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May 21, 2020

Steven Dahl
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Re: **Geologic Hazard Assessment**
Proposed surface mine expansion
Skagit County Parcel P44865

Dear Mr. Dahl:

This geologic hazard assessment was conducted to assess the risk of erosion and landslide hazards on the subject property and to determine whether the planned expansion of the existing surface gravel mine would increase the risk of significant erosion or landsliding.

Based on our assessment of the property and vicinity, it is our opinion that the planned gravel mine expansion is not located within any geologically hazardous area and will not be at risk of landslides or erosion. Furthermore, the proposed mine expansion will not increase the risk of landslide or erosion hazards on or off the site.

This geologic hazard assessment included a field inspection of the subject property and slopes in the immediate vicinity of the property. Our evaluation also included review of historic aerial photographs, available geologic mapping, and lidar (light detecting and ranging) imagery of the site and vicinity. Observations in the vicinity of the subject property and at sites with similar geology conditions also aided in our interpretations.

GENERAL GEOLOGY

The Geologic Map of the Sauk River 30- by 60-minute Quadrangle, Washington (Tabor and others, 2002) indicates that the subject property is underlain by Vashon recessional outwash (Figure 1).

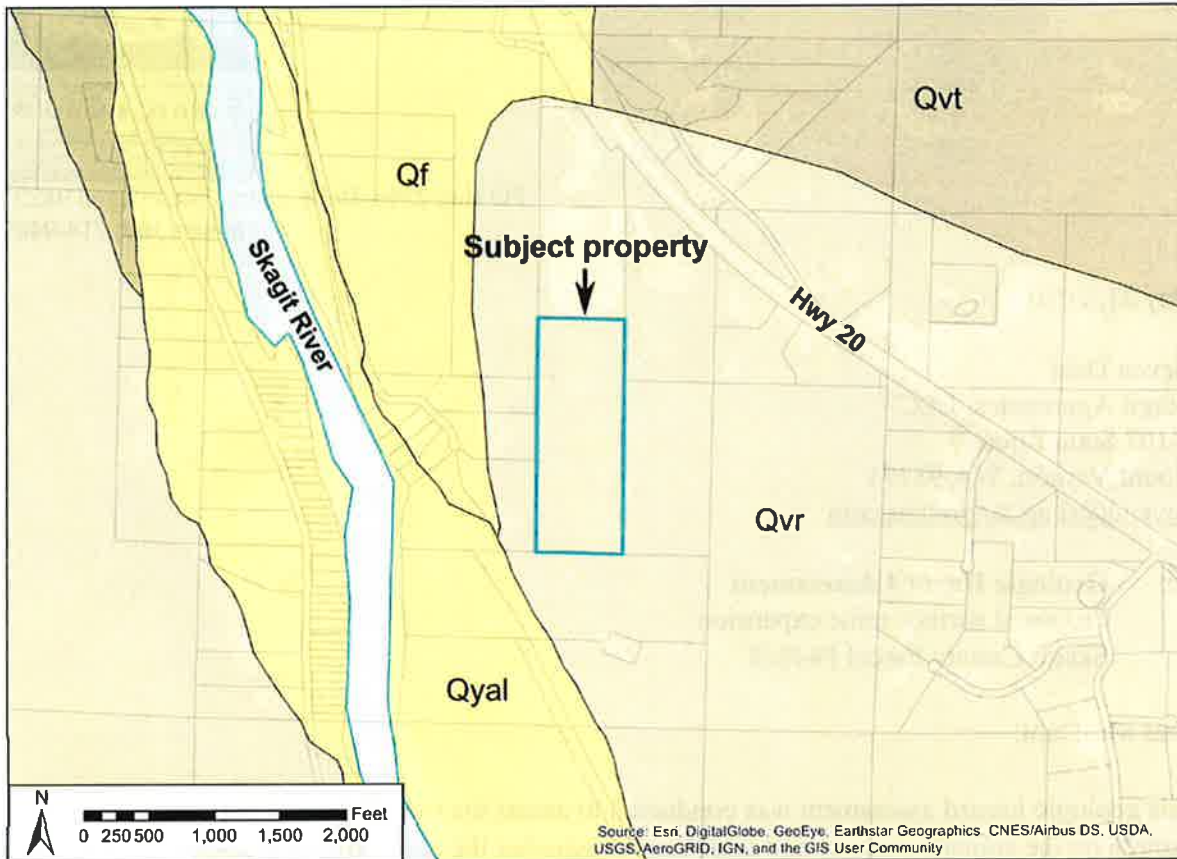


Figure 1. Geologic map of the subject property and vicinity based on geologic mapping by Tabor and others (2002). Qvr = Vashon recessional outwash, Qvt = Vashon till, Qf = Quaternary alluvial fan, Qyal = Quaternary younger alluvium.

Vashon recessional outwash consists of well-sorted and stratified sand and gravel deposits with minor silts and clays. The unit is typically parallel bedded but can also be locally cross-bedded. Recessional outwash was deposited in and along meltwater streams emanating from the toe of the receding glacial ice in the later stages of the last major glacial period, the Vashon Stage of the Fraser Glaciation approximately 14,000 to 12,000 years ago. Vashon recessional outwash was not overridden by glacial ice so tends to be less dense and compact than other glacial units.

Our observations are generally consistent with the above-described mapping. Observations at the existing gravel mine, review of well logs in the vicinity and hand-dug test pits on top of and along the gentle to moderate slopes of the subject property revealed medium dense sand and gravel with rounded pebbles and cobbles consistent with Vashon recessional outwash (Figure 2).



Figure 2. Photograph of recessional outwash in shallow test pit on subject property.

Soil observed from a hand-dug test pit excavated in the middle of one of the topographic depressions on the southern portion of the subject property was similar to that seen elsewhere on the property but had a higher silt and clay content with abundant charcoal, more consistent with a lower energy depositional. We interpret these depressions to be kettles, created when blocks of dead ice detached from the receding glacial ice and became buried or surrounded by sediment. The melting of the ice then formed the observed depressions. We observed no standing water or indications of saturated ground in any of the kettles.

Observations from the adjacent parcel to the north, which consists of an operational sand and gravel mine, are also generally consistent with mapped geology. Mine exposures revealed well-stratified sand and gravel deposits in excess of 75 to 100 feet thick (Figure 3). The sand and gravel deposits in the mine were generally medium dense to dense and able to maintain near-

vertical faces. Rip-up clasts of Vashon till up to 5 feet long were observed locally and are consistent with these deposits being recessional outwash.



Figure 3. Photograph of outwash in existing gravel mine on adjacent property to the north.

A road cut along Evergreen Hill Lane, near the base of the slope immediately west of the subject property, revealed similar deposits of fine to coarse sand and gravel consistent with outwash.

SITE SPECIFIC OBSERVATIONS

Pertinent features on the property and vicinity are indicated on the lidar bare earth image of the area (Figure 4). The subject property is located on a late-Pleistocene terrace in the Skagit River valley. We interpret this terrace to be remnant of the valley floor that formed at the late stages of the last glacial period.

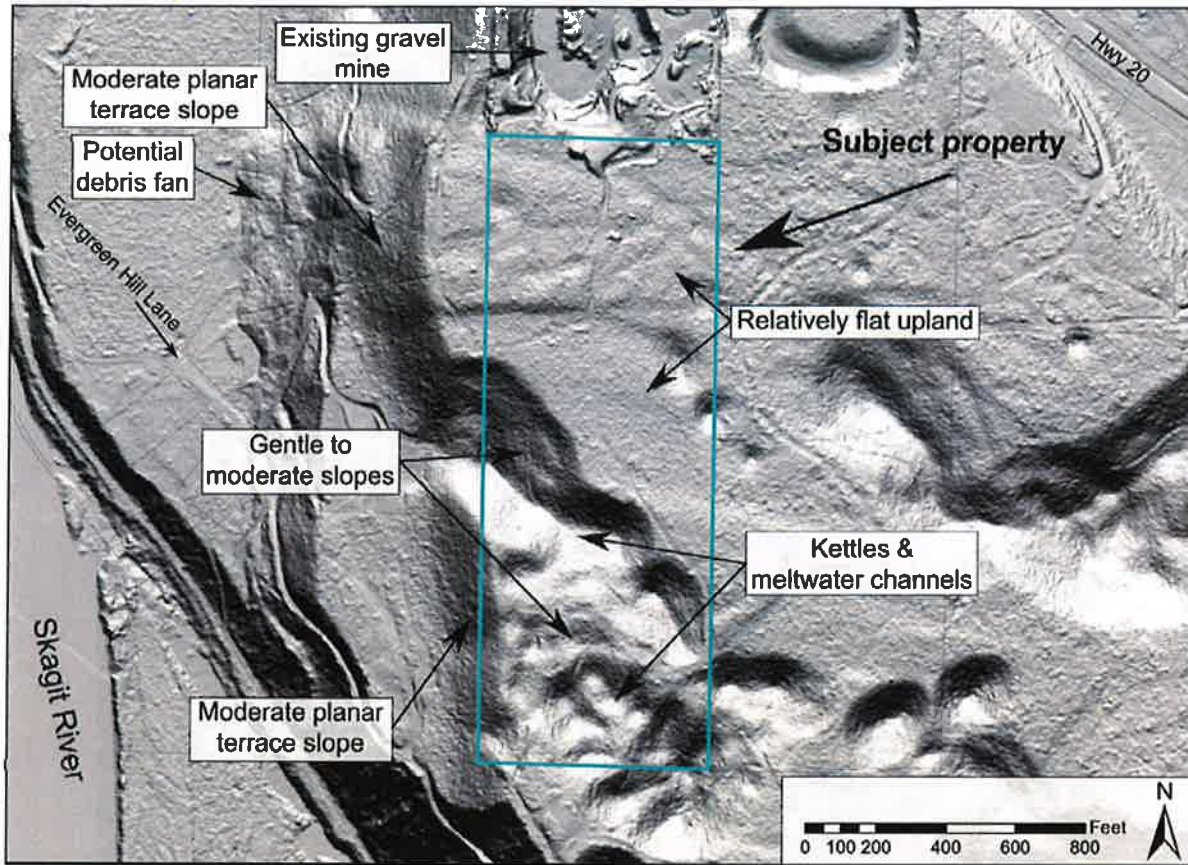


Figure 4. Annotated lidar hillshade image of the subject property and vicinity.

The northern portion of the property is a relatively flat terrace surface. The area is forested. A few old logging roads are present on the property. A moderate slope measuring approximately 25 degrees slopes down to the west approximately 150 feet from the west property boundary. The slope is relatively planar and shows no indications of instability. A fan of debris is located on the lower third of slope and is observable in lidar imagery (Figure 4). We interpret this debris fan slope to be colluvium derived from the slope above as a result of the past erosion of the terrace during river down cutting. The debris fan area is now stable as it is deposited on a lower terrace level above the active river valley.

The southern portion of the subject property consists of more irregular topography defined by depressions in the terrace formed by kettles. Slopes that descend to the base of the kettle features are typically moderate, measuring 10 to 20 degrees, increasing locally to 25 degrees for short sections of slope (Figure 5 and 6). Slopes are generally planar with no evidence of slope instability and slopes generally contain mature trees that stand vertically. One of the kettle slopes contains a sequence of several 3- to 4-foot wide benches. However, no fresh scarps, active raveling, or significantly bowed trees that would indicate slope instability are present. No surface water or evidence of intermittent surface water accumulation was observed in the kettles and soils are well drained throughout the property.

The western edge of the southern portion of the property is located on top of a moderate planar west-facing slope that measures approximately 25 to 30 degrees (Figure 7). This slope slopes down to another remnant terrace. No evidence of instability is evident on this slope and no existing or incipient fractures are present near the slope crest.

Vegetation on the subject property consists of a mixed forest that includes Douglas fir, western red cedar, red alder, big leaf maple, and few paper birch with an understory of Oregon grape, salal, and sword fern.



Figure 5. Photograph of the steeper slopes on the southern portion of the property that drop into a kettle.



Figure 6. Photograph of some of the gentler, undulating topography on the southern portion of the subject property.



Figure 7. Photograph of the moderate west-facing slope that drops from the southwestern edge of the subject property to a lower terrace below.

GEOLOGIC HAZARD EVALUATION

Slopes on the subject property generally consist of gentle to moderate slopes on the south side of the property associated with glacial landforms. During our site visit, we did not observe any evidence of previous, ongoing, or incipient slope failure on the site. The terraces observed locally on site slopes are more likely associated with historical logging activities and are not interpreted to represent historic or ongoing slope instability. We also did not observe any evidence of surface water features or groundwater perching, seepage, or springs on the subject property. Slope activity on the property is limited to minor surface raveling and/or soil creep on steeper slopes.

The planned use of the subject property as a gravel will eventually result in the excavation of the property, including these slopes, for the purpose of mining sand and gravel. This activity will further subdue or completely remove these slopes.

The western edge of the outwash terrace that composes the subject property rolls over onto a long, moderate, planar, west-facing slope towards elevated terraces above the Skagit River valley bottom. These slopes are adjacent to the subject property to the south and up to 150 feet from the western property edge to the north. These slopes also present no indications of previous, ongoing, or incipient slope failure that could negatively impact the subject property in the future.

We observed no evidence of a confining layer within the terrace that could promote future instability. Minor surface raveling or soil creep may occur along the surface of the slope but planned mining activities are unlikely to impact these slopes. Furthermore, we understand that mining regulations require mining activity to be set back from the property line, which will further remove any land disturbance from the steepest slopes in the vicinity of the property, such as those by the southwestern property edge.

The Skagit River is at least 350 feet from the toe of the slopes below the subject property and does not pose significant erosion or channel migration hazard.

CONCLUSIONS AND RECOMMENDATIONS

Based on our geologic hazard assessment, the subject property is not at risk of landslides or significant erosion. Furthermore, it is our opinion that the planned mining activity will not increase the risk of landslides or erosion on or off the property as long as the final mine slopes are completed consistent with the mine plans and best management practices.

We recommend that no soil or vegetation debris be placed on or within the 10 feet of the top edge of the slope to the west of the subject property. Such debris piles can eventually build up and form a wet unstable mass that will slide down the slope, damaging the slope and increasing the likelihood of a future slope failure.

Stratum Group appreciates the opportunity to be of service to you. Should you have any questions regarding this assessment please contact our office at (360) 714-9409.

Sincerely yours,

Stratum Group



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Licensed Engineering Geologist



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DANIEL McSHANE

