



Cobalt Geosciences, LLC
P.O. Box 82243
Kenmore, Washington 98028

October 4, 2022

Fall View LLC
C/O Land Pro Group
10515 20th Street SE, Suite 202
Lake Stevens, Washington

RE: Geotechnical Investigation
Proposed 39 Lot Subdivision
Parcel No.'s 27090500200300, 27090500200400, & 27090500201100
Gold Bar, 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 northwest of the intersection of May Creek Road and Ley Road in Gold Bar, Washington. The site consists of three adjoining parcels (No.'s 27090500200300, 27090500200400, and 27090500201100) with a total area of about 39 acres.

The property is mostly undeveloped and vegetated with grasses, blackberry vines, ferns, ivy, understory and variable diameter trees. There is a gravel driveway extending to a residence near the northwest corner of the property.

Most of the portions of the site where development is proposed is nearly level to slightly sloping downward in multiple directions. There are locally steep slopes north of the access driveway and in the western portion of the site extending downward to the north and west, respectively. These slopes have magnitudes of 20 to 35 feet and magnitudes ranging from 30 to 50 percent. These slopes appear to be consistent with former meanders of area rivers/streams.

The proposed development includes multiple new residential lots (potentially 39), roadways, utilities, and stormwater systems. Foundation loads will be light and site grading may include cuts and fills of 3 feet or less. Deeper excavations may be required for utilities and stormwater facilities.

Area Geology

The Geologic Map of the Skykomish 1:100,000 Quadrangle indicates that the site is underlain by Alluvium.

In this area, alluvium mostly consists of sand and gravel with local boulders and gravelly sands. These materials can locally grade downward into finer sands and local fine-grained materials. These deposits are mostly loose to medium dense.

Soil & Groundwater Conditions

As part of our evaluation, we excavated four test pits and four hand borings within the property, where accessible. Access was very difficult to most of the property due to very heavy vegetation and downed trees/obstructions.

The explorations encountered approximately 6 to 12 inches of vegetation and topsoil underlain by approximately 2.5 to 4 feet of loose to medium dense, silty-fine to medium grained sand trace to with gravel trace to with cobbles (Weathered Alluvium). These materials were underlain by medium dense, fine to medium grained sand trace to with gravel, cobbles and local boulders (Alluvium), which continued to the termination depths of the explorations. There were local interbeds of silty-sand within some of the explorations.

Groundwater was not encountered in the explorations during the field work. We note that severe caving occurred during the test pit excavation work; therefore, it was not possible to excavate below about 8 feet.

Based on our observations of the location of nearby ponds, suspected wetlands (inundated areas), rivers, and review of area topographic maps, groundwater is likely present between 190 and 205 feet above sea level. There is a possible wetland west of the site that has an elevation of about 190 feet. The Wallace River, north of the site, has an approximate elevation of 205 feet. Local river flood events could increase the elevation of groundwater for shorter duration periods.

It would be necessary to install one or more monitoring wells to determine seasonal high fluctuations of groundwater within the property. Based on the above information, groundwater would likely be 20 feet or more below site elevations.

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.

Landslide Hazards

Most critical area ordinances designate slopes with magnitudes greater than about 40 percent and vertical relief of at least 10 feet as potentially geologically hazardous (steep slope/landslide hazards).

The criteria that defines a landslide hazardous area in Snohomish County Code (SCC) 30.91L.040 was expanded to include lands within a distance from the top of the slope equal to the height of a slope and within a distance from the toe of the slope equal to two times the height of the slope. These changes are shown in legislative format below:

30.91L.040 Landslide hazard areas. "Landslide hazard areas" means areas potentially subject to mass earth movement based on a combination of geologic, topographic, and hydrologic factors, with a vertical height of 10 feet or more.

These include the following: (1) Areas of historic landslides as evidenced by landslide deposits, avalanche tracks, and areas susceptible to basal undercutting by streams, rivers or waves; (2) Areas with slopes steeper than 33 percent which intersect geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock, and which contain springs or ground water seeps; (3) Areas located in a canyon or an active alluvial fan, susceptible to inundation by debris flows or catastrophic flooding.

Most of the portions of the site where development is proposed is nearly level to slightly sloping downward in multiple directions. There are locally steep slopes north of the access driveway and in the western portion of the site extending downward to the north and west, respectively. These slopes have magnitudes of 20 to 35 feet and magnitudes ranging from 30 to 50 percent. These slopes appear to be consistent with former meanders of area rivers/streams.

The slope areas are well vegetated with trees and understory. We did not observe evidence of recent or historic landslide activity, severe erosion, or emergent groundwater (spring activity).

Overall, the slope areas within the site are stable at this time and do not currently constitute a landslide hazard area per the SCC. The proposed development may be located generally as proposed. We recommend a minimum 15 foot vegetated buffer from the top of steep slope areas (magnitudes of 33 percent or more) and a building setback of at least 25 feet. These values do not need to be additive.

Erosion Hazard

The Natural Resources Conservation Services (NRCS) maps for Snohomish County indicate that the site is underlain by Skykomish gravelly loam (0 to 30 percent slopes). Minor areas are underlain by Custer fine sandy loam and Sultan variant silt loam. These soils would have a slight to moderate 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 medium dense to very 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_I , 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	0.971	0.341	1.112	Null	0.72	Null	0.417

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 alluvial deposits which mostly consist of coarser sands and gravels with local interbeds of silty-sand.

The proposed residential structures may be supported on shallow foundation systems bearing on medium dense or firmer native soils or on structural fill placed on the native soils.

Local overexcavation or recompaction of loose weathered native soils may be necessary depending on the proposed elevations and locations of the new footings. All foundation subgrades should be evaluated during construction by the geotechnical engineer to determine if re-compaction is required.

Infiltration is generally feasible in the coarser alluvium that underlies most of the site. Any fill or fine grained soils should be removed if present in system excavations. The geotechnical engineer should be on site to verify soil conditions during construction.

We can provide additional recommendations once a civil plan has been prepared and/or if additional systems are under consideration for use. We should review the final plans to determine if additional recommendations are warranted.

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 large trees and in any areas underlain by undocumented fill.

The native soils consist of silty-sand with gravel, poorly graded sand, sand with gravel, and local sand with cobbles and boulders. Most of the coarse grained soils will be suitable for use as structural fill if they meet compaction and moisture requirements. Finer grained soils, where and if present, would be variably moisture sensitive. Cobbles larger than 3 inches should be removed prior to use as fill.

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 most of the construction. Any deeper temporary excavations should be sloped no steeper than 1.5H:1V (Horizontal:Vertical) in loose native soils and fill, and 1H:1V in medium 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 residential structures may be supported on shallow spread footing foundation systems 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. We should verify soil conditions during foundation excavation work. We recommend that all foundation subgrades be re-compacted (and verified by the geotechnical engineer) to at least 95 percent of the modified proctor as locally loose soils will likely be present.

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 structures. Provided that the footings are supported as recommended above, a net allowable bearing pressure of 2,000 pounds per square foot (psf) may be used for design. Detention vaults set at least 5 feet below grade may be designed using a bearing pressure of 5,000 psf.

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 225 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.

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)	18H* (Uniform Distribution) 1 in 2,500 year event
Seismic Increase for “At-rest” Conditions (Lateral Earth Pressure)	12H* (Uniform Distribution) 1 in 500 year event
Seismic Increase for “Active” Conditions (Lateral Earth Pressure)	6H* (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 Alluvium which mostly consists of fine to medium grained sand with gravel. Infiltration is suitable in these soil deposits. Groundwater was not encountered in the explorations. Based on our review of area topographic maps and locations of rivers/wetlands, groundwater could be present at variable depths below the site. Our interpretation would indicate groundwater at least 20 feet below grade; however, it would be necessary to utilize monitoring wells and winter-spring monitoring to confirm the groundwater elevations.

Because the alluvial deposits have not been overridden by glacial ice, this soil unit is considered normally-consolidated. The Washington State Department of Ecology 2019 Stormwater Management Manual for Western Washington allows determination of infiltration rates of this soil unit by Soil Particle Size Distribution testing. This method involves using a logarithmic equation and grain size values along with correction factors for testing type, soil homogeneity, and influent control.

The equation in conjunction with sieve analysis results yields design infiltration rates of between 3.8 and 4.1 inches per hour at depths of 3.5 to about 6 feet below grade. These rates reflect application of correction factors for variability (0.4 used), influent control (0.9), and testing analysis type (0.4). We should be provided with the final civil plans so that we may provide specific infiltration rates at specific system locations and depths. We recommend using the lower infiltration rate for system sizing/design or a Medium Sand designation from the USDA textural triangle (if applicable).

Infiltration systems should have a depth of at least 3.5 feet below existing grades and located at least 10 feet apart. Any fine grained soils or interbeds of fine grained soils must be removed prior to rock placement. We should verify soil conditions during excavation work.

We should be provided with final plans for review to determine if the intent of our recommendations has been incorporated or if additional modifications are needed. Verification testing of infiltration systems should be performed during construction by the geotechnical engineer.

Slab-on-Grade

We recommend that the upper 12 inches of the 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.

Pavements

The near surface subgrade soils generally consist of silty sand with gravel and poorly graded sand with gravel and silt. These soils are rated as good for pavement subgrade material (depending on silt content and moisture conditions). We estimate that the subgrade will have a California Bearing Ratio (CBR) value of 10 and a modulus of subgrade reaction value of $k = 200$ pci, provided the subgrade is prepared in general accordance with our recommendations.

We recommend that at a minimum, 18 inches of the existing subgrade material be moisture conditioned (as necessary) and re-compacted to prepare for the construction of pavement sections. Deeper levels of recompaction or overexcavation and replacement may be necessary in areas where fill and/or very poor (soft/loose) soils are present.

The subgrade should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D1557. In place density tests should be performed to verify proper moisture content and adequate compaction.

The recommended flexible and rigid pavement sections are based on design CBR and modulus of subgrade reaction (k) values that are achieved, only following proper subgrade preparation. It should be noted that subgrade soils that have relatively high silt contents will likely be highly sensitive to moisture conditions. The subgrade strength and performance characteristics of a silty subgrade material may be dramatically reduced if this material becomes wet.

Based on our knowledge of the proposed project, we expect the traffic to range from light duty (passenger automobiles) to heavy duty (delivery trucks). The following tables show the recommended pavement sections for light duty and heavy duty use.

ASPHALTIC CONCRETE (FLEXIBLE) PAVEMENT

LIGHT DUTY

Asphaltic Concrete	Aggregate Base*	Compacted Subgrade* **
2.5 in.	6.0 in.	18.0 in.

HEAVY DUTY

Asphaltic Concrete	Aggregate Base*	Compacted Subgrade* **
3.5 in.	6.0 in.	18.0 in.

PORTLAND CEMENT CONCRETE (RIGID) PAVEMENT

Min. PCC Depth	Aggregate Base*	Compacted Subgrade* **
6.0 in.	6.0 in.	18.0 in.

* 95% compaction based on ASTM Test Method D1557

** A proof roll may be performed in lieu of in place density tests

The asphaltic concrete depth in the flexible pavement tables should be a surface course type asphalt, such as Washington Department of Transportation (WSDOT) 1/2 inch HMA. The rigid pavement design is based on a Portland Cement Concrete (PCC) mix that has a 28 day compressive strength of 4,000 pounds per square inch (psi). The design is also based on a concrete flexural strength or modulus of rupture of 550 psi.

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 infiltration or stormwater system soil conditions
- 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 Fall View, LLC and their 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 Fall View, LLC 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



10/4/2022
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.

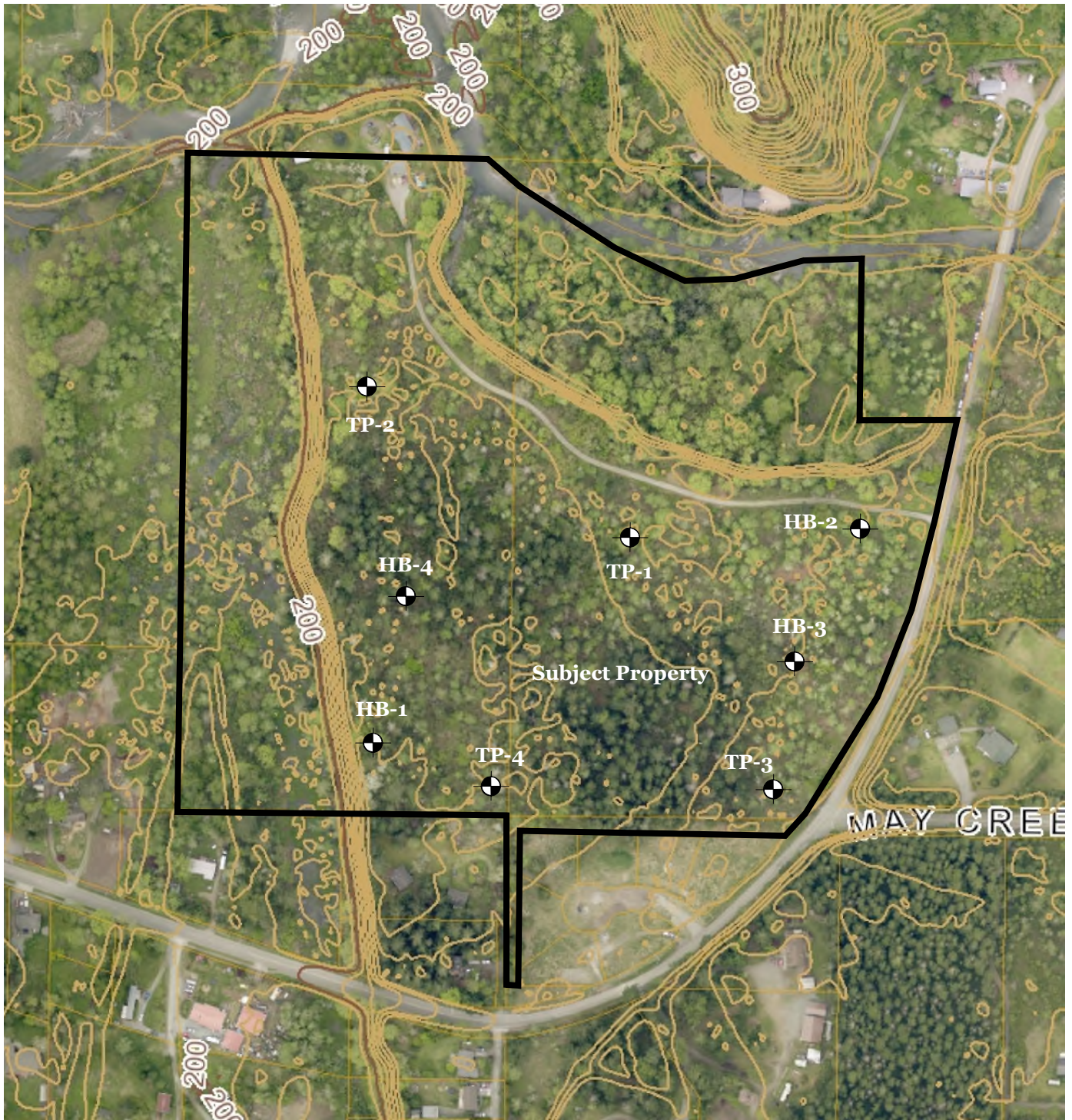
BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Cobalt Geosciences present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of 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.



Sno. Co. GIS Aerial Photo

HB-1
TP-1

**Approximate
 Test Pit and Hand Boring
 Location**



Not to Scale

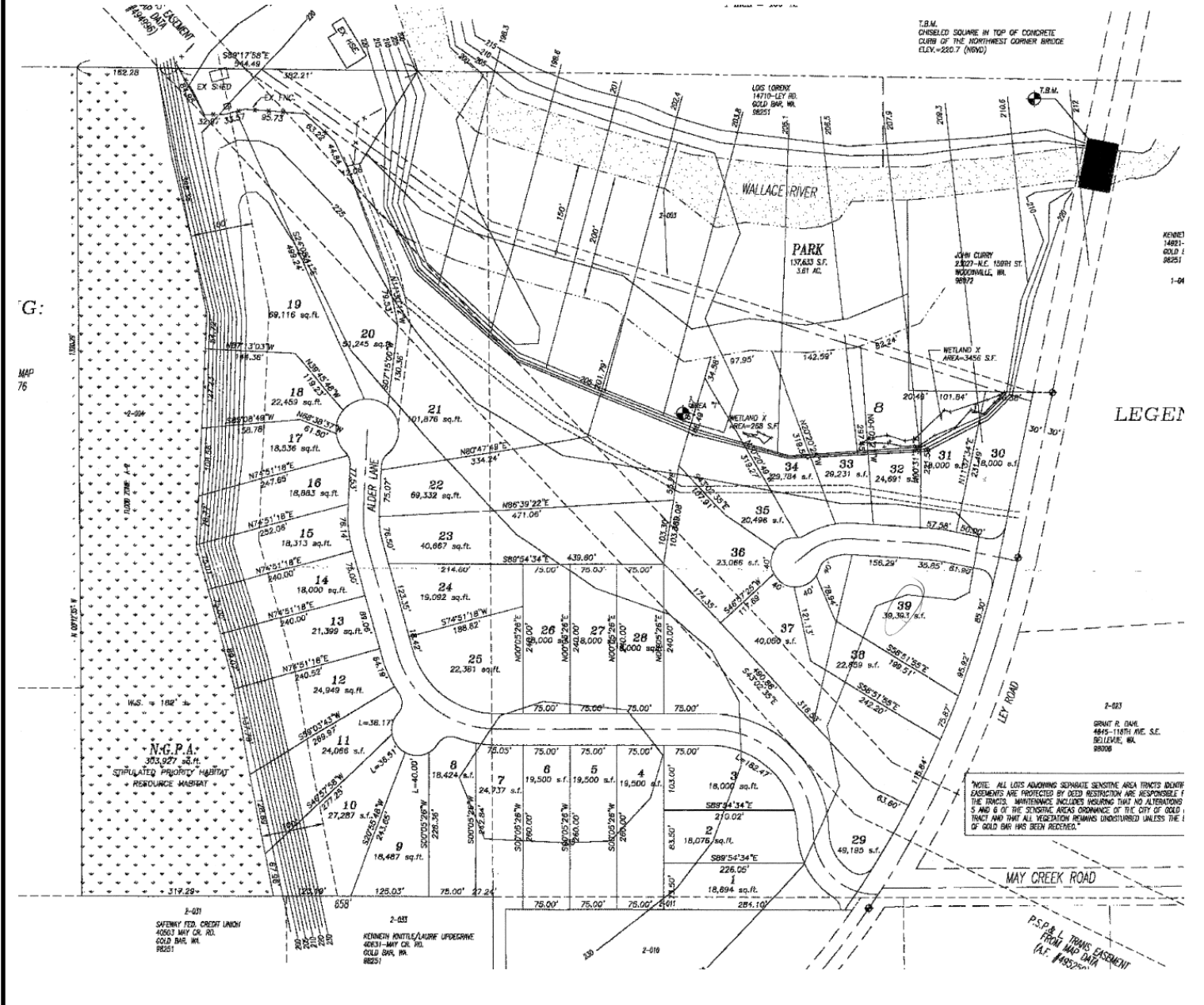


Proposed Residential Development
 May Creek Road
 Gold Bar, Washington

SITE MAP

FIGURE 1

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



Provided site layout.



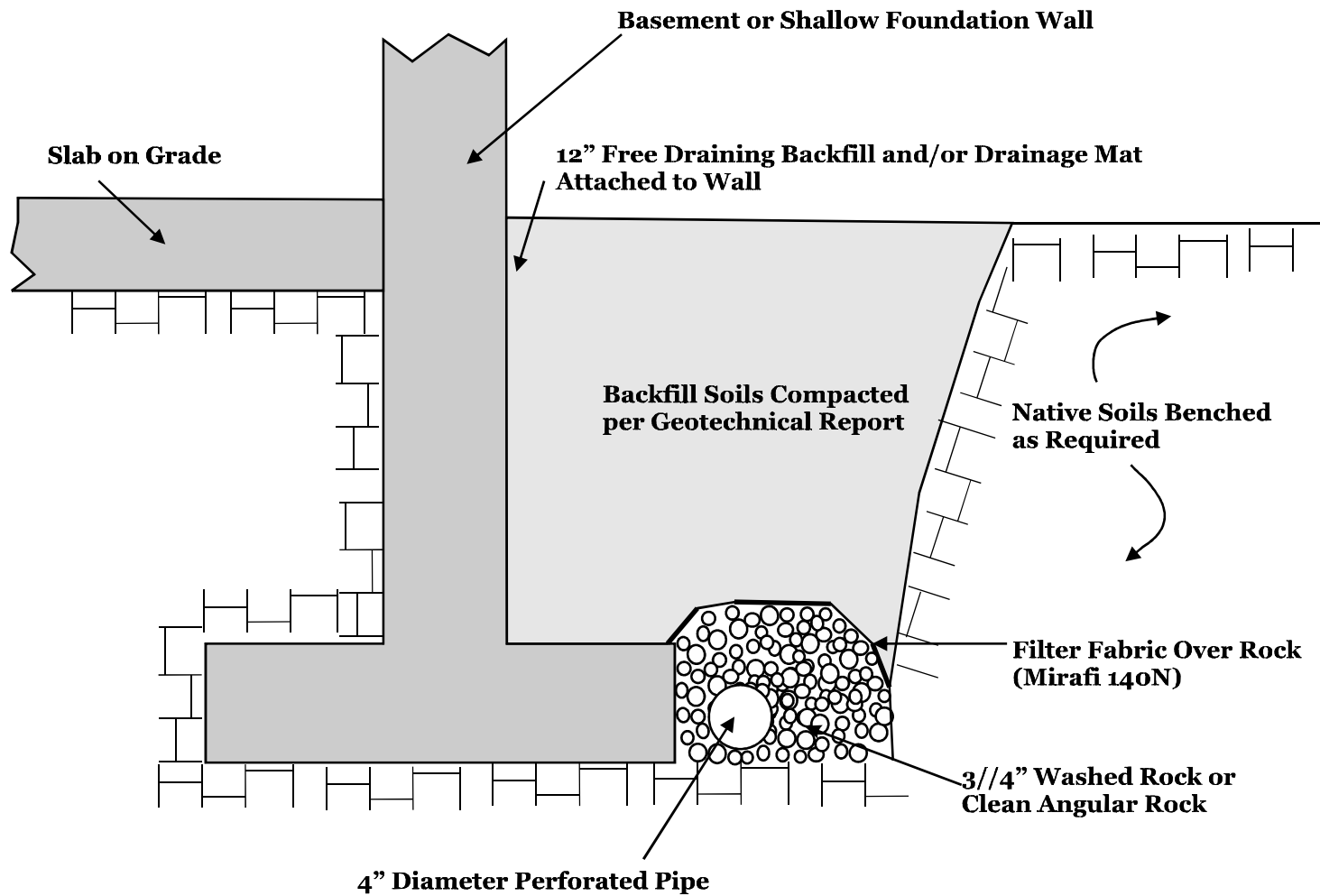
Not to Scale



Proposed Residential Development
 May Creek Road
 Gold Bar, Washington

SITE LAYOUT
FIGURE 2

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		
		FINE GRAINED SOILS (50% or more passes the No. 200 sieve)	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
Silts and Clays (liquid limit 50 or more)	Organic		OL	Organic silts and organic silty clays of low plasticity		
	Inorganic		MH	Inorganic silts, micaceous or diatomaceous fine sands or silty soils, elastic silt		
Silts and Clays (liquid limit 50 or more)	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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Soil Classification Chart

Figure C1

Test Pit TP-1

Date: September 2022	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
				Vegetation and Topsoil							
1			SM/SP	Loose to medium dense, silty-fine to medium grained sand with gravel mottled reddish brown to yellowish brown, moist to wet. (Weathered Alluvium)							
2	■		SP	Medium dense, fine to medium grained sand with gravel, local gravelly sands, trace to with cobbles and boulders, grayish brown, moist. (Alluvium)							
3				Local interbeds of silty-sand (less than 2 inches)							
4				Caving below 3 feet							
5	■										
6											
7											
8				End of Test Pit 8'							
9											
10											



Proposed Development
May Creek Road
Gold Bar, Washington

**Test Pit
Logs**

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Test Pit TP-2

Date: September 2022	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		
				Vegetation and Topsoil									
1			SM/SP	Loose to medium dense, silty-fine to medium grained sand with gravel mottled reddish brown to yellowish brown, moist to wet. (Weathered Alluvium)									
2	■												
3													
4													
5			SP	Medium dense, fine to medium grained sand with gravel, local gravelly sands, trace to with cobbles and boulders, grayish brown, moist. (Alluvium) Caving below 3.5 feet									
6	■												
7													
8													
9				End of Test Pit 8'									
10													



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Test Pit TP-3

Date: September 2022	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
				Vegetation and Topsoil							
1											
2	■		SM/ SP	Loose to medium dense, silty-fine to medium grained sand with gravel, mottled reddish brown to yellowish brown, moist to wet. (Weathered Alluvium)							
3				Local cobbles							
4			SP	Medium dense, fine to medium grained sand with gravel, local gravelly sands, trace to with cobbles and boulders, grayish brown, moist. (Alluvium)							
5	■			Local interbeds of silty-sand (less than 2 inches)							
6											
7				Caving below 4 feet							
8				End of Test Pit 8'							
9											
10											






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Test Pit TP-4

Date: September 2022	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		
				Vegetation and Topsoil									
1			SM/ SP	Loose to medium dense, silty-fine to medium grained sand with gravel mottled reddish brown to yellowish brown, moist to wet. (Weathered Alluvium)									
2	■												
3													
4			SP	Medium dense, fine to medium grained sand with gravel, local gravelly sands, trace to with cobbles and boulders, grayish brown, moist. (Alluvium) Local interbeds of silty-sand (less than 2 inches) Caving below 3 feet									
5	■												
6													
7													
8				End of Test Pit 8'									
9													
10													





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Hand Boring HB-1

Date: September 2022	Depth: 5'	Groundwater: None
Contractor: Cobalt	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		
				Vegetation and Topsoil									
1			SM/SP	Loose to medium dense, silty-fine to medium grained sand with gravel mottled reddish brown to yellowish brown, moist to wet. (Weathered Alluvium)									
2	■												
3													
4	■		SP	Medium dense, fine to medium grained sand with gravel, grayish brown, moist. (Alluvium)									
5				End of Hand Boring 5'									
6													
7													
8													
9													
10													



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Hand Boring HB-2

Date: September 2022	Depth: 5'	Groundwater: None
Contractor: Cobalt	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
		[Graphic Log: Topsoil]		Vegetation and Topsoil							
1		[Graphic Log: SM/SP Sand]	SM/SP	Loose to medium dense, silty-fine to medium grained sand with gravel mottled reddish brown to yellowish brown, moist to wet. (Weathered Alluvium)							
2	■										
3		[Graphic Log: SP Sand]	SP	Medium dense, fine to medium grained sand with gravel, grayish brown, moist. (Alluvium)							
4	■										
5				End of Hand Boring 5'							
6											
7											
8											
9											
10											



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Hand Boring HB-3

Date: September 2022	Depth: 5'	Groundwater: None
Contractor: Cobalt	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		
				Vegetation and Topsoil									
1			SM/SP	Loose to medium dense, silty-fine to medium grained sand with gravel mottled reddish brown to yellowish brown, moist to wet. (Weathered Alluvium)									
2	■												
3													
4	■		SP	Medium dense, fine to medium grained sand with gravel, grayish brown, moist. (Alluvium)									
5				End of Hand Boring 5' Refusal in gravel									
6													
7													
8													
9													
10													





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Hand Boring HB-4

Date: September 2022	Depth: 5'	Groundwater: None
Contractor: Cobalt	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
				Vegetation and Topsoil							
1			SM/ SP	Loose to medium dense, silty-fine to medium grained sand with gravel mottled reddish brown to yellowish brown, moist to wet. (Weathered Alluvium)							
2	■			Medium dense, fine to medium grained sand with gravel, grayish brown, moist. (Alluvium)							
3			■	SP	Medium dense, fine to medium grained sand with gravel, grayish brown, moist. (Alluvium)						
4				End of Hand Boring 5' Refusal in gravel							
5											
6											
7											
8											
9											
10											



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