# MESSENGER HOUSE PHASE II

## Geotechnical Engineering Report

Prepared for: Cascadia Senior Living & Fieldstone Communities

Project No. 200104 • June 22, 2020 • FINAL

earth + water

Aspect
CONSULTING

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Aspect Consulting, LLC

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# 1 Project Description

This report presents the results of Aspect Consulting, LLC's (Aspect) geotechnical engineering evaluation in support of the Phase II improvements at the Messenger House Care Center (Project) at 10861 NE Manitou Park Boulevard, Bainbridge Island, Washington, Kitsap County Parcels 4156-002-005-0203 and 4156-002-007-00003 (Site). The Project location is shown on Figure 1, Site Location Map. Our understanding of the Project was derived through conversations with the Project architect, Wenzlau Architects, and review of a conceptual redevelopment plan.

The Project will include the demolition and replacement of the existing south wing of Messenger House (built in 1986) with a new three-story building totaling approximately 60,000 square feet in area. The existing south wing is an above grade structure and the proposed replacement building will also be above grade. Existing Site features and the approximate footprint of the proposed building are shown on Figure 2.

Exterior improvements for the Project will include new hardscapes including patios, covered plazas, entrances, fire pits, and sidewalks in the southern portion of the Site. The existing central wing (built in 1917) will undergo an interior remodel as part of the Project but will not change the structural footprint or include significant foundation alterations. No changes are proposed at the existing north wing (built in 1997). No significant cuts, fills, or retaining walls are planned for the Project.

Aspect has completed a geotechnical engineering evaluation to inform the new building foundation and hardscapes design, provide a soil infiltration feasibility assessment, and satisfy the City's requirements related to the redevelopment of the Site given mapped landslide hazard areas (a subset of critical areas) at the Site. Our scope of work included a literature review, subsurface explorations to characterize the shallow subsurface soil and groundwater conditions underlying the Site, geotechnical laboratory testing, and geotechnical analyses and production of this report. Our work was completed in general accordance with our approved contract, authorized on March 23, 2020.

# 2 Site Conditions

This section presents the Site conditions, including geologic setting, Site surface conditions, and subsurface conditions encountered in our field investigation program and previous field investigations. This information provides context for the discussion of types and distribution of geologic soil units and a basis for our geotechnical engineering recommendations.

## 2.1 General Geology

The Site is located within the Puget Lowland, a broad area of tectonic subsidence flanked by two mountain ranges: the Cascades to the east and the Olympics to the west. The sediments within the Puget Lowland are the result of repeated cycles of glacial and nonglacial deposition and erosion. The most recent cycle, the Vashon Stade of the Fraser Glaciation (about 13,000 to 16,000 years ago), is responsible for most of the present day geologic and topographic conditions. During the Vashon Stade, the 1,000-foot-thick, Cordilleran Glacier advanced into the Puget Lowland. As the Cordilleran Glacier advanced southward, lacustrine and fluvial sediments were deposited in front of the glacier. Preglacial and proglacial sediments were overridden and consolidated by the advancing glacier, creating dense and hard soil deposits. At the interface between the advance soils and the glacial ice, the Cordilleran Glacier sculpted and smoothed the surface, and then deposited a consolidated basal till. As the Cordilleran Glacier retreated northward from Puget Lowlands to British Columbia, it left an unconsolidated sediment veneer over glacially consolidated deposits.

The available geologic mapping (Haugerud, 2011) indicates that subsurface conditions at the Site consist of Pleistocene-age, Vashon till (Qvt). Vashon till is described as a matrix-supported, dense, sandy diamict composed of a mixture of silt, sand, and gravel. These sediments have been compressed and consolidated by glacial ice, creating a dense/hard configuration.

## 2.2 Geologic Hazard Mapping

Portions of the Site are mapped as landslide hazard areas, a subset of critical areas, by the City of Bainbridge Island (COBI, 2018). The landslide hazard areas are categorized as 15 to 40 percent slopes (Moderate Slopes) and greater than 40 percent slopes (Steep Slopes). The mapped landslide hazard areas are shown on Figure 2.

## 2.3 Surface Conditions and Topography

The Site is bordered by NE Ocean Drive at the south, Manitou Park Boulevard NE at the east, by residential parcels to the north, and by privately owned undeveloped land at the west. The Site is generally flat (0 to 5 percent inclinations) over the western half, moderately sloped (5 to15 percent) in the center, and steeply sloped (15 to 50 percent) in limited areas in the north and northeast portions of the Site. The Site includes an asphalt-paved parking lot and driveway at the southwest and three existing buildings (the “north wing”, “central wing” and “south wing”). The remainder of the Site is moderately vegetated with non-deciduous trees and landscaped areas, with some garden areas that are likely fed by rainfall.

At the time of our Site visit (April 27, 2020), we observed no standing water or groundwater seepage at the Site or signs of erosion or slope instability such as tension cracks at the ground surface. Final grades around the existing structures appear to generally slope away from the structures such that surface water would drain away from the structures. Downspouts and roof drains connect to a substructure system; it was unclear where the outlets to these systems were.

Based on historical aerial imagery and Site maps, a theater and house used to exist in the southeast portion of the Site. Based on historical aerial imagery, the theater building was demolished between 2017 and 2018, and the house was demolished between 2009 and 2010. The approximate footprints of the demolished theater and house are shown on Figure 2.

## 2.4 Subsurface Conditions

Our understanding of subsurface conditions at the Site is based on our review of aerial photos, historical topographic maps, published geologic mapping of the area, and previous subsurface explorations at the Site. Our understanding is also based on our experience with local geology and our own subsurface exploration data collected for this Project.

### *2.4.1 Field Investigations by Aspect*

On April 27, 2020, Aspect completed 8 test pit explorations, designated ATP-01 through ATP-08, at the Site surrounding the existing south wing. The locations of our test pit explorations were chosen to inform geotechnical analyses and recommendations for the proposed building, hardscapes, and stormwater infiltration feasibility; the test pit locations are shown on Figure 2.

A more detailed description of the field exploration methods and exploration logs are presented in Appendix A.

### *2.4.2 Geotechnical Laboratory Testing by Aspect*

Aspect subcontracted geotechnical laboratory testing services, including moisture content, grain-size analyses, and modified Proctor tests on select soil samples obtained from our subsurface explorations. Detailed descriptions of the tests and results are presented in Appendix B and were incorporated into the exploration logs in Appendix A.

### *2.4.3 Previous On-Site Investigation*

The Site was previously explored for geotechnical purposes by Myers Biodynamics, Inc. (Myers) in 1994. We referenced their geotechnical report, which included data from their subsurface explorations and geotechnical laboratory testing to support our characterization of the Site and subsurface conditions (Myers, 1994). The subsurface explorations they performed included six borings (designated B-1 through B-6) and eight test pits (designated TP-1 through TP-8).

The geotechnical report by Myers Biodynamics, Inc. is included as Appendix C. The approximate locations of their subsurface explorations are shown on Figure 2. Based on its location, boring B-6 is the most relevant exploration by Myers for the proposed building.

### *2.4.4 Soil Units*

The soils encountered in the borings (starting at the ground surface) include topsoil, fill, and Vashon Till. Detailed descriptions of these soils are included below.

#### 2.4.4.1 Topsoil

Topsoil refers to a unit that contains a high percentage of organics, generally found at the ground surface and containing grass, mulch, and roots. We encountered up to 6 inches of topsoil within our explorations, with the exception of ATP-05, ATP-07, and ATP-08, where fill was encountered at the ground surface.

#### 2.4.4.2 Fill

Fill refers to material placed by human activity. Beneath the topsoil in ATP-02, ATP-03, ATP-04, and ATP-06 and at the ground surface in ATP-05, ATP-07, and ATP-08 we encountered fill that varied in composition and relative density/consistency. The fill was generally loose to dense sand with varying amounts of gravel (SM, SP)[1]. The fill in ATP-02 through ATP-04 and ATP-06 was relatively limited, extending to depths of 0.75 to 1.25 feet bgs.

We encountered metal and concrete debris to the depths explored in ATP-05, ATP-07, and ATP-08, which were advanced within the footprint of the demolished theater building. The bottom of the fill was not encountered in these explorations. Based on the locations of these explorations within the old theater footprint, we infer that the old theater had at least one level of basement, which was filled with undocumented fill after the theater building was demolished. Assuming one level of basement was filled, we anticipate that the fill may extend approximately 10 to 12 feet below ground surface (bgs)[2]. Of note, a basement wall of the old theater building was encountered in ATP-08. Based on the location of this test pit within the old theater footprint, we infer that this was an internal basement wall.

Because of the presence of concrete and metal debris, we consider the fill encountered at ATP-05, ATP-07, and ATP-08 to be nonengineered, meaning that its composition is not fully known, and it was not placed to a specified compaction rate. Experience has shown that nonengineered fill often contains other oversize materials such as concentrated organics, timbers, wood debris, and rocks.

The fill is anticipated to exhibit moderate to high compressibility and low shear strength.

#### 2.4.4.3 Vashon Till

Below the topsoil and fill in all explorations except ATP-05, ATP-07, and ATP-08, we encountered sand with varying amounts of silt and gravel (SM, SP-SM) extending to the bottom of the explorations. We interpreted these deposits to be weathered to unweathered Vashon Till. The weathered Vashon till typically comprised the upper 1 to 2.5 feet of the unit and was generally medium dense to dense, slightly moist to wet, and brown. The unweathered Vashon till was generally dense to very dense, dry to slightly moist, and gray.

The weathered Vashon till is anticipated to exhibit moderate compressibility and moderate shear strength. The unweathered Vashon till is anticipated to exhibit very low compressibility and high shear strength.

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[1] Soils classified in accordance with the Unified Soil Classification System (USCS), ASTM D2488.

[2] This inference is based on limited subsurface data. The actual depth of nonengineered fill may extend deeper than anticipated.

#### 2.4.4.4 Groundwater

Groundwater was generally not encountered in the explorations, except for groundwater seepage encountered in ATP-02 at approximately 3 feet bgs, within weathered Vashon till. Based on the relative moisture content of the underlying unweathered Vashon till deposits, we infer that the groundwater we encountered here was perched atop the unweathered Vashon Till. We observed consistent iron-oxide staining within the weathered till deposits, indicating that perched water may be seasonally present in this unit.

Groundwater levels will fluctuate seasonally with precipitation, as well as with changes in Site and near-Site usage.

# 3 Geologic Hazards

In this section, we describe the relevant geologic hazards to the Site and the Project. This section provides context for the City’s requirements related to the redevelopment of the Site given typical earthquake engineering considerations and mapped landslide hazard areas (a subset of critical areas) at the Site.

## 3.1 Earthquake Engineering

The Site is located within the Puget Lowland physiographic province, an area of active seismicity that is subject to earthquakes on shallow crustal faults and deeper subduction zone earthquakes. The Site area lies about 3 miles north of the Seattle fault zone, which consists of shallow crustal tectonic structures that are considered active (evidence for movement within the Holocene [since about 15,000 years ago]) and is believed to be capable of producing earthquakes of magnitude 7.3 or greater. The recurrence interval of earthquakes on this fault zone is believed to be on the order of 1,000 years or more. The most recent large earthquake on the Seattle fault occurred about 1,100 years ago (Pratt et al., 2015). There are also several other shallow crustal faults in the region capable of producing earthquakes and strong ground shaking.

The Site area also lies within the zone of strong ground shaking from earthquakes associated with the Cascadia Subduction Zone (CSZ). Subduction zone earthquakes occur due to rupture between the subducting oceanic plate and the overlying continental plate. The CSZ can produce earthquakes up to magnitude 9.3 and the recurrence interval is thought to be on the order of about 500 years. A recent study estimates the most recent subduction zone earthquake occurred around 1700 (Atwater et al., 2015).

Deep intraslab earthquakes, which occur from tensional rupture of the sinking oceanic plate, are also associated with the CSZ. An example of this type of seismicity is the 2001 Nisqually earthquake. Deep intraslab earthquakes typically are magnitude 7.5 or less and occur approximately every 10 to 30 years.

The following sections present descriptions of seismic design considerations for the Project.

### 3.1.1 Ground Response

The International Building Code (IBC) seismic design is based on the "Maximum Considered Earthquake (MCE)" with a 2 percent probability of exceedance (PE) in 50 years (2,475-year return period; ICC, 2015). The American Society of Civil Engineers (ASCE) created a hazard tool (ASCE, 2018) as a quick reliable way to look up key design parameters using the probabilistic ground motion studies and maps for Washington prepared by the U.S. Geological Survey. Seismic design should be completed with the specific ground motion parameters listed in Table 1 below.

**Table 1. Seismic Design Parameters**

| Design Parameter | Recommended Value |
|---|---|
| Site Class | C |
| Peak Ground Acceleration (PGA) | 0.555g$^{(1)}$ |
| Short Period Spectral Acceleration ($S_s$) | 1.354g |
| 1-Second Period Spectral Acceleration ($S_1$) | 0.532g |
| Site Coefficient ($F_a$) | 1.0 |
| Site Coefficient ($F_v$) | 1.3 |
| Design Short Period Spectral Acceleration ($S_{DS}$) | 0.903g |
| Design 1-Second Period Spectral Acceleration ($S_{D1}$) | 0.461g |

**Notes:**

1. g = gravitational force
2. Based on the latitude and longitude of the Site: 47.661803°N, 122.501841°W.

### 3.1.2 Surficial Ground Rupture

A trace of an east-west trending thrust fault zone (Seattle fault zone) projects through Bainbridge Island, with the nearest known active fault trace (an unnamed fault) located approximately 3 miles south of the Site (Gower et al., 1985). Due to the suspected long recurrence interval and the proximity of the Site to the mapped fault trace, the potential for surficial ground rupture at the Site is considered low during the expected life of the Project.

### 3.1.3 Liquefaction

Liquefaction occurs when loose, saturated, and relatively cohesionless soil deposits temporarily lose strength from seismic shaking. The primary factors controlling the onset of liquefaction include intensity and duration of strong ground motion, characteristics of subsurface soil, *in situ* stress conditions, and the depth to groundwater.

The Washington Department of Natural Resources (DNR) maps the Site as having very low liquefaction susceptibility (DNR, 2004). Given the relative density, grain size distribution, and geologic origin of the soils at the Site, we do not consider liquefaction to be a significant hazard for the Project.

## 3.2 Landslide Hazards

Landslides may be triggered by natural causes, such as precipitation, freeze-thaw cycles, or a seismic event, or be man-made (e.g., broken water pipes). Three types of landslides are common on steep slopes in the Puget Sound: topples, deep-seated rotational slides, and shallow flows (Varnes, 1978).

The City maps the Site as containing scattered Moderate Slopes with isolated areas of Steep Slopes. *The Coastal Zone Atlas of Washington* maps the Site as “Stable” (Ecology, 2020). Recent LiDAR studies (McKenna et al., 2008) do not map landslide headscarps or deposits at or near the Site.

We did not observe evidence of historical, recent, or incipient landslide activity at or near the Site. We also did not observe evidence of ongoing erosion, scour, or prominent groundwater seepage along the slopes. The stratigraphy of the Site soils is also not prone to landslide activity in the context of the Site and Project. In addition, the isolated sections of Steep Slopes are less than 10 feet tall. Given these observations, it is our opinion that landslide hazard at the Site is low and that the Site does not contain landslide hazard areas as defined by the City (COBI, 2018).

# 4 Geotechnical Engineering Conclusions and Recommendations

Based on our geotechnical evaluation of the Site that included reviewing the previous geotechnical report (Myers, 1994), data review, a Site reconnaissance, subsurface explorations, and geotechnical engineering analyses, the Project is feasible from a geotechnical perspective, provided the recommendations in this geotechnical report are properly incorporated into the Project design and construction. The key findings and conclusions include:

- The landslide hazard areas mapped at the Site do not exhibit evidence of historical, recent, or incipient landslide activity and the isolated areas of sections of Steep Slopes are less than 10 feet tall; therefore, it is our opinion that the Site does not contain landslide hazard areas as defined by the City and landslide hazard mitigation is not required for the Project.
- The proposed building may be supported on conventional spread and strip footings and slabs-on-grade overlying the native Vashon Till, or structural fill directly overlying Vashon Till, that is properly prepared and compacted. We do not recommend placing the building foundations and slabs-on-grade over existing fill or topsoil materials.
- Some overexcavation of the fill in the vicinity of the former theater and house in the southeast part of the proposed building will be required to replace the existing nonengineered fill and debris with new structural fill and to achieve foundation support from the Vashon Till. The overexcavation should be backfilled with

well-compacted structural fill to the foundation subgrade elevation to facilitate the use of conventional spread and strip footings and slabs-on-grade.

- We encountered an old basement wall within the former theater footprint and fill extending to depths in excess of 10 feet bgs.
- The Site subsurface conditions are not suitable for on-Site stormwater infiltration due to the presence of low permeability Vashon till underlying the Site. The Site stormwater should be collected and conveyed to an appropriate outlet in a controlled manner.

Detailed design and construction recommendations for the building foundations and slabs-on-grade and key earthwork activities anticipated for the Project are presented in the following sections.

## 4.1 Building Foundation Recommendations

Based on the subsurface conditions encountered at the Site, the proposed building may be supported using conventional spread or continuous (strip) footing foundations founded on undisturbed, firm and unyielding Vashon Till (bearing stratum) or structural fill directly overlying Vashon Till, that is properly prepared and compacted. The subsurface information at the Site suggests that the suitable bearing stratum for the new building foundations will generally be found within 4 feet of the ground surface with the exception of the demolished theater building footprint, where we encountered nonengineered fill and debris to the maximum depth of exploration at 10 feet bgs (in ATP-08). Where nonengineered fill is encountered, we recommend that it be overexcavated beneath foundation and slab-on-grade elements and replaced with compacted structural fill placed in accordance with our recommendations in Section 4.6.3.

The approximate depth to the bearing stratum and respective elevations of the bearing stratum from our Site explorations and previous explorations by Myers (Myers, 1994) are presented below in Table 2.

## Table 2. Depth to Bearing Stratum by Exploration

| Exploration | Exploration Performed By | Approximate Ground Surface Elevation* | Approximate Depth of Bearing Stratum | Approximate Elevation of Bearing Stratum* |
|---|---|---|---|---|
| ATP-01 | Aspect (2020) | 90 | 1.5 | EL. 88.5 |
| ATP-02 | Aspect (2020) | 86 | 3.5 | EL. 82.5 |
| ATP-03 | Aspect (2020) | 82 | 1.5 | EL. 80.5 |
| ATP-04 | Aspect (2020) | 79 | 4 | EL. 75 |
| ATP-05** | Aspect (2020) | 81 | >8.5 ft bgs | < EL.72.5 |
| ATP-06 | Aspect (2020) | 76 | 1.5 | EL. 74.5 |
| ATP-07** | Aspect (2020) | 72 | >5.2 ft bgs | < EL. 66.8 |
| ATP-08** | Aspect (2020) | 72 | >10 ft bgs | < EL. 62 |
| B-1 | Myers Biodynamics, Inc. (1994) | n/a | 10 | n/a |
| B-2 | Myers Biodynamics, Inc. (1994) | n/a | 5 | n/a |
| B-3 | Myers Biodynamics, Inc. (1994) | n/a | 2 | n/a |
| B-4 | Myers Biodynamics, Inc. (1994) | n/a | 2.5 | n/a |
| B-5 | Myers Biodynamics, Inc. (1994) | n/a | 3 | n/a |
| B-6 | Myers Biodynamics, Inc. (1994) | n/a | 2 | n/a |
| TP-4 | Myers Biodynamics, Inc. (1994) | n/a | 3 | n/a |
| TP-5 | Myers Biodynamics, Inc. (1994) | n/a | 3 | n/a |
| TP-6 | Myers Biodynamics, Inc. (1994) | n/a | 12.5 | n/a |

**Notes**:

*The elevation datum used in the geotechnical report by Myers was not documented. We have omitted reference to elevations for the explorations by Myers in this table to avoid inconsistency.

**These test pits were advanced through fill within the historical theater footprint. Native soils were not encountered within these explorations.

### 4.1.1 Minimum Footing Size and Embedment

Continuous strip footings should have a minimum width of 18 inches and individual spread footings should have a minimum width of 24 inches. We recommend exterior footings be embedded a minimum of 18 inches below the lowest adjacent grade and interior footings be embedded a minimum of 12 inches below the top of the slab.

### 4.1.2 Allowable Bearing Pressure

For shallow spread footing foundations founded atop unweathered Vashon Till, we recommend an allowable bearing pressure of 6,000 pounds per square foot (psf). For shallow spread footing foundations founded atop compact structural fill overlying unweathered Vashon Till, we recommend an allowable bearing pressure of 3,000 psf.

The allowable soil bearing pressure may be increased by up to one-third for temporary loading conditions such as wind or seismic loading.

### 4.1.3 Settlement

For spread footing foundations, and assuming the subgrade conditions described in the introduction to Section 4.1 and prepared as described in Section 4.6.2, we estimate the applied loads discussed in Section 4.1.2 will result in maximum total settlement of about 1 inch and ½ inch of differential settlement over a 50-foot length. Foundation settlement is expected to occur as the loads are applied.

### 4.1.4 Lateral Resistance

Wind, earthquakes, and unbalanced earth loads will subject the proposed structure to lateral forces. Lateral forces on a structure will be resisted by a combination of sliding resistance of its base or footing on the underlying soil and passive earth pressure against the buried portions of the structure. For use in design, an ultimate coefficient of friction of 0.5 may be assumed along the interface between the base of the footing and subgrade soils.

An ultimate passive earth pressure of 440 pounds per cubic foot (pcf) may be assumed for compact structural fill or undisturbed native soils adjacent to below-grade elements. The upper 1 foot of passive resistance should be neglected in design, unless the adjacent ground is protected/surfaced by pavement. The recommended coefficient of friction and passive pressure value assume unsaturated conditions and are ultimate values that do not include a safety factor. We recommend applying a factor of safety of at least 1.5 in design to determine allowable values for coefficient of friction and passive pressure.

## 4.2 Concrete Slab-On-Grade

We recommend overexcavation of the loose zones of nonengineered fill and any deleterious matter and replacement with structural fill beneath all slabs. To provide uniform support for the floor slab and to provide a capillary break, we recommend the floor slab be underlain by a minimum 6-inch-thick layer of free-draining, crushed rock or well-graded sand and gravel compacted to at least 95 percent maximum dry density (MDD). The capillary break material should have a maximum particle size of 3/4 inch, with no more than 80 percent passing the No. 4 sieve and less than 5 percent fines (material passing the U.S. Standard No. 200 sieve).

For slabs that are designed as a beam on elastic foundation, a modulus of vertical subgrade reaction of 150 pounds per cubic inch (pci) may be utilized.

The exterior of the below-grade foundation elements should also be waterproofed, and a vapor barrier membrane should be installed beneath the floor slabs. Waterproofing and membranes should be installed in accordance with the manufacturer’s recommendations.

## 4.3 Drainage Considerations

The outside edge of all perimeter footings and embedded walls should be provided with a drainage system consisting of a 4-inch-diameter (minimum), perforated, rigid pipe embedded in free-draining gravel meeting the requirements of Section 9-03.12(4) of the Standard Specifications, Gravel Backfill for Drains (WSDOT, 2020). The footing and wall drains should be a minimum of 1 foot thick, and a layer of low permeability soils should be used over the upper foot of the drain section to reduce the potential for surface water to enter the drain curtain. Prefabricated drain mats combined with relatively free-draining backfill may be used as an alternative to washed-rock footings and wall drains.

Final grades around the proposed structure should be sloped such that surface water drains away from the structures. Downspouts and roof drains should not be connected to the foundation drains in order to reduce the potential for flooding foundation drains and clogging. The footing drains should include cleanouts to allow for periodic maintenance and inspection.

## 4.4 Stormwater Infiltration

The presence of relatively impermeable Vashon till deposits indicates that concentrated stormwater infiltration is not practicable at the Site. We recommend stormwater management be accomplished using Low Impact Development (LID) methods combined with conventional methods, including catch basins and storm drainpipes that discharge into an appropriate system. LID methods, such as small rain gardens, bioswales, and permeable pavements, are feasible provided the systems incorporate underdrains and/or overflow redundancy to account for the low permeability and low infiltration capacity of the Site soils.

## 4.5 Retaining Walls

We understand that relatively short retaining walls may be required for the Project. Assuming cantilevered, cast-in-place retaining walls will retain less than 10 feet of soil and will retain compacted structural fill as described in Section 4.6.5 or native soils in a level configuration, we recommend the following design parameters:

- Active lateral earth pressures of 35 pcf, at-rest lateral earth pressures of 55 pcf, and allowable passive lateral earth pressures of 300 pcf (recommended passive earth pressure includes a factor of safety of 1.5)
- Active lateral earth pressures should be used to design retaining walls that will be allowed to yield laterally and at-rest lateral earth pressures should be used to design retaining walls that are not allowed to yield

- Passive earth pressures should be neglected within the upper two feet of the ground surface in front of the wall

Over-compaction of the backfill behind walls should be avoided. In this regard, we recommend compacting the backfill to about 90 percent of the MMD (ASTM D1557). Heavy compactors and large pieces of construction equipment should not operate within 5 feet of any embedded wall to avoid the buildup of excessive lateral pressures. Compaction close to the walls should be accomplished using hand-operated vibratory plate compactors. Lateral forces that may be induced on the walls due to other surcharge loads should be considered by the Project structural engineer.

We are available to review retaining wall design plans if conditions or wall types differ from our assumptions.

## 4.6 Earthwork Considerations

Based on the explorations performed across the Site and our understanding of the Project, it is our opinion that the Contractor should be able to complete earthwork and excavations with standard construction equipment. The soils encountered at the Site contain a significant percentage of fines material (particles passing the U.S. Standard No. 200 sieve), making them moisture sensitive and subject to disturbance when wet. We recommend planning the earthwork portions of the Project during the drier summer months.

We recommend that earthwork activities be specified in accordance with the following Washington State Department of Transportation (WSDOT) Standard Specifications (WSDOT, 2020). Appropriate erosion control measures should be in accordance with Section 8-01.3 *Erosion Control and Water Pollution Control, Construction Requirements*.

### *4.6.1 Temporary Erosion Control*

To prevent Site erosion during construction, appropriate temporary erosion and sedimentation control (TESC) measures should be used in accordance with our recommendations and local best management practices (BMPs). Specific TESC measures may include appropriately placed silt fencing, straw wattles, rock check dams, and plastic covering of soil stockpiles.

### *4.6.2 Subgrade Preparation*

Subgrade preparation within the proposed foundation areas and hardscapes should include removal of all topsoil, debris, loose fill soils, and any other deleterious materials. For the proposed foundations, we recommend that the bearing soils consist of undisturbed, dense to very dense, unweathered Vashon Till or compacted structural fill. Hardscapes may be placed over the weathered Vashon Till, provided it can be compacted to a relatively firm and unyielding condition. Based on our explorations, we estimate suitable bearing soils to be generally near the existing ground surface, typically 2 to 4 feet bgs. Within the old theater footprint, we anticipate some amount of overexcavation and replacement of the existing nonengineered fill (anticipated up to 12 feet bgs)[3] will be required to reach the suitable bearing soils.

The on-Site soils contain variable amounts of fine-grained particles, which makes them moisture sensitive and subject to disturbance when wet. The Contractor must use care during Site preparation and excavation operations so that any bearing surfaces are not disturbed. If this occurs, the disturbed material should be removed to expose undisturbed material.

All bearing surfaces should be trimmed neat and carefully prepared. All loose or softened soil should be removed from the bearing surface or compacted in-place prior to placing concrete or structural fill. We recommend that all bearing surfaces be observed by the Geotechnical Engineer to verify that the recommendations of this report have been followed.

If bearing surfaces are exposed during the winter season or periods of wet weather, it may be helpful to provide a layer of crushed rock or gravel to help preserve the subgrade. If gravel is used to protect the bearing surfaces, it should meet the gradation requirements for Class A Gravel Backfill for Foundations, as described in Section 9-03.12(1)A of the Standard Specifications (WSDOT, 2020).

### 4.6.3 Structural Fill

For purposes of this report, material placed under structures, pavement, sidewalks, as wall backfill, or as utility trench backfill, should be considered structural fill. We anticipate structural fill will be required primarily where overexcavation of existing nonengineered fill is required.

### 4.6.4 Reuse of Site Soils as Structural Fill

From a geotechnical standpoint, the existing native Vashon Till soils appear suitable for reuse as structural fill under hardscapes, provided the materials are excavated during the dry season and are screened to ensure they are relatively free of organics and other deleterious debris, and can be moisture-conditioned for compaction and compacted to a firm and unyielding condition. We do not recommend reusing reworked Vashon till as structural fill beneath foundations or slabs-on-grade. Due to the presence of debris within the existing nonengineered fill, we do not recommend it for reuse as structural fill.

Excavated material should be visually inspected by Aspect to determine its potential use as structural fill. Excavated material that is unsuitable as structural fill may be suitable as backfill for unimproved areas (i.e., landscaped areas) that are not sensitive to differential settlement over time.

Based on laboratory testing, the MDD and optimum moisture content of the native Vashon till are 135 pcf and 6 percent, respectively.

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[3] This inference is based on limited subsurface data. The actual depth of nonengineered fill may extend deeper than anticipated.

### 4.6.5 Imported Structural Fill

Imported structural fill should consist of relatively clean, free-draining, nonplastic, uniformly graded sand and gravel free from organic matter or other deleterious materials.

- For imported structural fill beneath foundation elements, Class A Gravel Backfill for Foundations, as specified in Section 9-03.12(1)A of the Standard Specifications (WSDOT, 2020), is appropriate. Alternatively, controlled density fill (CDF) can be used.
- For imported structural fill beneath new hardscapes, Crushed Surfacing Base Course (CSBC), as specified in Section 9-03.9(3) of the Standard Specifications (WSDOT, 2020), is acceptable.
- For imported structural fill behind retaining walls, Gravel Backfill for Walls as specified in Section 9-03.912(2), is appropriate.

### 4.6.6 Compaction Requirements

Structural fill should be at or near optimum moisture content at the time of placement and should be compacted to a percentage of the MDD as determined by test method ASTM International (ASTM) D1557, in accordance with the following recommendations:

- Structural fill beneath foundations and hardscapes should be compacted to at least 95 percent of the MDD
- In nonstructural areas, fill should be placed and compacted to a moderately firm/dense condition.
- Wall backfill compaction within 5 feet of any wall should be limited to 90 percent of the MDD to avoid damage to the structure. Compaction within 5 feet of a wall should be achieved using small hand-operated equipment in conjunction with thinner soil lifts to achieve the required compaction.

The procedure to achieve the specified minimum relative compaction depends on the size and type of compacting equipment, the number of passes, thickness of the layer being compacted, and certain soil properties. When the size of the excavation restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough lifts to achieve the required compaction. A sufficient number of in-place density tests should be performed as the fill is placed to verify the required relative compaction is being achieved. The frequency of the in-place density testing can be determined at the time of final design, when more details of the Project grading and backfilling plans are available.

Generally, loosely compacted soils are a result of poor construction technique or improper moisture content. Soils with a high percentage of silt or clay are particularly susceptible to becoming too wet, and coarse-grained materials easily become too dry, for proper compaction. Silty or clayey soils with a moisture content too high for adequate compaction should be dried as necessary, or moisture conditioned by mixing with drier materials, or other methods.

When the first fill is placed in a given area, and/or any time the fill material changes, the area should be considered a test section. The test section should be used to establish fill placement and compaction procedures required to achieve proper compaction. Aspect or qualified materials inspection personnel should observe placement and compaction of the test section to assist in establishing an appropriate compaction procedure. Once a placement and compaction procedure is established, the Contractor's operations should be monitored, and periodic density tests performed to verify that proper compaction is being achieved.

### 4.6.7 Temporary Excavations and Slopes

Temporary excavations may be required where excavation to bearing stratum is needed or where existing nonengineered fill should be overexcavated and replaced with structural fill. Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the Contractor. All temporary cuts in excess of 4 feet in height that are not protected by trench boxes or otherwise shored should be sloped in accordance with Part N of the Washington Administrative Code (WAC) 296-155 (WAC, 2020) as shown in the table below:

**Table 3. Temporary Excavation Cut Slope Recommendations**

| Soil Unit | OSHA Soil Classification | Maximum Temporary Slope | Maximum Height (ft) |
|---|---|---|---|
| Existing Nonengineered Fill | C | 1.5H:1V | 20 |
| Vashon Till | B | 1H:1V | 20 |

**Notes**:

OSHA = Occupational Safety and Health Administration

H:V = Horizontal : Vertical

The estimated maximum cut slope inclinations are provided for planning purposes only and are applicable to excavations without groundwater seepage or runoff, and assume dry to moist conditions. Flatter slopes will likely be necessary in areas where groundwater seepage exists, or where construction equipment surcharges are placed in close proximity with the crest of the excavation.

With time and the presence of seepage and/or precipitation, the stability of temporary unsupported cut slopes can be significantly reduced. Therefore, all temporary slopes should be protected from erosion by installing a surface water diversion ditch or berm at the top of the slope. In addition, the Contractor should monitor the stability of the temporary cut slopes, and adjust the construction schedule and slope inclination accordingly. Vibrations created by traffic and construction equipment may cause caving and raveling of the temporary slopes. In such an event, lateral support for the temporary slopes should be provided by the Contractor to prevent loss of ground support.

### 4.6.8 Permanent Slopes

In our opinion, permanent cut and fill slopes within Vashon till deposits up to 2H:1V are possible provided best management practices are followed. We recommend that cut and fill slopes be permanently seeded. Permanent seeding may be native plants and grasses (applied by hydroseed with tackifier) with a temporary biodegradable erosion control blanket to cover the hydroseed and provide temporary protection until the grasses grow through the blanket. Where possible, the native topsoil should be retained and incorporated into the slopes prior to seeding. The Washington State Department of Ecology (Ecology) *2019 Stormwater Management Manual for Western Washington* recommends permanent seeding and erosion control blankets be designed and installed in accordance with its Best Management Practices C120 and C122, respectively (Ecology, 2019).

### 4.6.9 Wet Weather Construction

The soils encountered across the Site are moisture sensitive and may be difficult to handle, prepare, or compact with construction equipment during periods of wet weather. Earthwork is typically most economical when performed under dry weather conditions. If earthwork is to be performed or fill is to be placed in wet weather or under wet conditions, the following recommendations should be incorporated into the contract specifications:

- Earthwork should be performed in small areas to minimize exposure to wet weather. Excavation or the removal of unsuitable soils should be followed promptly by the placement and compaction of clean structural fill. The size and type of construction equipment used may need to be limited to prevent soil disturbance.
- Materials used as structural fill should consist of clean, granular soil containing less than 7 percent fines. The fines should be nonplastic.
- The ground surface within the construction area should be sealed by a smooth drum vibratory roller (or equivalent) and under no circumstances should be left uncompacted and exposed to moisture. Soils which become too wet for compaction should be removed and replaced with clean granular materials.
- Excavation and placement of structural fill should be observed by the Geotechnical Engineer to verify that all unsuitable materials are removed, and suitable compaction is achieved.
- Local BMPs for erosion protection should be strictly followed.

### 4.6.10 Construction Dewatering

Significant groundwater was not encountered in the Site explorations; however, minor seepage and surficial runoff may be encountered at shallow depths. The Contractor should be prepared to adequately dewater foundation subgrade and excavations. We anticipate that strategically placed sumps and pumps will sufficiently control water inflow. Sumps are often constructed by placing a short section of perforated corrugated steel pipe (or surplus 8- to 12-inch well screen) in a small hole excavated below the subgrade elevation/excavation. The annular space around the pipe is backfilled with drain rock, with several inches placed inside the casing to help control the pumping of fines. Submersible pumps (trash pumps) are then placed inside the casing and connected to a central discharge pipe.

The Contractor should be responsible for design, implementation, and any necessary permits associated with any construction dewatering system used for the Project.

# 5 Recommended Additional Geotechnical Services

At the time of this report, Site grading, utilities, civil plans, and construction methods have not been finalized, and the recommendations presented herein are based on preliminary Project design information. If Project developments result in changes to the assumptions made herein, we should be contacted to determine if our recommendations should be revised.

Throughout this report, we have provided recommendations where we consider it would be appropriate for Aspect to provide additional geotechnical input to the design and construction process. Additional recommendations are summarized in this section.

## 5.1 Additional Design and Consultation Services

Before construction begins, we recommend that Aspect:

- Continue to meet with the design team as needed to address geotechnical questions that may arise throughout the remainder of the design process.
- Review the geotechnical elements of the Project plans to see that the geotechnical engineering recommendations are properly interpreted

## 5.2 Additional Construction Services

We are available to provide geotechnical engineering and monitoring services during construction. The integrity of the geotechnical elements depends on proper Site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent.

During the construction phase of the Project, we recommend that Aspect be retained to perform the following tasks:

- Review applicable submittals
- Observe and evaluate subgrade and structural fill placement for all footings and slabs-on-grade
- Attend meetings, as needed
- Address other geotechnical engineering considerations that may arise during construction

The purpose of our observations is to verify compliance with design concepts and recommendations and to allow design changes or evaluation of appropriate construction methods in the event that subsurface conditions differ from those anticipated prior to the start of construction.

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# 7 Limitations

Work for this project was performed for Cascadia Senior Living & Fieldstone Communities (Client), and this report was prepared consistent with recognized standards of professionals in the same locality and involving similar conditions, at the time the work was performed. No other warranty, expressed or implied, is made by Aspect Consulting, LLC (Aspect).

Recommendations presented herein are based on our interpretation of site conditions, geotechnical engineering calculations, and judgment in accordance with our mutually agreed-upon scope of work. Our recommendations are unique and specific to the project, site, and Client. Application of this report for any purpose other than the project should be done only after consultation with Aspect.

Variations may exist between the soil and groundwater conditions reported and those actually underlying the site. The nature and extent of such soil variations may change over time and may not be evident before construction begins. If any soil conditions are encountered at the site that are different from those described in this report, Aspect should be notified immediately to review the applicability of our recommendations.

Risks are inherent with any site involving slopes and no recommendations, geologic analysis, or engineering design can assure slope stability. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the Client.

It is the Client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, and agents, are made aware of this report in its entirety. At the time of this report, design plans and construction methods have not been finalized, and the recommendations presented herein are based on preliminary project information. If project developments result in changes from the preliminary project information, Aspect should be contacted to determine if our recommendations contained in this report should be revised and/or expanded upon.

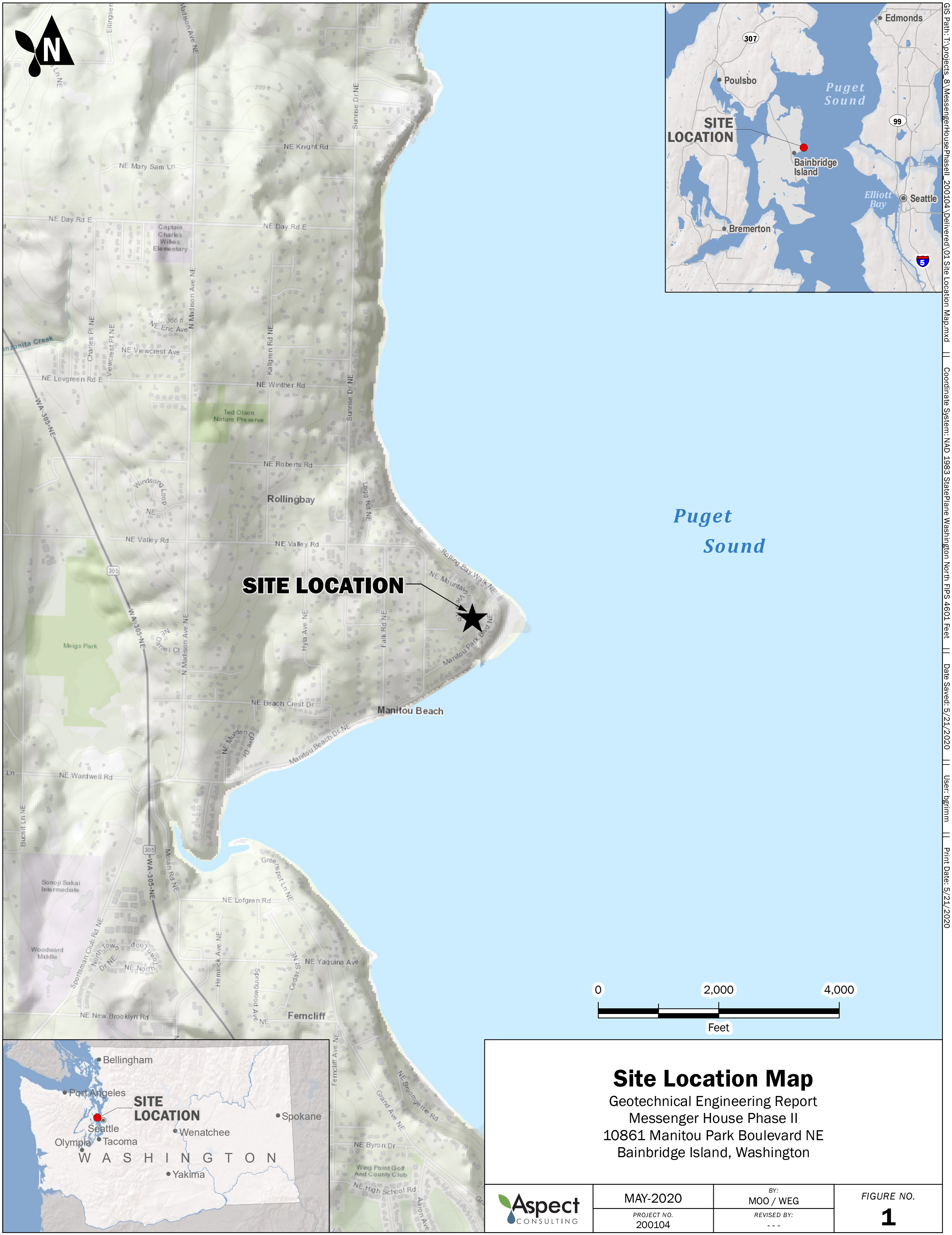
The scope of work does not include services related to construction safety precautions. Site safety is typically the responsibility of the contractor, and our recommendations are not intended to direct the contractor’s site safety methods, techniques, sequences, or procedures. The scope of our work also does not include the assessment of environmental characteristics, particularly those involving potentially hazardous substances in soil or groundwater.

All reports prepared by Aspect for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect. Aspect’s original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

**Please refer to Appendix D titled “Report Limitations and Guidelines for Use” for additional information governing the use of this report.**

We appreciate the opportunity to perform these services. If you have any questions please call Andrew J. Holmson, Associate Geotechnical Engineer, 206.780.7731.

# FIGURES



# Site Location Map

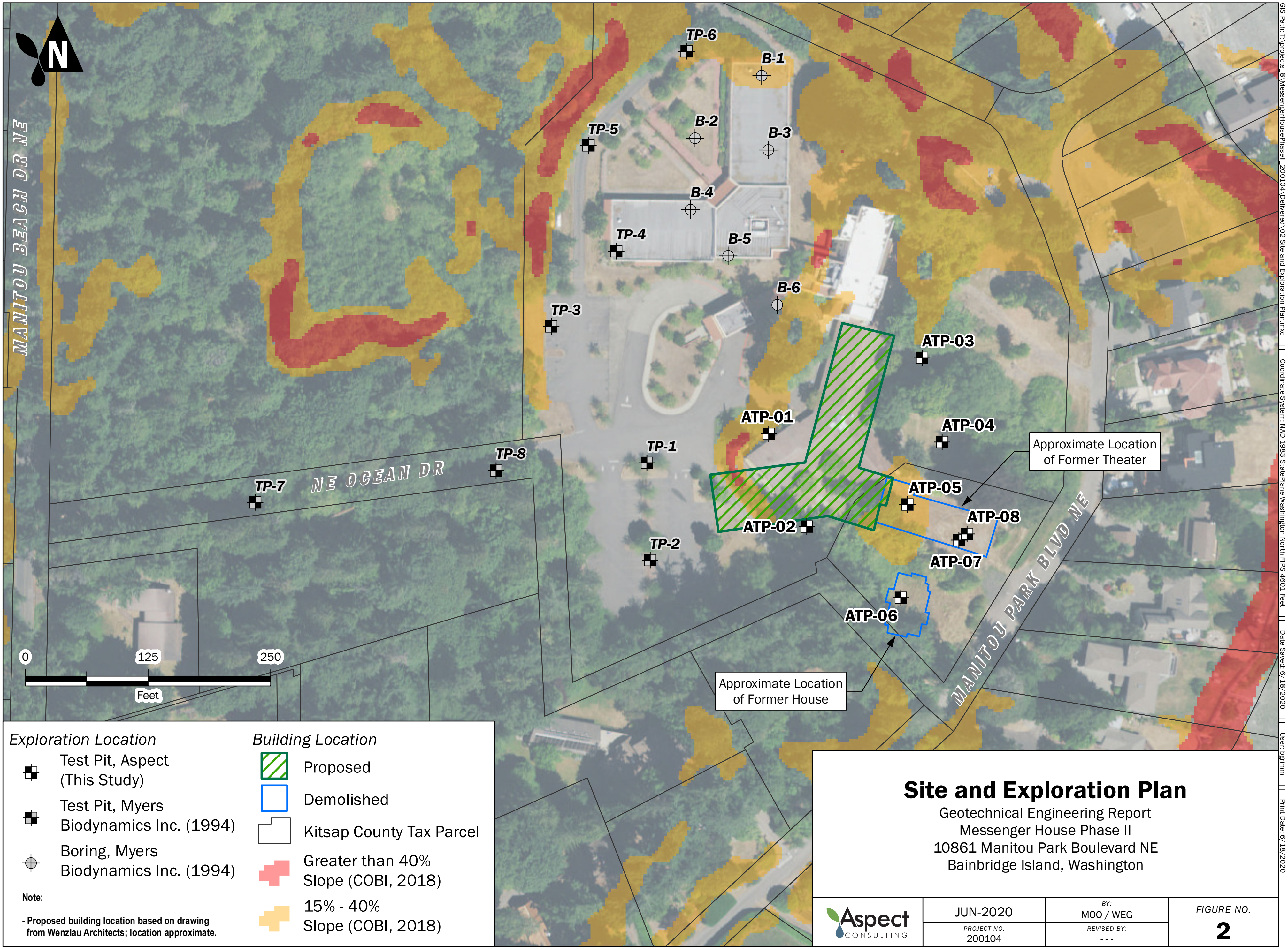
Geotechnical Engineering Report
Messenger House Phase II
10861 Manitou Park Boulevard NE
Bainbridge Island, Washington

Aspect CONSULTING

| | | | |
|---|---|---|---|
| MAY-2020 | BY:<br>MOO / WEG | FIGURE NO. | |
| PROJECT NO.<br>200104 | REVISED BY:<br>- - - | 1 | |

GIS Path: T:\projects_8\MessengerHousePhaseII_200104\Delivered\01 Site Location Map.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 5/21/2020 || User: bgrimm || Print Date: 5/21/2020

Basemap Layer Credits || Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



Note:

- Proposed building location based on drawing from Wenzlau Architects; location approximate.

# Site and Exploration Plan

Geotechnical Engineering Report
Messenger House Phase II
10861 Manitou Park Boulevard NE
Bainbridge Island, Washington

| | | | |
|---|---|---|---|
| Aspect CONSULTING | JUN-2020 | BY:<br>MOO / WEG | FIGURE NO.<br>**2** |
| | PROJECT NO.<br>200104 | REVISED BY:<br>- - - | |

Basemap Layer Credits || HxGN Content Program

GIS Path: T:\projects_8\MessengerHousePhaseII_200104\Delivered\02 Site and Exploration Plan.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 6/18/2020 || User: bgrimm || Print Date: 6/18/2020

# APPENDIX A

# Subsurface Explorations by Aspect

# A. Subsurface Explorations Methodology

Test pits ATP-01 through ATP-08 were dug using a track-mounted excavator on April 27, 2020. The excavation was performed by High Meadows Excavating, an experienced and licensed local excavator under subcontract to Aspect. The test pits were advanced to depths ranging from 4 to 10 feet below ground surface (bgs). Disturbed soil samples were obtained by hand at select intervals.

Relative density/consistency of the soils was estimated using a dynamic cone penetrometer (DCP) test. DCP blow count refers to the number of blows required to achieve 1.75 inches of penetration with a 1.5-inch, 45-degree cone driven using a 15-pound mass falling 20 inches to strike an anvil. DCP blow counts have been calibrated with Standard Penetration Test (SPT) N-values to quantitively estimate relative density or consistency of soil. Additional relative density/consistency observations were made using a 0.5-inch-diameter steel T-probe and through visual observations (such as resistance of the soil to the excavator bucket and stand-up time of the test-pit sidewalls, etc.).

The locations of the test pits are shown on Figure 2.

An Aspect geologist was present throughout the field exploration program to observe the drilling procedure, assist in sampling, and to prepare descriptive logs of the exploration. Soils were classified in general accordance with ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). The summary exploration log represents our interpretation of the contents of the field logs. The stratigraphic contacts shown on the individual summary logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The subsurface conditions depicted are only for the specific date and locations reported; therefore, are not necessarily representative of other locations and times.

| | | | | |
|---|---|---|---|---|
| Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve | Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve | ≤5% Fines | **GW** | Well-graded GRAVEL<br>Well-graded GRAVEL WITH SAND |
| | | | **GP** | Poorly-graded GRAVEL<br>Poorly-graded GRAVEL WITH SAND |
| | | ≥15% Fines | **GM** | SILTY GRAVEL<br>SILTY GRAVEL WITH SAND |
| | | | **GC** | CLAYEY GRAVEL<br>CLAYEY GRAVEL WITH SAND |
| | Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve | ≤5% Fines | **SW** | Well-graded SAND<br>Well-graded SAND WITH GRAVEL |
| | | | **SP** | Poorly-graded SAND<br>Poorly-graded SAND WITH GRAVEL |
| | | ≥15% Fines | **SM** | SILTY SAND<br>SILTY SAND WITH GRAVEL |
| | | | **SC** | CLAYEY SAND<br>CLAYEY SAND WITH GRAVEL |
| Fine-Grained Soils - 50%[1] or More Passes No. 200 Sieve | Silts and Clays Liquid Limit Less than 50% | | **ML** | SILT<br>SANDY or GRAVELLY SILT<br>SILT WITH SAND<br>SILT WITH GRAVEL |
| | | | **CL** | LEAN CLAY<br>SANDY or GRAVELLY LEAN CLAY<br>LEAN CLAY WITH SAND<br>LEAN CLAY WITH GRAVEL |
| | | | **OL** | ORGANIC SILT<br>SANDY or GRAVELLY ORGANIC SILT<br>ORGANIC SILT WITH SAND<br>ORGANIC SILT WITH GRAVEL |
| | Silts and Clays Liquid Limit 50% or More | | **MH** | ELASTIC SILT<br>SANDY or GRAVELLY ELASTIC SILT<br>ELASTIC SILT WITH SAND<br>ELASTIC SILT WITH GRAVEL |
| | | | **CH** | FAT CLAY<br>SANDY or GRAVELLY FAT CLAY<br>FAT CLAY WITH SAND<br>FAT CLAY WITH GRAVEL |
| | | | **OH** | ORGANIC CLAY<br>SANDY or GRAVELLY ORGANIC CLAY<br>ORGANIC CLAY WITH SAND<br>ORGANIC CLAY WITH GRAVEL |
| Highly Organic Soils | | | **PT** | PEAT and other mostly organic soils |

"WITH SILT" or "WITH CLAY" means 5 to 15% silt and clay, denoted by a "-" in the group name; e.g., SP-SM • "SILTY" or "CLAYEY" means >15% silt and clay • "WITH SAND" or "WITH GRAVEL" means 15 to 30% sand and gravel. • "SANDY" or "GRAVELLY" means >30% sand and gravel. • "Well-graded" means approximately equal amounts of fine to coarse grain sizes • "Poorly graded" means unequal amounts of grain sizes • Group names separated by "/" means soil contains layers of the two soil types; e.g., SM/ML.

Soils were described and identified in the field in general accordance with the methods described in ASTM D2488. Where indicated in the log, soils were classified using ASTM D2487 or other laboratory tests as appropriate. Refer to the report accompanying these exploration logs for details.

1. Estimated or measured percentage by dry weight
2. (SPT) Standard Penetration Test (ASTM D1586)
3. Determined by SPT, DCPT (ASTM STP399) or other field methods. See report text for details.

## GEOTECHNICAL LAB TESTS

MC = Natural Moisture Content
GS = Grain Size Distribution
FC = Fines Content (% < 0.075 mm)
GH = Hydrometer Test
AL = Atterberg Limits
C = Consolidation Test
Str = Strength Test
OC = Organic Content (% Loss by Ignition)
Comp = Proctor Test
K = Hydraulic Conductivity Test
SG = Specific Gravity Test

## CHEMICAL LAB TESTS

***Organic Chemicals***

BTEX = Benzene, Toluene, Ethylbenzene, Xylenes
TPH-Dx = Diesel and Oil-Range Petroleum Hydrocarbons
TPH-G = Gasoline-Range Petroleum Hydrocarbons
VOCs = Volatile Organic Compounds
SVOCs = Semi-Volatile Organic Compounds
PAHs = Polycyclic Aromatic Hydrocarbon Compounds
PCBs = Polychlorinated Biphenyls

***Metals***

RCRA8 = As, Ba, Cd, Cr, Pb, Hg, Se, Ag, (d = dissolved, t = total)
MTCA5 = As, Cd, Cr, Hg, Pb (d = dissolved, t = total)
PP-13 = Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn (d=dissolved, t=total)

## FIELD TESTS

PID = Photoionization Detector
Sheen = Oil Sheen Test
SPT[2] = Standard Penetration Test
NSPT = Non-Standard Penetration Test
DCPT = Dynamic Cone Penetration Test

## COMPONENT DEFINITIONS

| *Descriptive Term* | | *Size Range and Sieve Number* |
|---|---|---|
| Boulders | = | Larger than 12 inches |
| Cobbles | = | 3 inches to 12 inches |
| Coarse Gravel | = | 3 inches to 3/4 inches |
| Fine Gravel | = | 3/4 inches to No. 4 (4.75 mm) |
| Coarse Sand | = | No. 4 (4.75 mm) to No. 10 (2.00 mm) |
| Medium Sand | = | No. 10 (2.00 mm) to No. 40 (0.425 mm) |
| Fine Sand | = | No. 40 (0.425 mm) to No. 200 (0.075 mm) |
| Silt and Clay | = | Smaller than No. 200 (0.075 mm) |

## ESTIMATED[1] PERCENTAGE

| *% by Weight* | | *Modifier* | *% by Weight* | | *Modifier* |
|---|---|---|---|---|---|
| <1 | = | Subtrace | 15 to 25 | = | Little |
| 1 to <5 | = | Trace | 30 to 45 | = | Some |
| 5 to 10 | = | Few | >50 | = | Mostly |

## MOISTURE CONTENT

Dry = Absence of moisture, dusty, dry to the touch
Slightly Moist = Perceptible moisture
Moist = Damp but no visible water
Very Moist = Water visible but not free draining
Wet = Visible free water, usually from below water table

## RELATIVE DENSITY

***Non-Cohesive or Coarse-Grained Soils***

| *Density[3]* | | *SPT[2] Blows/Foot* | *Penetration with 1/2" Diameter Rod* |
|---|---|---|---|
| Very Loose | = | 0 to 4 | ≥ 2' |
| Loose | = | 5 to 10 | 1' to 2' |
| Medium Dense | = | 11 to 30 | 3" to 1' |
| Dense | = | 31 to 50 | 1" to 3" |
| Very Dense | = | > 50 | < 1" |

## CONSISTENCY

***Cohesive or Fine-Grained Soils***

| *Consistency[3]* | | *SPT[2] Blows/Foot* | *Manual Test* |
|---|---|---|---|
| Very Soft | = | 0 to 1 | Penetrated >1" easily by thumb. Extrudes between thumb & fingers. |
| Soft | = | 2 to 4 | Penetrated 1/4" to 1" easily by thumb. Easily molded. |
| Medium Stiff | = | 5 to 8 | Penetrated >1/4" with effort by thumb. Molded with strong pressure. |
| Stiff | = | 9 to 15 | Indented ~1/4" with effort by thumb. |
| Very Stiff | = | 16 to 30 | Indented easily by thumbnail. |
| Hard | = | > 30 | Indented with difficulty by thumbnail. |

## GEOLOGIC CONTACTS

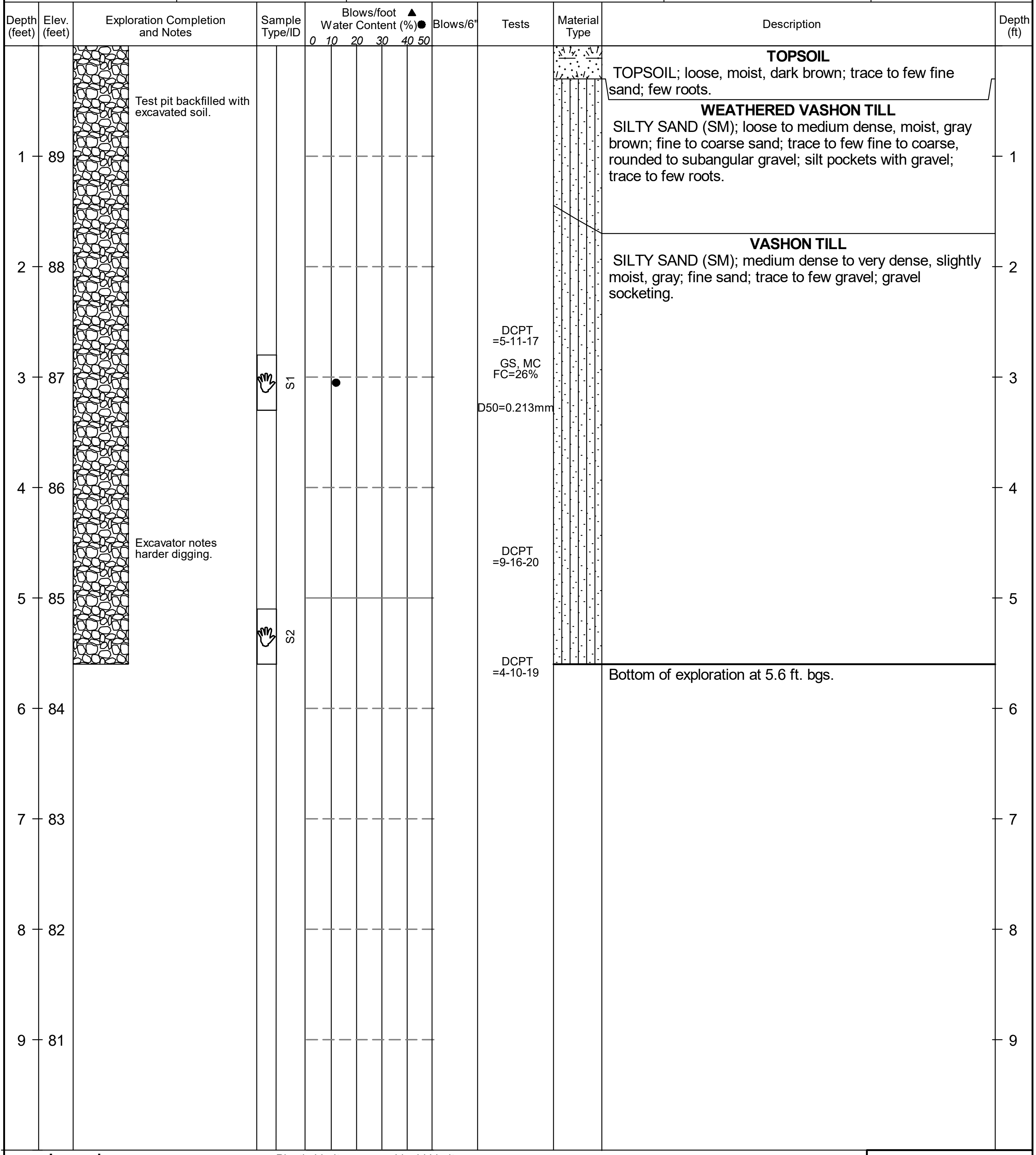
Observed and Distinct
Observed and Gradual
Inferred

Aspect CONSULTING

# Exploration Log Key

AI Path: Q:_ACAD Standards\FIELD REFERENCE\MASTERS\Exploration Log Key-2018.ai // user: jinman // last saved: 09/26/2018

| Aspect CONSULTING | Messenger House Phase II - 200104 | | | Geotechnical Exploration Log | |
|---|---|---|---|---|---|
| | *Project Address & Site Specific Location*<br>10861 Manitou Park Blvd. NE, Bainbridge Island, WA 98110, See Figure 2 | | | *Coordinates (Lat,Lon WGS84)*<br>47.6615, -122.5019 (est) | *Exploration Number*<br>**ATP-01** |
| *Contractor*<br>High Meadows Excavating, Inc. | *Equipment*<br>Deere 35D Excavator | *Sampling Method*<br>Grab | | *Ground Surface Elev. (NAVD88)*<br>90' (est) | |
| *Operator*<br>Andrew Monsaas | *Exploration Method(s)*<br>Trackhoe | *Work Start/Completion Dates*<br>4/27/2020 | | *Top of Casing Elev. (NAVD88)*<br>NA | *Depth to Water (Below GS)*<br>No Water Encountered |



Test pit backfilled with excavated soil.

Excavator notes harder digging.

DCPT =5-11-17

GS, MC
FC=26%

D50=0.213mm

DCPT =9-16-20

DCPT =4-10-19

**TOPSOIL**

TOPSOIL; loose, moist, dark brown; trace to few fine sand; few roots.

**WEATHERED VASHON TILL**

SILTY SAND (SM); loose to medium dense, moist, gray brown; fine to coarse sand; trace to few fine to coarse, rounded to subangular gravel; silt pockets with gravel; trace to few roots.

**VASHON TILL**

SILTY SAND (SM); medium dense to very dense, slightly moist, gray; fine sand; trace to few gravel; gravel socketing.

Bottom of exploration at 5.6 ft. bgs.

**Legend**

Sample Type: Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: WEG
Approved by: AJH

**Exploration Log**
**ATP-01**
Sheet 1 of 1

| Aspect CONSULTING | Messenger House Phase II - 200104 | Geotechnical Exploration Log | |
|---|---|---|---|
| | *Project Address & Site Specific Location*<br>10861 Manitou Park Blvd. NE, Bainbridge Island, WA 98110, See Figure 2 | *Coordinates (Lat,Lon WGS84)*<br>47.6613, -122.5018 (est) | *Exploration Number*<br>**ATP-02** |

| *Contractor* | *Equipment* | *Sampling Method* | *Ground Surface Elev. (NAVD88)* |
|---|---|---|---|
| High Meadows Excavating, Inc. | Deere 35D Excavator | Grab | 86' (est) |

| *Operator* | *Exploration Method(s)* | *Work Start/Completion Dates* | *Top of Casing Elev. (NAVD88)* | *Depth to Water (Below GS)* |
|---|---|---|---|---|
| Andrew Monsaas | Trackhoe | 4/27/2020 | NA | 3' (Seep) |

| Depth (feet) | Elev. (feet) | Exploration Completion and Notes | Sample Type/ID | Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50 | Blows/6" | Tests | Material Type | Description | Depth (ft) |
|---|---|---|---|---|---|---|---|---|---|
| | | Test pit backfilled with excavated soil. | | | | | | **TOPSOIL**<br>TOPSOIL; loose, moist, dark brown; fine to coarse sand; fine, subrounded gravel; few to little roots.<br>**FILL**<br>SILTY SAND (SM); loose, moist, gray; fine to coarse sand; fine to coarse, rounded to subangular gravel; trace roots. Buried topsoil (loose, moist, dark brown) observed from 0.8 to 1 ft bgs. | |
| 1 | 85 | | | | | | | **WEATHERED VASHON TILL**<br>SILTY SAND WITH GRAVEL (SM); medium dense to dense, moist to wet, brown yellow; fine to coarse sand; fine to coarse, rounded to subangular gravel; gravel socketing; few to little roots. | 1 |
| 2 | 84 | | | | | DCPT =7-9-10 | | | 2 |
| 3 | 83 | 4/27/2020 | | | | | | | 3 |
| 4 | 82 | | 🖑 S1 | | | DCPT => 30 | | **VASHON TILL**<br>SILTY SAND WITH GRAVEL (SM); medium dense to very dense, moist, gray; fine to coarse sand; fine to coarse, rounded to subangular gravel; gravel socketing. | 4 |
| | | | | | | | | Bottom of exploration at 4.2 ft. bgs. | |
| 5 | 81 | | | | | | | | 5 |
| 6 | 80 | | | | | | | | 6 |
| 7 | 79 | | | | | | | | 7 |
| 8 | 78 | | | | | | | | 8 |
| 9 | 77 | | | | | | | | 9 |

**Legend**

Plastic Limit ⊢⊣ Liquid Limit

Sample Type: 🖑 Grab sample

Water Level: Water Level (Seepage)

See Exploration Log Key for explanation of symbols

Logged by: WEG
Approved by: AJH

**Exploration Log ATP-02**

Sheet 1 of 1

| Aspect CONSULTING | **Messenger House Phase II - 200104** | | | **Geotechnical Exploration Log** | |
|---|---|---|---|---|---|
| | *Project Address & Site Specific Location*<br>10861 Manitou Park Blvd. NE, Bainbridge Island, WA 98110, See Figure 2 | | | *Coordinates (Lat,Lon WGS84)*<br>47.6617, -122.5013 (est) | *Exploration Number*<br>**ATP-03** |
| *Contractor*<br>High Meadows Excavating, Inc. | *Equipment*<br>Deere 35D Excavator | *Sampling Method*<br>Grab | | *Ground Surface Elev. (NAVD88)*<br>82' (est) | |
| *Operator*<br>Andrew Monsaas | *Exploration Method(s)*<br>Trackhoe | *Work Start/Completion Dates*<br>4/27/2020 | | *Top of Casing Elev. (NAVD88)*<br>NA | *Depth to Water (Below GS)*<br>No Water Encountered |

| Depth (feet) | Elev. (feet) | Exploration Completion and Notes | Sample Type/ID | Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50 | Blows/6" | Tests | Material Type | Description | Depth (ft) |
|---|---|---|---|---|---|---|---|---|---|
| | | Test pit backfilled with excavated soil. | | | | | | **TOPSOIL**<br>TOPSOIL; loose, moist, dark brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; few roots.<br>**FILL**<br>SILTY SAND (SM); loose to medium dense, moist, gray brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; trace roots. | |
| 1 | 81 | | | | | | | **WEATHERED VASHON TILL**<br>SILTY SAND (SM); loose to medium dense, moist to very moist, brown yellow; fine to coarse sand; fine to coarse, rounded to subrounded gravel; gravel socketing; trace roots. | 1 |
| 2 | 80 | | | | | DCPT =25, > 30 | | **VASHON TILL**<br>SILTY SAND (SM); dense to very dense, slightly moist, gray; fine sand; trace medium to coarse sand; few rounded to subangular gravel; gravel socketing; light iron-oxide staining. | 2 |
| 3 | 79 | | | | | | | | 3 |
| | | | ✋ S1 | ● | | Bulk sample GS, MC, and Proctor FC=23%<br>D50=0.278mm | | | |
| 4 | 78 | | | | | DCPT => 30 | | Bottom of exploration at 4 ft. bgs. | 4 |
| 5 | 77 | | | | | | | | 5 |
| 6 | 76 | | | | | | | | 6 |
| 7 | 75 | | | | | | | | 7 |
| 8 | 74 | | | | | | | | 8 |
| 9 | 73 | | | | | | | | 9 |

**Legend**

Sample Type: ✋ Grab sample

Plastic Limit ├──┤ Liquid Limit

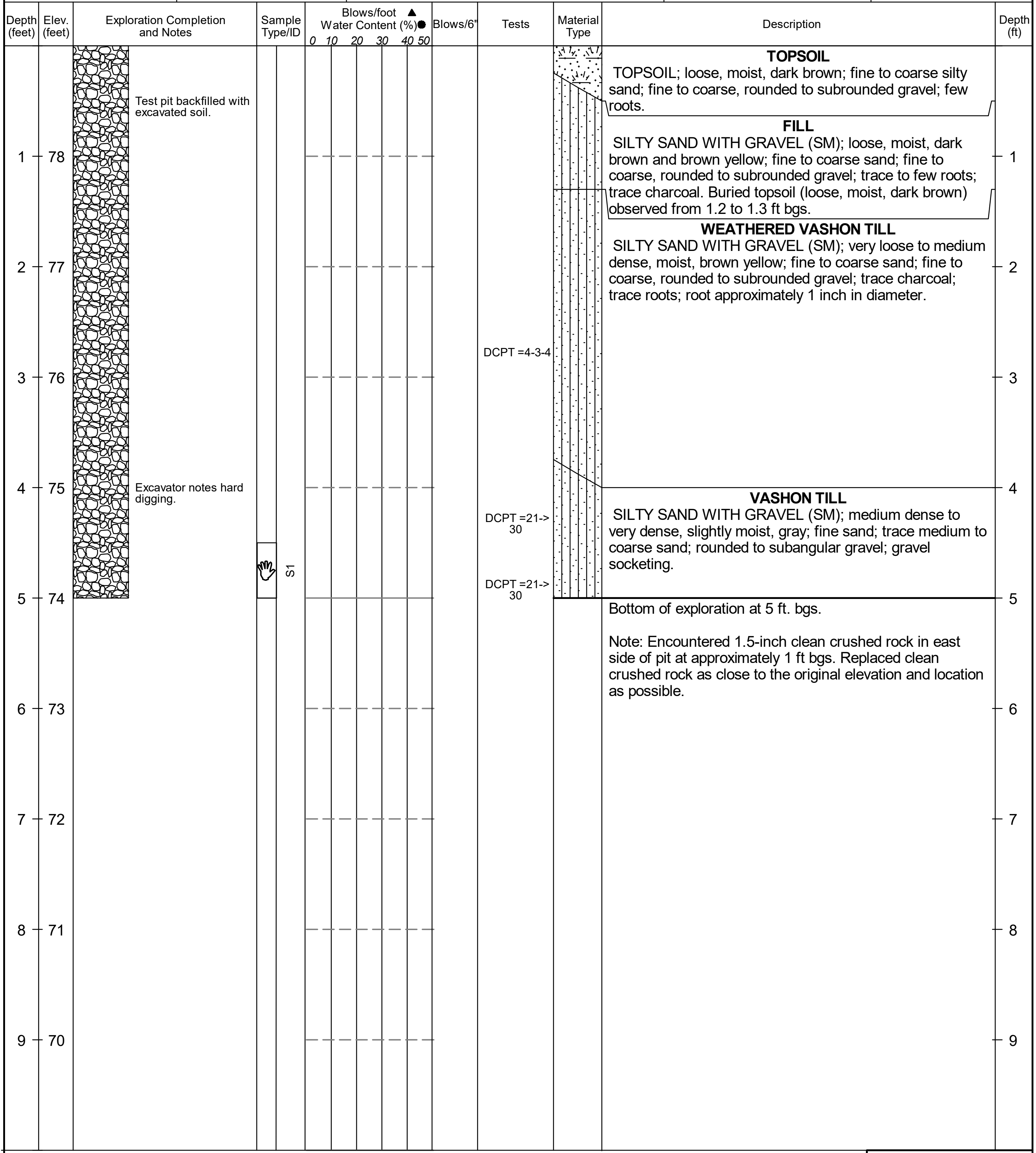
Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: WEG
Approved by: AJH

**Exploration Log**
**ATP-03**
Sheet 1 of 1

| Aspect CONSULTING | Messenger House Phase II - 200104 | | Geotechnical Exploration Log | |
|---|---|---|---|---|
| | *Project Address & Site Specific Location*<br>10861 Manitou Park Blvd. NE, Bainbridge Island, WA 98110, See Figure 2 | | *Coordinates (Lat,Lon WGS84)*<br>47.6615, -122.5012 (est) | *Exploration Number*<br>**ATP-04** |
| *Contractor*<br>High Meadows Excavating, Inc. | *Equipment*<br>Deere 35D Excavator | *Sampling Method*<br>Grab | *Ground Surface Elev. (NAVD88)*<br>79' (est) | |
| *Operator*<br>Andrew Monsaas | *Exploration Method(s)*<br>Trackhoe | *Work Start/Completion Dates*<br>4/27/2020 | *Top of Casing Elev. (NAVD88)*<br>NA | *Depth to Water (Below GS)*<br>No Water Encountered |



Test pit backfilled with excavated soil.

Excavator notes hard digging.

DCPT =4-3-4

DCPT =21-> 30

DCPT =21-> 30

**TOPSOIL**

TOPSOIL; loose, moist, dark brown; fine to coarse silty sand; fine to coarse, rounded to subrounded gravel; few roots.

**FILL**

SILTY SAND WITH GRAVEL (SM); loose, moist, dark brown and brown yellow; fine to coarse sand; fine to coarse, rounded to subrounded gravel; trace to few roots; trace charcoal. Buried topsoil (loose, moist, dark brown) observed from 1.2 to 1.3 ft bgs.

**WEATHERED VASHON TILL**

SILTY SAND WITH GRAVEL (SM); very loose to medium dense, moist, brown yellow; fine to coarse sand; fine to coarse, rounded to subrounded gravel; trace charcoal; trace roots; root approximately 1 inch in diameter.

**VASHON TILL**

SILTY SAND WITH GRAVEL (SM); medium dense to very dense, slightly moist, gray; fine sand; trace medium to coarse sand; rounded to subangular gravel; gravel socketing.

Bottom of exploration at 5 ft. bgs.

Note: Encountered 1.5-inch clean crushed rock in east side of pit at approximately 1 ft bgs. Replaced clean crushed rock as close to the original elevation and location as possible.

**Legend**

Sample Type: ✋ Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: WEG
Approved by: AJH

**Exploration Log**
**ATP-04**
Sheet 1 of 1

| | | | | |
|---|---|---|---|---|
| **Aspect CONSULTING** | **Messenger House Phase II - 200104**<br>*Project Address & Site Specific Location*<br>10861 Manitou Park Blvd. NE, Bainbridge Island, WA 98110, See Figure 2 | | **Geotechnical Exploration Log**<br>*Coordinates (Lat,Lon WGS84)*<br>47.6613, -122.5013 (est) | *Exploration Number*<br>**ATP-05** |
| *Contractor*<br>High Meadows Excavating, Inc. | *Equipment*<br>Deere 35D Excavator | *Sampling Method*<br>Grab | *Ground Surface Elev. (NAVD88)*<br>81' (est) | |
| *Operator*<br>Andrew Monsaas | *Exploration Method(s)*<br>Trackhoe | *Work Start/Completion Dates*<br>4/27/2020 | *Top of Casing Elev. (NAVD88)*<br>NA | *Depth to Water (Below GS)*<br>No Water Encountered |

| Depth (feet) | Elev. (feet) | Exploration Completion and Notes | Sample Type/ID | Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50 | Blows/6" | Tests | Description | Depth (ft) |
|---|---|---|---|---|---|---|---|---|
| | | Excavator indicates difficult digging at 0.3 ft. bgs.<br>Test pit backfilled with excavated soil. | | | | | **FILL**<br>SAND WITH SILT AND GRAVEL (SP-SM); medium dense to dense, moist, dark gray; fine to coarse sand; fine to coarse, rounded to angular gravel; roots and few organics to 0.4 ft. bgs. | |
| 1 | 80 | | | | | | | 1 |
| | | | ✋ S1 | | | | | |
| 2 | 79 | | | | | | | 2 |
| | | | | | | DCPT =11-26-39 | | |
| 3 | 78 | | | | | | SILTY SAND WITH GRAVEL (SM); medium dense to dense, moist, gray; fine sand; trace medium sand; few coarse sand; fine to coarse, rounded to angular gravel; possible concrete dust. | 3 |
| 4 | 77 | | | | | DCPT =10-20-25 | | 4 |
| 5 | 76 | | | | | | | 5 |
| 6 | 75 | | ✋ S2 | | | | Encountered small chunks of Vashon till. | 6 |
| | | | | | | | Encountered concrete chunks, bricks. | |
| 7 | 74 | | | | | | | 7 |
| | | | | | | DCPT =38-84-178 | | |
| 8 | 73 | | ✋ S3 | | | | Subtrace medium sand; trace coarse sand; Vashon till chunks with gravel socketing; brick chunks. | 8 |
| | | | | | | | Bottom of exploration at 8.5 ft. bgs. | |
| 9 | 72 | | | | | | | 9 |

**Legend**

Sample Type: ✋ Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: WEG
Approved by: AJH

**Exploration Log**
**ATP-05**
Sheet 1 of 1

**Aspect CONSULTING**

# Messenger House Phase II - 200104

# Geotechnical Exploration Log

| Project Address & Site Specific Location | Coordinates (Lat,Lon WGS84) | Exploration Number |
|---|---|---|
| 10861 Manitou Park Blvd. NE, Bainbridge Island, WA 98110, See Figure 2 | 47.6611, -122.5014 (est) | ATP-06 |

| Contractor | Equipment | Sampling Method | Ground Surface Elev. (NAVD88) |
|---|---|---|---|
| High Meadows Excavating, Inc. | Deere 35D Excavator | Grab | 76' (est) |

| Operator | Exploration Method(s) | Work Start/Completion Dates | Top of Casing Elev. (NAVD88) | Depth to Water (Below GS) |
|---|---|---|---|---|
| Andrew Monsaas | Trackhoe | 4/27/2020 | NA | No Water Encountered |

| Depth (feet) | Elev. (feet) | Exploration Completion and Notes | Sample Type/ID | Blows/foot ▲ Water Content (%) ● 0 10 20 30 40 50 | Blows/6" | Tests | Material Type | Description | Depth (ft) |
|---|---|---|---|---|---|---|---|---|---|
| | | Test pit backfilled with excavated soil. | | | | | | **TOPSOIL**<br>TOPSOIL; loose, moist, dark brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; trace roots; brick chunk. | |
| | | | | | | | | **FILL**<br>SILTY SAND WITH GRAVEL (SM); loose to medium dense, moist, dark brown; fine to coarse sand; fine, rounded to subrounded gravel; iron-oxide staining; trace woodchips and organics. | |
| 1 | 75 | | | | | | | | 1 |
| | | | | | | | | **VASHON TILL**<br>SILTY SAND WITH GRAVEL (SM); medium dense to dense, slightly moist, gray; fine sand; trace medium to coarse sand; fine, subrounded to subangular gravel; gravel socketing. | |
| 2 | 74 | Excavator notes hard digging. | | | | | | | 2 |
| | | | | | | DCPT => 30 | | | |
| 3 | 73 | | S1 | | | | | | 3 |
| 4 | 72 | | | | | | | | 4 |
| | | | | | | DCPT =13-> 30 | | Bottom of exploration at 4.2 ft. bgs. | |
| 5 | 71 | | | | | | | | 5 |
| 6 | 70 | | | | | | | | 6 |
| 7 | 69 | | | | | | | | 7 |
| 8 | 68 | | | | | | | | 8 |
| 9 | 67 | | | | | | | | 9 |

**Legend**

Sample Type: 🖐 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: WEG
Approved by: AJH

**Exploration Log ATP-06**

Sheet 1 of 1

| Aspect CONSULTING | Messenger House Phase II - 200104 | | | Geotechnical Exploration Log | |
|---|---|---|---|---|---|
| | *Project Address & Site Specific Location*<br>10861 Manitou Park Blvd. NE, Bainbridge Island, WA 98110, See Figure 2 | | | *Coordinates (Lat,Lon WGS84)*<br>47.6612, -122.5011 (est) | *Exploration Number*<br>**ATP-07** |
| *Contractor*<br>High Meadows Excavating, Inc. | *Equipment*<br>Deere 35D Excavator | *Sampling Method*<br>Grab | | *Ground Surface Elev. (NAVD88)*<br>72' (est) | |
| *Operator*<br>Andrew Monsaas | *Exploration Method(s)*<br>Trackhoe | *Work Start/Completion Dates*<br>4/27/2020 | | *Top of Casing Elev. (NAVD88)*<br>NA | *Depth to Water (Below GS)*<br>No Water Encountered |

| Depth (feet) | Elev. (feet) | Exploration Completion and Notes | Sample Type/ID | Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50 | Blows/6" | Tests | Material Type | Description | Depth (ft) |
|---|---|---|---|---|---|---|---|---|---|
| | | Test pit backfilled with excavated soil. | | | | | | **FILL**<br>SAND WITH GRAVEL (SP); loose to medium dense, moist, gray; fine to coarse sand; fine to coarse, rounded to subrounded gravel; trace silt. | |
| 1 | 71 | | 🖐 S1 | | | | | | 1 |
| 2 | 70 | Excavator notes hard digging. | | | | DCPT =31-62-86 | | Encountered metal wire debris. | 2 |
| 3 | 69 | | | | | | | CONCRETE; slab and concrete chunks. | 3 |
| 4 | 68 | | | | | DCPT =2-2-2 | | SAND WITH GRAVEL (SP); very loose, moist, gray; fine to coarse sand; fine to coarse, rounded to angular gravel; trace silt; silt chunks.<br>Trace roots up to 1 inch in diameter. | 4 |
| 5 | 67 | | 🖐 S2 | | | | | | 5 |
| | | | | | | | | Bottom of exploration at 5.2 ft. bgs.<br>Note: Refusal on concrete debris at 5.2 ft bgs. | |
| 6 | 66 | | | | | | | | 6 |
| 7 | 65 | | | | | | | | 7 |
| 8 | 64 | | | | | | | | 8 |
| 9 | 63 | | | | | | | | 9 |

**Legend**

Sample Type: 🖐 Grab sample

Plastic Limit ├──┤ Liquid Limit

Water Level: No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: WEG
Approved by: AJH

**Exploration Log ATP-07**

Sheet 1 of 1

Aspect CONSULTING

# Messenger House Phase II - 200104

# Geotechnical Exploration Log

| | | | | |
|---|---|---|---|---|
| *Project Address & Site Specific Location*<br>10861 Manitou Park Blvd. NE, Bainbridge Island, WA 98110, See Figure 2 | | | *Coordinates (Lat,Lon WGS84)*<br>47.6612, -122.5011 (est) | *Exploration Number*<br>**ATP-08** |
| *Contractor*<br>High Meadows Excavating, Inc. | *Equipment*<br>Deere 35D Excavator | *Sampling Method*<br>Grab | *Ground Surface Elev. (NAVD88)*<br>72' (est) | |
| *Operator*<br>Andrew Monsaas | *Exploration Method(s)*<br>Trackhoe | *Work Start/Completion Dates*<br>4/27/2020 | *Top of Casing Elev. (NAVD88)*<br>NA | *Depth to Water (Below GS)*<br>No Water Encountered |

| Depth (feet) | Elev. (feet) | Exploration Completion and Notes | Sample Type/ID | Blows/foot ▲ Water Content (%)● 0 10 20 30 40 50 | Blows/6" | Tests | Material Type | Description | Depth (ft) |
|---|---|---|---|---|---|---|---|---|---|
| | | Test pit backfilled with excavated soil. | | | | | | **FILL**<br>SAND WITH GRAVEL (SP); loose to medium dense, moist, gray; fine to coarse sand; fine to coarse, rounded to subangular gravel; few silt; few roots and organics to 0.3 ft. bgs. | |
| 1 | 71 | | | | | | | | 1 |
| | | | | | | | | SILTY SAND WITH GRAVEL (SM); medium dense, moist, brown yellow; fine to coarse sand; fine to coarse, rounded to subangular gravel; trace roots; brick pipe fragments. | |
| 2 | 70 | | | | | DCPT =9-11-16 | | | 2 |
| 3 | 69 | | | | | | | | 3 |
| | | | | | | | | CONCRETE; encountered 8-inch-thick concrete basement wall from 3.5 to the depth explored. | |
| 4 | 68 | | | | | | | | 4 |
| 5 | 67 | | | | | DCPT =12-18-19 | | Encountered metal pipe debris. | 5 |
| 6 | 66 | | | | | | | | 6 |
| 7 | 65 | | | | | | | | 7 |
| 8 | 64 | | | | | | | | 8 |
| 9 | 63 | | | | | | | | 9 |
| 10 | 62 | | | | | | | Bottom of exploration at 10 ft. bgs.<br>Note: Excavator reach limited to 10 ft bgs. | 10 |
| 11 | 61 | | | | | | | | 11 |
| 12 | 60 | | | | | | | | 12 |
| 13 | 59 | | | | | | | | 13 |
| 14 | 58 | | | | | | | | 14 |

**Legend**

Sample Type

Plastic Limit ├──┤ Liquid Limit

Water Level

No Water Encountered

See Exploration Log Key for explanation of symbols

Logged by: WEG
Approved by: AJH

**Exploration Log**
**ATP-08**
Sheet 1 of 1

# APPENDIX B

# Geotechnical Laboratory Testing

# B. Geotechnical Laboratory Testing

Aspect subcontracted a licensed materials-testing laboratory, Materials Testing & Consulting, Inc., to perform laboratory tests on selected soil samples to characterize certain engineering (physical) properties of the Site soils. Laboratory testing included determination of natural moisture content, grain-size distribution, and optimum moisture content and maximum dry density in general accordance with appropriate ASTM test methods. Test procedures are discussed below.

The moisture content of selected samples was analyzed in general accordance with ASTM D-2216, *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*.

The grain-size distribution of selected samples was analyzed in general accordance with ASTM D-6913, *Standard Test Method for Particle-Size Analysis of Soils* without hydrometer determination of fines content.

The optimum moisture content and maximum dry density of a selected sample was analyzed in general accordance with ASTM D-4718, *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort* (commonly known as the ‘Modified Proctor Test’), and included corrections for oversize particles.

The results of the moisture content tests are presented in tabular form in this appendix; moisture content results are also presented graphically on the boring logs in Appendix A. The results of the grain-size distribution tests are presented as curves in this appendix, plotting percent finer by weight versus grain size. The results of the Modified Proctor test is presented graphically in this appendix, plotting dry density with varying moisture contents.

Materials Testing & Consulting, Inc.
Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

**Client:** Aspect Consulting
**Address:** 701 2nd Ave Suite 550
Seattle, WA 98104
**Attn:** Mari Otto
**Date Revised:**

**Date:** May 11, 2020
**Project:** Q.C. - Messenger House Ph. II
**Project #:** 20B014-13
**Sample #:** B20-0475 - 0476
**Date Sampled:** April 27, 2020

As requested MTC, Inc. has performed the following test(s) on the sample referenced above. The testing was performed in accordance with current applicable AASHTO or ASTM standards as indicated below. The results obtained in our laboratory were as follows below or on the attached pages:

| | Test(s) Performed: | Test Results | | Test(s) Performed: | Test Results |
|---|---|---|---|---|---|
| X | Sieve Analysis | See Attached Reports | | Sulfate Soundness | |
| X | Proctor | 135.3 pcf at 5.9% | | Bulk Density & Voids | |
| | Sand Equivalent | | | WSDOT Degradation | |
| | Fracture Count | | | | |
| X | Moisture Content | See Attached Report | | | |
| | Specific Gravity, Coarse | | | | |
| | Specific Gravity, Fine | | | | |
| | Hydrometer Analysis | | | | |
| | Atterberg Limits | | | | |
| | Asphalt Extraction/Gradation | | | | |
| | Rice Density | | | | |

If you have any questions concerning the test results, the procedures used, or if we can be of any further assistance please call on us at the number below.

Meghan Blodgett Carrillo

Respectfully Submitted,
Meghan Blodgett-Carrillo
WABO Supervising Laboratory Technician

**Materials Testing & Consulting, Inc.**
Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

**Project:** Q.C. - Messenger House Phase II
**Project #:** 20B014-13
**Date Received:** May 7, 2020
**Date Tested:** May 7, 2020

**Client:** Aspect Consulting
**Sampled by:** Client
**Tested by:** M. Carrillo

## Moisture Content - ASTM C-566, ASTM D-2216 & AASHTO T-265

| Sample # | Location | Tare | Wet + Tare | Dry + Tare | Wgt. Of Moisture | Wgt. Of Soil | % Moisture |
|---|---|---|---|---|---|---|---|
| B20-0475 | ATP-1 S-1 @ 3ft | 686.9 | 3175.8 | 2906.4 | 269.4 | 2219.5 | 12.1% |
| | | | | | | | |
| B20-0476 | ATP-3 S-1 @ 3.5ft | 760.1 | 1274.2 | 1240.0 | 34.2 | 479.9 | 7.1% |

Reviewed by: Meghan Blodgett Carrillo

Meghan Blodgett-Carrillo

# Sieve Report

**Project:** Q.C. - Messenger House Ph. II
**Project #:** 20B014-13
**Client:** Aspect Consulting
**Source:** ATP-1 S-1 @ 3ft
**Sample#:** B20-0475

**Date Received:** 7-May-20
**Sampled By:** Client
**Date Tested:** 8-May-20
**Tested By:** C. Kriss

**ASTM D-2487 Unified Soils Classification System**
SM, Silty Sand
**Sample Color:**
gray

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04

**ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821**

**Specifications**
No Specs
**Sample Meets Specs ?** **N/A**

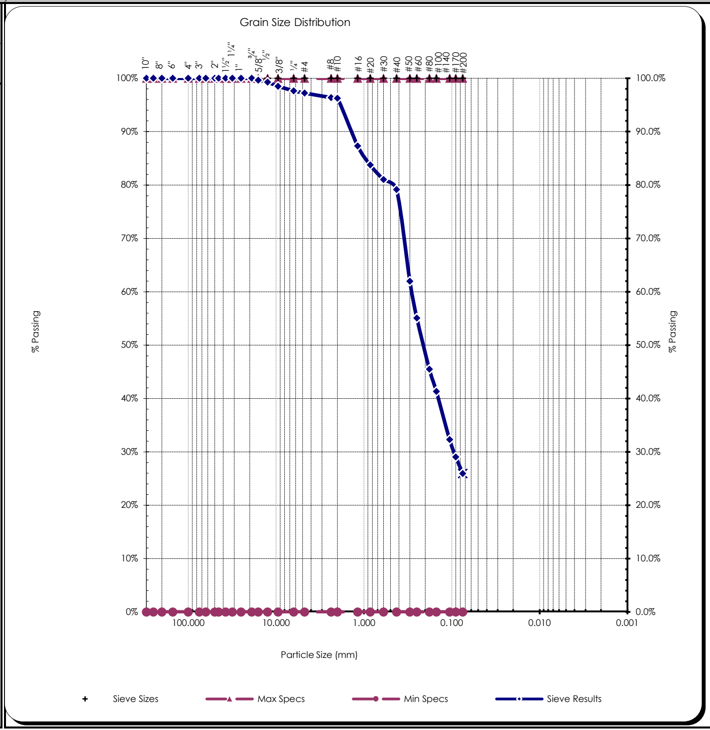
$D_{(5)}$ = 0.014 mm
$D_{(10)}$ = 0.029 mm
$D_{(15)}$ = 0.043 mm
$D_{(30)}$ = 0.095 mm
$D_{(50)}$ = 0.213 mm
$D_{(60)}$ = 0.286 mm
$D_{(90)}$ = 1.425 mm
Dust Ratio = 21/64

% Gravel = 2.8%
% Sand = 71.3%
% Silt & Clay = 26.0%
Liquid Limit = n/a
Plasticity Index = n/a
Sand Equivalent = n/a
Fracture %, 1 Face = n/a
Fracture %, 2+ Faces = n/a

Coeff. of Curvature, $C_C$ = 1.09
Coeff. of Uniformity, $C_U$ = 9.89
Fineness Modulus = 1.36
Plastic Limit = n/a
Moisture %, as sampled = 12.1%
Req'd Sand Equivalent =
Req'd Fracture %, 1 Face =
Req'd Fracture %, 2+ Faces =

**ASTM C-136, ASTM D-6913**

| Sieve Size US | Sieve Size Metric | Actual Cumulative Percent Passing | Interpolated Cumulative Percent Passing | Specs Max | Specs Min |
|---|---|---|---|---|---|
| 12.00" | 300.00 | | 100% | 100.0% | 0.0% |
| 10.00" | 250.00 | | 100% | 100.0% | 0.0% |
| 8.00" | 200.00 | | 100% | 100.0% | 0.0% |
| 6.00" | 150.00 | | 100% | 100.0% | 0.0% |
| 4.00" | 100.00 | | 100% | 100.0% | 0.0% |
| 3.00" | 75.00 | | 100% | 100.0% | 0.0% |
| 2.50" | 63.00 | | 100% | 100.0% | 0.0% |
| 2.00" | 50.00 | | 100% | 100.0% | 0.0% |
| 1.75" | 45.00 | | 100% | 100.0% | 0.0% |
| 1.50" | 37.50 | | 100% | 100.0% | 0.0% |
| 1.25" | 31.50 | | 100% | 100.0% | 0.0% |
| 1.00" | 25.00 | | 100% | 100.0% | 0.0% |
| 3/4" | 19.00 | 100% | 100% | 100.0% | 0.0% |
| 5/8" | 16.00 | | 100% | 100.0% | 0.0% |
| 1/2" | 12.50 | 99% | 99% | 100.0% | 0.0% |
| 3/8" | 9.50 | 99% | 99% | 100.0% | 0.0% |
| 1/4" | 6.30 | | 98% | 100.0% | 0.0% |
| #4 | 4.75 | 97% | 97% | 100.0% | 0.0% |
| #8 | 2.36 | | 96% | 100.0% | 0.0% |
| #10 | 2.00 | 96% | 96% | 100.0% | 0.0% |
| #16 | 1.18 | | 87% | 100.0% | 0.0% |
| #20 | 0.850 | | 84% | 100.0% | 0.0% |
| #30 | 0.600 | | 81% | 100.0% | 0.0% |
| #40 | 0.425 | 79% | 79% | 100.0% | 0.0% |
| #50 | 0.300 | | 62% | 100.0% | 0.0% |
| #60 | 0.250 | | 55% | 100.0% | 0.0% |
| #80 | 0.180 | | 45% | 100.0% | 0.0% |
| #100 | 0.150 | 41% | 41% | 100.0% | 0.0% |
| #140 | 0.106 | | 32% | 100.0% | 0.0% |
| #170 | 0.090 | | 29% | 100.0% | 0.0% |
| #200 | 0.075 | 26.0% | 26.0% | 100.0% | 0.0% |



**Comments:**

**Reviewed by:** Megh Blodgett Carrillo

Meghan Blodgett-Carrillo

# Materials Testing & Consulting, Inc.

Geotechnical Engineering • Special Inspection • Materials Testing • Environmental Consulting

MATERIALS TESTING & CONSULTING, INC.

# Sieve Report

**Project:** Q.C. - Messenger House Ph. II
**Project #:** 20B014-13
**Client:** Aspect Consulting
**Source:** ATP-3 S-1 @ 3.5ft
**Sample#:** B20-0476

**Date Received:** 7-May-20
**Sampled By:** Client
**Date Tested:** 8-May-20
**Tested By:** C. Kriss

**ASTM D-2487 Unified Soils Classification System**
SM, Silty Sand with Gravel
**Sample Color:**
grayish-brown

ACCREDITED
Certificate #: 1366.01, 1366.02 & 1366.04

## ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821

**Specifications**
No Specs
**Sample Meets Specs ?** N/A

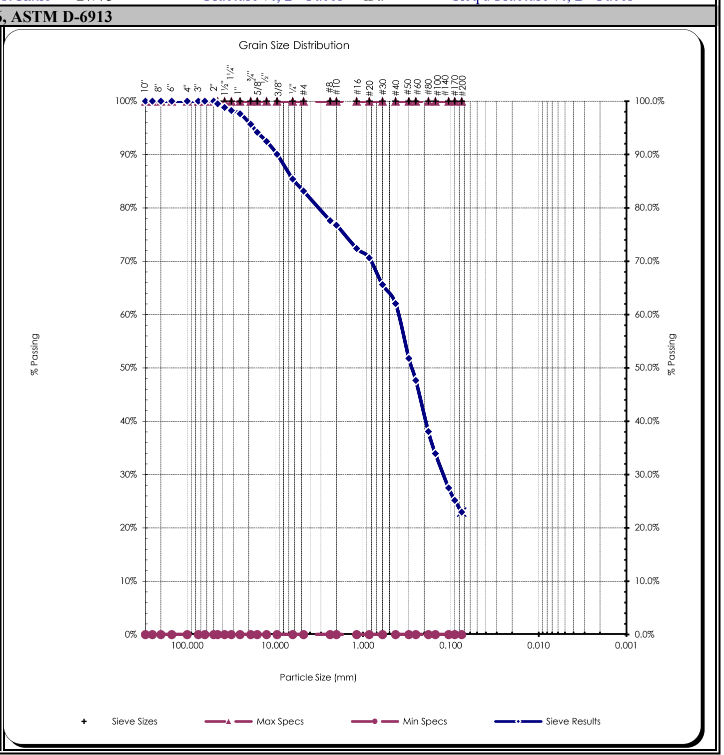
$D_{(5)}$ = 0.016 mm
$D_{(10)}$ = 0.033 mm
$D_{(15)}$ = 0.049 mm
$D_{(30)}$ = 0.123 mm
$D_{(50)}$ = 0.278 mm
$D_{(60)}$ = 0.400 mm
$D_{(90)}$ = 9.463 mm
Dust Ratio = 27/73

% Gravel = 16.8%
% Sand = 60.2%
% Silt & Clay = 23.0%
Liquid Limit = n/a
Plasticity Index = n/a
Sand Equivalent = n/a
Fracture %, 1 Face = n/a
Fracture %, 2+ Faces = n/a

Coeff. of Curvature, $C_C$ = 1.16
Coeff. of Uniformity, $C_U$ = 12.24
Fineness Modulus = 2.30
Plastic Limit = n/a
Moisture %, as sampled = 7.1%
Req'd Sand Equivalent =
Req'd Fracture %, 1 Face =
Req'd Fracture %, 2+ Faces =

## ASTM C-136, ASTM D-6913

| Sieve Size | | Actual Cumulative Percent Passing | Interpolated Cumulative Percent Passing | Specs Max | Specs Min |
|---|---|---|---|---|---|
| US | Metric | | | | |
| 12.00" | 300.00 | | 100% | 100.0% | 0.0% |
| 10.00" | 250.00 | | 100% | 100.0% | 0.0% |
| 8.00" | 200.00 | | 100% | 100.0% | 0.0% |
| 6.00" | 150.00 | | 100% | 100.0% | 0.0% |
| 4.00" | 100.00 | | 100% | 100.0% | 0.0% |
| 3.00" | 75.00 | | 100% | 100.0% | 0.0% |
| 2.50" | 63.00 | | 100% | 100.0% | 0.0% |
| 2.00" | 50.00 | 100% | 100% | 100.0% | 0.0% |
| 1.75" | 45.00 | | 100% | 100.0% | 0.0% |
| 1.50" | 37.50 | | 99% | 100.0% | 0.0% |
| 1.25" | 31.50 | | 98% | 100.0% | 0.0% |
| 1.00" | 25.00 | 98% | 98% | 100.0% | 0.0% |
| 3/4" | 19.00 | 96% | 96% | 100.0% | 0.0% |
| 5/8" | 16.00 | | 94% | 100.0% | 0.0% |
| 1/2" | 12.50 | 92% | 92% | 100.0% | 0.0% |
| 3/8" | 9.50 | 90% | 90% | 100.0% | 0.0% |
| 1/4" | 6.30 | | 85% | 100.0% | 0.0% |
| #4 | 4.75 | 83% | 83% | 100.0% | 0.0% |
| #8 | 2.36 | | 78% | 100.0% | 0.0% |
| #10 | 2.00 | 77% | 77% | 100.0% | 0.0% |
| #16 | 1.18 | | 72% | 100.0% | 0.0% |
| #20 | 0.850 | 71% | 71% | 100.0% | 0.0% |
| #30 | 0.600 | | 66% | 100.0% | 0.0% |
| #40 | 0.425 | 62% | 62% | 100.0% | 0.0% |
| #50 | 0.300 | | 52% | 100.0% | 0.0% |
| #60 | 0.250 | 48% | 48% | 100.0% | 0.0% |
| #80 | 0.180 | | 38% | 100.0% | 0.0% |
| #100 | 0.150 | 34% | 34% | 100.0% | 0.0% |
| #140 | 0.106 | | 27% | 100.0% | 0.0% |
| #170 | 0.090 | | 25% | 100.0% | 0.0% |
| #200 | 0.075 | 23.0% | 23.0% | 100.0% | 0.0% |



**Comments:** ____________________

**Reviewed by:** Meghan Blodgett Carrillo

Meghan Blodgett-Carrillo

# Proctor Report

**Project:** Q.C. - Messenger House Ph. II
**Project #:** 20B014-13
**Client:** Aspect Consulting
**Source:** ATP-3 S-1 @ 3.5ft
**Sample#:** B20-0476

**Date Received:** 7-May-20
**Sampled By:** Client
**Date Tested:** 8-May-20
**Tested By:** C. Kriss

**Unified Soils Classification System, ASTM D-2487**
SM, Silty Sand with Gravel
**Sample Color**
grayish-brown

**Sample Prepared:** Moist: X
Dry:
Manual:
Mechanical: X

**Test Standard:** ASTM D698:
ASTM D 1557: X
AASHTO T 99:
AASHTO T 180:
Method
A

| Assumed Sp. Gr. | Point Number | Percent Moisture | Dry Density |
|---|---|---|---|
| 2.70 | 1 | 3.4 % | 124.7 |
| | 2 | 5.3 % | 128.6 |
| | 3 | 7.4 % | 130.4 |
| | 4 | 9.4 % | 127.5 |

Certificate #: 1366.01, 1366.02 & 1366.04

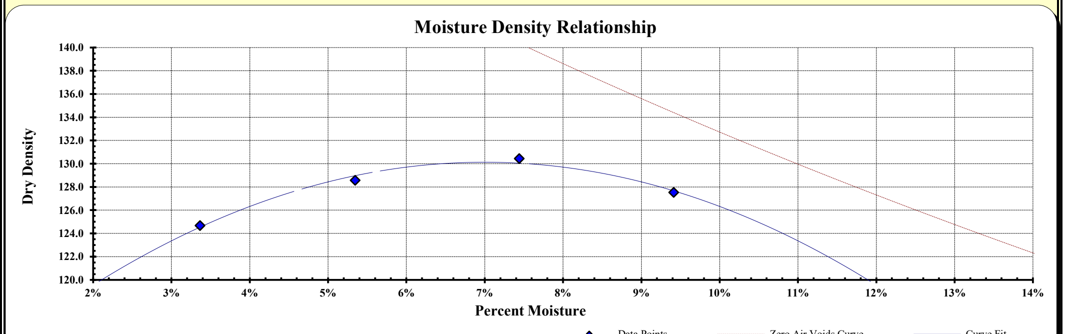
**Uncorrected Proctor Value**

| Max. Dry Density | | Optimum Moist |
|---|---|---|
| **130.1** | **lbs/ft³** | **7.0 %** |

**Value w/ Oversize Correction Applied**

| Max. Dry Density | | Optimum Moist |
|---|---|---|
| **135.3** | **lbs/ft³** | **5.9%** |

**Moisture Density Relationship**



**ASTM C-136**

| Sieve US | Size mm | Percent Passing | Specifications Max | Specifications Min |
|---|---|---|---|---|
| 12.00" | 300.00 | | 100.0 % | 0.0 % |
| 10.00" | 250.00 | | 100.0 % | 0.0 % |
| 8.00" | 200.00 | | 100.0 % | 0.0 % |
| 6.00" | 150.00 | | 100.0 % | 0.0 % |
| 4.00" | 100.00 | | 100.0 % | 0.0 % |
| 3.00" | 75.00 | | 100.0 % | 0.0 % |
| 2.50" | 63.00 | | 100.0 % | 0.0 % |
| 2.00" | 50.00 | 100 % | 100.0 % | 0.0 % |
| 1.75" | 45.00 | | 100.0 % | 0.0 % |
| 1.50" | 37.50 | | 100.0 % | 0.0 % |
| 1.25" | 31.50 | | 100.0 % | 0.0 % |
| 1.00" | 25.00 | 98 % | 100.0 % | 0.0 % |
| 3/4" | 19.00 | 96 % | 100.0 % | 0.0 % |
| 5/8" | 16.00 | | 100.0 % | 0.0 % |
| 1/2" | 12.50 | 92 % | 100.0 % | 0.0 % |
| 3/8" | 9.50 | 90 % | 100.0 % | 0.0 % |
| 1/4" | 6.30 | | 100.0 % | 0.0 % |
| #4 | 4.75 | 83 % | 100.0 % | 0.0 % |
| #8 | 2.36 | | 100.0 % | 0.0 % |
| #10 | 2.00 | 77 % | 100.0 % | 0.0 % |
| #16 | 1.18 | | 100.0 % | 0.0 % |
| #20 | 0.850 | 71 % | 100.0 % | 0.0 % |
| #30 | 0.600 | | 100.0 % | 0.0 % |
| #40 | 0.425 | 62 % | 100.0 % | 0.0 % |
| #50 | 0.300 | | 100.0 % | 0.0 % |
| #60 | 0.250 | 48 % | 100.0 % | 0.0 % |
| #80 | 0.180 | | 100.0 % | 0.0 % |
| #100 | 0.150 | 34 % | 100.0 % | 0.0 % |
| #140 | 0.106 | | 100.0 % | 0.0 % |
| #170 | 0.090 | | 100.0 % | 0.0 % |
| #200 | 0.075 | 23.0 % | 100.0 % | 0.0 % |

**ASTM D-4718, Misc. Oversize Correction Values**

**% Oversize Mat'l:** 17%

| % Oversize Retained | Corrected Density | Optimum Moisture |
|---|---|---|
| 5% | 131.6 | 6.6% |
| 10% | 133.2 | 6.3% |
| 15% | 134.7 | 6.0% |
| 20% | 136.3 | 5.7% |
| 25% | 138.0 | 5.3% |
| 30% | 139.7 | 5.0% |

**Specs:** No Specs
**Meets Specs?** N/A

% Gravel: 16.8%
% Sand: 60.2%
% Silt&Clay: 23.0%

$C_C$: 1.16
$C_U$: 12.24
FM: 2.30

$D_{(10)}$: 0.033
$D_{(30)}$: 0.123
$D_{(60)}$: 0.400

LL: n/a
PL: n/a
PI: n/a

Sand Equivalent: n/a
Req'd Sand Equivalent:

Fracture %, 1 Face: n/a
Fracture %, 2+ Faces: n/a
Req'd Fracture %, 1 Face:
Req'd Fracture %, 2+ Faces:

**Comments:** ______________________________

**Reviewed by:** Meghan Blodgett-Carrillo
Meghan Blodgett-Carrillo

# APPENDIX C

# Previous Geotechnical Report

MB
**Myers Biodynamics inc.**
geotechnical and environmental science and engineering

# GEOTECHNICAL DESIGN REPORT

## Messenger House
Addition

Prepared for:
Messenger House
10861 NE Manitou Park Boulevard
Bainbridge Island, WA 98110

Prepared By:
Myers Biodynamics, Inc.
600 Winslow Way East Suite 235
Bainbridge Island, Washington 98110

November 16, 1994
Project No. 94478-5

MB
**Myers Biodynamics inc.**
geotechnical and environmental science and engineering

November 16, 1994

Messenger House
10861 NE Manitou Park Boulevard
Bainbridge Island, Washington 98110

Attention: Mr. Ray Ramsdell

Re: Geotechnical Design Report
Messenger House Addition
Bainbridge Island, Washington

Dear Mr. Ramsdell:

This report presents the results of the geotechnical investigations and design recommendations for the proposed Messenger House Addition Project. The purpose of our work was to investigate subsurface conditions within the area of proposed addition and provide geotechnical recommendations for design and construction of the project. Our understanding of the project is based on information provided to our office by your and the project Architect Reed Reinvald.

The geotechnical scope of work for this project was conducted in general accordance with our letter of agreement dated September 30, 1994. The scope of work included review of readily available information, subsurface boring and test pit explorations, soil sample collection and laboratory testing, geotechnical analyses, and preparation of this report. Results of the exploration program and laboratory testing are presented in Appendices A and B.

## SITE AND PROJECT DESCRIPTION

The existing Messenger House facility is at 10861 NE Manitou Park Boulevard on Bainbridge Island, Washington. The approximate site location is shown on the Vicinity Map, Figure 1. The majority of the site topography is generally level to gently sloping within the project area. The site slopes down to the east with elevations ranging from 124 to 90 feet. East and northeast of the proposed addition area the topography slopes down more steeply with average maximum grades of 30% to 40%.

The proposed Messenger House project includes a building addition as well as road and parking improvements as described below. The general configuration of the existing Messenger House facility and proposed addition and improvements are shown on Figure 2.

### Building Addition

The proposed building addition extends north and west of the existing main building as shown on Figure 2. The new addition consists of an approximately 19,500 square foot area with a finish floor elevation of 102.9 feet. A basement level (approximately 3,500 square feet) is planned at the north end of the new addition with a finish floor elevation of about 91 feet. Basement access will be provided at the north end of the new addition.

600 WINSLOW WAY EAST BAINBRIDGE ISLAND WA 98110 ▪ BUS: (206) 842-6073 ▪ FAX: (206) 842-3797

The majority of the proposed building addition will be constructed across areas of existing gravel parking. The north part of the addition will be constructed where an old foundation and vegetated areas are present. The west end of the addition will be constructed in an existing forested area. Construction of the new addition will require cuts on the order of 10 to 12 feet in the basement area (north end), 2 to 4 feet over the central portion of the addition, and up to 14 feet at the west end of the addition. Fill thicknesses of 2 to 4 feet will be required for the new addition adjacent to the existing facility.

### Road and Parking Improvements

Road and parking improvements consist of several new parking areas south of the proposed addition. The existing gravel access driveway off of Manitou Beach Drive NE will be improved with asphalt pavement. The existing gravel road off of Mountain View Road NE will be realigned and provide access along the northwest and west side of the new addition. The proposed parking and road areas are shown on Figure 2.

Proposed parking areas are generally located in undeveloped forested areas. The southernmost parking lots will require 2 to 6 feet of fill while the northern parking lot will be constructed by a cut of 2 to 6 feet. The realigned access drive extends through existing parking and forested areas. Construction will require cuts of 6 to 8 feet near Mountain View Road and as much as 16 to 17 feet west of the proposed addition.

## INFORMATION REVIEW

Current site topographic and site features information was provided for our use. Topographic mapping included "Topography for Messenger House Care Center", dated January 15, 1994 by Adam & Goldsworthy, Inc. Site plan information included "Preliminary Design Site Plan" dated August 31, 1994, "Conceptual Grading Plan" dated September 8, 1994, and "Site Plan" dated October 17, 1994 by Architects Reed Reinvald.

## GENERALIZED SUBSURFACE CONDITIONS

The project site was explored by conducting six hollow-stem auger boring explorations, B-1 through B-6 and eight test pit explorations, TP-1 through TP-8. The approximate exploration locations are presented on the Site and Exploration Plan, Figure 2. Borings are located generally in the vicinity of the proposed building addition. Test pit explorations are located in areas of proposed roadway and parking improvements except for TP-4 which was advance at the west end of the proposed addition when drill rig access was limited due to topography and dense trees. Discussion of the field procedures and logs of the explorations are presented in Appendix A.

### Building Addition

Boring B-1 through B-6 were drilled in the vicinity of the proposed addition. Also, Test Pit TP-4 was excavated at the west end of the proposed addition where drill rig access was limited. Test Pit TP-6 was located in the vicinity of the north end of the addition. Site soils in the proposed building addition area generally consisted of topsoil or gravel (in parking areas) over loose to medium dense sand over very dense glacial till. Glacial till is a mixture of gravel, sand, silt and clay which has been overridden by glacial ice and is very dense where undisturbed. Topsoil thicknesses were typically less than 2 to 3 inches, except in heavily forested areas where topsoil and "forest duff" were somewhat thicker (3 to 4 inches). At the north end of the proposed addition loose fill was present above the sand and glacial till. Fill extended approximately 7 feet and 8 feet below grade at boring B-1 and B-2 respectively.

It is reported that fill at the north end of the proposed addition was placed during past site earthwork activities and building demolition. Concrete rubble was observed at the groundsurface in the existing parking lot near B-2. At boring B-2 concrete rubble pieces 2 to 3 feet in diameter were encountered just below the groundsurface. Test Pit TP-6 located west of the proposed addition encountered debris and rubble to depths as great as 7 feet below grade. Elsewhere borings in the addition area, B-3 through B-6 encountered less than 2 to 3 feet of fill below the groundsurface.

In explorations B-1, B-2, and TP-6 loose to medium dense sand soils were encountered below the fill. Sand was typically 2 to 5 feet thick. Below the sand and in all explorations glacial till was encountered. At the north end of the general addition area glacial till was at depths ranging from 10 feet to 12 1/2 feet to 7 feet in B-1, TP-6, and B-2 respectively. In all other explorations in the building area (B-3 through B-6 and TP-4) glacial till was encountered at depths of 2 to 3 feet below existing site grade.

Road and Parking Improvements

In the road and parking areas site conditions were investigated by test pit explorations. Areas were generally test pit TP-6 was advanced in the existing parking area and proposed access road realignment. Test pit TP-6 encountered fill to a depth of 7 feet below grade. Significant debris and rubble were present to 7 foot depth. Below the fill, loose to medium dense sand extended another 5 1/2 feet. Very dense glacial till was present at a depth of about 12 1/2 feet.

Test pit TP-5 was also excavated in the proposed access road alignment area where large cuts are required. Test Pit TP-5 encountered 3 to 4 inches Forest Duff and topsoil over native loose to medium dense silty sand with gravel soils. At a depth of 3 feet very dense glacial till soils were encountered. Test Pits TP-1 through TP-3 were advanced in proposed parking areas and encountered similar conditions with glacial till at a depth of 3 to 4 feet. At Test Pit TP-3 significant construction debris (primarily wood) was present at the groundsurface.

Test pits TP-7 and TP-8 were advanced adjacent to the existing Manitou Beach Drive access road. The access road itself is constructed on granular embankment fill soils or cuts in the native granular soils. Test pits were conducted adjacent to the road in low lying areas to observe native site soils. Concrete rubble fill was located on the edge of the existing road embankment at TP-8. Sand soils were below the rubble fill at TP-8. Test pit TP-7 encountered silt and clay soils to a depth of 5 1/2 feet. Those soils were soft and compressible to a depth of 3 feet. Glacial till was located at 5 1/2 feet. It is likely that at least the west 1/2 of the Manitou Beach access drive contains some relatively soft silt and/or clay soils adjacent to the access drive.

### Groundwater

No groundwater was encountered in the site explorations. However, soil mottling and staining indicates possible seasonal groundwater perched on top of the glacial till and in fill soils (when present). Also, rust-stained, clean sand seams were noted within the glacial till which likely indicates seasonal groundwater.

## GEOTECHNICAL ENGINEERING RECOMMENDATIONS

Geotechnical engineering recommendations presented in the following sections are based on the results of the subsurface explorations, laboratory test results, and our understanding of the proposed site development at the time this report was prepared.

### Site Preparation and Grading

Site preparation should generally involve the removal or relocation of existing site surface features including existing surface debris (near TP-3), concrete rubble (near B-2), existing concrete foundation (near B-3), utilities, and other existing site features. The surface should then be stripped of vegetation, topsoil and forest duff. It is likely that the majority of topsoil (typically 2 to 4 inches thick) will be removed in the process of stripping vegetation. Any additional topsoil (see TP-1 with 7 inches of topsoil) could be stockpiled for reuse in landscaping or other revegetation areas. Stockpiled soil should be protected from erosion. In forested areas stripping should include removal of stumps and roots which may require additional stripping and/or raking of the soil to depths of 2 to 3 feet.

After stripping, excavation to subgrade elevations will occur. In the north area of the site this will include excavation of existing fill material containing concrete rubble and other construction debris. Locations along the west side of the site at the proposed addition at the realigned Mountain View Road access drive, and at the parking area will require cuts up to 17 feet in height. Excavation of the very dense glacial till soils will likely require ripping with heavy equipment.

After excavation to subgrade elevations, we recommend that exposed soils be observed and any remaining areas of fill, rubble, soft, loose, or wet soils be removed. It is likely that some overexcavation may be required below the proposed site elevations, particularly in the area of B-1, B-2, and TP-6 which indicate existing fill and/or rubble at or below proposed grades. We recommend a representative from our firm observe the soil subgrade elevation to determine whether soils are adequate for fill placement, pavement sections, slab-on-grade, and the recommended allowable soil bearing pressure for footing foundation support.

In the road access areas, we recommend removal of fill soils containing rubble and organic debris. In the vicinity of Test Pit TP-6 this may require additional excavation of 2 to 3 feet below proposed road grade (elevation 103 feet at TP-6). If widening of the road embankment occurs along the Manitou Beach Drive access road (TP-7 and TP-8), soft silt or clay soils will be present after stripping for the western portion of the roadway widening area. Soft soils could be overexcavated until firm subgrade soils are encountered. Alternatively, a geotextile fabric could be used for added subgrade strength and separation between soft subgrade and embankment fill soils.

Site soils contain significant quantities of silt and fine sand and are sensitive to disturbance by construction activity when wet. Care should be taken to limit or avoid construction activity on exposed subgrade soils during wet weather. The subgrade soils may be protected during wet weather by use of a crushed rock working surface if needed.

Structural Fill

We recommend that any fill placed within the proposed addition, parking, road or walkway areas be placed as structural fill. Structural fill should consist of a granular soil free of organics, debris, or other deleterious material. Structural fill should be at a moisture content to allow for proper compaction.

If construction and fill placement are to occur during wet weather conditions, we recommend that structural fill material consist of an imported well-graded sand and gravel with less than 5 percent fines. Such a material could consist of "Gravel Borrow" as presented in Section 9-03.14 of the 1994 Washington State Department of Transportation Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications). However, the gradation should be modified so that a maximum 5 percent by weight of the material passes the U.S. No. 200 sieve as based on the minus 3/4 inch fraction.

Structural fill should be placed in lifts not exceeding 10-inches in loose thickness. Each lift should be compacted to a minimum relative density as presented below in Table 1. Structural fill should be limited to six-inch, loose thickness lifts where hand operated compaction equipment is used.

**TABLE 1**
**Messenger House Addition**
**Recommended Structural Fill Compaction**

| Fill Location | Minimum Relative Compaction* |
|---|---|
| Beneath Floor Slabs or Footings[+] | 95 percent |
| Under Pavement | |
| Upper 2 feet | 95 percent |
| Greater than 2 feet depth | 92 percent |
| Exterior Subgrade Wall Backfill and Around Footings | 95 percent |
| Utility Trenches | same as adjacent locations or 90 percent minimum |
| Fill Slopes (maximum 3H:1V) | 95 percent |

*Expressed as a percentage of the maximum dry density as determined by ASTM 1557 (Modified Proctor).

[+] See **Foundation Support** section for allowable soil bearing pressure recommendations

Site Soil Suitability as Structural Fill

The suitability of excavated site soils for use as structural fill depends on the gradation and moisture content of the soil when it is placed. As the amount of fines (soil particles passing the U.S. No. 200 sieve) increases, the soil becomes more sensitive to small changes in moisture content and compaction levels become more difficult to achieve. Soils containing greater than 5 percent fines are moisture sensitive and cannot be consistently compacted to a firm, non-yielding condition when the water content is greater than the optimum moisture content. The optimum moisture content is that moisture content which results in the greatest soil compacted dry density for a given compaction effort.

The site soils consist primarily of silty sand with gravel which generally contains substantial percentages of fines. Fines contents range from 15 to 40 percent (see Appendix B, Figures B1 and B2). These site soils are moisture sensitive and should be utilized as structural fill only during extended periods of dry weather when the moisture content can be controlled.

The very dense silty sand with gravel (glacial till) soils are generally at a moisture content suitable for compaction when excavated. However, if they become wetted during excavation or prior to placement, they may require spreading and drying to adjust the moisture for use as structural fill. Loose to medium dense sand and silty sand with gravel soils overlying the till may be too moist if excavated during wet weather. If wet weather construction is anticipated or is required to meet the project construction schedule, we recommend structural fill consist of a well graded sand and gravel with less than 5 percent fines as previously described.

### Foundation Support

Foundation support for the proposed addition can be provided by shallow spread footing foundations supported on the very dense glacial till soils. We recommend that shallow spread footing foundations be designed for a maximum allowable soil bearing pressure of 6,000 pounds per square foot (psf) for foundations on undisturbed glacial till. Glacial till soils are generally present within 0 to 2 feet of the anticipated footing elevations (1 to 2 feet below finished floor). The approximate depth and elevation of glacial till soils is presented below in Table 2. If glacial till soils are disturbed, loosened, or softened prior to construction of the footings, the soil should be overexcavated until dense, undisturbed glacial till soils are encountered.

**TABLE 2**
**Messenger House Addition**
**Depth to Glacial Till for Foundation Support**

| Exploration Number | Approx. exploration ground surface elevation | Approx. depth of glacial till | Approx. elevation of the top of glacial till |
|---|---|---|---|
| B-1 | 98 feet | 10 feet* | 88 feet* |
| B-2 | 106 feet | 5 feet* | 101 feet* |
| B-3 | 104 feet | 2 feet | 102 feet |
| B-4 | 108 feet | 2 1/2 feet | 103 1/2 feet |
| B-5 | 106 feet | 3 feet | 103 feet |
| B-6 | 102 feet | 2 feet | 100 feet |
| TP-4 | 113 feet | 3 feet | 110 feet |
| TP-5 | 120 feet | 3 feet | 117 feet |
| TP-6 | 104 feet | 12 1/2 feet | 91 1/2 feet |

* Based on drilling observation of cuttings and drilling action, no recovery of sample at the top of glacial till

Alternatively, footing foundations could be supported on properly placed and compacted structural fill. We recommend an allowable soil bearing pressure of 2,000 psf for footing foundations supported on structural fill. Structural fill should be placed on a firm, unyielding native soil subgrade and compacted to 95 percent of the maximum dry density (ASTM 1557) as recommended in the **Structural Fill** section of the report.

We recommend minimum footing widths of 24 inches for isolated spread footings and 18 inches for continuous (wall) footings. Allowable soil bearing pressures may be increased by one-third to include short-term loads such as seismic or wind loading. Footings should be embedded at least 18 inches below adjacent finished exterior grades or the interior floor slab grade, whichever is lower.

We recommend that a representative of our firm be contacted to observe subgrade soil conditions prior to structural fill placement to confirm suitable subgrade soil conditions. We also recommend we observe footing subgrade soils prior to footing construction to confirm soils are suitable for the design allowable soil bearing pressure.

### Settlement

We anticipate that footings supported on glacial till and designed for the maximum allowable soil bearing pressures recommended previously will experience total settlement of 1 inch or less. Differential settlement should be less than 1/2 inch between footings founded on glacial till. Greater differential settlement up to 3/4 inch is possible between footings founded on glacial till and structural fill. Due to the granular nature of site soils and/or structural fill, we anticipate the settlement will occur during construction as the loads are applied.

### Slab-On-Grade Floors

Subgrade preparation in the floor slab area should conform to the recommendations presented in the Site Preparation and Structural Fill sections of this report. Native sand or silty sand with gravel site soils in the proposed addition area should provide adequate support for slab-on-grade floor. Any soft, loose, or wet soils encountered in the floor slab area should be compacted to 95 percent of the maximum dry density or overexcavated and replaced with structural fill. Any areas of rubble, debris, or other existing fill should also be removed and replaced with structural fill. We recommend placing at least 6 inches of clean, free draining granular material beneath floor slabs to act as a capillary break. A suitable gradation for capillary break material would conform to Standard Specification 9-03.12(2) - Gravel Backfill For Walls.

### Drainage Considerations

The proposed addition will require adequate drainage to prevent the development of hydrostatic forces behind subgrade walls and to adequately convey water away from walls, footings, floor slabs, or existing structures. We recommend that exterior grades be sloped away from the proposed addition and existing structures to prevent water from collecting adjacent to the structures. Roof downspouts should not be permitted to discharge into foundation drains. Collected stormwater should be directed away from the proposed addition and existing structures.

Subsurface drainage control should be provided for the proposed addition and behind any subgrade walls. A perimeter footing drain system should be placed at the base of the exterior edge of footings. Footing drain pipe should be completely surrounded by at least 6 inches of drain gravel. Drain gravel should meet the gradation requirements given in the Standard Specifications 9-03.12(4)-Gravel Backfill For Drains. Filter fabric should surround the drain gravel with a minimum 12-inch overlap of the filter fabric edges. Convenient cleanouts should be provided to increase the useful life of the drains.

Subgrade walls should be backfilled with clean free-draining sand and gravel placed within 18 inches of the wall. A suitable wall backfill material is presented in the Standard Specification 9-03.12(2)-Gravel Backfill for Walls. Alternatively, a synthetic geocomposite drainage material could be utilized behind subgrade walls. Wall drainage material should connect hydraulically to the drain gravel surrounding the footing drain pipe.

### Subgrade Walls

Subgrade walls which are free to yield at least 0.001 times the height of the wall during backfilling ("active conditions") may be designed based on an equivalent fluid density of 35 pounds per cubic foot (pcf). Walls which are structurally restrained against yielding during backfilling ("at-rest conditions") should be designed for an equivalent fluid density of 55 pcf.

These design wall values assume a horizontal backfill and no buildup of hydrostatic forces behind the wall. The **Drainage Considerations** section of this report should be referenced for recommended drainage behind subgrade walls to prevent the buildup of hydrostatic forces behind the wall.

Subgrade walls should be backfilled in accordance with the recommendations presented in the **Structural Fill** section of this report. We recommend that only light weight, hand operated compaction equipment be allowed to operate within 2 to 3 feet of subgrade walls.

### Lateral Resistance

Lateral loads may be resisted by friction along the base of foundations and by passive soil resistance against buried foundations and subgrade walls. Footings on structural fill or undisturbed existing glacial till may be designed using a coefficient of base friction of 0.35. The friction value includes a factor of safety of 1.5. Passive soil resistance may be calculated based on an equivalent fluid density of 220 pcf. The passive value includes a factor of safety of 2 in order to limit lateral deformations. Passive resistance values also assume a horizontal ground surface beyond the footing or wall. We recommend ignoring passive resistance for the upper 12 inches of soil unless covered by a floor slab or pavement.

### Permanent Cut and Fill Slopes

Construction of the realigned access drive off of Mountain View Road will require a maximum 16 to 17 foot cut northwest of the proposed addition. We recommend permanent cut slopes be constructed no steeper than 3H:1V near the access road entrance off of Mountain View Road where fill is present (vicinity of TP-6). We recommend permanent cut slopes no steeper than 2H:1V in the very dense glacial till soils (vicinity of TP-5 and south). Clean sand seams were observed within some of the glacial till soils and could be a source of groundwater during wet weather.

If groundwater is seasonally present in glacial till sand seams, the 2H:1V slopes will be subject to sloughing, ravelling and small shallow slides. Because of the very dense native or glacial till deep seated slides will not occur. However, vegetation will be difficult to establish on the slope and maintenance/cleanup of the adjacent road may become significant if shallow sliding occurs. Flatter cut slopes of 3H:1V would alleviate these potential maintenance factors. If possible, an adjustment to flatter 3H:1V slopes should be considered as a contingency during construction if slope seepage is observed.

Fill placement should be constructed in accordance with the **site preparation** and **structural fill** section of this report. We recommend fill slopes be no steeper than 3H:1V. We understand a small amount of fill may be required to construct a power access road northeast of the addition. The fill will be on the order of one foot thick or less. Because the majority of this area will be overexcavated during construction of the basement area and backfilled with structural fill we anticipate no significant impacts to existing slope stability due to this minor (1 foot) fill placement. Where fill is placed over existing site grades, we recommend fill be placed by benching into the existing site soils. All cut and fill slopes should be protected from erosion (at all times) and revegetated after construction.

### Temporary Construction Slopes

Cut slopes for construction of the basement addition will be required. Although maintenance of safe construction slopes is the responsibility of the contractor, we anticipate glacial till soils may be cut as steep at 3/4H:1V for short term construction. Where loose native soils above the till or existing fill soils are present, flatter slopes (on the order of 1 1/2H:1V) will likely be required.

### Pavement Considerations

Pavement subgrade should be prepared in accordance with the recommendations presented in the **Site Preparation** section of this report. We recommend that all pavement subgrade be proofrolled to determine the presence of firm, non-yielding subgrade soil conditions. Soft, wet, or loose subgrade areas observed during proofrolling should be reconditioned and compacted to a firm, non-yielding condition or removed and replaced with structural fill. We recommend that proofrolling be accomplished with a fully loaded 10-yard dump truck or other similar heavy construction equipment.

For design of pavement, we recommend that a California Bearing Ration (CBR) value of 20 be used for firm, non-yielding, structural fill or medium dense or denser native soils. A pavement section consisting of 3 inches of asphalt concrete pavement over 4 inches base or crushed surfacing is recommended. This assumes some heavier loading from delivery trucks, buses, and potential fire truck traffic. The asphalt thickness could be reduced to 2 inches thickness where only light passenger car loading is anticipated.

### Rockery Wall

Construction of a low wall may be required at the cut for the realigned Mountain View access drive unless additional property or a slope easement can be obtained. A rockery wall could be utilized in this location. We recommend that the rockery be supported on firm native soils. If the subgrade consists of fill, organic, soft silt or clay soils, rubble or other debris they should be removed. If subgrade soils are disturbed during the rockery construction, any loose or soft soils should be removed to expose firm native soils for support of the rockery.

Important considerations in rockery construction include the following: 1) the rockery must have a firm foundation; 2) the rocks must be sound and have minimum width of 18 inches with larger rocks placed at the base; 3) the maximum slope of the rockery must be no steeper than 4V:1H; 4) a minimum 12-inches embedment from finished grade should be provided in front of the rockery; 5) a granular soil filter material should be placed behind the rockery to prevent the loss of material from between the rocks; 6) drainage material should be placed behind the rockery to prevent buildup of hydrostatic pressures; 7) the backfill behind the rockery should be adequately compacted to reduce potential settlement; and 8) the maximum backslope behind the rockery should be no steeper than 2H:1V, except at the north end of the site where existing fill soils (vicinity of TP-6) should be no steeper than 3H:1V.

The Rockery Detail presented on Figure 3 provides a general rockery design with slope height and minimum rock dimensions. In order to promote drainage behind the rockery wall we recommend a minimum 24 inches clean, well-graded sand and gravel similar to Standard Specification 9-03.12(2)-Gravel Backfill for Walls be placed behind the wall. A 6-inch zone of quarry spalls should be used between the rockery and sand and gravel to limit loss of backfill material from between the rocks. We recommend that the backfill be sealed at the ground surface with a minimum of 1 foot of relatively impervious soil (such as topsoil) to prevent surface water from entering directly into the backfill/drainage system. We recommend that a perforated drain pipe be installed at the base of the rockery backfill. The pipe should be surrounded by a minimum of 6 inches of drainage material in all directions, sloped to drain, and tightlined to a suitable outlet.

## RECOMMENDATIONS FOR ADDITIONAL SERVICES

We recommend that we be retained to review those portions of the plans and specifications that pertain to foundation support and earthwork to determine whether they are consistent with the recommendations presented in this report.

We also recommend that construction monitoring and consultation be performed by our firm to confirm that conditions encountered are consistent with those indicated by our explorations, to provide recommendations should conditions be revealed during construction that differ from those anticipated, and to evaluate whether earthwork activities comply with contract plans and specifications. Such activities should include subgrade preparations for foundations and floor slabs, structural fill placement and compaction, foundation soil bearing, and other geotechnical related earthwork activities.

## CLOSURE

This report was prepared for the exclusive use of the Messenger House and its consultants for specific application to the proposed addition project. The data and report should be provided to prospective contractors for their information but the report, conclusions, and interpretations should not be construed as a warranty of subsurface conditions.

Within the limitations of scope, schedule, and budget this report was prepared in accordance with generally accepted geotechnical engineering practices in this area at the time the report was prepared. No other warranty either expressed or implied is made. The conclusions and recommendations are based on our understanding of the project as described in the report and on-site conditions as observed at the time of our explorations.

If project plans change from those described in this report we should be contacted and retained to review the changed conditions. Also, if there is a substantial lapse of time between submission of this report and the start of construction, or if conditions have changed due to natural causes or construction operations at the site, or if conditions appear different from those described in our report, we should be contacted and retained to review our report. The purpose of the review is to determine the applicability of the conclusions and recommendations considering the time lapse or changed conditions.

We appreciate the opportunity to be of service to you on this project. Please contact our office at your convenience should you have any questions or require additional services.

MYERS BIODYNAMICS, INC.

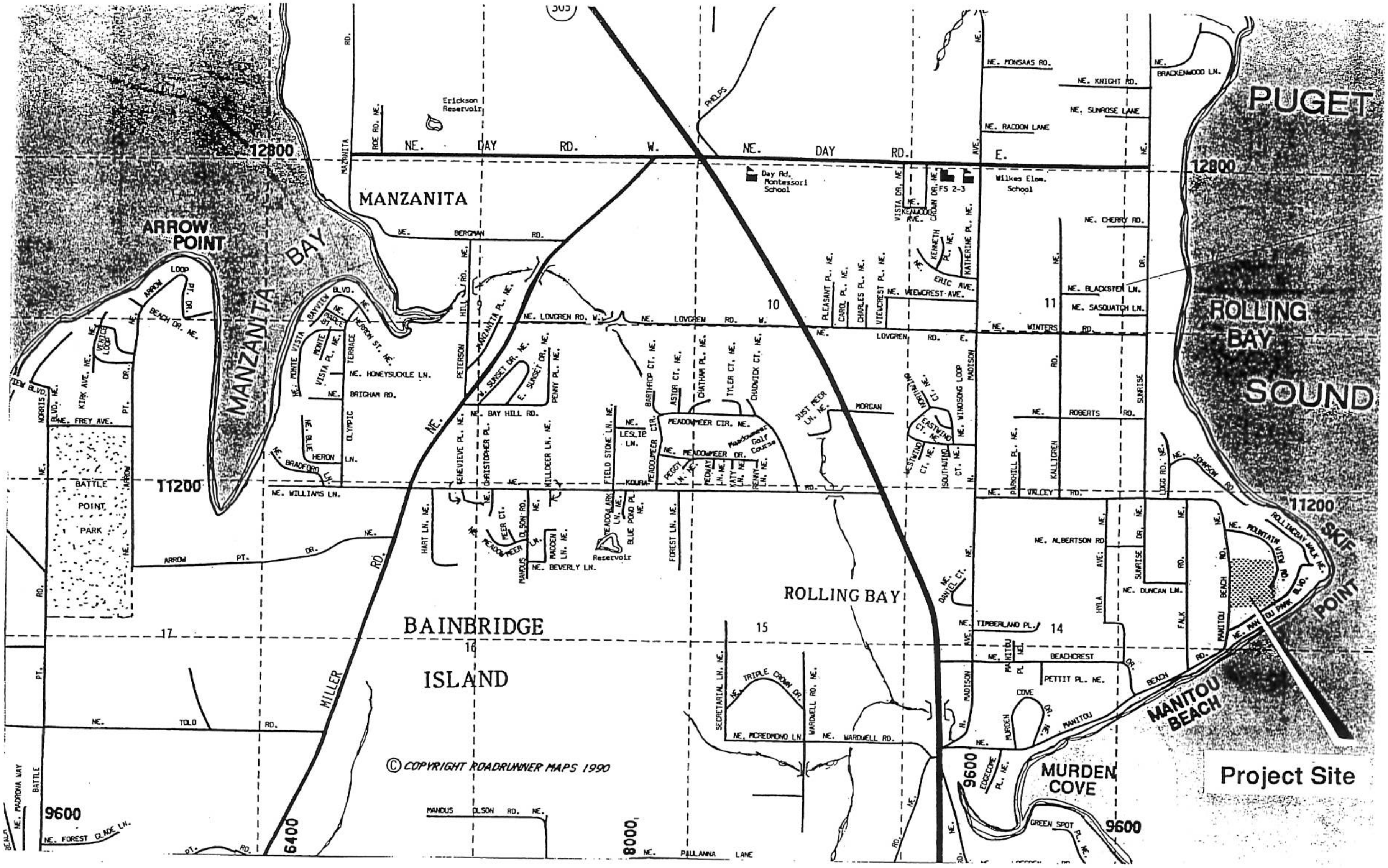
Jane N. Myers

Jane N. Myers, P.E.
Geotechnical Engineer

JNM/mmb

cc: Brian Fitzgerald/Architects Reed Reinvald

JANE N. MYERS
26144
EXPIRES July 9, 1995



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# Vicinity Map

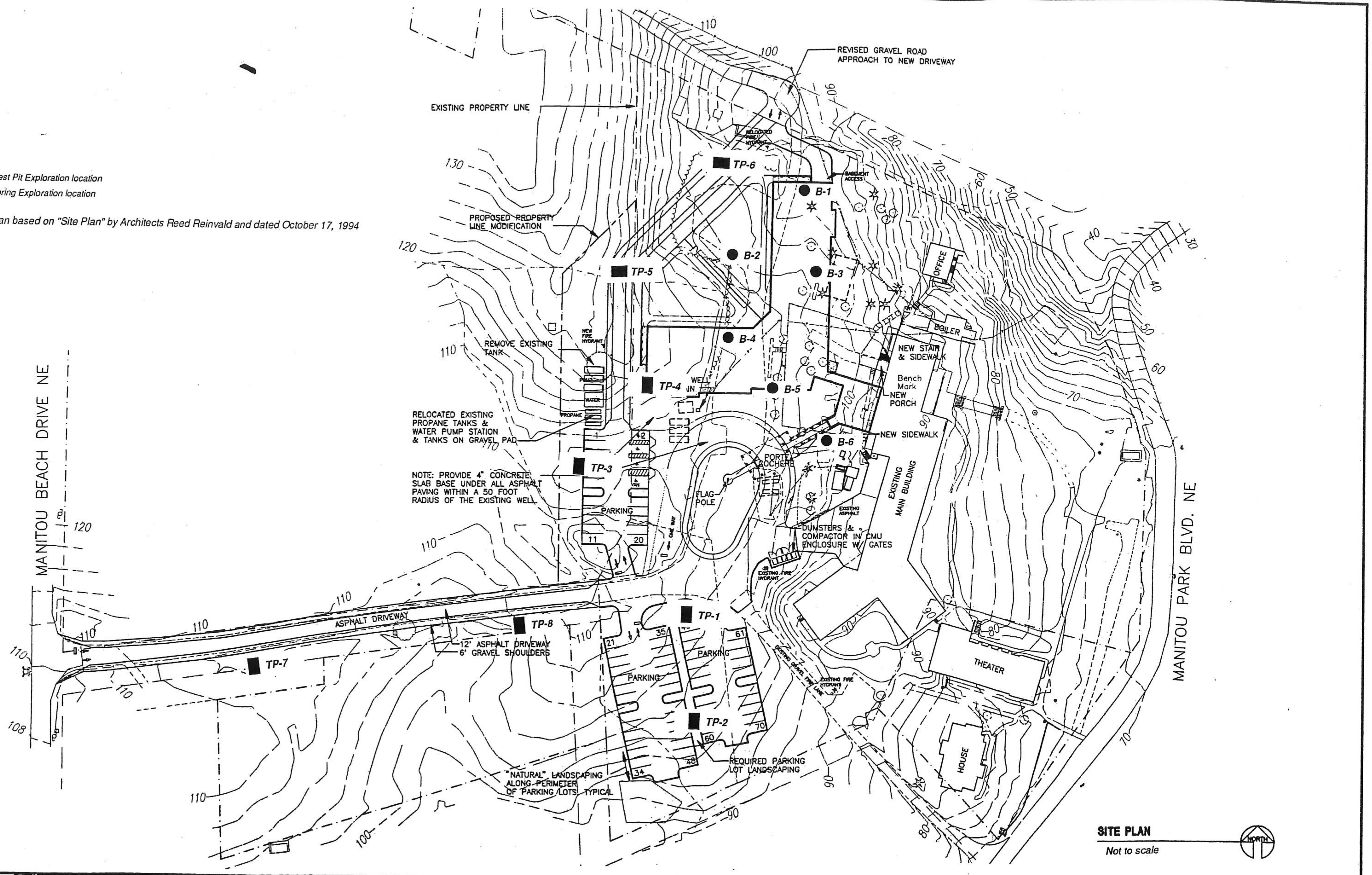
Messenger House Addition
Bainbridge Island, WA

| | |
|---|---|
| FIGURE NO 1 | REV |
| PROJECT NO 94478-5 | |
| DATE November '94 | |

**LEGEND:**

| | | |
|---|---|---|
| ■ | *TP-1* | *Test Pit Exploration location* |
| ● | *B-1* | *Boring Exploration location* |

*Note: Site plan based on "Site Plan" by Architects Reed Reinvald and dated October 17, 1994*



| | |
|---|---|
| NO. | 94478-5 |
| DATE | November '94 |
| SCALE | |
| DRAWN | |
| CHECKED | |

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engineers & scientists

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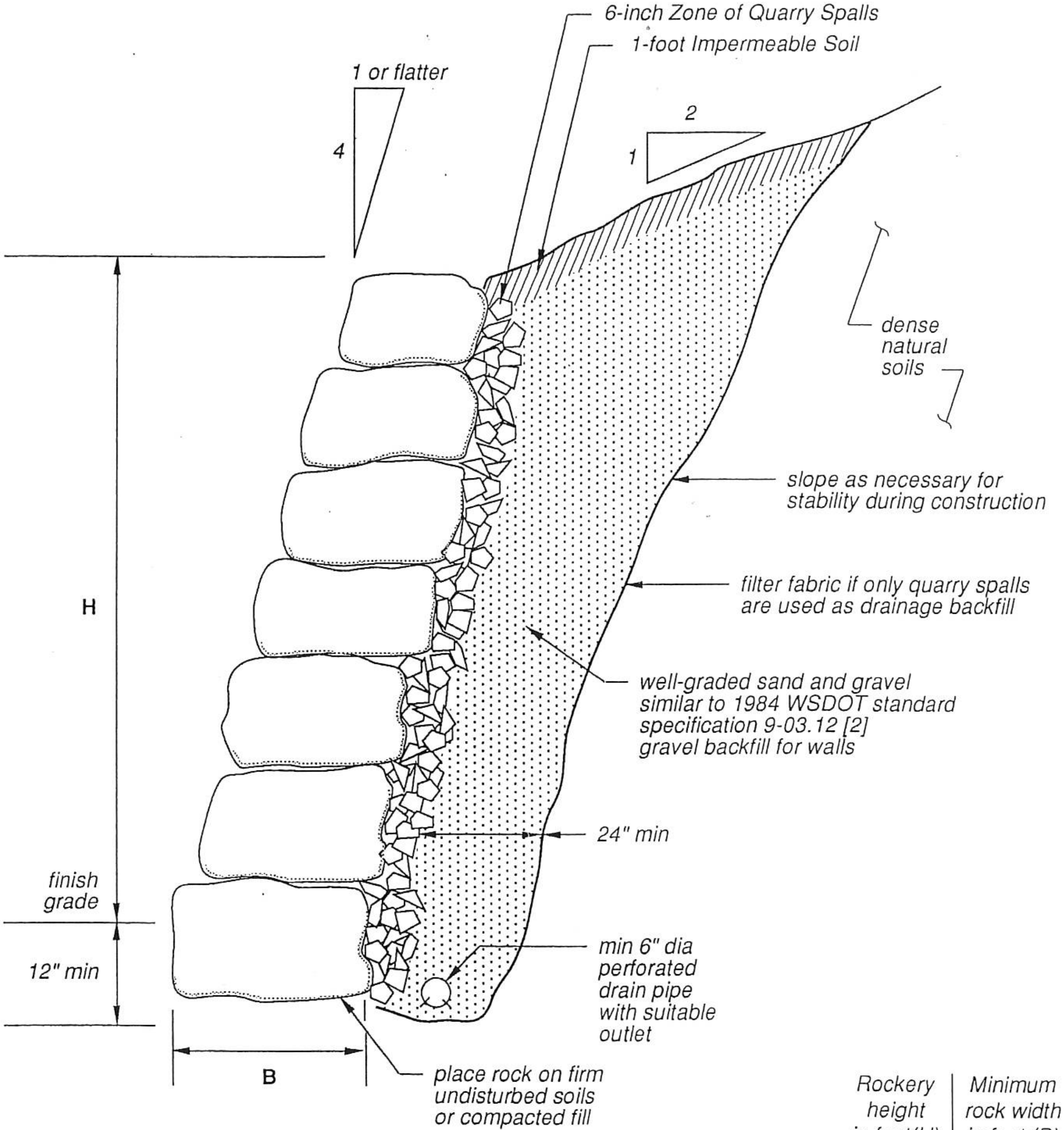
## Site and Exploration Plan
Messenger House Addition
Bainbridge Island, WA

FIGURE NO
2

# APPENDIX A



| Rockery height in feet(H) | Minimum rock width in feet (B) |
|---|---|
| <5 | 1½ |
| 5-7 | 2 |
| 7-10 | 3 |

Note: Refer to the text for discussion of rockery considerations

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Rockery Detail
Messenger House Addition

FIGURE NO 3
PROJECT NO 94478-5
DATE November '94

# APPENDIX A
# FIELD EXPLORATION PROGRAM

Subsurface conditions for the project site were explored by drilling six hollow stem auger borings and excavating eight test pits at the approximate locations shown on the Site and Exploration Plan, Figure 2. Logs of the borings, B-1 through B-6 are presented on Figure A-1 through A-6. The boring explorations were conducted on October 27, 1994. Borings were drilled to depths ranging from 17 to 22 feet below the existing ground surface at the time of the explorations. Logs of the test pits, TP-1 through TP-8 are presented on Figure A-7 through A-14. The test pits were excavated on November 2, 1994 to depths ranging from 5 to 13 foot depth. Subsurface conditions observed in the explorations were recorded on field exploration logs. Field logs were then modified if necessary after completion of the field work and laboratory testing. Selected samples for laboratory testing are also indicated on the logs.

The explorations were located in the field by taping or pacing relative to existing physical site features. The approximate ground surface elevation presented on the logs was interpolated from the site plan titled "Topography for Messenger House Care Center" by Adam & Goldworthy, Inc. dated January 15, 1994. The location and elevation of the explorations should be considered accurate to the degree implied by the method used.

A geotechnical engineer from Myers Biodynamics was present throughout the field work to observe the explorations, obtain soil samples, and to prepare field soil logs of the explorations. Soils were classified in general accordance with ASTM D-2488 "Standard Practice for Description and Identification of Soils" (Visual-Manual procedure). The logs attached as Figures A-1 through A-14 in this appendix represent our interpretations of the contents of the field logs and the results of selective soil laboratory testing.

## Borings

The borings were advanced with a truck-mounted Mobile B-59 hollow-stem auger drill rig under subcontract to our firm. Soil samples were collected through the hollow stem of the auger. Soil samples were collected using Standard Penetration Tests (SPT) methods at sample intervals of 2 1/2 to 5 feet.

Standard Penetration Tests (SPT) were taken with a split-spoon sampler driven into the soil a distance of 18 inches with a 140 pound hammer freely falling from a height of 30 inches. Blows for each 6 inches of penetration are shown on the boring logs. The number of blows required to drive the samples the last 12 inches is termed the Standard Penetration Test resistance. This resistance provides a qualitative measure of the relative density of cohesionless soils and consistency of cohesive soils. Representative portions of the split-spoon samples were placed in plastic jars, sealed, and transported to our office for further observation and selective laboratory testing.

## Test Pits

Test pit explorations were excavated with a LS 2650 excavator under subcontract to our firm. Representative soil samples were collected from the test pits, sealed in plastic jars, and transported to our office for further observation and selective laboratory analyses. The relative density of the soils, shown in parenthesis on the test pit logs, was estimated in the field at the time of the explorations.

# BORING LOG B-1

*This log applies only to boring location at the time of drilling. Subsurface conditions may differ at other locations and may also change over time. This log is a simplified interpretation of the actual conditions.*

## MESSENGER HOUSE ADDITION

| DEPTH, FT | ELEVATION | SAMPLES | BLOWS/6" | DESCRIPTION | OBSERVATION WELL | MOISTURE CONTENT % | OTHER TESTS |
|---|---|---|---|---|---|---|---|
| | | | | *Topsoil over* | | | |
| | | S-1 | 12<br>12<br>7 | *Silty SAND; medium dense, brown, slightly moist, trace to few gravel, trace organics (FILL)* | | 10 | |
| -5- | -000- | | | | | | |
| | | S-2 | 9<br>31<br>50/5" | *abundant fine gravel @ 8 foot depth* | | 5 | GS |
| | | | | *Fine SAND; very dense, light brown, slightly moist* | | | |
| -10- | -000- | | | *rough drilling (GLACIAL TILL ?)* | | | |
| | | S-3 | 50/3" | *No Recovery* | | | |
| -15- | -000- | | | *Sample of cuttings collected from 15 to 20 foot depth* | | 8 | GS |
| | | S-4 | 50/5" | *Silty SAND to Silty SAND with Gravel; very dense, light gray brown, moist, (GLACIAL TILL)* | | 10 | |
| -20- | -000- | | | | | | |
| | | | | *Refusal - large rock ?* | | | |
| | | | | *Bottom of Boring at 22 foot depth* | | | |

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DATE DRILLED October 27, 1994
ELEVATION (FT) 98±

FIGURE A-1 SH 1 OF 1
PROJECT NO 94478-5

# BORING LOG B-2

*This log applies only to boring location at the time of drilling. Subsurface conditions may differ at other locations and may also change over time. This log is a simplified interpretation of the actual conditions.*

## MESSENGER HOUSE ADDITION

| DEPTH, FT | ELEVATION | SAMPLES | BLOWS/6" | DESCRIPTION | OBSERVATION WELL | MOISTURE CONTENT % | OTHER TESTS |
|---|---|---|---|---|---|---|---|
| | | | | *gravel over* | | | |
| | | | | *2 to 3 foot diameter concrete rubble from 0 to 3 foot depth* | | | |
| | | | 6 | *Gravelly Silty SAND; medium dense, dark brown to brown, very moist,* | | 13 | GS |
| | | S-1 | 11 | *trace to few gravel, trace organics, (FILL)* | | | |
| | | | 14 | | | | |
| | | | | *Sand cuttings from 4 to 5 foot depth* | | | |
| -5- | -000- | | | | | | |
| | | | | *rough drilling, (GLACIAL TILL?)* | | | |
| | | | | *Silty SAND with gravel; light gray brown cuttings* | | | |
| | | S-2 | 50/4" | *no recovery* | | | |
| -10- | -000- | | | | | | |
| | | S-3 | 50/4" | *Silty SAND to Silty SAND with Gravel; very dense, light gray brown, moist* | | 9 | |
| | | | | *(GLACIAL TILL)* | | | |
| -15- | -000- | | | | | | |
| | | S-4 | 50/4" | | | 8 | |
| | | | | *Bottom of Boring at 17.3 foot depth* | | | |
| -20- | -000- | | | | | | |

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| | |
|---|---|
| DATE DRILLED | October 27, 1994 |
| ELEVATION (FT) | 106± |
| FIGURE | A-2 |
| SH | 1 |
| OF | 1 |
| PROJECT NO | 94478-5 |

# BORING LOG B-3

*This log applies only to boring location at the time of drilling. Subsurface conditions may differ at other locations and may also change over time. This log is a simplified interpretation of the actual conditions.*

## MESSENGER HOUSE ADDITION

| DEPTH, FT | ELEVATION | SAMPLES | BLOWS/6" | DESCRIPTION | OBSERVATION WELL | MOISTURE CONTENT % | OTHER TESTS |
|---|---|---|---|---|---|---|---|
| | | | | *Grass and Topsoil over* | | | |
| | | S-1 | 50/3" | *Silty SAND to Silty SAND with Gravel; very dense, light gray brown, slightly moist (GLACIAL TILL)* | | 6 | |
| -5- | -000- | | | *rough drilling* | | | |
| | | S-2 | 50/4" | | | 7 | |
| -10- | -000- | | | | | | |
| | | | | *Very rough drilling - cobble, boulder?* | | | |
| | | S-3 | 50/5" | | | 9 | |
| -15- | -000- | | | | | | |
| | | S-4 | 50/5" | *bottom of sample grades to Fine to Medium SAND; very dense, light gray brown, moist* | | 8 | |
| | | | | *Bottom of Boring at 17.9 foot depth* | | | |
| -20- | -000- | | | | | | |

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DATE DRILLED: October 27, 1994
ELEVATION (FT): 104±

FIGURE A-3 SH 1 OF 1
PROJECT NO 94478-5

# BORING LOG B-4

## MESSENGER HOUSE ADDITION

| DEPTH, FT | ELEVATION | SAMPLES | BLOWS/6" | DESCRIPTION | OBSERVATION WELL | MOISTURE CONTENT % | OTHER TESTS |
|---|---|---|---|---|---|---|---|
| | | | | *Gravel over*<br>*Cobble/Boulder/Concrete? at 1 1/2 to 2 foot depth* | | | |
| | | S-1 | 13<br>50/2" | *Silty SAND; medium dense, dark brown to brown, mottled, moist, trace organics, abundant roots at top of sample* | | 8 | |
| | | | | *Silty SAND to Silty SAND with Gravel; very dense, light gray brown, moist (GLACIAL TILL)* | | | |
| -5- | -000- | | | *rough drilling* | | | |
| | | S-2 | 50/1" | | | 7 | |
| -10- | -000- | | | | | | |
| | | S-3 | 50/4" | | | 8 | |
| -15- | -000- | | | | | | |
| | | S-4 | 50/5" | *as above with fine Sandy Silt laminations and grades to Fine to Medium SAND in bottom of sample* | | 9 | |
| | | | | *Bottom of Boring at 17.4 foot depth* | | | |
| -20- | -000- | | | | | | |

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DATE DRILLED October 27, 1994
ELEVATION (FT) 108±

FIGURE A-4 SH 1 OF 1
PROJECT NO 94478-5

# BORING LOG B-5

This log applies only to boring location at the time of drilling. Subsurface conditions may differ at other locations and may also change over time. This log is a simplified interpretation of the actual conditions.

## MESSENGER HOUSE ADDITION

| DEPTH, FT | ELEVATION | SAMPLES | BLOWS/6" | DESCRIPTION | OBSERVATION WELL | MOISTURE CONTENT % | OTHER TESTS |
|---|---|---|---|---|---|---|---|
| | | | | *Grass and topsoil over* | | | |
| | | S-1 | 8<br>50/6" | *Silty SAND; medium dense, red brown to brown mottled, moist, trace gravel, trace organics, abundant fine roots 2 to 2.5 foot depth* | | 12 | GS |
| -5- | -000- | | | *Fine to Medium Sand in cuttings from 3 to 7 foot depth* | | | |
| | | S-2 | 19<br>50/5" | *Silty SAND to Silty SAND with Gravel; very dense, light gray brown, moist (GLACIAL TILL)* | | 9 | GS |
| -10- | -000- | | | | | | |
| | | S-3a | 45 | *grades to*<br>*SAND with Silt* | | 5 | |
| | | S-3b | 50/5" | *Sandy SILT; hard, light gray, brown, moist, trace to few coarse sand and gravel* | | 14 | |
| -15- | -000- | | | | | | |
| | | S-4 | 28<br>50/5" | *grades to*<br>*Fine SAND; very dense, light green-gray brown, moist to slightly moist, trace medium to coarse sand and fine gravel, trace silt laminations* | | 7 | |
| | | | | *Bottom of Boring at 17.9 foot depth* | | | |
| -20- | -000- | | | | | | |

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| | |
|---|---|
| DATE DRILLED | October 27, 1994 |
| ELEVATION (FT) | 106± |
| FIGURE | A-5 |
| SH | 1 OF 1 |
| PROJECT NO | 94478-5 |

# BORING LOG B-6

*This log applies only to boring location at the time of drilling. Subsurface conditions may differ at other locations and may also change over time. This log is a simplified interpretation of the actual conditions.*

## MESSENGER HOUSE ADDITION

| DEPTH, FT | ELEVATION | SAMPLES | BLOWS/6" | DESCRIPTION | OBSERVATION WELL | MOISTURE CONTENT % | OTHER TESTS |
|---|---|---|---|---|---|---|---|
| | | | | *Gravel over* | | | |
| | | S-1 | 50/6" | *Silty SAND to Silty SAND with Gravel; very dense, light gray brown, moist, trace organics at top of sample (GLACIAL TILL)* | | 8 | |
| | | | | *sample of cuttings collected from 3 to 5 foot depth* | | 8 | |
| -5- | -000- | | | | | | |
| | | S-2 | 50/5" | | | 6 | |
| | | | | *rough drilling* | | | |
| -10- | -000- | | | | | | |
| | | S-3 | 50/3" | *grades to*<br>*SAND with Silt and Gravel; very dense, light gray brown, moist* | | 7 | |
| -15- | -000- | | | | | | |
| | | S-4 | 50/4" | | | 8 | |
| | | | | *Bottom of Boring at 17.3 foot depth* | | | |
| -20- | -000- | | | | | | |

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DATE DRILLED October 27, 1994
ELEVATION (FT) 102±

FIGURE A-6 SH 1 OF 1
PROJECT NO 94478-5

# TEST PIT LOG TP-1

## MESSENGER HOUSE ADDITION

**TEST PIT LOCATION: See Figure 2** SURFACE CONDITIONS: Blackberries

| DEPTH, FT | SAMPLES | DESCRIPTION | COMMENTS |
|---|---|---|---|
| | S-1 | *7 inches Topsoil - abundant roots* | *Lab Test: MC = 28%* |
| 1 | | | |
| | S-2 | *Silty SAND; (medium dense), red brown, mottled, moist to very moist, trace to few gravel, trace fine roots to 3 foot depth* | *Lab Test: MC = 11%* |
| 2 | | | *large Madrona root @ 3' depth* |
| 3 | | | |
| | S-3 | *Silty SAND to Silty SAND with Gravel; (very dense), light gray, moist, trace cobbles (GLACIAL TILL)* | *Lab Test: MC = 7%*<br>*Hard digging* |
| 4 | | | |
| 5 | | | |
| 6 | | *Bottom of test pit at 5 1/2 foot depth.*<br>*Completed and backfilled on November 2, 1994* | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

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DATE Nov. 2, 1994
ELEVATION (FT) approx. 106 ft.

FIGURE A-7
PROJECT NO 94478-5

# TEST PIT LOG TP-2

## MESSENGER HOUSE ADDITION

**TEST PIT LOCATION:** See Figure 2

**SURFACE CONDITIONS:** Douglas fir, ferns, ivy

| DEPTH, FT | SAMPLES | DESCRIPTION | COMMENTS |
|---|---|---|---|
| | | *3 - 4 inches Forest Duff* | |
| 1 | S-1 | *Silty SAND; (loose tro medium dense), red brown to light brown, moist, trace to few gravel, abundant roots to 3 foot depth* | |
| 2 | | | *Lab Test: MC = 12%* |
| 3 | | | *mottling on top of Glacial Till* |
| 4 | S-2 | *Silty SAND to Silty SAND with Gravel; (very dense), light gray, moist, trace cobbles (GLACIAL TILL)* | *Lab Test: MC = 8%*<br>*Hard digging* |
| 5 | | *Bottom of test pit at 5 foot depth.*<br>*Completed and backfilled on November 2, 1994* | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

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| | |
|---|---|
| DATE Nov. 2, 1994 | FIGURE A-8 |
| ELEVATION (FT) approx. 98 ft. | PROJECT NO 94478-5 |

# TEST PIT LOG TP-3

This log applies only to test pit location at the time of excavation. Subsurface conditions may differ at other locations and may also change over time. This log is a simplified interpretation of the actual conditions.

## MESSENGER HOUSE ADDITION

**TEST PIT LOCATION: See Figure 2** SURFACE CONDITIONS: Alder/construction debris

| DEPTH, FT | SAMPLES | DESCRIPTION | COMMENTS |
|---|---|---|---|
| | | *2 - 3 inches Forest Duff* | *abundant surface debris - wood, glass, ash/burnt debris* |
| 1 | S-1 | *Silty SAND; (loose); black to gray, moist, ashes and roots to 2 foot depth* | *Lab Test: MC = 34%* |
| 2 | | | |
| 3 | S-2 | *Silty Fine SAND; (dense to very dense), light gray brown, slightly moist, clean fine to medium sand seams with rust staining* | *Lab Test: MC = 11%* |
| 4 | | | |
| 5 | | *Silty SAND to Silty SAND with Gravel; (very dense), light gray brown, moist, trace cobbles (GLACIAL TILL)* | *mottling on top of Glacial Till*<br>*hard digging* |
| 6 | | | |
| 7 | | *Bottom of test pit at 6 foot depth.*<br>*Completed and backfilled on November 2, 1994* | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

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Bainbridge Island WA 98110
FAX: (206) 842-3797

DATE Nov. 2, 1994
ELEVATION (FT) approx. 108 ft.

FIGURE A-9
PROJECT NO 94478-5

# TEST PIT LOG TP-4

*This log applies only to test pit location at the time of excavation. Subsurface conditions may differ at other locations and may also change over time. This log is a simplified interpretation of the actual conditions.*

## MESSENGER HOUSE ADDITION

**TEST PIT LOCATION: See Figure 2**

**SURFACE CONDITIONS: Douglas fir, ferns, salal**

| DEPTH, FT | SAMPLES | DESCRIPTION | COMMENTS |
|---|---|---|---|
| | | *2 - 3 inches Forest Duff* | *abundant fine to 1 1/2" diameter roots to 2 foot depth*<br>*trace fine roots to 3 foot depth* |
| 1 | | *Silty SAND with Gravel; (loose to medium dense), red brown, moist* | |
| 2 | | | |
| | S-1 | | *Lab Test: MC = 11%, GS*<br>*mottled on top of till* |
| 3 | S-2 | *Silty SAND with Gravel; (very dense), light gray to light gray brown, slightly moist, trace cobbles (GLACIAL TILL)* | *Lab Test: MC = 4%* |
| 4 | | | |
| 5 | | | *hard digging* |
| 6 | | | |
| 7 | S-3 | | *Lab Test: MC = 6%, GS* |
| 8 | | | |
| 9 | | | |
| 10 | | *Bottom of test pit at 10 foot depth.*<br>*Completed and backfilled on November 2, 1994* | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

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DATE Nov. 2, 1994
ELEVATION (FT) approx. 113 ft.

FIGURE A-10
PROJECT NO 94478-5

# TEST PIT LOG TP-5

*This log applies only to test pit location at the time of excavation. Subsurface conditions may differ at other locations and may also change over time. This log is a simplified interpretation of the actual conditions.*

## MESSENGER HOUSE ADDITION

**TEST PIT LOCATION: See Figure 2**

SURFACE CONDITIONS: brush, alder

| DEPTH, FT | SAMPLES | DESCRIPTION | COMMENTS |
|---|---|---|---|
| | | *3 - 4 inches Forest Duff* | *abundant roots from 0 to 1 foot depth* |
| 1 | | | *roots less than 1 inch in diameter to 3 foot depth* |
| | S-1 | *Silty SAND; (loose to medium dense), red brown, moist to very moist, trace to few gravel* | |
| 2 | | | *Lab Test: MC = 13%* |
| 3 | | | |
| | S-2 | | *Lab Test: MC = 7%, GS* |
| 4 | | | |
| | | *Silty SAND to Silty SAND with Gravel; (very dense), light gray brown, moist, trace cobbles and boulders, occasional clean sand seams (GLACIAL TILL)* | |
| 5 | | | *very hard digging* |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| | | *Bottom of test pit at 12 foot depth.*<br>*Completed and backfilled on November 2, 1994* | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

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DATE Nov. 2, 1994
ELEVATION (FT) approx. 120 ft.

FIGURE A-11
PROJECT NO 94478-5

# TEST PIT LOG TP-6

*This log applies only to test pit location at the time of excavation. Subsurface conditions may differ at other locations and may also change over time. This log is a simplified interpretation of the actual conditions.*

## MESSENGER HOUSE ADDITION

**TEST PIT LOCATION:** See Figure 2

**SURFACE CONDITIONS:** Parking lot - grass/crushed rock

| DEPTH, FT | SAMPLES | DESCRIPTION | COMMENTS |
|---|---|---|---|
| | | *Crushed Rock Surfacing* | |
| 1 | | | *trace debris - wood, brick, concrete* |
| 2 | S-1 | *FILL: Silty SAND; (loose to medium dense), dark gray brown, very moist to wet, trace to few gravel, trace debris, cobbles, and boulders* | *Lab Test: MC = 14%* |
| 3 | | | |
| 4 | | | |
| 5 | | | *Lab Test: MC = 10%* |
| 6 | S-2 | *FILL: Silty SAND; (medium dense), red brown, moist, trace to few gravel, abundant debris* | *abundant debris - concrete pieces, fencing, metal (chain link fencing?)* |
| 7 | | *Fine to Medium SAND; (medium dense), light yellow brown, moist* | |
| 8 | | | *fine roots from 7 to 10 foot depth* |
| 9 | | | |
| 10 | S-3 | *grades to Fine to Medium SAND; (medium dense), light yellow brown to red brown, moist, trace to few gravel* | *Lab Test: MC = 6%* |
| 11 | | | |
| 12 | | | |
| 13 | | *Silty SAND with Gravel; (very dense), light gray brown, moist (GLACIAL TILL)* | |
| 14 | | *Bottom of test pit at 13 foot depth.*<br>*Completed and backfilled on November 2, 1994* | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

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| | |
|---|---|
| DATE | Nov. 2, 1994 |
| ELEVATION (FT) | approx. 104 ft. |
| FIGURE | A-12 |
| PROJECT NO | 94478-5 |

# TEST PIT LOG TP-7

*This log applies only to test pit location at the time of excavation. Subsurface conditions may differ at other locations and may also change over time. This log is a simplified interpretation of the actual conditions.*

## MESSENGER HOUSE ADDITION

**TEST PIT LOCATION: See Figure 2**

SURFACE CONDITIONS: blackberries

| DEPTH, FT | SAMPLES | DESCRIPTION | COMMENTS |
|---|---|---|---|
| 1 | S-1 | *2 - 3 inches Forest Duff*<br>*SILT; (medium stiff); black to dark brown, very moist, few to little organics and roots* | *Lab Test: MC = 57%*<br>*PP = 1.0 - 1.5 TSF*<br>*TV = 0.5 TSF* |
| 2<br>3 | S-2 | *Sandy Silty Clay; (soft); light brown and gray mottled, very moist* | *Lab Test: MC = 27%, AL*<br>*PP = 0.5 TSF*<br>*TV = 0.2 TSF* |
| 4<br>5 | S-3 | *Clayey Silty SAND; (medium dense) brown and light gray mottled, very moist*<br>*grades to interbedded clay and sand* | *Lab Test: MC = 18%* |
| 6 | | *Silty SAND with Gravel; (very dense), light gray brown, moist (GLACIAL TILL)* | |
| 7<br>8<br>9<br>10<br>11<br>12<br>13<br>14<br>15<br>16<br>17<br>18 | | *Bottom of test pit at 6 foot depth.*<br>*Completed and backfilled on November 2, 1994* | |

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DATE Nov. 2, 1994
ELEVATION (FT) approx. 109 ft.

FIGURE A-13
PROJECT NO 94478-5

# TEST PIT LOG TP-8

## MESSENGER HOUSE ADDITION

**TEST PIT LOCATION:** See Figure 2

SURFACE CONDITIONS: Road embankment/grasses

| DEPTH, FT | SAMPLES | DESCRIPTION | COMMENTS |
|---|---|---|---|
| | | *Trace Forest Duff* | |
| 1 | | *FILL: Concrete Rubble and Silty SAND with Gravel; (loose), dark brown, very moist, few to little wood and metal debris* | |
| 2 | | | |
| 3 | | | |
| 4 | | | *abundant roots at four foot depth* |
| 5 | | *Fine to Medium SAND; (medium dense), light yellow brown, slightly moist, trace to few gravel* | |
| 6 | S-1 | | *Lab Test: MC = 7%* |
| 7 | | *Bottom of test pit at 7 foot depth.*<br>*Completed and backfilled on November 2, 1994* | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |

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DATE Nov. 2, 1994
ELEVATION (FT) approx. 108 ft.

FIGURE A-14
PROJECT NO 94478-5

# APPENDIX B

# APPENDIX B
# LABORATORY TESTING

A laboratory testing program was performed to evaluate the index properties of the site soils and provide a correlation with geotechnical engineering parameters. Laboratory tests were performed on disturbed soil samples collected from the boring and test pit explorations. The laboratory testing performed and procedures followed are presented below. All testing was performed by Soil Technology of Bainbridge Island, Washington. Tests were conducted in general accordance with the American Society of Testing and Materials (ASTM) standard test procedures.

## SOIL CLASSIFICATION

Soil samples were collected during the exploration program and were visually classified in the field. Field visual classification methods of soils were conducted in general accordance with ASTM D-2488 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)". Field log soil classifications were updated as necessary based on the results of the laboratory testing.

## MOISTURE CONTENT (MC)

Moisture content determinations were performed on site soil samples in general accordance with ASTM D-2216. The results of these tests are presented on the exploration logs.

## GRAIN SIZE ANALYSIS (GS)

The laboratory testing program consisted of grain size analyses of selected site soil samples to determine grain size distribution. Grain size analyses were conducted in general accordance with ASTM D422. Samples selected for testing are indicated on the exploration logs. The wet sieve analyses was used for the grain size analyses which determines the particles greater than the U.S. No. 200 mesh sieve. The results of the grain size analyses are shown in this appendix on Figures B1 and B2.

Boring B-2 sample S-1 and boring B-5 sample S-1 were subjected to a modified analyses known as a Wash -200. The sample is washed through the No. 200 mesh sieve to determine the relative percentage of coarse and fine-grained material in the samples. The wash -200 test was performed in general accordance with ASTM D1140. The results of the wash-200 tests are presented in Table B1.

**TABLE B1**
**Messenger House Addition**
**Wash -200 Results**

| Exploration | Sample | Depth | % finer than No. 200 Sieve |
|---|---|---|---|
| B-2 | S-1 | 2.0 - 3.5 | 30 |
| B-5 | S-1 | 2.0 - 3.0 | 32 |

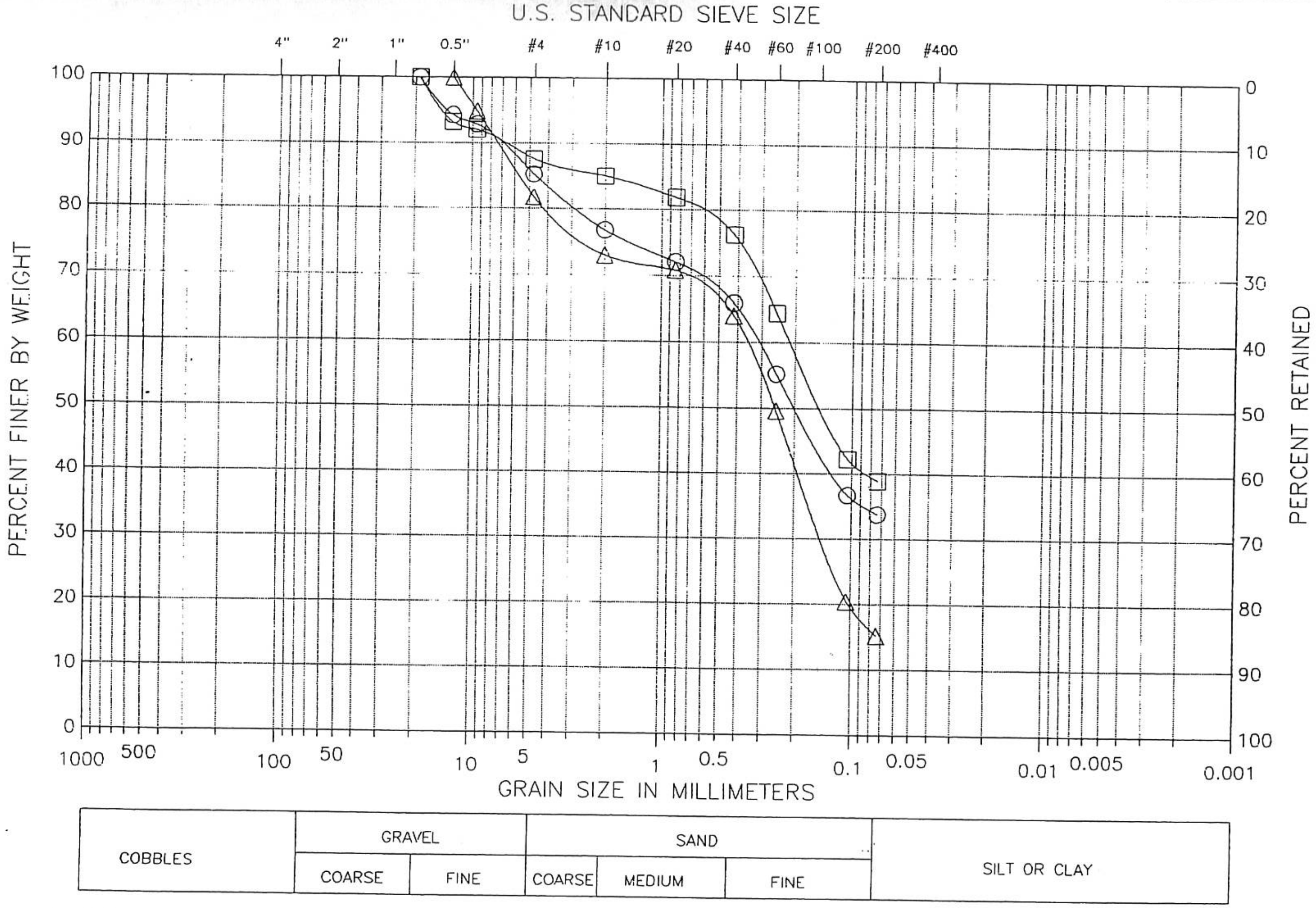
## ATTERBERG LIMITS(AL)

Liquid and plastic Atterberg limits were determined for fine grained, cohesive soils represented by test pit sample TP-7 sample S-2. The tests were performed in accordance with ASTM D4318 to aid in classification and correlation with engineering parameters of the soils. The results of the Atterberg limits tests are shown on Figure B3.

**Soil Technology, Inc.**

**Grain Size Analysis**

Project : MYERS BIODYNAMICS-MESSENGER HOUSE PR.# 94478-5
Project No.: j-649
Location: Messenger House
Date : Tue Nov 01 1994



| Symbol | Boring No. | Sample No. | Depth | Filename | Classification / Description | |
|---|---|---|---|---|---|---|
| ⦶ | B-1 | CUT | 15.0-20.0 | B_1CTTG | SM | Silty sand |
| △ | B-1 | S-2 | 7.0-8.4 | B_1S_2 | SM | Silty sand with gravel |
| ⊟ | B-5 | S-2 | 7.0-8.0 | B_5S_2 | SM | Silty sand |

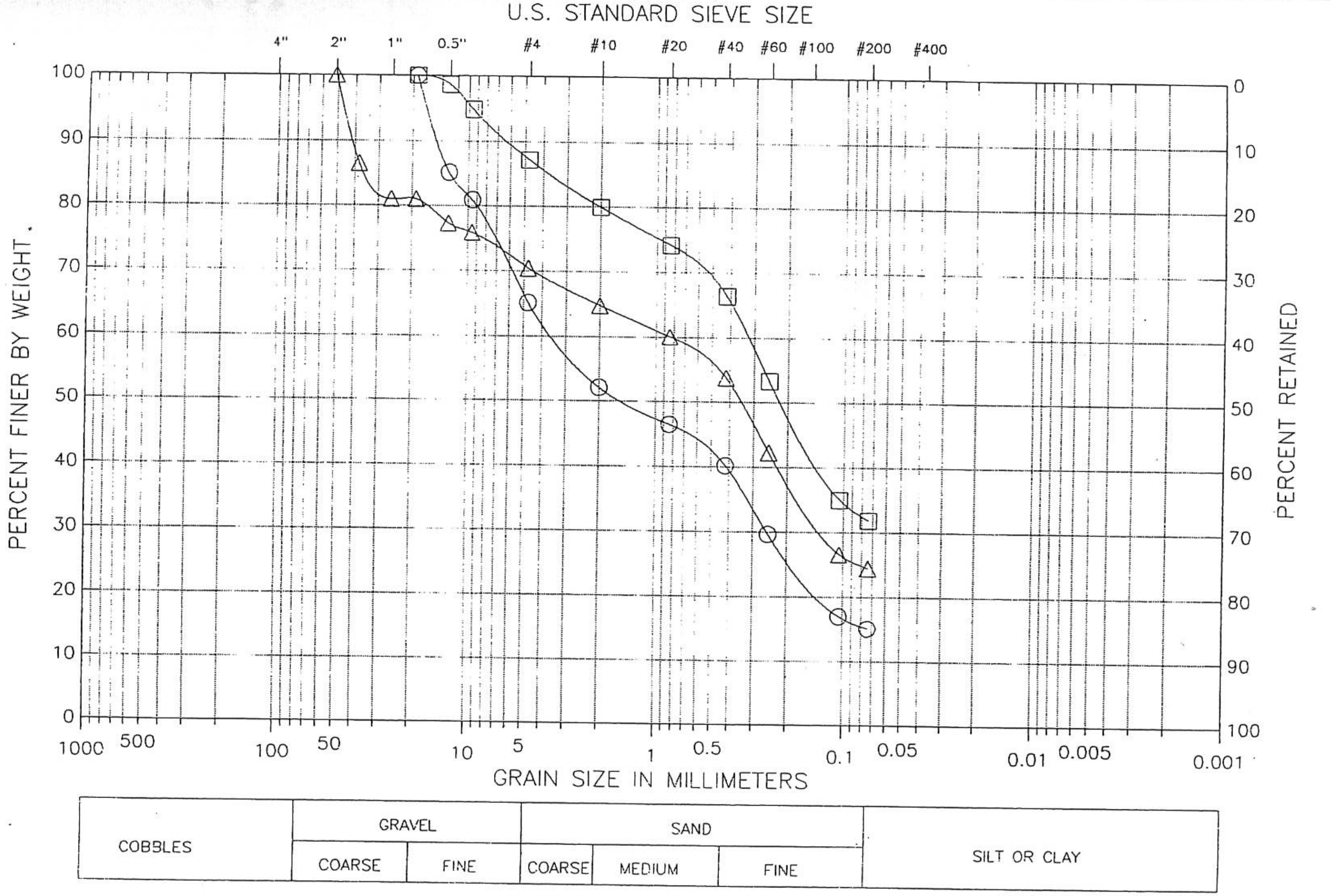
*All classification based on grain size only, no atterberg was peformed.

Figure B-1

**Soil Technology, Inc.**

**Grain Size Analysis**

Project : MYERS BIODYNAMICS–MESSENGER HOUSE PR.# 94478–5
Project No.: J–6493
Location: MESSENGER HOUSE
Date : Sun Nov 13 1994



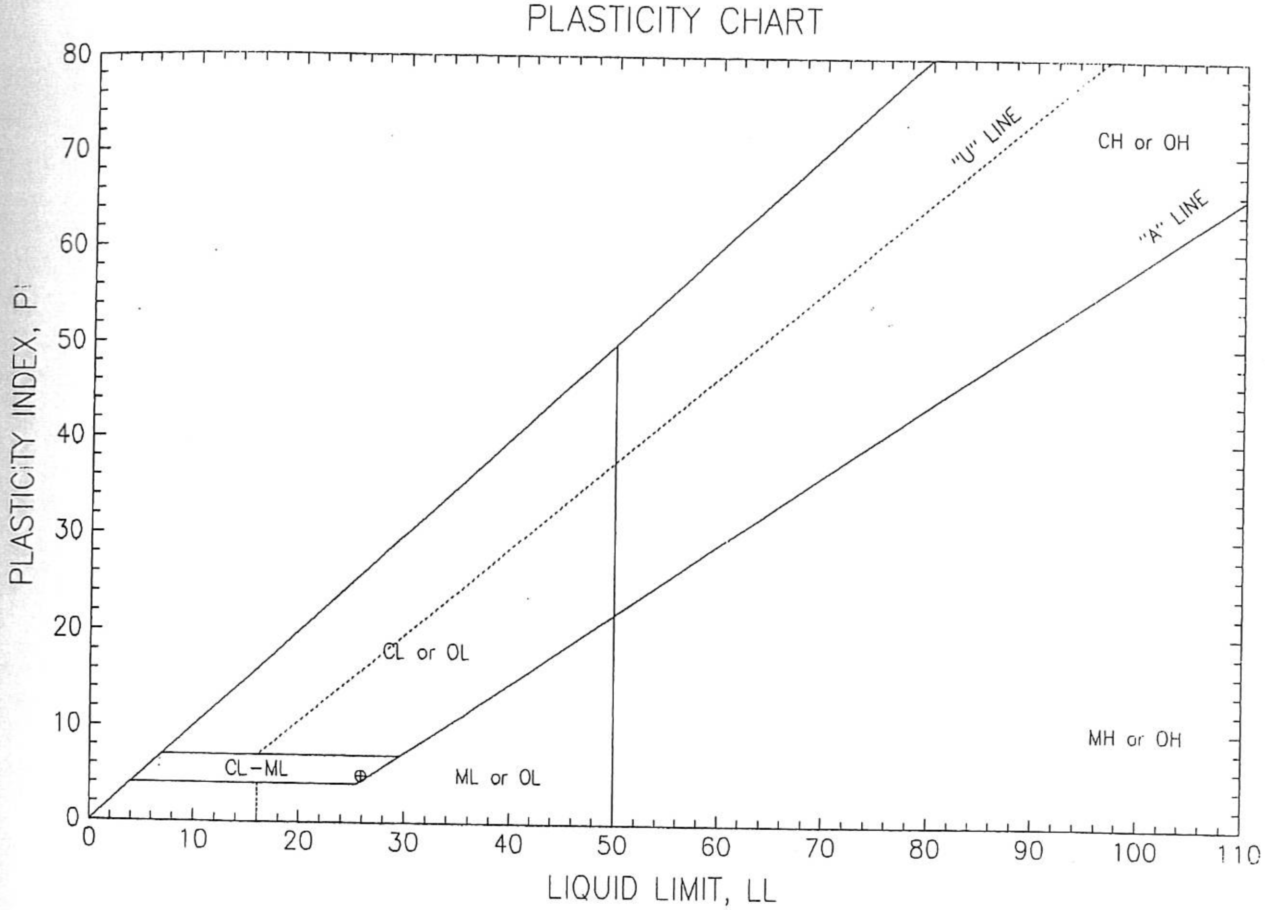
| Symbol | Boring No. | Sample No. | Depth | Filename | Classification / Description | |
|---|---|---|---|---|---|---|
| ⊖ | TP–4 | S–1 | 2.0–3.0 | TP_4S_1 | SM | Silty sand with gravel |
| △ | TP–4 | S–3 | 6.0–8.0 | TP_4S_3 | SM | Silty sand with gravel |
| ⊟ | TP–5 | S–2 | 3.0–4.0 | TP_5S_2 | SM | Silty sand |

*All classification based on grain size only, no atterberg was peformed.

Figure B-2

**Soil Technology, Inc.**

Project : MYERS BIODYNAMICS-MESSENGER HOUSE PR.# 94478-5
Project No. : J-649B
Location : MESSENGER HOUSE
Date : Tue Nov 08 1994



| Symbol | Sample Number | Water Content | Liquid Limit | Plastic Limit | Plasticity Index | Soil Classification<br>* Based on visual observation and plasticity |
|---|---|---|---|---|---|---|
| ○ | TP-7 S-2 | 27 | 26 | 21 | 5 | (CL-ML) Sandy silty clay |

Figure B-3

# APPENDIX D

# Report Limitations and Guidelines for Use

# REPORT LIMITATIONS AND GUIDELINES FOR USE

## This Report and Project-Specific Factors

Aspect Consulting, LLC (Aspect) considered a number of unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you
- Not prepared for the specific purpose identified in the Agreement
- Not prepared for the specific real property assessed
- Completed before important changes occurred concerning the subject property, project or governmental regulatory actions

## Geoscience Interpretations

The geoscience practices (geotechnical engineering, geology, and environmental science) require interpretation of spatial information that can make them less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Use Guidelines" apply to your project or site, you should contact Aspect.

## Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual limitations. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with our Agreement with the Client and recognized geoscience practices in the same locality and involving similar conditions at the time this report was prepared.

## Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as a change in property use or occupancy, or by natural events, such as floods, earthquakes, slope instability, or groundwater fluctuations. If any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

## Discipline-Specific Reports Are Not Interchangeable

The equipment, techniques, and personnel used to perform a geotechnical or geologic study differ significantly from those used to perform an environmental study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions, or recommendations (e.g., about the likelihood of encountering underground storage tanks or regulated contaminants). Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

We appreciate the opportunity to perform these services. If you have any questions please contact the Aspect Project Manager for this project.