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GEOTECHNICAL EVALUATION REPORT

PROPOSED SINGLE-FAMILY RESIDENCE
19300 NORTHWEST GILLIHAN ROAD
PORTLAND (SAUVIE ISLAND), OREGON

1/20/4

2N1W14A 00100

19300 NW
Gillihan Rd

01-130153 RS

Prepared for

MR. MARION SKORO
19300 NORTHWEST GILLIHAN ROAD
PORTLAND, OREGON 97231

Prepared by
Professional Services Industries, Inc.
6032 N. Cutter Circle, Suite 480
Portland, Oregon 97217
Telephone (503) 289-1918

PSI REPORT NO. 704-05222-1

November 28, 2000

psi *Information To Build On*
Engineering • Consulting • Testing

November 28, 2000

Mr. Marion Skoro
19300 Northwest Gillihan Road
Portland, Oregon 97231

Subject: Geotechnical Evaluation Report
Proposed Single-Family Residence at 19300 Northwest Gillihan Road
Portland (Sauvie Island), Oregon

Dear Mr. Skoro:

Professional Service Industries, Inc. (PSI) is pleased to submit our Geotechnical Evaluation Report for the above referenced project. The purpose of this service was to assist you, the architect, and the engineer in designing foundations and preparing plans and specifications for construction of the new single-family residence. The evaluation was completed in general accordance with our Proposal No. 704-00-P128, dated November 1, 2000. Written authorization for our services was provided by you on November 7, 2000. We are enclosing this summary report along with our formal detailed geotechnical evaluation report for your review.

Summary of Results

One Standard Penetration Test (SPT) soil boring (B-1) was completed in the proposed project area. The general soil profile was about 4 inches of topsoil underlain by moist, fine to medium coarse sand to a depth of 20 feet where a gray, fine sandy silt containing some wood particles was encountered to a depth of 35 feet. A fine gray sand was found to underlie the silt strata to the maximum depth of the 61-1/2 foot deep mud rotary soil boring. Groundwater was observed in the explorations performed on November 15, 2000 at a depth of approximately 11 feet below existing grade.

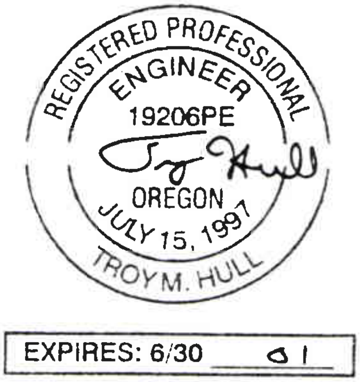
Summary of Recommendations

Based on the results of our soil borings, it is our opinion that the proposed building can be supported on conventional, shallow spread footings designed for a net maximum allowable soil bearing pressure of 2,000 pounds per square foot (psf) when founded on the sand strata, or on an engineered structural fill placed on this strata. Due to the closeness of the footing to the existing river bank and future potential erosion from the adjacent Columbia River, we highly recommend the footings be supported by piling to protect against undermining during a major erosion event. The use of 3" pin pile (galvanized) driven full length (approximately 21 feet) below grade into the medium dense sand on a grid of four feet on alternating sides of the footing should provide reasonable protection to future potential erosion events. If piles are not used to support the structure, we recommend a seismic study be performed to evaluate the potential for liquefaction and lateral spread to verify the appropriateness of a shallow foundation system. After the site has been stripped of topsoil, the concrete floor slab may be placed over the sand strata after the subgrade has been proofrolled to confirm its firmness.

General

Please refer to the attached report for a more detailed summary of our analysis and recommendations. If we can provide additional assistance or observation and testing services during construction, please do not hesitate to contact Charles Lane at (503) 289-1778, or (800) 783-6985.

Sincerely,
Professional Service Industries, Inc.



Charles R. Lane, P.E.
Senior Geotechnical Engineer

Troy Hull, P.E.
Department Manager

Attachment: Geotechnical Evaluation Report

cc: Bob Schatz, Architect
2118 Southeast Division Street
Portland, Oregon 97202

Benchmark Engineering
2905 Southeast Oakgrove Boulevard, Suite 8
Milwaukie, Oregon 97267

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Geotechnical Evaluation Report
Proposed Single-Family Residence at 19300 Northwest Gillihan Road
Portland (Sauvie Island), Oregon
November 28, 2000

1.0 Introduction

Professional Service Industries, Inc. (PSI) has conducted a geotechnical evaluation for the above referenced project site in general accordance with the scope of work as outlined in our proposal to Mr. Skoro. Written authorization for our services was provided by Mr. Skoro on November 7, 2000.

2.0 Proposed Construction

Construction proposed at this site is anticipated to consist of a single-family residence to replace an existing residence. The new home will be constructed on the outside and on the dike that protects Sauvie Island and will have a floor and footings approximately 8 feet below the top of the dike. Wall and column loads are not currently known, and have been assumed to be on the order of 1 to 2 kips per lineal foot and 10 to 20 kips, respectively. Maximum fills on the order of 2 feet are anticipated. The location of the site is shown on the attached Site Location Plan, Figure 1.

3.0 Scope of Work

The purpose of our evaluation was to assess the subsurface soil conditions at the site in order to provide appropriate recommendations for site preparation and foundation design. In general, our evaluation included the following authorized scope of work items:

3.1 Subsurface Exploration

In order to ascertain soil conditions at the site, one Standard Penetration Test soil borings (B-1) was made using a truck-mounted, hollow-stem, power auger equipped with an automatic hammer. Soil boring locations are shown on the attached Soil Boring Location Diagram, Figure 2. Logs of the borings are also attached.

The Standard Penetration Test is performed by driving a 2-inch, O.D., split-spoon sampler into the undisturbed formation located at the bottom of the advanced auger with repeated blows of a 140-pound, pin-guided, automatic hammer falling a vertical distance of 30 inches. The number of blows required to drive the sampler on foot is a measure of the soil consistency. It should be noted that automatic hammers generally produce lower standard penetration test values tan those obtained using a traditional safety hammer. Studies have generally indicated that penetration resistances may vary by a factor of 1.5 to 2 between the two methods. We have considered this drilling and testing methodology in our description of soil consistency, and in our evaluation of soil strength and compressibility.

Soil samples were taken at 2.5-foot intervals for the first 10 feet, and then at 5-foot intervals to the termination depths of the borings. Samples were identified in the field, placed in sealed containers, and transported to the laboratory for further classification and testing.

3.2 Laboratory Testing

Selected samples of the subsurface soils encountered were returned to our laboratory for further evaluation to aid in classification of the materials, and to help assess their strength and compressibility characteristics. The laboratory evaluation consisted of visual and textural examinations.

State of Oregon Geotechnical Hole Reports were submitted to the Oregon Water Resources Department as required by OAR 690-240-035 for each geotechnical boring 18 feet or greater in depth. Copies of these reports are attached.

3.3 Engineering Analyses

Engineering analyses and recommendations regarding general foundation design including allowable soil bearing pressures, minimum footing depth requirements, and estimates of foundation settlement are included in this report. In addition, recommendations were developed addressing site preparation, placement and compaction of fill materials, and site preparation of the floor slab areas.

The geotechnical recommendations presented in this report are based solely on the available project information, building location, and the subsurface materials described in this report. If any of the noted information is incorrect, please inform us in writing so that we may amend the recommendations presented in this report, if appropriate and if desired by the client. PSI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

The scope of services did not include a Seismic Site Hazard Investigation in accordance with Section 1804.2.1 of the 1998 State of Oregon Structural Specialty Code, or an environmental evaluation for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air, on or below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for information purposes.

4.0 Surface and Subsurface Features

4.1 Site Description

The site is presently occupied by a much smaller house that is being moved with the new home constructed on the river side of the dike in the area of the previous home, but with a much larger foot print. The site not covered by the existing house is grass covered.

4.2 Soils

Soils in the area consist of the man-made dike that protects Sauvie Island from the flood waters of the Columbia River. The dike is principally a fine to medium coars sand which overlies the alluvial, firm sandy silt that in turn overlies that alluvial, fine sand of the Columbia River.

The soil profile described above is generalized to highlight the major subsurface stratification features and material characteristics. The boring log included in the Appendix should be reviewed for specific information at individual test locations. These records include soil descriptions, stratifications and location of the samples. The stratifications shown on the exploration log represent the conditions only at the actual test location. Variations may occur and should be expected between locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on these exploration logs. The samples that were not altered by laboratory testing will be retained for 60 days from the date of this report and then they will be discarded.

4.3 Groundwater

Groundwater was encountered in boring B-1 at a depth of 11 feet at the time of drilling. We anticipate that the groundwater table may rise during months of peak runoff. Variations in groundwater levels should be expected seasonally, annually, and from location to location. We recommend the contractor determine the actual groundwater levels at the site a the time of the construction activities.

4.4 Seismic Considerations

The site falls within seismic Zone 3 with a seismic zone factor of 0.3 as classified by the 1998 State of Oregon Structural Specialty Code, an amendment to the Uniform Building Code, 1997 edition. Based on the local geology and the soil conditions encountered, the soil profile at the site is S_E with site coefficients of C_a = 0.54 and C_v = 0.85 (Table 16J, 16Q, and 16R). Our evaluation of the subsurface conditions at the site did not include an evaluation of the potential for soil liquefaction, or landslide hazards associated with a seismic event at the site, or in the vicinity of the project site. A site specific seismic evaluation was beyond the present scope of services for this project. Such an evaluation could be performed at an additional fee with your written authorization.

5.0 Conclusions and Recommendations

Based on the results of our field work, laboratory evaluation, and engineering analyses, it is our opinion that the site is suitable for the proposed structure and associated improvements provided the following recommendations are incorporated into the design and construction of the project.

5.1 Site Preparation

In general, we recommend that all structural improvement areas be drained of surface water, and stripped of surface vegetation, topsoil materials, highly saturated or disturbed soil, and any other deleterious materials encountered at the time of construction.

We envision that initial site preparation will consist of topsoil stripping, where applicable. We anticipate that topsoil stripping of the surface soils to a depth of 2 to 6 inches may be required. Additional site preparation will depend upon the proposed site grades and building features. Any footings, walls, slabs-on-grade, and pavements associated with the previous structures should be completely removed and disposed of off-site. Prior to backfilling any excavations with structural fill, the area should be observed by a representative of the geotechnical engineer to ensure that the above items have been properly removed, and the exposed subgrade is ready for fill placement.

All required structural fill materials placed in the building area should be moisture conditioned to with +/- 2 percent of optimum moisture content and compacted by mechanical means to a minimum of 95 percent of the material's maximum dry density as determined in accordance with ASTM D 1557 (Modified Proctor). Fill materials should be placed in layers that, when compacted, do not exceed about 8 inches.

5.2 Excavations

Excavation and construction operations may expose the on-site soils to inclement weather conditions. The stability of exposed soils may rapidly deteriorate due to precipitation or the action of heavy or repeated construction traffic. Accordingly, foundation and pavement area excavations should be adequately protected from the elements, and from the action of repetitive or heavy construction loadings.

5.2.1 Excavations/Slopes

Temporary earth slopes may be cut near vertical to heights of 4 feet. Excavations deeper than 4 feet should be performed in accordance with Department of Labor Occupational Safety and Health Administration (OSHA) guidelines for Type C soil. Job site safety is the responsibility of the project contractor.

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended it "Construction Standards for Excavations", 29 CFR, Part 1926, Subpart P. This document was issued to better insure the safety of personnel entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavations, or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and, if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal state regulations.

We are providing this information solely as a service to our client. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

5.3 Foundation Support

Based on the results of our soil borings, it is our opinion that the proposed building can be supported on conventional shallow spread footings designed for a net maximum allowable soil bearing pressure of 2,000 pounds per square foot (psf) when founded on the sand strata, or on an engineered structural fill placed on this strata. Continuous footings should extend a minimum depth of 18 inches beneath the lowest adjacent exterior grade in order to provide frost protection.

The allowable soil bearing pressure of 2,000 psf is intended for dead loads and sustained live loads can be increased by one-third for the total of all loads, including short-term wind or seismic loads.

Due to the closeness of the footings to the existing river bank and future potential erosion, we recommend the footing be placed on piling to protect against undermining during a major erosion event. The use of 3" pin pile (galvanized) driven full length (approximately 21 feet) below grade in the dense sand on a grid of four feet on alternate sides of the footing should provide reasonable short term protection to future potential erosion events.

Allowable lateral frictional resistance between the base of footings and the subgrade can be expressed as the applied vertical load multiplied by a coefficient of friction of 0.30. In addition, lateral loads may be resisted by passive earth pressures based on an equivalent fluid density of 250 pounds per cubic foot (pcf) for footings poured "neat" against in-situ soils or properly backfilled with structural fill. The recommended values above include a factor of safety of approximately 1.5, which is appropriate due to the amount of movement required to develop full passive resistance.

We estimate that foundations designed and constructed in accordance with the above recommendations will experience total settlements generally less than 1 inch with differential settlements generally less then ½ inch.

If the footings are placed on structural fill, the compacted fill should extend laterally one foot away from the edges of the footings for each one foot of fill below the footings when placed adjacent to a downhill slope. They may be excavated near vertical where the surface soils extend out level some distance, therefore providing a confining soil pressure against the fill. This oversizing, where a downhill slope is adjacent to the footing, is important to provide sufficient lateral stability in the fill soils directly below the footings.

If footings are constructed during wet weather, it may be necessary to protect the foundation excavation bottoms from disturbance during construction activities. In this regard, we recommend that a 3 to 4 inch thickness of crushed rock be placed at the bottom of the footing excavations immediately after the excavation is completed. If footings are constructed during the drier summer months, this crushed rock layer should not be required.

5.4 Retaining Walls

Lateral earth pressures on wall which are not restrained at the top, such as retaining walls, etc., may be calculated on the basis of an equivalent fluid pressure of 35 pcf for level backfill and 60 pcf for steeply sloping backfill. Walls that are restrained from yielding at the top may be calculated on the basis of an equivalent fluid pressure of 55 pcf for level backfill and 90 pcf for steeply sloping backfill. Lateral loads may be resisted by passive earth pressures acting against footings, and by frictional resistance between foundation elements and supporting soils. An equivalent fluid density of 250 pcf and a friction factor of 0.30 may be used for design for foundations bearing on and resisted by native soils, or structural fills supported on native soils. The recommended equivalent fluid density includes a factor of safety of 1.5, which is appropriate due to the amount of movement required to develop full passive resistance.

All backfill for retaining walls, foundation walls, etc., should be select granular material (sand and/or sandy gravel). We anticipate that on-site, native and fill soils will not be suitable for this purpose, and that it will be necessary to import material to the project for structure backfill. Native soils can be used for the last 18 to 24 inches of backfill, thus acting as a seal at the top of the granular backfill.

All backfill behind walls should be moisture conditioned to within +/- 2 percent of optimum moisture content and compacted by mechanical means to a minimum of 90 percent of the material's maximum dry density as determined in accordance with ASTM D 1557 (Modified Proctor). Fill materials should be placed in layers that, when compacted, do not exceed about 6 inches. Care in the placement and compaction of fill behind walls must be taken in order to insure that undue lateral loads are not placed on the walls.

5.5 Drainage Considerations

Any areas of the building which are to be developed below the exterior site grade must be provided with a well-designed drainage system in order to control hydrostatic pressures against walls, seepage of groundwater through basement wall, etc.

Under no circumstances should surface runoff water be led into foundation drains. Foundation drains should be placed at the base of footings in order to prevent surface and shallow perched water from migrating beneath the footings.

Surface run-off from roofs, parking areas, etc., should be tightlined to approved disposal areas.

5.6 Floor Slab Support

The proposed slab-on-grade may be supported on structural fills placed over subgrade after the removal of topsoil, and the upper soils have been proof rolled with a fully loaded dump truck in order to confirm their firmness. Any soft or otherwise unsuitable areas observed should be over-excavated down to firm subgrade and replaced with structural fill.

Where concrete slabs are designed as beams on an elastic foundation, the compacted subgrade should be assumed to have a modulus of subgrade reaction of 150 pounds per cubic inch.

In order to provide uniform subgrade reaction beneath any proposed floor slab-on-grade, we recommend that floor slabs be underlain by a minimum of 6 inches of free-draining (a maximum particle size of ¾ inch with less than 5 percent material passing the No. 200 sieve), well-graded gravel or crushed rock base course. Base course material should be moisture conditioned to within +/- 2 percent of optimum moisture content and compacted by mechanical means to a minimum of 95 percent of the material's maximum dry density as determined in accordance with ASTM D 1557 (Modified Proctor). Fill materials should be placed in layers that, when compacted, do not exceed about 8 inches.

The crushed rock should provide a capillary break to limit migration of moisture through the slab. If additional protection against moisture vapor is desired, a vapor retarding membrane may also be incorporated into the design. Factors such as cost, special considerations for construction, and the floor coverings suggest that decisions on the use of vapor retarding membranes be made by the architect and owner.

5.7 Construction Monitoring

It is recommended that PSI be retained to examine and identify soil exposures created during project excavations in order to verify that soil conditions are as anticipated. We further recommend that the structural fills be continuously observed and tested by our representative in order to evaluate the thoroughness and uniformity of their compaction. If possible, samples of fill materials should be submitted to our laboratory for evaluation prior to placement of fills on site.

It is also recommended that PSI be retained to provide observation and testing of construction activities involved in the foundation, earthwork, and related activities of this project. PSI cannot accept any responsibility for any conditions which deviated from those described in this report, nor for the performance of the foundation if not engaged to also provide construction observation and testing for this project.

Costs for the recommended observations during construction are beyond the scope of this current consultation. Such future services would be at an additional charge.

6.0 General

Our conclusions and recommendations described in this report are subject to the following general conditions:

6.1 Use of Report

This report is for the exclusive use of the addressee and their representative to use to design the proposed structure described herein and prepare construction documents. The data, analyses, and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us. In the absence of our written approval, we make no representation and assume no responsibility to other parties regarding this report.

6.2 Level of Care

The recommendations contained in this report are based on the available subsurface information obtained by PSI, and design details furnished for the proposed project. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project.

Services performed by the geotechnical engineer for this project have been conducted with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area. Nor warranty, expressed or implied, is made.

Sincerely,
Professional Services Industries, Inc.

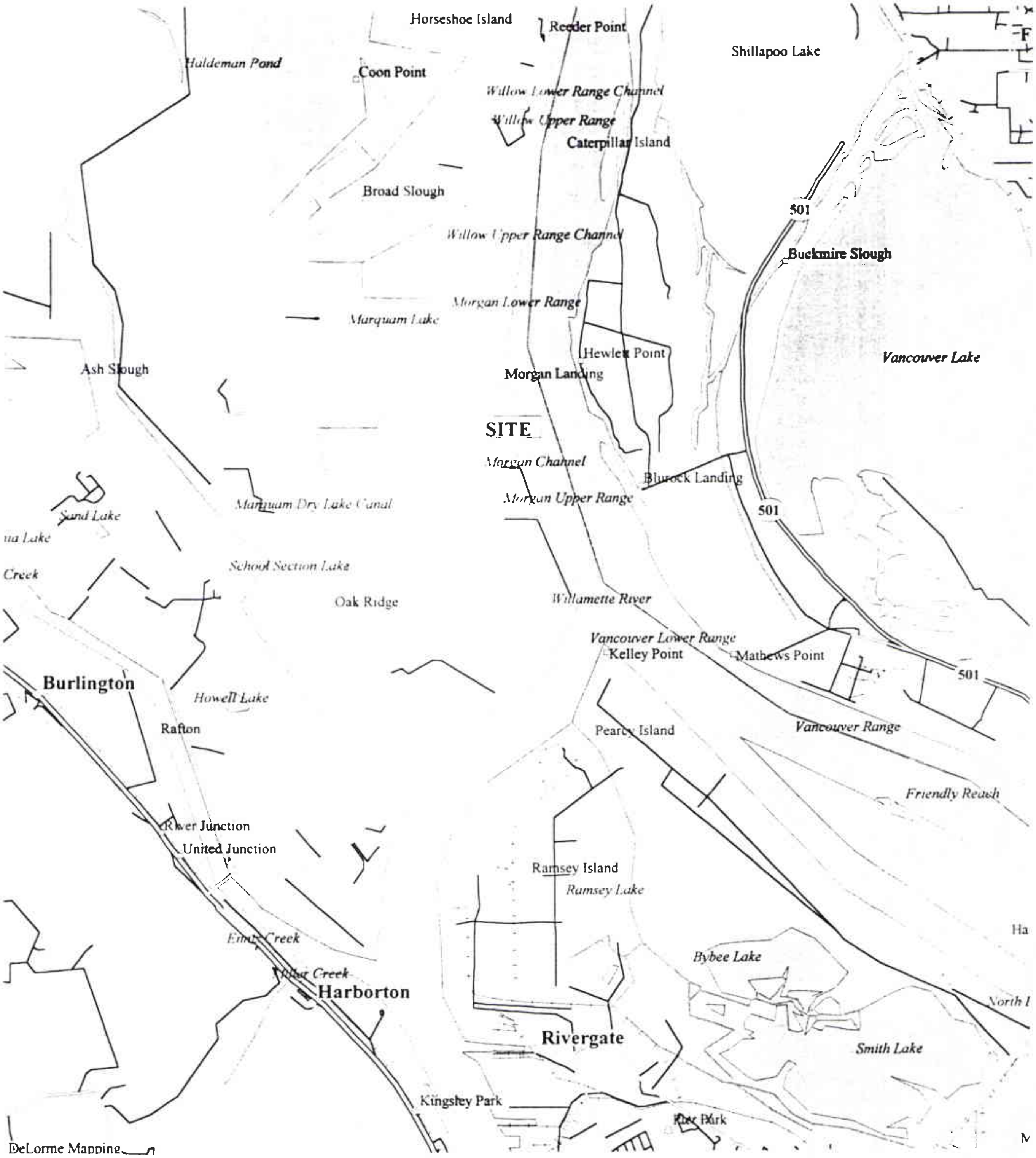
REGISTERED PROFESSIONAL ENGINEER 5944 OREGON JULY 14 1967 CHARLES R. LANE
ex 12-31-00

REGISTERED PROFESSIONAL ENGINEER 19206PE OREGON JULY 15, 1997 TROY M. HULL
EXPIRES: 6/30 01

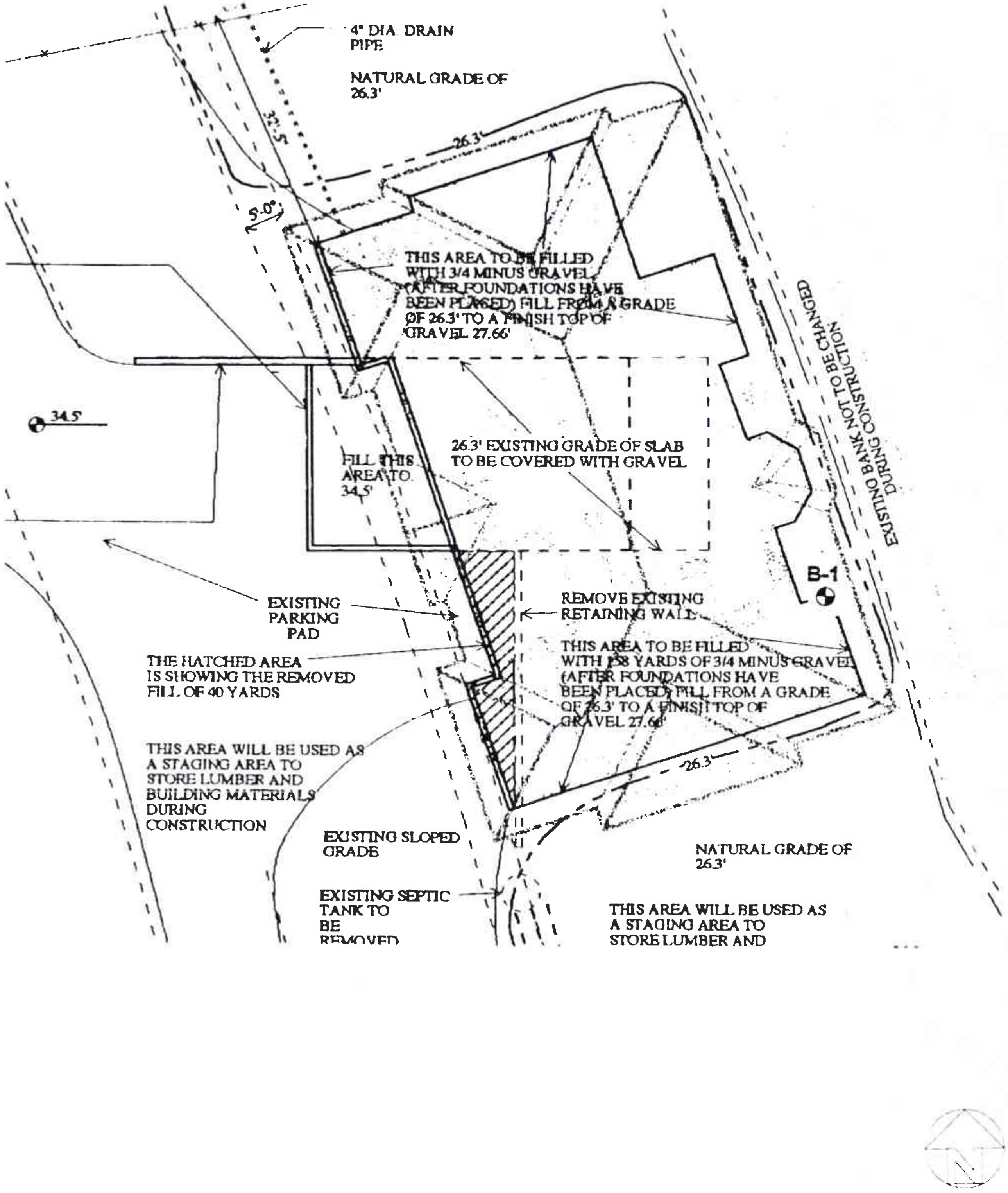
Charles R. Lane, P.E.
Senior Geotechnical Engineer

Troy Hull, P.E.
Department Manager

Attachments: Site Location Map
Boring Location Plan
Boring Log
General Notes
Soil Classification Chart



psi	SITE LOCATION MAP NEW SINGLE-FAMILY RESIDENCE MR. MARION SKORO 19300 N.W. GILLIHAM ROAD SAUVIE ISLAND PORTLAND, OREGON	DRAWN BY: R.F. JOB NO: 704-05222 DATE: 11-21-00 DRAWING NO: 1 OF 1 FIGURE NO: 1 SCALE: N.T.S.



psi

BORING LOCATION PLAN
NEW SINGLE-FAMILY RESIDENCE
MR. MARION SKORO
19300 N.W. GILLIHAM ROAD
SAUVIE ISLAND
PORTLAND, OREGON

DRAWN BY: R.F.
JOB NO: 704-05222
DATE: 11-21-00
DRAWING NO: 1 OF 1
FIGURE NO: 2
SCALE: 1"=20'

LOG OF TEST BORING NO. B-1

CLIENT: Mr. Marion Skoro
PROJECT: Single-family Residence

LOCATION: 19300 NW Gillihan Road, Portland
PSI PROJECT NUMBER: 704-05222
SURF. ELEV.:

DATE OF EXPLORATION: 11/15/2000
EQUIPMENT: CME 75 mud rotary w/auto hammer
LOGGED BY: Charles Lane, P.E.
BORING LOCATION: River Side of Existing House

DEPTH, FT.	SAMPLES	SOIL DESCRIPTION	SYMBOL	U.S.C.S. CLASS	MOISTURE CONTENT(%)	N-VALUE BLOWS PER FT	POCKET PEN(tsf)	% PASSING #200 SIEVE	REMARKS
	SPT 1	TOPSOIL - 4" of brown silt SAND - a fine to medium coarse sand, loose to medium dense		SP		6			
	SPT 2					7			
5	SPT 3					9			
	SPT 4					6			
10	SPT 5					6			
15	SPT 6					14			
20	SPT 7	SANDY SILT - a gray fine sandy silt containing some wood particles, soft to medium stiff		MLS		4			
25	SPT 8					4			
30	SPT 9					6			
35	SPT 10	SAND - a fine gray sand, loose to medium dense, occasional layers of silty sand		SP		8			
40	SPT 11					18			
45									

BL PTLD 05222.GPJ PSI CORP.GDT 11/28/00

psi
6032 North Cutter Circle, Suite 480
Portland, Oregon 97217-0126
(800) 783-6985

LOG OF TEST BORING NO. B-1

CLIENT: Mr. Marion Skoro
PROJECT: Single-family Residence

LOCATION: 19300 NW Gillihan Road, Portland
PSI PROJECT NUMBER: 704-05222

DATE OF EXPLORATION: 11/15/2000
EQUIPMENT: CME 75 mud rotary w/auto hammer
LOGGED BY: Charles Lane, P.E.
BORING LOCATION: River Side of Existing House

DEPTH, FT.	SAMPLES	SOIL DESCRIPTION	SYMBOL	U.S.C.S. CLASS	MOISTURE CONTENT(%)	N-VALUE (BLOWS PER FT)	POCKET PEN(tsf)	% PASSING #200 SIEVE	REMARKS
	SPT 12					6			
50	SPT 13					13			
55									
60	SPT 14					7			
65									
70									
75		Boring terminated at 61-1/2 feet below existing grade. Groundwater was encountered at 11 feet below grade after drilling. Boring backfilled with granular bentonite on 11/15/00.							
80		Stratification lines/depths shown are approximate. Actual soil and rock conditions encountered during construction may vary from those described above.							
85									
90									

BL PTLD 05222.GPJ PSI CORP.GDT 11/28/00

psi
6032 North Cutter Circle, Suite 480
Portland, Oregon 97217-0126
(800) 783-6985

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

N:	Standard Penetration Value: Blows per foot of 140 pound hammer falling 30 inches on a standard split-spoon penetrometer.
Qu:	Unconfined compressive strength (tsf).
Qp:	Penetrometer value, unconfined compressive strength (tsf).
Mc:	Water content (%).
LL:	Liquid limit (%).
PI:	Plasticity index (%).
δd:	Natural dry density (pcf).
▽:	Apparent groundwater level at time noted after completion.

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon - 1 3/8" I.D., 2" O.D.
SB:	Spilt-Barrel - 2 3/8" I.D., 3" O.D.
ST:	Shelby Tube - 3" O.D., except where noted.
BS:	Bulk Sample.
AU:	Auger Sample.
DB:	Diamond Bit.
CB:	Carbide Bit.
WS:	Washed Sample.

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

TERM (NON-COHESIVE SOILS)	STANDARD PENETRATION RESISTANCE
Very Loose	4 or less
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	Over 50

TERM (COHESIVE SOILS)	QU - (TSF)
Very Soft	0 - 0.25
Soft	0.25 - 0.50
Medium Stiff	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00 +

PARTICLE SIZE

Boulders	8 in +	Coarse Sand	5mm-0.6mm	Silt	0.074 mm-0.005mm
Cobbles	8 in-3 in	Medium Sand	0.6mm-02mm	Clay	0.005mm
Gravel	3 in-5 mm	Fine Sand	0.2mm-0.074mm		

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO 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 (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS