

March 21, 2008

City of Seattle
c/o SvR Design Group
1205 Second Avenue, Suite 200
Seattle, Washington 98101

Attention: Dave Rodgers, PE, LEED

Subject: Preliminary Geotechnical Evaluation
Burke Gilman Trail Corridor
11th Avenue NW to the Ballard Locks
Seattle, Washington
File No. 0129-128-00

INTRODUCTION

This letter presents a summary of our preliminary geotechnical engineering evaluation of subsurface information readily available for the Burke Gilman Trail Corridor Project in Seattle, Washington. GeoEngineers, Inc. completed a preliminary environmental study of the project alignment, the results of which are summarized in our Hazardous Materials Discipline report dated March 21, 2008.

The City of Seattle Department of Transportation (SDOT) currently has three projects that will extend the Burke Gilman Trail (Trail) pedestrian and bicycle corridor to Golden Gardens Park. This preliminary geotechnical evaluation discusses the portion of the project that will connect the existing terminus of the Trail at 11th Avenue NW and NW 45th Street to the Ballard Locks where the trail picks up again and ends at the intersection of 60th Avenue NW and Seaview Avenue NW. The proposed trail improvements will include repairs to the existing road and railways, adding landscaping and/or barrier walls between traffic and the connector trail, installing associated utilities, and the widening of portions of the shoulder along the existing road alignment to accommodate a bike lane.

SITE CONDITIONS

SURFACE CONDITIONS

The project alignment is located along the north shoreline of Salmon Bay, which connects Lake Union to the Puget Sound via the Hiram M. Chittenden Locks. The project alignment is shown on the attached Project Alignment Map, Figure 1. The project alignment is located in a relatively flat area and the ground surface slopes gently downward toward Salmon Bay in the south-southwest. The ground surface along the project alignment ranges between about Elevation 20 feet and Elevation 30 feet above mean sea level.

The area around the proposed right of way is occupied by restaurants, residential buildings, and small shops. Also many industries such as sand and gravel facilities, boat yards, and fuel transfer facilities are located along the north shore of Salmon Bay and along the planned project alignment.

Surface water in the area also generally flows to the south-southwest where it is not controlled by on-site storm water systems and/or municipal drains.

REVIEW OF GEOLOGIC MAP

Published geologic information for the project vicinity includes the “Geologic Map of Seattle – A Progress Report” by the United States Geological Survey dated 2005. The soils mapped in the area include four geologic units associated with the Vashon glaciation (about 15,000 years ago). These soil units include alluvium (Qal), recessional outwash (Qvr), glacial till (Qvt), and advance outwash (Qva). These soil units are shown in Figure 1.

The alluvium and recessional outwash typically consist of mixtures of loose to dense silt, sand and gravel with varying amounts of cobbles that were deposits by running water either from the retreating glaciers or subsequent streams that developed downstream of the retreating glaciers. The glacial till typically includes dense to very dense silty sand and gravel with occasional cobbles and boulders that were deposited below the advancing glaciers. The advance outwash underlies the glacial till and includes dense to very dense sand and silty sand that was deposited by streams emanating from the advancing glaciers.

There are also areas of artificial fill identified on the geologic map. These areas are associated with road building activities and site development along the north side of Salmon Bay and are also shown in Figure 1.

ENVIRONMENTALLY CRITICAL AREAS MAPPING

We also reviewed Environmentally Critical Area (ECA) maps available from the City of Seattle web site. The only ECA located along the alignment is a liquefaction prone area mapped at the east end of the planned alignment. The mapped ECA is located south of the east end of the alignment as shown in Figure 1 and within an area mapped as artificial fill and alluvium. These mapped soils also underlie much of the east end of the alignment and the potential for liquefaction should be considered to be likely in this area.

REVIEW OF EXISTING EXPLORATION DATA

We collected and reviewed exploration data available from the GeoMap NW (The Pacific Northwest Center for Geologic Mapping Studies at the University of Washington) website and from projects completed by GeoEngineers in the area. The approximate locations of these nearby explorations are shown in Figure 1.

We reviewed approximately 10 exploration logs for previous projects completed near the proposed Burke Gilman Trail alignment. The presence of fill and native soils is indicated by each of these exploration logs. Fill ranging in thickness from about 2 feet to more than 20 feet has been identified along the alignment. The fill generally consists of soft silt and sandy silt, and loose silty sand with variable gravel content. Some of deeper explorations encountered dense glacially consolidated soils below the fill. The native soils typically consist of medium dense to very dense sand with variable silt content.

Ground water, where noted in the previous studies, was encountered at depths ranging from about 3 to 12 feet below the ground surface. The direction of groundwater flow in the project alignment is expected to be from the north-northeast towards Salmon Bay to the south-southwest based on the topography of the area.

We also reviewed exploration logs for five borings provided by SvR Design for work completed in 2002 by Seattle Public Utilities Materials Laboratory for the Salmon Bay Drainage Project. The explorations are located along NW 54th Street, between 26th Avenue NW and 28th Avenue NW. Subsurface conditions include 10 to 13 feet of fill overlying native sand and silty sand with gravel. The fill is generally loose sand and silty sand with gravel containing occasional wood debris and refuse. Groundwater levels were measured during drilling (February 2002) at depth of 6 to 8 feet below the ground surface. The approximate locations of these explorations are shown in Figure 1.

OTHER DOCUMENTS REVIEWED

We reviewed portions of the “Salmon Bay Storm Drainage Improvements Predesign Report” prepared by Seattle Public Utilities Resource Development Division dated February 2001. The predesign report includes discussion of surface water ponding along NW 54th Street, between 24th Avenue NW and 28th Avenue NW. Severe ponding on both private and public property was noted in the report.

In addition to the drainage issues described above, a groundwater seep was observed on the northwest corner of the 14th Avenue NW and NW 45th Street intersection during the windshield survey conducted for the “Hazardous Materials Discipline Report – Burke Gilman Trail Corridor, 11th Avenue to the Ballard Locks” (GeoEngineers, 2008). The seep originates on City ROW and flows into a catchbasin on private property and is not located within the Project alignment. The seep has been observed previously during historical investigations. We reviewed a memorandum prepared by Sound Environmental Strategies (SES) dated July 24, 2007 that describes seepage conditions at 1451 NW 46th Street. The seepage conditions are described as flow originating from the right-of-way and flowing on to the southeast corner of the adjacent property. SES suggests that the source of the seepage water may be a water supply line that is leaking nearby. This area is to the north of the alignment and not likely impacted by the proposed project.

RECONNAISSANCE

We completed a general field reconnaissance on April 19, 2007 to observe surface conditions along the project alignment. The reconnaissance was completed to identify conditions that are of potential concern regarding geologic hazards or ground conditions that might impact the proposed development of the Burke Gilman Trail. The reconnaissance included observation of existing site features and improvements, general topography and vegetation. The intent was to help identify areas of significant geotechnical concern for development of the Burke Gilman Trail within the project alignment. General observations made during the field reconnaissance are presented below.

- The alignment from 11th Avenue NW to the overpass at 15th Avenue NW includes railroad tracks along the north side of NW 45th Street, and two traffic lanes surface with asphalt concrete pavement.
- The railroad angles NW 45th Street below the overpass and then follows the south side of the road to 17th Avenue NW and beyond.
- Cement concrete pavement roadway surfacing extends west from 15th Avenue NW to 17th Avenue NW.
- The asphalt concrete pavement is very broken up and potholed in the area of 17th Avenue NW and NW 47th Street. There are curbs on both sides of 17th Avenue NW and NW 47th Street.

- Ballard Avenue NW is a wide asphalt concrete pavement surfaced roadway with curbs on both sides.
- NW Vernon Place is cement concrete pavement surfaced roadway with curbs on both sides.
- Cement concrete pavement roadway traffic lanes are present along the Shilshole Avenue NW section from NW Vernon Place to about 200 feet east of NW Market Street where it changes to asphalt concrete pavement. The north shoulder of this section of Shilshole Avenue NW is asphalt concrete pavement and the south shoulder is unpaved. There are no curbs until you get to 24th Avenue NW.
- NW Market Street includes asphalt concrete pavement and curbs on both sides.
- 28th Avenue NW includes asphalt concrete pavement from NW Market Street to the railroad right-of-way, and no curbs.
- The railroad right-of-way includes a set of tracks and unpaved road along the north side of the tracks. The south side of the tracks is primarily sloping ground that descends to businesses located along Salmon Bay.

CONCLUSIONS

Explorations from several studies from GeoMap NW (The Pacific Northwest Center for Geologic Mapping Studies at the University of Washington) and other studies in our files were reviewed. These data provide a good basis for understanding the ground conditions along the alignment. However, additional explorations may be necessary to explore shallow subsurface conditions in specific sections of the alignment if new pavement is added or improvements to the existing pavement sections proposed.

Based on our review of geologic mapping and available exploration data, we anticipate that the subsurface soils along much of the project alignment will consist of fill overlying native deposits. This area of “artificial fill” is shown in Figure 1. In some of the explorations reviewed the areas of fill are as much as 20 feet thick. We expect that the fill is predominantly associated with development of the existing roadways and adjacent properties.

The critical areas mapping indicates a liquefaction prone area at the east end of the alignment. Liquefaction is a phenomenon where soils experience a rapid loss of internal strength as a consequence of strong ground shaking. Ground settlement, lateral spreading and/or sand boils may result from soil liquefaction. The existing roadways and proposed bike trail supported on liquefiable soils could suffer some settlement during strong ground shaking.

We recommend that the need for, and number of, new explorations be evaluated after the final alignment has been determined. Based on our observations, we conclude that explorations will be necessary along the unpaved roadway shoulders if the trail will be located in these areas, to evaluate the pavement distress in the area of 17th Avenue NW and NW 47th Street, and along the railroad right-of-way at the west end of the alignment where new pavements will be added. If the trail extends along the south side of the railroad additional explorations may be needed in this area as well. Finally, we understand that 10- to 12-foot-high retaining walls will be required along a portion of the trail alignment. Explorations will be needed in the area(s) of these retaining walls for the purpose of the structural engineer’s retaining wall design.

LIMITATIONS

We have prepared this letter for the exclusive use City of Seattle and their consultants, including SVR Designs, for the evaluation of preliminary geotechnical considerations for development of the Burke Gilman Trail Corridor located between 11th Avenue NW and the Ballard Locks in Seattle, Washington.

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

Please call if you have any questions.

Sincerely yours,

GeoEngineers, Inc.



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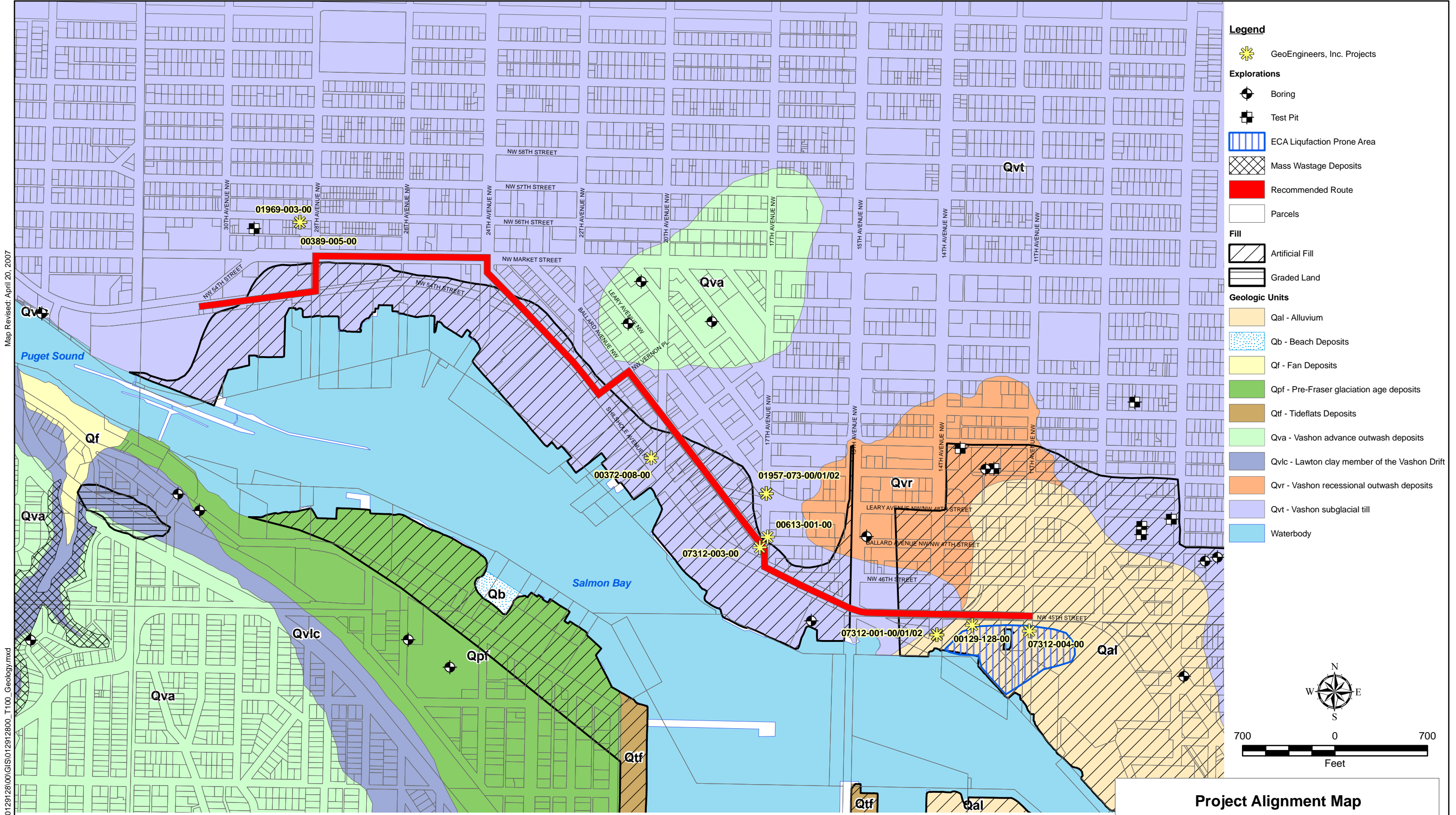
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Three copies submitted (one copy by e-mail)

Disclaimer: Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

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Map Revised: April 20, 2007

Office: SEA
 Path: P:\0129128\00\GIS\012912800_T1\00_Geology.mxd

Reference: "The Geologic Map of Seattle - A Progress Report" by USGS dated 2005. Parcels provided by King County GIS data center. Critical Areas Information from City of Seattle DPD.

Notes:
 1. The locations of all features shown are approximate.
 2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Project Alignment Map

Burke Gilman Trail Corridor
 King County, Washington