Geotechnical Evaluation Report

Proposed Ogden West Meetinghouse
3691 West 2200 South
Ogden, Utah (41.2267°, -112.0687°)
LDS Property Number: 602-0268

Prepared for:
The Church of Jesus Christ of Latter-day Saints
c/o BHD Architects
65 Wadsworth Park Drive, Suite 205
Draper, Utah 84020

GSH

Prepared by
GSH Geotechnical
January 27, 2025

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January 27, 2025
Job No. 0153-561-25

Mr. Mike Davey and Mr. Lafe Harris
The Church of Jesus Christ of Latter-day Saints
c/o BHD Architects
65 Wadsworth Park Drive, Suite 205
Draper, Utah 84020

Mr. Davey and Mr. Harris:

Re: Geotechnical Evaluation Report
Proposed Ogden West Meetinghouse
3691 West 2200 South
Ogden, Utah (41.2267°, -112.0687°)
Property Number: 602-0268

1. EXECUTIVE SUMMARY

This report presents the results of our geotechnical study performed at the site of the proposed Ogden West Meetinghouse to be located at 3691 West 2200 South in Ogden, Utah.

The soils across the site were generally similar at the boring locations. Borings were completed to depths ranging from 5.5 to 46.5 feet. Topsoil and/or loose/disturbed soils due to previous agricultural activities were encountered in each boring to depths ranging from 12 to 18 inches. Additionally, non-engineered fills were encountered in each boring to depths ranging from 1.0 to 3.0 feet beneath the ground surface. Natural soils were encountered below the non-engineered fill in each boring. The natural soils consisted of silty/clayey sands. Borings B-1 and B-3 encountered clay with varying silt and sand depths of approximately 9.0 to 18.5 feet beneath the ground surface.

The natural sand soils were very loose to medium dense, slightly moist to saturated, and orange, tan, light brown, and brown in color. The natural sand soils are anticipated to exhibit moderately high strength and moderately low compressibility characteristics under the anticipated load range.

The natural clay soils at the site were typically soft to stiff, saturated, gray, light brown, and brown in color. The natural clay soils are anticipated to exhibit moderate strength and compressibility characteristics under the anticipated load range.

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Groundwater was measured as shallow as 5.1 feet below the ground surface. GSH recommends placing floor slabs no closer than 4 feet from the highest groundwater elevation. Based on the anticipated cuts necessary to reach design subgrades, we anticipate temporary and permanent dewatering may be necessary. Floor slabs must be placed a minimum of 4 feet from the stabilized groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation. Additionally, proof rolling of the natural subgrade must not be completed if cuts extend to within 1 foot of the groundwater surface. In areas where cuts are to extend to within 1 foot of the groundwater surface, stabilization must be anticipated.

The results of the study indicate that the proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable natural granular soils or granular structural fill extending to suitable natural granular soils. Under no circumstance shall footings, floor slabs, or pavements be placed upon topsoil, loose/disturbed soils, or non-engineered fill. Additionally due to the presence of potentially liquefiable sand soils, and shallow groundwater, GSH also evaluated supporting the proposed structures upon soil reinforcement methods such as a grid of rammed-aggregate piers. Rammed-aggregate piers offer increased bearing, less earthwork, and the ability to bypass and reduce the amount of settlement of the potentially liquefiable sand soils.

The most significant geotechnical aspects of the site are the surface vegetation, topsoil, loose/disturbed soils, and non-engineered fills encountered throughout the site as well as the relatively shallow depth to groundwater and potential for liquefaction induced settlement.

Prior to proceeding with construction, removal of all non-engineered fills, loose/disturbed soil, surface vegetation, root systems, 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 pavements and exterior flatwork areas is required. All footing excavations must extend to undisturbed natural soils.

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 section of the Wasatch fault zone located approximately 7.0 miles to the northeast of the site.

Calculations were performed using the procedures described in the 2014 Soil Liquefaction During Earthquakes Monograph by Idriss and Boulanger[1]. Our calculations indicate the very loose, saturated sand layer encountered in Boring B-1 could liquefy during the design seismic event. Calculated settlement associated with the liquefaction of each layer within the borings was less than 2.0 inches. This magnitude of settlement must be evaluated by the structural engineer to design for life safety. Additionally, lateral spread and ground rupture are unlikely to occur.

[1] Idriss, I. M., and Boulanger, R. W. (2014), Soil liquefaction during earthquakes: Monograph MNO-12, Earthquake Engineering Research Institute, Oakland, CA, 261 pp.

2. INTRODUCTION

This report presents the results of the geotechnical study performed at the site of the proposed Ogden West Meetinghouse to be located at 3691 West 2200 South in Ogden, Utah. The general location of the site with respect to existing roadways, as of 2025, is presented on Figure 1, Vicinity Map. A more detailed site plan showing the proposed construction and existing roadways is presented on Figure 2, Site Plan. The approximate locations of the borings completed in conjunction with this study are also presented on Figure 2.

3. AUTHORIZATION

Authorization was provided by the client returning a signed "Agreement Between Client and Geotechnical Consultant" in accordance with our Professional Services Agreement No. 25-0105.

4. PROJECT DESCRIPTION, PURPOSE OF EVALUATION, & SCOPE OF WORK

The objectives and scope of our study were planned in discussions among Mr. Mike Davey and Mr. Lafe Harris of BHD Architects, and Mr. Michael S. Huber of GSH Geotechnical, Inc. (GSH).

In general, the objectives of this study were to:

1. Define and evaluate the subsurface soil and groundwater conditions at the proposed site.

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

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

1. A field program consisting of the drilling, logging, and sampling of 11 borings.

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.

5. 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 6, Design Criteria, 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.

6. DESIGN CRITERIA

The meetinghouse structure will be constructed on an approximately 3.5-acre parcel. The structure will be 1 to 1-extended level in height and of wood-frame construction established slab on grade and supported over conventional spread and continuous wall footings.

Maximum real column and wall loads are anticipated to be 120 kips and 5 kips per lineal foot, respectively. Real loads are defined as the total of all dead plus frequently applied (reduced) live loads.

At-grade paved parking and roadway areas will be part of the overall site development. Projected traffic in the parking areas is anticipated to consist of a light volume of automobiles and light trucks with no medium-weight or heavyweight trucks. In primary drive areas within the church parking lot, traffic is projected to consist of a light volume of automobiles and light trucks with occasional medium-weight and heavyweight trucks (mainly garbage trucks).

Maximum site grading cuts and fills are anticipated to be on the order of 1 to 3 feet.

7. SITE CONDITIONS

The site is currently agricultural land located at 3691 West 2200 South in Ogden, Utah. The site slopes gently downward to the northwest with a total relief of approximately 2 to 3 feet. Vegetation at the site consists of agricultural grasses and sparse weeds.

The site is bounded to the north by 2200 South Street followed by single-family residential structures; to the east by Weber District Fire Station 66 followed by vacant/undeveloped land; to the south by active construction sites for single-family residential structures; and to the west by single-family residential structures along with Allen Road.

8. FIELD STUDY

In order to define and evaluate the subsurface soil and groundwater conditions across the site, 11 borings were extended to depths ranging from 5.5 to 46.5 feet below existing grades. These borings were completed using a truck-mounted drill rig equipped with hollow-stem augers. The approximate locations of the borings are presented on Figure 2. Additionally, a stormwater percolation test to determine the percolation rate was performed in Boring B-8 at a depth of 5.5 feet.

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 penetrated were obtained for subsequent laboratory testing and examination. The soils were classified in the field based upon visual and textural properties. These classifications were later supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3K, 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 (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 Borings B-1 through B-3 to provide a means of monitoring the groundwater fluctuations. The borings were backfilled with auger cuttings.

9. SUBSURFACE CONDITIONS AND GROUNDWATER

Topsoil and/or loose/disturbed soils due to previous agricultural activities were encountered in each boring to depths ranging from 12 to 18 inches. Additionally, non-engineered fills were encountered in each boring to depths ranging from 1.0 to 3.0 feet beneath the ground surface. Natural soils were encountered below the non-engineered fill in each boring. The natural soils consisted of silty/clayey sands. Borings B-1 and B-3 encountered clay with varying silt and sand depths of approximately 9.0 to 18.5 feet beneath the ground surface.

The natural sand soils were very loose to medium dense, slightly moist to saturated, and orange, tan, light brown, and brown in color. The natural sand soils are anticipated to exhibit moderately high strength and moderately low compressibility characteristics under the anticipated load range.

The natural clay soils at the site were typically soft to stiff, saturated, gray, light brown, and brown in color. The natural clay soils are anticipated to exhibit moderate strength and compressibility characteristics under the anticipated load range.

For additional details pertaining to the subsurface conditions encountered, please refer to Figures 3A through 3K, 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.

Groundwater was measured at the boring locations at depths ranging from 5.1 to 5.8 feet below the existing ground surface.

Groundwater levels vary with changes in season and rainfall, construction activity, irrigation, snow melt, surface water run-off, and other site-specific factors.

10. LABORATORY TESTING

10.1 General

To provide data necessary for our engineering analysis, a laboratory testing program was performed. This program included moisture, density, partial gradation, Atterberg limits, chemical, and topsoil suitability tests. The following paragraphs describe the tests and summarize the test data.

10.2 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 3K.

10.3 Partial Gradation Tests

To aid in classifying the granular soils, partial gradation tests were performed. Results of the tests are tabulated below and presented on the boring logs, Figures 3A through 3K:

Boring No.	Depth (feet)	Percent Passing No. 200 Sieve	Moisture Content Percent	Soil Classification
B-1	5.0	39.1	21.2	SM/SC
B-1	15.0	34.9	24.4	SM
B-2	2.5	21.9	22.2	SM
B-2	5.0	43.1	25.8	SM
B-2	10.0	56.2	33.1	SM/SC*
B-2	15.0	48.0	35.7	SM*
B-3	2.5	9.5	26.5	SP/SM
B-3	10.0	68.2	29.6	CL
B-4	5.0	44.1	27.9	SM/SC
B-6	5.0	27.3	25.2	SM/SC
B-8	5.0	39.1	30.1	SM
B-10	5.0	47.3	25.9	SM/SC*
B-11	2.5	43.4	26.5	SM/SC

* Sample tested contained layer of clay

10.4 Atterberg Limits Test

To aid in classifying the soils, an Atterberg limits test was performed on a sample of the fine-grained cohesive soils. Results of the test are tabulated below and presented on the boring logs, Figures 3A through 3K:

Boring No.	Depth (feet)	Liquid Limit (percent)	Plastic Limit (percent)	Plasticity Index (percent)	Soil Classification
B-1	20.0	30	21	9	CL
B-1	35.0	46	26	20	CL

10.5 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 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-1	2.5	SM/SC	8.0	64

10.6 Topsoil Tests

A series of topsoil tests were performed on a representative surface sample. The results of these tests are included in Appendix A, Topsoil Testing Report.

11. RECOMMENDATIONS AND CONCLUSIONS

11.1 SUMMARY OF FINDINGS

The proposed structures may be supported upon conventional spread and continuous wall foundations supported upon suitable natural granular soils and/or structural fill extending to suitable natural granular soils. Additionally due to the presence of potentially liquefiable sand soils, and shallow groundwater, GSH also evaluated supporting the proposed structures upon soil reinforcement methods such as a grid of rammed-aggregate piers. Rammed-aggregate piers offer increased bearing, less earthwork, and the ability to bypass and reduce the amount of settlement of the potentially liquefiable sand soils.

The most significant geotechnical aspects at the site are:

1. The relatively shallow depth to groundwater.
2. The existing surface vegetation, topsoil, and loose/disturbed soils across much of the site.
3. The existing non-engineered fills across much of the site.
4. The potentially liquefiable sand layer encountered in Boring B-1.

Prior to proceeding with construction, removal of all debris, surface vegetation, root systems, topsoil, loose/disturbed soils, non-engineered fill, and any deleterious materials from beneath an area extending out at least 5 feet from the perimeter of the proposed structure footprints and 3 feet beyond 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. 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 pavements.

Some of the on-site non-engineered fill soils encountered were granular. On-site granular soils, including 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.

Groundwater was measured as shallow as 5.1 feet below the ground surface. GSH recommends placing floor slabs no closer than 4 feet from the highest groundwater elevation. Based on the anticipated cuts necessary to reach design subgrades, we anticipate temporary and permanent dewatering may be necessary. Floor slabs must be placed a minimum of 4 feet from the stabilized groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

Proof rolling of the natural subgrade must not be completed if cuts extend to within 1 foot of the groundwater surface. In areas where cuts are to extend to within 1 foot of the groundwater surface, stabilization must be anticipated.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

A very loose, saturated sand layer was encountered in Boring B-1. Due to liquefiable soils being present, the site has been determined to be Site Class F (in accordance with Section 20.3.1, Site Class F of ASCE 7-16). According to ASCE 7-16, a site-specific response analysis is required. Section 20.3.1 of ASCE 7-16 provides exception to this requirement under certain conditions.

These options will need to be reviewed and evaluated by the project structural engineer. If needed, GSH can provide additional information and analysis, including a complete site-specific response analysis.

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

11.2 EARTHWORK

11.2.1 Site Preparation

Initial site preparation will consist of the removal of all debris, loose/disturbed soils, 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 structure footprint and 3 feet beyond 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.

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 the 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 shall 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.

Due to the relatively high groundwater, site grading cuts should be kept to a minimum. Cuts extending to within 1 foot of the groundwater elevation will likely disturb the natural clay soils and proof rolling must not be completed. Stabilization must be anticipated in areas where cuts are to extend to within 1 foot of the groundwater surface.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

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.

11.2.2 Temporary Excavations

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:1.0V). 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, shall be no steeper than one-half horizontal to one vertical (0.5H:1.0V). For excavations up to 8 feet, in granular soils and above the water table, the slopes shall 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.

To reduce disturbance of the natural soils during excavation, it is recommended that low-impact, track-mounted equipment with smooth edge buckets/blades be utilized.

The static groundwater table was encountered as shallow as 5.1 feet below the existing surface and may be shallower with seasonal fluctuations. Consideration for dewatering of utility trenches, excavations for the removal of non-engineered fill, and other excavations below this level should be incorporated into the design and bidding process.

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.

11.2.3 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.

On-site granular soils may be re-utilized as structural site grading fill if they do not contain construction debris or deleterious material and meet the requirements of structural fill. Fine-grained soils will require very close moisture control and may be very difficult, if not impossible, to properly place and compact during wet and cold periods of the year. Therefore, clay and silt soils are not recommended to be re-utilized as structural fill.

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).

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) shall 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.

11.2.4 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 AASHTO[2] T180 (ASTM[3] D1557) 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 5	95
Site grading fills outside area defined above	0 to 5	90
Utility trenches within structural areas	--	96
Road base	--	96

Structural fills greater than 5 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 11.2.1, Site Preparation, of this report.

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.

Coarse gravel and cobble mixtures (stabilizing fill), 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 fill may be compacted by passing moderately heavy construction equipment or large self-propelled compaction equipment at least twice.

[2] American Association of State Highway and Transportation Officials
[3] American Society for Testing and Materials

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.

11.2.5 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 – 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 T180 (ASTM D1557) 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.

The static groundwater table was encountered as shallow as 5.1 feet below the existing surface and may be shallower with seasonal fluctuations. Dewatering of utility trenches and other excavations below this level should be anticipated.

11.3 GROUNDWATER

On January 16, 2025 (6 days following drilling), groundwater was measured within the PVC pipes installed as tabulated below:

Boring No.	Groundwater Depth (feet)
	January 16, 2025
B-1	5.8
B-2	5.1
B-3	5.3

Based on the anticipated cuts necessary to reach design subgrades, we anticipate temporary and permanent dewatering will be necessary. Floor slabs must be placed a minimum of 4 feet from the stabilized groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

The groundwater measurements presented are conditions at the time of the field exploration and may not be representative of other times or locations. Groundwater levels may vary seasonally and with precipitation, as well as other factors including irrigation. Evaluation of these factors is beyond the scope of this study. Groundwater levels may, therefore, be at shallower or deeper depths than those measured during this study, including during construction and over the life of the structure.

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.

11.3.1 Stormwater Percolation Test

A stormwater percolation test was performed at a depth of approximately 5.5 feet in the representative natural sand soils at Boring B-8. We recommend using a design percolation rate of 20 minutes per inch. This design percolation rate shall be considered typical for the sand soils at the site.

11.4 SPREAD AND CONTINUOUS WALL FOUNDATIONS

11.4.1 Design Data

The results of our analysis indicate that the proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable natural granular soils and/or structural fill extending to suitable natural granular soils. For design, the following parameters are provided with respect to the projected loading discussed in Section 6, Design Criteria, 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 Capacity for Real Load Conditions for Footings Established Upon Suitable Natural Granular Soils	- 3,000 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.

11.4.2 Installation

Under no circumstances shall the footings be established upon loose or disturbed soil, surface vegetation, root systems, topsoil, rubbish, construction debris, non-engineered fill, frozen soil, or other deleterious materials. If unsuitable soils are encountered, they must be completely removed and replaced with compacted structural fill.

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

11.4.3 Settlements

Based on column loadings, soil bearing capacities, and the foundation recommendations as discussed above, settlements are anticipated 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.

11.5 SPREAD AND CONTINUOUS WALL FOUNDATIONS ESTABLISHED UPON RAMMED-AGGREGATE PIERS

11.5.1 General

Due to the presence of potentially liquefiable sand soils and shallow groundwater, GSH also evaluated supporting the proposed structures upon soil reinforcement methods such as a grid of

rammed-aggregate piers. Rammed-aggregate piers offer increased bearing, less earthwork, and the ability to bypass and reduce the amount of settlement of the potentially liquefiable sand soils.

11.5.2 Design Data

Rammed-aggregate piers soil reinforcement elements are constructed by drilling a 24- or 30-inch diameter hole and then building a bottom bulb of clean, open-graded stone using a beveled, high-energy tamper. The rammed-aggregate piers shaft is constructed on top of the bottom bulb using well graded highway base course stone placed in thin lifts (12 inches compacted thickness). The result is a reinforced zone of soil directly under footings that allows for the construction of shallow spread footings proportioned for a relatively high bearing pressure. Rammed-aggregate piers elements are spaced singly under continuous footings or in close groups to support concentrated column loads.

Rammed-aggregate piers soil reinforcement is a design/build element and must be designed and constructed by a licensed installer. The installer should provide layout and detailed design calculations sealed by a professional engineer licensed in the State of Utah. The design calculations should demonstrate that rammed-aggregate piers soil reinforcement is designed to control settlement to magnitudes within the criteria for this project.

For the design of conventional spread and continuous wall foundation constructed over rammed-aggregate piers elements, the parameters are provided below:

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	- 16 inches
Minimum Recommended Width for Isolated Spread Footings	- 30 inches
Bearing Capacity for Footings Overlying Rammed-Aggregate Piers	- Approximately 4,000 to 6,000 pounds per square foot*

* To be developed as design build by rammed-aggregate piers licensed installer.

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.

11.5.3 Installation

Foundations must be established directly upon the undisturbed tops of the pier systems. It is recommended that prior to installing rammed-aggregate piers, all site grading activities be completed.

Unsuitable soils shall be completely removed beneath footings. Under no circumstances shall the footings be installed overlying organics, deleterious materials, frozen soil, or within ponded water.

11.5.4 Settlements

Maximum settlements of foundations designed and installed over rammed-aggregate piers should be less than one-half inch. However, these estimates will be refined with the design of the system.

11.6 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 0.40 for footing interface the natural granular soils or granular structural fill may 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.

11.7 FLOOR SLABS

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

Additionally, GSH recommends that floor slabs be constructed a minimum of 4.0 feet from the stabilized groundwater elevation. Site grading fill may be utilized to raise the overall grade to achieve the required separation between the floor slab and the highest groundwater elevation.

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.

In accordance with the Geotechnical Evaluation Report Template, floor slabs are to be constructed without control or construction joints, reinforced with No. 4 bars at 18 inches on-center each way, and shall include a 15-mil vapor retarder placed directly under the concrete with at least 4 inches of "free-draining" fill, described previously, placed below the vapor retarder.

11.8 PAVEMENTS

All pavement areas must be prepared as previously discussed (see Section 11.2.1, Site Preparation). Under no circumstances shall pavements be established over topsoil, loose/disturbed soils, non-engineered fills, surface vegetation, root systems, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. With the subgrade soils and the projected traffic (40-year design life) as discussed in Section 6, Design Criteria, the pavement sections on the following pages are recommended.

Parking Areas

(Light Volume of Automobiles and Light Trucks,
Occasional Medium-Weight Trucks,
No Heavyweight Trucks)
[6 equivalent 18-kip axle loads per week]

Flexible:

3.0 inches	Asphalt concrete
7.0 inches	Aggregate base
Over	Properly prepared natural subgrade soils and/or structural site grading fill extending to suitable natural subgrade soils

Rigid:

5.0 inches	Portland cement concrete (non-reinforced)

4.0 inches	Aggregate base
Over	Properly prepared natural subgrade soils and/or structural site grading fill extending to suitable natural subgrade soils

Parking Lot Drive Lanes and Access Driveways

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

Flexible:

3.0 inches	Asphalt concrete
8.0 inches	Aggregate base
Over	Properly prepared natural subgrade soils and/or structural site grading fill extending to suitable natural subgrade soils

Rigid:

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

For trash enclosure and associated approach slabs (one 40,000-pound axel load per week), we recommend a pavement section consisting of 8.0 inches of Portland cement concrete, 12.0 inches of aggregate base, over properly prepared natural subgrade or site grading structural fills extending to suitable natural soils.

The 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 shall have a minimum 28-day unconfined compressive strength of 4,500 pounds per square inch, contain

6 percent ±1 percent air-entrainment, and meet the requirements given below in Section 11.9, Cement Types, of this report. In accordance with the Geotechnical Evaluation Report Template, 25 percent fly ash is required in all concrete exposed to freeze-thaw cycles and deicers.

The crushed stone shall conform to applicable sections of the current Utah Department of Transportation (UDOT) Standard Specifications. All asphalt material and paving operations shall 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. Gradation requirements for UDOT aggregate roadbase are presented below:

Sieve Size	Job Mix Gradation Target Blend
1 1/2 inch	100
1 inch	90-100
3/4 inch	70-85
1/2 inch	65-80
3/8 inch	55-75
No. 4	40-65
No. 16	25-40
No. 200	7-11

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.

11.9 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.

11.10 DOWNSPOUTS

It is recommended that all surface water be directed away from the building with positive drainage measures, including downspouts.

11.11 GEOSEISMIC SETTING

11.11.1 General

Utah municipalities have adopted the International Building Code (IBC) 2021. The IBC 2021 code refers to ASCE 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7-16) determines the seismic hazard for a site based upon 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).

11.11.2 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 section of the Wasatch fault zone located approximately 7.0 miles to the northeast of the site.

11.11.3 Site Class

Due to liquefiable soils being present, the site has been determined to be Site Class F (in accordance with Section 20.3.1, Site Class F of ASCE 7-16). According to ASCE 7-16, a site-specific response analysis is required. Section 20.3.1 of ASCE 7-16 provides exception to this requirement under certain conditions. These options will need to be reviewed and evaluated by the project structural engineer. If needed, GSH can provide additional information and analysis, including a complete site-specific response analysis.

11.11.4 Ground Motions

The IBC 2021 code is based on USGS mapping, which provides values of short and long period accelerations for average bedrock values for the Western United States and must be corrected for local soil conditions. The following table 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 F Soil Profile. Based on the site latitude and longitude (41.2267 degrees north and 112.0686 degrees west, respectively), the values for this site are tabulated on the following page.

Spectral Acceleration Value, T	Bedrock Boundary [mapped values] (% g)	Site Coefficient	Site Class * [adjusted for site class effects] (% g)	Design Values* (% g)
Peak Ground Acceleration	*	F_a = *	*	*
0.2 Seconds (Short Period Acceleration)	S_S = *	F_a = *	S_{MS} = *	S_{DS} = *
1.0 Second (Long Period Acceleration)	S_1 = *	F_v = *	S_{M1} = *	S_{D1} = *

* See Section 11.11.3, Site Class.

11.11.5 Liquefaction

The site is located in an area that has been identified by the Utah Geological Survey (UGS) as being a "high" 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.

Calculations were performed using the procedures described in the 2014 Soil Liquefaction During Earthquakes Monograph by Idriss and Boulanger[4]. Our calculations indicate the very loose, saturated sand layer encountered in Boring B-1 could liquefy during the design seismic event. Calculated settlement associated with the liquefaction of each layer within the borings was less than 2.0 inches. This magnitude of settlement must be evaluated by the structural engineer to design for life safety. Additionally, lateral spread and ground rupture are unlikely to occur.

11.12 SITE VISITS

Prior to placement of foundations and site grading fills, GSH must verify that suitable natural soils have been encountered below floor slabs, footings, structural fill, and pavements.

[4] Idriss, I. M., and Boulanger, R. W. (2014), Soil liquefaction during earthquakes: Monograph MNO-12, Earthquake Engineering Research Institute, Oakland, CA, 261 pp.

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.

Michael S. Huber, P.E.
State of Utah No. 343650
Vice President/Senior Geotechnical Engineer

MSH:jmt

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figures 3A through 3N, Boring Logs
Figure 4, Key to Boring Log (USCS)
Attachment A Topsoil Testing Report

Addressee (email)
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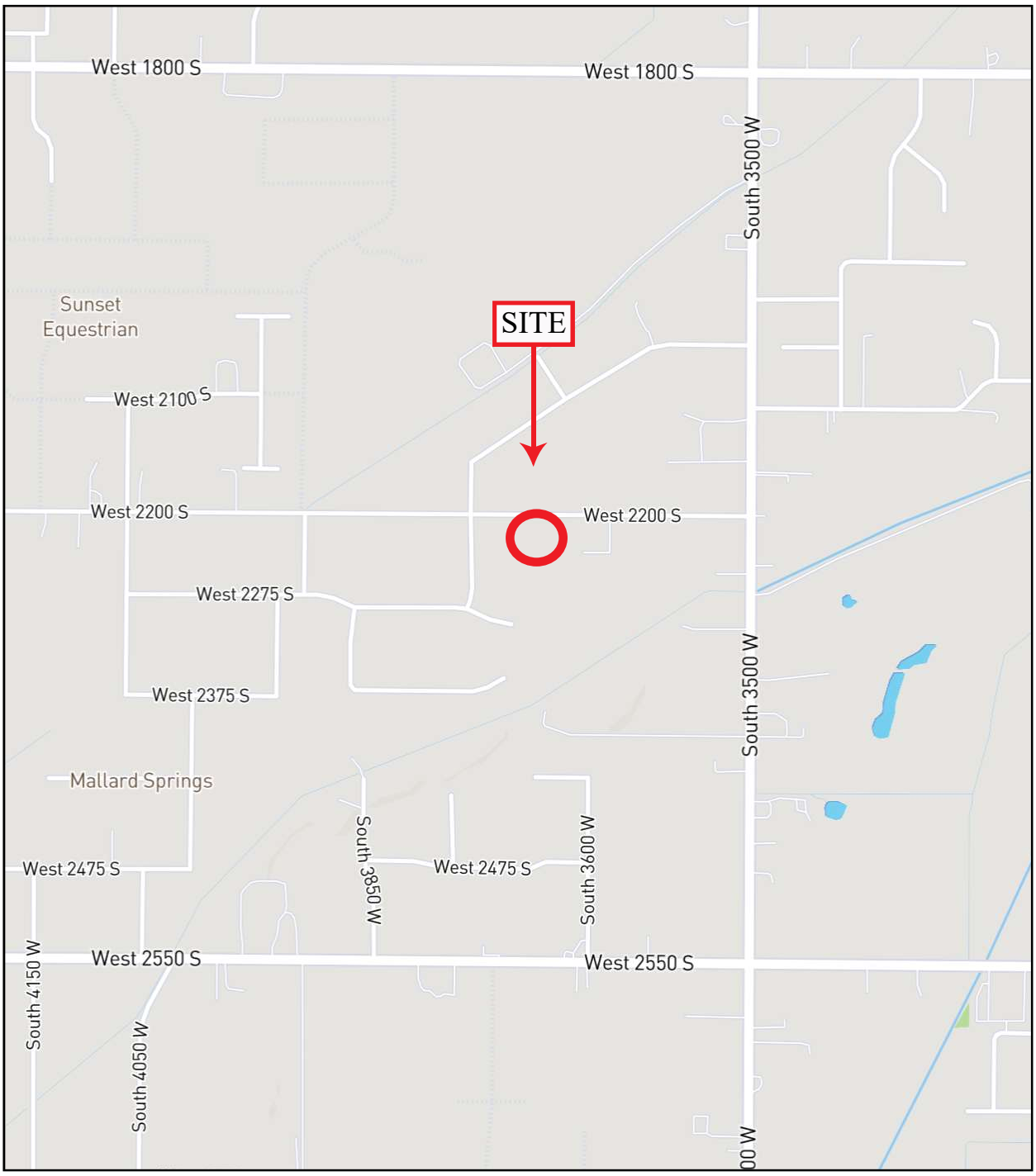
Lafe Harris (lafe@bhdarchitects.com)

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
JOB NO. 0153-561-25



0.1 0 0 0 0 0 0.1 0.2 0.3 MI 0.4

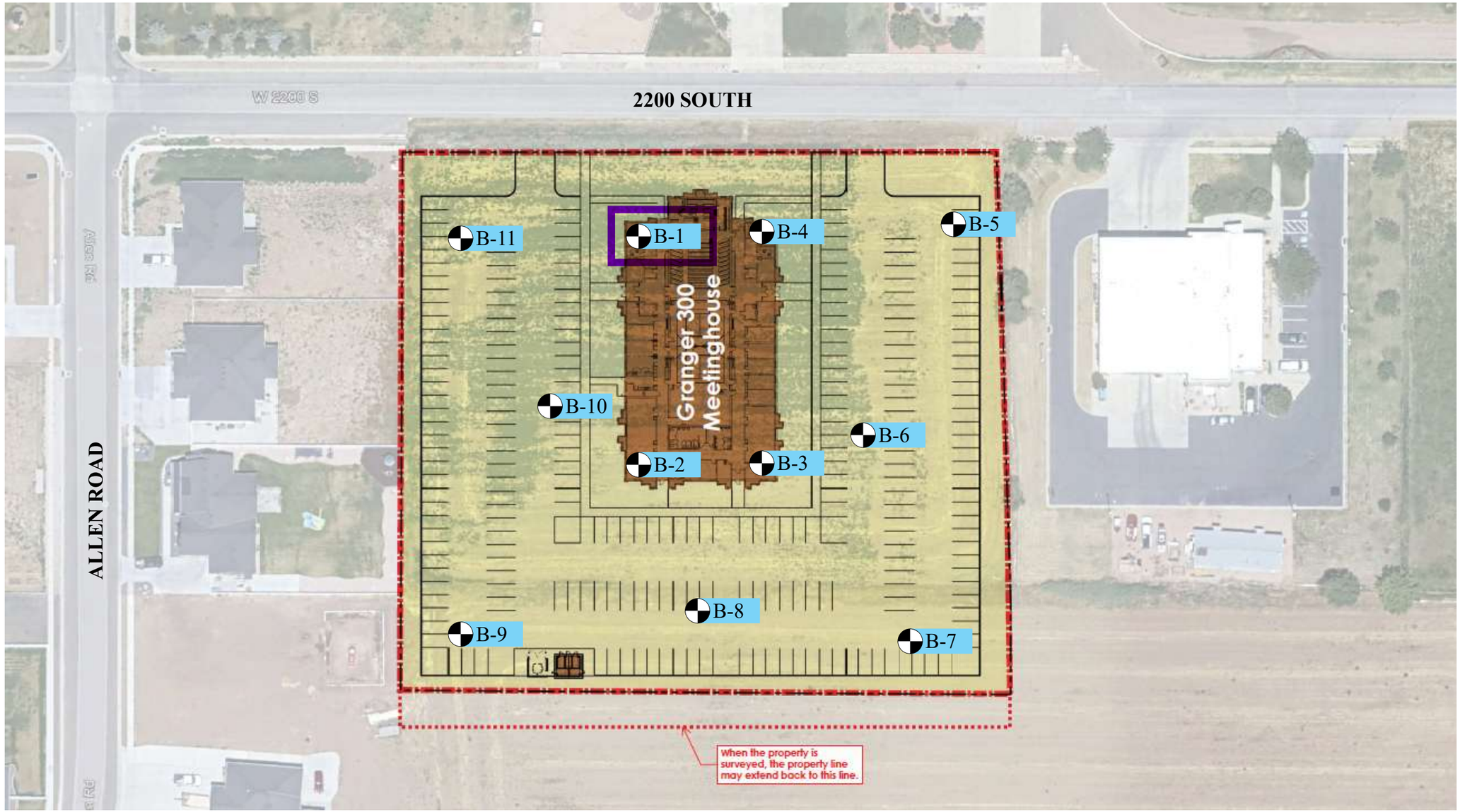
200 0 0 200 400 M 600

FIGURE 1
VICINITY MAP

REFERENCE:
ALL TRAILS - NATIONAL GEOGRAPHIC TERRAIN
DATED 2025

GSH

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS
JOB NO. 0153-561-25



REFERENCE:
ADAPTED FROM DRAWING ENTITLED
"PROPOSED SITE PLAN - OGDEN WEST"
BY BHD ARCHITECTS, DATED 11/7/1024

APPROXIMATE SCALE IN FEET
35 0 35 70

FIGURE 2
SITE PLAN

GSH

BORING LOG

Page: 1 of 2

BORING: B-1

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 5.8' (1/16/25) | 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 FILL	FINE TO MEDIUM SANDY CLAY, FILL with major roots (topsoil) to 18"; dark brown									loose/disturbed slightly moist soft
		grades silty clay; dark/light brown		4							moist loose
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND brown	5	15		21.2		39.1			medium dense saturated
	SM	SILTY FINE TO MEDIUM SAND brown/orange	10	28							saturated medium dense
											heave
			15	3		24.4		34.9			very loose
	CL	FINE TO MEDIUM SANDY CLAY brown	20	4					30	9	saturated soft
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3A

GSH

BORING LOG

Page: 2 of 2

BORING: B-1

CLIENT: The Church of Jesus Christ of Latter-day Saints PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) DATE STARTED: 1/10/25 DATE FINISHED: 1/10/25

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25								
		grades silty clay with trace fine to medium sand		3							
			30	5							medium stiff
			35	3					46	20	soft
			40	10							stiff
		grades with layers of fine to medium sand up to 6" thick; gray									
		grades brown									
	SM	SILTY FINE TO MEDIUM SAND brown	45	6							saturated loose
		End of Exploration at 46.5'. Installed 1.25" diameter slotted PVC pipe to 46.5'.	50								

See Subsurface Conditions section in the report for additional information.

FIGURE 3A
(continued)

BORING LOG

Page: 1 of 1

BORING: B-2

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 5.1' (1/16/25) | 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 FILL	SILTY CLAY, FILL with fine to medium sand; organics; major roots (topsoil) to 12"; dark brown									loose/disturbed slightly moist soft
	SM	SILTY FINE TO MEDIUM SAND brown									moist loose
				18		22.2		21.9			
▼			5								
				18		25.8		43.1			saturated
		grades tan									
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND with layers of silty clay up to 1" thick; brown	10								saturated loose
				17		33.1		56.2			
	SM	SILTY FINE TO MEDIUM SAND with layers of silty clay up to 1/2" thick; tan/brown	15								saturated loose
				13		35.7		48.0			
		End of Exploration at 16.0'.	20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3B

BORING LOG

Page: 1 of 1

BORING: B-3

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 5.3' (1/16/25) | 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								
	SM FILL	SILTY FINE TO MEDIUM SAND with major roots (topsoil) to 18"; dark brown									loose/disturbed slightly moist
	SM	SILTY FINE TO MEDIUM SAND tan									loose moist loose
				16		26.5		9.5			
▼			5	20							saturated
		grades light brown									
	CL	FINE TO MEDIUM SANDY CLAY light brown	10								saturated stiff
				12		29.6	84	68.2			
		End of Exploration at 11.5'. Installed 1.25" diameter slotted PVC pipe to 11.5'.	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: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 2.5' (1/10/25) | 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								
	SM FILL	SILTY FINE TO MEDIUM SAND, FILL with major roots (topsoil) to 12"; dark brown									loose/disturbed slightly moist
▼	SM/ SC	SILTY/CLAYEY FINE SAND tan									loose slightly moist medium dense saturated
			5			27.9		44.1			
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3D

BORING LOG

Page: 1 of 1

BORING: B-5

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: Not Encountered (1/10/25) | 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								
	SM FILL	SILTY FINE TO MEDIUM SAND, FILL with trace clay; major roots (topsoil) to 12"; dark brown									loose/disturbed slightly moist loose
	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND tan									slightly moist medium dense
			5								
		End of Exploration at 5.5'. No groundwater encountered at time of drilling.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3E

BORING LOG

Page: 1 of 1

BORING: B-6

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 2.5' (1/10/25) | 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								
	SM FILL	SILTY FINE TO MEDIUM SAND, FILL with major roots (topsoil) to 18"; dark brown									loose/disturbed slightly moist
▼	SM/ SC	SILTY/CLAYEY FINE SAND tan									loose moist medium dense saturated
			5			25.2		27.3			
		End of Exploration at 5.5'.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3F

BORING LOG

Page: 1 of 1

BORING: B-7

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 2.5' (1/10/25) | 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								
	SM FILL	SILTY FINE TO MEDIUM SAND, FILL with major roots (topsoil) to 12"; dark brown									loose/disturbed slightly moist
▼	SM	SILTY FINE TO MEDIUM SAND with trace clay; light brown									loose moist medium dense saturated
			5								
		End of Exploration at 5.5'.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3G

BORING LOG

Page: 1 of 1

BORING: B-8

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 5.0' (1/10/25) | 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								
	SM FILL	SILTY FINE TO MEDIUM SAND, FILL with major roots (topsoil) to 12";brown									loose/disturbed slightly moist
	SM	SILTY FINE TO MEDIUM SAND tan									loose slightly moist medium dense
▼			5			30.1		39.1			saturated
		End of Exploration at 5.5'.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3H

BORING LOG

Page: 1 of 1

BORING: B-9

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 2.5' (1/10/25) | 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								
	SM FILL	SILTY FINE TO MEDIUM SAND, FILL with trace clay; major roots (topsoil) to 12"; brown									loose/disturbed slightly moist loose
▼	SM	SILTY FINE TO MEDIUM SAND with trace clay; light brown									moist medium dense saturated
			5								
		End of Exploration at 5.5'.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3I

BORING LOG

Page: 1 of 1

BORING: B-10

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 2.5' (1/10/25) | 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								
	SM FILL	SILTY FINE TO MEDIUM SAND, FILL with major roots (topsoil) to 12"; dark brown									loose/disturbed slightly moist
▽	SM/SC	SILTY FINE TO MEDIUM SAND with some clay; tan									loose moist medium dense saturated
		grades with layers of silty clay up to 1" thick	5			25.9		47.3			
		End of Exploration at 5.5'.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3J

BORING LOG

Page: 1 of 1

BORING: B-11

CLIENT: The Church of Jesus Christ of Latter-day Saints | PROJECT NUMBER: 0153-561-25

PROJECT: Proposed Ogden West Meetinghouse (602-0268) | DATE STARTED: 1/10/25 | DATE FINISHED: 1/10/25

LOCATION: 3691 West 2200 South, Ogden, Utah | GSH FIELD REP.: JA

DRILLING METHOD/EQUIPMENT: 3-1/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: 2.5' (1/10/25) | 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								
	SM FILL	SILTY FINE TO MEDIUM SAND, FILL with trace clay; major roots (topsoil) to 12"; dark brown									loose/disturbed slightly moist
▼	SM/ SC	SILTY/CLAYEY FINE TO MEDIUM SAND tan				26.5		43.4			loose moist medium dense saturated
			5								
		End of Exploration at 5.5'.									
			10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

FIGURE 3K

CLIENT: The Church of Jesus Christ of Latter-day Saints
PROJECT: Proposed Ogden West Meetinghouse (602-0268)
PROJECT NUMBER: 0153-561-25

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 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:

Weakly: Crumbles or breaks with handling or slight finger pressure.

Moderately: Crumbles or breaks with considerable finger pressure.

Strongly: Will not crumble or break with finger pressure.

MODIFIERS:

Trace <5%

Some 5-12%

With > 12%

MOISTURE CONTENT (FIELD TEST):

Dry: Absence of moisture, dusty, dry to the touch.

Moist: Damp but no visible water.

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

APPENDIX A

Topsoil Testing Report

Topsoil Testing Report

Project	Name **Ogden West Meetinghouse**		Property Number : Not given
	Site Street Address, City, State/Province Ogden West, UT		
Person Submitting Test	Name **Mike Huber GSH mike@gshgeotech.com**	Date Requested **13 Jan 2025**	Phone **801 685 9190**
	Address, City, State/Province **473 W 4800 S, SLC, UT 84123**		Fax **2990**
Soil Testing Laboratory	Name **QA Consulting and Testing, LLC**	Date Submitted **24 Jan 2025**	Phone 801 372 7177
	Address, City, State/Province **645 South 240 East Salem, UT 84653 vonisaman@comcast.net**		Cel 801 372 7177

General

1. Owner will pay for pre-bid testing and one (1) final top-soil test.

Landscape Architect Instructions

1. Landscape Architect shall determine by investigation quality and quantity of topsoil on site before landscape design. Add physical and fertility recommendations from laboratory recommendations to relevant Church specifications.

Contractor Instructions

1. Test installed topsoil. Installed topsoil shall comply with Project Specifications.
2. If installed topsoil does not comply, Contractor will enhance and test at no cost to Owner until installed topsoil complies with Project Specifications.

Testing Instructions

1. Collect at least two (2) samples of on-site topsoil and each anticipated topsoil source. If site soil profile or borrow pit are not uniform, additional samples shall be taken. Uniform composite samples may also be used if properly acquired and documented.
2. Submit required soil samples to soil testing laboratory along with all required (for this report and laboratory) information.

Soil Testing Laboratory Instructions

1. This report must be completely filled out and provide soil interpretation and amendment, fertilizer, and soil conditioner recommendations for use by Landscape Architect. These recommendations should consider lawn areas, tree and shrub areas, and native plant areas.
2. Provide appropriate times for fertilizing.
3. Return completed Topsoil Testing Report to person submitting the test.

SOIL SAMPLE LOG

Soil Sample No.	Description of location where sample was taken	History of use of the soil
Ogden West	Surface, B1 on S #1	Topsoil

Existing Conditions Test Report

("Acceptable Levels" refers to the allowable soil specifications prior to being amended)

SOIL TEST DATA

Sample No.	pH(1)	EC(1) dS/m	SAR(1)	**% Sand**	**% Silt**	% Clay	Text(2) Class	%(3) OM	NO3-N(4) ppm	P(5) ppm	K(5) ppm	Fe(5) ppm
Ogden West	7.7	1.1	0.1	**84**	**9**	7	Loamy Sand	2.5	27	73	254	27
Acceptable Level(s)	5.5 - 8.0	<3.0	<6.0	15-**60**	**10**-60	5-30	(2)	>1.0	>20	>11	>130	>10

Rocks and Materials

Sample No.	**Percent (%) > 2.0 mm <1/4"**	Rocks Present ≥ 1.5 inch (38 mm) Indicate as present or not present	Toxic minerals & chemicals, noxious weeds, weed seeds, objectionable/construction materials
Ogden West	**2.5 (>1/4" 0%)**	Not Present	None observed
Acceptable Level	**≤ 2.0 percent**	< 1.5 inch (38 mm)	

Landscape Area Description
Lawn Areas: Receive 5 inches (125 mm) topsoil plus recommended amendments and fertilizers.

Shrub/Tree Areas: Unless otherwise indicated, plant pits are to be backfilled with three (3) parts native soil and one part compost or other recommended amendments. Additionally, contractor will add recommended fertilizer.

Native Grass/Shrub/Tree Areas: Planting to receive minimum recommended amendments and fertilizers for establishment.

INFILTRATION RATE	
Documented Infiltration rate of test sample(s) based on texture at 90 percent relative density (To nearest 1/10th of an inch)	
Sample No.	Rate
Ogden West	3.1 Inches/Hour

Interpretation Summary of Test Results:

Ogden West Meetinghouse

Ogden West does **not** meet Acceptable Levels for % Sand, % Silt and Rock % >2 mm.

Specify plant materials tolerant of well drained soils.

Soil Amendments, Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas: Amendments: Apply an organic material (compost, etc.) at 5.0 cu yds/1000 sq ft for every 5" of topsoil depth. Incorporate well. See the Compost Quality Guidelines for Landscaping, attached. Or, apply a similar product at label rate following manufacturer's recommendation for soil preparation and turf maintenance. No additional organic material is recommended for organic matter content ≥5%. Fertilizer: Apply a Nitrogen fertilizer at label rate. Applying Nitrogen will maintain the nitrogen bank in the soil. Incorporate well. Conditioner: None.

Shrub/Tree Areas: Amendments: See **Landscape Area Description** above. Fertilizer: Apply a Nitrogen fertilizer at label rate. Incorporate well. Conditioner: None.

Native Grass/Shrub/Tree Areas: Amendments: None. Conditioners: None. Fertilizer: Apply a Nitrogen fertilizer at 1/2 label rate. Incorporate well.

Scarify the subsoil at least 6" before applying topsoil.

Long Term (5 Year) Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas: Amendments: None. Conditioner: None. Fertilizer: Continue with above recommendation.

Shrub/Tree Areas: Amendments: None. Conditioner: None. Fertilizer: As a top dress, continue with above recommendation.

Native Grass/Shrub/Tree Areas: Amendments: None. Conditioner: None. Fertilizer: Top dress every other year with 1/2 label rate of a Nitrogen fertilizer, or per nurseryman's recommendation.

Continued next page

Ogden West (cont.)

COMPOST QUALITY GUIDELINES FOR LANDSCAPING*

Category	pH**	Soluble Salts** dS/m or mmho/cm	Sodium Adsorption Ratio** (SAR)	Carbon:Nitrogen Ratio*** (C:N)	% Moisture****	≥98% Coarse Material Passing (dry wt basis)
Ideal	6 to 8	≤5	<10	≤20:1	25 to 35	3/8" (9.5 mm)
Acceptable	5-6, 8-9	≤10	≤20	21:1 to 30:1	<25, >35	3/4" (19 mm)
Suspect	<5, >9	>10	>20	<10:1, >30:1	<20, >50	<98% 3/4"

for composts with biosolid feedstocks, biosolids must meet EPA 503 Class A standards

*Von Isaman MPS, President of QA Consulting and Testing LLC, Dr. Rich Koenig, USU Cooperative Extension Soils Specialist, and Dr. Teresa Cerny, USU Cooperative Extension Horticulturalist, 3 March 2003.
** 1:5 Compost:Water Slurry on Coarse Material passing 3/8" (9.5 mm)
*** on Coarse Material passing 3/8" (9.5 mm)
**** on total sample

Acceptable level Soluble Salts and/or SAR composts then do not exceed 5 cu yds/1000 sq ft for every 5 inches of soil depth.

End.

GshOgdenWestLdsRpt25.124