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January 28, 2008

Mr. Dale Sweeney
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Geotechnical Report
Proposed Hotel
34839 Pacific Highway South
Federal Way, Washington
Job Name: Sweeney,D.PacHwyS

INTRODUCTION

This report summarizes the results of our geotechnical engineering services for the proposed new hotel to be constructed at 34839 Pacific Highway South in Federal Way, Washington. The approximate location of the site is shown on Figure 1.

Our understanding of the project is based on our discussions with you, our review of the available project plans and our local experience with similar projects in the vicinity of the site. We were provided with a preliminary a site plan showing the planned building location and parking lot configuration. The plan indicates the project will consist of constructing a new 4-story hotel building in the approximate center of the site with parking areas provided along all sides. An access driveway will enter the site from Pacific Highway South at the sites' northeast corner and lead to a porte cochere over the main building entrance along the north side of the building. Site stormwater will discharge to a detention pipe located under the south parking lot. The site layout is shown on the Site Plan, Figure 2.

No topographic site plan was available at the time of our study. However, based on our observations at the time of our site visit, we expect cuts and fills up to 10 feet to achieve finish grades. Although specific design details are not available, we expect the structure will consist of typical spread footing foundations with slab-on-grade floors. Foundation loads should be in the range of 4 to 6 kips per foot for bearing walls and up 100 kips for isolated columns.

SCOPE

The purpose of our services is to evaluate the surface and subsurface conditions at the site as a basis for developing and providing geotechnical recommendations and design criteria for the proposed site development. Specifically, the scope of services for this project included the following:

1. Conducting a geologic reconnaissance of the site area.
2. Exploring the subsurface conditions at the site by monitoring the excavation of four track-hoe excavated test pits at selected locations across the site.

3. Addressing the appropriate geotechnical regulatory requirements for the proposed site development, including seismic hazards and liquefaction potential.
4. Providing geotechnical recommendations for site grading including site preparation, subgrade preparation, fill placement criteria, suitability of on-site soils for use as structural fill, temporary and permanent cut and fill slopes, and drainage and erosion control measures.
5. Providing recommendations and design criteria for foundation and floor slab support, including allowable bearing capacity, lateral soil pressures and estimates of settlement.
6. Providing recommendations for discharge of the site stormwater.
7. Providing recommendations and design criteria for parking lot pavements.
8. Providing recommendations for site drainage.

SITE CONDITIONS

Surface

The approximate 2.5-acre project site is located at 34839 Pacific Highway South in the city of Federal Way, Washington. The project site is bordered with undeveloped property to the south and west, a hotel to the north, and Pacific Highway South to the east. The site is currently developed with a small one-story commercial building in the northeast corner, a small one-story metal building in the approximate center of the site, and a few outbuildings at various locations along the east end of the site.

Surface grades at the site slope down to the west at surface inclinations ranging from 5 to 15 percent. Towards the western end of the site, surface grades increase to approximately 20 to 35 percent down to a wetland area along the western property line. The slope down to the wetland along the sites' western property line is approximately 20 feet tall.

The majority of the site is covered with either grass or gravel. The west end of the site is vegetated with various medium-sized coniferous and deciduous trees with moderately thick underbrush. No areas of erosion were apparent on the site slopes; no standing water was observed on the site at the time of our site work.

Soils

The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS), formerly known as the Soil Conservation Service (SCS), for King County has mapped the site soils as consisting of Everett-Alderwood gravely sandy loam (EwC) soils that form on 6 to 15 percent slopes. According to the NRCS, the Everett-Alderwood soils at the site have a "moderate" potential for erosion when exposed. We observed no active erosion in the site area during our reconnaissance. Based on our observations, the site soils will have a low susceptibility to erosion, particularly where vegetation is established. An excerpt from the NRCS map is provided in Figure 3.

Geology

According to the *Geologic map of the Poverty Bay 7.5 Minute Quadrangle, Washington*, by Derek B. Booth, Howard H. Waldron, and Kathy G. Troost (2003), the site is underlain by Recessional outwash (Qvr). This soil unit is described as well stratified sand and gravel deposited by streams and rivers issuing from the front of the receding ice sheet. It is generally lightly oxidized and commonly very compact. In our opinion, based on the

soils observed in our test pits, the site soils would be better classified as glacial Till (Qvt). This soil unit is described as a compact mixture of sand, gravel, silt and clay. An excerpt from the USGS map is provided in Figure 4.

Subsurface Explorations

On November 2, 2007, a representative from our office was on site to explore subsurface conditions at the site by observing the excavation of 4 trackhoe test pits to a maximum depth of 10 feet below existing surface grades. The approximate test pit locations are shown on the Site Plan, Figure 2

Our representative continuously monitored the excavations, maintained logs of the subsurface conditions encountered in each test pit, obtained representative soil samples, and observed pertinent site features. The specific number, location, and depth of the explorations were selected by GeoResources personnel in the field. The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) provided in Figure 5. The explorations performed as part of this evaluation indicate subsurface conditions at specific locations only and actual subsurface conditions can vary across the site. Furthermore, the nature and extent of any such variation would not become evident until additional explorations are performed or until construction activities have begun. The test pit logs are provided in Figure 5. Representative soil samples obtained from the test pits were placed in sealed containers and taken to a laboratory for possible further examination and testing.

Subsurface Conditions

The subsurface conditions encountered in the test pits were fairly uniform. The soils we observed in the test pits generally consist of 6 inches of topsoil overlying old fill and silty sand with gravel consistent with glacial till.

In Test Pits TP-1, TP-3 and TP-4, we encountered loose to medium dense, moist fill consisting of silty sand with gravel and occasional topsoil and construction debris to depths ranging from 1 to 7 ½ feet below surface grades. The fill was thicker towards the west end of the site. Underlying the fill in Test Pits TP-1, TP-3 and TP-4, and in Test Pit TP-2, we encountered medium dense to dense, moist silty sand with gravel consistent with glacial till.

We did not encounter groundwater seepage in any of the test pits excavated at the site. To the depths explored, we did not encounter mottled soils or other evidence suggesting a seasonal groundwater table develops at the site. However, based on the mapped stratigraphy of the area and the existence of fill over dense glacial till, we do anticipate a seasonal [perched groundwater table will develop under the site during the wet winter months (October through May). This water table will fluctuate seasonally due to precipitation, and future development both on and near the site.

GEOLOGIC HAZARDS

Erosion

Section 18-28 in the City of Federal Way municipal code defines erosion hazard areas as those areas having a "severe" or "very severe" erosion hazard due to natural agents such as wind, rain, splash, frost action or stream flow. The USDA NRCS has mapped the site soils as Everett-Alderwood soils having a "moderate" potential for erosion due to rainfall when exposed. Regardless of the erosion classification of the site, erosion and sediment control measures as required by the city of Federal Way will need to be in place prior to and during construction activity at the site.

Landslide

Section 18-28 in the City of Federal Way municipal code defines landslide hazard areas as those areas potentially subject to episodic downslope movement of a mass of soil or rock including but not liimited to the followiing areas:

a. Any area with a combination of:
    1. Slopes greater than 15 percent;
    2. Permeable sediment overlying a relatively impermeable sediment or bedrock;
    3. Springs or groundwater seeps.

b. Any area which has shown movement during the Holocene epoch, from 10,000 years ago to the present, or which is underlain by mass wastage debris of that epoch.
c. Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action.
d. Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding.
e. Areas that have a "severe" limitation for building site development because of slope conditions, according to the USDA SCS.
f. Those areas mapped as Class U (Unstable), Uos (Unstable old slides), and Urs (unstable recent slides) by the Department of Ecology.
g. Slopes having a gradient steeper than 80 percent subject to rock fall during seismic shaking.

No evidence of landslide activity, or significant erosion was observed at the site at the time of our site visit. We did observe slopes steeper than 15 percent but with no permeable sediment overlying relatively impermeable sediment or bedrock was observed, and no seepage. No planes of weakness or rockfall hazards were observed at the site. No other landslide hazard criteria were observed at the site or the immediate adjacent areas. Based on the above, it does not appear that the site has an active landslide hazard on or within 25 feet of the property.

Steep Slope

Section 18-28 in the City of Federal Way municipal code defines steep slope hazard areas as those areas with a slope of 40 percent or greater and with a vertical relief of 10 or more feet. Based on the topographic map provided to us and our observations during our site reconnaissance, the site does not have areas sloping greater than 40 percent with a vertical height of at least 10 feet, therefore the site is not classified as having steep slope hazard areas.

Seismic

The state of Washington has recently adopted the 2003 International Building Code (IBC). Based on the soil conditions encountered and the local geology, per chapter 16 of the 2003 (IBC) site class "C" should be used in structural design. This correlates to Soil Profile Type S_C in the 1997 Uniform Building Code (UBC). This is based on the inferred range of SPT (Standard Penetration Test) blow counts relative to trackhoe excavation progress and probing with a ½-inch diameter steel probe rod. The presence of glacially consolidated soil conditions were assumed to be representative for the site conditions beyond the depths explored.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure. The increase in pore water pressure is induced by vibrations. Liquefaction mainly affects geologically recent deposits of loose, fine-grained sands that are below the groundwater table. Based on the medium dense

to dense and well-graded nature of the soils observed on the site, and the lack of an established water table to the depths explored, it is our opinion that there is no risk for liquefaction to occur at this site during an earthquake.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on our study, it is our opinion soil and groundwater conditions are suitable for the proposed commercial development. The multi-story structure can be supported on conventional spread footings bearing on competent native soils or on structural fill placed above these native soils. Floor slabs and pavements can be similarly supported. The upper 1 to 7 ½ feet of old fill soils observed in Test Pits TP-1, TP-3 and TP-4 contain significant amounts of organics and trash debris and will not be suitable for support of structural elements, or for use as structural fill. Prior to construction, these unsuitable old fill soils should be removed from under new foundation and slab-on-grade areas and from under utility lines and structures. Grade should be restored with new structural fill. Parking lot pavements can be constructed on the native soils or the existing fill if the pavement section includes a drainage layer, and the exposed pavement subgrade can be compacted to a firm and non-yielding condition.

Detailed recommendations regarding these issues and other geotechnical design considerations are provided in the following sections of this report. These recommendations should be incorporated into the final design drawings and construction specifications.

Erosion and Sedimentation Control

The City of Federal Way Municipal code defines erosion hazard areas as those areas having a severe or very severe erosion hazard due to natural agents such as wind, rain, splash, frost action or stream flow. As previously discussed, the USDA NRCS has mapped the site soils as Everett-Alderwood soils having a "moderate" potential for erosion due to rainfall when exposed. We observed no active erosion on the site or on the slopes adjacent the site area during our reconnaissance. In our opinion, the potential for erosion is not a limiting factor in site development. Erosion hazards can be mitigated by applying Best Management Practices (BMPs) outlined in the Washington State Department of Ecology's (Ecology) *Stormwater Management Manual for the Puget Sound Basin.* Erosion protection measures, as required by the City of Federal Way, will need to be in place prior to starting grading activity on the site.

If the required erosion and sediment control BMPs are properly implemented and maintained, it is our opinion that the planned development will not increase the potential for erosion at the site or on adjacent properties. Similarly, it is our opinion that the planned development will not increase the potential for site instability resulting from erosion or added sediment transport to the watercourse along the west end of the property.

Site Preparation and Grading

To prepare the site for construction, all vegetation, organic surface soils, and other deleterious materials including any existing structures, foundations or abandoned utility lines should be stripped and removed from the site. Organic topsoil and the old fill containing organic and trash debris will not be suitable for use as structural fill, but may be used for limited depths in non-structural areas. Prior to construction, the existing fill containing topsoil and trash debris should be removed from under new foundation and

slab-on-grade areas and from under the site utility lines and utility structures. Stripping depths ranging from 1 to 7 ½ feet should be expected to remove these unsuitable soils.

Once clearing and stripping operations are complete, cut and fill operations can be initiated to establish desired grades. Prior to placing fill, all exposed surfaces should be proofrolled or probed to determine if any isolated soft and yielding areas are present. Proofrolling should also be performed in cut areas that will provide direct support for new construction. We recommend that a member of our staff evaluate the exposed subgrade conditions after removal of vegetation and topsoil stripping is completed and prior to placement of structural fill. If excessively yielding areas are observed and cannot be stabilized in place by compaction, the affected soils should be excavated and removed to firm bearing soil and grade restored with new structural fill. The depth and extent of overexcavation should be evaluated by our field representative at the time of construction.

Suitability of On-Site Materials as Fill

Our study indicates the native soils are currently in a moist condition and contain a relatively high percentage of fines (silt and clay-size particles), which will make them difficult to use as structural fill in wet weather conditions. The existing fill soils contain varying amounts of organic and construction debris, which will make them unsuitable for use as structural fill. Accordingly, the ability to use the native and fill soils from site excavations as structural fill will depend on their moisture content, organic and construction debris content, and the prevailing weather conditions when site grading activities take place.

If structural fill will be imported to the site and grading activities are planned during the wet winter months, or if they are initiated during the summer and extend into fall and winter, the owner should be prepared to import a wet weather structural fill. For this purpose, we recommend importing a wet weather structural fill as described in the **"Structural Fill"** Section of this report.

Structural Fill

All fill placed to establish finish grades and utility trench backfill should be placed as structural fill. The appropriate lift thickness will depend on the fill characteristics and compaction equipment used. We recommend that the appropriate lift thickness be evaluated by our field representative during construction. For planning purposes, we recommend a maximum loose-lift thickness of 12 inches. We recommend that our representative be present during site grading activities to observe the work and perform field density tests.

Fill should be compacted to at least 95 percent of the soils laboratory maximum dry density (MDD) as determined in accordance with ASTM D-1557 (Modified Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this same ASTM standard.

The suitability of material for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines (material passing the No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and compaction becomes more difficult to achieve. During wet weather, we recommend using a well-graded sand and gravel with less than 5 percent (by weight) passing the No. 200 sieve based on that fraction passing the 3/4-inch sieve. If prolonged dry weather prevails during the earthwork and foundation installation phase of construction, a slightly higher (up to 10 to 12 percent) fines content will be acceptable.

Material placed for structural fill should be free of debris, organic matter, trash and cobbles greater than 6 inches in diameter. The moisture content of the fill material should be adjusted as necessary for proper compaction.

Building Setback

Based on the soils encountered in the test pits, the mapped stratigraphy of the site, our site observations and our conclusion regarding site stability, it is our opinion that the site slopes do not constitute a landslide or steep slope hazard and therefore no geologic hazard area buffer is necessary. However, the City of Federal Way building department may require a building setback in accordance with IBC standard requirements. The IBC does require a building setback from slopes that are greater than 30 percent. According to the IBC, when the geotechnical report demonstrates that a reduced or eliminated setback, together with design and engineering solutions, will meet the intent of the chapter, such reduced or eliminated setback and design and engineering solutions may be permitted. Vegetation in the setback area may be enhanced, if approved/required by the City of Federal Way. Clearing, grading and filling within the setback area is allowed if it can be demonstrated that the existing vegetation will not be adversely impacted or that it can be mitigated (enhanced).

In our opinion, the foundations for the structure should be provided with at least a 15-foot setback from the site slopes with surface inclinations that exceed 30 percent in accordance with the 2003 International Building Code (IBC). Where necessary, the building setback for the house foundations may be measured horizontally from the lower outside edge of the footing to the face of the steep slope, in accordance with UBC/IBC. Where this 'Setback Modification' is utilized, the foundation elements should be extended vertically to meet the recommended setback criteria. This modification is based on the foundation elements extending to and being founded in the medium dense to dense native soils. Maintaining the prescribed setback in this manner provides the conventional foundation bearing prism beneath the footing.

Weathering, erosion and the resulting surficial sloughing and shallow land sliding are natural processes that affect steep slope areas. As noted, no evidence of surficial raveling or sloughing was observed at the site. To manage and reduce the potential for these natural processes, we recommend the following:

- No drainage of concentrated surface water or significant sheet flow onto or near the steep slope areas. Drainage from the roof area should be tightlined to flatter, lowland area beyond the toe of the steep slope.
- No fill should be placed within the setback area. Grading should be limited to providing surface grades that promote surface flows away from the slope crest to an approved point of collection for dispersal beyond the toe of the slope.
- No percolation of surface water within 20 feet of Building Setback or top of the steep slope.

Excavations

All excavations at the site associated with confined spaces, such as utility trenches and retaining walls, must be completed in accordance with local, state, or federal requirements. Based on current Washington State Safety and Health Administration (WSHA) regulations, the upper loose to medium dense fill and silty sand with gravel observed on the site would be classified as Type C soils. The deeper, dense silty sand with gravel at the site would be classified as Type A soils.

According to WSHA, for temporary excavations of less than 20 feet in depth, the side slopes in Type C soils should be laid back at a slope inclination of 1.5:1 (Horizontal:Vertical) or flatter from the toe to the crest of the slope. Side slopes in Type A soils can be laid back at a slope inclination of 0.75:1. All exposed slope faces should be covered with a durable reinforced plastic membrane during construction to prevent slope raveling and rutting during periods of precipitation. These guidelines assume that all surface loads are kept at a minimum distance of at least one half the depth of the cut away from the top of the slope and that significant seepage is not present on the slope face. Flatter cut slopes will be necessary where significant raveling or seepage occurs, or if construction materials will be stockpiled along the slope crest. If these safe temporary slope inclinations cannot be achieved due to property line constraints, shoring may be necessary.

This information is provided solely for the benefit of the owner and other design consultants, and should not be construed to imply that GeoResources assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

Foundations

The structure can be supported on conventional spread footing foundations bearing on competent native soils or on new structural fills placed above these native soils. Foundation subgrades should be prepared as recommended in the **"Site Preparation"** section of this report. As previously discussed, the upper 1 to 7 ½ feet of old fill soils observed in Test Pits TP-1, TP-3 and TP-4 contain significant amounts of organics and construction debris and will not be suitable for support of foundation elments. Prior to construction, these unsuitable old fill soils should be removed from under new foundation areas and replaced with new structural fill. Alternatively, the foundations can be deepened to extend through the old fill to bear on the underlying undisturbed native soils observed at 1 to 7 ½ feet below surface grades.

Perimeter foundations exposed to the weather should bear at a minimum depth of 18 inches below final exterior grades for frost protection. Interior foundations can be constructed at any convenient depth below the floor slab. With footings founded as recommended, we recommend they be designed for an allowable soil bearing capacity of 2,500 pounds per square foot (psf) for combined dead and long-term live loads. The weight of the footing and any overlying backfill should be neglected. The allowable bearing value may be increased by one-third for short-term loads such as those induced by seismic events or wind loads. With the anticipated loads and this bearing stress applied, building settlements should be less than one-half inch total and one-quarter inch differential. All footing areas should be evaluated by a representative of GeoResources prior to placement of forms.

For designing foundations to resist lateral loads, a base friction coefficient of 0.40 can be used. Passive earth pressures acting on the sides of the footings can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 325 pounds per cubic foot (pcf). We recommend not including the upper 12 inches of soil in this computation because it can be affected by weather or disturbed by future grading activity. This value assumes the foundations will be constructed neat against competent native soil or backfilled with structural fill, as described in the **"Structural Fill"** section of this report. The values recommended include a safety factor of 1.5.

Site Retaining Walls

The magnitude of earth pressure development on below-grade walls, such as basement or retaining walls, will partly depend on the quality of the wall backfill. We recommend placing and compacting wall backfill as structural fill. Wall backfill below structurally loaded areas, such as pavements or floor slabs, should be compacted according to the specifications provided in the **"Structural Fill"** section of this report.

To guard against hydrostatic pressure development, drainage must be installed behind the wall. We recommend that wall drainage consist of a minimum 12 inches of clean sand and/or gravel with less than 3 percent fines placed against the back of the wall. In addition, a drainage collector system consisting of 4-inch perforated PVC pipe should be installed behind the wall to provide an outlet for any accumulated water. The drains should be provided with cleanouts at easily accessible locations. These cleanouts should be serviced at least once every year. The wall drainage material should be capped at the ground surface with 1-foot of relatively impermeable soil to prevent surface intrusion into the drainage zone.

With wall backfill placed and compacted as recommended and drainage properly installed, unrestrained walls can be designed for an active earth pressure equivalent to a fluid weighing 35 pcf. For restrained walls, we do not recommend using at rest earth pressures. For walls that will be restrained at the top, an additional uniform lateral pressure of 100 psf should be included. These values assume a horizontal backfill condition and that no other surcharge loading, such as traffic, sloping embankments, or adjacent buildings, will act on the wall. If such conditions exist, then the imposed surcharge loading must be included in the wall design. Friction at the base of the wall foundation and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in the **"Foundations"** section of this report.

Slab-On-Grade Floors

Slab-on-grade floors should be supported on subgrades prepared as recommended in the **"Site Preparation"** section of this report. As previously discussed, the upper 1 to 7 ½ feet of old fill soils observed in Test Pits TP-1, TP-3 and TP-4 contain significant amounts of organics and construction debris and will not be suitable for support of slab-on-grade floors. Prior to construction, these unsuitable old fill soils should be removed from under new slab-on-grade areas and replaced with new structural fill.

Immediately below the floor slab, we recommend placing a four-inch thick capillary break layer of clean, free-draining, coarse sand or fine gravel that has less than three percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slabs. The drainage material should be placed in one lift and compacted to a firm and unyielding condition.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and aid in uniform curing of the concrete slab. It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will not assist in uniform curing of the slab, and may serve as a water supply for moisture transmission through the slab and affecting floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained.

Parking Lot Pavement

Parking lot pavement at the project site should be constructed on subgrades prepared as recommended in the **"Site Preparation"** section of this report. As previously discussed, the upper 1 to 7 ½ feet of old fill soils observed in Test Pits TP-1, TP-3 and TP-4 contain significant amounts of organics and trash debris. Prior to paving, these existing fill soils should be mechanically compacted to a firm and non-yield condition. Additionally, the pavement section should be provided with a drainage layer between the asphalt and the underlying compacted subgrade soils.

The thickness of the various components of the pavement depends on the subgrade soils and the traffic conditions to which the pavement will be subjected. We expect traffic to mainly consist of light passenger vehicles, with only occasional heavy service vehicles. Based on this information, and with a properly prepared and stable subgrade composed of on-site native granular soils, or compacted old fill soils, we recommend the following pavement section:

Options	Pavement Element	Thickness (inches)
Option 1	Asphalt Concrete (AC)	3
	Crushed Rock Base (CRB)	4
Option 2	Asphalt Concrete (AC)	2
	Asphalt Treated Base (ATB)	3
	Crushed Rock Base (CRB)	4

All paving materials should conform to the Washington State Department of Transportation (WSDOT) specifications for Class B asphalt concrete and CRB surfacing. Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability. To improve performance, we recommend surface drainage gradients of at least two percent. Some longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur

Regardless of the relative compaction achieved, the subgrade must be firm and unyielding before paving. Proofrolling the subgrade with heavy construction equipment should be completed to verify this condition. We recommend compacting fill placed for pavement subgrades according to the recommendations provided in the **"Structural Fill"** section of this report.

Stormwater Detention Pipe

The site stormwater will discharge to a detention pipe located under the south parking lot. We understand the detention pipe will entail storage and a stormfilter for cleaning prior to discharge to the wetland located along the west end of the site. The detention pipe should be supported on a subgrade prepared as recommended in the **"Site Preparation"** section of this report. Accordingly, if the existing old fill containing organics

and construction debris is evident along the pipe subgrade, it should be removed and replaced with new structural fill.

We examined the existing soils underlying the site to determine if infiltration of the development stormwater was feasible. Due to the medium dense to dense, well-graded, and cemented nature of the native glacial till soils that underlie the site, it is our opinion that infiltration of the site stormwater is not feasible. It is also our opinion that the planned stormwater detention system will not increase the stability of the site slopes.

Utilities

We expect that underground utilities, such as sanitary sewer, storm, and water will consist of a series of pipes, vaults, manholes, and catch basins. The utility excavations should be performed in accordance with appropriate governmental guidelines. Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) specifications. The existing fill at the site containing organics and trash debris will not be suitable for support of the utility lines and structures. Prior to construction, these unsuitable old fill soils should be removed from under the utility lines and structures.

We anticipate that the on-site, non-organic soils will be suitable for use as structural backfill. If import soil is used as utility trench backfill, it should consist of a material meeting the wet weather fill recommendations provided in the **"Structural Fill"** section of this report. Controlled-density fill (CDF) is most often suitable for use as backfill in any weather condition and could be used as a convenient, but more expensive, alternative to granular backfill soil.

We recommend that utility backfill soils be compacted according to the recommendations provided in the **"Structural Fill"** section of this report. CDF backfill does not require compaction but should have a compressive strength commensurate with the application.

Drainage

All ground surfaces, pavements, and sidewalks should be sloped away from the structure. Surface water runoff should be controlled using a system of berms, drainage swales, and/or catchbasins, and conveyed to an approved point of controlled discharge. We recommend conventional roof and foundation drains be installed for all structures. The footing drains should be tightlined independent of the roof drains unless an adequate gradient will prevent backflow into the footing drains

Surface water shall not be allowed to flow uncontrolled over the crest of the site slopes and embankments. Surface water should be directed away from the slope crests to a point of collection and controlled discharge. If constructed according to code, a dispersion trench would be considered a controlled discharge mechanism. If site grades do not allow for directing surface water away from the slopes, then the collected water should be tightlined down the slope face in a controlled manner.

LIMITATIONS

We have prepared this supplemental report for use by Dale Sweeney and members of their design team for use in the design and permitting portions of this project. This report and the data used in preparing this report should be provided to prospective contractors for bidding or estimating purposes only. Our report, conclusions and interpretations are based on data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

When the project design is finalized, we recommend the design and specifications be reviewed by our firm to see that our recommendations have been interpreted and implemented as intended. If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

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 this report was prepared. No other conditions, expressed or implied, should be understood.

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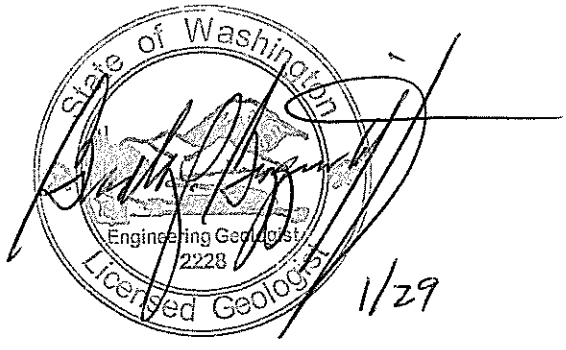
We appreciate the opportunity to be of continued service to you on this project. Please do not hesitate to call with any additional comments or questions.

Respectfully submitted,
GeoResources, LLC

EXPIRES 11-08-2008

Bernard P. Knoll II, PE
Senior Engineer



BRADLEY P. BIGGERSTAFF

Brad P. Biggerstaff, LEG
Principal

BPK:BPB:bpk
Document ID: Sweeney,D.PacificHighwayS.GR
Attachments:
Figure 1 – Site Vicinity Map
Figure 2 – Site Plan
Figure 3 – USDA NRCS Soils Map
Figure 4 – USGS Map
Figure 5 – Unified Soil Classification System (USCS)
Figure 6 – Test Pit Logs

Approximate Site Location

GeoResources, LLC
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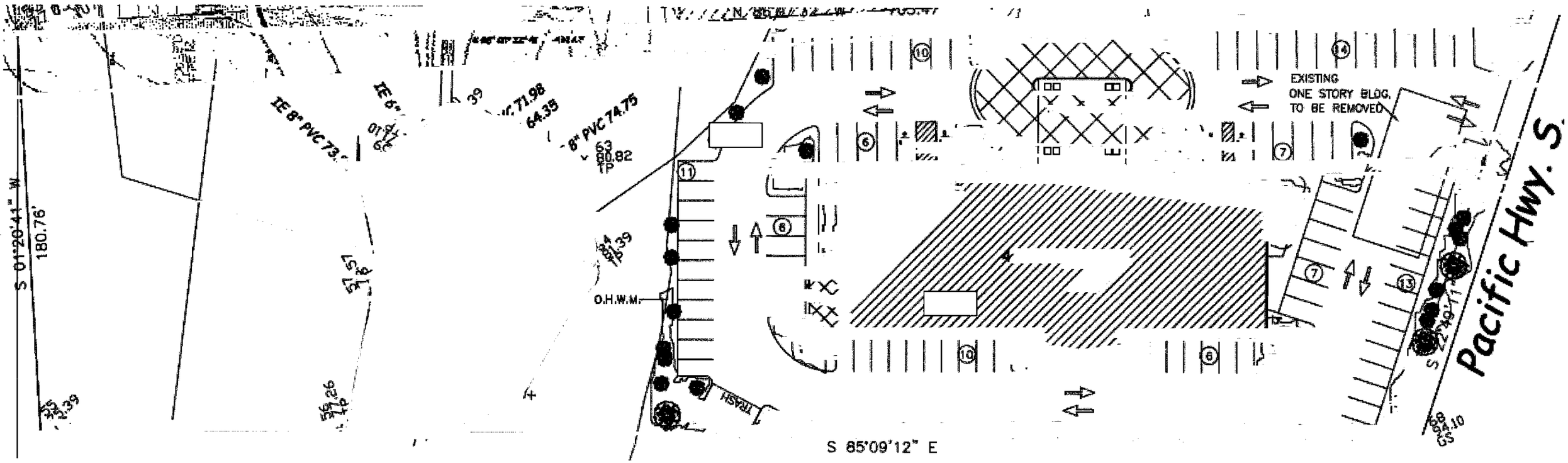
Site Vicinity Map
34839 Pacific Highway South
Federal Way, Washington

Job #: Sweeney,D.PacificHwyS	January 2008	Figure 1



Site plan provided by TNT Engineering.

APPROXIMATE SCALE
1" = 30'

APPROXIMATE TEST PIT LOCATION
APPROXIMATE LOCATION OF SLOPES > 40%
APPROXIMATE LOCATION OF SLOPES > 15 - 39%

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Site Plan
34839 Pacific Highway South
Federal Way, Washington

Job #: Sweeney,D.PacificHwyS	January 2008	Figure 2

Approximate S Location

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
EwC		2.4	100.0%
Totals for Area of Interest (AOI)		2.4	100.0%

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USDA NRCS Map
34839 Pacific Highway South
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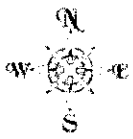
Job #: Sweeney,D.PacificHwyS	January 2008	Figure 3

Approximate Site Location



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USGS Map
34839 Pacific Highway South
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Job #: Sweeney,D.PacificHwyS	Janauary 2008	Figure 4

UNIFIED 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 D2488-90.
2. Soil classification using laboratory tests is based on ASTM D2487-90.
3. Description 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, 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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Unified Soil Classification System (USCS)
34839 Pacific Highway South
Federal Way, Washington

Job #: Sweeney.D.PacificHwyS	January 2008	Figure 5

Test Pit TP-1

Location: See Site Plan

Depth (ft.)	Soil Type	Description
		(3 inches grass roots and TOPSOIL)
0.0 - 4.0	-	FILL: Gray and brown silty sand with gravel and cobbles, loose to medium dense, moist. (Fill was organic-laced from 3 to 4 feet.)
4.0 - 6.5	SM	Brownish-orange silty SAND with gravel, slightly cemented, medium dense, moist. (Weathered Glacial Till)
6.5 - 8.0	SM	Gray silty SAND with gravel, moderately cemented, dense. (Glacial Till)

Terminated at 8 feet below the ground surface.
No caving observed.
No groundwater observed.

Test Pit TP-2

Location: See Site Plan

Depth (ft.)	Soil Type	Description
		(2 inches grass roots and TOPSOIL)
0.0 - 3.5	SM	Gray silty SAND with gravel, moderately cemented, dense. (Glacial Till)

Terminated at 3 ½ feet below the ground surface.
No caving observed.
No groundwater observed.

Test Pit TP-3

Location: See Site Plan

Depth (ft.)	Soil Type	Description
		(4 inches grass roots and TOPSOIL)
0.0 - 7.5	-	FILL: Gray and brown silty sand with gravel and cobbles, loose to medium dense, moist to wet. (Fill was organic-laced with construction debris and a strong organic odor from 5 to 7 ½ feet.)
7.5 - 9.0	SM	Brownish-orange silty SAND with gravel, slightly cemented, medium dense, moist. (Weathered Glacial Till)
9.0 - 10.0	SM	Gray silty SAND with gravel, moderately cemented, dense. (Glacial Till)

Terminated at 10 feet below the ground surface.
No caving observed.
No groundwater observed.

Test Pit TP-4

Location: See Site Plan

Depth (ft.)	Soil Type	Description
		(2 inches grass roots and TOPSOIL)
0.0 - 1.0	-	FILL: Brown silty sand with gravel loose to medium dense, moist.
1.0 - 4.0	SM	Brownish-orange silty SAND with gravel, slightly cemented, medium dense, moist. (Weathered Glacial Till)
4.0 - 6.0	SM	Gray silty SAND with gravel, moderately cemented, dense. (Glacial Till)

Terminated at 6 feet below the ground surface.
No caving observed.
No groundwater observed.

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Test Pit Logs
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