GSH

REPORT
GEOTECHNICAL STUDY
RIVERTON **TOWNE STORAGE ~~RIVERTON~~**
12650 SOUTH SUNDAY DRIVE
RIVERTON, UTAH

Submitted To:

Menlove Construction
4243 West Nike Drive
West Jordan, Utah 84088

Submitted By:

GSH Geotechnical, Inc.
473 West 4800 South
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October 16, 2015

Job No. 0877-019-15

GSH

October 16, 2015
Job No. 0877-019-15

Mr. Ken Menlove
Menlove Construction
4243 West Nike Drive
West Jordan, Utah 84088

Mr. Menlove:

Re: Report
Geotechnical Study
Towne Storage Riverton
12650 South Sunday Drive
Riverton, Utah

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the proposed Towne Storage to be located at approximately 12650 South Sunday Drive in Riverton, Utah. The general location of the site with respect to major topographic features and existing facilities, as of 2015, is presented on Figure 1, Vicinity Map. A more detailed layout of the site showing the proposed building and adjacent roadways is presented on Figure 2, Site Plan. The locations of the test pits excavated in conjunction with this study are also presented on Figure 2.

1.2 OBJECTIVES AND SCOPE

The objectives and scope of our study were planned in discussions between Mr. Ken Menlove of Menlove Construction and Mr. Bill Turner 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 site.

2. Provide appropriate foundation, earthwork, pavement 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 excavating, logging, and sampling of 10 test pits.

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 returning a signed copy of our Professional Services Agreement No. 15-0939 dated and executed on September 14, 2015.

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 test pits, 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

A storage unit facility comprising over 83,000 total square feet is planned for the site. The structures are anticipated to be one to one-extended level in height and of masonry/metal construction established slab on grade. Structural loads will be transmitted down through columns and bearing walls to the supporting foundations. Maximum real wall loads are anticipated to be on the order of 1 kip per lineal foot. Real loads are defined as the total of all dead plus frequently applied (reduced) live loads. Average uniform floor slab loads on the order of 150 to 200 pounds per square foot are anticipated.

At-grade paved parking and drive areas will be part of the overall site development. Projected traffic in parking areas is anticipated to consist of a light volume of automobiles and light trucks and occasional medium-weight trucks. In primary drive areas, traffic is projected to consist of a moderate volume of automobiles and light trucks, a light volume of medium-weight trucks, and occasional heavy-weight trucks.

Maximum site grading cuts and fills are anticipated to be minor to moderate at the site, on the order of 2 to 3 feet. Larger cuts and fills may be required in isolated areas.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions at the proposed site, 10 test pits were excavated to depths ranging from about 10 to 13 feet below existing grade using a rubber tire-mounted backhoe. Locations of the test pits are presented on Figure 2.

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

A 2.42-inch inside diameter hand sampler was utilized in the subsurface sampling at the site. Most samples were obtained using a shovel and placed in plastic bags.

3.2 LABORATORY TESTING

3.2.1 General

In order to provide data necessary for our engineering analyses, a laboratory testing program was completed. The program included moisture, density, Atterberg limits, partial gradation, 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 test pit logs, Figures 3A through 3J.

3.2.3 Atterberg Limits Tests

To aid in classifying the soils at the site, liquid limit and plastic limit (Atterberg limits) tests were performed on representative samples of the near-surface soils encountered at the site. The results of these tests are provided in the table on the following page.

Sample	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
TP-1 at 4.0 ft	27	16	11	CL Fill
TP-4 at 6.0 ft	26	15	11	CL
TP-6 at 2.5 ft	28	16	12	CL

3.2.3 Partial Gradation Test

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

Boring No.	Depth (feet)	Percent Passing No. 200 Sieve	Soil Classification
TP-1	4.0	45	SC
TP-2	4.0	2.9	GP
TP-3	5.0	26	GC Fill
TP-4	1.0	23	SC Fill
TP-5	2.0	33	SC Fill
TP-7	3.0	25	SC Fill
TP-8	5.0	13	SM
TP-9	1.0	14	SC Fill
TP-10	5.0	1.2	GP

3.2.4 Chemical Tests

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

Test Pit No.	Depth (feet)	Soil Classification	pH	Total Water Soluble Sulfate (mg/kg-dry)
TP-2	1.0	CL	8.57	5.72

4. SITE CONDITIONS

4.1 SURFACE

The site consists of a vacant parcel situated between Sunday Drive and Totorica Circle south of 12600 South Street. The topography of the site overall slopes gently downward to the east with overall relief on the order of a few feet. Vegetation consists of scattered weeds and grasses. Some small piles of fill currently exist on the site. The site is bordered on the north by 12600 South Street and a building/yard occupied by South Valley Sewer District, on the east by Totorica Circle and single-family residences beyond, and on the south and west by Sunday Drive and vacant land beyond.

4.2 SUBSURFACE SOIL AND GROUNDWATER

The near-surface soil conditions encountered in each of the test pits consisted of either topsoil/disturbed or surficial fill soils. Approximately 1 foot of topsoil/disturbed soils were encountered at the surface of Test Pit TP-2. Fill soils, considered to be non-engineered fill (untested and/or undocumented), were encountered from the surface and extending to depths of about 2 to 8 feet in the other test pits. The non-engineered fill consisted of silty clay with varying sand content, clayey fine and coarse gravel, and clayey to silty fine sand. The fill varied in stiffness/density and was generally slightly moist, brown, and anticipated to exhibit variable and, most likely poor, engineering characteristics under the anticipated loading range.

Underlying the topsoil/disturbed soils/fill and extending to the maximum depths explored of about 10 to 13 feet in the test pits were natural soil layers consisting of silty clay with some fine sand, clayey to silty fine sand, and fine and coarse gravel with varying amounts of silt and/or clay. The natural silty clay soils were stiff, slightly moist to moist, brown in color, and are anticipated to exhibit low to moderate strength and moderate compressibility characteristics under the anticipated loading range. The natural sand/gravel soils were medium dense to dense, dry to slightly moist, brown, and are anticipated to exhibit high strength and low compressibility characteristics under the anticipated loading range.

For a more detailed description of the subsurface soils encountered, please refer to Figures 3A through 3J, Test Pit 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.

During excavation operations, groundwater was not encountered to the maximum explored depth, about 13 feet. Seasonal and longer-term groundwater fluctuations could occur, with the highest seasonal levels generally occurring during the late spring and early summer months. We do not anticipate that groundwater levels will affect construction at this site.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

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

The most significant geotechnical aspect of the site is the presence of non-engineered fills ranging from about 2 to 8 feet in thickness from the existing surface. Fill thickness variability should be expected throughout the site, both laterally and vertically. Non-engineered fills must be completely removed in building and rigid pavement areas. Under asphalt concrete (flexible) pavements, the non-engineered fills soils may remain if properly prepared, as discussed later in this report.

The non-engineered fill soils and other natural soils can be re-used as structural site grading fill if they meet the requirements of such. Fine-grained soils (clays and silts) will require close moisture control during placement and compaction. This will be extremely difficult during wet and cold periods of the year.

Due to the variable nature of the non-engineered fill soils, a qualified geotechnical engineer from GSH must aid in verifying that all non-engineered fills have been completely removed prior to the placement of structural site grading fills, floor slabs, footings, or foundations.

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

5.2 EARTHWORK

5.2.1 Site Preparation

Initial site preparation will consist of the removal of non-engineered fills, surface vegetation, topsoil, loose/disturbed surficial soils, and other deleterious materials from an area extending out at least 3 feet from the perimeter of the proposed structures, rigid pavements, and exterior flatwork. Non-engineered fill soils may remain in flexible pavement areas provided that the remaining soils do not contain deleterious materials and the upper 12 inches are scarified, moisture prepared, and recompacted to the requirements of structural fill. As an option to recompaction underneath new pavements, the upper 12 inches of non-engineered fills may be removed and replaced with structural fill over proofrolled subgrade. Even with proper preparation, flexible pavements established overlying non-engineered fill soils may encounter some long-term movements unless the non-engineered fill soils are completely removed.

Prior to the placement of structural site grading fill, pavements, floor slabs, or footings, the exposed natural subgrade should be proofrolled by running moderate-weight rubber tire-mounted construction equipment uniformly over the surface at least 3 times. If excessively soft or

otherwise unsuitable soils are encountered beneath footings, they must be totally removed. 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. Non-engineered fill soils must be dealt with as previously discussed in this section and must be completely removed under floor slabs and exterior flatwork.

Surface vegetation and other deleterious materials should generally be removed from the site. Topsoil, although unsuitable for utilization as structural fill, may be stockpiled for subsequent landscaping purposes.

5.2.2 Temporary Excavations

Temporary construction excavations in cohesive soil, above or below the water table, not exceeding 4 feet in depth, may be constructed with near-vertical sideslopes. Temporary excavations up to 10 feet deep in fine-grained cohesive soils may be constructed with sideslopes no steeper than one-half-horizontal to one-vertical (0.5H:1.0V). For excavations up to 10 feet in granular soils, the slopes should be no steeper than one-horizontal to one-vertical (1.0H:1.0V). Temporary excavations encountering loose, relatively clean, and/or saturated cohesionless soils (not anticipated at the site) will be very difficult and will require very flat sideslopes and/or shoring, bracing, and/or dewatering. Excavations deeper than 10 feet are not anticipated at the site.

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

5.2.3 Structural Fill

Structural fill is defined as all fill which will ultimately be subjected to structural loadings, such as imposed by footings, floor slabs, pavements, etc. Structural fill will be required as backfill over foundations and utilities, as site grading fill, and possibly as replacement fill below footings. All structural fill must be free of sod, rubbish, topsoil, frozen soil, and other deleterious materials. Imported structural fill shall consist of a well-graded mixture of sand and gravel with less than 20 percent fines and less than 30 percent larger than 0.75 inch.

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 (non-engineered fill and natural) soils may be re-utilized as structural site grading fill, provided any deleterious materials and particles larger than 4 inches are removed. Note, however, that utilization of the fine-grained soils (clays and silts) as structural site grading fill will require tight moisture control, which will be very difficult, if not impossible, during wet

and/or cold periods of the year. Only granular soils are recommended as structural fill in confined areas, such as around foundations, within utility trenches, and as replacement fill below foundations.

To stabilize soft subgrade conditions, a mixture of coarse gravels and cobbles and/or 1.5-inch to 2.0-inch size gravel (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.

5.2.4 Fill Placement and Compaction

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

Location	Total Fill Thickness (feet)	Minimum Percentage of Maximum Dry Density
Beneath an area extending at least 3 feet beyond the perimeter of the structure	0 to 8	95
Outside area defined above	0 to 5	90
Outside area defined above	5 to 8	95
Aggregate Base/Subbase	---	96

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

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

Coarse gravel and cobble mixtures (stabilizing fill), if utilized, shall be end-dumped, spread to a maximum loose lift thickness of 15 inches, and compacted by dropping a backhoe bucket onto the surface continuously at least twice. As an alternative, the stabilizing fill may be compacted by passing moderately heavy construction equipment or large self-propelled compaction equipment at least twice. Subsequent fill material placed over the coarse gravels and cobbles

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

shall be adequately compacted so that the "fines" are "worked into" the voids in the underlying coarser gravels and cobbles.

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

5.2.5 Utility Trenches

All utility trench backfill material below structurally loaded facilities (footings, floor slabs, flatwork, pavements, etc.) shall be placed at the same density requirements established for structural fill. If the surface of the backfill becomes disturbed during the course of construction, the backfill shall be proofrolled and/or properly compacted prior to the construction of any exterior flatwork over a backfilled trench. Proofrolling 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 proofrolling, they shall 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. GSH recommends that as the major utilities continue onto the site that these compaction specifications are followed.

Fine-grained soil, including the on-site clays, are not recommended for utility trench backfill.

5.3 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.3.1 Design Data

The proposed structure may be supported upon conventional spread and continuous wall foundations established upon suitable natural soils and/or structural fill extending to suitable natural soils. Under no circumstances shall footings be placed overlying non-engineered fill soils. For design, with respect to the proposed construction and anticipated loading given in Section 2.0, Proposed Construction, the parameters below are recommended:

Minimum Depth of Embedment for Frost Protection	- 30 inches
Minimum Depth of Embedment for Non-frost Conditions	- 15 inches
Minimum Width for Continuous Wall Footings	- 18 inches
Minimum Width for Isolated Spread Footings	- 24 inches

Recommended Net Bearing Pressure for Real Load Conditions	
For footings on suitable natural soils	- 2,000 pounds per square foot
For footings on minimum 18 inches structural fill	- 2,500 pounds per square foot
Bearing Pressure Increase for Seismic Loading	- 50 percent

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

5.3.2 Installation

Under no circumstances shall the footings be established upon non-engineered fills, topsoil, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. If unsuitable soils are encountered, they must be completely removed and replaced with compacted structural fill.

The width of structural fill, where placed below footings, should extend laterally at least 6.0 inches beyond the edges of the footings in all directions for each foot of fill thickness beneath the footings. For example, if the width of the footing is 2.0 feet and the thickness of the structural fill beneath the footing is 1.5 feet, the width of the structural fill at the base of the footing excavation would be a total of 3.5 feet, centered below the footing.

5.3.3 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 1 inch or less. Approximately 60 percent of the quoted settlement should occur during construction.

5.4 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 0.30 for natural clay soils or 0.40 for structural fill 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.

5.5 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 non-engineered fill soils, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. 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 0.75- to 1.0-inch minus clean gap-graded gravel. Settlements of lightly to moderately loaded floor slabs are anticipated to be minor.

5.6 PAVEMENTS

The existing soils will exhibit relatively poor pavement support characteristics when saturated or nearly saturated. All pavement areas must be prepared as previously discussed (see Section 5.2.1, Site Preparation). Rigid pavements shall not be placed overlying non-engineered fills, even if properly prepared. With the subgrade soils and the projected traffic as discussed in Section 2, Proposed Construction, the following pavement sections are recommended:

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

Flexible:		
	2.5 inches	Asphalt concrete
	7.0 inches	Aggregate base
	Over	Properly prepared subgrade soils
Rigid:		
	5.0 inches	Portland cement concrete (non-reinforced)
	4.0 inches	Aggregate base
	Over	Properly prepared subgrade soils*

* Non-engineered fill soils must be completely removed from below rigid pavements.

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

Flexible:

3.0 inches	Asphalt concrete
8.0 inches	Aggregate base
Over	Properly prepared subgrade soils

Rigid:

5.5 inches	Portland cement concrete (non-reinforced)
4.0 inches	Aggregate base
Over	Properly prepared subgrade soils*

* Non-engineered fill soils must be completely removed from below rigid pavements.

For dumpster pads, we recommend a pavement section consisting of 6.5 inches of Portland cement concrete, 4.0 inches of aggregate base, over properly prepared suitable natural subgrade or site grading structural fills extending to suitable natural soils. Dumpster pads shall not be constructed overlying non-engineered fills unless heavily reinforced.

These above rigid pavement sections are for non-reinforced Portland cement concrete. Concrete should be designed in accordance with the American Concrete Institute (ACI) and joint details should conform to the Portland Cement Association (PCA) guidelines. The concrete should have a minimum 28-day unconfined compressive strength of 4,000 pounds per square inch and contain 6 percent ±1 percent air-entrainment.

5.7 CEMENT TYPES

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

5.8 GEOSEISMIC SETTING

5.8.1 General

Utah municipalities have adopted the International Building Code (IBC) 2012. 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 structure must be designed in accordance with the procedure presented in Section 1613, Earthquake Loads, of the IBC 2012 edition.

5.8.2 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 is the Salt Lake Segment of the Wasatch Fault, located approximately 8.5 miles east of the site.

5.8.3 Soil Class

For dynamic structural analysis, the Site Class D - Stiff Soil Profile as defined in Chapter 20 of ASCE 7 (per Section 1613.3.2, Site Class Definitions, of IBC 2012) can be utilized.

5.8.4 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 boundary for the Maximum Considered Earthquake (MCE). This Site Class B 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 an MCE event and incorporates a soil amplification factor for a Site Class D soil profile in the fourth column. Based on the site latitude and longitude (40.5208 degrees north and -111.9968 degrees west, respectively), the values for this site is tabulated below:

Spectral Acceleration Value, T	Site Class B Boundary [mapped values] (% g)	Site Coefficient	Site Class D [adjusted for site class effects] (% g)	Design Values (% g)
Peak Ground Acceleration	44.9	F_a = 1.051	47.2	31.5
0.2 Seconds (Short Period Acceleration)	S_S = 112.3	F_a = 1.051	S_{MS} = 118	S_{DS} = 78.7
1.0 Second (Long Period Acceleration)	S_1 = 37.3	F_v = 1.654	S_{M1} = 61.7	S_{D1} = 41.1

5.8.5 Liquefaction

Liquefaction is defined as the condition when saturated, loose, finer-grained sand-type soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Due to the lack of a shallow groundwater at this site, liquefaction is not anticipated to occur at the site during the design seismic event.

5.9 SITE VISITS

As stated previously, due to the variable nature of the non-engineered fill soils, a qualified geotechnical engineer from GSH must aid in verifying that all non-engineered fill soils have been completely removed prior to the placement of structural site grading fills, floor slabs, footings, or foundations.

5.10 CLOSURE

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

Respectfully submitted,

GSH Geotechnical, Inc.

LICENSED PROFESSIONAL ENGINEER
171715
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PRE/AMH:jlh

Encl. Figure 1, Vicinity Map
Figure 2, Site Plan
Figures 3A through 3J, Test Pit Logs
Figure 4, Key to Test Pit Log (USCS)

Addressee (email)

MENLOVE CONSTRUCTION
JOB NO. 0877-019-15

FIGURE 1
VICINITY MAP

REFERENCE:
ALL TRAILS - NATIONAL GEOGRAPHIC TERRAIN
DATED 2015

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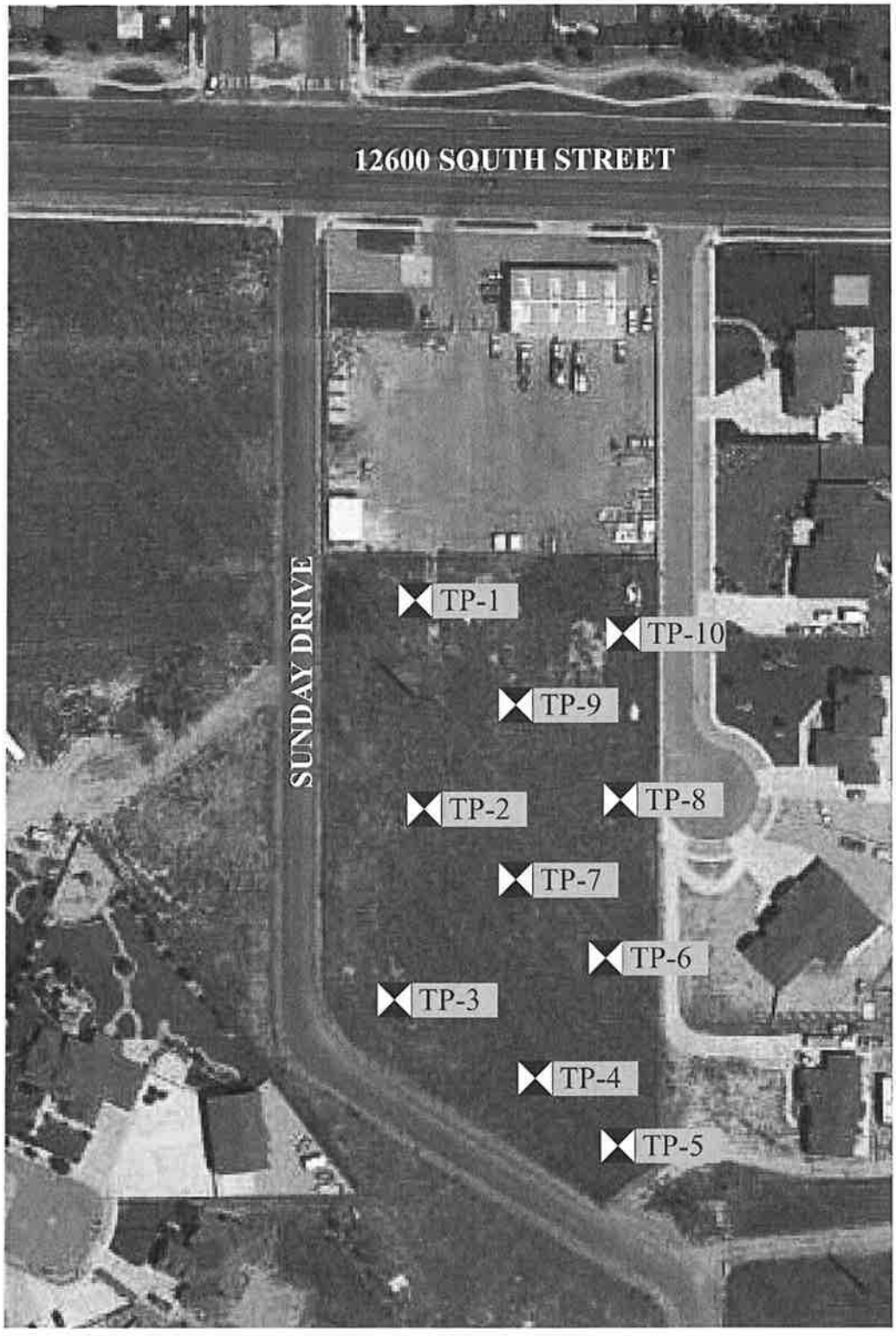
MENLOVE CONSTRUCTION
JOB NO. 0877-019-15



APPROXIMATE SCALE IN FEET
30 0 30 60

REFERENCE:
ADAPTED FROM AERIAL PHOTOGRAPH
DOWNLOADED FROM GOOGLE EARTH
IMAGERY DATE: 6/15/2015.

FIGURE 2
SITE PLAN

GSH

GSH — TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-1

CLIENT: Menlove Construction — PROJECT NUMBER: 0877-019-15

PROJECT: Towne Storage Riverton — DATE STARTED: 9/18/15 — DATE FINISHED: 9/18/15

LOCATION: 12650 South Sunday Drive, Riverton, Utah — GSH FIELD REP.: KB

EXCAVATING METHOD/EQUIPMENT: JCB 214S - Backhoe

GROUNDWATER DEPTH: Not Encountered (9/18/15) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	CL FILL	SILTY CLAY, FILL with fine to coarse sand and some fine and coarse gravel; brown								slightly moist very stiff
	SC	CLAYEY FINE SAND with some coarse gravel; brown with trace oxidation	5		10		45	27	11	moist medium stiff
	GP/ GM	FINE AND COARSE GRAVEL with fine to coarse sand and some silt; brown								moist medium dense
		End of Exploration at 10.0' No significant sidewall caving. No groundwater encountered at time of excavation.	10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3A

GSH	TEST PIT LOG Page: 1 of 1	TEST PIT: TP-2

CLIENT: Menlove Construction — PROJECT NUMBER: 0877-019-15

PROJECT: Towne Storage Riverton — DATE STARTED: 9/18/15 — DATE FINISHED: 9/18/15

LOCATION: 12650 South Sunday Drive, Riverton, Utah — GSH FIELD REP.: KB

EXCAVATING METHOD/EQUIPMENT: JCB 214S - Backhoe

GROUNDWATER DEPTH: Not Encountered (9/18/15) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	CL	SILTY CLAY with some fine sand and some fine and coarse gravel; major roots (topsoil) and disturbed soil in upper 1"; brown								slightly moist stiff
	GP	FINE AND COARSE GRAVEL with fine to coarse sand and trace silt; brown								dry medium dense
						1		2.9		
			5							
		grades with trace silt								
		End of Exploration at 10.0' No significant sidewall caving. No groundwater encountered at time of excavation.	10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3B

GSH — TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-3

CLIENT: Menlove Construction — PROJECT NUMBER: 0877-019-15

PROJECT: Towne Storage Riverton — DATE STARTED: 9/18/15 — DATE FINISHED: 9/18/15

LOCATION: 12650 South Sunday Drive, Riverton, Utah — GSH FIELD REP.: KB

EXCAVATING METHOD/EQUIPMENT: JCB 214S - Backhoe

GROUNDWATER DEPTH: Not Encountered (9/18/15) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	CL FILL	SILTY CLAY, FILL with some fine sand and some fine gravel; brown								slightly moist medium stiff
	GC FILL	CLAYEY FINE AND COARSE GRAVEL, FILL with trace cobbles; slight cementation; brown								slightly moist dense
			5		4		26			
		rubber hose at 8'								
	GP/ GM	FINE AND COARSE GRAVEL with fine to coarse sand with some silt and cobbles; brown								slightly moist dense
			10							
		End of Exploration at 11.0' No significant sidewall caving. No groundwater encountered at time of excavation.								
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3C

GSH — TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-4

CLIENT: Menlove Construction — PROJECT NUMBER: 0877-019-15

PROJECT: Towne Storage Riverton — DATE STARTED: 9/18/15 — DATE FINISHED: 9/18/15

LOCATION: 12650 South Sunday Drive, Riverton, Utah — GSH FIELD REP.: KB

EXCAVATING METHOD/EQUIPMENT: JCB 214S - Backhoe

GROUNDWATER DEPTH: Not Encountered (9/18/15) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	SC FILL	CLAYEY FINE SAND, FILL with some fine gravel; some roots in upper 1'; dark brown-brown			5		23			slightly moist medium dense
	GC FILL	CLAYEY FINE GRAVEL, FILL with fine to coarse sand; brown	5							slightly moist medium dense
	CL	SILTY CLAY with fine sand and trace coarse gravel; brown						26	11	slightly moist medium stiff
	GC	CLAYEY FINE AND COARSE GRAVEL with fine to coarse sand; brown	10							slightly moist medium dense
	CL	FINE SANDY CLAY with some fine and coarse gravel, trace cobbles; light brown with oxidation								slightly moist stiff
		End of Exploration at 13.0' No significant sidewall caving. No groundwater encountered at time of excavation.	15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3D

GSH — TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-5

CLIENT: Menlove Construction — PROJECT NUMBER: 0877-019-15

PROJECT: Towne Storage Riverton — DATE STARTED: 9/18/15 — DATE FINISHED: 9/18/15

LOCATION: 12650 South Sunday Drive, Riverton, Utah — GSH FIELD REP.: KB

EXCAVATING METHOD/EQUIPMENT: JCB 214S - Backhoe

GROUNDWATER DEPTH: Not Encountered (9/18/15) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	SC FILL	CLAYEY FINE SAND, FILL with some fine gravel; some scattered roots; brown								slightly moist medium dense
					4		33			
	SM FILL	SILTY FINE SAND, FILL light brown								slightly moist medium dense
					10	88				
	GP/ GM	FINE AND COARSE GRAVEL with fine to coarse sand and some silt; brown	5							slightly moist medium dense
			10							
		End of Exploration at 10.0' No significant sidewall caving. No groundwater encountered at time of excavation.	15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3E

GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-6

CLIENT: Menlove Construction | PROJECT NUMBER: 0877-019-15

PROJECT: Towne Storage Riverton | DATE STARTED: 9/18/15 | DATE FINISHED: 9/18/15

LOCATION: 12650 South Sunday Drive, Riverton, Utah | GSH FIELD REP.: KB

EXCAVATING METHOD/EQUIPMENT: JCB 214S - Backhoe

GROUNDWATER DEPTH: Not Encountered (9/18/15) | ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	SM FILL	SILTY FINE SAND, FILL with trace fine gravel, some scattered roots; brown								slightly moist medium dense
	CL	SILTY CLAY with fine sand and some fine and coarse gravel; brown	5					28	12	slightly moist stiff
	GP/GM	FINE AND COARSE GRAVELS with fine to coarse sand and some silt; brown	10							slightly moist medium dense
		End of Exploration at 10.0' No significant sidewall caving. No groundwater encountered at time of excavation.	15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3F

GSH — TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-7

CLIENT: Menlove Construction — PROJECT NUMBER: 0877-019-15

PROJECT: Towne Storage Riverton — DATE STARTED: 9/18/15 — DATE FINISHED: 9/18/15

LOCATION: 12650 South Sunday Drive, Riverton, Utah — GSH FIELD REP.: KB

EXCAVATING METHOD/EQUIPMENT: JCB 214S - Backhoe

GROUNDWATER DEPTH: Not Encountered (9/18/15) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	CL FILL	SILTY CLAY, FILI with some fine sand and trace fine gravel; brown								slightly moist medium stiff
	SC FILL	CLAYEY FINE TO COARSE SAND, FILI with fine and coarse gravel; brown			4		25			slightly moist medium dense
	GP	FINE AND COARSE GRAVEL with fine to coarse sand,some silt, and some cobbles; brown	5							slightly moist medium dense
		End of Exploration at 10.0' No significant sidewall caving. No groundwater encountered at time of excavation.	10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3G

GSH — TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-8

CLIENT: Menlove Construction — PROJECT NUMBER: 0877-019-15

PROJECT: Towne Storage Riverton — DATE STARTED: 9/18/15 — DATE FINISHED: 9/18/15

LOCATION: 12650 South Sunday Drive, Riverton, Utah — GSH FIELD REP.: KB

EXCAVATING METHOD/EQUIPMENT: JCB 214S - Backhoe

GROUNDWATER DEPTH: Not Encountered (9/18/15) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	CL FILL	SILTY CLAY, FILL with some fine sand and some fine and coarse gravel; some debris/garbage; brown								slightly moist stiff
	SM	SILTY FINE TO COARSE SAND with fine and coarse gravel and trace to some clay; brown	5		2		13			dry medium dense
	GP/ GM	FINE AND COARSE GRAVEL with fine to coarse sand and some silt; brown grades with some cobbles								slightly moist medium dense
		End of Exploration at 10.0' No significant sidewall caving. No groundwater encountered at time of excavation.	10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3H

GSH TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-9

CLIENT: Menlove Construction | PROJECT NUMBER: 0877-019-15

PROJECT: Towne Storage Riverton | DATE STARTED: 9/18/15 | DATE FINISHED: 9/18/15

LOCATION: 12650 South Sunday Drive, Riverton, Utah | GSH FIELD REP.: KB

EXCAVATING METHOD/EQUIPMENT: JCB 214S - Backhoe

GROUNDWATER DEPTH: Not Encountered (9/18/15) | ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	SC FILL	CLAYEY FINE TO MEDIUM SAND, FILL with some coarse sand and fine and coarse gravel; some scattered roots; brown			3		14			slightly moist medium dense
	GP	FINE AND COARSE GRAVEL with fine to coarse sand and some silt; brown								slightly moist medium dense
		grades with some cobbles	5							
		End of Exploration at 10.0' No significant sidewall caving. No groundwater encountered at time of excavation.	10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3I

GSH	TEST PIT LOG Page: 1 of 1	TEST PIT: TP-10

CLIENT: Menlove Construction — PROJECT NUMBER: 0877-019-15

PROJECT: Towne Storage Riverton — DATE STARTED: 9/18/15 — DATE FINISHED: 9/18/15

LOCATION: 12650 South Sunday Drive, Riverton, Utah — GSH FIELD REP.: KB

EXCAVATING METHOD/EQUIPMENT: JCB 214S - Backhoe

GROUNDWATER DEPTH: Not Encountered (9/18/15) — ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	CL FILL	SILTY CLAY, FILL with trace to some fine sand and fine gravel; brown								slightly moist stiff
	SM FILL	FINE TO MEDIUM SILTY SAND, FILL piece of old cable line; brown with oxidation								slightly moist medium dense
	GP	FINE AND COARSE GRAVEL with fine to coarse sand and trace silt; brown								slightly moist medium dense
			5		2		1.2			
		grades more sandy								
		grades with some cobbles	10							
		End of Exploration at 11.0' No significant sidewall caving. No groundwater encountered at time of excavation.								
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3J

CLIENT: Menlove Construction
PROJECT: Towne Storage Riverton
PROJECT NUMBER: 0877-019-15

KEY TO TEST PIT LOG

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

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

⑥ **Moisture (%):** Water content of soil sample measured in laboratory; expressed as percentage of dryweight of

⑦ **Dry Density (pcf):** The density of a soil measured in laboratory; expressed in pounds per cubic foot.

⑧ **% Passing 200:** Fines content of soils sample passing a No. 200 sieve; expressed as a percentage.

⑨ **Liquid Limit (%):** Water content at which a soil changes from plastic to liquid behavior.

⑩ **Plasticity Index (%):** Range of water content at which a soil exhibits plastic properties.

⑪ **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