



Cobalt Geosciences, LLC
P.O. Box 82243
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August 18, 2020

Igor Tsapenko
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RE: Limited Geotechnical Evaluation
Proposed Residential Development
13020 NE 80th Street
Kirkland, Washington

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

The purpose of our evaluation was to determine the feasibility of utilizing infiltration devices for stormwater runoff management along with providing recommendations for foundation and retaining wall design.

Site and Project Description

The site is located at 13020 NE 80th Street in Kirkland, Washington. The site consists of one rectangular parcel (No. 7420400020) with a total area of about 18,150 square feet.

The southern portion of the property is developed with a single-family residence and driveway. The remainder of the property is undeveloped and vegetated with grasses, blackberry vines, ivy, ferns, and variable diameter trees. The site is nearly level to very slightly sloping in multiple directions.

The property is bordered to the north and west by residential properties, to the east by 131st Place NE, and to the south by NE 80th Street.

The project includes subdivision of the parcel followed by construction of one or two new homes. Stormwater management may include dispersion, detention, or infiltration facilities depending on feasibility.

Area Geology

The Geologic Map of King County indicates that the site is underlain by Vashon Advance Outwash.

Vashon Advance Outwash includes sand with minor amounts of gravel and local silt interbeds. These materials are typically permeable and can interfinger with Vashon Glacial Till. These soils can resemble Ice Contact Deposits in some areas.

Soil & Groundwater Conditions

As part of our evaluation, we excavated one test pit and one hand boring within the property to determine the shallow soil and groundwater conditions, where accessible.

The explorations encountered about 6 inches of topsoil and grass underlain by 4.5 to 5 feet of loose to medium dense, silty-fine to medium grained sand trace gravel (Weathered Advance Outwash). This layer was underlain by dense, fine to medium grained sand trace gravel (Outwash), which continued to the termination depths of the explorations.

Groundwater was not encountered in the explorations during the field work. There is slight chance that groundwater will be present below the site. We reviewed historic explorations conducted at Rose Hill Elementary. Moist to wet soils were locally present 11 to 13 feet below grade in some of the borings. For the purposes of infiltration system design, we recommend assuming a seasonal high groundwater table of 9 feet below grade.

Stormwater Management Feasibility

The site is underlain by weathered and unweathered Vashon Advance Outwash. These soils are typically permeable, particularly below the weathered zone.

We performed an in-situ infiltration test (Small Scale PIT) in TP-1 at a depth of approximately 6 feet below grade. After testing and application of correction factors for site variability (0.5), testing (0.5), and influent control (0.9), the infiltration rate was 1.1 inches per hour. We used a slightly higher variability factor to account for localized areas of silty-sand and pieces of till-like material. We excavated the area after testing and did not encounter groundwater or restrictive layers.

We recommend utilizing infiltration drywells using the design rate or sized per the “Medium Sand” criteria described in the King County Surface Water Design Manual, if applicable. Drywells should be located at least 10 feet from property lines and structures and set at a depth of 6 to 8 feet below grade.

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.

Foundation Design

The proposed residences 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 should be removed and replaced with structural fill below foundation elements. Structural fill below footings should consist of clean angular rock 5/8 to 2 inches in size.

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 2,000 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 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 if any concrete walls are proposed in yard areas.

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)	11H* (Uniform Distribution)
Seismic Increase for “Active” Conditions (Lateral Earth Pressure)	6H* (Uniform Distribution)
Passive Earth Pressure on Low Side of Wall (Allowable, includes F.S. = 1.5)	Neglect upper 2 feet, then 300 pcf EFD ⁺
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.

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.

Closure

The information presented herein is based upon professional interpretation utilizing standard practices and a degree of conservatism deemed proper for this project. We emphasize that this report is valid for this project as outlined above and for the current site conditions and should not be used for any other site.

Sincerely,

Cobalt Geosciences, LLC



8/18/2020
Phil Haberman, PE, LG, LEG
Principal

PH/sc



TP-1
HB-1



**Approximate Test Pit &
Hand Boring Location**



Proposed Two Lot Development
13020 NE 80th Street
Kirkland, Washington

SITE PLAN
FIGURE 1

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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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Soil Classification Chart

Figure C1

Test Pit TP-1

Date: July 30, 2020		Depth: 10'		Groundwater: None		
Contractor: Jim		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
1				Topsoil/Grass		
2			SM/SP	Loose to medium dense, silty-fine to medium grained sand trace gravel, reddish brown to yellowish brown, dry to moist. (Weathered Advance Outwash)		
3						
4						
5						
6			SP	Medium dense to dense, fine to medium grained sand trace gravel, grayish brown, moist. (Advance Outwash)		
7						
8				-Local SM and Cemented Pieces of Till or Ice Contact Deposits		
9						
10				End of Test Pit 10'		

Hand Boring HB-1

Date: July 30, 2020		Depth: 7'		Groundwater: None		
Contractor: Cobalt		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
1				Topsoil/Grass		
2			SM	Loose to medium dense, silty-fine to medium grained sand trace gravel, reddish brown to yellowish brown, dry to moist. (Weathered Advance Outwash)		
3						
4						
5			SP	Medium dense to dense, fine to medium grained sand trace gravel, grayish brown, moist. (Advance Outwash)		
6						
7				End of Hand Boring 7'		
8						
9						
10						



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**Test Pit &
Hand Boring
Logs**

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