REPORT
GEOTECHNICAL STUDY
AMUNDSEN BUILDING
2468 SOUTH MAIN STREET
WOODS CROSS, UTAH 84010

Submitted To:

All Points B2B NSL LLC
240 North East Promontory
Farmington, Utah 890255

Submitted By:

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473 West 4800 South
Salt Lake City, Utah 84123

September 19, 2017

Job No. 0525-018-17

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Mrs. Angela Amundsen
All Points B2B NSL LLC
240 North East Promontory
Farmington, Utah 89025

Mrs. Amundsen:

Re: Report
Geotechnical Study
Amundsen Building
2468 South Main Street
Woods Cross, Utah 84010

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the Amundsen Building to be located at 2468 South Main Street in Woods Cross, Utah. The general location of the site with respect to existing roadways, as of 2017, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing proposed facilities, existing roadways, and the borings drilled in conjunction with this study is presented on Figure 2, Site Plan.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of the study were planned in discussions between Mr. Tyson Kearney of Eckman Mitchell Construction, LLC. and Mr. Robert Gifford of GSH Geotechnical, Inc. (GSH).

In general, the objectives of this study were to:

1. Define and evaluate the subsurface soil and groundwater conditions across the site.

2. Provide appropriate foundation, earthwork, pavement, and geoseismic recommendations to be utilized in the design and construction of the proposed facilities.

In accomplishing these objectives, our scope has included the following:

1. A field program consisting of the drilling, logging, and sampling of 4 exploration borings, as well as performing an infiltration test.

2. A laboratory testing program.

3. An office program consisting of the correlation of available data, engineering analysis, and the preparation of this summary report.

1.3 AUTHORIZATION

Authorization was provided by returning a signed copy of the Professional Services Agreement No. 17-0653 dated June 29, 2017.

1.4 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils encountered in the exploration borings, projected groundwater conditions, and the layout and design data discussed in Section 2, Proposed Construction. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted engineering principles and practices in this area at this time.

2. PROPOSED CONSTRUCTION

A 1- to 2-story structure and associated pavements are proposed to be constructed at the site. The structure will include a full-depth basement supported over conventional spread and continuous wall foundations consisting of light steel and masonry block construction. An additional slab-on-grade coffee shop structure may also be included as part of future development of the site.

Maximum real column and wall loads are anticipated to be on the order of 100 to 150 kips and 4 to 7 kips per lineal foot, respectively. Real loads are defined as the total of all dead plus frequently applied (reduced) live loads.

Paved driveways and parking areas are also planned around the structure. Projected traffic in the parking areas is anticipated to consist of a light volume of automobiles and light trucks, with occasional medium and heavyweight trucks.

Site development will require some earthwork in the form of minor cutting and filling. At this time, we anticipate that maximum site grading cuts and fills, excluding utilities, will be on the order of 1 to 3 feet.

3. SITE INVESTIGATIONS

3.1 GENERAL

It should be understood that subsurface conditions in unexplored locations or at other times may vary from those encountered at specific boring locations. If such variations are noted during construction or if project development plans are changed, GSH must review the changes and amend our recommendations, if necessary.

Boring locations were established by estimating distances and angles from site landmarks. If increased accuracy is desired by the client, we recommend that the boring locations and elevations be surveyed.

3.2 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions across the site, 4 borings were drilled within the accessible areas. These borings were completed to depths ranging from 8.5 to 20.5 feet with a truck-mounted drill rig equipped with hollow-stem augers. The approximate locations of the borings are presented on Figure 2.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the drilling operations, a continuous log of the subsurface conditions encountered was maintained. In addition, samples of the typical soils encountered were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural examination. These classifications were supplemented by subsequent inspection and testing in our laboratory. Graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3D, Boring Logs. Soils were classified in accordance with the nomenclature described on Figure 4, Key to Boring Log (USCS).

A 3.25-inch outside diameter, 2.42-inch inside diameter drive sampler (Dames & Moore) and a 2.0-inch outside diameter, 1.38-inch inside diameter drive sampler (SPT) were utilized at select locations and depths. The blow counts recorded on the boring logs were those required to drive the sampler 12 inches with a 140-pound hammer dropping 30 inches.

Following completion of drilling operations, 1.25-inch diameter slotted PVC pipe was installed in Boring B-1 in order to provide a means of monitoring the groundwater fluctuations. The borings were backfilled with auger cuttings.

3.3 LABORATORY TESTING

3.3.1 General

In order to provide data necessary for our engineering analysis, a laboratory testing program was performed. This program included moisture, density, consolidation, and chemical tests. The following paragraphs describe the tests and summarize the test data.

3.3.2 Moisture and Density Tests

To provide index parameters and to correlate other test data, moisture and density tests were performed on selected samples. The results of these tests are presented on the boring logs, Figures 3A through 3D.

3.3.3 Consolidation Tests

To provide data necessary for our settlement analysis, consolidation testing was performed on 2 representative samples of the natural fine-grained clay soils encountered at the site. The results of these tests indicate that the samples tested were moderately to highly over-consolidated and will exhibit moderate strength and moderate compressibility characteristics under the anticipated loading. Detailed results of the tests are maintained within our files and can be transmitted to you, upon your request.

3.3.4 Chemical Tests

To determine if the site soils will react detrimentally with concrete, chemical tests were performed on a representative sample of the near-surface silty clay soil encountered at the site. The results of the chemical tests are tabulated below:

Boring No.	Depth (feet)	Soil Classification	pH	Total Water Soluble Sulfate (mg/kg-dry)
B-4	2.5	CL	8.93	286

4. SITE CONDITIONS

4.1 SURFACE

The site is located to the northwest of U.S. Highway 89 in Woods Cross, Utah. At the time of the drilling, an unoccupied commercial building, along with the associated driveways and parking area, occupied the site. Since the drilling operations, the building has been demolished. The topography of the site is relatively flat with a total relief of 3 to 5 feet and slopes downward in a southern direction. The site is sparsely vegetated with various weeds and grasses along the perimeter.

The site is bounded to the north by Wells Fargo Credit Union, to the east by U.S. Highway 89 followed by Smiths Grocery Store, to the south by Bountiful Bicycle, and to the west by 575 West followed by vacant/undeveloped land.

4.2 SUBSURFACE SOIL

The following paragraphs provide generalized descriptions of the subsurface profiles and soil conditions encountered within the borings conducted during this study. As previously noted, soil conditions may vary in unexplored locations.

The borings were drilled to depths ranging from 8.5 to 20.5 feet. The soil conditions encountered in each of the borings, to the depths penetrated, were generally similar across the boring locations.

- Borings completed within existing parking lot areas encountered up to 5 inches of asphalt and up to 12 inches of aggregate base.

- Non-engineered fill soils were encountered in Borings B-1, B-2, and B-3, to depths ranging from 1.5 to 5.0 feet beneath the existing ground surface.

- Natural soils were encountered below the ground surface or non-engineered fill in all of the borings at depths ranging from 1.5 to 5.0 feet below the existing ground surface. The natural soils consisted primarily of silty clay with varying contents of sand and gravel.

The non-engineered fill primarily consisted of silty sand and sandy clay with varying contents of gravel. Unless in-place density test records are available indicating the existing fills have been compacted to the requirements for structural fill as indicated later in this report, they must be considered as non-engineered fill.

The natural clay soils were soft to stiff, moist to saturated, brown in color, and moderately to highly over-consolidated. The natural clay soils are anticipated to exhibit moderate to high strength and moderate to low compressibility characteristics under the anticipated loading.

For a more descriptive interpretation of subsurface conditions, please refer to Figures 3A through 3D, Boring Logs. The lines designating the interface between soil types on the boring logs generally represent approximate boundaries. In situ, the transition between soil types may be gradual.

4.3 GROUNDWATER

Groundwater levels vary with changes in season and rainfall, construction activity, surface water run-off, and other site-specific factors. Groundwater levels in this area are typically lowest in the late summer-early fall and highest in the late winter-early spring; consequently, the water table may vary at times.

Groundwater was encountered at this site at depths of 18 feet at the time of drilling. On September 18, 2017 (17 days following drilling), groundwater was measured within the piezometers installed as tabulated below:

Boring No.	**Groundwater Depth (feet)**
	September 18, 2017
B-1	19.8

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The proposed structures may be supported upon conventional spread and continuous wall foundations supported upon suitable natural soils and/or structural fill extending to suitable natural soils.

The most significant geotechnical aspects at the site are:

1. The existing structures and utilities to be demolished/relocated.

2. The existing non-engineered fills across a portion of the site.

Prior to proceeding with construction, demolition and removal of the existing structures, slabs, foundations, pavements, associated debris, surface vegetation, root systems, topsoil, non-engineered fill, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed building foundations and 3 feet beyond rigid pavements and exterior flatwork areas will be required. All existing utility locations should be reviewed to assess their impact on the proposed construction and abandoned and/or relocated as appropriate.

Due to the developed nature of this site and the surrounding area, additional non-engineered fills may exist in unexplored areas of the site and at greater depths. Based on our experience, non-engineered fills are frequently erratic in composition and consistency. All surficial loose/disturbed soils and non-engineered fills must be removed below all footings, floor slabs, and rigid pavements. The in situ, non-engineered fills may remain below flexible pavements if free of any deleterious materials, of limited thickness, and if properly prepared, as discussed later in this report. Additionally, non-engineered fills may also be created by the demolition of the existing structures.

Existing non-engineered fills may be re-utilized as structural site grading fill if they meet the criteria for such, as stated later in this report.

Detailed discussions pertaining to earthwork, foundations, pavements, and the geoseismic setting of the site are presented in the following sections.

5.2 EARTHWORK

5.2.1 Site Preparation

Initial site preparation will consist of the demolition and removal of the existing structures, slabs, foundations, pavements, associated debris, non-engineered fills, surface vegetation, root systems, topsoil, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed building foundations and 3 feet beyond rigid pavements and exterior flatwork areas. All existing utility locations should be reviewed to assess their impact on the proposed construction and abandoned and/or relocated as appropriate.

In situ, non-engineered fills may remain below flexible pavements if free of debris and deleterious materials, less than 3 feet in thickness, and if properly prepared. Proper preparation below pavements will consist of the scarification of the upper 12 inches below asphalt concrete (flexible pavement), followed by moisture preparation and re-compaction to the requirements of structural fill.

Subsequent to stripping and prior to the placement of floor slabs, foundations, structural site grading fills, exterior flatwork, and pavements, the exposed subgrade must be proof rolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or otherwise unsuitable soils are encountered beneath footings, they must be completely removed. If removal depth required is greater than 2 feet below footings, GSH must be notified to provide further recommendations. In pavement, floor slab, and outside flatwork areas, unsuitable natural soils should be removed to a maximum depth of 2 feet and replaced with compacted granular structural fill.

Subgrade preparation as described must be completed prior to placing overlying structural site grading fills. Even with proper preparation, pavements established overlying non-engineered fills may encounter some long-term movements unless the non-engineered fills are completely removed.

GSH must be notified prior to the placement of structural site grading fills, floor slabs, footings, and pavements to verify that all loose/disturbed soils and non-engineered fills have been completely removed and/or properly prepared.

5.2.2 Temporary Excavations

Temporary excavations up to 10 feet deep in fine-grained cohesive soils, above or below the water table, may be constructed with sideslopes no steeper than one-half horizontal to one vertical (0.5H:1.0V). Excavations deeper than 10 feet are not anticipated at the site.

For granular (cohesionless) soils, construction excavations above the water table, not exceeding 4 feet, should be no steeper than one-half horizontal to one vertical (0.5H:1.0V). For excavations up to 10 feet, in granular soils and above the water table, the slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult and will require very flat sideslopes and/or shoring, bracing, and dewatering.

Final fill slopes should be constructed with sideslopes no steeper than two horizontal to one vertical (2H:1V). Additionally these slopes should be vegetated for erosion control with low water requirements to reduce saturation-promoted slope movements.

To reduce disturbance of the natural soils during excavation, it is recommended that smooth edge buckets/blades be utilized.

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated.

5.2.3 Structural Fill

Structural fill is defined as all fill which will ultimately be subjected to structural loadings, such as imposed by footings, floor slabs, pavements, etc. Structural fill will be required as backfill over foundations and utilities, as site grading fill, and as replacement fill below footings. All structural fill must be free of surface vegetation, root systems, rubbish, topsoil, frozen soil, and other deleterious materials.

Structural site grading fill is defined as structural fill placed over relatively large open areas to raise the overall grade. For structural site grading fill, the maximum particle size shall not exceed 4 inches; although, occasional larger particles, not exceeding 8 inches in diameter, may be incorporated if placed randomly in a manner such that "honeycombing" does not occur and the desired degree of compaction can be achieved. The maximum particle size within structural fill placed within confined areas shall be restricted to 2 inches.

Imported structural fill below foundations and floor slabs shall consist of a well graded sand and gravel mixture with less than 30 percent retained on the three-quarter-inch sieve and less than 20 percent passing the No. 200 Sieve (clays and silts).

On-site soils, including existing non-engineered fills, may be re-utilized as structural site grading fill if they meet the criteria for such as stated herein. However, should some of these soils contain coarse gravel in excess of 30 percent retained on the three-quarter-inch sieve by weight and, therefore, cannot be tested for compaction using conventional means (laboratory Proctors and nuclear densometer), then re-utilization of these fill/natural soils as structural site grading fill will require either screening and/or full-time observation during placement to document compaction means and methods.

Fine-grained soils, such as clays and silts, are not recommended for re-utilization as structural fill.

To stabilize soft subgrade conditions (if encountered) or where structural fill is required to be placed closer than 2.0 feet above the water table at the time of construction, a mixture of coarse angular gravels and cobbles and/or 1.5- to 2.0-inch gravel (stabilizing fill) should be utilized. It may also help to utilize a stabilization fabric, such as Mirafi 600X or equivalent, placed on the natural ground if 1.5- to 2.0-inch gravel is used as stabilizing fill.

5.2.4 Fill Placement and Compaction

All structural fill shall be placed in lifts not exceeding 8 inches in loose thickness. Structural fills shall be compacted in accordance with the percent of the maximum dry density as determined by the ASTM[1] D-1557(AASHTO[2] T-180) compaction criteria in accordance with the following table:

Location	Total Fill Thickness (feet)	Minimum Percentage of Maximum Dry Density
Beneath an area extending at least 5 feet beyond the perimeter of the structure	0 to 10	95
Site grading fills outside area defined above	0 to 5	90
Site grading fills outside area defined above	5 to 10	95
Utility trenches within structural areas	--	96
Road base	--	96

Structural fills greater than 10 feet thick are not anticipated at the site.

Subsequent to stripping and prior to the placement of structural site grading fill, the subgrade shall be prepared as discussed in Section 5.2.1, Site Preparation, of this report. In confined areas, subgrade preparation should consist of the removal of all loose or disturbed soils.

1 American Society for Testing and Materials
2 American Association of State Highway and Transportation Officials

Coarse angular gravel and cobble mixtures (stabilizing fill), if utilized, shall be end dumped, spread to a maximum loose lift thickness of 15 inches, and compacted by dropping a backhoe bucket onto the surface continuously at least twice. As an alternative, the stabilizing fill may be compacted by passing moderately heavy construction equipment or large self-propelled compaction equipment at least twice. Subsequent fill material placed over the coarse gravels and cobbles shall be adequately compacted so that the "fines" are "worked into" the voids in the underlying coarser gravels and cobbles. Where soil fill materials are to be placed directly over more than about 18 inches of clean gravel, a separation geofabric, such as Mirafi 140N or equivalent, is recommended to be placed between the gravel and subsequent soil fills.

Non-structural fill may be placed in lifts not exceeding 12 inches in loose thickness and compacted by passing construction, spreading, or hauling equipment over the surface at least twice.

5.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (footings, floor slabs, flatwork, pavements, etc.) shall be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill shall be proof rolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proof rolling shall be performed by passing moderately loaded rubber tire-mounted construction equipment uniformly over the surface at least twice. If excessively loose or soft areas are encountered during proof rolling, they shall be removed to a maximum depth of 2 feet below design finish grade and replaced with structural fill.

Many utility companies and City-County governments are now requiring that Type A-1a or A-1b (AASHTO Designation – basically granular soils with limited fines) soils be used as backfill over utilities. These organizations are also requiring that in public roadways, the backfill over major utilities be compacted over the full depth of fill to at least 96 percent of the maximum dry density as determined by the AASHTO T-180 (ASTMD-1557) method of compaction. GSH recommends that as the major utilities continue onto the site that these compaction specifications are followed.

Fine-grained soils, such as silts and clays, are not recommended for utility trench backfill in structural areas.

5.3 GROUNDWATER

Groundwater was encountered at this site at depths of 18 feet at the time of drilling. On September 18, 2017 (17 days following drilling), groundwater was measured within the piezometer installed at Boring B-1 at 19.8 feet.

Based on the anticipated cuts necessary to reach design subgrades, we do not anticipate significant groundwater control problems during mass grading operations. However, dewatering may be required during deeper excavations, such as those for utility construction and/or for the removal of non-engineered fills.

The extent and nature of any dewatering required during construction will be dependent on the actual groundwater conditions prevalent at the time of construction and the effectiveness of construction drainage to prevent run-off into open excavations.

5.4 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.4.1 Design Data

The results of our analysis indicate that the proposed structures may be supported upon conventional spread and continuous wall foundations established upon suitable natural soils and/or structural fill extending to suitable natural soils. For design, the following parameters are provided:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous Wall Footings	- 18 inches
Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Capacity for Real Load Conditions	- 2,500 pounds per square foot
Bearing Capacity Increase for Seismic Loading	- 50 percent

The term "net bearing capacity" refers to the allowable pressure imposed by the portion of the structure located above lowest adjacent final grade. Therefore, the weight of the footing and backfill to lowest adjacent final grade need not be considered. Real loads are defined as the total of all dead plus frequently applied live loads. Total load includes all dead and live loads, including seismic and wind.

5.4.2 Installation

Under no circumstances shall the footings be installed upon non-engineered fills, loose or disturbed soils, topsoil, surface vegetation, root systems, rubbish, construction debris, or other deleterious materials. If unsuitable soils are encountered, they must be removed and replaced with compacted granular fill. If granular soils become loose or disturbed, they must be recompacted prior to pouring the concrete.

The width of structural replacement fill below footings should be equal to the width of the footing plus one foot for each foot of fill thickness.

5.4.3 Settlements

Based on column loadings, soil bearing capacities, and the foundation recommendations as discussed above, we expect primary total settlement beneath individual foundations to be less than one inch.

The amount of differential settlement is difficult to predict because the subsurface and foundation loading conditions can vary considerably across the site. However, we anticipate differential settlement between adjacent foundations could vary from one-half to three-quarter-inch. The final deflected shape of the structure will be dependent on actual foundation locations and loading.

5.5 LATERAL RESISTANCE

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of friction of 0.30 may be utilized for the footing interface with in situ natural soils and 0.40 for footing interface with granular structural fill. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot. Below the water table, this granular soil should be considered equivalent to a fluid with a density of 150 pounds per cubic foot.

A combination of passive earth resistance and friction may be utilized provided that the friction component of the total is divided by 1.5.

5.6 LATERAL PRESSURES

The structure is anticipated to be constructed with full-depth basements. Parameters, as presented within this section, are for backfills which will consist of drained soil placed and compacted in accordance with the recommendations presented herein.

The lateral pressures imposed upon subgrade facilities will, therefore, be basically dependent upon the relative rigidity and movement of the backfilled structure. For active walls, such as retaining walls which can move outward (away from the backfill), drained backfill may be considered equivalent to a fluid with a density of 40 pounds per cubic foot in computing lateral pressures. For more rigid subgrade walls that are not more than 10 inches thick, granular backfill may be considered equivalent to a fluid with a density of 50 pounds per cubic foot. For very rigid non-yielding walls, granular backfill should be considered equivalent to a fluid with a density of at least 60 pounds per cubic foot. The above values assume that the surface of the soils slope behind the wall is horizontal and that the granular fill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

For seismic loading of retaining/below-grade walls, the uniform lateral pressures below, in pounds per square foot (psf), should be added based on wall depth and wall case:

Uniform Lateral Pressures			
Wall Height (Feet)	**Active Pressure Case (psf)**	**Moderately Yielding Case (psf)**	**At Rest/Non-Yielding Case (psf)**
4	40	75	105
6	60	110	160
8	80	145	210
10	100	180	265

5.7 FLOOR SLABS

Floor slabs may be established upon suitable natural soils and/or upon structural fill extending to suitable stabilized natural soils. Under no circumstances shall floor slabs be established over non-engineered fills, loose/disturbed soils, surface vegetation, root systems, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

In order to facilitate curing of the concrete and to provide a capillary moisture break, it is recommended that floor slabs be directly underlain by at least 4 inches of “free-draining” fill, such as “pea” gravel or three-quarters to one inch minus clean gap graded gravel.

Settlement of lightly loaded floor slabs designed according to previous recommendations (average uniform pressure of 200 pounds per square foot or less) is anticipated to be less than one-quarter of an inch.

5.8 PAVEMENTS

The natural clay soils and non-engineered fills will exhibit poor pavement support characteristics when saturated. All pavement areas must be prepared as previously discussed (see Section 5.2.1, Site Preparation). Under no circumstances shall pavements be established over unprepared non-engineered fills, loose or disturbed soils, topsoil, surface vegetation, root systems, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. With the subgrade soils and the projected traffic as discussed in Section 2, Proposed Construction, the following pavement sections are recommended:

Parking Areas and Drive Lanes

(Moderate Volume of Automobiles and Light Trucks,
Light Volume of Medium-Weight Trucks,
and Occasional Heavyweight Trucks)
[6 equivalent 18-kip axle loads per day]

Flexible Pavements:
(Asphalt Concrete)

4.0 inches	Asphalt concrete
9.0 inches	Aggregate base
Over	Properly prepared fills, natural subgrade soils, and/or structural site grading fill extending to properly prepared fills, natural subgrade soils

Rigid Pavements:
(Non-reinforced Concrete)

5.5 inches	Portland cement concrete (non-reinforced)
5.0 inches	Aggregate base
Over	Properly prepared natural subgrade soils and/or structural site grading fill extending to properly prepared natural subgrade soils

For dumpster pads, we recommend a pavement section consisting of 6.5 inches of Portland cement concrete, 5.0 inches of aggregate base, over properly prepared natural subgrade or site grading structural fills. Dumpster pads should not be constructed overlying non-engineered fills under any circumstances.

These above rigid pavement sections are for non-reinforced Portland cement concrete. Concrete should be designed in accordance with the American Concrete Institute (ACI) and joint details should conform to the Portland Cement Association (PCA) guidelines. The concrete should have a minimum 28-day unconfined compressive strength of 5,000 pounds per square inch and contain 6 percent ±1 percent air-entrainment.

The crushed stone should conform to applicable sections of the current UDOT Standard Specifications. All asphalt material and paving operations should meet applicable specifications of the Asphalt Institute and UDOT. A GSH technician shall observe placement and perform density testing of the base course material and asphalt.

Please note that the recommended pavement section is based on estimated post-construction traffic loading. If the pavement is to be constructed and utilized by construction traffic, the above pavement section may prove insufficient for heavy truck traffic, such as concrete trucks or tractor-trailers used for construction delivery. Unexpected distress, reduced pavement life, and/or premature failure of the pavement section could result if subjected to heavy construction traffic and the owner should be made aware of this risk. If the estimated traffic loading stated herein is not correct, GSH must review actual pavement loading conditions to determine if revisions to these recommendations are warranted.

5.9 CEMENT TYPES

The laboratory tests indicate that the natural soils tested contain a negligible amount of water soluble sulfates. Based on our test results, concrete in contact with the on-site soil will have a low potential for sulfate reaction (ACI 318, Table 4.3.1). Therefore, all concrete which will be in contact with the site soils may be prepared using Type I or IA cement.

5.10 GEOSEISMIC SETTING

5.10.1 General

Utah municipalities have adopted the International Building Code (IBC) 2015. The IBC 2015 code determines the seismic hazard for a site based upon 2008 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

5.10.2 Faulting

Based on our review of available literature, no active faults pass through or immediately adjacent to the site. The nearest active mapped fault consists of the Weber Section of the Wasatch Fault located about 0.7 mile to the southeast of the site.

5.10.3 Soil Class

For dynamic structural analysis, the Site Class D - Stiff Soil Profile as defined in Chapter 20 of ASCE 7 (per Section 1613.3.2, Site Class Definitions, of IBC 2015) can be utilized.

5.10.4 Ground Motions

The IBC 2015 code is based on 2008 USGS mapping, which provides values of short and long period accelerations for the Site Class B boundary for the Maximum Considered Earthquake (MCE). This Site Class B boundary represents average bedrock values for the Western United States and must be corrected for local soil conditions. The table below summarizes the peak ground and short and long period accelerations for the MCE event and incorporates the appropriate soil amplification factor for a Site Class D soil profile. Based on the site latitude and longitude (40.8632 degrees north and 111.8951 degrees west, respectively), the values for this site are tabulated on the following table:

Spectral Acceleration Value, T	Site Class B Boundary [mapped values] (% g)	Site Coefficient	Site Class D [adjusted for site class effects] (% g)	Design Values (% g)
Peak Ground Acceleration	63.4	F_a = 1.000	63.4	42.3
0.2 Seconds (Short Period Acceleration)	S_S = 158.4	F_a = 1.000	S_{MS} = 158.4	S_{DS} = 106
1.0 Second (Long Period Acceleration)	S_1 = 61.3	F_v = 1.500	S_{M1} = 92	S_{D1} = 61.3

5.10.5 Liquefaction

The site is located in an area that has been identified by the Utah Geological Survey (USGS) as being a "low" liquefaction potential zone. Liquefaction is defined as the condition when saturated, loose, granular soils lose their support capabilities because of excessive pore water pressure, which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event.

Due to the clayey nature of the soils within the borings, liquefaction is not anticipated to occur within the soils encountered at this site.

5.11 SITE VISITS

GSH must verify that all topsoil/disturbed soil, and any other unsuitable soils have been removed, that non-engineered fills have been removed and/or properly prepared, and that suitable soils have been encountered prior to placing site grading fills, footings, slabs, and pavements. Additionally, GSH must observe fill placement and verify in-place moisture content and density of fill materials placed at the site.

5.12 Closure

If you have any questions or would like to discuss these items further, please feel free to contact us at (801) 685-9190.

Respectfully submitted,

GSH Geotechnical, Inc.

Kylie D. Spilker, E.I.T.
Staff Engineer

Reviewed by:

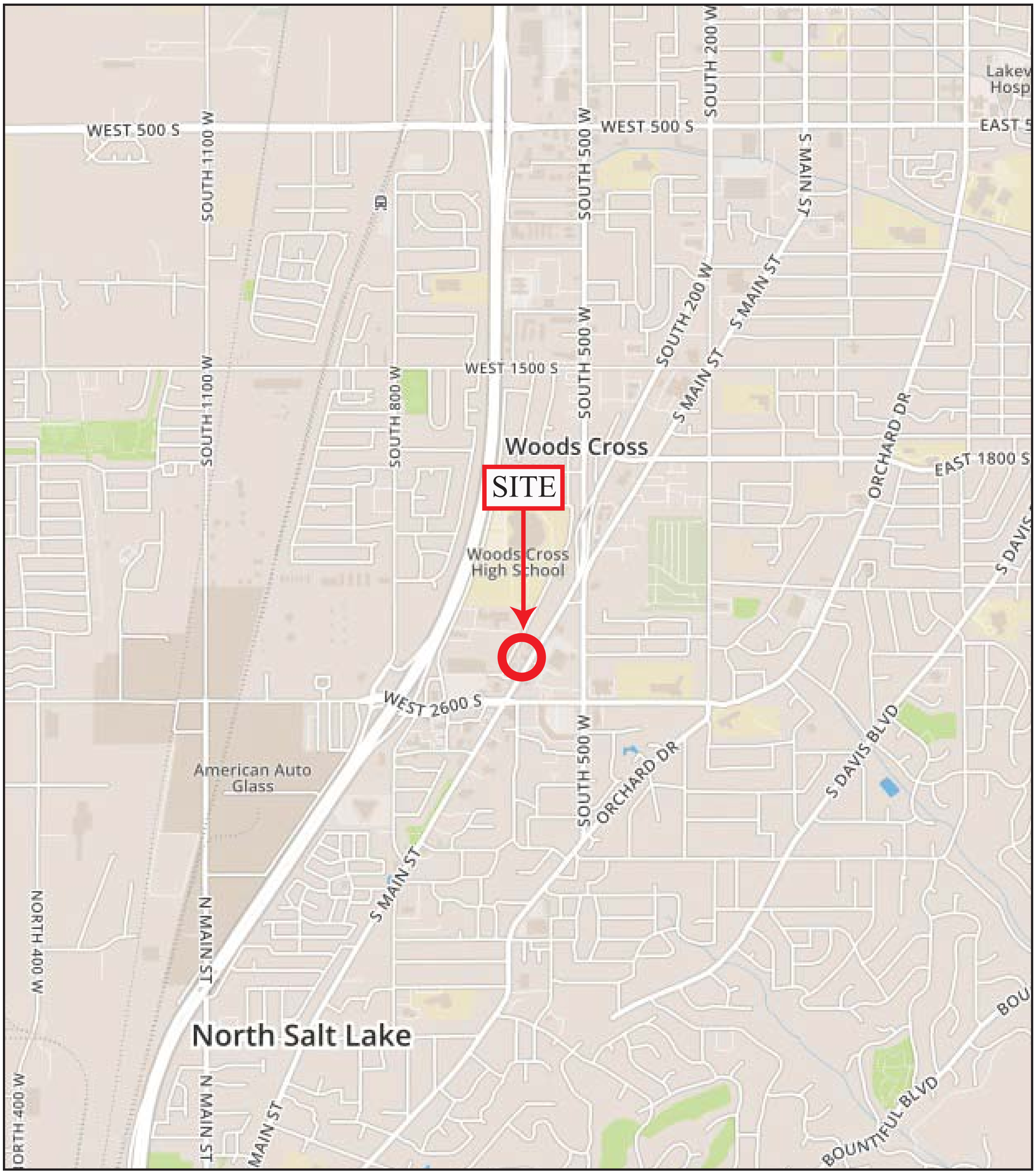
Alan D. Spilker, P.E.
State of Utah No. 334228
President/Senior Geotechnical Engineer

KDS/ADS:jlh

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figures 3A through 3D, Log of Borings
Figure 4, Key to Boring Log (USCS)

Addressee (email)

ALL POINTS B2B NSL, LLC
JOB NO.0525-018-17



0.5 0 0.5 1 1.5 2 KM 2.5

0.5 0 0.5 MI 1

FIGURE 1
VICINITY MAP

GSH

REFERENCE:
ALL TRAILS - NATIONAL GEOGRAPHIC TERRAIN
DATED 2017

ALL POINTS B2B NSL, LLC
JOB NO. 0525-018-17

FIGURE 2
SITE PLAN

REFERENCE:
ADAPTED FROM DRAWING ENTITLED
“SITE PLAN FOUR” DATED 6/05/17

APPROXIMATE SCALE: 1” = 23’

GSH

BORING LOG

Page: 1 of 1

BORING: B-1

CLIENT: All Points B2B NSL, LLC — PROJECT NUMBER: 0525-018-17

PROJECT: Amundsen Building — DATE STARTED: 9/1/17 — DATE FINISHED: 9/1/17

LOCATION: 2468 South Main Street, Wood Cross, Utah — GSH FIELD REP.: BG

DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger — HAMMER: Automatic — WEIGHT: 140 lbs — DROP: 30"

GROUNDWATER DEPTH: 19.8' (9/18/17) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		5.0" ASPHALT									
		1.0' ROAD BASE									
	CL FILL	SILTY CLAY, FILL with gravel; brown									slightly moist
				23	X						very stiff
	SM FILL	SILTY FINE TO MEDIUM SAND, FILL with fine gravel; brown		5	X						slightly moist soft
	CL	SILTY CLAY brown with oxidation	5								slightly moist
				13	X						stiff
		grades light to dark brown									
			10	13	X	18.8	104				
		grades light brown		9	X						medium stiff
			15								
▼		grades with occasional layers of silty fine sand up to 2" thick		13	X						stiff saturated
			20								
		End of Exploration at 20.5'. Installed 1.25" diameter slotted PVC pipe to 20.5'.									
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3A

GSH

BORING LOG

BORING: B-2

CLIENT: All Points B2B NSL, LLC | PROJECT NUMBER: 0525-018-17

PROJECT: Amundsen Building | DATE STARTED: 9/1/17 | DATE FINISHED: 9/1/17

LOCATION: 2468 South Main Street, Wood Cross, Utah | GSH FIELD REP.: BG

DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: Not Encountered (9/1/17) | ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		3.5" ASPHALT									
		1.0' ROAD BASE									
	CL FILL	FINE TO COARSE SANDY CLAY, FILl with fine gravel; brown									slightly moist medium stiff
				7	X						
	CL	FINE TO COARSE SANDY CLAY with fine gravel; dark brown	5								slightly moist
				14	X	18.3	83				stiff
			10								
		grades with silty clay; gray/brown with oxidation									
				6	X	29.6	86				medium stiff
		End of Exploration at 15.0'. No groundwater encountered at time of drilling.	15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3B

BORING LOG

BORING: B-3

CLIENT: All Points B2B NSL, LLC | PROJECT NUMBER: 0525-018-17
PROJECT: Amundsen Building | DATE STARTED: 9/1/17 | DATE FINISHED: 9/1/17
LOCATION: 2468 South Main Street, Wood Cross, Utah | GSH FIELD REP.: BG
DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"
GROUNDWATER DEPTH: Not Encountered (9/1/17) | ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		3.0" ASPHALT									
		1.0' ROAD BASE									
	CL FILL	SILTY CLAY, FILL with fine gravel; brown									slightly moist
	CL	SILTY CLAY brown with oxidation		10							slightly moist stiff
			5	14							
		grades gray	10	10							
		End of Exploration at 10.5'. No groundwater encountered at time of drilling.	15, 20, 25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3C

BORING LOG

Page: 1 of 1

BORING: B-4

CLIENT: All Points B2B NSL, LLC	PROJECT NUMBER: 0525-018-17
PROJECT: Amundsen Building	DATE STARTED: 9/1/17 DATE FINISHED: 9/1/17
LOCATION: 2468 South Main Street, Wood Cross, Utah	GSH FIELD REP.: BG
DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger	HAMMER: Automatic WEIGHT: 140 lbs DROP: 30"
GROUNDWATER DEPTH: Not Encountered (9/1/17)	ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		3.0" ASPHALT									
		1.0' ROAD BASE									
	CL	SILTY CLAY with fine gravel; brown									slightly moist medium stiff
				6							
			5	25		21.2	103				very stiff
		grades gray with oxidation		17							stiff
		End of Exploration at 8.5'. No groundwater encountered at time of drilling.	10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3D

CLIENT: All Points B2B NSL, LLC PROJECT: Amundsen Building PROJECT NUMBER: 0525-018-17	**KEY TO BORING LOG**

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫

COLUMN DESCRIPTIONS

① **Water Level:** Depth to measured groundwater table. See symbol below.

② **USCS:** (Unified Soil Classification System) Description of soils encountered; typical symbols are explained below.

③ **Description:** Description of material encountered; may include color, moisture, grain size, density/consistency,

④ **Depth (ft.):** Depth in feet below the ground surface.

⑤ **Blow Count:** Number of blows to advance sampler 12" beyond first 6", using a 140-lb hammer with 30" drop.

⑥ **Sample Symbol:** Type of soil sample collected at depth interval shown; sampler symbols are explained below.

⑦ **Moisture (%):** Water content of soil sample measured in laboratory; expressed as percentage of dryweight of

⑧ **Dry Density (pcf):** The density of a soil measured in laboratory; expressed in pounds per cubic foot.

⑨ **% Passing 200:** Fines content of soils sample passing a No. 200 sieve; expressed as a percentage.

⑩ **Liquid Limit (%):** Water content at which a soil changes from plastic to liquid behavior.

⑪ **Plasticity Index (%):** Range of water content at which a soil exhibits plastic properties.

⑫ **Remarks:** Comments and observations regarding drilling or sampling made by driller or field personnel. May include other field and laboratory test results using the following abbreviations:

CEMENTATION:	MODIFIERS:	MOISTURE CONTENT (FIELD TEST):
Weakly: Crumbles or breaks with handling or slight finger pressure.	**Trace** <5%	**Dry:** Absence of moisture, dusty, dry to the touch.
Moderately: Crumbles or breaks with considerable finger pressure.	**Some** 5-12%	**Moist:** Damp but no visible water.
Strongly: Will not crumble or break with finger pressure.	**With** > 12%	**Saturated:** Visible water, usually soil below water table.

Descriptions and stratum lines are interpretive; field descriptions may have been modified to reflect lab test results. Descriptions on the logs apply only at the specific boring locations and at the time the borings were advanced; they are not warranted to be representative of subsurface conditions at other locations or times.

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS SYMBOLS	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	**GRAVELS** More than 50% of coarse fraction retained on No. 4 sieve.	**CLEAN GRAVELS** (little or no fines)	GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
			GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
		GRAVELS WITH FINES (appreciable amount of fines)	GM	Silty Gravels, Gravel-Sand-Silt Mixtures
			GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	SANDS More than 50% of coarse fraction passing through No. 4 sieve.	**CLEAN SANDS** (little or no fines)	SW	Well-Graded Sands, Gravelly Sands, Little or No Fines
			SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines
		SANDS WITH FINES (appreciable amount of fines)	SM	Silty Sands, Sand-Silt Mixtures
			SC	Clayey Sands, Sand-Clay Mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	**SILTS AND CLAYS** Liquid Limit less than 50%		ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity
			CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	Organic Silts and Organic Silty Clays o f Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH	Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils
			CH	Inorganic Clays of High Plasticity, Fat Clays
			OH	Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS			PT	Peat, Humus, Swamp Soils with High Organic Contents

Note: Dual Symbols are used to indicate borderline soil classifications.

STRATIFICATION:

DESCRIPTION	THICKNESS
Seam	up to 1/8"
Layer	1/8" to 12"

Occasional: One or less per 6" of thickness
Numerous; More than one per 6" of thickness

TYPICAL SAMPLER GRAPHIC SYMBOLS

- Bulk/Bag Sample
- Standard Penetration Split Spoon Sampler
- Rock Core
- No Recovery
- 3.25" OD, 2.42" ID D&M Sampler
- 3.0" OD, 2.42" ID D&M Sampler
- California Sampler
- Thin Wall

WATER SYMBOL

Water Level

FIGURE 4

GSH