

May 21, 2008

KA Project No. 092-08048

ABBEEY ROAD GROUP, LLC
Attn: Job #03-143
P.O. Box 207
Puyallup, Washington 98371

**RE: Limited Geotechnical Engineering Investigation
Soil Bearing Verification for Portable Building**
Cascade Christian Master Plan
811 21st Street Southeast
Puyallup, Washington

To Whom It May Concern:

In accordance with your request and authorization, our firm performed a footing subgrade bearing verification inspection on May 13, 2008. Our work was performed in accordance with our proposal G08-068WAB, dated April 22, 2008.

We understand that a single-story, wood framed school portable building will be constructed north of the existing school portable area (north side of the existing school facility near the stormwater pond facility area).

A senior engineering geologist performed the field work on May 13, 2008. The field investigation consisted of hand augering and sampling two exploratory hand auger borings that provided general coverage of the portable site to be developed. The exploratory hand auger borings reached depths of approximately 4.5 to 5 feet below the existing site grades. Figure 2 shows the approximate locations of the exploratory hand auger borings. Representative samples of the subsurface soils were collected from the hand auger borings and sealed in plastic bags. These samples were transported to our laboratory for further examination and 30 day storage before disposal. The soils encountered, in the exploratory hand auger borings, were continuously examined and visually classified in accordance with the Unified Soil Classification System (USCS).

The soils encountered in the exploratory hand auger borings were generally typical of the anticipated soils on site. The soils encountered in the Exploratory Hand Augers HA-1 and HA-2 below grass sod layer consisted of approximately 2 feet of loose to medium dense, fine to medium grained sand, to silty fine to medium grained sand with gravel (Pre-Load Material). The pre-load material is underlain by loose/soft to medium dense/stiff, interbedded silty very fine to fine grained sand, to very fine to fine grained sandy silt,

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to elastic silt (Recent Alluvium) down to the termination depth of Exploratory Hand Augers HA-1 and HA-2 (approximately 4.5 to 5 feet, respectively, below the existing site grade).

For more specific information about the soils encountered, please refer to the logs of the exploratory hand auger borings attached at the end of this letter report.

The exploratory hand auger borings were checked for the presence of groundwater during and immediately following the drilling operations. Groundwater was encountered in Exploratory Hand Auger Boring HA-2 at approximately 5 feet below the existing site grade. Groundwater was not encountered in Exploratory Hand Auger Boring HA-1 at the date and time of our field exploration work.

It should be recognized that water table elevations may fluctuate with time. The groundwater level will be dependent upon seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Therefore, water levels at the time of the field investigation may be different from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

Groundwater flow may become heavier during construction if it takes place during the wet weather season. This may cause difficulties with the grading and excavation work. Certain remedial and/or dewatering measures may be required.

In accordance with the Pierce County Seismic Hazard Map, the site is designated as a potential liquefaction and/or dynamic settlement hazard area. Soil liquefaction is a state where soil particles lose contact with each other and become suspended in a viscous fluid. This suspension of the soil grains results in a complete loss of strength as the effective stress drops to zero. Liquefaction normally occurs under saturated conditions in soils such as sand in which the strength is purely frictional. However, liquefaction has occurred in soils other than clean sand. Liquefaction usually occurs under vibratory conditions such as those induced by seismic events.

Since the sites underlying soils are susceptible to liquefaction, the 2006 *IBC* recommends that the site be classified as Class *F* and a site specific seismic study be performed to evaluate seismic parameters, which is beyond our scope. However, if the proposed structures are relatively smaller with natural period less than 0.5 sec, the overall soil profile may be approximated as site class soil profile of *E* as defined by Table 1613.1.2 of the 2003 *International Building Code (2003 IBC)* for the purpose of evaluating seismic parameters, particularly F_A and F_V . A site class soil profile of *E* applies to a profile consisting primarily of a soft soil more than 10 feet in depth.

We referenced the U.S. Geological Survey (USGS) Earthquake Hazards Program website to obtain values for S_S , S_I , 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)
- 29.87 (10% Probability of Exceedence in 50 years)
- 53.27 (2% Probability of Exceedence in 50 years)

S _s	117.8% of g
S ₁	39.9% of g
F _A	0.9 (USGS Earthquakes Hazard Program Seismic Design Value for Buildings)
F _V	2.4 (USGS Earthquakes Hazard Program Seismic Design Value for Buildings)

Based on our site observations, the most economical option is to support the proposed light weight wood framed portable structure on shallow foundation systems bearing on the existing medium dense pre-load fill soils (**based on field verification**) or on sections of properly compacted, structural fill, placed on the existing medium dense pre-load fill soils (**based on field verification**). However, it should be understood that the portable structure may incur liquefaction damage during certain seismic events, and this damage may require repair prior to re-occupying the building, or the damage may require replacing the portable structure, however the structure should be designed to offer safe exit following the design earthquake.

Based on the soil conditions encountered it is our opinion that the continuous wall or column footings should be designed for a net allowable bearing pressure of 1,500 pounds per square foot (psf) dead plus live load, if the footings bear directly on the existing medium dense pre-load fill soil (**based on field verification**) or on structural fill, placed on the medium dense pre-load fill soil (**based on field verification**). In any case, the underlying preload soils or structural fill soils should be medium dense to a depth of 2B (B = width of footing) below the portable building footing elements

A 1/3 increase in the above values may be used for short duration, wind and seismic loads. 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. Footings should have a minimum width of 12 inches regardless of load.

If constructed as recommended, the total static settlement is not expected to exceed 1 inch. Differential settlement, along a 20-foot exterior wall footing, or between adjoining column footings, should be less than ½ inch, producing an angular distortion of 0.002, under static conditions. 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 or if a strong seismic event results in liquefaction of the underlying soils.

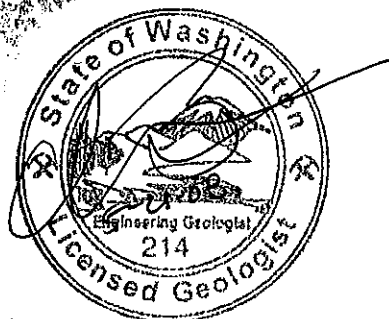
Seasonal rainfall, water run-off, and the normal practice of watering trees and landscaping areas around the proposed buildings, should not be permitted to flood and/or saturate footings. To prevent the buildup of water within the footing areas, continuous footing drains (with cleanouts) should be provided at the bases of the footings. The footing drains should consist of a minimum 4-inch diameter perforated pipe, sloped to drain, with perforations placed down and enveloped by 1-inch sized washed rock in all directions and filter fabric to prevent the migration of fines.

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.30 acting between the bases of foundations and the supporting subgrade. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 200 pounds per cubic foot (pcf) acting against the appropriate vertical footing faces. 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. A 1/3 increase in the above values may be used for short duration, wind and seismic loads.

We hope that this letter provides the information required at this time. If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (425) 485-5519.

Respectfully submitted,

KRAZAN & ASSOCIATES, INC.

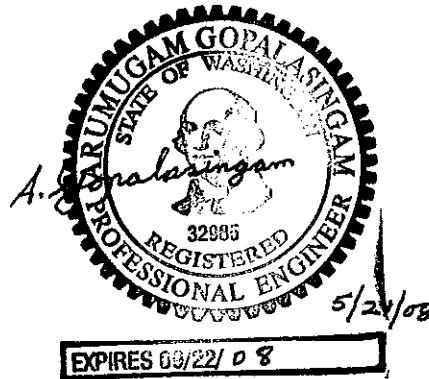


CHRIS J. BEHRENS

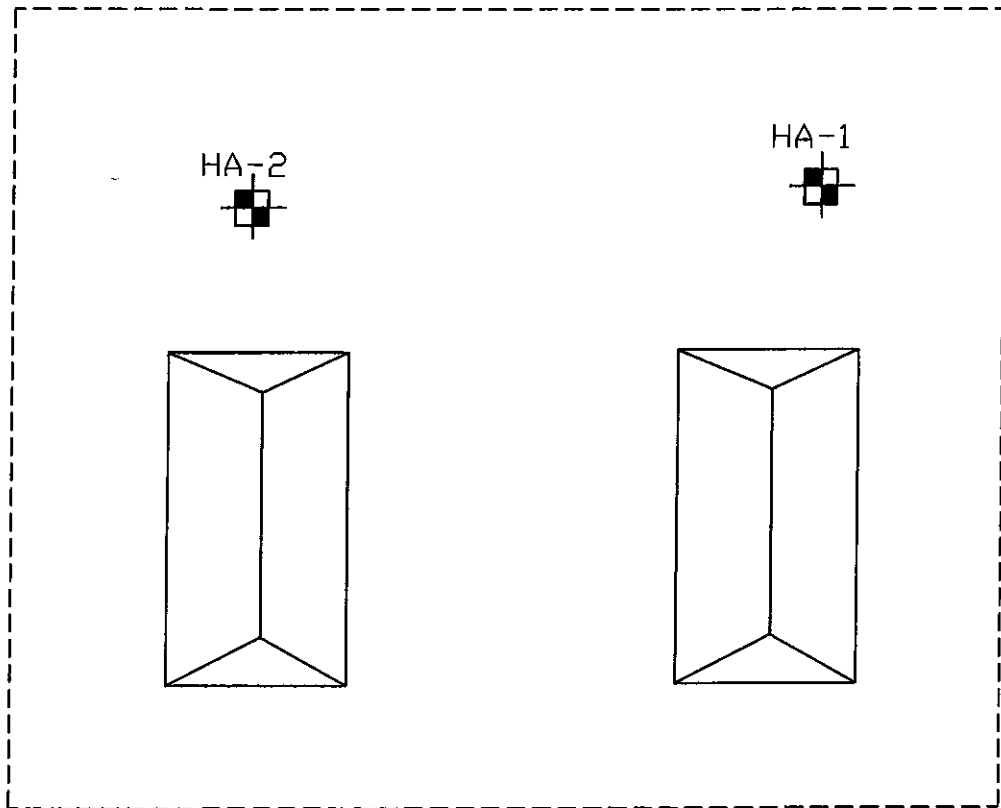
Chris Behrens, P.G., P.E.G.
Senior Engineering Geologist

CB/gs

Attachments

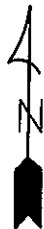


Gopal A. Singam, P.E.
Geotechnical Division Manager



(Existing Portable Area)

Stormwater Pond Facility



LEGEND

Hand Auger Location HA-1

<h1>Site Plan</h1>		
Cascade Christian School Puyallup, WA		Figure 2
No Scale	Job Number: 092-08048	Drawn By: C.B.
		Reviewed By: C.B.
Date: May 19, 2008	Krazan & ASSOCIATES, INC.	Drawing Number: 1
		Drawing Type: Site Plan

KRAZAN AND ASSOCIATES
 11715 North Creek Parkway South
 Suite C-106
 Bothell, Washington 98011

LOG OF EXPLORATORY HAND AUGER BORING HA-1

PROJECT: Cascade Christian School Portable
 PROJECT NO.: 092-08048

DATE: 5-13-08
 PAGE: 1 of 1

SURFACE ELEVATION:
 SAMPLE METHOD: Grab

LOCATION:

DEPTH (ft)	USC SYMBOL	WATER LEVEL	MATERIAL DESCRIPTION	EQUIVALENT N-VALUE (DCP)	SAMPLES	Natural Moisture Content and Atterberg Limits			
						Plastic Limit	Moisture Content	Liquid Limit	
						20	40	60	80
0			POORLY GRADED SAND (SP) Grass over loose, fine grained sand, grayish brown, damp. (Pre-Load Material)						
1			SILTY SAND WITH GRAVEL (SM) Loose to medium dense, very fine to fine grained sand, grayish brown, damp to moist. Pocket penetrometer Test at approximately 12 inches 2.5 tsf. (Pre-Load Material)	7					
2			SILTY SAND (SM) to SANDY SILT (ML) Medium dense, very fine to fine grained sand, very dark grayish brown, damp to moist. (Recent Alluvium)	15					
3			SANDY SILT (ML) Medium dense, very fine grained sand, very dark grayish brown, damp to moist. (Recent Alluvium)	30					
4			End of Exploratory Hand Auger Boring						
5									
6									
7									
8									
9									
10									
11									

Water Level Initial: ∇ Final: ∇

Water Observations: NA

Notes:

KRAZAN AND ASSOCIATES
 11715 North Creek Parkway South
 Suite C-106
 Bothell, Washington 98011

LOG OF EXPLORATORY HAND AUGER BORING HA-2

PROJECT: Cascade Christian School Portable
 PROJECT NO.: 092-08048

DATE: 5-13-08
 PAGE: 1 of 1

SURFACE ELEVATION:
 SAMPLE METHOD: Grab

LOCATION:

DEPTH (ft)	USC SYMBOL	WATER LEVEL	MATERIAL DESCRIPTION	EQUIVALENT N-VALUE (DCP)	SAMPLES	Natural Moisture Content and Atterberg Limits			
						Plastic Limit	Moisture Content	Liquid Limit	
						20	40	60	80
1			SILTY SAND WITH GRAVEL (SM) Grass over dense, fine to medium grained sand, grayish brown, damp. Pocket Pen Test at approximately 6 inches 5 tsf. (Pre-Load Material)						
2			SILTY SAND (SM) to SANDY SILT (ML) Medium dense, very fine to fine grained sand, very dark grayish brown, damp to moist. (Recent Alluvium)	17					
3			SILT (ML) to ELASTIC SILT (MH) Stiff, very dark grayish brown, moist. (Recent Alluvium)						
4			SILTY SAND (SM) to SANDY SILT (ML) Very loose/soft, very fine grained sand, very dark grayish brown, moist to wet. (Recent Alluvium)	2					
5		▼	End of Exploratory Hand Auger Boring						
6									
7									
8									
9									
10									
11									

Water Level Initial: ▼ Final: ▼

Water Observations: Approx. 5 ft.

Notes: