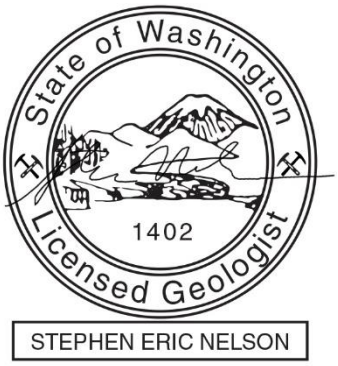
# TECHNICAL MEMORANDUM

| | |
|---|---|
| **Client:** | City of Mercer Island |
| **Project:** | Sewer Pump Station No. 20 Replacement |
| **Project File:** | M-I 0240089.00.0002 |
| **Project Manager:** | Kenny Gomez, P.E. |
| **Composed by:** | Steve Nelson, LG, LEG, LHG |
| **Reviewed by:** | Edwin Halim, P.E. |
| **Subject:** | Engineering Geology Investigation |
| **Date:** | January 31, 2025 |




Signed: 01/31/2025

## Introduction

The City of Mercer Island's (City) Pump Station (PS) No. 20 is located at 8790 85th Avenue SE near the southern tip of the island and along the Lake Washington shoreline. PS 20 was constructed nearly 60 years ago, and the pumps were replaced approximately 30 years ago. The existing pumps clog multiple times a year, pump at less than their design capacity (based on testing), and need replacement. After performing alternative analysis, it was decided to construct a new lift station adjacent to the existing station to minimize the construction risks due to the need for continuous temporary pumping if the pump station is rehabilitated.

The City intends to construct several improvements that will extend the facility footprint north of the existing north wall to construct a new wet well that will require excavation, shoring, and groundwater control to support the construction.

This technical memorandum summarizes the findings of a limited subsurface investigation to observe, characterize, and document earth and groundwater conditions of the proposed PS No. 20 improvements and associated subsurface piping, identify potential geologic hazards, and provide recommendations for design and construction of the proposed improvements.

This technical memorandum was prepared in accordance with the Washington State Department of Licensing's *Guidelines for Preparing Engineering Geology Reports in Washington* (2006) and Chapter 18.220 Revised Code of Washington (RCW).

This technical memorandum was prepared for the sole use of the City for the purpose of identifying and describing probable geologic, groundwater, and geotechnical conditions at the proposed site in support of design of the PS No. 20 improvements. No other uses are implied or authorized. The findings of this technical memorandum are limited to the available site investigation information collected at the time and locations of the investigation as described in this technical memorandum and may not represent specific conditions at areas not investigated at the site.

This technical memorandum is prepared to provide the RH2 Engineering, Inc., (RH2) design team with specific site information as a basis to support design and construction. In addition, this technical memorandum provides contractors with baseline geologic, groundwater, and geotechnical site-specific information as a common basis to interpret existing site conditions, prepare bids, and complete the project with appropriate means and methods of construction. This technical memorandum also may provide a basis to evalute claims of potential differing site conditions. Site-specific geologic or groundwater conditions may outlie those described in this technical memorandum, which could affect means and methods, schedule, and/or materials to complete the work, possibly warranting additional City compensation.

# Limitations

This technical memorandum summarizes available and relevant geologic information for the site conditions that are expected to be encountered during construction and may affect the contractor's rate of progress, tooling selection, tool wear, and/or approach to bidding the project. This technical memorandum provides a contractual basis for allocation of geotechnical risk during performance of the work and does not define a single correct interpretation of the site's geotechnical conditions. The following information represents the site conditions that bidders and the selected contractor should assume for estimating costs and selecting the approach, and for which the contractor is responsible during construction.

# Site Setting

Pump Station No. 20 (Site) is on the south end of Mercer Island in City right-of-way at the south end of 85th Avenue SE. The Site is bordered on the south by Lake Washington (Lake) and on the east and west by residences. The Site is in the SW ¼ SW ¼ of Section 31, Township 24 N, Range 05 E, centered at latitude 47.524655 degrees north and longitude 122.226128 degrees west at approximately 25 feet in elevation above mean sea level (AMSL). The Site is approximately 4 miles south of the center of the downtown area of the City. The general layout of the property is shown in the attached **Figure 1**.

The Site is developed and covered by pavement or landscaping in addition to the existing PS, which is covered by a flat concrete vault lid. The surrounding area is used for a single-family residence. The Site has been modified by cut and fill to construct 85th Avenue and foundations for the nearby residences. The existing PS was constructed by cutting a flat surface below the Lake level to construct the concrete vault enclosing the PS. The site topography and LIDAR imagery indicate that portions of the Site are underlain by fill soil.

# Proposed Site Design

Construction of the replacement PS will require excavating into native soil to create a level surface to construct a cast-in-place concrete wet-well and dry well structure founded on a layer of crushed rock and structurally tied to the existing PS. The excavation for the new PS will be 20 to 25 feet below ground surface (bgs).

The new PS excavation will be backfilled with controlled density fill (CDF) to fill the void space between the excavation and the concrete structure.

Trenches and shallow pits excavated to install the supporting sewer piping and vaults will be backfilled with structural fill.

Stormwater generated on the Site will be managed through shallow catch basins connected to the existing piping system and directed away from the Site for off-site discharge.

# Regional and Local Geology

Regional and local geologic information for the Site includes publicly available soil mapping by the Natural Resources Conservation Service, geologic, geological hazard, and LiDAR mapping by the Washington State Department of Natural Resources (DNR), groundwater and soil boring data managed by the Washington State Department of Ecology (Ecology), and geotechnical reports for nearby residences on file with the City Building Department. These sources of Site-related information are included in the **References** section.

RH2 reviewed driller's logs for borings and wells completed within ½ mile of the Site (Ecology well log website). RH2 also reviewed the DNR subsurface boring database and City Building Department records, which included several geotechnical reports prepared for development of residences near the Site. RH2 reviewed as-built drawings of the existing pump station that included a boring log for a soil boring completed south of PS No. 20 (**Figure 1**).

Review of existing geologic information indicates that the Site and surrounding area are underlain by a surficial layer of fill, and lakeshore loose weathered soil (colluvium), and weathered glacial deposits underlain by a pre-glacial, over-consolidated, very stiff silty clay. Boring logs indicate that local groundwater occurs in perched layers above the Lake level and within geologic units deeper than the Lake elevation.

# Site Investigation

On September 27, 2024, RH2 observed the excavation of a soil boring to a depth of 37 feet bgs. RH2 subcontracted with Holt Services to provide a tracked hollow-stem auger drilling rig to complete the boring. RH2 observed representative soil samples retrieved from the boring to identify stratigraphy, composition, texture, structure, and cohesion of fill and native earth materials encountered in the boring. Samples were collected using 2-inch diameter split spoons driven with a 140-pound auto hammer and steel rods per Standard Penetration Test methods.

No groundwater was encountered in the boring below a perched sandy layer at a depth of 6 feet bgs. The boring was backfilled with hydrated bentonite chips and excavated soil. The soil boring location is shown on the attached **Figure 1**. The drilling log is also included as **Attachment 1**.

The soil boring encountered brown to gray granular fill and loose to colluvium, alluvium, and glacial deposits to a depth of 9 feet bgs. Below this depth, the boring encountered gray to blue gray, firm to very stiff, moist, moderate plasticity silty clay with faint laminations to 37 feet bgs, equivalent to -9 feet AMSL. The density and apparent plasticity of the silty clay unit increased

progressively below 15 feet to the bottom of the boring. Atterberg limit testing of representative samples are included in Attachment 2. Groundwater was encountered as perched layers in the shallow geologic unit; no groundwater was observed in samples from the silty clay unit, although the samples were moist.

The silty clay unit was observed in all geotechnical soil borings near the Site to depths up to 60 feet bgs, equivalent to a lower elevation of least -20 feet AMSL.

# Site Geologic Conditions

## Site Geologic Units

Based on previous work and the findings of this investigation, two geologic units underlie the Site. The uppermost geologic unit at the Site is a mixture of unconsolidated loose fill, lakeshore colluvium, and glacial deposits consisting of variable amounts of sand, silt, and gravel. Soil borings within ½ mile of the Site encountered the uppermost geologic unit from ground surface to approximately 10 feet bgs. Groundwater within this unit occurs as unconfined perched lenses within more permeable zones, and groundwater flows towards the Lake.

The second geologic unit consists of light gray to bluish gray very stiff silty clay (ML) that is slightly moist, firm to very stiff, moderately plastic silty clay. At the time of its formation, this silt was over consolidated by thousands of feet of glacial ice. The pre-glacial silty clay unit below the Site is likely at least 50 feet thick. Groundwater within this unit was not observed but may be considered under confined pressure equivalent to the elevation of the Lake.

The existing PS No. 20 was constructed in 1966. No as-builts or specifications are available to indicate what methods were used to shore the excavation sidewalls and isolate the excavation from the Lake. The backfill around the existing PS is unknown and may consist of permeable granular material, concrete, or grout. Any or all of these backfill materials may interfere with the construction of the replacement PS or alter the subsurface hydrology around the PS, requiring limited to significant groundwater control if granular backfill is hydraulically connected to the Lake.

# Site Suitability for Project Objectives

The geologic characteristics and geotechnical properties of the geologic units underlying the Site present no fatal flaws for design, construction, and operation of the proposed replacement PS and associated utilities. The findings of this investigation, supported by existing geologic and groundwater information, are sufficient to support siting, design, and construction decisions.

## Investigation Statement and Uncertainties and Reliability

The Site investigation followed RH2's scope of work and accomplished the objectives for Site characterization and geological hazard analysis. Although sample retrieval was limited, the observed soil/geologic unit samples were consistent with mapped soil composition and local geology. Conditions observed during the Site investigation support conclusions regarding geologic unit composition and density, and groundwater conditions. No supplemental

investigations are warranted pending review of Site conditions and development of preliminary civil design.

# Geologic Hazards

The DNR website was reviewed for geologic hazards at the Site. The information that follows summarizes the geologic hazards and relative risk that they pose to the proposed PS and associated utlities:

- The DNR maps the Site as underlain by prehistoric (greater than 150 years) landslide deposits generated from a scarp north of E Mercer Way. The landslide deposits are consolidated and covered by homes and landscaping. Risks from shallow and deep-seated landslides are negligible.
- Risk of liquefaction is very low due to the very stiff silty clay. Shallow soil is mapped by DNR as moderate to high liquefaction susceptibility, but the new PS will be founded in the deeper silty clay.
- The seismic design should be based on the Site location (latitude 47.524542 degrees north and longitude 122.226144 degrees west) and a Seismic Site Class of C.
- The risk of persistent groundwater seepage from surrounding native soil into Site excavations during Site development is low to high, depending on the degree of hydraulic connection with Lake Washinton.
- The steep slope and loose soil may be considered an erosion risk, which may be mitigated through proper construction stormwater management.
- The risk of encountering soil or groundwater that potentially contains toxic or hazardous materials is negligible.

# Geotechnical Properties

The following geotechnical properties for the silty clay at the Site are estimated based on the observed soil composition and density of the very stiff silty clay unit at a depth of approximately 10 to at least 37 feet bgs. The PS will be founded on a 25-foot-deep excavation cut into the silty clay.

The silty clay unit may support a structure with an appropriately designed foundation that spreads a load that does not exceed a net allowable bearing capacity of 3,000 pounds per square foot (psf). This estimate may be increased by 33 percent for transient loading due to seismic effects.

The backfill material selected for the new wet well would have characteristic earth pressure values for select granular fill or CDF. Earth pressure estimated values for silty clay are summarized in **Table 1**.

**Table 1**

**Summary of Earth Pressures (Level Backfill, Drained)**

| Geologic Unit | Friction Angle (degrees) | Unit Weight (pcf) | Cohesion (psf) | At Rest (psf) | Active (psf) | Passive (psf) |
|---|---|---|---|---|---|---|
| Select Import Structural Fill | 31-35<br>32 avg | 130-135<br>135 avg | 0 | 63 | 41 | 439 |
| Silty clay | 26 | 125 | 1,250 | 70 | 49 | 320 |

psf= pounds per cubic foot

The coefficient of friction between silty clay soil and granular fill is estimated at 0.45.
The silty clay may be considered as a Site Class C, Hard Soil.
The silty clay is essentially impermeable.

# Proposed Site Construction

The replacement PS will be constructed by excavating into silty clay to create a uniform level surface at a depth of 25 feet bgs. The excavation will be backfilled with imported structural fill (either CDF or select granular material compacted in lifts). The excavation will require shoring to maintain stability. The proximity of nearby residences and the tight access and limits preclude the use of driven shoring methods such as a soldier pile wall; a large shoring box system is likely the most suitable method for constructing the wet well. Limited groundwater control to collect seepage from the floor and walls of the excavation should be effectively managed by sumping systems.

The associated sewer and stormwater piping will be constructed by excavating 3- to 4-foot-deep trenches into native soil and placing piping with imported bedding material and imported structural fill.

# Recommendations

## Excavation for Foundation and Underground Utilities

- The native soil may be excavated readily with a backhoe or excavator. Stiff cohesive clay will be encountered during excavation and may require special buckets to excavate and remove. Excavation should proceed until a uniformly dense surface has been cut into native soil at the design depth. The last foot of native soil could be left in place until the construction of the wet well is imminent.

## Slopes And Shoring

- The temporary slope constructed in the silty clay unit may stand vertically as the shoring system is installed. The shoring system's design and construction is the responsibility of the contractor.

- Shoring should be designed to protect workers inside trench excavations and support slopes, particularly where top soil and shallow weathered glacial till soil may be loose. All excavations should comply with all Occupational Safety and Health Administration safety requirements.
- All excavated slopes should be reviewed periodically for stability, including a review of the top of the slope for tension cracks and the sidewalls and floors for evidence of seepage or saturated soil conditions.
- The native silty clay unit is moderately erodible. All excavated slopes should be protected from erosion during precipitation events by plastic sheeting or other techniques that prevent rain splash erosion and rilling.

## Inspection and Treatment of Subgrade

- A Licensed Engineering Geologist (LEG) or Professional Engineer with geotechnical experience (PEG) should inspect the excavations to confirm whether the native earth materials exposed during excavation are consistent with this technical memorandum and favorable for proceeding with the project as planned.

## Subgrade Preparation

- The excavation subgrade for the wet well should be flat, dry, and free of loose earth materials. Any fill used to replace soft zones at the subgrade should consist of imported trench backfill placed in 8-inch lifts and compacted with a plate compactor or equivalent. Each lift should be compacted to a firm and unyielding surface to achieve 95 percent of maximum dry density (MDD) as determined by the Modified Proctor Test (ASTM D1557).

## Use of Excavated Earth Materials

- Excavated native silty clay is unsuitable for structural fill and shall be exported offsite.

## Imported Fill Characteristics and Excavation Drainage

- The native silty clay unit is very stiff and exhibits low permeability and limited to no infiltration capacity. Consequently, any groundwater seepage or infiltrated stormwater entering the backfill will accumulate on the cut surface and within the backfill placed on the cut surface. Drainage of the cut surfaces and backfill may be promoted by specifying structural backfill to support the wet well with a low fines content between 3 and 5 percent.
- Fill placed against the portion of the wet well at or below the elevation of the Lake should be CDF poured neat against the excavation as the box shoring is removed. Fill placed against the portion of the wet well above the elevation of the Lake should be permeable granular drain backfill that promotes drainage around the wet well to intercept and convey stormwater and groundwater seepage away from the structure walls.

- Permanent gravity drainage of excavations above the Lake elevation should be promoted through construction of perimeter drains and collector drains along the wall of the structures and conveyed via tightline piping into Site drainage structures (catch basins and maintenance holes). Drainage piping should be of sufficient strength to resist compaction loading and backfill loading and of sufficient size to promote permanent drainage even if capacity is lost through plugging or volume reduction.

## Compaction and Testing of Imported Fill

- Representative samples of imported fill should be tested to establish optimum moisture content and MDD.
- Imported trench backfill material should be tested for moisture content just prior to placement. Trench backfill should be within 3 percentage points of its optimum moisture content when placed.
- Trench backfill should be placed in lifts that are not more than 8 inches thick. Placement and compaction of the fill should be observed by an LEG or PEG.
- All imported fill used as backfill below the PS and wet well foundations and below paved areas should be compacted to 95 percent of MDD as determined in accordance with the Modified Proctor Test (ASTM D1557).

# Attachments

Figure 1 - Existing Site Plan

Attachment 1 - Drilling Logs

Attachment 2 - Atterberg Limit Testing Results

# References

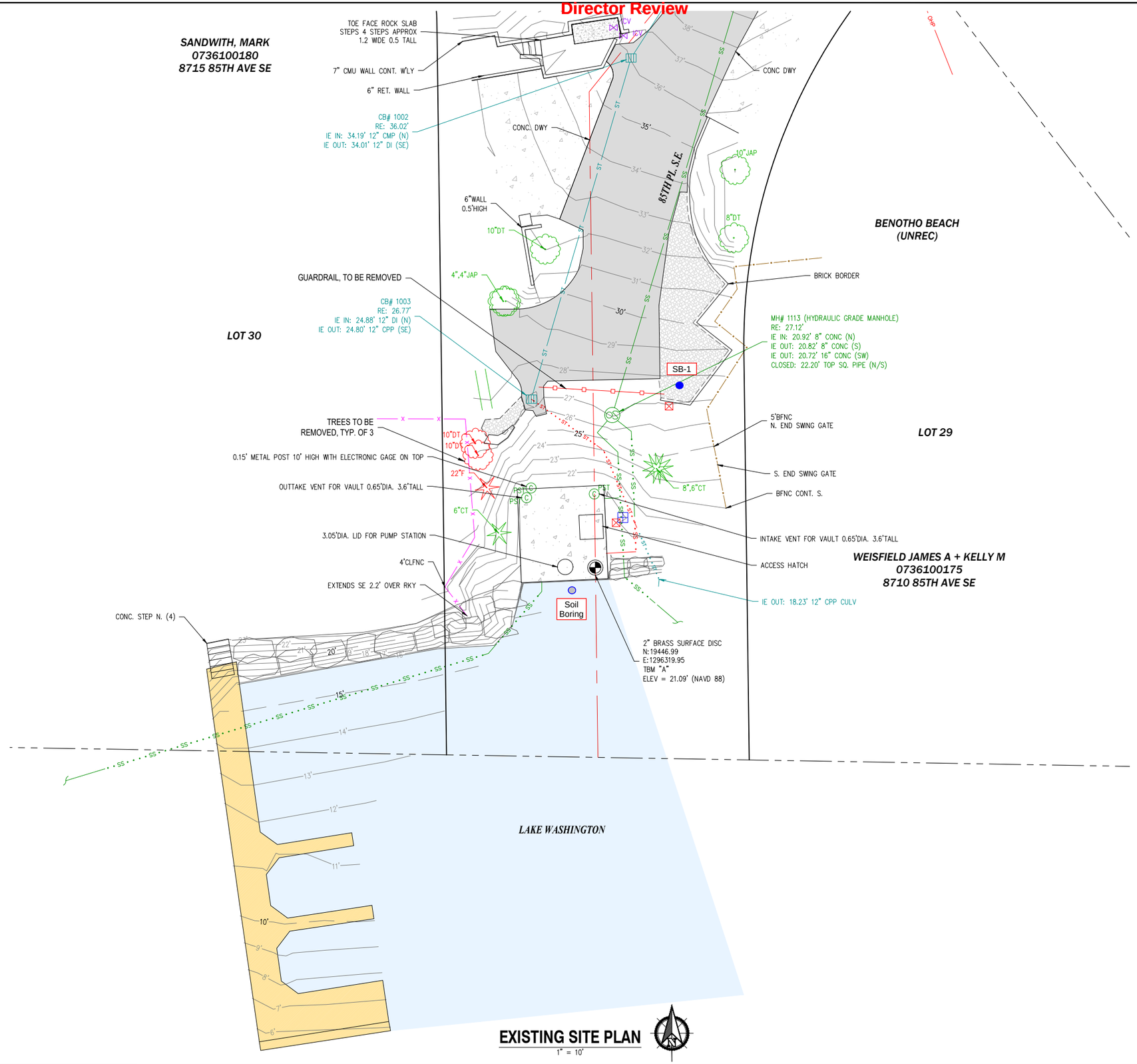
City of Mercer Island. January 2025. Geotechnical reports for neighboring properties on file with City Building Department. Retrieved from https://www.mercerisland.gov/cpd/page/building.

Washington State Department of Ecology. (2024). Well Construction & Licensing. Retrieved from https://appswr.ecology.wa.gov/wellconstruction/map/WCLSWebMap/WellConstructionMapSearch.aspx.

Washington State Department of Natural Resources. (2024). Washington Geologic Information Portal. Retrieved from https://geologyportal.dnr.wa.gov/.

# *Figure*

Director Review




## EXISTING SITE PLAN

1" = 10'

RH2

CITY OF MERCER ISLAND
SEWER PUMP STATION 20
REPLACEMENT

EXISTING SITE PLAN

PRELIMINARY

| | |
|---|---|
| JOB NO.: | 24-0089 |
| CLIENT: | M-I |
| FILENAME: | LS20-D-SITEX.DWG |
| SAVE DATE: | Nov 18, 2024 |
| PLOT DATE: | Nov 18, 2024 |
| ENGINEER: | MAH |
| REVIEWED: | EH |

REVISIONS

| NO. | DATE | DESCRIPTION | BY | REVIEW |
|---|---|---|---|---|

SCALE: SHOWN

0" 1" 2"

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

DWG NO.: C02

SHEET NO.: 3 11

# Attachment 1

Drilling Logs

Director Review

# FIELD BORING LOG

Page 1 of 1

Project Name: Mercer Island PS 20
Site Location: 85th Ave SE
Project #: 24 0089
Field Staff: S Nelson
Start/End Date: 11-8-24

Boring #: B-1
Driller: Holt
Drill Rig: Track B61
Drill Method: HSA
Casing /Auger: 4-6 inch

| Time | Sample | Depth | SPTs | % Recov | Backfill | Litho | Observations |
|---|---|---|---|---|---|---|---|
| 10:55 | 1 | 5 / 6.5 | 0/1/3 | 80 | | FILL | Silty Sand, moist to wet (FILL) some clay |
| 11:00 | 2 | 7.5 / 9 | 1/3/5 | 80 | | FILL / COLLUV. | Some silt clay FILL to 8 feet 8-9 feet - SAND with Silt, brown dry to moist |
| 11:05 | 3 | 10 / 11.5 | 2/4/7 | 100 | | Silty CLay (CL) | olive to grey-blue moderate plasticity firm moist |
| 11:10 | 4 | 12.5 / 14 | 6/8/11 | 100 | | Silty Clay (CL) | grey-blue, stiff |
| 11:20 | 5 | 15 / 16.5 | 4/8/11 | 100 | | CL | As above |
| 11:30 | 6 | 20 / 21.5 | 5/9/16 | 100 | | | As above hard to stiff |
| 11:40 | 7 | 25 / 26.5 | 6/7/13 | 100 | | | As above |
| 12:00 | 8 | 30 / 31.5 | 11/14/14 | 100 | | | As above very stiff |
| 12:05 | 9 | 35 / 36.5 | 9/10/16 | 100 | | | As above |
| | | / | / / | | | | |
| | | / | / / | | | | |
| | | / | / / | | | | |

NOTES: Boring backfilled with hydrated bentonite chips.

# *Attachment 2*

Atterberg Limit Testing Results

| EXPLORATION DESIGNATION | TOP DEPTH (feet) | BOTTOM DEPTH (feet) | MOISTURE CONTENT (%) | ORGANIC CONTENT (%) | SPECIFIC GRAVITY | ATTERBERG LIMITS (%) | | | % GRAVEL | % SAND | % FINES | ASTM SOIL CLASSIFICATION | SAMPLE DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | LL | PL | PI | | | | | |
| SB-1,20 | 20.0 | 20.5 | 30.3 | | | 49 | 25 | 24 | | | | CL | Dark gray, lean CLAY |
| SB-1,30 | 30.0 | 30.5 | 29.4 | | | 40 | 23 | 17 | | | | CL | Dark gray, lean CLAY |

Notes: 1. This table summarizes information presented elsewhere in the report and should be used in conjunction with the report test, other graphs and tables, and the exploration logs.
2. The soil classifications in this table are based on ASTM D2487 and D2488 as applicable.

GeoSciences Inc.

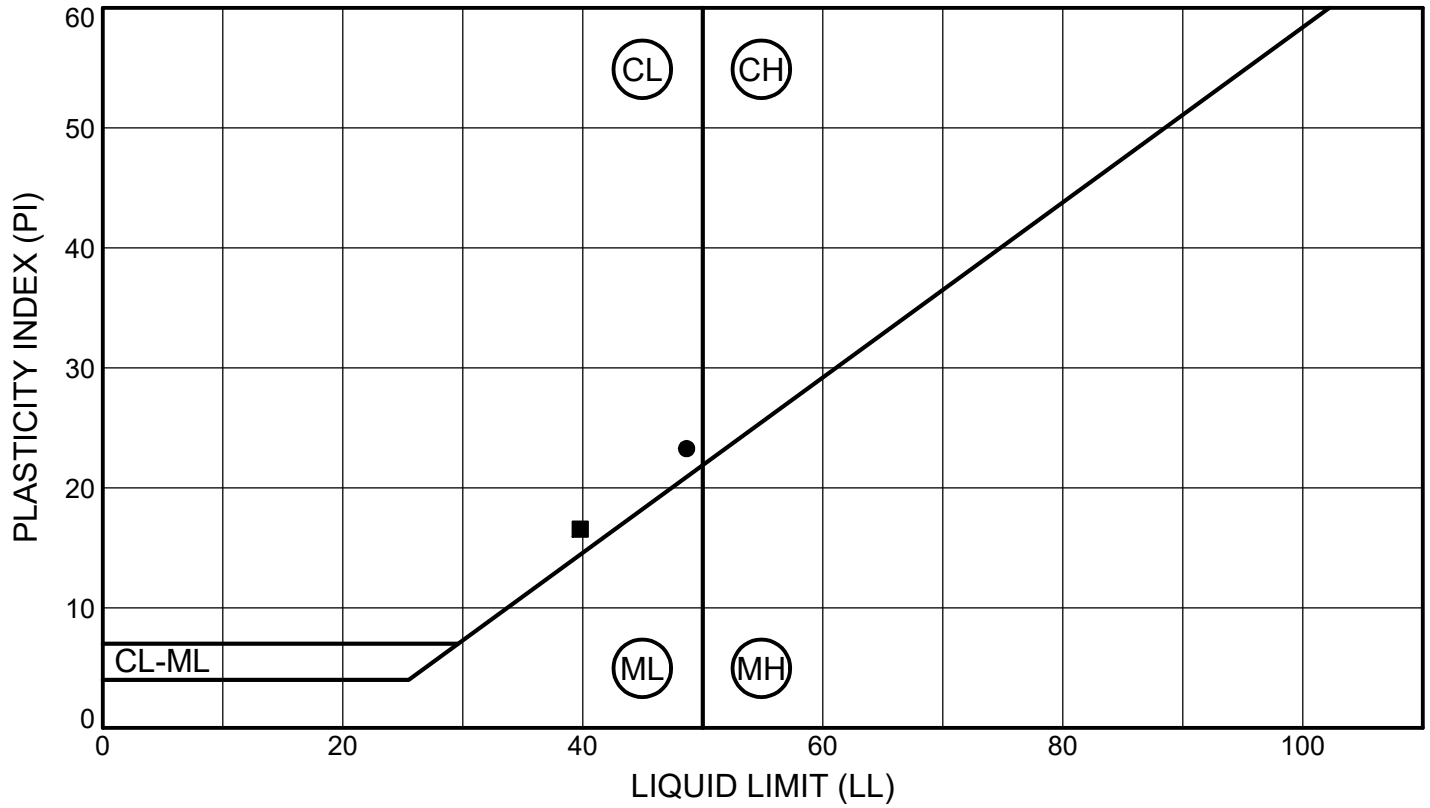
Laboratory Testing for RH2
MI-20
Mercer Island, WA
Client Project No.: MI-24-0089 Task 2

SUMMARY OF
MATERIAL PROPERTIES



PROJECT NO.: 2012-013 T3500 FIGURE: 1

Director Review




| SYMBOL | SAMPLE | | DEPTH (ft) | CLASSIFICATION | % MC | LL | PL | PI | % Fines |
|---|---|---|---|---|---|---|---|---|---|
| ● | SB-1 | 20 | 20.0 - 20.5 | (CL) Dark gray, lean CLAY | 30 | 49 | 25 | 24 | |
| ■ | SB-1 | 30 | 30.0 - 30.5 | (CL) Dark gray, lean CLAY | 29 | 40 | 23 | 17 | |

HWA GeoSciences Inc.

Laboratory Testing for RH2
MI-20
Mercer Island, WA
Client Project No.: MI-24-0089 Task 2

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX OF SOILS
METHOD ASTM D4318

PROJECT NO.: 2012-013 T3500 FIGURE: 2