GEOTECH
CONSULTANTS, INC.
13256 NE 20th Street, Suite 16
Bellevue, WA 98005
(425) 747-5618
FAX (425) 747-8561

June 15, 1998

JN 98171

Motion Financial Management
c/o Stuart Silk Architects
80 Vine Street, Suite 201
Seattle, Washington 98121

Attention: Stuart Silk

Subject: **Geotechnical Engineering Study**
Proposed Mixed-Use Building
14 Roy Street
Seattle, Washington

Dear Mr. Silk:

We are pleased to present this geotechnical engineering report for the mixed-use building to be constructed in Seattle, Washington. The scope of our work consisted of exploring site surface and subsurface conditions, and then developing this report to provide recommendations for general earthwork and design criteria for foundations, retaining walls, and temporary shoring. Our work was authorized by your acceptance of our proposal, P-4477, dated February 26, 1998.

The subsurface conditions of the proposed building site were explored with four test borings that encountered stiff to hard, clayey silt. In the boring conducted near the southwestern corner of the proposed building, this clayey silt was overlain with approximately 13 feet of sand. The sand was relatively loose to approximately 6 feet below the existing grade. The proposed building can be supported by conventional foundations bearing on the hard, native silt soils or on the dense, native sand. Two underground storage tanks were previously removed from the northwestern portion of the site. In the areas of these tanks, the building should be supported on a deep foundation system such as driven pipe piles or drilled piers, or these foundations could be overexcavated and restored to the footing grade with lean concrete. Shoring against the face of the existing retaining wall on the northern property line will also be a geotechnical concern. The silt soils are sensitive to moisture, and this moisture sensitivity will make wet weather grading more difficult and costly.

The attached report contains a discussion of the study and our recommendations. Please contact us if there are any questions regarding this report, or if we can be of further assistance during the design and construction phases of this project.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.

James H. Strange, Jr.
Geotechnical Engineer

JHS:alt

GEOTECHNICAL ENGINEERING STUDY
Proposed Mixed-Use Building
14 Roy Street
Seattle, Washington

This report presents the findings and recommendations of our geotechnical engineering study for the site of the proposed mixed-use building in Seattle. The Vicinity Map, Plate 1, illustrates the general location of the site.

We were provided with site plans, cross-sections, and a topographic map. Stuart Silk Architects developed these plans, which are dated February 11, 1998. Based on these plans, and discussions with the project architect, we anticipate that the building will have a finished floor elevation of 143 to 145 feet, which is very near the elevation of the existing grade on a majority of the site. The proposed structure will cover nearly all of the site area. New foundations walls will be constructed in front of the existing retaining walls located on the northern and eastern property lines. Three floors of residential space will be constructed above the first floor retail space, and a two-level parking garage will be incorporated into the northern (rear) portion of the proposed structure.

SITE CONDITIONS

Surface

The subject site is located on the northwestern corner of the intersection of Roy Street and First Avenue at the southern toe of Queen Anne Hill. The rectangular property features 120 feet of frontage along First Avenue and 136 feet of frontage along Roy Street. The adjacent lane along Roy Street is a traffic lane, but the closest lane along First Avenue is utilized for street parking.

Currently, the site is developed with a structure that occupies the northern 10 to 20 feet of the property. This structure incorporates a retaining wall along the northern property line. The wall is approximately 15 feet tall, and a 5- to 6-foot-tall rockery is located above the eastern half of the wall. Parking areas are located above the wall and above the rockery. The eastern half of the subject site is surfaced with asphalt and utilized as a pay parking lot. The western half of the property was the site of a restaurant building, but since its demolition this portion of the site has been covered with a layer of quarry rock.

Subsurface

The subsurface conditions were explored by drilling four test borings at the approximate locations shown on the Site Exploration Plan, Plate 2. The field exploration program was based upon the proposed construction and required design criteria, the site topography and access, the subsurface conditions revealed during drilling, and the scope of work outlined in our proposal.

The borings were drilled on April 27, 1998, using a truck-mounted, hollow-stem auger drill. Samples were taken at 5-foot intervals with a standard penetration sampler. This split-spoon sampler, which has a 2-inch outside diameter, is driven into the soil with a 140-pound hammer

falling 30 inches. The number of blows required to advance the sampler a given distance is an indication of the soil density or consistency. A geotechnical engineer from our staff observed the drilling process, logged the test borings, and obtained representative samples of the soil encountered. The Test Boring Logs are attached as Plates 3 through 6.

Our borings generally revealed hard, clayey silt to the maximum explored depth of 31 feet. The silt in Boring 4 (southwestern corner of the site) was overlain by loose to dense sand. The sand became wet and dense at approximately 5 to 7 feet below grade. As part of a previous environmental study, Clayton Environmental Consultants installed two monitoring wells in the southwestern portion of the subject site. These wells also encountered loose sand soils that became dense at 7 to 8 feet below the ground surface.

The final logs represent our interpretations of the field logs. The stratification lines on the logs represent the approximate boundaries between soil types at the exploration locations. The actual transition between soil types may be gradual, and subsurface conditions can vary between exploration locations. The logs provide specific subsurface information only at the locations tested. If a transition in soil type occurred between samples in the borings, the depth of the transition was interpreted. The relative densities and moisture descriptions indicated on the test boring logs are interpretive descriptions based on the conditions observed during drilling.

Groundwater

Groundwater seepage was observed in Boring 4 at a depth of 9 feet. The test borings were left open for only a short time period. Therefore, the seepage levels on the logs represent the location of transient water seepage and may not indicate the static groundwater level. It should be noted that groundwater levels vary seasonally with rainfall and other factors. We anticipate that groundwater could be found in fracture zones in the silt and clay, between the loose sand and the underlying dense sand or above the hard silt.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on our explorations, it is our opinion that development of the subject site with the proposed mixed-use building is feasible from a geotechnical engineering standpoint. The proposed structure can be supported by a conventional foundation bearing on the dense sands and hard silts. Based on the proposed foundation elevations, some overexcavation will be necessary in at least the southwestern portion of the structure to expose the dense sands. Any overexcavation should be backfilled with lean concrete, as structural fill will not provide the necessary strength for the high design bearing capacity. The exception to the limitations on structural fill is the placement of up to 6 inches of washed crushed rock, or 2- to 4-inch spalls over the footing subgrades to protect the bearing surfaces. Substantial overexcavations, driven pipe piling, or drilled piers will be required in the footing areas that extend over the previously backfilled tank excavations. Test pits should be conducted in the backfilled excavations prior to construction. This would help in assessing the most practical foundations to extend through the fill.

Based on the proposed building location, shoring will be necessary along the northern and eastern sides of the site. The existing retaining walls along the northern and eastern sides of the site can be left in place behind the shoring, but weep holes will need to be cored into the existing walls to provide some drainage. Four-inch-diameter holes should be cored through the walls on 5-foot centers. Also, staging of the shoring installation and existing structure demolition should be controlled in order to avoid destabilizing the walls during construction. The existing north wall will be laterally braced to provide stability when the existing building is demolished. We understand that the structural engineer plans to install cantilevered shoring on the interior of the existing northern wall, and possibly the eastern wall. Shoring should be used for all excavations in front of the existing walls.

The site soils are very silty, moisture sensitive, and easily disturbed when wet. Earthwork operations and grading activities undertaken in wet weather will likely be subject to additional costs due to delays and the need to import additional granular fill. Due to their low compacted strength and low permeability, the native silt soils should not be used as structural fill or retaining wall backfill.

The silt encountered in our explorations was originally deposited as lake sediment before being glacially consolidated. These deposits usually contain bedding planes that are often not horizontal. Bedding that dips down into an excavation can sometimes cause localized soil failures in the excavation face. If the bedding dips at an angle close to the installation angle of the tieback anchors, the capacity of the anchors may decrease. Flatter, temporarily cut slopes may be necessary, depending on the bedding encountered during excavation. It would be difficult and very costly to perform the type and the number of explorations needed to determine the dip of the bedding planes prior to starting excavation. Our personnel can assist with remedial procedures, if the bedding becomes a significant consideration during excavation.

Geotech Consultants, Inc. should be allowed to review the final development plans to verify that the recommendations presented in this report are adequately addressed in the design. Such a plan review would be additional work beyond the current scope of work for this study, and it may include revisions to our recommendations to accommodate site, development, and geotechnical constraints that become more evident during the review process.

Conventional Foundations

The proposed structure can be supported on conventional continuous and spread footings bearing on undisturbed, dense sand or hard silt. As previously mentioned, no fill other than a thin, protective layer of angular rock should be placed beneath the structures foundations. We recommend that continuous and individual spread footings have minimum widths of 16 and 24 inches, respectively. They should be bottomed at least 18 inches below the lowest adjacent finish ground surface for frost protection. The local building codes should be reviewed to determine if different footing widths or embedment depths are required. Footing subgrades must be cleaned of loose or disturbed soil prior to pouring concrete. Depending upon site and equipment constraints, this may require removing the disturbed soil by hand.

Some overexcavation will be required below the footings to expose competent native soil. Lean (1½ sack) concrete should be used to fill any overexcavated hole. The overexcavation should extend 6 inches beyond the edges of the footing.

An allowable bearing pressure of 4,000 pounds per square foot (psf) is appropriate for footings constructed according to the above recommendations. A one-third increase in this design bearing pressure may be used when considering short-term wind or seismic loads. For the above design criteria, it is anticipated that the total post-construction settlement of footings founded on competent native soil will be about three-quarters inch, with differential settlements on the order of one-half inch in a distance of 50 feet along a continuous footing.

Lateral loads due to wind or seismic forces may be resisted by friction between the foundation and the bearing soil, or by passive earth pressure acting on the vertical, embedded portions of the foundation. For the latter condition, the foundation must be either poured directly against relatively level, undisturbed soil or surrounded by level structural fill. We recommend using the following design values for the foundation's resistance to lateral loading:

Parameter	Design Value
Coefficient of Friction	0.35
Passive Earth Pressure	350 pcf

Where: (i) pcf is pounds per cubic foot, and (ii) passive earth pressure is computed using the equivalent fluid density.

If the ground in front of a foundation is loose, the passive earth pressure given above will not be appropriate. We recommend a safety factor of at least 1.5 for the foundation's resistance to lateral loading, when using the above design values.

Drilled Concrete Piers

In the location of the previously backfilled tank locations, drilled, concrete-filled piers may be used, if it is uneconomical to excavate to bearing soil. These piers can be attempted with conventional auger drills using open hole methods, but the drilling contractor should have access to casing, in case sloughing occurs in the backfilt soil or wet sands. Where substantial caving is encountered, it would be necessary to use augercast methods or driven piles. If water is in a hole at the time of pouring, the concrete should be tremied to the bottom of the hole.

A wide variety of depths and pier diameters are possible, but we recommend using a minimum pier diameter of 16 inches. The vertical capacity of piles will be developed by a combination of frictional shaft resistance along the embedment length and pile end-bearing.

Parameter	Allowable Value
Pile Shaft Friction	800 psf
Pile End-Bearing	8,000 psf

Where: (i) pcf is pounds per cubic foot.

The above values are valid only for dense or hard soils and assume that the bottom of the pier is embedded a minimum of 10 feet into the competent soils below any loose sand or tank backfill. The base of the pier must be cleaned of loose or disturbed material, and this cleaning may require the use of a bucket auger. Center-to-center pier spacing should be no less than three times the pier diameter.

We appreciate the opportunity to be of service on this project. If you have any questions, or if we may be of further service, please do not hesitate to contact us.

Respectfully submitted,

GEOTECH CONSULTANTS, INC.

James H. Strange, Jr.
Geotechnical Engineer

EXPIRES 10/25/99

Marc R. McGinnis, P.E.
Associate

JHS/MRM: alt

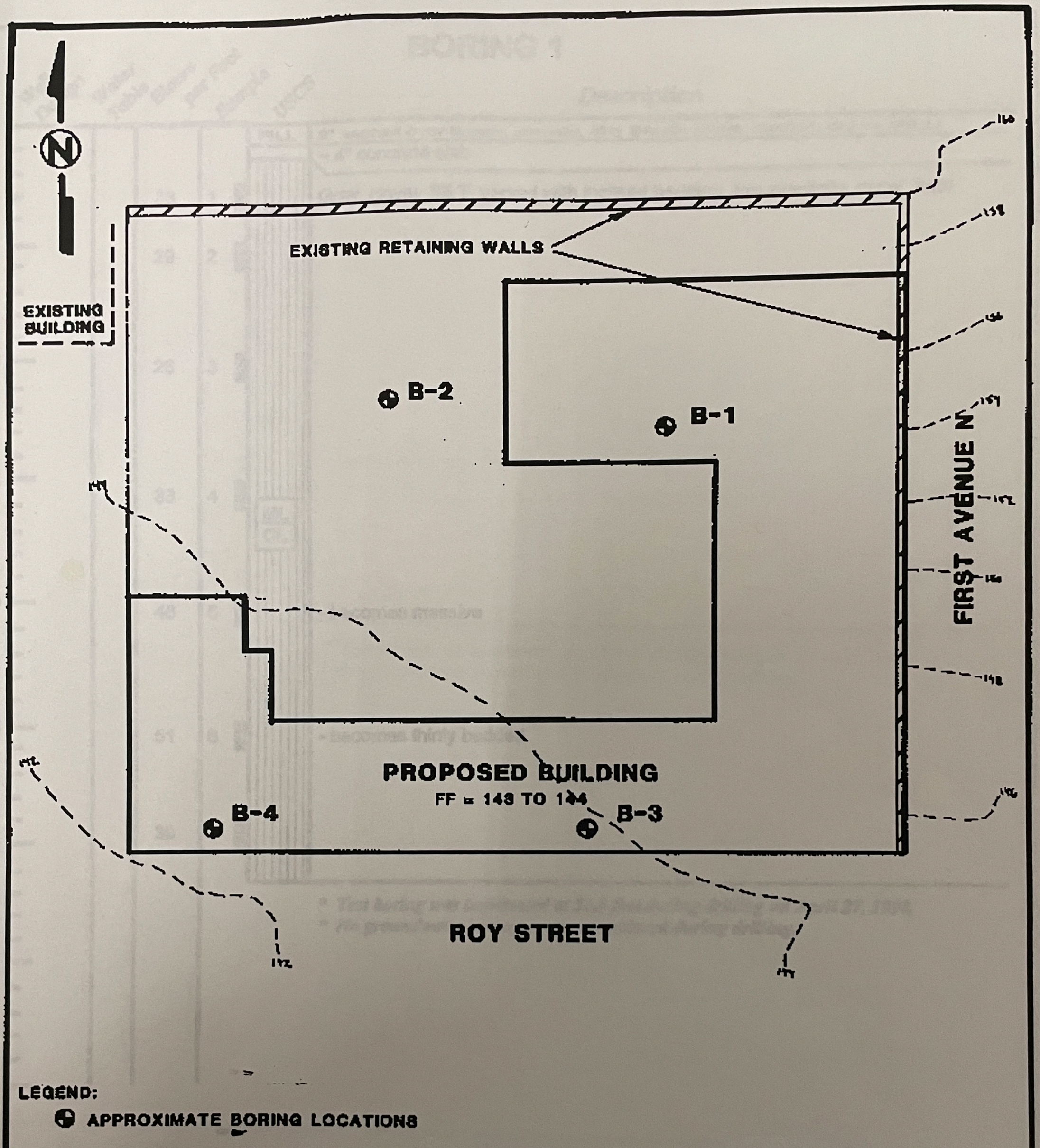
cc: CT Engineering - Craig Roberts

GEOTECH CONSULTANTS

VICINITY MAP

14 ROY STREET
SEATTLE, WA

Job No.:	Date:	Logged By:	Plate:
98171	MAY 1998		- 1



GEOTECH CONSULTANTS

SITE EXPLORATION PLAN

14 ROY STREET

SEATTLE, WA

Job No.:	Date:		Plate:
98171	MAY 1998		2

BORING 1

Well Design	Water Table	Blows per Foot	Sample	USCS	Description
				FILL	2" asphalt over brown, gravelly, silty SAND, moist, medium-dense (FILL)
					~ 4" concrete slab
		33	1		Gray, clayey SILT, varved with inclined bedding, low plasticity, moist, hard
		29	2		
		26	3		
		33	4	ML/CL	
		46	5		- becomes massive
		51	6		- becomes thinly bedded
		39	7		

5 10 15 20 25 30 35 40

* *Test boring was terminated at 31.5 feet during drilling on April 27, 1998.*
* *No groundwater seepage was encountered during drilling.*

GEOTECH
CONSULTANTS, INC.

BORING LOG
14 Roy Street
Seattle, Washington

Job No:	Date:	Logged by:	Plate:
98171	June 1998	JHS	3

BORING 2

Well Design	Water Table	Blows per Foot	Sample	USCS	Description
				ML	Brown, sandy, low plasticity SILT, moist, medium stiff
					- becomes very stiff
5		59	1		Gray, clayey SILT, low plasticity, moist, hard
10		51	2		
				ML/CL	
15		44	3		- becomes blocky, thinly bedded
20		62	4		
25					
30					
35					
40					

* *Test boring was terminated at 21.5 feet during drilling on April 27, 1998.*
* *No groundwater seepage was encountered during drilling.*

GEOTECH
CONSULTANTS, INC.

BORING LOG
14 Roy Street
Seattle, Washington

Job No:	Date:	Logged by:	Plate:
98171	June 1998	JHS	4

BORING 3

Well Design	Water Table	Blows per Foot	Sample	USCS	Description
		38	1	ML CL	Brown, clayey SILT, low plasticity, moist, hard
		42	2		- with some slickensides
		38	3		

5 10 15 20 25 30 35 40

* *Test boring was terminated at 14 feet during drilling on April 27, 1998.*
* *No groundwater seepage was encountered during drilling.*

GEOTECH
CONSULTANTS, INC.

BORING LOG
14 Roy Street
Seattle, Washington

Job No:	Date:	Logged by:	Plate:
98171	June 1998	JHS	5

BORING 4

Well Design	Water Table	Blows per Foot	Sample	USCS	Description
				FILL	Brown, sandy SILT with occasional gravel and wood debris, moist, loose *(FILL)*
		10	1		Brown, gravelly, slightly silty SAND, fine- to medium-grained, moist, loose
		63	2	SP SM	- becomes gray, wet, dense *(hydrocarbon odor noted)*
		40	3	ML CL	Brown, clayey SILT, low plasticity, moist, hard
		29	4		

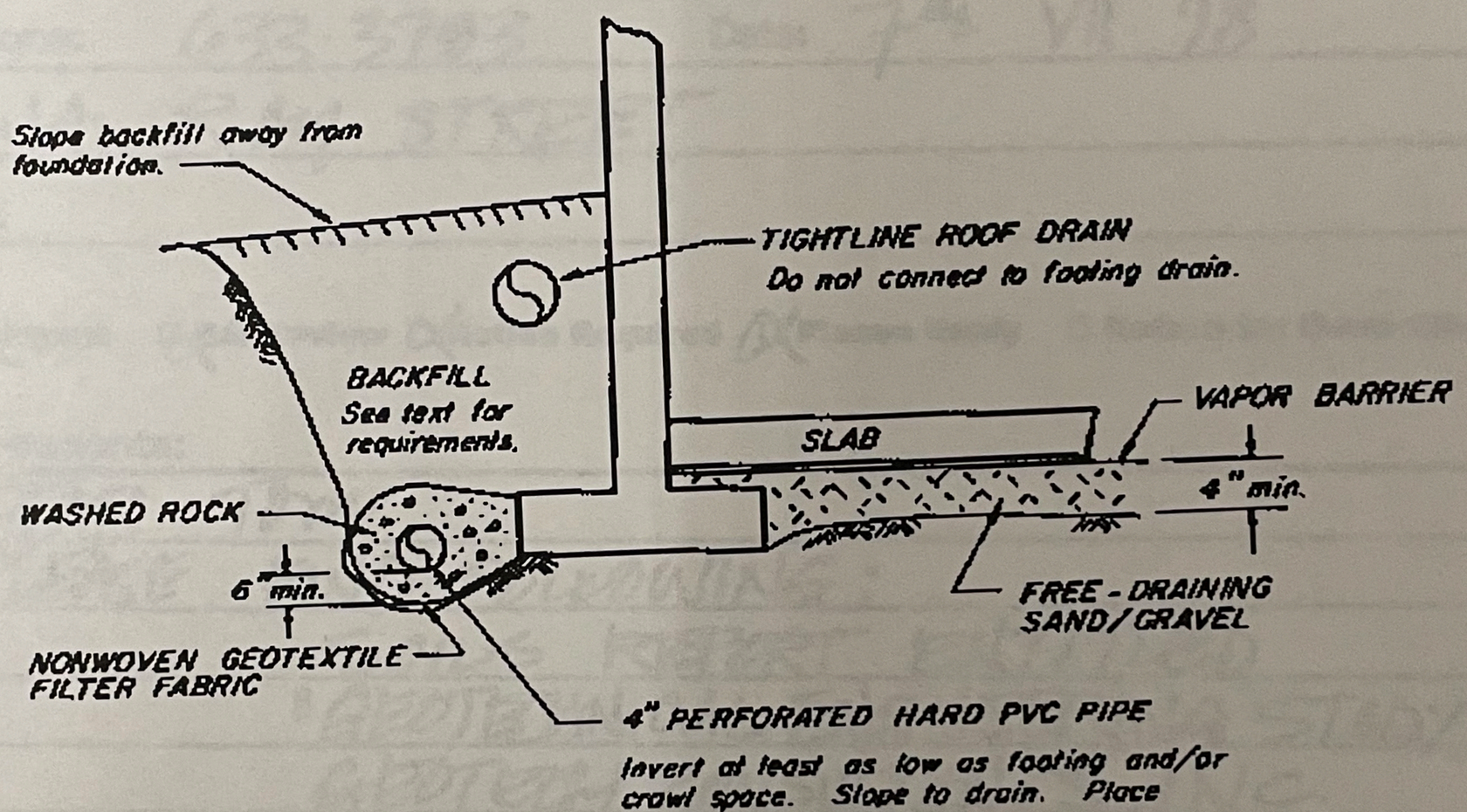
5 10 15 20 25 30 35 40

* *Test boring was terminated at 19 feet during drilling on April 27, 1998.*
* *Groundwater seepage was encountered at 9 feet during drilling.*

GEOTECH
CONSULTANTS, INC.

BORING LOG
14 Roy Street
Seattle, Washington

Job No:	Date:	Logged by:	Plate:
98171	June 1998	THS	6



GEOTECH CONSULTANTS

FOOTING DRAIN DETAIL

14 ROY STREET

SEATTLE, WA

Job No.:	Date:	Scale:	Plate:
98171	MAY 1998	N.T.S.	7