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Ph. 253-896-1011
Fx. 253-896-2633

GeoResources, LLC
5007 Pacific Hwy. E, Suite 20
Fife, Washington 98424

February 19, 2009

Ms. Elizabeth Cox
PO Box 966
Gig Harbor, WA 98335
(253) 853-4382

Geologic Assessment: Landslide
Hazard Geotechnical Letter
Proposed Short Plat
2218-55th Street NW
Pierce County, Washington
PN: 0221178004
Job: Cox.55thStNW.LHGL

INTRODUCTION

This letter presents the results of our landslide hazard assessment for the proposed short plat to be located at 2218 – 55th Street NW in the Gig Harbor area of Pierce County, Washington. The general location of the site is shown on the attached Site Vicinity Map, Figure 1.

Our understanding of the project is based on our discussions with you, our review of the plans provided, our February 10, 2009 site visit, and our experience in the area. We understand that you propose to divide the existing 3.22 acre tax parcel into two new lots. The existing residence will remain on Lot 2. The new lot and proposed residence will be located greater than 100 feet west of the top of the shoreline bluff. We anticipate that the residence will be a conventional, one to three-story, wood-framed structure supported on spread and continuous foundations. The residence will have likely have a daylight basement. A companion Shoreline Erosion Hazard Geotechnical Evaluation is completed under a separate cover.

The services described in this report were prepared under the responsible charge of Brad Biggerstaff, LEG and Glen Coad, PE. Mr. Coad and Mr. Biggerstaff meet the qualifications contained in Title 18E, Section 18E.80.30 to prepare a landslide hazard geological assessment. Mr. Coad and Mr. Biggerstaff understand the requirements of the current Landslide Hazard Area Chapter 18E.80 and the definitions of the applicable terms contained within Chapter 18.25. Individuals under the responsible charge of Mr. Coad and Mr. Biggerstaff have performed a landslide hazard geological assessment, conducted a field investigation, and researched available historic records on the above referenced site. **In our opinion, the scope of services completed for this project is adequate to meet the requirements of the Department and it does not appear that an active landslide hazard area exists within 300 feet of the site.**

SCOPE

The purpose of our services was to evaluate the surface and subsurface conditions at the site as a basis for assessing potential adverse impacts to and from the slopes located within the site area. We understand that because of the height and inclination of the slopes on the site, an assessment is being required by Pierce County Title 18E to address geologic hazards at the site. Specifically, our scope of services for the project included the following:

1. Visiting the site and conducting a geologic reconnaissance to assess the site's soil, groundwater and slope conditions.
2. Addressing the appropriate geotechnical regulatory requirements for the proposed site development.

No subsurface exploration or laboratory testing were completed as part of the scope for this assessment. However, we were able to observe near surface soil conditions as exposed in open septic perc holes and on portions of the shoreline bluff on the site.

Our services were originally outlined in our January 23, 2009 *Proposal for Geotechnical Engineering Services*. We received signed authorization to proceed with our scope of services from Ms. Elizabeth Cox dated February 6, 2009.

SITE CONDITIONS

Surface Conditions

The subject parcel is located at 2218 – 55th Street NW in the Gig Harbor area of Pierce County, Washington. The parcel is rectangular in shape, measures approximately 182 feet north to south by 750 feet east to west and encompasses approximately 3.22 acres. The site is currently developed with an existing single family residence, detached garage, gazebo, driveway, and septic drainfield. Access to the shoreline is via a community gated shoreline stairway located on the north property line of the site. Stormwater on the site is currently captured via several catch-basins, cut-off drains and multiple tightlines down to a dissipation structure at the toe of the slope. The site is bounded by existing residences on the north, south, and west and by The Narrows on the east. The site has approximately 180 feet of frontage along the Narrows. The site and adjacent parcels for greater than 1000 feet from the site do not have bulkheads.

The site is located on the east margin of the Gig Harbor glacial upland area. The surrounding areas slope down to the east at inclinations of 6 to 12 percent increasing to 18 percent on the west portion of the site. The ground surface flattens for approximately 100 linear feet then slopes at 15 to 16 percent towards the existing driveway. It appears that the northeast portion of the driveway is situated on up to 5 feet of fill material above the native ground surface. A drainage culvert was observed under this portion of the driveway. East of the driveway, we observed the gated entrance to the shoreline stairway at the top of the shoreline bluff. The top elevation of the shoreline bluff lowers as it wraps to the east and south around the existing residence. The shoreline bluff has inclinations of 70 to 85 percent with isolated near vertical faces up to 15 feet in height. The shoreline bluff on the site and adjacent properties has approximately 140 to 170 feet of vertical relief. Total topographic relief across the site is on the order of 200 feet. As per Title 18E, Section 80, Appendix A, a site plan with topography is not required to accompany the Geotechnical Letter, however a site plan is included as Figure 2, for the convenience of the reader.

Vegetation on the upland, west portion of the site consists of scattered trees and isolated ferns. We understand several trees blew over in recent years on the upland portion of the site. Therefore the majority of the upland, west portion of the site is sparsely vegetated. Ornamental shrubs and grass were observed adjacent to the existing residence. Vegetation of the shoreline bluff consists of predominately large maples and young alders with scattered cedar, hemlock and fir trees. We observed bowed trunks near the top and toe of the slope and tilted trees at the toe of the slope indicating evidence of natural surficial soil creep. The vegetation on the lower 1 to 2 feet of the slope was undercut approximately one foot into the slope. Invasive blackberry bushes were observed on portions of the slope in areas of full sun.

Horse tail and a seepage zone were observed near the top of the shoreline stairs at the contact between the overlying sands and the underlying hard silts at the time of our site

visit. This seepage zone progressed into a shallow stream which incised into the forest leaf litter layer down slope. Evidence of erosion was observed near isolated footings for the stairway at the time of our site visit. No evidence of landslide activity or deep-seated slope instability was observed at the site or within 300 feet of the site at the time of our site visit.

Site Soils

The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey for Pierce County maps the soils in the area of the site as Harstine gravelly sandy loam (16C) on the upland portion of the site, Xerochrepts (47F) on the shoreline bluff, and Coastal beach deposits (11A) along the shoreline. The Harstine soils are derived from glacial till that form on 6 to 15 percent slopes and are listed as having a "moderate" erosion hazard. The Xerochrepts soils are typically derived from glacial till or glacial outwash deposits that form on 45 to 70 percent slopes. The Xerochrepts soils are listed as having a "very severe when exposed" erosion hazard. Based on the observed soils on the parcel, an adjustment in the mapped soil contacts would indicate the upland portion of the site is underlain by Indianola loamy sand (18C) soils derived from sandy glacial outwash deposits. A copy of the SCS map for the site vicinity is attached as Figure 3.

Site Geology

The draft *Geologic Map of the Gig Harbor 7.5-minute Quadrangle, Washington*, Kathy A. Troost, Derek B. Booth, and R.E. Wells indicates the site underlain by advance outwash (Qva), Possession drift deposits (Qpdc), Owens silt (Qos), Double bluff drift till (Qdbt), and Defiance silt (Qds), successively towards the shoreline. The advance outwash soils were deposited during the most recent Vashon Stade of the Fraser Glaciation, approximately 12,000 to 15,000 years ago. The advance outwash soils consist of a poorly sorted, lightly stratified mixture of sand and gravel that may contain localized deposits of clay and silt that were deposited by meltwater streams emanating from the advancing ice mass. The underlying silts consist of hard silts and clays and the drift deposits consist of glacial cemented gravelly silty sands. These deposits were formed between 70,000 and 280,000 years ago. As such, advance outwash, and all underlying units are considered overconsolidated and exhibit high strength and low compressibility characteristics. The weathered surficial soils are generally considered normally consolidated and offer moderate strength characteristics. No areas of landslides or landslide debris are mapped on or within 300 feet of the site. An excerpt of the above referenced map is included as Figure 4. The soils observed on the site generally confirm the mapped stratigraphy.

The Department of Ecology Coastal Atlas indicates the slope stability as "stable" on the upland portion of the site and "unstable" on the steeper, shoreline bluff portion of the site. An excerpt of the DOE Coastal Atlas is included as Figure 5. The Department of Ecology oblique aerial shoreline photographs were reviewed and are included for the years 2006 and 2000 as Figures 6a and 6b, respectively.

Landslide Hazard Area- Per Pierce County Title 18E, Section 80

The Pierce County Municipal Code, Chapter 18E defines a landslide hazard area as an area potentially subject to mass movement because of a combination of geologic, seismic, topographic, hydrologic, or manmade factors. These areas may be identified by the presence of any of the following indicators:

1. Areas of historic failures including areas of unstable, old and recent landslides or landslide debris within a head scarp.
2. Areas with active bluff retreat that exhibit continuing sloughing or calving of bluff sediments, resulting in a vertical or steep bluff face with little or no vegetation.

3. Areas with both of the following characteristics:
 - a) Slopes steeper than 20 percent with a vertical relief of 20 feet or more; and
 - b) Hillsides that intersect geologic contacts with relatively permeable sediment overlying a relatively impermeable sediment or bedrock.
4. Slopes that are parallel or sub-parallel to planes of weakness, such as bedding planes, joint systems and fault planes, in subsurface materials;
5. Areas exhibiting geomorphologic features indicative of past slope failures, such as hummocky ground, back-rotated benches on slopes, etc.
6. Areas with tension cracks/ground fractures along or near the edge of the top of a bluff or ravine.
7. Areas with structures that exhibit structural damages such as settling and cracking of the building foundation or separation of steps or porch from a main structure that is located near the edge of a bluff or ravine.
8. The occurrence of toppling, leaning, bowed, or jackstrawed trees that are caused by disruption of ground surface by active movement.
9. Areas with slopes containing soft or liquefiable soils.
10. Areas where gulying and surface erosion have caused dissection of the bluff edge or slope face as a result of drainage or discharge from pipes, culverts, ditches, and natural drainage courses.
11. Areas where seeps or springs or indicators of a shallow groundwater table are observed on or adjacent to the face of the slopes.
12. Areas of greater than 40 percent slopes with 15 feet or more vertical relief.
13. Areas that are at risk of mass movement due to seismic events.
14. Areas that include alluvial or colluvial fans located at the base of steep slopes and drainage.

CONCLUSIONS

Based on our observations and site evaluation, it is our opinion that a landslide hazard area does not exist on or within 300 feet of the site.

Landslide Hazard Indicators – per Pierce County Section 18E.80.020

Pierce County, Chapter 18E.80, Section 18E.80.020 uses the above referenced 14 item checklist to define a landslide hazard area. Based on our observations of the site and review of published information, we offer the following comments.

No evidence of landslide activity, or significant erosion was observed at the site at the time of our site visit. Evidence of erosion as one-foot of undercutting was observed at the toe of the slope. This erosion did not appear to translate upslope. Some slopes steeper than 20 percent were observed on the site, with intersecting contacts near the top of the slope on the site. Slopes steeper than 40 percent with more than 15 feet occupy the shoreline bluff portion of the site. We do not anticipate any development on slopes greater than 30 percent. A seepage zone was observed near the top of the slope in the northeast portion of the site at the time of our site visit. No planes of weakness or rockfall hazards were observed at the site. No other landslide hazard criteria were observed at the site or the immediate adjacent areas.

Based on the above, the site has four of the above landslide hazard indicators on or within 300 feet of the site (20 percent slopes with observed contacts, bowed trees, seeps on the face of the slope, and slopes steeper than 40 percent with 15 feet of relief). However, no evidence of landslide activity or active landslides hazards was observed on the site or adjacent areas. In our opinion, the site does not constitute an active landslide hazard area. Since no evidence of landslide activity or active landslides hazards were observed at the site, no prescriptive buffer should be required by Pierce County Planning and Land Services (PALS).

Seismic Hazards

Based on our observation and the subsurface units mapped at the site, we interpret the structural site conditions to correspond to a seismic Site Class "C" in accordance with Table 1613.5.2 in the 2006 IBC (International Building Code) documents. This is based on the likely range of equivalent SPT (Standard Penetration Test) blow counts for the soil types observed in the site area. These conditions were assumed to be representative for the conditions based on our experience in the vicinity of the site.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in pore water pressure. The increase in pore water pressure is induced by seismic vibrations. Liquefaction mainly affects geologically recent deposits of loose, fine-grained sands that are below the groundwater table. Based on the density and consolidated nature of the glacial soils observed on the site, it is our opinion that the risk for liquefaction to occur at this site during an earthquake is negligible. Provided the design criteria listed below are followed, the proposed structure will have no greater seismic risk damage than other appropriately designed structures in the Puget Sound area.

Site Drainage

All ground surfaces, pavements and sidewalks at the site should be sloped away from structures. The lot should also be carefully graded to ensure positive drainage away from all structures and property lines. Surface water runoff from the roof area, driveways, perimeter footing drains, and wall drains, should be collected, tightlined, and conveyed to an appropriate discharge point.

LIMITATIONS

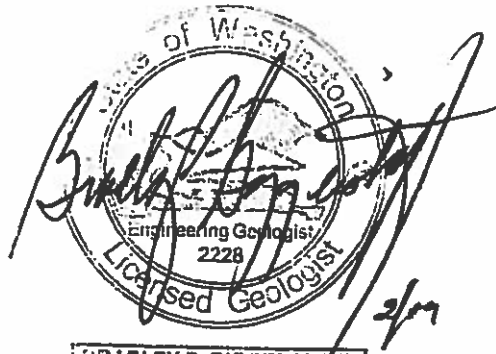
We have prepared this report for Ms. Elizabeth Cox and members of the design team for use in evaluating a portion of this project. Subsurface conditions described herein are based on our observations of exposed soils on the parcel. This report may be made available to regulatory agencies or others, but this report and conclusions should not be construed as a warranty of subsurface conditions. Subsurface conditions can vary over short distances and can change with time.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time this report was prepared. No warranty, express or implied, should be understood.

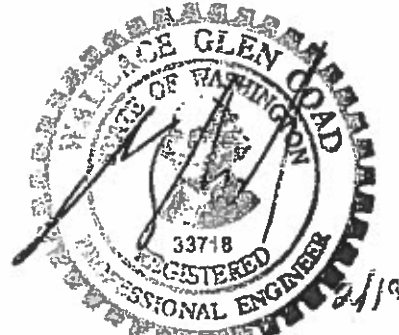


We have appreciated working for you on this project. Please do not hesitate to call at your earliest convenience if you have any questions or comments.

Respectfully submitted,
GeoResources, LLC



BRADLEY P. BIGGERSTAFF
Bradley P. Biggerstaff, LEG
Principal



W. Glen Coad, PE
Principal

BPB:WGC:rmh

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Attachments:

- Figure 1: Vicinity Map
- Figure 2: Site Plan
- Figure 3: SCS Soil Survey
- Figure 4: USGS Geology Map
- Figure 5: Coastal Zone Atlas
- Figures 6a & 6b: DOE Oblique Shoreline Photographs