



**REPORT
GEOTECHNICAL STUDY
THE BRIDGES AT WOLF CREEK
NORTHWEST OF FAIRWAY DRIVE
NEAR EDEN, WEBER COUNTY, UTAH**

Submitted To:

Lewis Homes
Attention: Mr. Eric Householder
3718 North Wolf Creek Drive
Eden, Utah

Submitted By:

GSH Geotechnical, Inc.
1596 West 2650 South
Ogden, Utah 84401

January 21, 2016

Job No. 1661-05N-15

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Mr. Eric Householder
Lewis Homes
3718 North Wolf Creek Drive
Eden, Utah 84310

Mr. Eric Householder

Re: Report
Geotechnical Study
The Bridges at Wolf Creek
Northwest of Fairway Drive
Near Eden, Weber County, Utah
(41.3389 N, 111.8323 W)

1. INTRODUCTION

1.1 GENERAL

This report presents the results of our geotechnical study performed at the site of the Bridges at Wolf Creek development located northwest of Fairway Drive near Eden, Utah. The general location of the site with respect to surrounding roadways, as of 2014, is presented on Figure 1, Vicinity Map. A more detailed aerial view of the site property with surrounding roadways and existing facilities 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 among Mr. Ryan Christensen of Gardner Engineering, Mr. Eric Householder of Lewis Homes, and Mr. Andrew Harris of GSH Geotechnical, Inc. (GSH).

In general, the objectives of this study were to:

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

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

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

1. A field program consisting of the excavating, logging, and sampling of 33 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 Proposal No. 15-1205Nrev1 dated December 10, 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

The proposed project consists of subdividing and constructing a 357-lot residential subdivision on the approximately 195-acre parcel located northwest of Fairway Drive near Eden, UT. The development will include single-family residences with full basements, installation of utilities to service the proposed residences, and associated roadways and pavements.

Construction will likely consist of reinforced concrete footings and foundation walls supporting 1 to 3 wood-framed levels above grade with some stone, brick, or stucco veneer. Slab on grade floors will be established at or near existing site grades. Projected maximum column and wall loads are on the order of 10 to 20 kips and 1 to 3 kips per lineal foot, respectively.

New residential roadways will be part of the development. It is anticipated that the residential streets will be constructed of asphalt pavement with relatively light projected traffic that includes primarily passenger vehicles, daily delivery trucks, daily buses, and an occasional semi-tractor/trailer combination.

Site development will require a moderate amount of earthwork in the form of site grading. We estimate in general that maximum cuts and fills to achieve design grades will be on the order of 2 to 10 feet. Larger fills and cuts may be required at isolated areas.

3. SITE INVESTIGATIONS

3.1 FIELD PROGRAM

In order to define and evaluate the subsurface soil and groundwater conditions at the site, 33 test pits were excavated to depths of about 5.0 to 13.0 feet below existing grade, at which depth practical refusal of the excavating equipment occurred. The test pits were excavated using a rubber tire mounted excavator provided by the client. Test pit locations are presented on Figure 2.

The field portion of our study was under the direct control and continual supervision of an experienced member of our geotechnical staff. During the course of the excavating 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. Representative samples taken were placed in sealable plastic bags and containers. A 2.42-inch inside diameter thin-wall drive sampler was also utilized in the subsurface sampling at the site. The soils were classified in the field based upon visual and textural examination. These classifications have been supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representation of the subsurface conditions encountered is presented on Figures 3A through 3GG, Test Pit Log. Soils were classified in accordance with the nomenclature described on Figure 4, Key to Test Pit Log (USCS).

Following completion of excavating and logging, each test pit was backfilled. Although an effort was made to compact the backfill with the rubber tire mounted excavator, backfill was not placed in uniform lifts and compacted to a specific density. Consequently, settlement of the backfill with time is likely to occur.

3.2 LABORATORY TESTING

3.2.1 General

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

3.2.2 Moisture and Density

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 test pit logs, Figures 3A through 3GG.

3.2.3 Partial Gradation Test

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

Test Pit No.	Depth (feet)	Percent Passing No. 200 Sieve	Soil Classification
TP-1	9.0	23.4	GC
TP-3	3.0	15.3	GC
TP-9	6.0	29.9	GC
TP-12	3.0	19.0	GC
TP-16	3.0	18.1	GC
TP-21	3.0	17.5	GC
TP-25	6.0	36.0	GC
TP-30	10.0	12.1	GC
TP-33	3.0	47.8	GC-CL

3.2.4 Atterberg Limit Tests

To aid in classifying the soils, an Atterberg limit test was performed on a sample of the fine-grained cohesive soils. Results of the test are tabulated below:

Test Pit No.	Depth (feet)	Liquid Limit (percent)	Plastic Limit (percent)	Plasticity Index (percent)	Soil Classification
TP-6	5	95	22	73	CH
TP-16	6	81	23	58	CH
TP-27	5	43	16	27	CL

3.2.5 Consolidation Tests

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

4. SITE CONDITIONS

4.1 SURFACE

The subject property consists of an irregularly shaped, approximately 195-acre parcel northwest of Fairway Drive near Eden, Utah. Vegetation at the site consists primarily of native grasses, weeds, brush, and numerous trees. The subject property slopes to the south and west at grades of about 5 percent to 30 percent with a change in elevation of about 200 feet across the site. The subject property is bordered by undeveloped property to the north and south, by residential development to the west, and by residential development and undeveloped property to the east.

4.2 SUBSURFACE SOIL

The soil conditions encountered vary across the site. At the majority of the test pit locations, the upper 3 to 6 inches contain major roots (topsoil) and are loose/disturbed. Natural soils were encountered beneath the topsoil/disturbed soils to the full depth penetrated, about 5.0 to 13.0 feet, and consisted of clayey gravels fine and coarse gravel with varying amounts of fine to coarse sand, cobbles, and boulders up to 3 feet in diameter, silty clays with varying fine to coarse sand content, and occasional mixtures of these soils. Major soil layering encountered ranged from a thickness of roughly 1.0 foot up to about 13.0 feet.

The granular soils encountered are medium dense to very dense, moist, brown to dark brown in color, and will exhibit moderate strength and moderately low compressibility characteristics under the anticipated loading range.

The fine-grained clay/silt soils encountered are medium stiff to very stiff, moist, brown to dark brown to gray in color, and will exhibit slightly moderate to moderate strength and moderate compressibility characteristics under the anticipated loading range.

The lines designating the interface between soil types on the boring logs generally represent approximate boundaries. In-situ, the transition between soil types may be gradual.

4.3 GROUNDWATER

Groundwater was not encountered at the test pit locations at the time of field investigation. Seasonal and longer-term groundwater fluctuations of 1 to 2 feet should be anticipated. The

highest seasonal levels will generally occur during the late spring and summer months. Seasonal groundwater may also be encountered in low-lying areas and perched groundwater may develop within low permeability clay layers. Irrigation on this and surrounding fields/canals may also create additional seasonal groundwater fluctuations. However, groundwater is not expected to significantly affect construction at the site.

5. DISCUSSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

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

The most significant geotechnical aspects of the site are the moderate strength characteristics of the fine-grained silts/clays encountered at the site and the excavatability of the dense clayey gravels with cobbles and boulders.

The on-site soils may be re-utilized as structural site grading fill if they meet the requirements for such, as stated herein. It should be noted that from a handling and compaction standpoint, soils containing high amounts of fines (silts and clays) are very sensitive to changes in moisture content and will require very close moisture control during placement and compaction. This will be very difficult, if not impossible, during wet and cold periods of the year. Additionally, many of the clayey gravels with cobbles and boulders encountered at the site contain excessive amounts of coarse material (more than 30 percent retain on the three-quarter inch sieve) and material larger than 8 inches in diameter. The clayey gravel soils may require screening to be utilized as structural site grading fill. Additionally, excessively coarse materials cannot be tested for compaction using conventional means (nuclear densometer) and will require full-time observation during placement to document compaction.

A qualified geotechnical engineer from GSH will need to verify that all topsoil, disturbed soils, and non-engineered fill soils have been completely removed and that suitable subgrade soils have been encountered prior to the placement of structural site grading fills, floor slabs, footings, foundations, or rigid pavements.

In the following sections, detailed discussions pertaining to earthwork, foundations, at-grade concrete 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 surface vegetation, topsoil, and other deleterious materials from beneath an area extending out at least 3 feet from the perimeter of the proposed buildings, pavements, and exterior flatwork areas.

Additional site preparation will consist of the removal of existing non-engineered fills (if encountered) from an area extending out at least 3 feet from the perimeter of residential structures and rigid pavements.

Existing non-engineered fill materials (if encountered) may remain beneath the flexible pavement sections and light flatwork provided the soils are properly prepared and do not contain construction debris or deleterious materials, and the owner accepts that some settlement of pavements/flatwork could occur. Proper preparation shall consist of scarifying, moisture conditioning, and re-compacting the upper 12 inches to the requirements for structural fill. As an option to recompaction, the upper 12 inches of non-engineered fills soils may be removed and replaced with granular subbase over proofrolled subgrade. Even with proper preparation, pavements established overlying non-engineered fills may encounter some long-term movements unless the non-engineered fills are completely removed.

Subsequent to stripping and prior to the placement of structural site grading fill, rigid 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 three times.

If excessively soft or otherwise unsuitable soils are encountered beneath footings, they must be totally removed. If removal depth required is more than 2 feet at groundwater level, GSH must be notified to provide additional recommendations. In pavement, floor slab, and outside flatwork areas, unsuitable natural soils should be removed to a maximum depth of 2 feet and replaced with compacted granular structural fill.

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 excavations up to 8 feet deep in fine-grained cohesive soils, above or below the water table, may be constructed with sideslopes no steeper than one-half horizontal to one vertical (0.5H:1V). Excavations deeper than 8 feet are not anticipated at the site.

For granular (cohesionless) soils, construction excavations above the water table, not exceeding 4 feet, should be no steeper than one-half horizontal to one vertical (0.5H:1V). For excavations up to 8 feet, in granular soils and above the water table, the slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult and will require very flat sideslopes and/or shoring, bracing and dewatering.

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

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

5.2.3 Unbraced Slopes

Based on the existing soils and conditions GSH recommends that unbraced slopes be no steeper than 3H:1V for heights up to 15 feet. Taller and/or steeper slopes will likely require retaining walls. GSH must review and evaluate (where appropriate) the proposed slope configurations once grading configurations have been finalized. Additionally, GSH recommends timely revegetation of unbraced slopes to reduce runoff channeling/rutting.

5.2.4 Structural Fill

Structural fill will be required as site grading fill, as backfill over foundations and utilities, and possibly as replacement fill beneath some footings. All structural fill must be free of sod, rubbish, construction debris, frozen soil, and other deleterious materials.

Structural site grading fill is defined as fill placed over fairly large open areas to raise the overall site grade. The maximum particle size within structural site grading fill should generally not exceed 4 inches; although, occasional particles up to 6 to 8 inches may be incorporated provided that they do not result in “honeycombing” or preclude the obtainment of the desired degree of compaction. In confined areas, the maximum particle size should generally be restricted to 2.5 inches.

The on-site soils may be re-utilized as structural site grading fill if they meet the requirements for such, as stated herein. It should be noted that from a handling and compaction standpoint, soils containing high amounts of fines (silts and clays) are very sensitive to changes in moisture content and will require very close moisture control during placement and compaction. This will be very difficult, if not impossible, during wet and cold periods of the year. Additionally, many of the clayey gravels with cobbles and boulders encountered at the site contain excessive amounts of coarse material (more than 30 percent retain on the three-quarter inch sieve) and material larger than 8 inches in diameter. The clayey gravel soils may require screening to be utilized as structural site grading fill. Additionally, excessively coarse materials cannot be tested for compaction using conventional means (nuclear densometer) and will require full-time observation during placement to document compaction.

Only granular soils are recommended in confined areas such as utility trenches, below footings, around foundations, etc. Generally, we recommend that all imported granular structural fill consist of a well-graded mixture of sands and gravels with no more than 20 percent fines (material passing the No. 200 sieve) and less than 30 percent retained on the 3/4 inch sieve. The plasticity index of import fine-grained soil should not exceed 18 percent.

To stabilize soft subgrade conditions (if encountered) or where structural fill is required to be placed closer than 1.0 foot above the water table at the time of construction, a mixture of coarse gravels and cobbles and/or 1.5- to 2.0-inch gravel (stabilizing fill) should be utilized. It may also

help to utilize a stabilization fabric, such as Mirafi 600X or equivalent, placed on the native ground if 1.5- to 2.0-inch gravel is used as stabilizing fill.

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.

5.2.5 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 ASTM¹ D-1557(AASHTO² T-180) compaction criteria in accordance with the table below:

Location	Total Fill Thickness (feet)	Minimum Percentage of Maximum Dry Density
Structural fill beneath an area extending at least 3 feet beyond the perimeter of the structure	0 to 10	95
Site grading fills outside area defined above	0 to 5	90
Site grading fills outside area defined above	5 to 10	95
Trench backfill in structural areas	--	96
Road base	-	96

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

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

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.

Utilization of a filter fabric, such as Mirafi 600X or equivalent, over soft subgrade may also be advantageous.

5.2.6 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.

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

Fine-grained soils, including the on-site clays, are not recommended for utility trench backfill in structural areas.

5.3 SPREAD AND CONTINUOUS WALL FOUNDATIONS

5.3.1 Design Data

The results of our analyses indicate that the proposed structures may be supported upon conventional spread and/or continuous wall foundations established upon suitable natural soils or granular structural fill extending to suitable natural soils. For design, with respect to the proposed construction and anticipated loading given in Section 2.0, Proposed Construction, the following parameters are recommended:

Minimum Recommended Depth of Embedment for Frost Protection	- 30 inches
Minimum Recommended Depth of Embedment for Non-frost Conditions	- 15 inches
Recommended Minimum Width for Continuous	

Wall Footings	- 18 inches
Minimum Recommended Width for Isolated Spread Footings	- 24 inches
Recommended Net Bearing Pressure for Real Load Conditions	- 2,000 pounds per square foot
Bearing Pressure Increase for Seismic Loading	- 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 should the footings be established upon non-engineered fills, potentially collapsible soils, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water. It is anticipated that the upper 12 to 18 inches of existing soil has been weathered and likely un-suitable to support footings in their present state. If unsuitable soils are encountered, they must be completely removed and replaced with compacted structural fill. If granular soils become loose or disturbed, they must be recompacted to the requirements for structural fill.

The width of structural replacement fill below footings should be equal to the width of the footing plus one foot for each foot of fill thickness. For instance if the footing width is 2 feet and the structural fill depth beneath the footing is 2 feet, the fill replacement width should be 4 feet, centered beneath 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 40 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 should be utilized for foundations placed over natural soils and a coefficient of 0.40 should be utilized for foundations placed over granular structural fill. Passive resistance provided by properly placed and compacted granular structural fill above the water table may be considered equivalent to a fluid with a density of 300 pounds per cubic foot.

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 LATERAL PRESSURES

The lateral pressure parameters, as presented within this section, are for backfills which will consist of drained granular soil placed and compacted in accordance with the recommendations presented herein. The lateral pressures imposed upon subgrade facilities will, therefore, be basically dependent upon the relative rigidity and movement of the backfilled structure. For active walls, such as retaining walls which can move outward (away from the backfill), granular backfill may be considered equivalent to a fluid with a density of 35 pounds per cubic foot in computing lateral pressures. For more rigid walls (moderately yielding), generally not exceeding 8 feet in height, granular backfill may be considered equivalent to a fluid with a density of 45 pounds per cubic foot. The above values assume that the surface of the soils slope behind the wall is no steeper than 4 horizontal to 1 vertical and that the granular fill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

For seismic loading, a uniform pressure should be added. The uniform pressures based on different wall heights are provided in the following table:

Wall Height (feet)	Seismic Loading Active Case (psf)	Seismic Loading Moderately Yielding (psf)
4	25	55
6	40	85
8	55	115

5.6 FLOOR SLABS

Floor slabs may be established upon suitable natural soils and/or upon structural fill extending to suitable natural soils. Under no circumstances should the floor slabs be established overlying existing non-engineered fills, potentially collapsible soils, loose or disturbed soils, sod, rubbish,

construction debris, other deleterious materials, frozen soils, or within ponded water. In order to facilitate construction and curing of the concrete, it is recommended that floor slabs be directly underlain by a minimum 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 (average uniform pressure of 200 pounds per square foot or less) is anticipated to be less than 1/4 inch.

The tops of all floor slabs in habitable areas must be established at least 2 feet above the highest anticipated normal water level or the maximum groundwater level controlled by land drains.

5.7 SUBDRAINS

5.7.1 General

Groundwater was not encountered at the site, however clay layers encountered at the site may cause a “perched watertable” to form on top of the clay layers, therefore a perimeter foundation subdrain is recommended. We recommend that the perimeter foundation subdrain be installed as indicated below.

5.7.2 Foundation Subdrains

Foundation subdrains should consist of a 4-inch diameter perforated or slotted plastic or PVC pipe enclosed in clean gravel. The invert of a subdrain should be at least 2 feet below the top of the lowest adjacent floor slab. The gravel portion of the drain should extend 2 inches laterally and below the perforated pipe and at least 1 foot above the top of the lowest adjacent floor slab. The gravel zone must be installed immediately adjacent to the perimeter footings and the foundation walls. To reduce the possibility of plugging, the gravel must be wrapped with a geotextile, such as Mirafi 140N or equivalent. Above the subdrain, a minimum 4-inch-wide zone of “free-draining” sand/gravel should be placed adjacent to the foundation walls and extend to within 2 feet of final grade. The upper 2 feet of soils should consist of a compacted clayey cap to reduce surface water infiltration into the drain. As an alternative to the zone of permeable sand/gravel, a prefabricated “drainage board,” such as Miradrain or equivalent, may be placed adjacent to the exterior below-grade walls. Prior to the installation of the footing subdrain, the below-grade walls should be dampproofed. The slope of the subdrain should be at least 0.3 percent. The gravel placed around the drain pipe should be clean 0.75-inch to 1.0-inch minus gap-graded gravel and/or “pea” gravel. The foundation subdrains can be discharged into the area subdrains, storm drains, or other suitable down-gradient location.

5.8 PAVEMENTS

5.8.1 Design Criteria

The existing natural clayey soils encountered at the site will exhibit poor pavement support characteristics when saturated or near saturated. All pavement areas must be prepared as previously discussed. With the subgrade soils and the projected traffic as discussed in Section 2, Proposed Construction, the following pavement sections are recommended:

Minor Streets/Cul-de-Sac Traffic

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

Flexible Pavement:

3.0 inches	Asphalt concrete
10.0 inches	Aggregate base
Over	Properly prepared non-engineered fills, properly prepared natural subgrade soils, and/or structural site grading fill extending to natural subgrade soils.

Or

3.0 inches	Asphalt concrete
6.0 inches	Aggregate base
6.0 inches	Sub base
Over	Properly prepared non-engineered fills, properly prepared natural subgrade soils, and/or structural site grading fill extending to natural subgrade soils

5.9 GEOSEISMIC SETTING

5.9.1 General

Utah municipalities adopted the International Building Code (IBC) 2012 and International Residential Code (IRC) for One- to Two-Family Dwellings 2012 on July 1, 2013. The IBC and IRC 2012 codes determine the seismic hazard for a site based upon 2008 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

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

5.9.2 Site 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.

5.9.3 Faulting

Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The nearest active fault is the Weber Section of the Wasatch Fault Zone, approximately 5.1 miles west of the site.

5.9.4 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 a MCE event and incorporates a soil amplification factor for a Site Class D soil profile in the second column. Based on the site latitude and longitude (41.3389 degrees north and -111.8323 degrees west, respectively), the values for this site are tabulated on the following page.

	Site Class B		Site Class D	
Spectral	Boundary		[adjusted for site	Design
Acceleration	[mapped values]	Site	class effects]	Values
Value, T	(% g)	Coefficient	(% g)	(% g)
Peak Ground Acceleration	37.7	$F_a = 1.123$	42.3	28.2
0.2 Seconds (Short Period Acceleration)	$S_s = 94.2$	$F_a = 1.123$	$S_{MS} = 105.8$	$S_{DS} = 70.5$
1.0 Second (Long Period Acceleration)	$S_1 = 32.1$	$F_v = 1.758$	$S_{M1} = 56.4$	$S_{D1} = 37.6$

5.9.5 Liquefaction

The site is located in an area that has been identified by the Utah Geologic Survey as having “moderate” liquefaction potential. 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.

Liquefaction of near-surface soils at the site is not anticipated during the design seismic event due to the unsaturated nature of the granular soils, and the cohesive (clayey) nature of the other site soils; however the liquefaction susceptibility of the underlying soils (deeper than our explorations) is unknown and would require further investigation to quantify.

5.10 SITE VISITS

As stated previously, prior to placement of foundations, floor slabs, pavements, and site grading fills, a geotechnical engineer from GSH must verify that all non-engineered fills, topsoil, and disturbed/loose soils have been removed and suitable subgrade conditions encountered. Additionally, GSH must observe fill placement and verify in-place moisture content and density of fill materials placed at the site.

5.11 CLOSURE

If you have any questions or would like to discuss these items further, please feel free to contact us at (801) 393-2012.

Respectfully submitted,

GSH Geotechnical, Inc.



Andrew M. Harris, P.E.
State of Utah No. 7420456
Senior Geotechnical Engineer



Reviewed by:



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

AMH/BNR:mmh

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

Addressee (email)

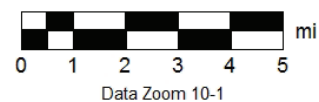
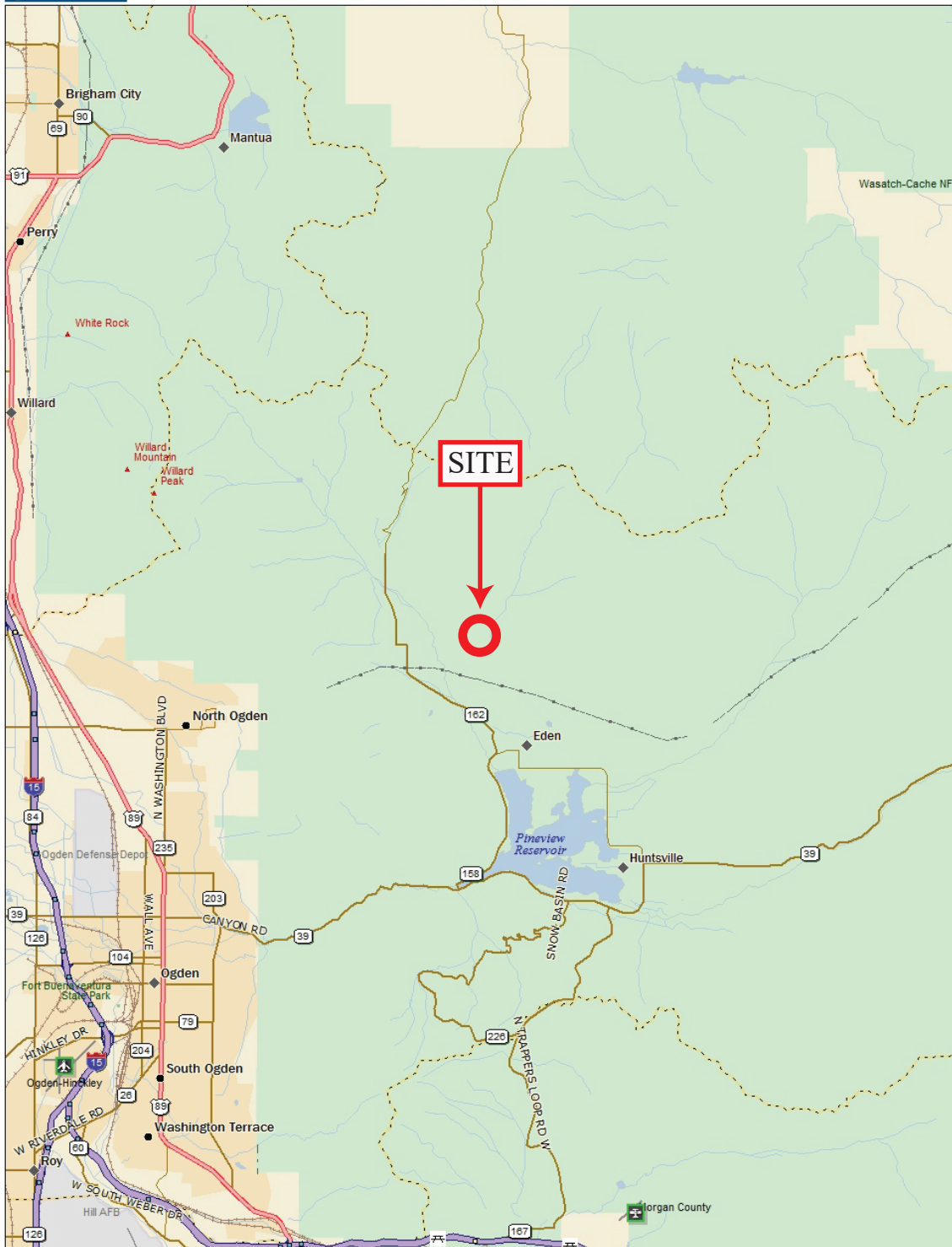


FIGURE 1
VICINITY MAP
 GSH





TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-2

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15 DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							moist loose dense
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles and boulders; major roots (topsoil) to 4"; brown to reddish-brown								
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time of excavation	5							
			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: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15

DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles and boulders; major roots (topsoil) to 3"; dark brown								moist loose dense
					15		23			
			5							
		End of Exploration at 6.0' due to excavator refusal 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 3C



TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-4

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15 DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
	GC	Ground Surface	0							moist loose dense
		CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles and boulders; major roots (topsoil) to 5"; brown								
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time if excavation	5							
			10							
			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: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15

DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles and boulders; major roots (topsoil) to 3"; dark brown								moist loose medium dense
			5							dense
		End of Exploration at 6.0' due to excavator refusal 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 3E



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-6

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15

DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	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; occasional fine and coarse gravel; major roots (topsoil) to 3"; brown								moist loose
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles and boulders; brown								stiff moist dense
	CH	SILTY CLAY with some fine sand; some fine and coarse gravel; numerous cobbles; gray	5					95	73	moist stiff
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles and boulders; grayish-tan								moist dense
		End of Exploration at 10.0' due to excavator refusal 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 3F



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-7

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15

DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	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; occasional fine and coarse gravel; major roots (topsoil) to 3"; brown								moist loose stiff
		occasional cobbles and boulders	5							
		light brown	10							
	GC	CLAYEY COBBLES AND BOULDERS with fine and coarse gravel; light brown								moist dense
		End of Exploration at 13.0' due to excavator refusal 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 3G



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-8

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/18/15 DATE FINISHED: 12/18/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/18/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							moist loose dense
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles and boulders; major roots (topsoil) to 3"; brown								
		grades reddish-brown								
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time of excavation	5							
			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: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	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; some fine and coarse gravel; occasional cobbles; major roots (topsoil) to 3"; brown								moist loose stiff
			5							moist dense
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; brown			15		30			
		grades with numerous cobbles								
		End of Exploration at 8.0' due to excavator refusal 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 31



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-10

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles; occasional boulders; major roots (topsoil) to 3"; brown to dark brown								moist loose dense
		grades light brown								
			5							
	GC	CLAYEY FINE AND COARSE GRAVEL with occasional to some cobbles; light brown								moist dense
		End of Exploration at 8.0' due to excavator refusal 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 3J



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-11

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							moist loose dense
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles; occasional boulders; major roots (topsoil) to 4"; brown								
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time of excavation	5							
			10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3K



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-12

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles; occasional boulders; major roots (topsoil) to 3"; dark brown								moist loose dense
		grades with numerous cobbles; occasional to some boulders; brown			8		19			very dense
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time of excavation	5							
			10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3L



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-13

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	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; some fine and coarse gravel; occasional cobbles; major roots (topsoil) to 3"; brown								moist loose stiff
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time of excavation	5							
			10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3M



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-14

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles; major roots (topsoil) to 3"; dark brown								moist
	CL	SILTY CLAY with some fine sand; some fine and coarse gravel; occasional cobbles; major roots (topsoil) to 3"; brown								loose
										moist
										stiff
			5							
		grades with numerous cobbles and occasional boulders								
		End of Exploration at 7.5' due to excavator refusal 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 3N



TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-15

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15 DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							moist loose stiff
	CL	SILTY CLAY with some fine sand; occasional to some fine and coarse gravel; major roots (topsoil) to 3"; brown to dark brown								
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles; occasional boulders; brown	5							moist dense
		End of Exploration at 8.0' due to excavator refusal 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 30



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-16

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY COBBLES with fine and coarse gravel; some fine to coarse sand; major roots (topsoil) to 3"; dark brown								moist loose dense
		occasional boulders up to 3' in diameter			7		18			
	CH	SILTY CLAY with some fine sand; some fine and coarse gravel; occasional to some cobbles; occasional boulders; light brown	5					81	58	moist stiff
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles; occasional boulders; brown	10							moist dense
		End of Exploration at 11.0' due to excavator refusal 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 3P



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-17

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles and boulders; major roots (topsoil) to 3"; dark brown								moist loose dense
		numerous boulders at 4.0'								
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time of excavation	5							
			10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3Q



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-18

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							moist loose stiff
	CL	SILTY CLAY with some fine sand; some fine and coarse gravel; major roots (topsoil) to 3"; reddish-brown								
		occasional cobbles								
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time of excavation	5							
			10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3R



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-19

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15 DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	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; occasional fine and coarse gravel; major roots (topsoil) to 3"; brown								moist loose stiff
		occasional cobbles								very stiff
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time of excavation	5							
			10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3S



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-20

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15

DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	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; some fine and coarse gravel; occasional cobbles and boulders; major roots (topsoil) to 4"; brown								moist loose stiff
										very stiff
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles; reddish-brown	5							moist dense
		End of Exploration at 8.0' due to excavator refusal 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 3T



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-21

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15

DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles; major roots (topsoil) to 4"; dark brown								moist loose dense
					10		18			
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time of excavation	5							
			10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3U



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-22

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/16/15

DATE FINISHED: 12/16/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/16/15)

ELEVATION: ---

WATER LEVEL	U S C S	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; some fine and coarse gravel; occasional cobbles and boulders; major roots (topsoil) to 3"; brown								moist loose stiff
										very stiff
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; occasional to numerous cobbles; reddish-brown	5							moist dense
		End of Exploration at 6.5' due to excavator refusal 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 3V



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-24

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/18/15

DATE FINISHED: 12/18/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/18/15)

ELEVATION: ---

WATER LEVEL	U S C S	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 and coarse gravel; blocky structure; major roots (topsoil) to 4"; brown								moist loose very stiff
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles; occasional boulders; brown								moist dense
		End of Exploration at 5.0' due to excavator refusal No significant sidewall caving No groundwater encountered at time of excavation	5							
			10							
			15							
			20							
			25							

See Subsurface Conditions section in the report for additional information.

FIGURE 3X



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-25

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	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; some fine gravel; major roots (topsoil) to 6"; brown with oxidation mottling								moist loose medium stiff
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles and boulders; brownish-gray with oxidation	5							moist dense
					21		36			
		End of Exploration at 9.0' due to excavator refusal 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 3Y



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-26

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15

DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles and boulders; some fine to coarse sand; major roots (topsoil) to 3"; brown								moist loose dense
			5							very dense
		End of Exploration at 6.5' due to excavator refusal 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 3Z



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-27

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/17/15 DATE FINISHED: 12/17/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/17/15)

ELEVATION: ---

WATER LEVEL	U S C S	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; blocky structure; major roots (topsoil) to 3"; brown			18	91				moist loose stiff
		grades with occasional to some fine and coarse gravel	5					43	27	
	GC	CLAYEY FINE AND COARSE GRAVEL with occasional to some cobbles and boulders; brown with oxidation								moist dense
		End of Exploration at 10.0' due to excavator refusal 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 3AA



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-28

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/18/15

DATE FINISHED: 12/18/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/18/15)

ELEVATION: ---

WATER LEVEL	U S C S	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; occasional cobbles; major roots (topsoil) to 3"; dark brown								moist loose stiff
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles; occasional boulders; brown								moist dense
			5							
	CH	SILTY CLAY with some fine sand; some fine and coarse gravel; numerous cobbles; light grayish-brown								moist very stiff
			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 3BB



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-29

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/18/15

DATE FINISHED: 12/18/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/18/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with numerous cobbles and boulders; major roots (topsoil); dark brown								moist loose dense
		grades brown	5							
		End of Exploration at 8.5' due to excavator refusal 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 3CC



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-30

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/18/15

DATE FINISHED: 12/18/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/18/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles; occasional boulders; major roots (topsoil) to 4"+; brown to dark brown								moist loose to 4" dense
					7		12			
		grades with fewer boulders	5							
			10							
		End of Exploration at 11.5' 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 3DD



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-31

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/18/15

DATE FINISHED: 12/18/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/18/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles; occasional boulders; major roots (topsoil) to 3"; brown to dark brown								moist loose to 3" dense
			5							
		grades with numerous cobbles and boulders; brown								
			10							
		End of Exploration at 10.0' due to excavator refusal 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 3EE



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-32

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/18/15

DATE FINISHED: 12/18/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/18/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles; occasional boulders; major roots (topsoil) to 4"+; brown to dark brown								moist loose to 4"+ dense
			5							
		End of Exploration at 6.0' due to excavator refusal 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 3FF



GSH

TEST PIT LOG

Page: 1 of 1

TEST PIT: TP-33

CLIENT: Lewis Homes

PROJECT NUMBER: 1661-05N-15

PROJECT: The Bridges at Wolf Creek

DATE STARTED: 12/18/15

DATE FINISHED: 12/18/15

LOCATION: Northwest of Fairway Drive, near Eden, Weber County, Utah

GSH FIELD REP.: AA

EXCAVATING METHOD/EQUIPMENT: Komatsu PC200 - Backhoe

GROUNDWATER DEPTH: Not Encountered (12/18/15)

ELEVATION: ---

WATER LEVEL	U S C S	DESCRIPTION	DEPTH (FT.)	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0							
	GC	CLAYEY FINE AND COARSE GRAVEL with some fine to coarse sand; numerous cobbles and boulders; major roots (topsoil) to 4"; brown to dark brown								moist loose to 4" dense
					25		48			
			5							
			10							
		End of Exploration at 10.0' due to excavator refusal 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 3GG

CLIENT: Lewis Homes
PROJECT: The Bridges at Wolf Creek
PROJECT NUMBER: 1661-05N-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
		GRAVELS WITH FINES (appreciable amount of fines)	GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No 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
		SANDS WITH FINES (appreciable amount of fines)	SP	Poorly-Graded Sands, Gravelly Sands, Little or No 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 Limit less Liquid than 50%	ML	Inorganic Silts and Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity	
		CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays	
		OL	Organic Silts and Organic Silty Clays of Low Plasticity	
	SILTS AND CLAYS Limit greater than 50% Liquid than	MH	Inorganic Silts, Micaceous or Diatomaceous 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

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

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

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

FIGURE 4

