			51.5
#30			46.3
#40	9.7	4.1	
#50			36.5
#60	5.9	1.4	
#100	4.1	0.6	20.6
#200	2.4	0.1	11.1

SOIL DESCRIPTION

○ TP-1: 5.5' - GP
Brown poorly graded gravel with sand
Moisture:6.7%

□ TP-1: 8.5' - GP
Brown poorly graded gravel with sand
Moisture:9.4%

△ TP-5: 2' - SP-SM
Brown poorly graded sand with silt and gravel
Moisture:13.1%

REMARKS:

○ Sampled by:SJS
Tested by:TBD

□ Date:01/05/06
Sampled by:SJS
Tested by:TBD

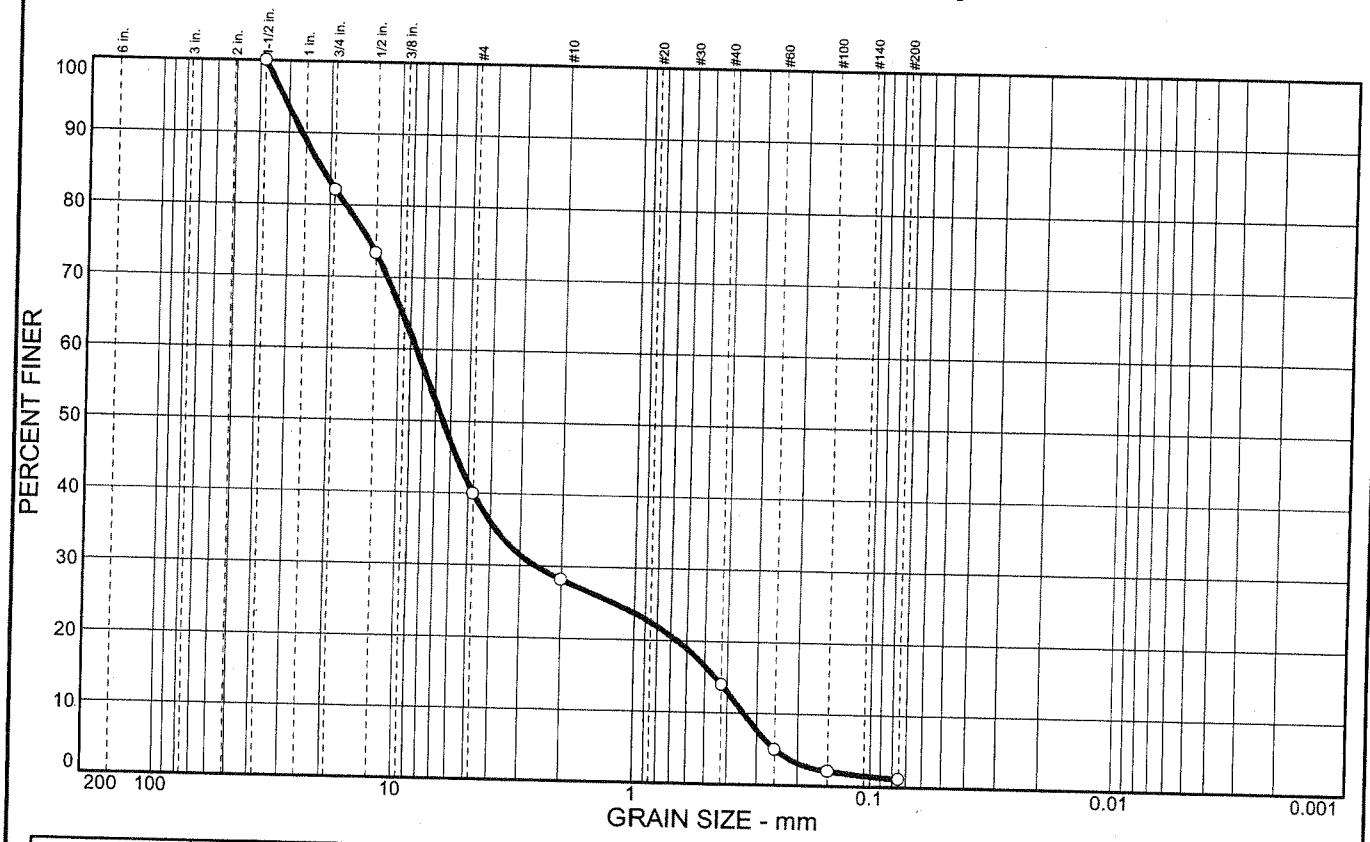
△ Date:1/9/05
Sampled by:SJS
Tested by:TBD

○ Source: Sample No.: TP-1 Elev./Depth: 5.5'
□ Source: Sample No.: TP-1 Elev./Depth: 8.5'
△ Source: Sample No.: TP-5 Elev./Depth: 2'

EARTH CONSULTANTS, INC.

Client: Alpha Development Corporation
Project: Merrill Ranch, Pierce County, Washington
Project No.: 12716 Plate B1

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		60.0	38.9	1.1		GW			

SIEVE Inches size	PERCENT FINER ○
1.5	100.0
0.75	82.1
0.5	73.4

	GRAIN SIZE
D_{60}	8.46
D_{30}	2.56
D_{10}	0.342

	COEFFICIENTS
C_c	2.27
C_u	24.73

SIEVE number size	PERCENT FINER ○
#4	40.0
#10	28.2
#40	13.9
#60	5.0
#100	2.1
#200	1.1

SOIL DESCRIPTION

○ TP-8: 9' - GW
Gray well-graded gravel with sand
Moisture:4.0%

REMARKS:

○ Date:01/05/06
Sampled by:SJS
Tested by:TBD

○ Source: Sample No.: TP-8 Elev./Depth: 9'

EARTH CONSULTANTS, INC.

Client: Alpha Development Corporation
Project: Merrill Ranch, Pierce County, Washington
Project No.: 12716 Plate B3

APPENDIX C

USDA TEST PIT LOGS

E-12716

Test Pit TP-1 **Approximate elevation—395'**

Depth (feet)	USCS	USDA Soil Classification
0–0.5	TPSL	Topsoil
0.5–4.5	SM	Brown, sandy LOAM, loose, moist
4.5–13	GP	Brown, extremely gravelly coarse SAND, medium dense to dense, moist - 18% moisture at 2.5' - 2.4% fines, 6.7% moisture at 5.5' - infiltration test conducted at 5.5' - 9.4% moisture at 8.5' - 6.7% moisture at 12.5'

Test Pit TP-2 **Approximate elevation—420'**

Depth (feet)	USCS	USDA Soil Classification
0–0.5	TPSL	Topsoil
0.5–3	SM	Brown, sandy LOAM, medium dense, moist
3–9	SM	Brown, gravelly sandy LOAM, very dense, moist (Glacial Till) - 8.4% moisture at 4'

Test Pit TP-3 **Approximate elevation—400'**

Depth (feet)	USCS	USDA Soil Classification
0–0.5	TPSL	Topsoil
0.5–11	SM	Brown, sandy LOAM, loose, moist - becomes medium dense at 3' - 17.6% moisture at 6' - contains lenses of sand at 8' - 14.9% moisture at 10'
11–12.5	GP	Gray, extremely gravelly coarse SAND, medium dense, moist - light sloughing at 11.5'

USDA TEST PIT LOGS, Continued

E-12716

Test Pit TP-4		Approximate elevation—396'
Depth (feet)	**USCS**	**USDA Soil Classification**
0–0.5	TPSL	Topsoil
0.5–3	SM	Brown, sandy LOAM, loose, moist - becomes medium dense at 2'
3–5	GP	Gray, extremely gravelly coarse SAND, medium dense, moist
5–6	SP	Gray, very gravelly coarse SAND, medium dense, moist - 11.8% moisture at 6 feet

Test Pit TP-5		Approximate elevation—402'
Depth (feet)	**USCS**	**USDA Soil Classification**
0–0.5	TPSL	Topsoil
0.5–3	SP-SM	Brown, sandy LOAM, loose, moist - becomes medium dense at 2' - 13.1% moisture and 11.1% fines at 2'
3–8.5	SM	Gray, gravelly sandy LOAM, medium dense to dense, moist - 13.4% moisture at 4' - iron oxide staining at 7'
8.5–10	SP	Gray, very gravelly coarse SAND, medium dense, moist - 2% moisture at 9.5'

Test Pit TP-6		Approximate elevation—393'
Depth (feet)	**USCS**	**USDA Soil Classification**
0–0.5	TPSL	Topsoil
0.5–2.5	SM	Brown, sandy LOAM, loose, moist - 29.9% moisture at 2 feet
2.5–3	SM	Brown, extremely gravelly sandy LOAM, dense, moist
3–8.5	SP	Gray, very gravelly coarse SAND, medium dense, moist - 5% moisture and 0.8% fines at 4.5' - Infiltration test conducted at 4.5' - 5.3% moisture at 7'
8.5–12	GP	Gray, extremely gravelly coarse SAND, medium dense, moist - 5.3% moisture, 1.8% fines at 9'

USDA TEST PIT LOGS, Continued

E-12716

Test Pit TP-7 **Approximate elevation—393'**

Depth (feet)	USCS	USDA Soil Classification
0–0.5	TPSL	Topsoil
0.5–5	SM	Brown, sandy LOAM, medium dense, moist - 23.1% moisture at 3'
5–8.5	GP	Gray, extremely gravelly coarse SAND, dense, moist - 4.2% moisture at 8'

Test Pit TP-8 **Approximate elevation—392'**

Depth (feet)	**USCS**	**USDA Soil Classification**
0–0.5	TPSL	Topsoil
0.5–1	SM	Brown, sandy LOAM, medium dense, moist (Fill) - contains miscellaneous household debris
1–5	SM	Brown, sandy LOAM, medium dense, moist
5–8	GP	Gray, extremely gravelly coarse SAND, medium dense, moist - 3.7% moisture and 0.2% fines at 5' - Infiltration test conducted at 5'
8–12	GW	Gray, extremely gravelly coarse SAND, medium dense, moist - 4% moisture, 1.1% fines at 9'

Test Pit TP-9 **Approximate elevation—391'**

Depth (feet)	**USCS**	**USDA Soil Classification**
0–0.5	TPSL	Topsoil
0.5–3	SM	Brown, sandy LOAM, loose, moist
3–6.5	SP	Gray, very gravelly coarse SAND, medium dense, moist - 8.8% moisture at 5'
6.5–8.5	GP	Gray, extremely gravelly coarse SAND, medium dense, moist - 3.7% moisture at 8'

USDA TEST PIT LOGS, Continued

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Test Pit TP-10 **Approximate elevation—393'**

Depth (feet)	USCS	USDA Soil Classification
0–0.5	TPSL	Topsoil
0.5–2	SM	Brown, sandy LOAM, loose, moist
2–8	GP	Gray, extremely gravelly coarse SAND, medium dense, moist - 3% moisture at 3.5' - 4.5% moisture at 7.5'

DISTRIBUTION

E-12716

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