COBALT GEOSCIENCES

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

March 14, 2022

Matthew Strittmatter
mstrittmatter@thebluelinegroup.com

RE: Groundwater Elevation Evaluation
Proposed Development
9110 53rd Avenue West
Mukilteo, Washington

In accordance with your authorization, Cobalt Geosciences, LLC has prepared this letter to discuss the results of our groundwater elevation evaluation at the site. In preparation of this letter, we have reviewed the provided civil plans dated March 30, 2021 by Blueline Group and the previous geotechnical report for the project dated July 30, 2021 by Earth Solutions Northwest (ESNW).

The plans indicate that the development will include seven new residential lots, an access roadway, retaining walls, and a detention vault. The detention vault will be located in the eastern portion of the site below the new access roadway. The vault will extend about 16 feet below existing grade in that area.

We anticipate that stormwater runoff from new driveways, roadways, and roof areas will be collected and routed to the detention vault with overflow to City infrastructure. We are not aware of the use of infiltration systems at the site. The plans show retaining walls will be located near the west property line and near the southeast corner of the property, supporting new structural fills.

We understand that the City of Mukilteo requested seasonal high groundwater elevations at the site and a discussion of "how surface and groundwater will move through the site to the proposed wall footing drains."

The site is located near the top of a low ridge that slopes downward to the east and west at variable magnitudes. There are steeper slopes near the west property line above existing residential developments. The City notes that there have been drainage issues within downslope developments, including surface water runoff, local groundwater at shallow depths, and ponding.

The site elevations range from about 410 to 380 feet above sea level with the lower elevations located near the west property line within a moderately steep slope area. There is a possible wetland area located several hundred feet east of the property at or near an elevation of 393 feet above sea level. Figure 1 shows the area topography relative to the site. Figure 2 is a light detection and ranging (LiDAR) map showing the surface features in this area.

There are local ravine/gully features north and west of the site, sloping downward to the west would presumably be an area where groundwater and surface waters are most easily conveyed/flow (path of least resistance).

Soil & Groundwater Conditions

As part of our evaluation, we excavated two test pits at the site where accessible to supplement the work previously performed by ESNW; specifically, to determine if groundwater is present at the site at shallow depths below the site. This work was conducted in early March 2022, during the typical wet season. The previous test pits by ESNW were conducted in June 2021 and did not encounter groundwater to the depths explored.

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

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.

Our test pits encountered approximately 12 inches of vegetation and topsoil underlain by approximately 5 to 7 feet of loose to medium dense, silty-fine to medium grained sand with gravel (Weathered Glacial Till or Drift). These materials were underlain by dense to very dense, silty-fine to medium grained sand with gravel (Glacial Till or Drift), which continued to the termination depths of the explorations.

Groundwater was not encountered in the test pits during our excavation work. Based on the soil conditions and topography, it appears that groundwater is at an elevation of 375 feet above sea level or lower within the property.

This part of Mukilteo is mapped as being underlain by Vashon Glacial Till which is typically dense and impermeable. We encountered soils generally consistent with a coarser glacial till (ablation till). Vashon Advance Outwash is mapped within the ravine features west and downslope of the site.

Based on the presence of an apparent wetland east of the site (surface expression of likely groundwater) and large upslope areas that contribute to surface and shallow groundwater, it is our opinion that there are areas where surface waters become ponded on fine grained till. This surface water slowly infiltrates and migrates along the denser till, likely downward to the west until the groundwater either emanates from slopes as spring activity, is intercepted by drainage features (utility trenches, subsurface collection drains), or flows into the outwash sands that underlie the till.

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.

Conclusions and Recommendations

The site is underlain by coarser glacial till which becomes denser with depth. We did not observe groundwater in our recent test pits or any signs that groundwater becomes perched within the till. It appears that groundwater in this area is well below the site elevations, likely perched on finer grained dense glacial till likely slowing migrating to the west.

The proposed development includes collection of all runoff from new impervious surfaces with routing into a detention vault. The overflow for the vault is anticipated to be connected to City infrastructure. This should result in a net decrease in the volume of precipitation that currently falls onto the property and presumably either infiltrates down to the groundwater table or

migrates laterally over the ground or at shallow depths and onto adjacent properties. The project civil engineer's runoff calculations should confirm the anticipated change in runoff for pre- and post-development conditions.

The retaining wall drain systems will collect any built-up surface water (from precipitation primarily) and direct it from behind the walls. This is necessary since most retaining walls are designed under drained conditions and would fail if the backfill soils become saturated. We do not expect these drains to collect much stormwater based on the soil conditions observed.

Closure

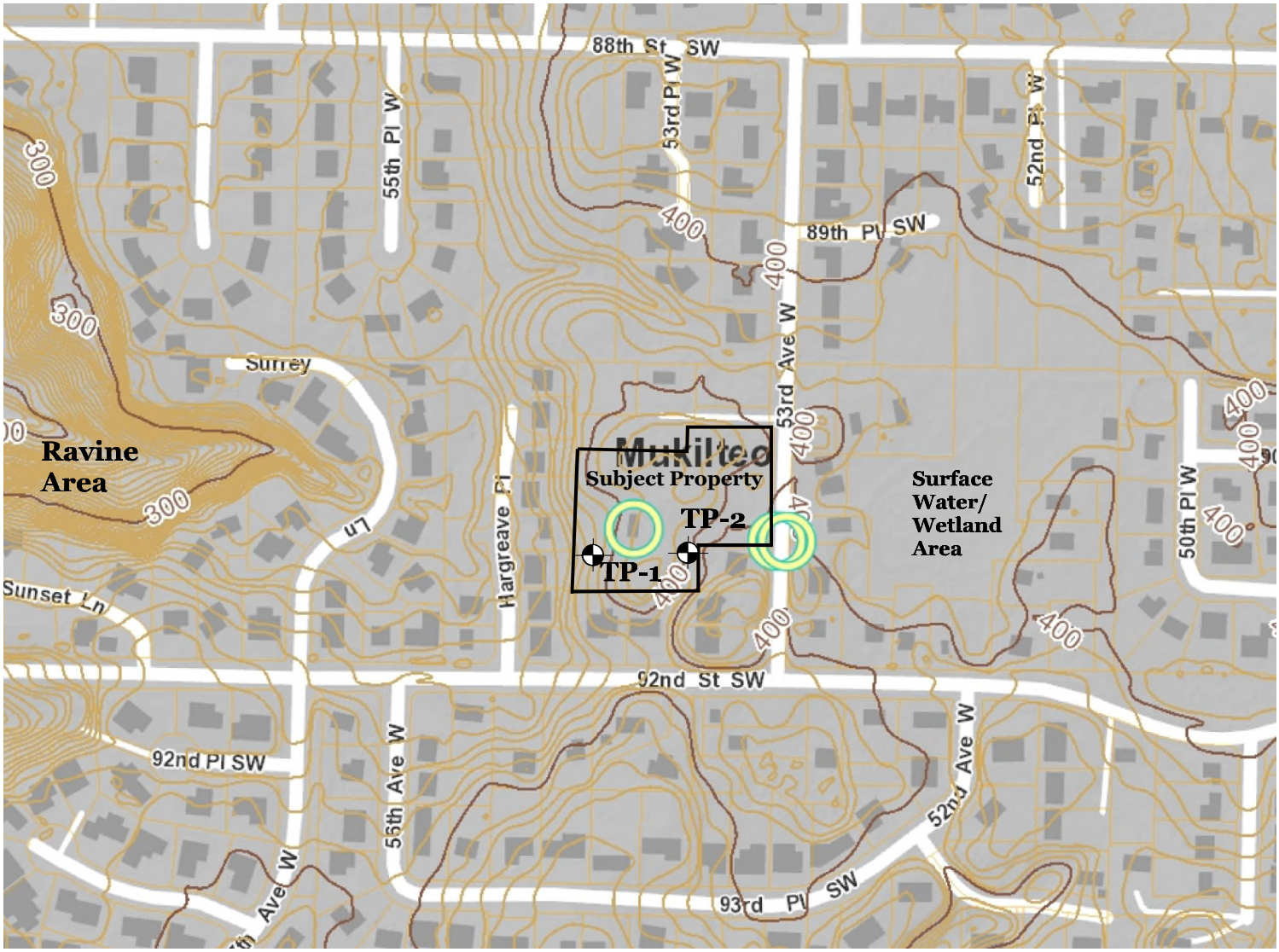
The recommendations contained in this report are based on assumed continuity of soils with those of our test holes and planned grading/drainage systems. Cobalt Geosciences should be provided with final civil drawings when they become available in order that we may review our design recommendations and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

Sincerely,

Cobalt Geosciences, LLC

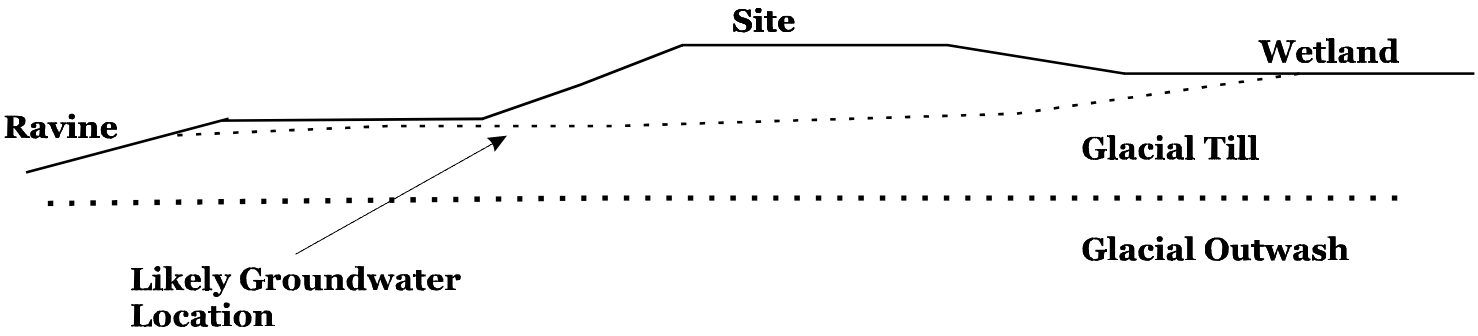
3/14/2022

Phil Haberman, PE, LG, LEG
Principal



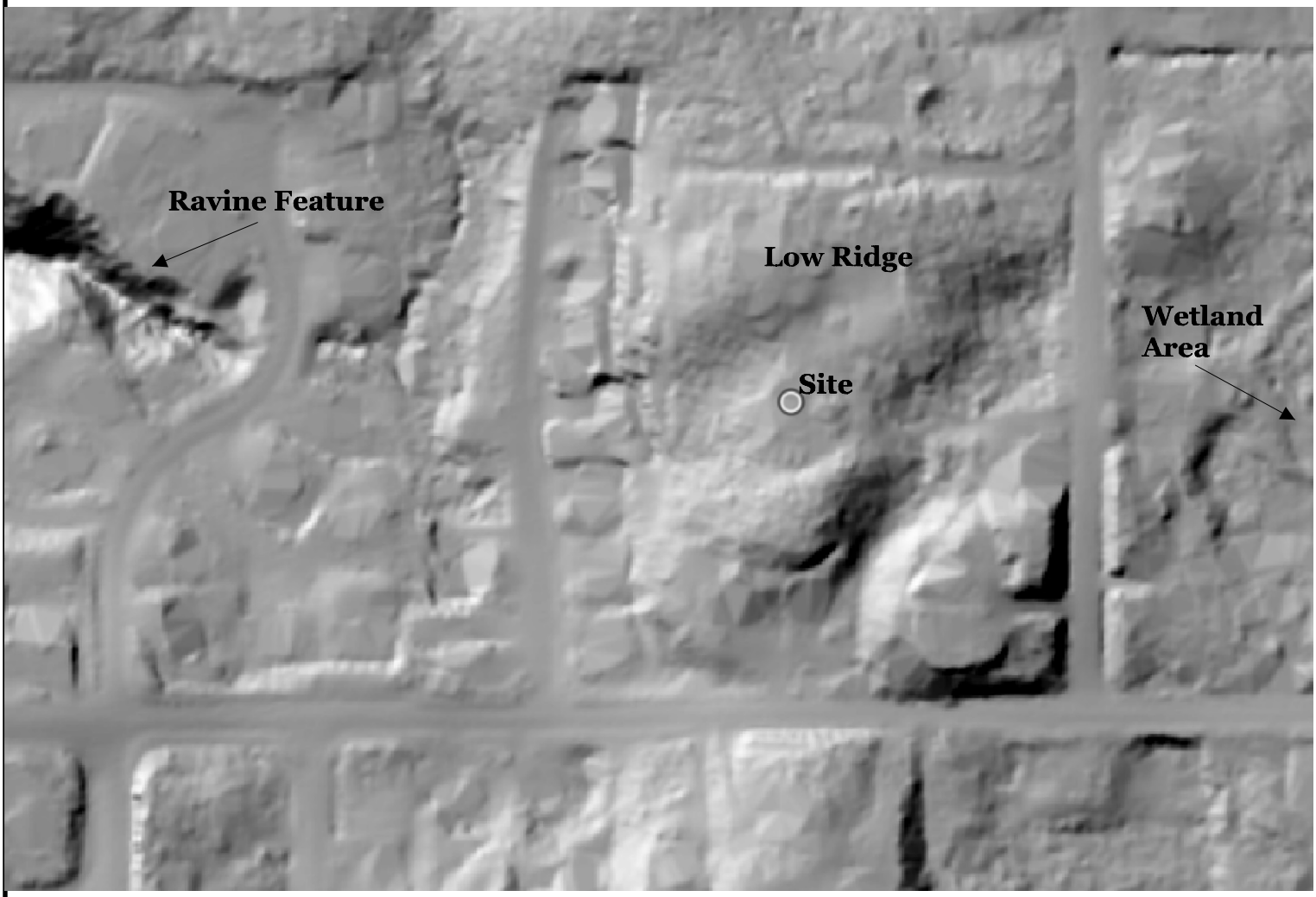
TP-1 **Approximate Test Pit Location**

N



Generalized Section

COBALT GEOSCIENCES	Proposed Development 9110 53rd Avenue West Mukilteo, Washington	**SITE MAP** **FIGURE 1**	Cobalt Geosciences, LLC P.O. Box 82243 Kenmore, WA 98028 (206) 331-1097 www.cobaltgeo.com cobaltgeo@gmail.com



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LIDAR IMAGE FIGURE 2

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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
			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

Test Pit TP-1

Date: March 2022	Depth: 14'	Groundwater: None
Contractor: Jim	Elevation:	Logged By: PH Checked By: SC

Depth (Feet)	Interval	Graphic Log	USCS Symbol	Material Description
				Topsoil/Vegetation
			SM	Loose to medium dense, silty-fine to medium grained sand with gravel, reddish brown to yellowish brown, moist to wet. (Weathered Glacial Till) Locally gradational with SP-SM
8			SM	Dense to very dense, silty-fine to medium grained sand with gravel, grayish brown, moist. (Glacial Till)
14				End of Test Pit 14'

Groundwater

Moisture Content (%)
Plastic Limit — Liquid Limit

DCP Equivalent N-Value
0 10 20 30 40 50

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Test Pit TP-2

Date: March 2022	Depth: 14'	Groundwater: None
Contractor: Jim	Elevation:	Logged By: PH Checked By: SC

Depth (Feet)	Interval	Graphic Log	USCS Symbol	Material Description	Groundwater
				Topsoil/Vegetation	
4			SM	Loose to medium dense, silty-fine to medium grained sand with gravel, reddish brown to yellowish brown, moist to wet. (Weathered Glacial Till) Locally gradational with SP-SM	
8			SM	Dense to very dense, silty-fine to medium grained sand with gravel, grayish brown, moist. (Glacial Till)	
14				End of Test Pit 14'	
16					
18					
20					

Moisture Content (%)
Plastic Limit — Liquid Limit

DCP Equivalent N-Value
0 10 20 30 40 50

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Test Pit Logs

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