REPORT

GEOTECHNICAL CONSULTATION

PROPOSED RESIDENCE

7100 BLOCK, SOUTHEAST 35TH STREET

MERCER ISLAND, WASHINGTON

FOR

MR. ART PEDERSON

GeoEngineers

May 9, 1989

Consulting Geotechnical
Engineers and Geologists

Mr. Art Pederson
4735 West Mercer Way
Mercer Island, Washington 98040

Dear Mr. Pederson:

Report
Geotechnical Consultation
Proposed Residence
7100 Block, Southeast 35th Street
Mercer Island, Washington
File No. 1700-01-6

INTRODUCTION

This report presents the results of our geotechnical consultation at the site of your proposed residence on Southeast 35th Street on Mercer Island. The scope of our services was based on discussions with your architect, Mr. Steve Myrvang, and a surface reconnaissance of the site. Written authorization for our services was provided by you on April 26, 1989. No plan of the site has been provided. The location and dimensions of the site were provided verbally by Mr. Myrvang.

We understand that you are planning to construct a two- or three-story residence to be supported by a combination of piles and spread footings. We further understand that the City of Mercer Island requires that a geotechnical study be completed in order to satisfy the Department of Community Development Guideline No. 22.

The purpose of our work is to provide you with recommendations and design criteria for the geotechnical aspects of the new residence and to address the City's requirements for a geotechnical study. Our specific scope of services includes:

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1. Review currently available information regarding soil and ground water conditions in the vicinity of the site.
2. Perform a geologic reconnaissance of the site and adjacent areas.
3. Explore subsurface conditions at the site by means of hand-dug test pits and auger holes.
4. Develop recommendations for foundation support of the structure, including shallow and deep foundation support as appropriate.
5. Provide design parameters for the lateral resistance of the structure, including lateral earth pressures for use in the design of walls or piles, as required.
6. Provide recommendations for site grading and earthwork, including compaction and fill material requirements.
7. Provide recommendations for surface and subsurface drainage requirements, including erosion control.

SITE CONDITIONS

The site is located immediately south of Southeast 35th Street (extended) and immediately west of the existing residence at 3507 - 72nd Avenue Southeast, as shown on the Site Plan, Figure 1. The site is rectangular in shape, and measures 112.5 feet east-west by 100 feet north-south. Existing residential housing borders the site on all sides.

The site is situated within a westward sloping swale. The physical control for developing the Site Plan was based on two property corner stakes in the northwest and southwest corners and the site dimensions provided. The accuracy of the site features as shown on our Site Plan should be regarded accordingly.

The site slopes steeply downward at about 45 degrees for about 8 to 15 feet from the east property line to a moderately sloping area at about 15 degrees that comprises the main portion of the site. About 30 feet from the west property line, the slope steepens to about 35 degrees

through a vertical height of 30 feet to a 20-foot-wide nearly level bench west of the site. The total relief from the east property line to the bench west of the site is approximately 70 feet, yielding an overall slope of 2H:1V (horizontal to vertical). The north property line is bordered by a rockery and fill embankment varying in height from 5 to 10 feet. The topography of the property to the south is similar.

The site is vegetated with scattered deciduous trees, primarily maple and five relatively large and straight-trunked Douglas fir trees. The understory consists of moderately dense brush.

Shallow subsurface soil and ground water conditions were evaluated by excavating three test holes using hand tools at the locations shown on our Site Plan, Figure 1. Test holes were excavated by a geological engineer from our firm who selected the exploration locations, identified the soils encountered, observed ground water conditions and maintained a detailed log of each exploration. Soils encountered were classified in general accordance with the Unified Soil Classification System described in Figure 2. Logs of the test holes are presented in Figure 3.

The test holes indicate that the near-surface soils across the site consist of 4 to 6 inches of forest duff and topsoil underlain by a loose to medium dense silty sand or sand with silt with variable amounts of gravel to the maximum depth of 42 inches of the test holes. The soils appeared to grade to dense at the maximum depth of the explorations. Based on our previous experience and geologic mapping in the site area, we expect that the soil deposits described above are underlain by glacially consolidated soil.

Based on our observations of the surface topography, the 45-degree sloping embankment bordering the east side of the site probably is fill. No other fill is expected on the remainder of the site.

No surface water or ground water was observed during our site reconnaissance or in the test holes.

CONCLUSIONS AND RECOMMENDATIONS

It is our opinion that the proposed residence may be satisfactorily supported using spread footing and/or pile support, provided that the footings and/or piles are supported on dense to very dense glacially consolidated soil. It must be understood that there is an inherent stability risk associated with any hillside construction; however, it is our opinion that the risk is small for the design life of the residence provided the recommendations in this report are followed.

The on-site soils are moisture sensitive with regard to earthwork performed during wet weather. We recommend that foundation construction be performed only during periods of prolonged dry weather.

SPREAD FOOTINGS

Spread footings should be founded on the dense to very dense or hard glacially consolidated soil. This should typically require the excavation depth for the footings to range up to 3-1/2 feet deep. In the event the footing excavations do not encounter glacially consolidated soil, the footing may be overexcavated and replaced with structural fill, or the allowable bearing pressure should be reduced. We recommend that all footing excavations be examined by a representative of our firm to determine that suitable bearing soils have been exposed. Any unsatisfactory material encountered in these excavations should be overexcavated to the depth determined by our representative.

We recommend that all exterior spread footings be set back at least 5 feet from the top of the steep slope along the west property line and have a minimum depth of embedment below lowest adjacent finished grade of 18 inches. Interior spread footings should also be set back as previously described and have a minimum embedment of 12 inches below lowest adjacent finished grade. Individual column footings and continuous wall footings should have minimum widths of 18 and 15 inches, respectively. Spread footings designed and constructed as recommended above may be designed using an allowable bearing value of 2000 pounds per square foot (psf).

This bearing value applies to the total of all dead plus long-term live loads exclusive of the weight of the footing and any overlying backfill. An increase in this value of up to one-third may be made when considering wind or seismic loading.

We expect that spread footings will experience less than a 1/2-inch settlement for the allowable design loads and will occur essentially immediately on their application. This magnitude of settlement can normally be accommodated by residential structures.

PILE FOUNDATIONS

The building or a portion thereof may also be supported on concrete piles that are drilled down into dense to very dense or hard glacially consolidated soils. The piles may be located on the steep slope along the west property line if required. The following design criteria are based on our experience with using piles at similar sites. We expect a zone of up to 3-1/2 feet of weathered soil that is subject to movement down-slope. For design of piles within this upper 3-1/2-foot zone, we recommend an active lateral load equivalent to a fluid weighing 50 pcf applied over two pile diameters. Passive resistance below the 3-1/2-foot depth may be designed using an equivalent fluid density of 200 pcf. Providing that the pile tip is embedded in dense to very dense or hard glacially consolidated soil and has a minimum embedment depth of 5 feet, an end bearing capacity of 8000 psf is recommended for downward acting loads. The end bearing capacity may be increased to 10,000 psf for a minimum embedment depth of 8 feet.

LATERAL SOIL PRESSURES

Lateral soil pressures which act on subsurface walls will be a function of the nature and compaction of the backfill. In addition, hydrostatic pressure from ground water must be considered.

Assuming the soil behind the wall is drained and the backfill surface is inclined at 15 degrees or less, we recommend a design active lateral earth pressure equivalent to a fluid weighing 40 pcf. We recommend this value be increased to 60 pcf for walls constructed closer than a distance

0.5H from the toe of steeper than 15-degree slopes or rockeries. The value H corresponds to the height of the excavation.

For lateral soil resistance we recommend a passive earth pressure equivalent to 300 pcf where the ground is relatively level. Where the ground surface slopes down at approximately 15 degrees, we recommend this value be reduced to 200 pcf. For conventional walls, a coefficient of friction of 0.4 can be used between the base of the wall and the soil to provide additional lateral resistance.

SITE GRADING AND EARTHWORK

We recommend the building site be stripped of vegetation and significant organic material including tree roots greater than 4 inches in diameter. We expect that the stripping depths will be quite variable, although it appears that up to about 4 to 6 inches will be necessary in most areas. Greater depths will be necessary in areas with thick vegetation and trees. This material should be wasted off site.

As mentioned previously, the prevailing on-site soil is moisture sensitive, difficult to operate on and very difficult to compact during wet weather. Rubber-tired vehicles and even foot traffic disturb this type of soil when it is above optimum moisture. It also has a moderate erosion potential in place but is easily transported by running water. Therefore, silt fences and other measures will be necessary to control erosion and sediment transport during construction. The forest duff acts as a protective layer to the surficial soil and should be removed only where and when necessary.

Those areas which are stripped or excavated to design subgrade elevations or are to receive structural fill should be probed with a steel rod. Any soft, loose or otherwise unsuitable areas identified during probing should be recompacted if practical or removed and replaced with structural fill. We recommend the probing of the subgrade be observed by a representative from our firm to assess the adequacy of the subgrade conditions and to identify areas needing remedial work.

Structural Fill and Fill Placement: We recommend that fills at the site be kept to a minimum height of 5 feet and no additional soil be imported to the site. All fill necessary in the building area and on slopes should be placed as compacted structural fill subsequent to probing and remedial work as appropriate. The fill should be placed in horizontal lifts not exceeding 10 inches in loose thickness. Each lift must be conditioned to the proper moisture content and then uniformly compacted. Fill placed in the building area should be compacted to at least 95 percent of the maximum dry density as determined by the ASTM D-1557 test procedure.

Fill placed on slopes steeper than 4H:1V should be appropriately benched and keyed into dense native soils. We recommend permanent structural fill slopes be no steeper than 2H:1V. The compaction equipment should be run over the edge of the fill to provide good compaction or the fill can be overbuilt by several feet and cut back to the required slope. Hydroseeding or other erosion protection should be applied immediately.

All structural fill material should be free of organics, debris and other deleterious material with no individual particles larger than 5 inches in diameter. As the amount of fines (that portion passing the No. 200 sieve) increases, the soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve, particularly during wet weather. Generally, soils containing more than about 5 percent fines by weight cannot be properly compacted when the moisture content is more than a few percent from optimum.

Most of the on-site soils that are expected to be available for fill possess a fines content greater than 5 percent such that this material could not be used for structural fill except during periods of extended dry weather. It may be necessary to moisture condition this soil by adding water or drying out as appropriate to reach optimum moisture content for compaction.

DRAINAGE

Runoff from the roof of the planned residence or from other impermeable areas such as patios and driveways should not be allowed to discharge on the site. Runoff must be properly collected and tightlined away from the site to a suitable discharge point. We also recommend that irrigation systems be carefully controlled to avoid excessive amounts of water entering the soil.

EROSION

The soils underlying the site have a high potential for erosion during construction. Temporary erosion control will be necessary and should include the proper control of surface water runoff, minimizing the time of exposure in the area stripped during site preparation, and prompt revegetation.

USE OF THIS REPORT

We have prepared this report for use by Mr. Art Pederson and your architect and engineer for developing a portion of this project. GeoEngineers should be retained to review design plans when developed to see that our conclusions and recommendations have been interpreted as intended and also to examine the subgrade before pouring the concrete footings.

The scope of this investigation does not include services related to construction safety precautions and our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described herein.

The hand-dug explorations are considered limited in evaluating subsurface conditions. The glacially consolidated soils were not actually penetrated by our explorations, but were interpreted to exist at a depth where hand digging became difficult due to the apparent dense conditions of the soils encountered.

We strongly recommend that our firm be retained to provide monitoring and consultation during construction to confirm that the conditions

encountered are consistent with those indicated by the explorations and provide recommendations for changes should the conditions revealed during construction differ from those anticipated.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No other conditions, express or implied, should be understood.

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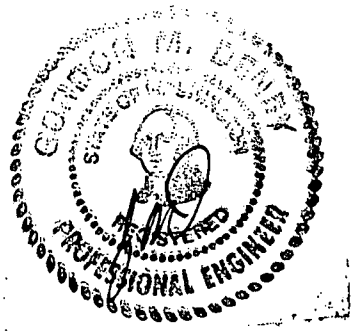
If there are any questions concerning this report or if we can provide additional services, please call.

Yours very truly,

GeoEngineers, Inc.



Brian R. Beaman
Geological Engineer

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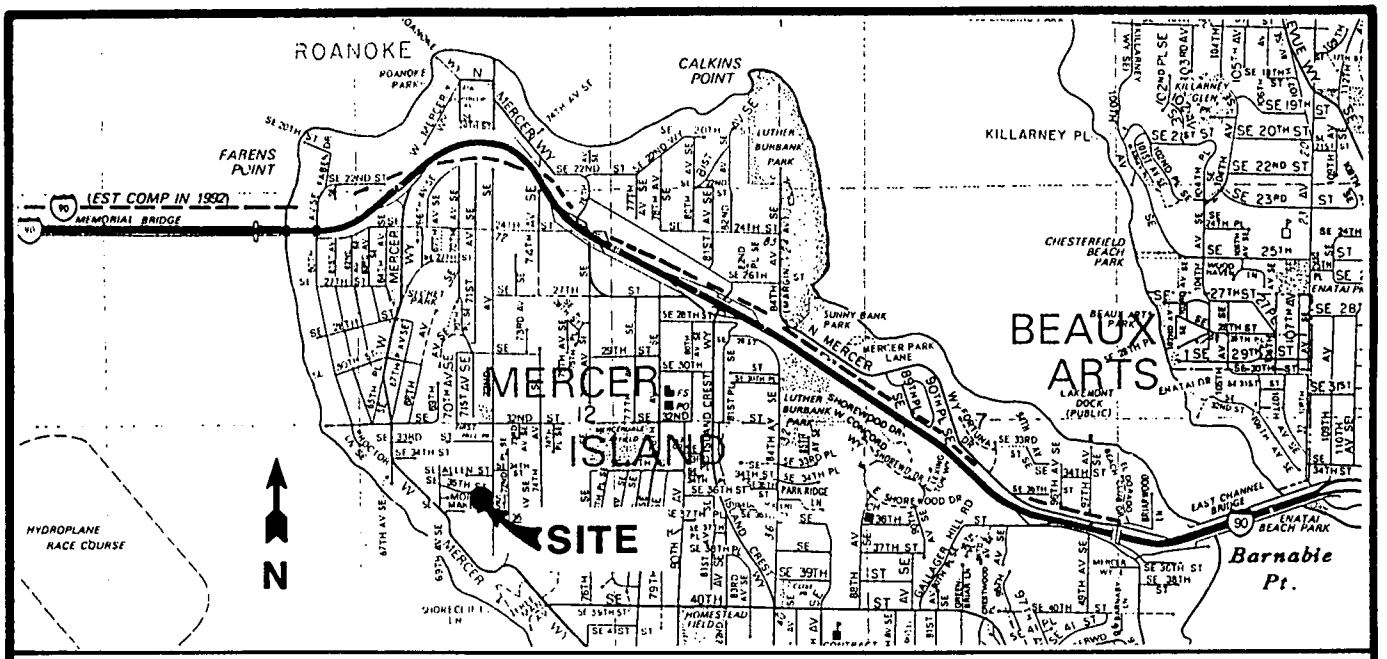
Associate

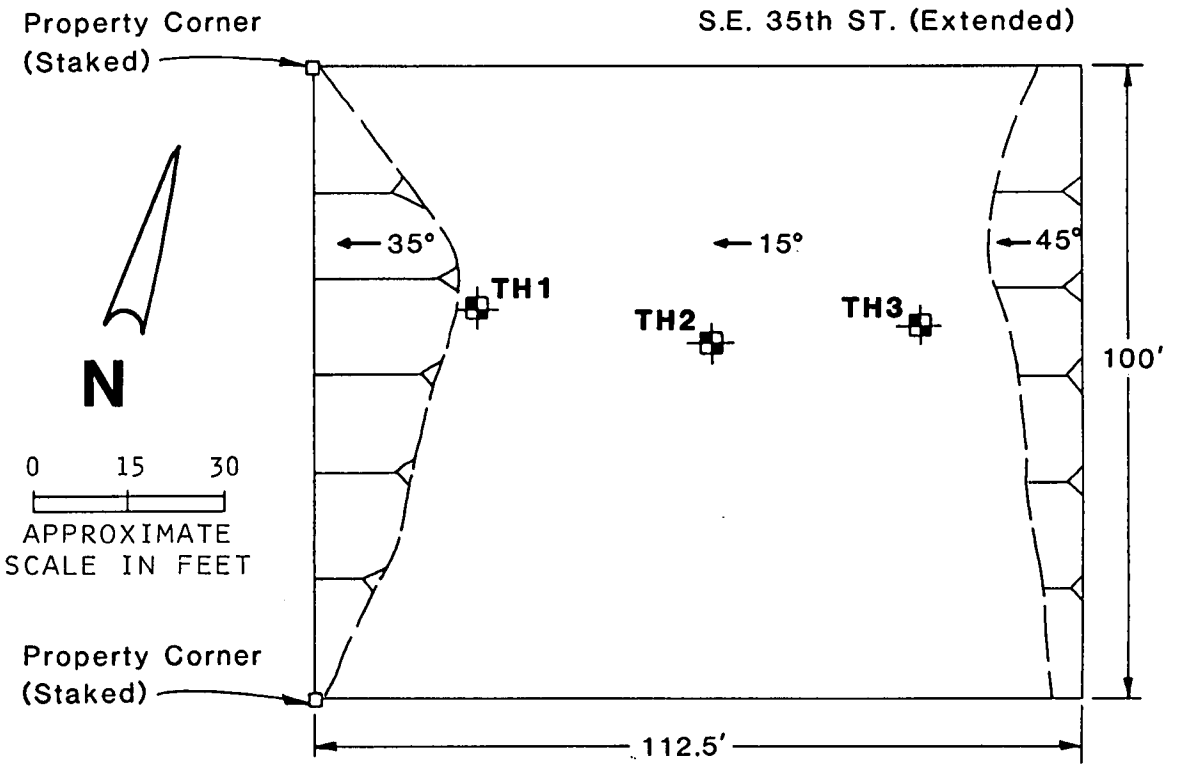
BRB:GMD:cs

Three copies submitted

Attachments



VICINITY MAP No Scale



NOTE: SITE DIMENSIONS ARE BASED ON LIMITED FIELD CONTROL AND ROUGH SURVEYING TECHNIQUES.

EXPLANATION:

TH1 TEST PIT LOCATION AND NUMBER

←15° DOWN SLOPE INCLINATION AND DIRECTION

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SITE PLAN

FIGURE 1

1700-01-6 BRB:KKT 5-5-89

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50% OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS MORE THAN 50% PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-83.
2. Soil classification using laboratory tests is based on ASTM D2487-83.
3. Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry – Absence of moisture, dusty, dry to the touch

Moist – Damp, but no visible water

Wet – Visible free water or saturated, usually soil is obtained from below water table

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SOIL CLASSIFICATION SYSTEM

FIGURE 2

GEI 85-88

LOG OF TEST HOLE

DEPTH BELOW GROUND SURFACE (INCHES)	GROUP SOIL CLASSIFICATION SYMBOL	DESCRIPTION
		TEST HOLE 1
0 - 4"		FOREST DUFF AND TOPSOIL
4" - 18"	SM	BROWN SILTY FINE SAND WITH A TRACE OF GRAVEL (MEDIUM DENSE, MOIST)
18" - 30"	SP-SM	BROWN FINE TO MEDIUM SAND WITH SILT AND GRAVEL (MEDIUM DENSE, MOIST)
		GRADES TO DENSE AT 30 INCHES
		TEST HOLE COMPLETED AT 30 INCHES ON 4/27/89
		OCCASIONAL ROOTS TO 18 INCHES
		NO FREE GROUND WATER OBSERVED
		TEST HOLE 2
0 - 4"		FOREST DUFF AND TOPSOIL
4" - 18"	SM	BROWN SILTY FINE SAND WITH A TRACE OF GRAVEL (MEDIUM DENSE, MOIST)
18" - 36"	SP-SM	BROWN FINE TO MEDIUM SAND WITH SILT AND GRAVEL (MEDIUM DENSE, MOIST)
		GRADES TO DENSE AT 36 INCHES
		TEST HOLE COMPLETED AT 36 INCHES ON 4/27/89
		OCCASIONAL ROOTS TO 24 INCHES
		NO FREE GROUND WATER OBSERVED
		TEST HOLE 3
0 - 6"		FOREST DUFF AND TOPSOIL
6" - 42"	SM	BROWN SILTY SAND WITH GRAVEL (LOOSE, MOIST)
		GRADES TO GRAY AND MEDIUM DENSE AT 24 INCHES
		GRADES TO DENSE AT 42 INCHES
		TEST HOLE COMPLETED AT 42 INCHES ON 4/27/89
		OCCASIONAL ROOTS TO 18 INCHES
		NO FREE GROUND WATER OBSERVED

GEI 68-88

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LOG OF TEST HOLE

FIGURE 3