



April 19, 2022
Updated October 12, 2023

Laurie Yang
Laurieyang92@gmail.com

RE: Geotechnical Evaluation
Proposed Residence
8456 SE 40th Street
Mercer Island, Washington

In accordance with your authorization, Cobalt Geosciences, LLC has prepared this letter to discuss the results of our geotechnical evaluation at the referenced site.

The purpose of our evaluation was to provide recommendations for foundation design, grading, and earthwork.

Site Description

The site is located at 8456 SE 40th Street in Mercer Island, Washington. The site consists of one nearly rectangular parcel (No. 5021900790) with a total area of about 11,930 square feet.

The south-central portion of the site is developed with a residence and walkways. There is a detached garage in the northeast portion of the site with a short driveway.

The remainder of the property is undeveloped and vegetated with grasses, bushes, and variable diameter trees. The site slopes gently downward to the northeast, east, and south from the central portion of the property. Relief is less than 6 feet.

The site is bordered to the north and west by residential properties, to the east by 86th Avenue SE, and to the south by SE 40th Street.

The proposed development includes a new residence and driveway. Stormwater will include infiltration or other systems depending on feasibility. Site grading may include cuts and fills of 3 feet or less and foundation loads are expected to be light.

We note that the current civil plans indicate use of a 3 foot deep drywell located northwest of the new structure.

Area Geology

The Geologic Map of King County, indicates that the site is underlain by Vashon Glacial Till.

Vashon Glacial Till includes mixtures of silt, sand, clay, and gravel. These materials are usually impermeable and are typically dense to very dense below a weathered zone.

Soil & Groundwater Conditions

As part of our evaluation, we excavated three hand excavations within the property, where accessible. There was inadequate access for an excavator due to walls, fencing and trees.

We returned in October 2023 to excavate test pits where accessible (created access through a fence) and near the proposed infiltration trench locations.

The explorations encountered approximately 6 inches of grass and topsoil underlain by approximately 3 to 4 feet of loose to medium dense, silty-fine to medium grained sand with gravel trace cobbles (Weathered Glacial Till). These materials were underlain by dense to very dense, silty-fine to fine grained sand trace gravel (Vashon Glacial Till), which continued to the termination depths of the explorations.

Groundwater was not encountered in the explorations; however, the shallow soils were locally mottled. Based on our observations, very light seepage could become perched on the denser till during the wet season. Volumes would be light and likely 5 to 10 feet below grade, if present.

Water table elevations often fluctuate over time. The groundwater level will depend on a variety of factors that may include seasonal precipitation, irrigation, land use, climatic conditions and soil permeability. Water levels at the time of the field investigation may be different from those encountered during the construction phase of the project.

Erosion Hazard

The Natural Resources Conservation Services (NRCS) maps for King County indicate that the site is underlain by Arents, Alderwood material (6 to 15 percent slopes). These soils would have a slight erosion potential in a disturbed state depending on the slope magnitude.

It is our opinion that soil erosion potential at this project site can be reduced through landscaping and surface water runoff control. Typically, erosion of exposed soils will be most noticeable during periods of rainfall and may be controlled by the use of normal temporary erosion control measures, such as silt fences, hay bales, mulching, control ditches and diversion trenches. The typical wet weather season, with regard to site grading, is from October 31st to April 1st. Erosion control measures should be in place before the onset of wet weather.

Seismic Hazard

The overall subsurface profile corresponds to a Site Class *D* as defined by Table 1613.5.2 of the International Building Code (IBC). A Site Class *D* applies to an overall profile consisting of stiff/medium dense soils within the upper 100 feet.

We referenced the U.S. Geological Survey (USGS) Earthquake Hazards Program Website to obtain values for S_s , S_t , F_a , and F_v . The USGS website includes the most updated published data on seismic conditions. The following tables provide seismic parameters from the USGS web site with referenced parameters from ASCE 7-16.

Seismic Design Parameters (ASCE 7-16)

| Site Class | Spectral Acceleration at 0.2 sec. (g) | Spectral Acceleration at 1.0 sec. (g) | Site Coefficients | | Design Spectral Response Parameters | | Design PGA |
|------------|---------------------------------------|---------------------------------------|-------------------|-------|-------------------------------------|----------|------------|
| | | | F_a | F_v | S_{DS} | S_{D1} | |
| D | 1.411 | 0.491 | 1.0 | Null | 0.941 | Null | 0.604 |

Additional seismic considerations include liquefaction potential and amplification of ground motions by soft/loose soil deposits. The liquefaction potential is highest for loose sand with a high groundwater table. The site has a low likelihood of liquefaction. For items listed as “Null” see Section 11.4.8 of the ASCE.

Conclusions and Recommendations

General

The site is underlain by weathered and unweathered glacial till which becomes denser with depth. The proposed residence may be supported on a shallow foundation system bearing on medium dense or firmer native soils or on structural fill placed on the native soils. Local overexcavation of loose weathered native soils may be necessary depending on the proposed elevations and locations of the new footings.

We understand that infiltration is essentially the only feasible option due to site grades. Provided a basement is not proposed, shallow infiltration using trenches is generally feasible in the weathered till. Systems must have clearance above the restrictive layer, which was observed about 3.75 to 4 feet below site elevations. Permeable pavements are generally feasible depending on their location and elevations.

The current drywell system northwest of the structure appears generally feasible. We must be on site to verify soil conditions during system placement. If possible, the system should have an overflow via tightline to the east property line onto a rock splash pad or connection to City storm.

Site Preparation

Trees, shrubs and other vegetation should be removed prior to stripping of surficial organic-rich soil and fill. Based on observations from the site investigation program, it is anticipated that the stripping depth will be 6 to 18 inches. Deeper excavations will be necessary below foundation systems, below large trees, and in any areas underlain by undocumented fill.

The native soils consist of silty-sand with gravel. Most of the native soils may be used as structural fill provided they achieve compaction requirements and are within 3 percent of the optimum moisture. Some of these soils may only be suitable for use as fill during the summer months, as they will be above the optimum moisture levels in their current state. These soils are variably moisture sensitive and may degrade during periods of wet weather and under equipment traffic.

Imported structural fill should consist of a sand and gravel mixture with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). Structural fill should be placed in maximum lift thicknesses of 12 inches and should be compacted to a minimum of 95 percent of the modified proctor maximum dry density, as determined by the ASTM D 1557 test method.

Temporary Excavations

Based on our understanding of the project, we anticipate that the grading could include local cuts on the order of approximately 3 feet or less for foundation and most of the utility placement. Any deeper temporary excavations should be sloped no steeper than 1.5H:1V (Horizontal:Vertical) in loose native soils and fill, 1H:1V in medium dense native soils and 3/4H:1V in dense to very dense native soils. If an excavation is subject to heavy vibration or surcharge loads, we recommend that the excavations be sloped no steeper than 2H:1V, where room permits.

Temporary cuts should be in accordance with the Washington Administrative Code (WAC) Part N, Excavation, Trenching, and Shoring. Temporary slopes should be visually inspected daily by a qualified person during construction activities and the inspections should be documented in daily reports. The contractor is responsible for maintaining the stability of the temporary cut slopes and reducing slope erosion during construction.

Temporary cut slopes should be covered with visqueen to help reduce erosion during wet weather, and the slopes should be closely monitored until the permanent retaining systems or slope configurations are complete. Materials should not be stored or equipment operated within 10 feet of the top of any temporary cut slope.

Soil conditions may not be completely known from the geotechnical investigation. In the case of temporary cuts, the existing soil conditions may not be completely revealed until the excavation work exposes the soil. Typically, as excavation work progresses the maximum inclination of temporary slopes will need to be re-evaluated by the geotechnical engineer so that supplemental recommendations can be made. Soil and groundwater conditions can be highly variable. Scheduling for soil work will need to be adjustable, to deal with unanticipated conditions, so that the project can proceed and required deadlines can be met.

If any variations or undesirable conditions are encountered during construction, we should be notified so that supplemental recommendations can be made. If room constraints or groundwater conditions do not permit temporary slopes to be cut to the maximum angles allowed by the WAC, temporary shoring systems may be required. The contractor should be responsible for developing temporary shoring systems, if needed. We recommend that Cobalt Geosciences and the project structural engineer review temporary shoring designs prior to installation, to verify the suitability of the proposed systems.

Foundation Design

The proposed residence may be supported on a shallow spread footing foundation system bearing on undisturbed dense or firmer native soils or on properly compacted structural fill placed on the suitable native soils. Any undocumented fill and/or loose native soils should be removed and replaced with structural fill below foundation elements. Structural fill below footings should consist of clean angular rock 5/8 to 4 inches in size. We should verify soil conditions during foundation excavation work.

For shallow foundation support, we recommend widths of at least 16 and 24 inches, respectively, for continuous wall and isolated column footings supporting the proposed structure. Provided that the footings are supported as recommended above, a net allowable bearing pressure of 2,500 pounds per square foot (psf) may be used for design.

A 1/3 increase in the above value may be used for short duration loads, such as those imposed by wind and seismic events. Structural fill placed on bearing, native subgrade should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Footing excavations should be inspected to verify that the foundations will bear on suitable material.

Exterior footings should have a minimum depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower. Interior footings should have a minimum depth of 12 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is lower.

If constructed as recommended, the total foundation settlement is not expected to exceed 1 inch. Differential settlement, along a 25-foot exterior wall footing, or between adjoining column footings, should be less than 1/2 inch. This translates to an angular distortion of 0.002. Most settlement is expected to occur during construction, as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated. All footing excavations should be observed by a qualified geotechnical consultant.

Resistance to lateral footing displacement can be determined using an allowable friction factor of 0.40 acting between the base of foundations and the supporting subgrades. Lateral resistance for footings can also be developed using an allowable equivalent fluid passive pressure of 250 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces (neglect the upper 12 inches below grade in exterior areas). The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance.

Care should be taken to prevent wetting or drying of the bearing materials during construction. Any extremely wet or dry materials, or any loose or disturbed materials at the bottom of the footing excavations, should be removed prior to placing concrete. The potential for wetting or drying of the bearing materials can be reduced by pouring concrete as soon as possible after completing the footing excavation and evaluating the bearing surface by the geotechnical engineer or his representative.

Concrete Retaining Walls

The following table, titled **Wall Design Criteria**, presents the recommended soil related design parameters for retaining walls with a level backslope. Contact Cobalt if an alternate retaining wall system is used. This has been included for new cast in place walls, if any are proposed.

| Wall Design Criteria | |
|--|---|
| “At-rest” Conditions (Lateral Earth Pressure – EFD ⁺) | 55 pcf (Equivalent Fluid Density) |
| “Active” Conditions (Lateral Earth Pressure – EFD ⁺) | 35 pcf (Equivalent Fluid Density) |
| Seismic Increase for “At-rest” Conditions (Lateral Earth Pressure) | 21H* (Uniform Distribution) 1 in 2,500 year event |
| Seismic Increase for “At-rest” Conditions (Lateral Earth Pressure) | 14H* (Uniform Distribution) 1 in 500 year event |
| Seismic Increase for “Active” Conditions (Lateral Earth Pressure) | 7H* (Uniform Distribution) |
| Passive Earth Pressure on Low Side of Wall | Neglect upper 2 feet, then 275 pcf EFD ⁺ |

| | |
|---|------|
| (Allowable, includes F.S. = 1.5) | |
| Soil-Footing Coefficient of Sliding Friction (Allowable; includes F.S. = 1.5) | 0.40 |

*H is the height of the wall; Increase based on one in 500 year seismic event (10 percent probability of being exceeded in 50 years),

+EFD – Equivalent Fluid Density

The stated lateral earth pressures do not include the effects of hydrostatic pressure generated by water accumulation behind the retaining walls. Uniform horizontal lateral active and at-rest pressures on the retaining walls from vertical surcharges behind the wall may be calculated using active and at-rest lateral earth pressure coefficients of 0.3 and 0.5, respectively. A soil unit weight of 125 pcf may be used to calculate vertical earth surcharges.

To reduce the potential for the buildup of water pressure against the walls, continuous footing drains (with cleanouts) should be provided at the bases of the walls. The footing drains should consist of a minimum 4-inch diameter perforated pipe, sloped to drain, with perforations placed down and enveloped by a minimum 6 inches of pea gravel in all directions.

The backfill adjacent to and extending a lateral distance behind the walls at least 2 feet should consist of free-draining granular material. All free draining backfill should contain less than 3 percent fines (passing the U.S. Standard No. 200 Sieve) based upon the fraction passing the U.S. Standard No. 4 Sieve with at least 30 percent of the material being retained on the U.S. Standard No. 4 Sieve. The primary purpose of the free-draining material is the reduction of hydrostatic pressure. Some potential for the moisture to contact the back face of the wall may exist, even with treatment, which may require that more extensive waterproofing be specified for walls, which require interior moisture sensitive finishes.

We recommend that the backfill be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. In place density tests should be performed to verify adequate compaction. Soil compactors place transient surcharges on the backfill. Consequently, only light hand operated equipment is recommended within 3 feet of walls so that excessive stress is not imposed on the walls.

Stormwater Management Feasibility

The site is underlain by weathered and unweathered Glacial Till. The glacial till acts as a restrictive layer through which vertical infiltration is very slow. Some infiltration can be feasible in the weathered zones above the restrictive layer depending on several factors, including depth to soil mottling, topography, and elevations/locations of any nearby structures, including basements.

We performed a small scale pilot infiltration test (PIT) in TP-1 to determine the feasibility of stormwater management systems in the area of the currently proposed infiltration trench. The test was performed in general accordance with the Washington State Department of Ecology stormwater manual.

The area was excavated to a testing depth of approximately 2 feet below the ground surface. The design infiltration rate was determined by applying correction factors to the measured infiltration rate as prescribed in Volume III, Section 3.3.6 of the DOE. The measured rate must be reduced through appropriate correction factors for site variability (CF_V), uncertainty of test method (CF_T), and degree of influent control (CF_M) to prevent siltation and bio-buildup.

It should be noted that construction traffic or other disturbance to the target infiltration area could compact the soil, which may decrease the effective infiltration rates. The correction factors and resulting design infiltration rate are also shown in the table below.

| Test Number | Test Depth (ft) | Measured Infiltration Rate (in/hr) | Correction Factors | | | Design Infiltration Rate (in/hr) |
|-------------|-----------------|------------------------------------|--------------------|-----------------|-----------------|----------------------------------|
| | | | CF _V | CF _T | CF _M | |
| TP-1 | 2 | 1.05 | 0.8 | 0.5 | 0.9 | 0.38 |

The weathered glacial till has some capacity for infiltration of stormwater runoff. Any trenches must have the required clearance above the restrictive layer, which was found approximately 3.75 to 4 feet below grade at the two test pit locations. Soil mottling was essentially at this elevation as well.

Systems should be designed using the rate above or the Loamy Sand designation from the King County Surface Water Design Manual (SWDM) if prescriptive sizing is proposed.

Permeable pavements are feasible provided they are located in areas with minimal excavation work so that there is at least 12 inches of weathered till below the base rock. Systems should have a minimum of 10 inches of base rock and 5 inches of asphalt or concrete.

The near surface soils (weathered till sample) had an organic content of 3.6 percent by weight and a Cation Exchange Capacity of 5.9 meq if this information is required for water quality function.

The current plans show a larger drywell northwest of the residence. This is generally suitable provided we review soil conditions during construction. It may be necessary to enlarge the area to accommodate any local denser soils at shallow depths (if present).

Slab-on-Grade

We recommend that the upper 12 inches of the existing native soils within slab areas be re-compacted to at least 95 percent of the modified proctor (ASTM D1557 Test Method).

Often, a vapor barrier is considered below concrete slab areas. However, the usage of a vapor barrier could result in curling of the concrete slab at joints. Floor covers sensitive to moisture typically requires the usage of a vapor barrier. A materials or structural engineer should be consulted regarding the detailing of the vapor barrier below concrete slabs. Exterior slabs typically do not utilize vapor barriers.

The American Concrete Institutes ACI 360R-06 Design of Slabs on Grade and ACI 302.1R-04 Guide for Concrete Floor and Slab Construction are recommended references for vapor barrier selection and floor slab detailing.

Slabs on grade may be designed using a coefficient of subgrade reaction of 210 pounds per cubic inch (pci) assuming the slab-on-grade base course is underlain by structural fill placed and compacted as outlined above. A 4- to 6-inch-thick capillary break layer should be placed over the prepared subgrade. This material should consist of pea gravel or 5/8 inch clean angular rock.

A perimeter drainage system is recommended unless interior slab areas are elevated a minimum of 12 inches above adjacent exterior grades. If installed, a perimeter drainage system should consist of a 4-inch diameter perforated drain pipe surrounded by a minimum 6 inches of drain rock wrapped in a non-woven geosynthetic filter fabric to reduce migration of soil particles into the drainage system. The perimeter drainage system should discharge by gravity flow to a suitable stormwater system.

Exterior grades surrounding buildings should be sloped at a minimum of one percent to facilitate surface water flow away from the building and preferably with a relatively impermeable surface cover immediately adjacent to the building.

Erosion and Sediment Control

Erosion and sediment control (ESC) is used to reduce the transportation of eroded sediment to wetlands, streams, lakes, drainage systems, and adjacent properties. Erosion and sediment control measures should be implemented, and these measures should be in general accordance with local regulations. At a minimum, the following basic recommendations should be incorporated into the design of the erosion and sediment control features for the site:

- Schedule the soil, foundation, utility, and other work requiring excavation or the disturbance of the site soils, to take place during the dry season (generally May through September). However, provided precautions are taken using Best Management Practices (BMP's), grading activities can be completed during the wet season (generally October through April).
- All site work should be completed and stabilized as quickly as possible.
- Additional perimeter erosion and sediment control features may be required to reduce the possibility of sediment entering the surface water. This may include additional silt fences, silt fences with a higher Apparent Opening Size (AOS), construction of a berm, or other filtration systems.
- Any runoff generated by dewatering discharge should be treated through construction of a sediment trap if there is sufficient space. If space is limited other filtration methods will need to be incorporated.

Utilities

Utility trenches should be excavated according to accepted engineering practices following OSHA (Occupational Safety and Health Administration) standards, by a contractor experienced in such work. The contractor is responsible for the safety of open trenches. Traffic and vibration adjacent to trench walls should be reduced; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced, especially during or shortly following periods of precipitation.

In general, silty soils were encountered at shallow depths in the explorations at this site. These soils have low cohesion and density and will have a tendency to cave or slough in excavations. Shoring or sloping back trench sidewalls is required within these soils in excavations greater than 4 feet deep.

All utility trench backfill should consist of imported structural fill or suitable on site soils. Utility trench backfill placed in or adjacent to buildings and exterior slabs should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. The upper 5 feet of utility trench backfill placed in pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D1557. Below 5 feet, utility trench backfill in pavement areas should be compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. Pipe bedding should be in accordance with the pipe manufacturer's recommendations.

The contractor is responsible for removing all water-sensitive soils from the trenches regardless of the backfill location and compaction requirements. Depending on the depth and location of the proposed utilities, we anticipate the need to re-compact existing fill soils below the utility structures and pipes. The contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction procedures.

CONSTRUCTION FIELD REVIEWS

Cobalt Geosciences should be retained to provide part time field review during construction in order to verify that the soil conditions encountered are consistent with our design assumptions and that the intent of our recommendations is being met. This will require field and engineering review to:

- Monitor and test structural fill placement and soil compaction
- Observe bearing capacity at foundation locations
- Observe slab-on-grade preparation
- Monitor foundation drainage placement
- Verify soil conditions at infiltration systems (if utilized).
- Verify subgrade conditions for pavement areas
- Observe excavation stability

Geotechnical design services should also be anticipated during the subsequent final design phase to support the structural design and address specific issues arising during this phase. Field and engineering review services will also be required during the construction phase in order to provide a Final Letter for the project.

CLOSURE

This report was prepared for the exclusive use of Laurie Yang and her appointed consultants. Any use of this report or the material contained herein by third parties, or for other than the intended purpose, should first be approved in writing by Cobalt Geosciences, LLC.

The recommendations contained in this report are based on assumed continuity of soils with those of our test holes and assumed structural loads. Cobalt Geosciences should be provided with final architectural and civil drawings when they become available in order that we may review our design recommendations and advise of any revisions, if necessary.

Use of this report is subject to the Statement of General Conditions provided in Appendix A. It is the responsibility of Laurie Yang who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Cobalt Geosciences should any of these not be satisfied.

Sincerely,

Cobalt Geosciences, LLC



10/12/2022
Phil Haberman, PE, LG, LEG
Principal

Statement of General Conditions

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Cobalt Geosciences and the Client. Any use which a third party makes of this report is the responsibility of such third party.

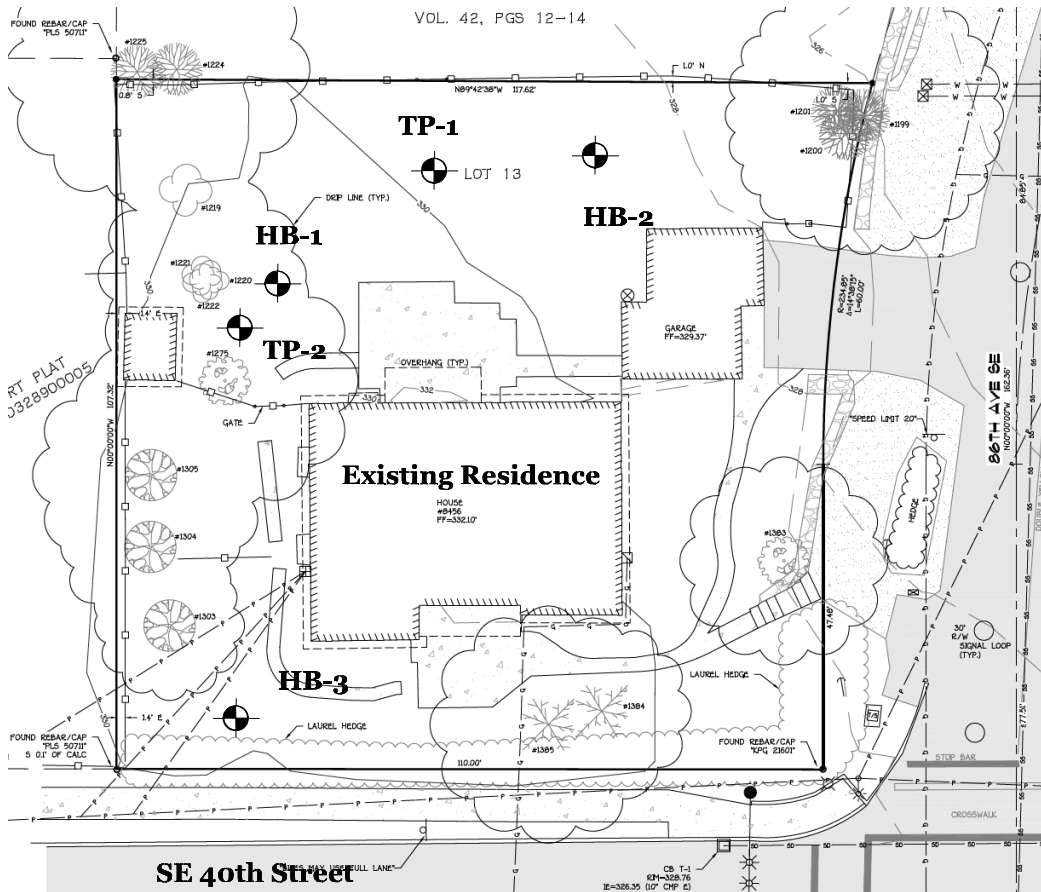
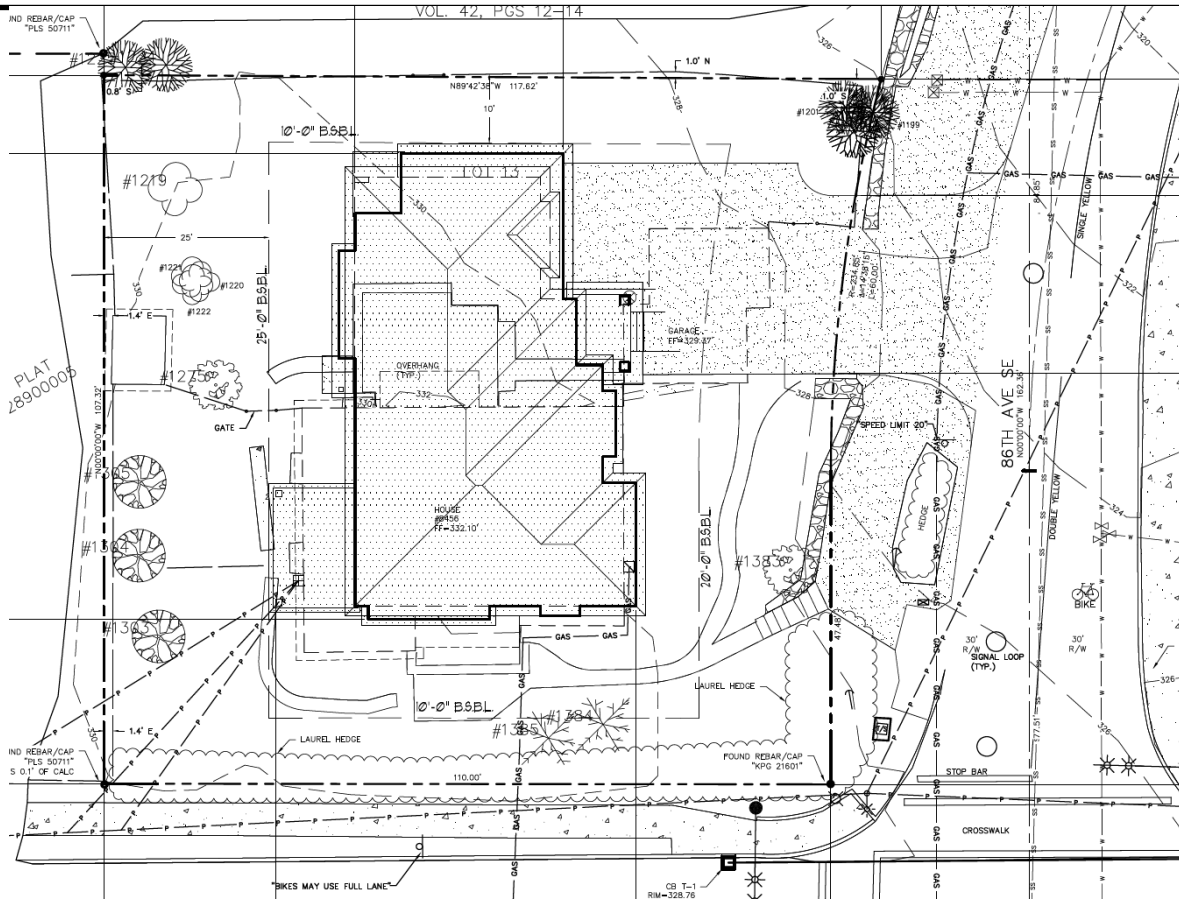
BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Cobalt Geosciences present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Cobalt Geosciences is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Cobalt Geosciences at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Cobalt Geosciences must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Cobalt Geosciences will not be responsible to any party for damages incurred as a result of failing to notify Cobalt Geosciences that differing site or sub-surface conditions are present upon becoming aware of such conditions.

PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Cobalt Geosciences, sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Cobalt Geosciences cannot be responsible for site work carried out without being present.



HB-1
TP-1

Approximate Test Pit & Hand Boring Location

Provided topographic survey

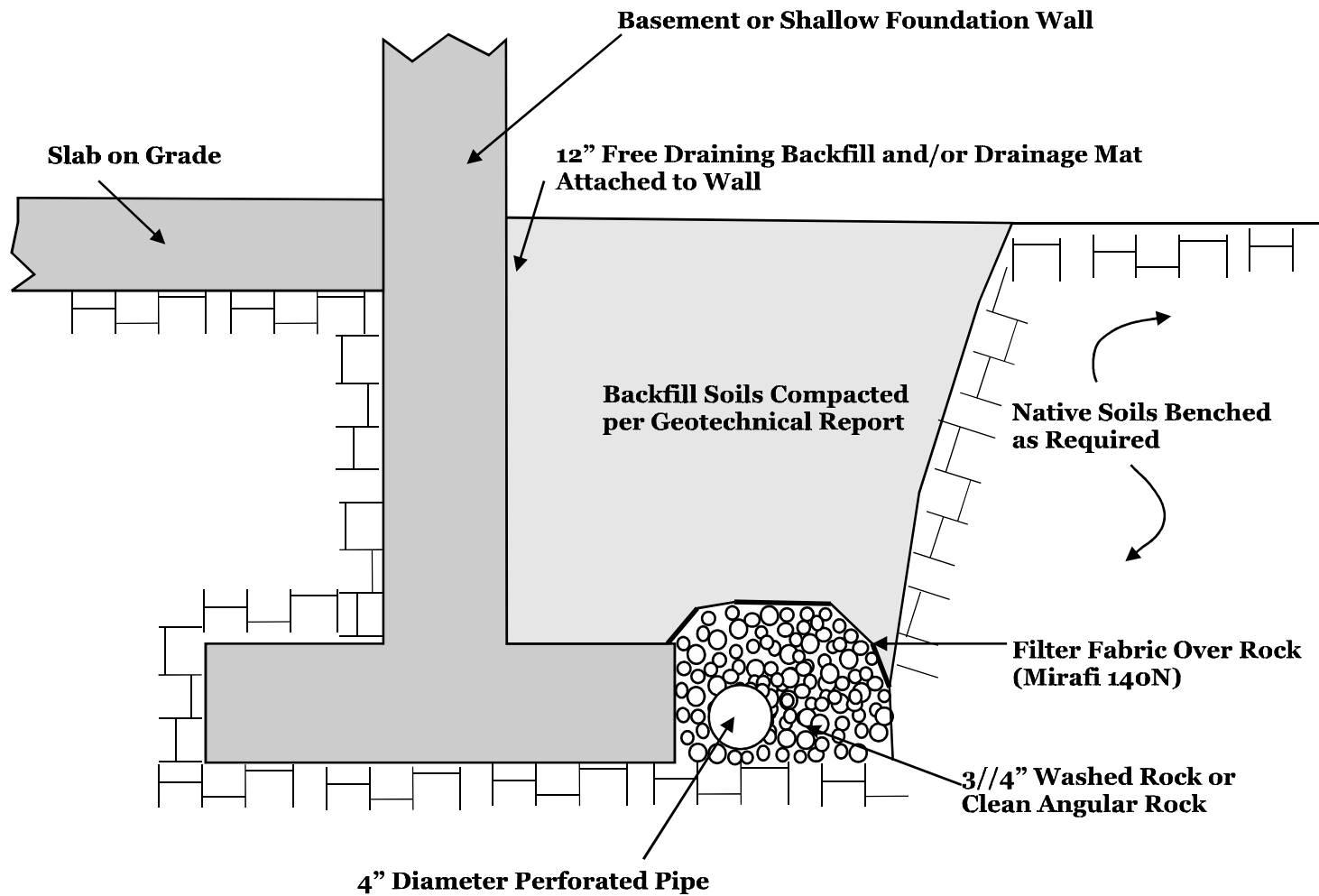
Not to Scale



Proposed Residence
8456 SE 40th Street
Mercer Island, Washington

**SITE
MAPS
FIGURE 1**

Cobalt Geosciences, LLC
P.O. Box 82243
Kenmore, WA 98028
(206) 331-1097
www.cobaltgeo.com
cobaltgeo@gmail.com



Not to Scale



Typical Foundation Drain Detail

Attachment

Cobalt Geosciences, LLC
 PO Box 1792
 North Bend, WA 98045
 (206) 331-1097
www.cobaltgeo.com
phil@cobaltgeo.com

Unified Soil Classification System (USCS)

| MAJOR DIVISIONS | | | SYMBOL | TYPICAL DESCRIPTION | |
|--|---|--|--|--|--|
| COARSE GRAINED SOILS (more than 50% retained on No. 200 sieve) | Gravels (more than 50% of coarse fraction retained on No. 4 sieve) | Clean Gravels (less than 5% fines) | GW | Well-graded gravels, gravels, gravel-sand mixtures, little or no fines | |
| | | Gravels with Fines (more than 12% fines) | GP | Poorly graded gravels, gravel-sand mixtures, little or no fines | |
| | | Gravels with Fines (more than 12% fines) | GM | Silty gravels, gravel-sand-silt mixtures | |
| | | Gravels with Fines (more than 12% fines) | GC | Clayey gravels, gravel-sand-clay mixtures | |
| | Sands (50% or more of coarse fraction passes the No. 4 sieve) | Clean Sands (less than 5% fines) | SW | Well-graded sands, gravelly sands, little or no fines | |
| | | Sands with Fines (more than 12% fines) | SP | Poorly graded sand, gravelly sands, little or no fines | |
| | | Sands with Fines (more than 12% fines) | SM | Silty sands, sand-silt mixtures | |
| | | Sands with Fines (more than 12% fines) | SC | Clayey sands, sand-clay mixtures | |
| | | Silts and Clays (liquid limit less than 50) | Inorganic | ML | Inorganic silts of low to medium plasticity, sandy silts, gravelly silts, or clayey silts with slight plasticity |
| | | | Inorganic | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| Organic | OL | | Organic silts and organic silty clays of low plasticity | | |
| Silts and Clays (liquid limit 50 or more) | Inorganic | | MH | Inorganic silts, micaceous or diatomaceous fine sands or silty soils, elastic silt | |
| | Inorganic | CH | Inorganic clays of medium to high plasticity, sandy fat clay, or gravelly fat clay | | |
| | Organic | OH | Organic clays of medium to high plasticity, organic silts | | |
| HIGHLY ORGANIC SOILS | Primarily organic matter, dark in color, and organic odor | PT | Peat, humus, swamp soils with high organic content (ASTM D4427) | | |

| Classification of Soil Constituents |
|---|
| <p>MAJOR constituents compose more than 50 percent, by weight, of the soil. Major constituents are capitalized (i.e., SAND).</p> <p>Minor constituents compose 12 to 50 percent of the soil and precede the major constituents (i.e., silty SAND). Minor constituents preceded by "slightly" compose 5 to 12 percent of the soil (i.e., slightly silty SAND).</p> <p>Trace constituents compose 0 to 5 percent of the soil (i.e., slightly silty SAND, trace gravel).</p> |

| Grain Size Definitions | |
|------------------------|-------------------------------|
| Description | Sieve Number and/or Size |
| Fines | < #200 (0.08 mm) |
| Sand | #200 to #40 (0.08 to 0.4 mm) |
| -Fine | #40 to #10 (0.4 to 2 mm) |
| -Medium | #10 to #4 (2 to 5 mm) |
| -Coarse | |
| Gravel | #4 to 3/4 inch (5 to 19 mm) |
| -Fine | 3/4 to 3 inches (19 to 76 mm) |
| -Coarse | |
| Cobbles | 3 to 12 inches (75 to 305 mm) |
| Boulders | >12 inches (305 mm) |

| Relative Density (Coarse Grained Soils) | | Consistency (Fine Grained Soils) | |
|--|---------------------|-------------------------------------|-------------------------|
| N, SPT, Blows/FT | Relative Density | N, SPT, Blows/FT | Relative Consistency |
| 0 - 4 | Very loose | Under 2 | Very soft |
| 4 - 10 | Loose | 2 - 4 | Soft |
| 10 - 30 | Medium dense | 4 - 8 | Medium stiff |
| 30 - 50 | Dense | 8 - 15 | Stiff |
| Over 50 | Very dense | 15 - 30 | Very stiff |
| | | Over 30 | Hard |

| Moisture Content Definitions | |
|------------------------------|--|
| Dry | Absence of moisture, dusty, dry to the touch |
| Moist | Damp but no visible water |
| Wet | Visible free water, from below water table |



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 P.O. Box 82243
 Kenmore, WA 98028
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www.cobaltgeo.com
cobaltgeo@gmail.com

Soil Classification Chart

Figure C1

Test Pit TP-1

| Date: October 2023 | | Depth: 8' | | Groundwater: None | | |
|--------------------|----------|----------------|-------------|---|-------------|--|
| Contractor: Jim | | Elevation: N/A | | Logged By: PH Checked By: SC | | |
| Depth (Feet) | Interval | Graphic Log | USCS Symbol | Material Description | Groundwater | Moisture Content (%) |
| | | | | | | Plastic Limit -----●----- Liquid Limit |
| | | | | | | DCP Equivalent N-Value |
| | | | | | | 0 10 20 30 40 50 |
| 1 | | | | Grass and Topsoil | | |
| 2 | ■ | | SM | Loose to medium dense, silty-fine to fine grained sand with gravel, mottled yellowish brown to grayish brown, moist. (Weathered Glacial Till) | | |
| 3 | | | | Mottling at 3.75 to 4.1 feet | | |
| 4 | | | SM | Dense to very dense, silty-fine to medium grained sand with gravel, grayish brown to olive gray, moist. (Glacial Till) | | |
| 5 | | | | | | |
| 6 | ■ | | | | | |
| 7 | | | | | | |
| 8 | | | | End of Test Pit 8' | | |
| 9 | | | | | | |
| 10 | | | | | | |

Test Pit TP-2

| Date: October 2023 | | Depth: 8' | | Groundwater: None | | |
|--------------------|----------|----------------|-------------|---|-------------|--|
| Contractor: Jim | | Elevation: N/A | | Logged By: PH Checked By: SC | | |
| Depth (Feet) | Interval | Graphic Log | USCS Symbol | Material Description | Groundwater | Moisture Content (%) |
| | | | | | | Plastic Limit -----●----- Liquid Limit |
| | | | | | | DCP Equivalent N-Value |
| | | | | | | 0 10 20 30 40 50 |
| 1 | | | | Grass and Topsoil | | |
| 2 | ■ | | SM | Loose to medium dense, silty-fine to medium grained sand with gravel, mottled reddish brown to yellowish brown, moist. (Weathered Glacial Till) | | |
| 3 | | | | Mottling at 3.75 to 4' | | |
| 4 | | | SM | Dense to very dense, silty-fine to medium grained sand with gravel, grayish brown, moist. (Glacial Till) | | |
| 5 | ■ | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | End of Test Pit 8' | | |
| 9 | | | | | | |
| 10 | | | | | | |



Proposed Residence
8456 SE 40th Street
Mercer Island, Washington

**Test Pit
Logs**

Cobalt Geosciences, LLC
P.O. Box 82243
Kenmore, WA 98028
(206) 331-1097
www.cobaltgeo.com
cobaltgeo@gmail.com

Hand Boring HB-1

| Date: April 2022 | | Depth: 6' | | Groundwater: None | | |
|------------------|----------|----------------|-------------|---|-------------|---|
| Contractor: | | Elevation: | | Logged By: PH Checked By: SC | | |
| Depth (Feet) | Interval | Graphic Log | USCS Symbol | Material Description | Groundwater | Moisture Content (%) |
| | | | | | | <div style="display: flex; align-items: center;"> Plastic Limit <div style="flex-grow: 1; border-bottom: 1px solid black; position: relative; margin: 0 5px;"> ● </div> Liquid Limit </div> |
| | | | | | | DCP Equivalent N-Value |
| | | | | | | 0 10 20 30 40 50 |
| 1 | | Topssoil/Grass | | | | |
| 2 | | SM | | Loose to medium dense, silty-fine to medium grained sand with gravel, dark yellowish brown, moist. (Weathered Glacial Till) | | |
| 3 | | | | | | |
| 4 | | SM | | Dense to very dense, silty-fine to medium grained sand with gravel, mottled yellowish brown to grayish brown, moist. (Glacial Till) | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | End of Hand Boring 6' | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |

Hand Boring HB-2

| Date: April 2022 | | Depth: 6' | | Groundwater: None | | |
|------------------|----------|----------------|-------------|---|-------------|---|
| Contractor: | | Elevation: | | Logged By: PH Checked By: SC | | |
| Depth (Feet) | Interval | Graphic Log | USCS Symbol | Material Description | Groundwater | Moisture Content (%) |
| | | | | | | <div style="display: flex; align-items: center;"> Plastic Limit <div style="flex-grow: 1; border-bottom: 1px solid black; position: relative; margin: 0 5px;"> ● </div> Liquid Limit </div> |
| | | | | | | DCP Equivalent N-Value |
| | | | | | | 0 10 20 30 40 50 |
| 1 | | Topssoil/Grass | | | | |
| 2 | | SM | | Loose to medium dense, silty-fine to medium grained sand with gravel, dark yellowish brown, moist. (Weathered Glacial Till) | | |
| 3 | | | | | | |
| 4 | | SM | | Dense to very dense, silty-fine to medium grained sand with gravel, mottled yellowish brown to grayish brown, moist. (Glacial Till) | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | End of Hand Boring 6' | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |



Proposed Residence
8456 SE 40th Street
Mercer Island, Washington


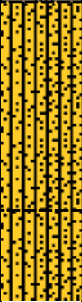
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cobaltgeo@gmail.com

Hand Boring HB-3

Date: April 2022 Depth: 6' Groundwater: None

Contractor: Elevation: Logged By: PH Checked By: SC

| Depth (Feet) | Interval | Graphic Log | USCS Symbol | Material Description | Groundwater | Moisture Content (%) | | | | | |
|--------------|----------|---|-------------|---|-------------|------------------------|--------------|----|----|----|----|
| | | | | | | Plastic Limit | Liquid Limit | | | | |
| | | | | | | DCP Equivalent N-Value | | | | | |
| | | | | | | 0 | 10 | 20 | 30 | 40 | 50 |
| | |  | | Topsoil/Grass | | | | | | | |
| 1 | |  | SM | Loose to medium dense, silty-fine to medium grained sand with gravel, dark yellowish brown, moist. (Weathered Glacial Till) | | | | | | | |
| 2 | ■ | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
| 5 | | | SM | Dense to very dense, silty-fine to medium grained sand with gravel, mottled yellowish brown to grayish brown, moist. (Glacial Till) | | | | | | | |
| 6 | ■ | | | | | | | | | | |
| 7 | | | | End of Hand Boring 6' | | | | | | | |
| 8 | | | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | | | | | | | | | | |



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