REPORT
GEOTECHNICAL STUDY
PROPOSED WEST WEBER ELEMENTARY REPLACEMENT
4178 WEST 900 SOUTH
OGDEN, UTAH 84404

Submitted To:

Weber School District
5320 South Adams Avenue Parkway
Ogden, Utah 84404

Submitted By:

GSH Geotechnical, Inc.
473 West 4800 South
Salt Lake City, Utah 84123

August 14, 2013

Job No. 0303-009-13

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Weber School District
5320 South Adams Avenue Parkway
Ogden, Utah 84404

Attention: Mr. Drew Wilson

Gentlemen:

Re: Report
Geotechnical Study
Proposed West Weber Elementary Replacement
4178 West 900 South
Ogden, Utah 84404

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed West Weber Elementary replacement located at the 4178 west 900 South in Ogden, Utah. The general location of the overall site with respect to major topographic features and existing facilities, as of 1998 and 1999, is presented on Figure 1, Vicinity Map. A more detailed layout of the overall site showing the location of the existing elementary school, the proposed replacement elementary school and roadways is presented on Figure 2, Site Plan. The locations of the borings drilled in conjunction with this study are also presented on Figure 2.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were outlined in the project solicitation JW140002 with additional discussions with Messrs. Drew Wilson and Jeffery Walker of Weber School District.

In general, the objectives of this study were to:

1. Accurately define and evaluate the subsurface soil and groundwater conditions across the site.

Gordon Spilker Huber Geotechnical Consultants, Inc.
4426 South Century Drive, Suite 100
Salt Lake City, Utah 84123
Tel: (801) 685-9190 Fax: (801) 685-2990
www.gshgeotech.com

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

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

1. A field program consisting of the drilling, logging, and sampling of 9 borings.

2. A laboratory testing program.

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

1.3 AUTHORIZATION

Authorization was provided by letter notification dated July 29, 2013 with regard to our Professional Services Agreement No. 13-0737 dated July 25, 2013.

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, of this report. 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

Proposed construction will consist of constructing a new single-story slab-on-grade school with multiple wings directly to the northwest of the existing school building. The structure will be of wood-frame and masonry bearing walls construction. Projected wall loads will be on the order of 4 to 8 kips per lineal foot with potential isolated column loads up to 80 kips. The existing school building will subsequently be demolished and new pavements constructed in its location.

Traffic in the parking areas is projected to consist of a light volume of automobiles and light trucks and occasional medium-weight trucks. In the primary roadway/loop area, traffic is projected to consist of a moderate volume of automobiles and light trucks, up to roughly 10 busses per day, a light volume of medium-weight trucks, and occasional heavy-weight trucks.

Site development will require a minimal amount of earthwork in the form of site grading. We estimate that maximum fills to achieve design grades will be on the order of 2 feet.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions at the site, 9 borings were explored to depths ranging from 4.5 to 31.0 feet below existing grade. The borings were drilled using a truck-mounted drill rig equipped with hollow-stem augers. 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, relatively undisturbed and small disturbed 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 have been supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3I, Log of Borings. Soils were classified in accordance with the nomenclature described on Figure 4, Key to Boring Log.

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, one and one-quarter-inch diameter slotted PVC pipe was installed in Borings B-1 through B-6 in order to provide a means of monitoring the groundwater fluctuations.

3.2 LABORATORY TESTING

3.2.1 General

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

3.2.2 Moisture and Density Tests

To aid in classifying the soils and to help 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 3I.

3.2.3 Partial Gradation Tests

To aid in classifying the granular soils, partial gradation tests were performed. Results of the tests are tabulated below:

Boring No.	Depth (feet)	Percent Moisture Content	Percent Passing No. 200 Sieve	Soil Classification
B-1	5.0	29.2	90.6	ML
B-1	10.0	24.6	7.3	SP-SM
B-1	14.5	34.2	11.5	SP-SM
B-2	9.5	33.6	76.2	ML
B-2	14.5	27.8	4.8	SP
B-3	7.5	25.4	2.2	SP
B-3	14.5	27.8	7.1	SP-SM
B-4	9.5	28.9	3.9	SP
B-4	14.5	26.5	2.3	SP
B-5	9.5	29.7	43.4	SM
B-5	14.5	26.8	7.6	SP-SM
B-6	9.5	28.2	54.5	SC-CL

3.2.4 Consolidation Tests

A consolidation test was performed on each of 4 representative samples of the silty/sandy clays between 2.5 and 5.0 feet encountered in the exploration borings. The results indicate that the finer-grained soils are moderately over-consolidated and will exhibit moderate compressibility characteristics when loaded below the over-consolidation pressure. Detailed results of the test are maintained within our files and can be transmitted to you, upon your request.

3.2.5 Chemical Tests

To determine if the site soils will react detrimentally with concrete, chemical tests were performed on a representative sample of the surficial clay soils encountered in Boring B-4 at a depth of 2.5 feet below existing grade. The results of the chemical tests are tabulated on the following page.

Boring No.	Depth (feet)	Soil Classification	pH	Total Water Soluble Sulfate (mg/kg-dry)
B-4	2.5	CL	8.10	7.1

4. SITE CONDITIONS

4.1 SURFACE

The existing school property is located at 4178 West 900 South and is approximately 8.5 acres in size. Access to the property is from the north side of 900 South. The existing school structure is located at the south-central portion of the property. Asphalt parking borders the building along the east and west with an asphalt-surface playground directly north of the building. Grass fields cover the approximate northern half of the property. A single-family residential home with agricultural fields borders the site to the east with vacant agricultural property to the north and west.

The site property is relatively flat. The planned replacement school will be located within the existing grass fields on the northern side of the property and extend south into the existing asphalt-paved playground. New parking and drop-off loops will be located where the present building is, as well as to the east and west of the existing building.

4.2 SUBSURFACE SOIL

The soil conditions encountered in each of the borings, to the depths penetrated, are relatively similar. At Borings B-1 and B-3 through B-7, clay soils were encountered at the surface extending to depths of 4.5 to 9.5 feet. At Boring B-2, sandy gravel with some silty/clay fill was encountered from the surface down to approximately 4.5 feet underlain by silty clay to a depth of 10 feet. This fill must be considered as non-engineered. The upper 6 inches at each of these borings (Borings B-1 through B-7) contained major roots/topsoil. Below the surficial clay layer, silt and sands with varying fines (clays/silts) were encountered to depths of 18 to 20 feet. This layer of silt/sand was occasionally broken up with silty/sandy clay layers up to 3 feet thick at some of the borings. Below the silt and sand layers and extending to the maximum depth penetrated, 31 feet, silty/sandy clay exists.

Borings B-8 and B-9 were located within the existing west parking lot with 3.0 to 3.5 inches of asphalt over granular fill soils to approximately 1.5 feet. Below the fill, natural clay soil extended to the full depth penetrated, 4.5 feet, in Boring B-8. A 1.5-foot layer of silty sand over silty clay to 4.5 feet was encountered below the fill in Boring B-9.

The natural clays are primarily medium stiff to stiff in the upper sequence and are moderately over-consolidated and will exhibit moderate to high compressibility characteristics under the

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design loading. The deeper clay soils vary from very soft to medium stiff below the water table. Additionally, the natural clay soils are moist grading saturated and brown and gray in color.

The natural sand soils are loose to medium dense, saturated, brown and gray in color, and will generally exhibit moderately high strength and low compressibility characteristic under the design static loading. At borings B-1, B-3, and B-4, there are layers of loose sand which could liquefy during the design seismic event.

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 was measured 8 days following drilling. Groundwater measurements are tabulated below:

Boring No.	Static Groundwater 8-days After Drilling (feet below surface) August 10, 2013
B-1	4.3
B-2	4.0
B-3	4.75
B-4	4.6
B-5	4.25
B-6	4.6

Seasonal and longer-term groundwater fluctuations on the order of 1.0 to 1.5 feet are projected, with the highest seasonal levels generally occurring during the late spring and early summer months.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

The results of our study show that the proposed addition may be supported upon conventional spread and continuous wall foundations established upon suitable natural soils and/or structural fill extending to suitable natural soils.

The most significant geotechnical aspects of the subsurface conditions include:

1. The loose, saturated sand soils with the potential to liquefy during the design seismic event.

2. The high groundwater table.

3. The non-engineered fill encountered to 4.5 feet in Boring B-2.

Our calculations indicate that there are layers of sand with some silt encountered at Borings B-1, B-3, and B-4 between 9.5 and 18 feet which would liquefy during the design seismic event. Associated settlements were calculated on the order of 0.5 to 1.5 inches. This magnitude of settlement should be tolerable to design for life safety. Ground rupture and lateral spread are not expected to occur.

Static groundwater was measured between 4.0 and 4.75 feet below the surface at the boring locations. With the groundwater this shallow, it is recommended that site grading cuts be kept to a minimum not exceeding 1.5 feet below natural grade, excluding removal of non-engineered fills. Additionally, it is recommended that the top of the lowest habitable slab be kept a minimum of 3 feet above the existing groundwater level.

Non-engineered fill was encountered at Boring B-2 to a depth of approximately 4.5 feet. All non-engineered fills must be removed below buildings and concrete pavements but may remain below flexible pavement if properly prepared, as well as remain in non-structural areas if free of debris and deleterious material.

In the following sections, detailed discussions pertaining to earthwork, foundations, lateral resistance and pressure, floor slabs, pavements, and the geoseismic setting of the site are provided.

5.2 DESIGN GROUNDWATER

It is recommended that the top of the lowest slabs in habitable areas be established at least 3 feet above the highest measured level in conjunction with this study. If floor slab elevations are required to be deeper, a drain system should be incorporated. Recommendations for a drain system may be provided by GSH once slab and elevation details are made available.

5.3 EARTHWORK

5.3.1 Site Preparation

Prior to initiation of major construction activities, all surface vegetation and any other deleterious materials must be removed extending out three feet from the proposed structure and pavement areas. Trees and their associated root bulbs will require deeper removal depths. All non-engineered fills must be removed below the building and concrete pavements. Existing asphalt pavements may remain below new pavement sections if grading permits and the asphalt is properly broken up to allow drainage. Any existing utilities in conflict with the new facility will need to be properly abandoned and/or relocated.

It is our understanding that the existing school building will remain in operation while the new building is under construction. Once the new building is completed, the existing building will be demolished. New pavements will be constructed in the area of the existing building.

Site preparation shall include the removal of the existing school building and all associated debris and any other deleterious materials. Old foundations should be removed to a minimum of 1.5 feet below new pavement areas. Existing non-engineered fills, if free of debris and deleterious materials, may remain below flexible pavements if properly prepared. Proper preparation shall consist of moisture preparing and compacting the upper 9 inches to the requirements for structural fill discussed later in this report.

Prior to the placement of structural site grading fill, pavements, floor slabs, or footings, and where the exposed natural subgrade is a minimum of 3 feet above groundwater, the exposed subgrade shall be proofrolled by running moderate-weight rubber tire-mounted construction equipment uniformly over the surface at least 2 times. 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, 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.

Vegetation and other deleterious materials should be removed from the site. Stripped topsoil will be unsuitable for structural fill but may be stockpiled for subsequent landscaping purposes.

5.3.2 Excavations

Static groundwater was measured as shallow as 4 feet below the existing surface in Boring B-2. Temporary construction excavations in cohesive soil, not exceeding 4 feet in depth and above or below the groundwater table, may be constructed with near-vertical sideslopes. Temporary excavations up to 8 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:1V). Excavations deeper than 8 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:1V). For excavations up to 8 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.

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.

5.3.3 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 potentially as replacement fill below footings. All structural fill must be free of sod, rubbish, topsoil, frozen soil, and other deleterious materials.

Structural site grading fill is defined as fill placed over relatively large open areas to raise the overall grade. For structural site grading fill, the maximum particle size shall generally 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 generally be restricted to 2 inches.

On-site natural soils are not recommended for structural site grading fill as these soils are above optimum moisture content and predominately fine-grained in the upper sequence. The existing granular soils associated with existing pavements may be re-utilized as site grading fills below new pavement areas.

Imported granular structural fill should consist of a fairly well-graded mixture of sand and gravel with less than 20 percent fines.

To stabilize soft subgrade conditions or where structural fill is required to be placed below a level one foot above the water table at the time of construction, a mixture of coarse, fractured gravels and cobbles (stabilizing fill) should be utilized.

Non-structural site grading fill is defined as all fill material not designated as structural fill and may consist of any cohesive or granular soils not containing excessive amounts of degradable material.

5.3.4 Fill Placement and Compaction

Structural fill (other than stabilizing 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 AASHTO[1] T-180 (ASTM[2] D-1557) compaction criteria in accordance with the table on the following page.

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

Location	Total Fill Thickness (feet)	Minimum Percentage of Maximum Dry Density
Beneath an area extending at least 3 feet beyond the perimeter of the structure	0 to 10	95
Outside area defined above	0 to 5	90
Outside area defined above	5 to 10	95
Aggregate Base/Subbase	--	95

Structural fills greater than 8 feet thick are not anticipated at the site.

Coarse gravel and cobble mixtures (stabilizing fill), if utilized, should 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 should be adequately compacted so that the "fines" are "worked into" the voids in the underlying coarser gravels and cobbles.

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.

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.

5.3.5 Utility Trenches

Groundwater was encountered as shallow as 4 feet below the surface in Boring B-2. The contractor must be prepared to dewater as necessary.

All utility trench backfill material below structurally loaded facilities (flatwork, floor slabs, paved areas, etc.) should be placed to the same material and density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill should be proofrolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proofrolling may 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 proofrolling, they should be removed to a maximum depth of 2 feet below design finish grade and replaced with structural fill.

Most 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 (ASTM D-1557) method of compaction.

Fine-grained cohesive soils, such as clays and silts, are not recommended for use as trench backfill.

5.4 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.4.1 Design Data

The proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable undisturbed natural soils and/or structural fill extending to suitable natural soils. We recommend where possible that foundations be established a minimum of 2 feet above groundwater. For design, the following parameters are provided with respect to the projected loading discussed in Section 2, Proposed Construction of this report:

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 Pressure for Real Load Conditions	- 2,000 pounds per square foot
Bearing Pressure Increase for Seismic Loading Downward vertical loading only	- 50 percent

The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above the 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 should the footings be established upon soft, loose or disturbed soils, non-engineered fills, sod, rubbish, frozen soils, debris, or within ponded water. If the natural soils upon which the footings are to be established become loose or disturbed, they must be removed and replaced with granular structural fill compacted to the requirements stated in this report. If granular structural fill upon which the footings are to be established become disturbed, they should be recompacted to the requirements for structural fill.

The width of replacement fill below footings should be equal to the width of the footing plus one additional foot for each foot of fill thickness placed. For example, if the width of the footing is 2 feet and the thickness of the structural fill beneath the footing is 1 foot, the width of the structural fill at the base of the footing excavation would be a total of 3 feet. We recommend that footing excavations be completed with a smooth-lip bucket to reduce disturbance of the bearing subgrade soils.

5.4.3 Settlements

Maximum settlements of foundations designed and installed in accordance with recommendations presented herein and supporting maximum anticipated loads as discussed in Section 2, Proposed Construction, are anticipated to be on the order of one-quarter to five-eighths of an inch.

Approximately 60 percent of the quoted settlement should occur during construction.

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 0.40 should be utilized. 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 proposed new building is planned to be constructed slab on grade. However, for the purpose of potential shallow subgrade structures up to 4 feet below the surface, such as utility boxes, etc., the following lateral pressure discussion is provided.

The lateral pressure parameters, as presented within this section, are for backfills, which will consist of drained granular 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), granular backfill may be considered equivalent to a fluid with a density of 35 pounds per cubic foot in computing lateral pressures. For more rigid walls, granular backfill may be considered equivalent to a fluid with a density of 45 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 and below-grade walls up to 4 feet tall, uniform pressures of 25 and 55 pounds per square foot should be added for active and more rigid case walls, respectively.

5.7 FLOOR SLABS

Floor slabs may be established upon properly prepared, suitable undisturbed natural soils and/or upon structural fill extending to suitable natural soils. Topsoil and non-engineered fills are not considered suitable. To provide a capillary 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. A vapor barrier should be considered below sensitive flooring. Settlements of lightly to moderately loaded floor slabs are anticipated to be minor.

5.8 CEMENT TYPES

Laboratory tests indicate that the site soils contain negligible amounts of water soluble sulfates. Therefore, all concrete which will be in contact with the site soils may be prepared with standard Type I or IA cement.

5.9 PAVEMENTS

The natural clay soils at the surface will exhibit poor to fair engineering characteristics when saturated. Pending final grading the existing pavement sections may or may not be allowed to remain. The following design is based on the natural clay soil for subgrade and the projected traffic as discussed in Section 2, Proposed Construction, the pavement sections on the following pages are recommended.

Parking Areas

(Light Volume of Automobiles and Light Trucks,
Occasional Medium-Weight Trucks,
and No Heavy-Weight Trucks)
[1-2 equivalent 18-kip axle loads per day]

Flexible:

3.0 inches	Asphalt concrete
7.0 inches	Aggregate base course
Over	Properly prepared non-engineered fills/disturbed soil, suitable natural soils and/or structural site grading fill extending to suitable natural soils

Rigid pavements must not be established over non-engineered fills/disturbed soil.

Rigid:

5.0 inches	Portland cement concrete (non-reinforced)
5.0 inches	Aggregate base course
Over	Suitable natural soils and/or structural site grading fill extending to suitable natural soils

Primary Roadway and Personal Vehicle Drop-off Loop

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

Flexible:

3.0 inches	Asphalt concrete
9.0 inches	Aggregate base course
Over	Properly prepared non-engineered fills/disturbed soil, suitable natural soils and/or structural site grading fill extending to suitable natural soils

Rigid pavements must not be established over non-engineered fills/disturbed soil.

Rigid:

6.0 inches	Portland cement concrete (non-reinforced)
4.0 inches	Aggregate base course
Over	Suitable natural soils and/or structural site grading fill extending to suitable natural soils

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Primary Roadway and Bus Loop

(Moderate Volume of Automobiles and Light Trucks,
Light Volume of Medium weight Trucks,
and Occasional Heavy-Weight Trucks, and up to 10 Busses)
[10 to 15 equivalent 18-kip axle loads per day]

Flexible:

3.5 inches	Asphalt concrete
10.0 inches	Aggregate base course
Over	Properly prepared non-engineered fills/disturbed soil, suitable natural soils and/or structural site grading fill extending to suitable natural soils

Rigid pavements must not be established over non-engineered fills/disturbed soil.

Rigid:

6.5 inches	Portland cement concrete (non-reinforced)
6.0 inches	Aggregate base course
Over	Suitable natural soils and/or structural site grading fill extending to suitable natural soils

These rigid pavement sections are for non-reinforced Portland cement concrete. Construction of the rigid pavement should be in sections 10 to 12 feet in width with construction or expansion joints or one-quarter depth saw-cuts on no more than 12-foot centers. Saw-cuts must be completed within 24 hours of the "initial set" of the concrete and should be performed under the direction of the concrete paving contractor. The concrete should have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch and contain 6 percent ±1 percent air-entrainment.

5.10 GEOSEISMIC SETTING

5.10.1 General

Utah municipalities adopted the International Building Code (IBC) 2012 on July 1, 2013. The IBC 2012 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).

The structures must be designed in accordance with the procedure presented in Section 1613, Earthquake Loads, of the IBC 2012 edition.

5.10.2 Soil Class

Static groundwater measured 8 days after drilling was encountered between depths of 4.0 to 4.75 feet below the surface. Very loose, saturated sand soils were encountered at 3 of the borings completed within the building footprint between depths of 9.5 and 18.0 feet below the surface.

Our analysis shows that layers of these saturated sand soils could liquefy during the design seismic event (see Section 5.10.5, Liquefaction). According to the IBC 2012, which references ASCE-7-10, Chapter 20, "Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils..." are designated under site Class F. However, the potential settlements due to liquefaction are anticipated to be 1.5 inches or less. This magnitude of settlement can typically be tolerated by an adequately designed structure to protect life safety. Additionally, surface rupture and lateral spreading are not anticipated to occur. Therefore, we recommend the site be designated under Site Class D - Stiff Soil Profile for design.

5.10.3 Faulting

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The nearest active fault consists of the Weber Segment of the Wasatch Fault approximately 7 miles east of the site.

5.10.4 Ground Motions

The IBC 2012 code is based on 2008 USGS mapping, which provides values of short and long period accelerations for the Site Class B-C boundary for the Maximum Considered Earthquake (MCE). This Site Class B-C boundary represents a hypothetical bedrock surface and must be corrected for local soil conditions. The following table summarizes the peak ground and short and long period accelerations for a MCE event and incorporates a soil amplification factor for a Site Class D soil profile in the second column. Based on the site latitude and longitude (41.250

degrees north and 112.079 degrees west, respectively), the values for this site are tabulated below:

Spectral Acceleration Value, T Seconds	Site Class B-C Boundary [mapped values] (% g)	Site Class D [adjusted for site class effects] (% g)
Peak Ground Acceleration	51.0	51.1
0.2 Seconds, (Short Period Acceleration)	$S_S = 137.8$	$S_{MS} = 91.9$
1.0 Seconds (Long Period Acceleration)	$S_1 = 38.5$	$S_{M1} = 41.8$

The IBC 2012 code design accelerations (S_{DS} and S_{D1}) are based on multiplying the above accelerations (adjusted for site class effects) for the MCE event by two-thirds.

5.10.5 Liquefaction

The site is located in an area that has been identified by the Utah Earthquake Preparedness Information Center Utah Division of Comprehensive Emergency Management for Weber County as having "high" liquefaction potential. Liquefaction is defined as the condition when saturated, loose, fine sand-type soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will not liquefy during a major seismic event.

Our calculations indicate that the saturated sand soils encountered between 12 and 18 feet in Borings B-1 and B-3 and between 9.5 and 13.0 feet in Boring B-4 would liquefy during the design seismic event. Calculated settlement associated with the liquefaction ranges from 0.5 up to 1.5 inches at the top of the layers. This magnitude of settlement should be tolerable to design for life safety. Calculations were performed using the procedures described in the 2008 Soil Liquefaction During Earthquakes Monograph by Idriss and Boulanger[3].

5.11 SITE VISITS

GSH must observe the foundation installation/excavations prior to placing footings to verify that that the excavations extend to suitable natural soils and the recommendations provided herein are adhered to.

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3 Idriss, I. M., and Boulanger, R. W. (2008), Soil liquefaction during earthquakes: Monograph MNO-12, Earthquake Engineering Research Institute, Oakland, CA, 261 pp.

GSH

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.

Bryan N. Roberts, P.E.
State of Utah No. 276476
Project Geotechnical Engineer

Reviewed by:

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

BNR/ADS:jlh

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

Addressee (3 + email)

cc: Mr. Tony Armer (email)
MHTN Architects Inc.

WEBER SCHOOL DISTRICT
JOB NO. 0303-009-13

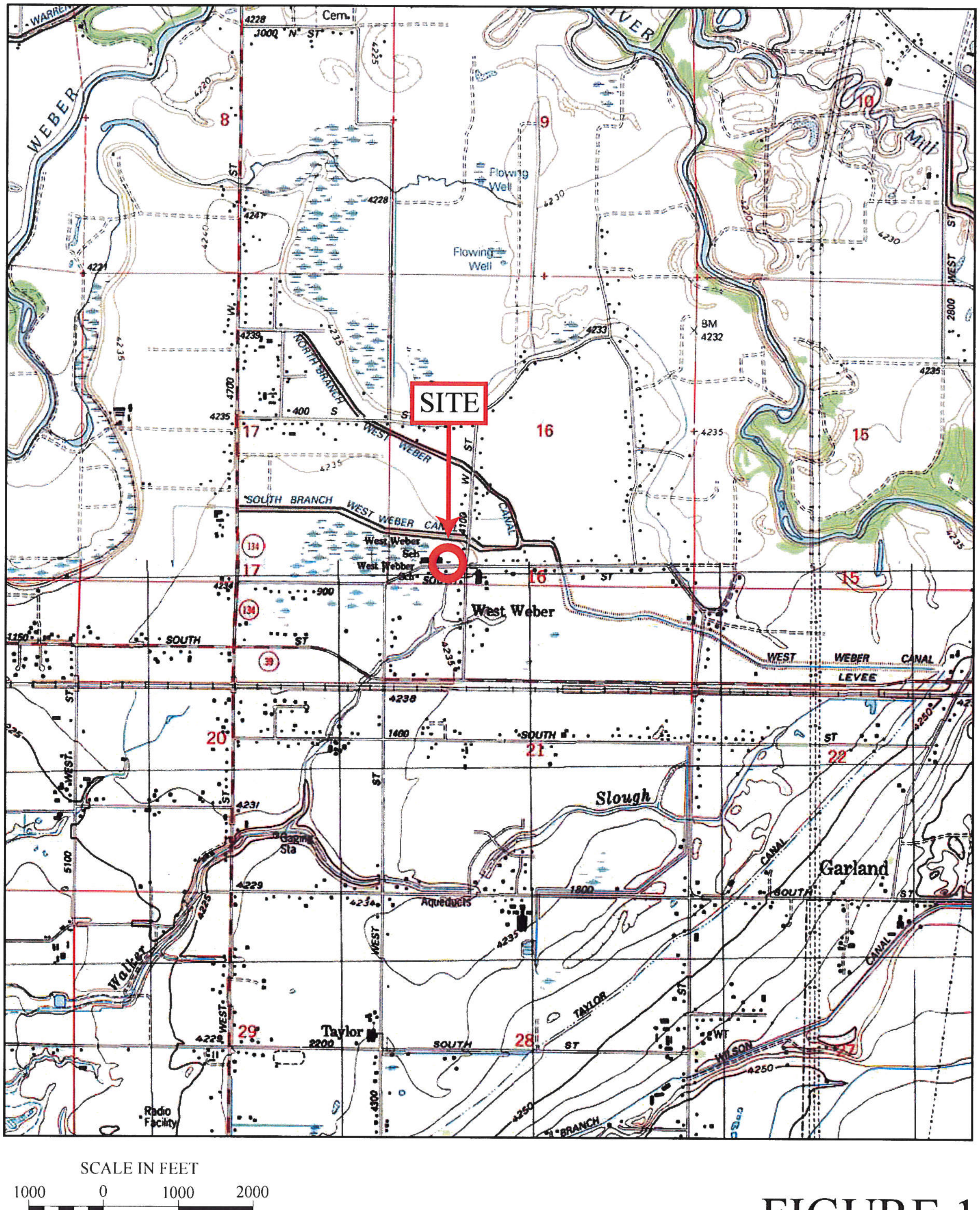

FIGURE 1
VICINITY MAP

GSH

REFERENCE:
USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE MAP(S)
ENTITLED "ROY, UTAH" DATED 1998 AND "PLAIN CITY, UTAH"
DATED 1999

WEBER SCHOOL DISTRICT
JOB NO. 0303-009-13

REFERENCE:
ADAPTED FROM DRAWING PROVIDED BY CLIENT
NOT DATED

FIGURE 2
SITE PLAN
GSH

GSH

BORING LOG

BORING: B-1

CLIENT: Weber School District

PROJECT NUMBER: 0303-009-13

PROJECT: Proposed West Weber Elementary Replacement

DATE STARTED: 08/01/13 **DATE FINISHED:** 08/01/13

LOCATION: 4178 West 900 South Ogden, Utah

GSH Field Rep.: RAG/CJ

DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger

HAMMER: Automatic **WEIGHT:** 140 lbs **DROP:** 30"

GROUNDWATER DEPTH: 10.0' (08/01/13) 4.3' (08/10/13)

ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	CL	**SILTY CLAY** with some fine sand; major roots (topsoil) to 6"; brown								very moist medium stiff
				5	32.5	86				
▼	ML	**CLAYEY SILT** with some fine sand; brown	5	7	29.2		90.6			saturated very loose
	SP/SM	**FINE TO MEDIUM SAND** with some silt; brown								
			10	11	24.6		7.3			saturated loose
			15	7	34.2		11.5			
	CL	**FINE TO MEDIUM SANDY CLAY** gray								
			20	4						saturated medium stiff
		End of exploration at 21.0'. Installed 1-1/4" diameter slotted PVC pipe to 21.0'.								
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3A

GSH — BORING LOG

BORING: B-2

CLIENT: Weber School District — **PROJECT NUMBER:** 0303-009-13

PROJECT: Proposed West Weber Elementary Replacement — **DATE STARTED:** 08/01/13 **DATE FINISHED:** 08/01/13

LOCATION: 4178 West 900 South Ogden, Utah — **GSH Field Rep.:** RAG/CJ

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

GROUNDWATER DEPTH: 7.0' (08/01/13) 4.0' (08/10/13 — **ELEVATION:** ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	GM FILL	**FINE GRAVEL; FILL** with some silt and fine to coarse sand; major roots (topsoil) to 6"; gray									moist loose
				7							
▼											saturated
	CL	**SILTY CLAY** with some fine to medium sand and fine gravel; gray	5	6							saturated medium stiff
		grades with some fine sand; brown									saturated
	ML	**CLAYEY SILT** with some fine sand; brown	10	4		33.6		76.2			saturated loose
	SP	**FINE TO MEDIUM SAND** with trace silt; gray/brown									
			15	18		27.8		4.8			medium dense
	CL	**FINE SANDY CLAY** with some silt; gray	20	6							saturated medium stiff
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3B

GSH

BORING LOG

BORING: B-2

CLIENT: Weber School District | **PROJECT NUMBER:** 0303-009-13

PROJECT: West Weber Elementary | **DATE STARTED:** 08/01/13

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		grades with occasional fine sand layers up to 1"; gray	25	2/ 12"	ǁ						soft
			30	1/ 12"	ǁ						very soft
		End of exploration at 31.0'. Installed 1-1/4" diameter slotted PVC pipe to 31.0'.	35								
			40								
			45								
			50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3B (cont'd)

GSH

BORING LOG

Page: 1 of 1

BORING: B-3

CLIENT: Weber School District
PROJECT NUMBER: 0303-009-13
PROJECT: Proposed West Weber Elementary Replacement
DATE STARTED: 08/01/13 **DATE FINISHED:** 08/01/13
LOCATION: 4178 West 900 South, Ogden, Utah
GSH Field Rep.: RAG/CJ
DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger
HAMMER: Automatic **WEIGHT:** 140 lbs **DROP:** 30"
GROUNDWATER DEPTH: 6.5' (08/01/13) 4.75' (08/10/13)
ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	**SILTY CLAY** with some fine to medium sand; major roots (topsoil) to 6"; brown/gray									moist medium stiff
▼			5	3		32.1	87				saturated soft
	SP	**FINE TO MEDIUM SAND** with trace silt; brown									saturated loose
				21		28.4		2.2			
	CL	**FINE TO MEDIUM SANDY CLAY** with some silt and occasional layers up to 4" thick of silty clay with some fine sand; brown	10	3							saturated soft
	SM/SP	**FINE TO MEDIUM SAND** with some silt; brown									saturated medium dense
			15	10		27.8		7.1			
	CL	**FINE SANDY CLAY** with some silt; gray	20	9							saturated stiff
		End of exploration at 21.0'. Installed 1-1/4" diameter slotted PVC pipe to 21.0'.									
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3C

GSH BORING LOG

Page: 1 of 1

BORING: B-4

CLIENT: Weber School District — **PROJECT NUMBER:** 0303-009-13

PROJECT: Proposed West Weber Elementary Replacement — **DATE STARTED:** 08/02/13 **DATE FINISHED:** 08/02/13

LOCATION: 4178 West 900 South, Ogden, Utah — **GSH Field Rep.:** RAG/CJ

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

GROUNDWATER DEPTH: 5.5' (08/02/13) 4.6' (08/10/13) — **ELEVATION:** ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	**SILTY CLAY** with some fine sand; major roots (topsoil) to 6"; brown									moist stiff
				18							
▼			5	10		28.6	94				saturated medium stiff
	SM	**SILTY FINE TO MEDIUM SAND** with trace clay; brown									saturated loose
	SP	**FINE TO MEDIUM SAND** with trace silt; brown	10	8		28.9		3.9			saturated loose
			15	15		26.5		2.3			medium dense
	CL	**FINE SANDY CLAY** with occasional layers up to 2" thick of silty clay with trace fine sand; gray	20	14							saturated stiff
		End of exploration at 21.0'. Installed 1-1/4" diameter slotted PVC pipe to 21.0'.	25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3D

GSH — BORING LOG

Page: 1 of 1

BORING: B-5

CLIENT: Weber School District — **PROJECT NUMBER:** 0303-009-13

PROJECT: Propoed West Weber Elementary Replacement — **DATE STARTED:** 08/02/13 **DATE FINISHED:** 08/02/13

LOCATION: 4178 West 900 South, Ogden, Utah — **GSH Field Rep.:** RAG/CJ

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

GROUNDWATER DEPTH: 5.5' (08/02/13) 4.25' (08/10/13) — **ELEVATION:** ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	**SILTY CLAY** with some fine to medium sand; major roots (topsoil) to 6"; brown/gray									moist medium stiff
▼			5	7		31.6	91				saturated
	SP	**FINE TO MEDIUM SAND** with trace silt; brown									saturated very loose
	CL	**FINE SANDY CLAY** with some silt; brown		1/9"							saturated very soft
	SM	**SILTY FINE TO MEDIUM SAND** with some clay and occasional layers up to 2" thick of silty clay with some fine to medium sand; brown	10	9		29.7		43.4			saturated loose
	SP/SM	**FINE TO MEDIUM SAND** with some silt; brown/gray	15	20		26.8		7.6			medium dense
	CL	**FINE SANDY CLAY** with occasional layers up to 1" thick of clayey silty fine to medium sand; gray	20	11							saturated medium stiff
		End of exploration at 21.0'. Installed 1-1/4" diameter slotted PVC pipe to 21.0'.	25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3E

GSH BORING LOG

Page: 1 of 1

BORING: B-6

CLIENT: Weber School District | **PROJECT NUMBER:** 0303-009-13

PROJECT: Proposed West Weber Elementary Replacement | **DATE STARTED:** 08/02/13 **DATE FINISHED:** 08/02/13

LOCATION: 4178 West 900 South, Ogden, Utah | **GSH Field Rep.:** RAG/CJ

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

GROUNDWATER DEPTH: 6.0' (08/02/13) 4.6' (08/10/13) | **ELEVATION:** ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	**SILTY CLAY** with some fine sand; major roots (topsoil) to 6"; brown									very moist medium stiff
				5	X	26.0	95				
▼											saturated
		grades with occasional fine to medium sandy layers up to 2" thick	5	10	X	28.6	90				
	SC/CL	**FINE SANDY CLAY/CLAYEY FINE SAND** with some silt; brown	10	7	X	28.2		54.5			saturated very loose/ medium stiff
	SM/SP	**FINE TO MEDIUM SAND** with some silt; occasional layers up to 2" thick; brown/gray	15	11	‖	28.3		10.6			saturated medium dense
	CL	**SILTY CLAY** with some fine sand and occasional layers up to 1" thick of clayey silty fine to medium sand; gray									saturated stiff
			20	11	X						
		End of exploration at 21.0'. Installed 1-1/4" diameter slotted PVC pipe to 21.0'.									
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3F

GSH BORING LOG

Page: 1 of 1

BORING: B-7

CLIENT: Weber School District | **PROJECT NUMBER:** 0165-023-13

PROJECT: Proposed West Weber Elementary Replacement | **DATE STARTED:** 08/02/13 **DATE FINISHED:** 08/02/13

LOCATION: 4178 West 900 South, Ogden, Utah | **GSH Field Rep.:** RAG/CJ

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

GROUNDWATER DEPTH: No Groundwater Encountered (08/02/13) | **ELEVATION:** ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL	**SILTY CLAY** with some fine sand; major roots (topsoil) to 6"; brown			◣						moist
					◣						very moist
		End of exploration at 4.5'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3G

GSH

BORING LOG

BORING: B-8

CLIENT: Weber School District | **PROJECT NUMBER:** 0303-009-13

PROJECT: Proposed West Weber Elementary Replacement | **DATE STARTED:** 08/02/13 **DATE FINISHED:** 08/02/13

LOCATION: 4178 West 900 South, Ogden, Utah | **GSH Field Rep.:** RAG/CJ

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

GROUNDWATER DEPTH: No Groundwater Encountered (08/02/13) | **ELEVATION:** ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		ASPHALT to 3"									moist
	GM	**FINE TO COARSE SANDY FINE GRAVEL** with some silt; brown									
	CL	**SILTY CLAY** with some fine to medium sand; brown									moist
											very moist
		End of exploration at 4.5'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3H

GSH

BORING LOG

Page: 1 of 1

BORING: B-9

CLIENT: Weber School District — **PROJECT NUMBER:** 0303-009-13

PROJECT: Proposed West Weber Elementary Replacement — **DATE STARTED:** 08/02/13 **DATE FINISHED:** 08/02/13

LOCATION: 4178 West 900 South, Ogden, Utah — **GSH Field Rep.:** RAG/CJ

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

GROUNDWATER DEPTH: No Groundwater Encountered (08/02/13) — **ELEVATION:** ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
		ASPHALT to 3.5"									
	GM	**FINE SANDY FINE GRAVEL** with silt and clay; brown									moist
	SM	**FINE TO MEDIUM SAND** with some silt and clay; brown			◣						moist
	CL	**SILTY CLAY** with some fine sand; brown			◣						very moist
		End of exploration at 4.5'. No groundwater encountered at time of drilling.	5								
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

PROJECT: Proposed West Weber Elementary Replacement
PROJECT LOCATION: 4178 West 900 South, Ogden, Utah
PROJECT NUMBER: 0303-009-13

KEY TO BORING LOG

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 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 measure groundwater table. See symbol below.

2 **USCS**: Graphic depiction of subsurface material encountered; typical symbols are explained below.

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

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

5 **Blow Count**: Number of blows required to advance sampler (12 inches) beyond first. using a 140-lb hammer with a 30 inch 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 dry weight of specimen.

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

9 **% Passing 200:** Fines content of soil sample passing a No. 200 sieve measured in laboratory, expressed as a percentage.

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

11 **Placsticity 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. Other field and laboratory test results; using the following abbreviations:

CEMENTATION	MODIFIERS	MOISTURE CONTENT (FIELD TEST)
Weakly: Crumbles or breaks with handling of 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

MAJOR DIVISIONS			SYMBOLS Letter	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS More than 50% of No. 200 sieve size.	GRAVELS More than 50% of coarse fraction retained in No. 4 sieve.	CLEAN GRAVELS (little or no fines)	GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
			GP	Poorly Graded Gravel, 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 of 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 Clays of Medium to High Plasticity, Organic Silts
HIGHLY ORGANIC SOILS			PT	Peat, Humus, Swamp Soils with High Organic Contents

Note: Dual Symbols are used to indicate borderline soil classifications

STRATIFACTION

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

STRATIFACTION

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

LOG KEY SYMBOLS

- Water Level

FIGURE 4

GSH