COBALT
GEOSCIENCES

Geotechnical Investigation
Proposed Commercial Development

16xxx 51st Avenue NE
Marysville, Washington

March 7, 2020

Table of Contents

LIST OF APPENDICES

1.0 Introduction

In accordance with your authorization, Cobalt Geosciences, LLC (Cobalt) has completed a geotechnical investigation for the proposed commercial development located at 16xxx 51st Avenue NE in Marysville, Washington (Figure 1).

The purpose of the geotechnical investigation was to identify subsurface conditions and to provide geotechnical recommendations for foundation design, stormwater management, earthwork, soil compaction, and suitability of the on-site soils for use as fill.

The scope of work for the geotechnical evaluation consisted of a site investigation followed by engineering analyses to prepare this report. Recommendations presented herein pertain to various geotechnical aspects of the proposed development, including foundation support of the new building(s) and new pavements.

2.0 Project Description

The project includes construction of one or more commercial buildings, utilities, parking areas, and access roadways. We have not received a site plan showing the location of the new development. We should be provided with civil and structural plans when they become available.

Anticipated building loads are expected to be light to moderate and site grading will include cuts and fills on the order of 3 feet or less. Stormwater management will include infiltration devices, if feasible.

3.0 Site Description

The site is located at 16xxx 51st Avenue NE in Marysville, Washington (Figure 1). The property consists of four nearly rectangular shaped parcels (No.'s 31052700200700, 31052700201000, 31052700301100, and 31052700300100) with a total area of about 75 acres.

The site is currently undeveloped and vegetated with grasses, blackberry vines, and other low-lying vegetation. The property is nearly level to very slightly sloping in multiple directions. Topographic relief is less than 4 feet.

The site is bordered to the north, east, and south by commercial, residential, and agricultural properties, and to the west by 51st Avenue NE.

4.0 Field Investigation

4.1.1 Site Investigation Program

The geotechnical field investigation program was completed on February 21, 2020 and included excavating and sampling six hand borings within the property for subsurface analysis.

The soils encountered were logged in the field and are described in accordance with the Unified Soil Classification System (USCS).

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A Cobalt Geosciences field representative conducted the explorations, collected disturbed soil samples, classified the encountered soils, kept a detailed log of the explorations, and observed and recorded pertinent site features.

The results of the sampling are presented on the exploration logs enclosed in Appendix C.

5.0 Soil and Groundwater Conditions

5.1.1 Area Geology

The site lies within the Puget Lowland. The lowland is part of a regional north-south trending trough that extends from southwestern British Columbia to near Eugene, Oregon. North of Olympia, Washington, this lowland is glacially carved, with a depositional and erosional history including at least four separate glacial advances/retreats. The Puget Lowland is bounded to the west by the Olympic Mountains and to the east by the Cascade Range. The lowland is filled with glacial and non-glacial sediments consisting of interbedded gravel, sand, silt, till, and peat lenses.

The Geologic Map of Washington – Northwest Quadrant, indicates that the site is underlain by Vashon Recessional Outwash – Marysville Sand member.

Marysville Sand consists of normally consolidated sands with local interbeds of silt and clay. These materials are typically highly permeable with a high groundwater table.

Explorations

All of the hand borings encountered 6 to 18 inches of topsoil and grass underlain by 2 to 3 feet of loose to medium dense, fine to medium grained trace gravel trace to some silt (Weathered Marysville Sand). These materials were underlain by medium dense, fine to medium grained sand trace gravel (Marysville Sand), which continued to the termination depth of the hand borings.

5.1.2 Groundwater

Groundwater was encountered between approximately 1.75 and 2 feet below grade in the hand borings. Groundwater should be expected below the site between about 1.5 and 4 feet below grade. Groundwater appears to consist of a shallow regional aquifer in the area. There are numerous shallow monitoring wells installed throughout the property by the wetland consultant.

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.

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6.0 Geologic Hazards

6.1 Erosion Hazard

The Natural Resources Conservation Services (NRCS) maps for Snohomish County indicate that the site is underlain by Custer fine sandy loam and Norma loam. These soils would have a moderate to severe 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.

6.2 Seismic Hazard

The overall subsurface profile corresponds to a Site Class *D* as defined by Table 1613.5.2 of the 2015 International Building Code (2015 IBC). A Site Class *D* applies to an overall profile consisting of 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_1, F_a, and F_v. The USGS website includes the most updated published data on seismic conditions. The site specific seismic design parameters and adjusted maximum spectral response acceleration parameters are as follows:

PGA	(Peak Ground Acceleration, in percent of g)
S_S	106.30% of g
S_1	37.90% of g
F_A	1.075

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 shallow soils have a slight liquefaction potential. We can evaluate liquefaction potential upon request, particularly if habited or multi-story structures will be proposed.

7.0 DISCUSSION

7.1.1 General

The site is underlain by Marysville Sand that varies between loose and medium dense to about 4 feet below grade. Below about 4 feet, the soils are primarily medium dense. The proposed commercial building(s) may be supported on a shallow foundation system bearing on medium dense or firmer native soils, re-compacted native soils, and/or structural fill placed on suitable native soils.

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Localized infiltration may be feasible depending on the overall grading plan. In order to maintain clearance above groundwater, infiltration systems may need to be located at or near existing elevations which could require fill placement over much of the site. Permeable pavements may be considered for local flow control.

If excavations are planned that will extend below the water table, it may be necessary to install water-tight shoring with well points. We can provide additional recommendations upon request and once plans have been developed.

8.0 Recommendations

8.1.1 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 may be necessary if fill is encountered.

The native soils consist of silty-sand with gravel and poorly graded sand with gravel and silt. These 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.

8.1.2 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, mass grading, and utility placement. Excavations should be sloped no steeper than 1.5H:1V in loose to medium dense native soils and 1H:1V in medium dense soils above the groundwater table. 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.

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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.

8.1.3 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.

8.1.4 Foundation Design

The proposed commercial building(s) may be supported on a shallow spread footing foundation system bearing on undisturbed medium dense or firmer native soils or on properly compacted structural fill placed on the suitable native soils. If structural fill is used to support foundations, then the zone of structural fill should extend beyond the faces of the footing a lateral distance at least equal to the thickness of the structural fill.

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It will be necessary to re-compact any and all loose soils below foundation elevations. We recommend using a large vibratory roller or ho-pack to compact these materials. All excavation and compaction work should be monitored by the geotechnical engineer.

For shallow foundation support, we recommend widths of at least 18 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 2,000 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 ½ 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 allowable friction factor and allowable equivalent fluid passive pressure values include a factor of safety of 1.5. 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.

8.1.5 Stormwater Management

Infiltration is generally feasible in Marysville Sand; however, the limiting factor may be clearance above the groundwater table. Permeable pavements may be considered locally for flow control. In general, infiltration rates in Marysville Sand range from 4 to 8 inches per hour.

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In order to maintain at least 12 inches of clearance above groundwater, it would be necessary to fill the site at least 12 inches.

We can provide location-specific infiltration recommendations once civil plans have been prepared.

8.1.6 Slab-on-Grade

We recommend that the upper 12 inches of the existing fill and/or 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 180 pounds per cubic inch (pci) assuming the slab-on-grade base course is underlain by structural fill placed and compacted as outlined in Section 8.1. A 4 to 6 inch thick capillary break consisting of 5/8 inch clean angular rock or pea gravel should be placed over the prepared subgrade.

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.

8.1.7 Groundwater Influence on Construction

Groundwater was encountered between approximately 1.75 and 2 feet below grade in the hand borings. Groundwater should be expected below the site between about 1.5 and 4 feet below grade.

If groundwater is encountered, it may be necessary to install several well points around excavations to adequately lower the groundwater table. Any system should be designed by the contractor. We can provide additional recommendations upon request.

8.1.8 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.

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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, sandy 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.Smoke3y 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.

8.1.9 Pavement Recommendations

The near surface subgrade soils generally consist of sand with silt and gravel. 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, 12 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. Any soils that cannot be compacted to required levels should be removed and replaced with imported structural fill.

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.

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ASPHALTIC CONCRETE (FLEXIBLE) PAVEMENT

LIGHT DUTY

Asphaltic Concrete	Aggregate Base*	Compacted Subgrade* **
2.5 in.	6.0 in.	12.0 in.

HEAVY DUTY

Asphaltic Concrete	Aggregate Base*	Compacted Subgrade* **
3.5 in.	6.0 in.	12.0 in.

PORTLAND CEMENT CONCRETE (RIGID) PAVEMENT

Min. PCC Depth	Aggregate Base*	Compacted Subgrade* **
6.0 in.	6.0 in.	12.0 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) ½ 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.

9.0 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
- Verify infiltration system soils, if utilized
- Monitor subgrade preparation of roadways
- Observe excavation stability

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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.

10.0 Closure

This report was prepared for the exclusive use of John Sandstrom and his 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 John Sandstrom 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.

Respectfully submitted,

Cobalt Geosciences, LLC

Original signed by:

Exp. 6/26/2020

Phil Haberman, PE, LG, LEG
Principal

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APPENDIX A
Statement of General Conditions

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.

APPENDIX B
Figures: Vicinity Map, Site Plan

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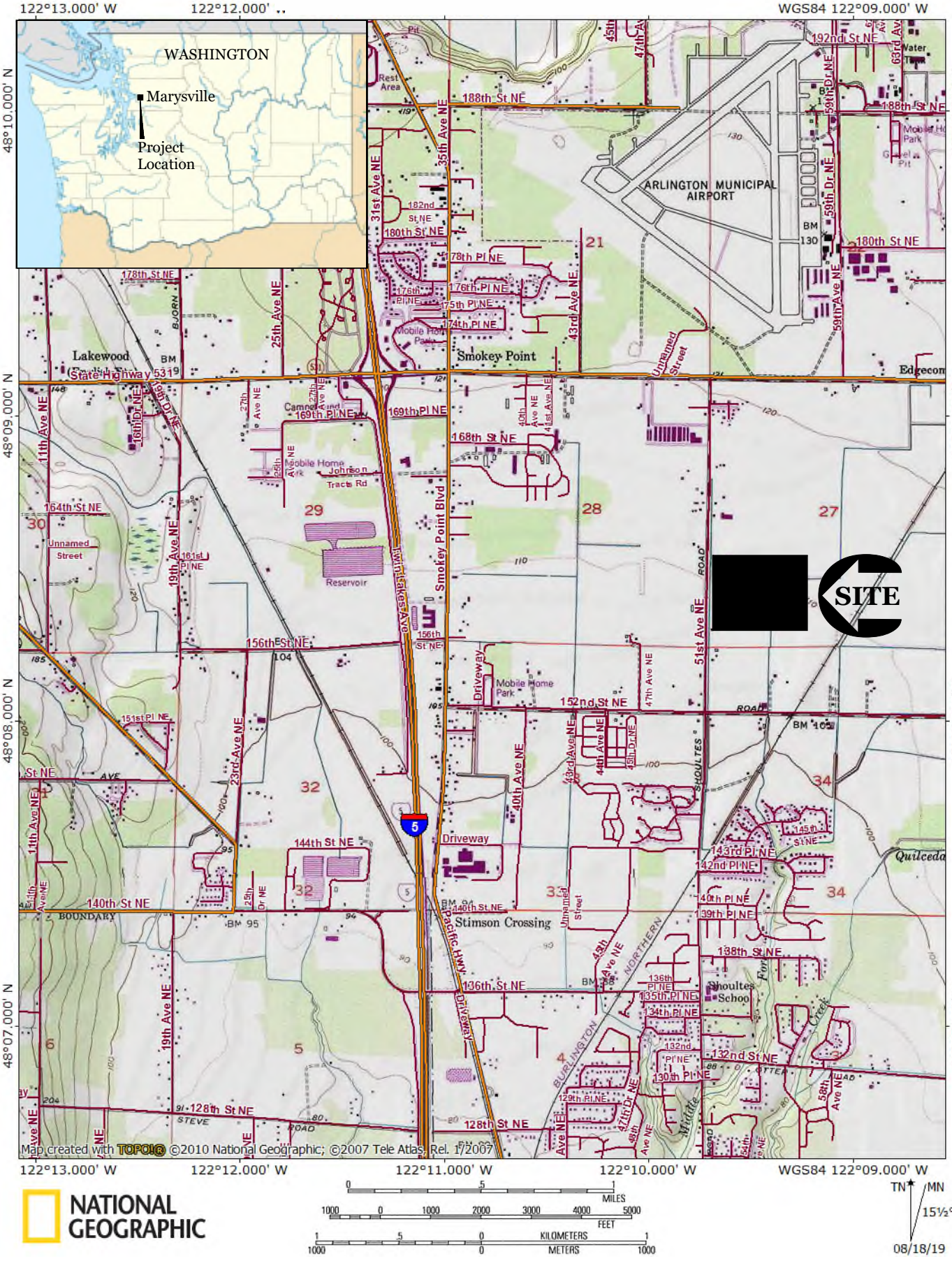

COBALT GEOSCIENCES

Proposed Commercial Development
16xxx 51st Avenue NE
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VICINITY MAP
FIGURE 1

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HB-1 **Approximate Hand Boring Location**

N

Not to Scale

COBALT GEOSCIENCES	Proposed Commercial Development 16xxx 51st Avenue NE Marysville, Washington	**SITE PLAN** **FIGURE 2**	Cobalt Geosciences, LLC P.O. Box 82243 Kenmore, WA 98028 (206) 331-1097 www.cobaltgeo.com cobaltgeo@gmail.com

APPENDIX C
Exploration Logs

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
			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
			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
			SP	Poorly graded sand, gravelly sands, little or no fines
		Sands with Fines (more than 12% fines)	SM	Silty sands, sand-silt mixtures
			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
			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
			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

MAJOR constituents compose more than 50 percent, by weight, of the soil. Major constituents are capitalized (i.e., SAND).

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).

Trace constituents compose 0 to 5 percent of the soil (i.e., slightly silty SAND, trace gravel).

Grain Size Definitions

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

Relative Density (Coarse Grained Soils)

N, SPT, Blows/FT	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
Over 50	Very dense

Consistency (Fine Grained Soils)

N, SPT, Blows/FT	Relative Consistency
Under 2	Very soft
2 - 4	Soft
4 - 8	Medium stiff
8 - 15	Stiff
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

Log of Hand Boring HB-1

Date: February 21, 2020	Depth: 6'	Initial Groundwater: 1.75'
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
						Vegetation/Topsoil
1					SP/ SM	Loose to medium dense, fine to medium grained sand trace gravel trace to some silt, yellowish brown to grayish brown, moist. (Weathered Recessional Outwash - Marysville Sand)
2	■					
3					SP	Medium dense, fine to medium grained sand trace gravel, grayish brown, moist. (Recessional Outwash - Marysville Sand)
4	■					
5						
6						End of Hand Boring 6'
7						
8						
9						
10						

Groundwater ▼

Moisture Content (%)
Plastic Limit — Liquid Limit

DCP Equivalent N-Value
0 10 20 30 40 50

COBALT GEOSCIENCES

Proposed Comm. Development
16xxx 51st Avenue NE
Marysville, Washington

Hand Boring Log

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

Log of Hand Boring HB-2

Date: February 21, 2020	Depth: 6'	Initial Groundwater: 2'
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
1						Vegetation/Topsoil
2	■				SP/ SM	Loose to medium dense, fine to medium grained sand trace gravel trace to some silt, yellowish brown to grayish brown, moist. (Weathered Recessional Outwash - Marysville Sand)
3						
4	■				SP	Medium dense, fine to medium grained sand trace gravel, grayish brown, moist. (Recessional Outwash - Marysville Sand)
5						
6						End of Hand Boring 6'
7						
8						
9						
10						

Groundwater ▼

Moisture Content (%)
Plastic Limit — Liquid Limit

DCP Equivalent N-Value
0 10 20 30 40 50

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Log of Hand Boring HB-3

Date: February 21, 2020	Depth: 6'	Initial Groundwater: 1.75'
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
						Vegetation/Topsoil
1					SP/ SM	Loose to medium dense, fine to medium grained sand trace gravel trace to some silt, yellowish brown to grayish brown, moist. (Weathered Recessional Outwash - Marysville Sand)
2	■					
3					SP	Medium dense, fine to medium grained sand trace gravel, grayish brown, moist. (Recessional Outwash - Marysville Sand)
4	■					
5						
6						End of Hand Boring 6'
7						
8						
9						
10						

Groundwater ▼

Moisture Content (%)
Plastic Limit — Liquid Limit

DCP Equivalent N-Value
0 10 20 30 40 50

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Log of Hand Boring HB-4

Date: February 21, 2020	Depth: 6'	Initial Groundwater: 1.75'
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
0						Vegetation/Topsoil
1					SP/ SM	Loose to medium dense, fine to medium grained sand trace gravel trace to some silt, yellowish brown to grayish brown, moist. (Weathered Recessional Outwash - Marysville Sand)
2	■					
3					SP	Medium dense, fine to medium grained sand trace gravel, grayish brown, moist. (Recessional Outwash - Marysville Sand)
4	■					
5						
6						End of Hand Boring 6'
7						
8						
9						
10						

Groundwater ▼

Moisture Content (%)
Plastic Limit — Liquid Limit

DCP Equivalent N-Value
0 10 20 30 40 50

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Log of Hand Boring HB-5

Date: February 21, 2020	Depth: 6'	Initial Groundwater: 2'
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
1						Vegetation/Topsoil
2	■				SP/ SM	Loose to medium dense, fine to medium grained sand trace gravel trace to some silt, yellowish brown to grayish brown, moist. (Weathered Recessional Outwash - Marysville Sand)
3						
4	■				SP	Medium dense, fine to medium grained sand trace gravel, grayish brown, moist. (Recessional Outwash - Marysville Sand)
5						
6						End of Hand Boring 6'
7						
8						
9						
10						

Groundwater ▼

Moisture Content (%)
Plastic Limit — Liquid Limit

DCP Equivalent N-Value
0 10 20 30 40 50

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Log of Hand Boring HB-6

Date: February 21, 2020	Depth: 6'	Initial Groundwater: 2'
Contractor:	Elevation: N/A	Sample Type: Grab
Method: Hand Auger	Logged By: PH Checked By: SC	Final Groundwater: N/A

Depth (Feet)	Interval	% Recovery	Blows/6"	Graphic Log	USCS Symbol	Material Description
						Vegetation/Topsoil
1					SP/ SM	Loose to medium dense, fine to medium grained sand trace gravel trace to some silt, yellowish brown to grayish brown, moist. (Weathered Recessional Outwash - Marysville Sand)
2	■					
3						
4	■				SP	Medium dense, fine to medium grained sand trace gravel, grayish brown, moist. (Recessional Outwash - Marysville Sand)
5						
6						End of Hand Boring 6'
7						
8						
9						
10						

Groundwater: ▼ at 2'

Moisture Content (%): Plastic Limit — Liquid Limit

DCP Equivalent N-Value: 0 10 20 30 40 50

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Marysville, Washington

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