julie

From: Julian Liu [julianliu717@hotmail.com]
Sent: Friday, February 12, 2010 10:12 PM
To: courtney@nkarch.com
Cc: Pat Hunsaker
Subject: RE: Hunsaker Residence
Attachments: 10-004RPT-SFR4017WMercerWay-PatHunsaker.doc; 10-004RPT-HunsakerResidence-SignaturePage&Plates.pdf

Attached is my geotechnical report for the subject project. Please contact me if you have questions.

Julian Liu
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19213 Kenlake Place NE
Kenmore, WA 98028
(O)425-483-9134 (F)425-486-2746

Subject: Hunsaker Residence - Appropriate soils for tree planting
Date: Wed, 10 Feb 2010 16:13:02 -0800
From: courtney@nkarch.com
To: julianliu717@hotmail.com

Hi Julian-

Mercer Island will be requiring Pat to plant four 6'-0" Douglas Fir saplings on the uphill or east side of the property (to the east of the existing access road). Before she officially submits the permit requirement, the City Arborist, Kathy Parker, at Mercer Island Development Services would like to confirm with you that the soil in that area is sufficient for tree plantings of that size. Is this something that you can confirm based on your existing geotechnical analysis? Or will this require further analysis? Please let me know. Thanks.

Courtney McCunney, LEED AP
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LIU & ASSOCIATES, INC.

Geotechnical Engineering Engineering Geology Earth Science

February 12, 2010

Mr. Pat Hunsaker
3842 West Mercer Way
Mercer Island, WA 98040

Dear Mr. Hunsaker:

Subject: Geotechnical Engineering Study
Pat Hunsaker Residence
4017 West Mercer Way
Mercer Island, Washington
L&A Job No. 10-004

INTRODUCTION

We have completed a geotechnical engineering study for the site of the proposed new single-family residence, located at the above address in Mercer Island, Washington. The general location of the site is shown on Plate 1 – Vicinity Map. The purpose of this study is to characterize the subsurface conditions of the site and provide geotechnical recommendations for grading, site stabilization, erosion mitigation, surface and ground water drainage control, excavation shoring, and building foundation design and construction for the proposed development of the site. Presented in this report are our findings and geotechnical recommendations.

PROJECT DESCRIPTION

The site is a water-front property situated on the east shore of Lake Washington. For our use in this study, you provided us with a set of architectural drawings, topographic survey plan, and site plan of the proposed new residence. The topographic survey plan shows that the site is an irregularly-shaped parcel of land, tugged between an existing residence to the north (referred in

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this report as the project north), a nearly level, paved, parking area to the south, the lower stretch of a winding, joint-use, paved driveway to the east, and Lake Washington to the west.

The proposed new house will be a two-story, wood-framed structure with a basement underneath. The basement will be below grade along its east side and will be day-lighted along its west side. It will be supported on concrete basement walls, interior bearing walls and columns. The construction of the basement will require cut from 10 to 20 feet deep along the east side of the house and decreasing westward along the north and south sides of the house to about zero to 2 feet along the west side of the house. After the completion of the house, the ground on the east side of the house will be raised by about 2 to 3 feet or more with fill to the finish subgrade level of the driveway coming around the east side of the house.

SCOPE OF SERVICES

Our scope of services for this study comprises specifically the following:

1. Review geologic and soil conditions of the site based on a published geologic map.
2. Explore the subsurface conditions of the site with two test borings to an average depth of about 20 feet.
3. Perform necessary geotechnical engineering analyses based on soil data obtained from the test borings.
4. Provide recommendations for grading, site stabilization, excavation shoring, erosion mitigation, surface and ground water drainage control, and soil parameters for foundation design and construction, etc.
5. Prepare a written report to present our findings, conclusions and recommendations.

SITE CONDITIONS

SURFACE CONDITIONS

The subject site is adjoined by a single-family residence to the north and a paved parking area to the south, butting against the lower stretch of the joint-use driveway to the east and backed into Lake Washington to the west. The paved parking area south of the subject site is constructed on structural fill, rising some 28 to 30 feet above the lake level and is accessed from West Mercer Way by the joint-use driveway. The downhill side of the lower stretch of this driveway is supported by a tied-back soldier pile shoring wall against which the subject site is butted.

The subject site is currently accessed via a dirt ramp from the north edge of the paved parking area to the middle of the site. The terrain within the site generally slopes down westerly to northwesterly steeply to moderately towards Lake Washington. The slopes in the northeast corner area and west of the dirt ramp are at 50 percent or steeper grade, while the western 20 to 40 feet of the site flattens to about 5 to 25 percent grade. The site is presently undeveloped and is dotted by widely isolated mature deciduous trees and covered by sporadic patches of grass.

GEOLOGIC SETTING

The Preliminary Geologic Map of Seattle and Vicinity, Washington, by H. H. Waldron, B. A. Liesch, D. R. Mullineaux, and D. R. Crandell, published by U. S. Geological Survey in 1962, was referenced for the geologic and soil conditions at the site. According to this publication, the surficial soil units at and in the vicinity of the roadway site is mapped as Older Sand (Q_{OS}) underlain by Older Clay (Q_C).

The geology of the Puget Sound Lowland has been modified by the advance and retreat of several glaciers in the past and subsequent deposits and erosion. The latest glacier advanced to the Puget Sound Lowland is referred to as the Vashon Stade of the Fraser Glaciation, which has occurred during the later stages of the Pleistocene Epoch and retreated from the region some 14,500 years ago.

The Older Sand soil unit is composed of sand-dominated advance outwash deposits, which are proglacial fluvial and lacustrine sediments laid down by slow-moving meltwater streams from the advancing but distant Vashon glacier. It generally consists of light-brown to light-gray, well-sorted, fine-to-medium-grained sand. The Older Sand soil unit also includes occasional lenses of thin silt or coarse sand and small gravel. In confined situations, the Older Sand soils are generally in dense to very dense state. They, however, may subject rather easily to rainwash erosion and gullying and could loosen and slough off to its angle of repose if exposed on slopes devoid of vegetation cover. The Older Sand soils are of moderate to high permeability and can allow storm runoff to infiltrate through relatively easily.

The Older Clay soil unit normally underlies the Older Sand soil and generally consists of proglacial lacustrine deposits of the Vashon Drift. It is composed mostly of dark-gray, cohesive, over-consolidated, fine-sandy to clayey silt. It is in part massive, but commonly horizontally laminated and interbedded with light-gray silt. It may contains a few beds of fine to very fine sand locally. The thickness of the Older Clay unit ranges from a few feet to as much as 150 feet. Over-ridden by Vashon glacier, the Older Clay soils generally are very stiff to hard, with extremely low permeability, in their natural undisturbed state. Where exposed, the upper few inches to a couple of feet of this soil unit may be weathered and saturated, with much weaker strength.

SOIL CONDITIONS

Subsurface conditions of the site were explored with two test borings. The test borings were drilled on February 2, 2010, to 20.5 and 21.5 feet deep with a track-mounted Mobile 40 drill rig owned and operated by Davies Drilling. The approximate locations of the test borings are shown on Plate 2 - Site and Exploration Location Plan. Soil samples obtained from the test borings were visually classified in general accordance with United Soil Classification System, a copy of which is presented on Plate 3. A geotechnical engineer from our office was present during the exploration, who examined the soil samples retrieved from the test borings and the soil and geologic conditions encountered, and completed logs of test borings. Detailed descriptions of the soils encountered during site exploration are presented in test boring logs on Plates 4 and 5.

Standard Penetration Tests (SPT) were conducted, in accordance with ASTM D-1586, in the bore holes using a standard split-spoon sampler of 2-inch outside diameter, driven with a 140-pound hammer that was raised and released for a 30-inch free fall. The number of blows required to advance the sampler a given distance is an indication of the density for granular soils or the consistency of cohesive soils. The sampler was advanced 18 inches and the total number of blows for the last 12 inches were recorded on the boring logs as SPT N-values.

The test borings revealed that the subject site is mantled by a layer of loose fill or disturbed soils about 1.2 feet thick. Underlying the layer of fill or disturbed soils is a layer of Older Sand of gray, loose to medium-dense, slightly silty fine to medium sand, about 3.3 to 4.1 feet thick. In Test Boring No. 1, located on the east side of the new house, the Older Sand layer is underlain by a layer of gray, medium-stiff, fine sandy to clayey silt, about 3.6 feet thick but in 1/2-to-1-inch bedding. Underlying this medium-stiff silt in Test Boring No. 1 and underlying the Older Sand layer in Test Boring No. 2, located on the west side of the new house, is a fresh Older Clay deposit of very-stiff to hard, clayey silt to the depth explored.

GROUNDWATER CONDITION

Groundwater table was encountered at 2.1 feet deep in Test Boring No. 1 at about 25 minutes after completion of drilling and at 9.0 feet deep in Test Boring No. 2 at completion of drilling. We estimated that groundwater table in Test Boring No. 2 could rise up to about 5.0 feet when stabilized. The groundwater appeared to be from stormwater infiltrating into the more-permeable, loose, surficial soils and perching on the underlying practically impermeable fine sandy to clayey silt soils. The depth to and the amount of perched groundwater may fluctuate seasonally, depending on precipitation, surface runoff, ground vegetation cover, site utilization, and other factors. This perched groundwater may completely dry up during the dry summer and fall months, and may accumulate and rise during the wet winter months.

DISCUSSIONS AND RECOMMENDATIONS

GENERAL

Based on the geologic conditions indicated on the above-referenced geologic map and the subsurface conditions encountered by the test borings drilled on the subject site, it is our opinion that the proposed new residence is feasible from a geotechnical engineering viewpoint, provided that the recommendations in this report are fully implemented and observed during construction. The fill and loose surficial soils over the site should be stripped down to the hard clayey silt deposit within the building pad of the proposed house. The underlying hard clayey silt Older Clay soils have high shear strength and are capable of providing adequate foundation support to the proposed residence. Conventional footing foundations constructed on or into the hard clayey silt soils may be used to support the proposed house if groundwater can be dewatered and the footing foundations constructed on dry ground. Otherwise, driven steel piles seated into the underlying hard clayey silt deposit should be used to support the new house. Structural fill, if required for site grading, should be placed on proof-rolled, unyielding, Older Sand and/or Older Clay deposit following the stripping of the surficial unsuitable soils.

The onsite surficial soils contain a high percentage of fines, and are sensitive to moisture and can be easily disturbed by construction traffic. Grading and foundation construction work should proceed and be completed during the dryer period from April 1 through October 31. The site should be completely stabilized beyond this dryer period.

Interceptor trench drains should be installed on the uphill sides of the construction areas, as required, to intercept and drain surface runoff and near-surface perched groundwater away from construction areas in order to minimize soil erosion and facilitate grading and foundation construction work. The interceptor trench drains may also be constructed as permanent drainage facilities to minimize groundwater under the new house.

GEOLOGIC HAZARDS AND REMEDIATION

Landslide Hazard

The subject site is located within critical areas with potential landslide, erosion and drainage hazards. Landslides, groundwater seepage and heavy storm runoff are known to occur on the western slope above Lake Washington on which the subject site is situated. The lower portion of the existing joint-use driveway is cut into hard clayey silt Older Clay deposit and have encountered heavy groundwater seepage flowing within the Older Sand layer over the surface of the underlying Older Clay deposit. Progressive groundwater seepage can cause soil erosion and landslide and is the main cause of previous landsides occurring on the western slope of Mercer Island. An interceptor trench drain had to be installed along the base of the retaining wall on the inside edge of the existing joint-use driveway to intercept and drain away seepage of perched groundwater.

Groundwater seepage problem of the driveway has not occurred again since the completion of the interceptor trench drain. The hard clayey silt Older Clay deposit underlying the subject site at shallow depth has high shear strength and is of high resistant against slope failure if properly drained. It is our opinion that the landslide hazard of the site will be adequately mitigated if the recommendations for erosion and drainage controls recommended in this report are fully implemented and observed.

Erosion Hazard

The fill, topsoil and medium-dense sand Older Sand deposit mantling the site are of low resistance against erosion. Erosion may occur in these weaker surficial soils over the steeper areas of the subject site if they are devoid of vegetation cover and overly saturated. Progressive erosion can lead to shallow, skin-type mudflows in the steeper areas of the site. To mitigate such erosion hazard, vegetation outside of construction limits should be preserved and maintained. Unpaved exposed finished ground within the site resulted from construction activities should be re-seeded and re-vegetated as soon as possible. The hard clayey silt Older Clay deposit underlying the site at shallow depth does not allow tree roots to penetrate very deep and tall trees with shallow root system can be toppled during windstorms. Therefore, trees capable of growing to significant height, such as Douglas fir, should not be planted on steep slopes as they will exert a heavy loading on the steep slopes when they grow to mature height.

Concentrated stormwater should not be discharged uncontrolled onto the ground within or adjacent to the site. Stormwater over impervious surfaces, such as roofs and paved driveway, should be captured by an underground drain line system connected to roof downspouts and by catch basins installed in paved driveway. Water collected by these drain line systems should be tightlined to discharge into a storm sewer or a suitable stormwater disposal facility.

Seismic Hazard

The Puget Sound region is in an active seismic zone. The site is underlain at shallow depth by hard clayey silt Older Clay deposit of high shear strength. Therefore, it is our opinion that the potential for seismic hazards, such as landslides, liquefaction, lateral soil spreading, to occur on the site should be minimal if the erosion and drainage control recommendations in this report are fully implemented and observed. The proposed house, however, should be designed for seismic forces induced by strong earthquakes. Based on the soil conditions encountered by the test explorations, it is our opinion that Seismic Use Group I and Site Class D should be used in the seismic design of the proposed residences in accordance with the 2006 International Building Code (IBC).

TEMPORARY DRAINAGE AND EROSION CONTROL

The onsite surficial soils contain a high percentage of fines which are sensitive to moisture and can be easily disturbed by construction traffic. A layer of clean, 2-to-4-inch quarry spalls should be placed over areas of frequent traffic, such as the entrance to the site, as required, to protect the subgrade soils from disturbance by construction traffic.

A silt fence should be installed along the downhill boundaries of the site to minimize transport of sediment into Lake Washington. The bottom of the filter cloth of the silt fences should be anchored in a gravel-filled trench.

Ditches or interceptor trench drains should be installed on the uphill sides of construction areas, as required, to intercept and drain away storm runoff and near-surface groundwater seepage. Water captured by such ditches or interceptor trench drains should be discharged into a temporary holding and settling pond. Only clear and clean water from the settling pond may be released into nearby storm inlets or Lake Washington. Storm inlets adjacent to the subject site should be covered with a filter sock to prevent sediment from entering the storm sewer system. The filter socks should be cleaned frequently during construction to prevent clogging, and should be removed after completion of construction.

Spoil soils should be hauled off of the site as soon as possible. Spoil soils and imported structural fill material to be stored on site should be located in areas where the ground surface is no steeper than 15% grade, and should covered with plastic tarps securely weighted down with sandbags.

SITE PREPARATION AND GENERAL GRADING

Vegetation within construction limits should be cleared and grubbed and debris removed. Fill, topsoil, and unsuitable weak surficial soils should be completely stripped within building pad of the house and footprint of the driveway. The exposed soils after stripping should be compacted to a non-yielding state, as required, with a vibratory compactor and proof-rolled with a piece of heavy earthwork equipment.

EXCAVATION AND FILL SLOPES

Under no circumstance should excavation slopes be steeper than the limits specified by local, state and federal safety regulations if workers have to perform construction work in excavated areas. The east side of the subject site is abutted by an existing tied-back soldier pile retaining wall lining the outer edge of the lower stretch of the joint-use driveway. Excavation next to this existing soldier pile wall may destabilize it. The stability of this wall should be analyzed by its original designer, as additional tieback anchors may have to be installed on this wall to assure its stability during the construction of the subject house.

Outside of the influence of the soldier pile wall of the joint-use driveway, we recommend that unsupported temporary cuts greater than 4 feet in height be no steeper than 1H:1V in fill, topsoil and medium-dense Older Sand soils, and no steeper than 1/2H:1V in the underlying hard clayey silt soils. Permanent cut banks should be no steeper than 2-1/4H:1V in the fill and topsoil, no steeper than 2H:1V in medium-dense Older Sand soils, and no steeper than 1-1/2H:1V in hard clayey silt Older Clay soils. The soil units and the stability of cut slopes should be observed and verified by a geotechnical engineer or engineering geologist during excavation. Permanent fill embankments should be no steeper than 2-1/4H:1V. Upon completion, the sloping face of permanent fill embankments should be thoroughly compacted to a non-yielding state with a hoe-pack.

The above recommended cut and fill slopes are under the assumption that groundwater seepage would not be encountered during construction. If groundwater is encountered, the construction work should be immediately halted and the slope stability re-evaluated. The slopes may have to be flattened and other measures, such as dewatering, excavation shoring walls, may have to be implemented to stabilize the slopes. Stormwater should not allowed to flow uncontrolled over cut and fill slopes. Permanent cut slopes or fill embankments should be seeded and vegetated as soon as possible for erosion protection and long-term stability, and should be covered with clear plastic sheets, as required, to protect them from erosion until the vegetation is fully established.

EXCAVATION SHORING

General

Construction of the proposed house will require cut about 10 to 20 feet deep along the east side of the house. The east side of the subject site is abutted by a tied-back soldier pile retaining wall of the adjacent joint-use driveway. Prior to building footprint excavation for the house, the stability of this existing soldier pile wall should be evaluated by the original designer of this wall.

Additional tie-back anchors may have to be constructed on the soldier piles of this wall to assure its stability affected by the excavation required for the subject house.

A soldier pile wall appears to be required along the east and at least part of the north and south sides of the proposed house to support cut banks. The inclination of cut slopes should be in compliance with our recommendations under the EXCAVATION AND FILL SLOPE section in this report, except that temporary cut slope between the adjacent existing soldier pile wall and the new shoring wall on the east side of the house should be no steeper than 2H:1V, as shown on Plate 6, to protect the existing soldier pile wall of the joint-use driveway. The temporary cut slope should be lined by a layer of non-woven filter fabric and weighted down with rock spalls if groundwater seepage is encountered the cut slope. An interceptor trench drain should be installed at about one to two feet from the new shoring wall on the east side of the house to intercept and drain away surface runoff and groundwater seepage from the construction of the house. This interceptor trench drain should be at least 18 inches wide and cut at least 15 inches below the surface of the Older Clay deposit. It should be lined by a layer of non-woven filter fabric. A 6-inch perforated PVC drain line should be laid at bottom of the trench, with the trench backfilled with clean, 3/4-to-1-1/4-inch, washed gravel or crushed rock to within about 8 to 10 inches of the top of trench. The gravel or crushed rock is to be covered with non-woven filter fabric, with the remaining trench filled to top of the trench with the same gravel or crushed rock.

Excavation shoring walls may be required to support cut banks along the east, north and south sides of the house. We recommend that cantilever and/or one-level tieback soldier pile walls be used for excavation shoring. The soldier piles are constructed by drilling holes in the ground and inserting steel beams in drilled holes. The drilled holes should be to be filled with one-sack lean grout mix. The soldier piles are normally spaced at 4 to 8 feet on centers, with treated timber boards lagged between soldier piles.

Design Soil Parameters

Our recommendations for the design of cantilever or one-level tieback soldier pile shoring walls are presented on Plate 6. We recommend that the shoring walls be designed for an active soil pressure of 30 pcf EFD (equivalent fluid density). To counter the active pressure, we recommend a passive lateral soil pressure of 400 pcf EFD over soldier pile toe embedment in the hard clayey silt Older Clay soils be used. The active soil pressure is to be applied on one pile spacing above bottom of excavation and one pile-diameter below; while the passive pressure is to be applied on the lesser of one pile-spacing and two pile-diameters. Treated timber boards should be lagged between the soldier piles. Timber lagging boards may be designed for one half of the above recommended active soil pressure, taking into consideration of the arching effect of soils. The above recommended soil parameters for design of soldier pile shoring walls are ultimate values. The temporary shoring walls should be designed for a factor of safety of at least 1.25 against sliding and 1.4 against overturning failures.

The above recommended design parameters are based on the assumption that shoring walls are fully drained. Lagging boards should be shimmed to leave a 1/4-inch gap between the boards to allow groundwater to seep through. A layer of non-woven filter fabric, such as 140NS by Mirafi, Inc., should be placed against the back of the lagging boards before backfilling the voids behind the lagging boards. The filter fabric would allow water to flow through while keeping soils in place. Voids behind the shoring wall should be filled with clean free-draining gravelly sand or pea gravel and densified tightly against the lagging boards.

Tieback Anchors

Tieback anchors, if required for lateral support to the shoring walls, should be of the drilled and grout-in-place type installed in the hard clayey silt Older Clay soils. Grouted anchors are constructed by drilling a slanted hole into the ground behind the shoring walls, inserting in the holes an anchor tendon assembly consisting of steel wire strands or a threaded steel bar, and inject cement-sand grout mix to fill up the drilled hole. The pullout resistance of such tieback anchors is developed from the adhesion between the grout bulb and the soils confining the grout bulb. The grouted anchors should be designed for an allowable adhesive stress of 1,200 psf in the hard clayey silt soils. Higher allowable adhesive values may be used if double-grouting or triple-grouting technique is used by shoring contractors. If such technique is used, it is the responsibility of the shoring contractors to design the tieback anchors and should present in writing to the geotechnical engineer his/her design and installation technique and procedure for approval prior to construction of tieback anchors. The bond length of tieback anchors should be outside of the wedge envelope of 55 degrees with horizon starting at the tip of soldier piles upward.

Continuous auger should be used to drilled tieback anchor holes to maintain open holes and minimize soil sloughing and ground loss. Loose cutting in drilled holes should be cleaned out of the holes as much as possible. Anchor bar or tendon assemblies should be centralized in drilled holes with centralizers. Cement-sand grout should be pumped from the bottom of holes upward to replace groundwater in the holes. Grout mix should achieve a compressive strength of at least 2,500 psi in 3 days. Stressing of tieback anchor should be allowed only if the grout mix has achieved the above required strength.

At least five percent of tieback anchors, randomly selected by the geotechnical engineer, should be performance-tested. The test loads should be applied with a hydraulic jack and the anchor head movements at each load level measured with a dial gage accurate to 0.001 inch. The dial gage should be mounted on an independent fixed reference point such as a tripod resting on the ground in front of the test anchor. The applied loads should be measured with a pressure gage calibrated with the hydraulic jack prior to the anchor testing. The anchor should first be stressed to a seated load of 0.10P (P = Design Load) and then released to remove the slack in the anchor system. The anchors should then be loaded in increments of 0.25P up to 1.5P. Each load increment should be held for 5 minutes and the anchor head displacement recorded at 1 , 2, 3 and 5 minutes. If the total movement between 1 and 5 minutes exceeds 0.04 inch, the load increment shall be held for an additional 55 minutes, and the total movements recorded at 10, 20, 30, 45 and 60 minutes at the maximum test load, the displacement should be recorded at 1, 2, 5, 10, 20, 30 and 60 minutes for creep measurement. The anchors should then be unloaded completely and reloaded to 1.0P in increments of 0.25P, with each load increment held for 5 minutes. The anchor displacement at design load is then recorded.

Each of the remaining anchors should be proof-tested to 135% of design load. The testing setup for proof tests shall be same as for performance tests described above. The anchors should be loaded in increments of 0.25P up to 1.35P. Each load increment should be held for 1 minute and the anchor head movement recorded. The maximum test load should be held for 10 minutes and the movement recorded at 1 , 2, 3, 5 and 10 minutes. If the total movement between 1 and 10 minutes exceeds 0.04 inch, the load shall be held for an additional 50 minutes, and the total movements recorded at 15, 20, 25, 30, 45 and 60 minutes.

An anchor is acceptable if: 1) its total elastic movements measured at design load from a performance test does exceed 80% of the theoretical elongation of the free length plus 50% of the bond length, 2) its total movement measured at design load from a proof test does not exceed 80% of the theoretical elongation of the free length, and 3) its creep rate does not exceed 0.08 inches per log cycle of time during the final log cycle of the performance test or proof test. Accepted anchors should be locked off at design load. Failed anchors should be locked off at a decreased design load determined by the shoring wall designer and an additional anchor should be installed for each failed ones to make up the difference in pullout resistance.

Shoring Wall Drainage

Our recommended drainage control for shoring walls is shown on Plate 7. A curtain of drain mat, such as Miradrain 6000 by Mirafi, Inc. or equivalent, should be tacked onto the face of the lagging boards. Groundwater flowing down to bottom of the curtain of drain mat should be conveyed through PVC drain pipes embedded in the concrete walls and footings to flow into a French drain installed along the inside of the perimeter footing foundations or grade beams. Water collected in the French drain should be tightlined to drain into a storm sewer or a suitable stormwater disposal facility.

STRUCTURAL FILL

Structural fill is the fill that supports structural or traffic load. Structural fill should consist of clean granular soils free of organic and other deleterious substances and with particles not larger than four inches. Structural fill should have a moisture content within one percent of its optimum moisture content at the time of placement. The optimum moisture content is the water content in soils that enable the soils to be compacted to the highest dry density for a given compaction effort.

Onsite silty sand Older Sand or clayey silt Older Clay soils should not be used as structural fill. Imported material to be used as structural fill should be clean, free-draining, granular soils containing no more than 5 percent by weight finer than the No. 200 sieve based on the fraction of the material passing No. 4 sieve, and should have individual particles not larger than four inches. The ground over which structural fill is to be placed should be prepared in accordance with recommendations in the SITE PREPARATION AND GENERAL GRADING and EXCAVATION AND FILL SLOPES sections of this report. Structural fill should be placed in lifts no more than 10 inches thick in its loose state, with each lift compacted to a minimum percentage of the maximum dry density determined by ASTM D1557 (Modified Proctor Method) as follows:

Application	% of Maximum Dry Density
Within building pads and under foundations	95%
Roadway/driveway subgrade	95% for top 3 feet and 90% below
Retaining wall backfill	92%
Utility trench backfill	95% for top 4 feet and 90% below

BUILDING FOUNDATIONS

General

Foundations supporting the proposed house should be constructed into the underlying hard clayey silt Older Clay deposit. If building footprint excavation of the house can be adequately dewatered for construction on dry ground, footing foundations may be used. Otherwise, pile foundations penetrating through the surficial weaker soils, below groundwater level, into the underlying hard clayey silt Older Clay soils should be used. Based on the subsurface conditions encountered by the test borings drilled on the site, we estimate that footing foundations may be used over the eastern half of the house and pile foundation may be required for the western half of the house.

Footing Foundations

Conventional footing foundations founded on hard clayey silt Older Clay deposit may be used to support the proposed house only if they can be constructed on dry ground. The footing foundations should be constructed at least 12 inches into the underlying undisturbed hard clayey silt Older Clay soils. Water should not be allowed to accumulate in excavated footing trenches.

Disturbed soils in footing trenches should be completely removed down to undisturbed, native, fresh till soils prior to pouring concrete for the footings.

If the above recommendations are followed, our recommended design criteria for footing foundations are as follows:

- The allowable soil bearing pressure for design of footing foundations, including dead and live loads, should be no greater than 3,000 psf if constructed into hard clayey silt soils. The footing bearing soils should be verified onsite by a geotechnical engineer after the footing trenches are excavated and before the footings poured.

- The minimum depth to bottom of perimeter footings below adjacent final exterior grade should be no less than 18 inches. The minimum depth to bottom of the interior footings below top of floor slab should be no less than 12 inches.

- The minimum width should be no less than 16 inches for continuous footings, and no less than 24 inches for individual footings, except those footings supporting light-weight decks or porches.

A one-third increase in the above recommended allowable soil bearing pressure may be used when considering short-term, transitory, wind or seismic loads. For footing foundations designed and constructed per recommendations above, we estimate that the maximum total post-construction settlement of the buildings should be 3/4 inch or less and the differential settlement across building width should be 1/2 inch or less.

Lateral loads on the proposed residence may be resisted by the friction force between the foundations and the subgrade soils or the passive earth pressure acting on the below-grade portion of the foundations. For the latter, the foundations must be poured "neat" against undisturbed soils or backfilled with a clean, free-draining, compacted structural fill. We recommend that an equivalent fluid density (EFD) of 325 pcf (pounds per cubic foot) for the passive earth pressure be used for lateral resistance. The above passive pressure assumes that the backfill is level or inclines upward away from the foundations for a horizontal distance at least 1.5 times the depth of the foundations below the final grade. A coefficient of friction of 0.50 between footing foundations and the subgrade soils may be used. The above recommended soil parameters are unfactored values, and a proper factor of safety should be used in calculating the resisting forces against lateral loads on the proposed residence.

Pile Foundations

If groundwater in building footprint excavation of the house is encountered and can not be adequately dewatered for footing foundation construction on dry ground, then pile foundations should be used to support the proposed house. If pile foundations have to be utilized, we recommend steel pipe piles constructed of 6-inch-minimum standard steel pipes (6.625 inch outside diameter by 0.28 inch wall) be used.

Steel pipe piles should be driven with a hydraulic, minimum 1250-pound, impact hammer, capable of delivering minimum 600 blows per minute, or a minimum 850-pound differential-acting air hammer capable of delivering minimum 1200 blows per minute, or equivalent hammers. Steel pipe piles should be driven to penetrate through the surficial weak soils and seated into the underlying hard clayey silt Older Clay soils. All piles should be driven to "refusal" defined as "at least 25 seconds of continuous driving for one inch of pile penetration".

Steel piles of 6-inch standard pipe driven to "refusal" should be able to develop an ultimate bearing capacity of 28 tons per pile against axial compressive load. The allowable bearing capacity of pin piles should not be more than 14 tons per piles based on a factor of safety of 2.0.

A one-third increase in the above recommended allowable pile bearing capacity may be used when considering short-term, transitory, wind or seismic loads. For long term corrosion protection, steel pipe piles and their accessories should be galvanized or coated with bituminous paint..

Steel pipe piles will mostly be embedded in the surficial weak soils and not able to penetrate very deep into the underlying hard clayey silt Older Clay soils. Consequently, the capability of piles against lateral load will be limited. Therefore, resistance against lateral loads should be achieved with battered steel pipe piles inclined at no flatter than 4V:1H. The horizontal component of the axial compressive bearing capacity of the piles driven to refusal, as recommended above, should be calculated as resistance of battered piles against lateral loads.

At least one load test should be conducted on a production steel pipe pile randomly selected by geotechnical engineer to assure required bearing capacity of the piles. Steel pipe piles should be coated with asphaltic paint or galvanized to provide long-term corrosion protection.

BASEMENT AND RETAINING WALLS

Basement walls restrained horizontally at the top are considered unyielding and should be designed for a lateral soil pressure under the at-rest condition; while retaining walls free to move at the top should be designed for active lateral soil pressure. We recommend that a lateral soil pressure of 45 pcf EFD be used for the design of foundation walls restrained at the top; and 35 pcf EFD for retaining walls unrestrained at the top. These lateral soils pressures are applicable to walls with level backslope. With a backslope rising away from the walls, an additional pressure of 0.75 pcf per degree of angle of the backslope above horizontal should be added to the above pressures. To counter the active or at-rest soil pressure, a passive lateral soil pressure of 350 pcf EFD may be used, except that the passive pressure within the top 12 inches of the finish subgrade should be ignored. The above passive pressure is applicable to walls with level rising backslope away from the walls. The above lateral soil pressures are under the assumption that groundwater behind the walls is fully drained. To resist against sliding, the friction force between the footings and the subgrade soils may be calculated based on a coefficient of friction of 0.50. The above soil parameters are ultimate values, and proper factors of safety should be used in the design of the basement and retaining walls against sliding and overturning failures. Basement walls or retaining walls may be supported on footing foundations embedded at least one foot into the underlying, undisturbed, hard clayey silt Older Clay soils, with an allowable soil bearing pressure not to exceed 3,000 psf.

A drain line consisting of perforated, rigid PVC drain pipe, at least 4 inches in diameter, should be installed at a few inches below bottom of basement or retaining wall foundations to intercept and drain away groundwater flowing towards the walls. The drain lines should have sufficient slope (0.5 percent minimum) to generate flow by gravity, and water collected in the drain line should be tightlined to discharge into a storm sewer or a suitable stormwater disposal facility. The drain lines should be completely embedded in washed gravel wrapped in a layer of non-woven filter fabric, such as 140N by Mirafi Inc. or approved equal. A vertical drainage blanket at least 12 inches thick, consisting of clean, 3/4 to 1-1/2-inch, washed gravel or crushed rock, should be placed against the walls. Alternatively, a vertical drain mat, such as Miradrain 6000 by Mirafi Inc. or equivalent, may be placed against the walls as the vertical drainage blanket. The vertical drainage blanket or drain mat should be hydraulically connected to the drain lines at the base of the perimeter walls.

SLAB-ON-GRADE FLOORS

Slab-on-grade floors, if used for the proposed house, should be placed on firm subgrade soils prepared as outlined in the SITE PREPARATION AND GENERAL EARTHWORK and the

STRUCTURAL FILL sections of this report. Where moisture control is critical, the slab-on-grade floors should be placed on a capillary break which is in turn placed on the compacted subgrade. The capillary break should consist of a minimum four-inch-thick layer of clean, free-draining, 3/4-inch crushed rock, containing no more than 3 percent by weight passing the No. 4 sieve. A vapor barrier, such as a 6-mil plastic membrane, may be placed over the capillary break, as required, to keep moisture from migrating upwards.

DRIVEWAY PAVEMENT

Performance of driveway pavement is critically related to the conditions of the underlying subgrade soils. We recommend that the subgrade soils under the driveway be treated and prepared as described in the SITE PREPARATION AND GENERAL EARTHWORK and STRUCTURAL FILL sections of this report. Prior to placing base material, the subgrade soils should be compacted to a non-yielding state with a mechanical compactor and proof-rolled with a piece of heavy construction equipment, such as a fully-loaded dump truck. Any areas with excessive flexing or pumping should be over-excavated and re-compacted, or replaced with structural fill or crushed rock placed and compacted in accordance with the recommendations provided in the STRUCTURAL FILL section of this report.

We recommend that a minimum 4-inch-thick layer of compacted, 7/8-inch, crushed rock base (CRB) be used for the driveway. The crushed rock base should be topped with a 3-inch asphalt course or 4-inch concrete pavement. If concrete pavement is used, it should be reinforced with a layer of welded wire fabric placed at mid-depth of the pavement.

DRAINAGE CONTROL

Building Footprint Excavation

Building footprint excavation for the proposed house, if encountering groundwater seepage, should have bottom of excavation sloped and ditches excavated along the bases of cut banks to direct collected groundwater into sump pits from which water can be pumped out.

A layer of 2-inch crushed rock should be placed over footing bearing subgrade soils, as required, to protect the soils from disturbance by construction traffic. This crushed rock base should be built to a few inches above groundwater level, but not less than 6 inches thick. The crush rock base should be compacted in 12-inch lifts to a non-yielding state with a vibratory mechanical compactor.

Runoff Over Impervious Surfaces

Storm runoff over impervious surfaces, such as roofs and paved driveway, should be collected by underground drain line systems connected to downspouts and by catch basins installed in paved driveway. Stormwater thus collected should be tightlined to discharge into a nearby storm sewer inlet or a suitable stormwater disposal facility.

Building Footing Drain

A subdrain system should be installed, around the perimeter footings of the proposed residence. The subdrain should consist of a 4-inch-minimum-diameter, perforated, rigid, drain pipe, laid a few inches below bottom of the perimeter footings of the building. The trench and the drain line should have a sufficient gradient (0.5% minimum) to generate flow by gravity. The drain line should be wrapped in a non-woven filter fabric sock and completely enclosed in clean washed gravel. The remaining trench may be backfilled with clean onsite soils. Water collected by the perimeter footing subdrain system should be tightlined, separately from the roof and surface stormwater drain lines, to discharge into a storm sewer or a suitable stormwater disposal facility.

Surface Drainage

Water should not be allowed to stand in any areas where footings, on-grade-slabs, or pavement is to be constructed. Finish ground surfaces should be graded to direct surface runoff away from the proposed residence. We recommend the finished ground be sloped at a gradient of 3 percent minimum for a distance of at least 10 feet away from the buildings, except in the areas to be paved.

Cleanouts

Sufficient number of cleanouts at strategic locations should be provided for underground drain lines. The underground drain lines should be cleaned and maintained periodically to prevent clogging.

RISK EVALUATION STATEMENT

The subject site is mapped within geologic hazard areas. It is, however, underlain at shallow depth by hard clayey silt Older Clay soils. These basal soils are of high shear strength and the site should be quite stable if the recommendations in this report are fully implemented and observed. Proper and adequate erosion and surface/groundwater drainage controls are key to maintain site stability during and after completion of construction.

The geologic hazard areas within the site, however, will be modified and stabilized with the recommendations in this report. If our recommendations are fully implemented in design and construction of this project, it is our opinion that the development for the site will be designed in such a way that the risk of the site and adjacent properties is eliminated or mitigated to the extent that the plat site can be determined as safe.

LIMITATIONS

This report has been prepared for the specific application to this project for the exclusive use by Mr. Pat Hunsaker and his associates, representatives, consultants and contractors. We recommend that this report, in its entirety, be included in the project contract documents for the information of the prospective contractors for their estimating and bidding purposes and for compliance with the recommendations in this report during construction. The conclusions and interpretations in this report, however, should not be construed as a warranty of the subsurface conditions. The scope of this study 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 in this report for design considerations.

Our recommendations and conclusions are based on the geologic and soil conditions encountered in the test borings drilled on the site, and our experience and engineering judgment. The conclusions and recommendations are professional opinions derived in a manner consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area. No warranty, expressed or implied, is made.

The actual subsurface conditions of the site may vary from those encountered by the test borings. The nature and extent of such variations may not become evident until construction starts. If variations appear then, we should be retained to re-evaluate the recommendations of this report, and to verify or modify them in writing prior to proceeding further with the construction of the proposed development.

CLOSURE

We are pleased to be of service to you on this project. Please feel free to contact us if you have any questions regarding this report or need further consultation.

Yours very truly,
LIU & ASSOCIATES, INC.

J. S. (Julian) Liu, Ph.D., P.E.
Consulting Geotechnical Engineer

Seven plates attached

CLOSURE

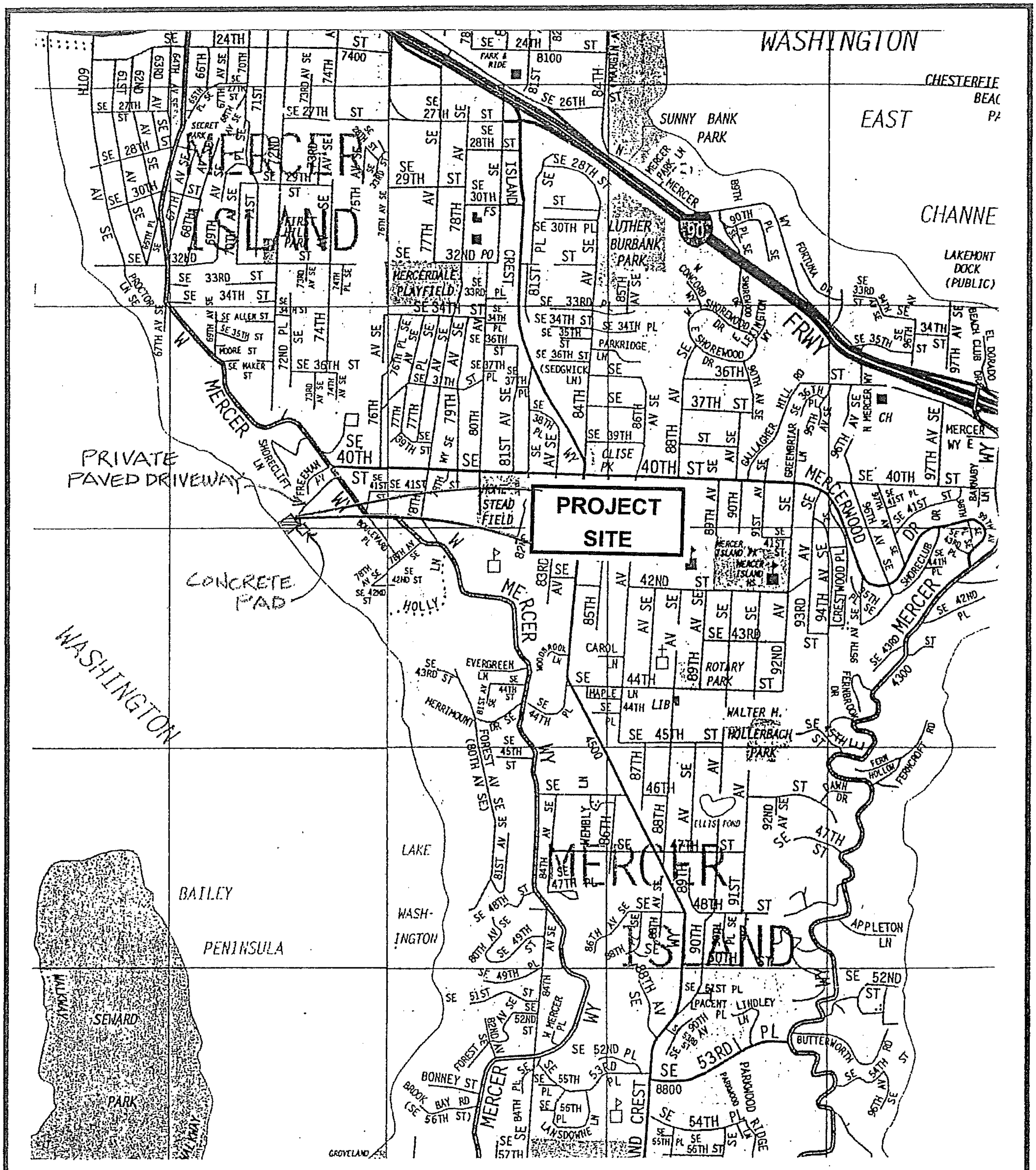
We are pleased to be of service to you on this project. Please feel free to contact us if you have any questions regarding this report or need further consultation.

JEONG S. LIU
STATE OF WASHINGTON
2/12/2010
27589
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 7/17/ 2011

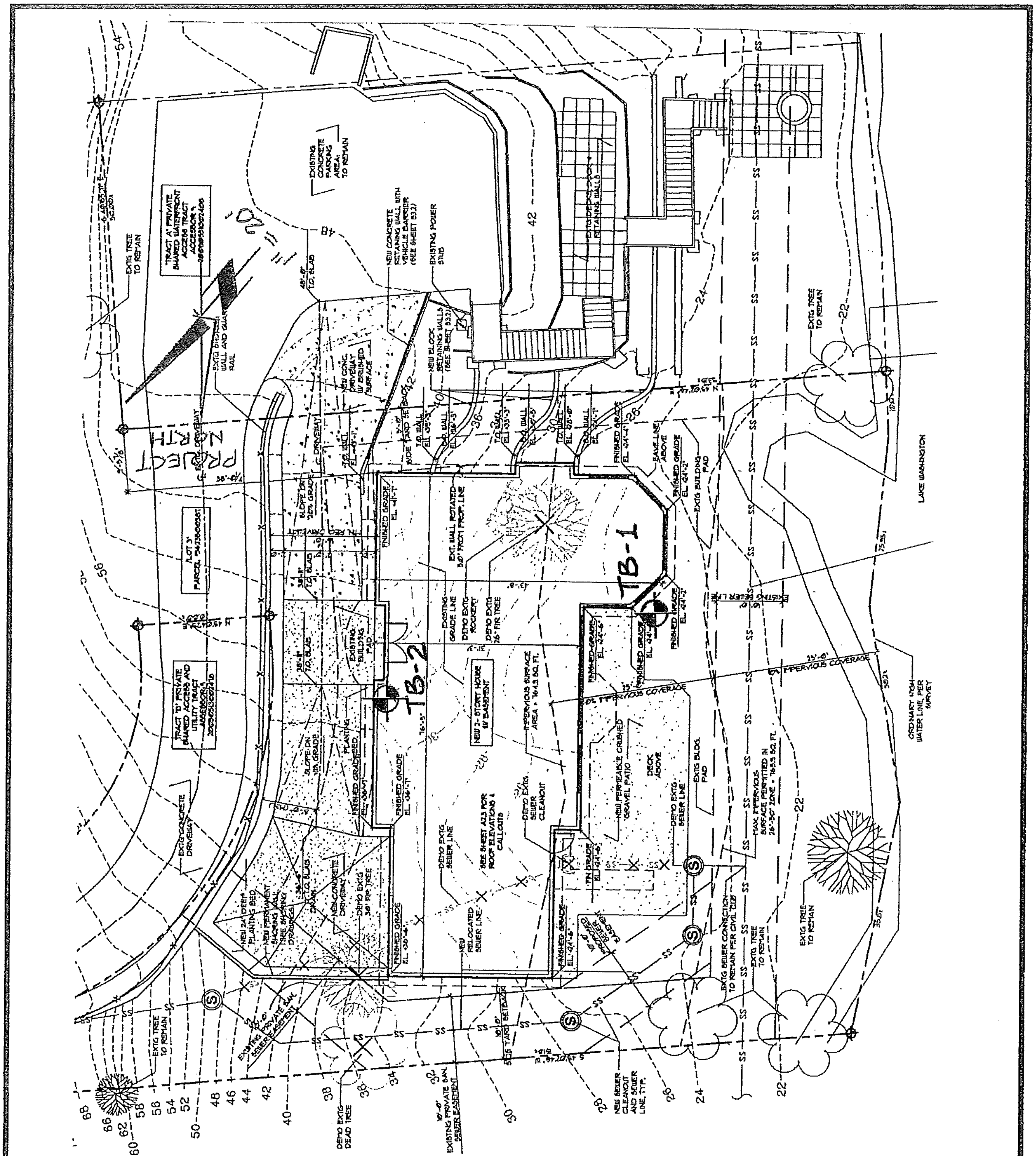
Yours very truly,
LIU & ASSOCIATES, INC.

J. S. (Julian) Liu, Ph.D., P.E.
Consulting Geotechnical Engineer

Seven plates attached



LIU & ASSOCIATES, INC.	VICINITY MAP PAT HUNSAKER RESIDENCE 4041 WEST MERCER WAY MERCER ISLAND, WASHINGTON
Geotechnical Engineering · Engineering Geology · Earth Science	JOB NO. 10-004	DATE 1/27/2010	PLATE 1



LIU & ASSOCIATES, INC.

Geotechnical Engineering · Engineering Geology · Earth Science

SITE AND EXPLORATION LOCATION PLAN
PAT HUNSAKER RESIDENCE
4041 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

JOB NO. 10-004	DATE 1/27/2010	PLATE 2

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS MORE THAN 50% RETAINED ON THE 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 PASSING 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% PASSING ON THE NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50%	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILTY 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 SILT, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

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 BLOW-COUNT DATA, VISUAL APPEARANCE OF SOILS, AND/OR TEST DATA.

SOIL MOISTURE MODIFIERS:

DRY - ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH

SLIGHTLY MOIST - TRACE MOISTURE, NOT DUSTY

MOIST - DAMP, BUT NO VISIBLE WATER

VERY MOIST - VERY DAMP, MOISTURE FELT TO THE TOUCH

WET - VISIBLE FREE WATER OR SATURATED, USUALLY SOIL IS OBTAINED FROM BELOW WATER TABLE

BORING NO. B-1

Logged By: JSL 2/2/2010 Ground Elev. ±

Depth ft.		USCS	Soil Description	Sample Type	Sample No.	(N) Blows/ ft.	W %	Other Test
		SM	Dark-brown to brown mixed, loose, silty fine SAND, trace gravel, with occasional wood debris and brick, fragments, moist (FILL or DISTURBED SOIL)	SS	1	10		
	▽	SP/SM	Gray, loose to medium-dense, slightly silty, fine to medium SAND, very moist to wet (OLDER SAND)					
5				SS	2	9		
		ML	Gray, medium-stiff, fine sandy to clayey SILT, in 1/2-to-1-in bedding, slighty moist (OLDER CLAY)					
10		ML	Gray, hard to very-hard, clayey SILT, massive, slightly moist (OLDER CLAY)	SS	3	58		
15			- Same	SS	4	65		
20			- Same	SS	2	12/32/ 40/5"		
25			Test boring terminated at 21.5 ft, groundwater table measured 2.1 ft deep approximately 25 minutes after completion of drilling.					

LEGEND: SS - 2" O.D. Split-Spoon Sample
ST - 3" O.D. Shelby-Tube Sample
B - Bulk Sample

GROUNDWATER: Seal
Water Level
Observation Well Tip

LIU & ASSOCIATES, INC.

Geotechnical Engineering · Engineering Geology · Earth Science

BORING LOG
PAT HUNSAKER RESIDENCE
4017 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

JOB NO. 10-004 DATE 2/2/2010 PLATE 4

BORING NO. B-2

Logged By: JSL   2/2/2010   Ground Elev. ±

Depth ft.	USCS	Soil Description	Sample Type	Sample No.	(N) Blows/ ft.	W %	Other Test
	SM	Dark-brown to dark-brown mixed, loose, silty fine SAND, with occasional wood debris and brick fragments, moist (FILL or DISTURBED SOIL)	SS	1	8		
	SP/SM	Gray, loose to medium-dense, slightly silty, fine to medium SAND, very moist to wet (OLDER SAND)					
5	ML	Light-gray, very-stiff to hard, fine sandy to clayey SILT, in about 1-in bedding, slighty moist (OLDER CLAY)	SS	2	44		
10	ML	Gray, hard to very-hard, clayey SILT, massive, slightly moist (OLDER CLAY)	SS	3	60		
15		- Same	SS	4	11/24/ 50/5"		
20		- Same	SS	2	24 & 44/5"		
25		Test boring terminated at 20.5 ft, groundwater table measured at 9.0 ft deep at completion of drilling.					

LEGEND: SS - 2" O.D. Split-Spoon Sample
ST - 3" O.D. Shelby-Tube Sample
B - Bulk Sample

GROUNDWATER: Seal
Water Level
Observation Well Tip

LIU & ASSOCIATES, INC.

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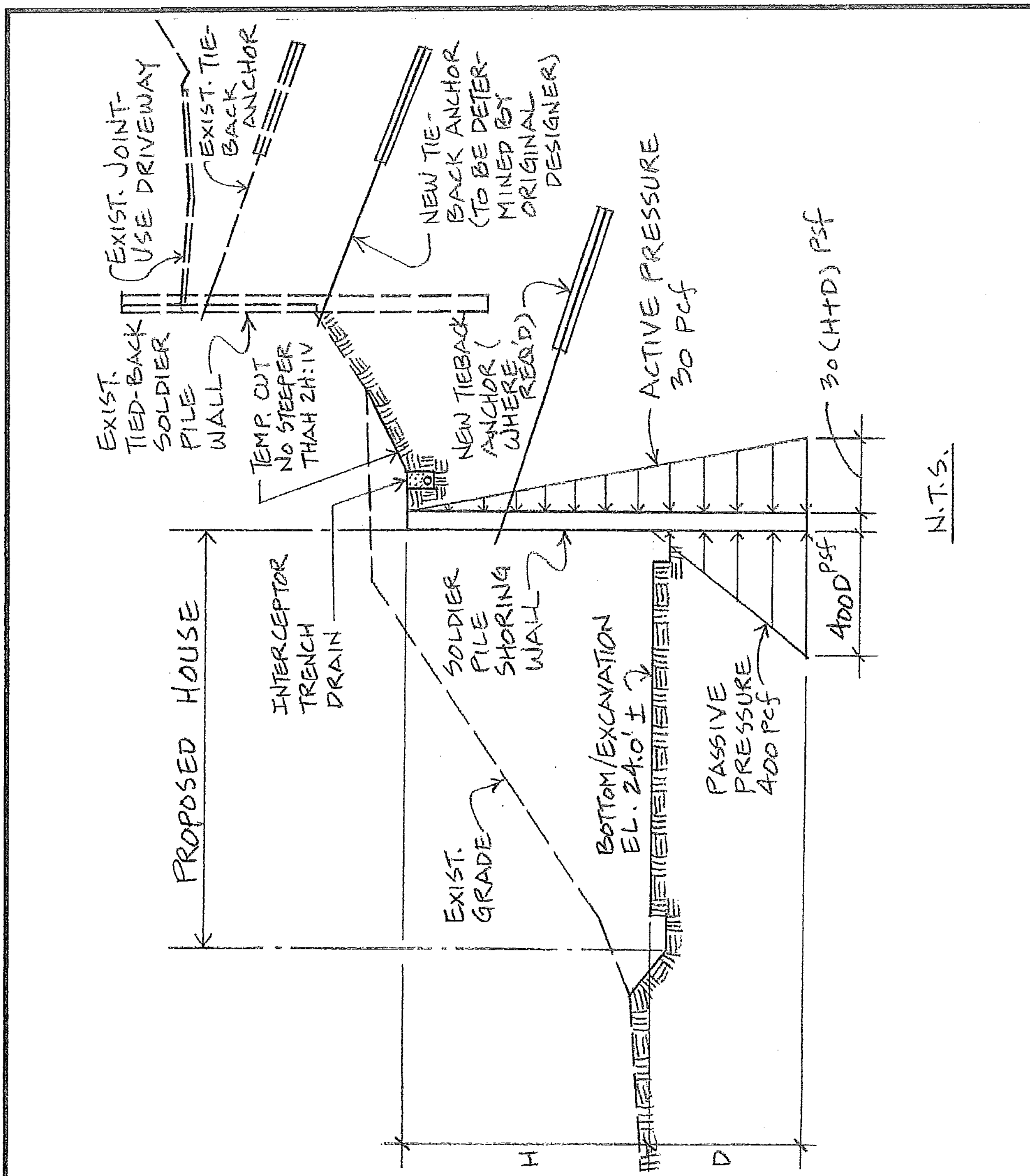
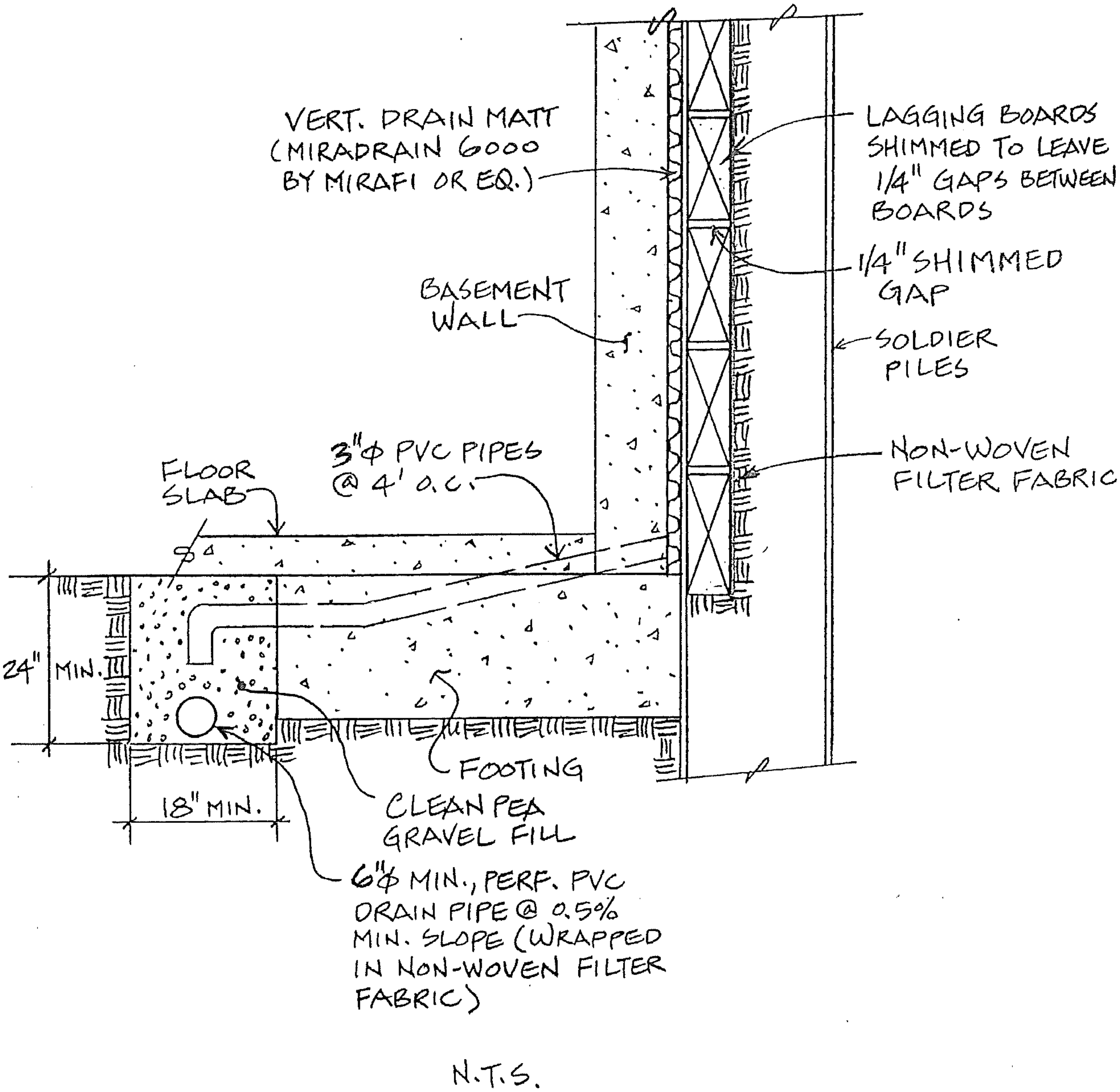
BORING LOG
PAT HUNSAKER RESIDENCE
4017 WEST MERCER WAY
MERCER ISLAND, WASHINGTON

JOB NO. 10-004 | DATE 2/2/2010 | PLATE 5



LIU & ASSOCIATES, INC. Geotechnical Engineering · Engineering Geology · Earth Science	SOLDIER PILE SHORING WALL DESIGN PAT HUNSAKER RESIDENCE 4041 WEST MERCER WAY MERCER ISLAND, WASHINGTON JOB NO. 10-004 | DATE 1/30/2010 | PLATE 6



LIU & ASSOCIATES, INC. Geotechnical Engineering · Engineering Geology · Earth Science	SHORING WALL DRAINAGE PAT HUNSAKER REISDENCE 4017 WEST MERCER WAY MERCER ISLAND, WASHINGTON
	JOB NO. 10-004 | DATE 2/5/2010 | PLATE 7

LIU & ASSOCIATES, INC.

Geotechnical Engineering · Engineering Geology · Earth Science

September 20, 2007

Mr. Pat Hunsaker
4039 West Mercer Way
Mercer Island, WA 98040

Dear Mr. Hunsaker:

Subject: Slope Stabilization and Erosion Control
Access Road for Hunsaker Development
40xx West Mercer Way
Mercer Island, Washington
L&A Job No. 4A067

Soil disturbance was caused by previous slide on the slope along the north boundary of the subject property behind the roadway soil nail and soldier pile shoring walls. We conducted an inspection on September 18, 2007, of the stabilization and erosion control measures implemented for this slide.

The disturbed area on this slope has now been stabilized by a series of short pin pile walls lagged with timber boards. The walls are each about 2 feet tall stepping down the slope at about 3 to 4 feet apart. The pin piles are consisted of one-inch galvanized steel pipes spaced at about 2 feet on centers and were driven to refusal with a sledge hammer. One-inch-thick treated timber boards are lagged behind the pin piles. The disturbed area are backfilled with compacted clean soils, re-seeded and replanted, and covered with jute matting. The area is irrigated periodically with a garden hose.

It is our opinion that the stabilization and erosion control measures completed to date for the slope are acceptable. Irrigation of the grass and shrubs should continue until the vegetation is fully established on the slope. If this is achieved, it is our opinion that the slope will be stabilized.

19213 Kenlake Place NE · Kenmore, Washington 98028
Phone (425) 483-9134 · Fax (425) 486-2746

Please call if you have any questions.

STATE OF WASHINGTON
9/20/2007
27589
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 7/17/2009

Yours very truly,
LIU & ASSOCIATES, INC.

J. S. (Julian) Liu, Ph.D., P.E.
Consulting Geotechnical Engineer

DAILY FIELD REPORT

LIU & ASSOCIATES, INC.

Geotechnical Engineering, Engineering Geology & Earth Science

19213 Kenlake Place NE
Kenmore, Washington 98028
Phone: (425) 483-9134 Fax: (425) 486-2746

Job No.	Field Rep.	Page	Report No.
4A067	J. Liu	1 of 1	12
Miles	**Time On Site**	**Date**	**Day of Week**
44	12:20P	6/8/2007	Fri.
Travel Time (Hrs)	**Time Off Site**	**Weather**	
1.5	12:45P	Sunny	
Vehicle Hrs on Site	**Hrs Charged**	**Visitors**	
	2		

Project	Job Location	Client
Access Road - Hunsaker Development	40xx W. Mercer Way, Mercer Island	Fairmont Development
General Contractor	**General Contractor Proj. Manager**	**Received Unchecked By**
Fairmont Development	Bob Canaan	
Earth Contractor	**Earth Work Contractor Supt.**	**Received Checked By**

At the request by Pat Hunsaker, I come on site today to have a final inspection of the repair of the landslide occurred behind the shoring wall along the north side of the driveway. At the time of my site visit, the shallow timber board retaining walls are installed in steps down the slope and the longitudinal trench of the drain pipe down the slope has been backfilled with 2-inch-minus crushed rock, topped with about 6 to 8 inches of topsoil. The repair area is landscaped and planted with shrubs. It is my opinion that the landslide has been properly repaired.

JEONG S. LIU
STATE OF WASHINGTON
27589
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 7/17/2007

6/8/07

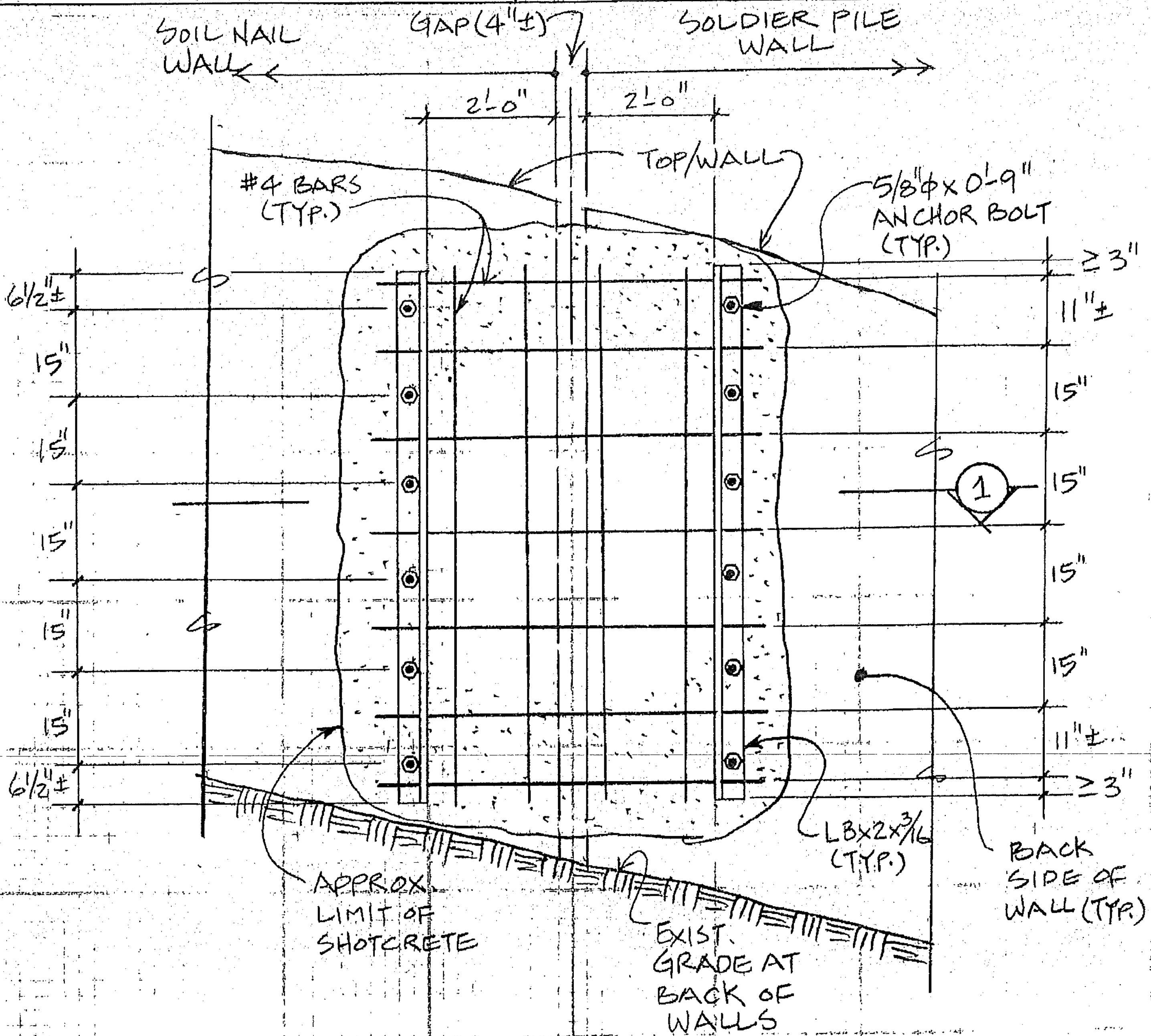
Copy to:

1) Pat Hunsaker
2)
3)
4)

☐ Continued on Next Page

LIU & ASSOCIATES, INC.
Geotechnical Engineering • Engineering Geology • Earth Science
19213 KENLAKE PLACE NE • KENMORE, WA 98028
PHONE: (425) 483-9134 • FAX: (425) 486-2746

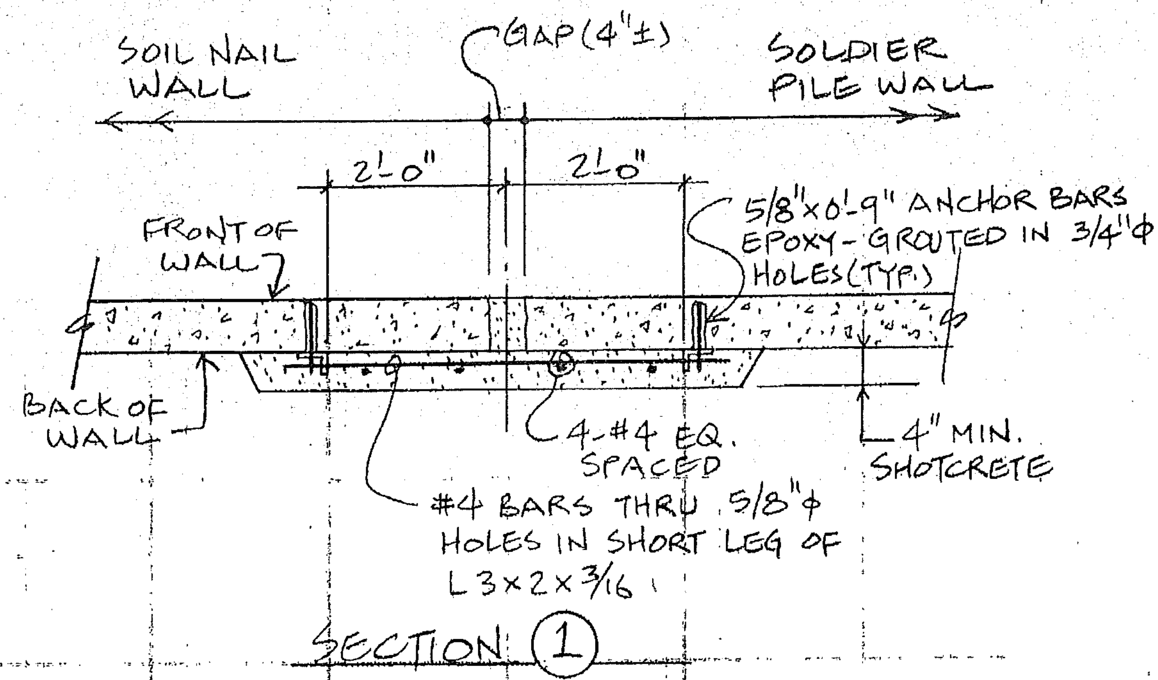
Project REPAIR OF GAP IN WALL DRIVEWAY - HUNSAKER PROPERTY
Sheet No. 1 of 2
Prop. No.
Job No. 4A.67
By JSL Date 12/6/06 Ck'd by Date



ELEVATION (BACK OF WALL)
1" = 2'

LIU & ASSOCIATES, INC.
Geotechnical Engineering • Engineering Geology • Earth Science
19213 KENLAKE PLACE NE • KENMORE, WA 98028
PHONE: (425) 483-9134 • FAX: (425) 486-2746

Project REPAIR OF GAP IN WALL DRIVEWAY - HUNSAKER PROPERTY
Sheet No. 2 of 2
Prop. No.
Job No. 4A067
By JSL Date 12/6/06 Ck'd by ______ Date ______



GENERAL NOTES

1. The gap in the wall to be repaired is a cold joint between the soil nail wall and the soldier pile wall.
2. The plywood boards and dirt on the back side of the walls within area of shotcrete application and the gap filler material and dirt in the gap of the walls shall be removed and thoroughly cleaned before proceed with the gap repair work.
3. The steel angles to be mounted on the walls shall comply with ASTM A36 and should be sandblasted and painted or galvanized for corrosion protection.
4. The anchor bolts shall comply with ASTM A307, and shall be epoxy-grouted in holes drilled into the concrete walls. The bolts shall be tightened snuggly against the steel angles and the walls.
5. Steel rebars shall be deformed billet steel bars conforming to ASTM A 615 Grade 40. Steel rebars shall be clean and free of rust, mill scale and other foreign substances at the time of installation.
6. Shotcrete application shall be in accordance with the standards specified in UBC, Chapter 26 - "Shotcrete" and ACI 506. Shotcrete shall be batched, mixed, transported, and placed in compliance with ACI 506-66. Shotcrete shall have a zero slump and a compressive strength of at least 3,000 psi at 7 days. Shotcrete shall be applied by experienced nozzle-man and crew.