Geotechnical Engineering Report

Riverton AAP Store
Riverton, UT
May 17, 2016
Terracon Project No. 61165053

Prepared for:
TKC Land Development II, LLC
5935 Carnegie Boulevard, Suite 200
Charlotte, North Carolina 28209

Prepared by:
Terracon Consultants, Inc.
Midvale, Utah

OK

May 17, 2016

Terracon

TKC Land Development II, LLC
5935 Carnegie Boulevard, Suite 200
Charlotte, North Carolina 28209

Attn: Ms. Beth Godfrey
P: [704] 319-8155
M: [704] 942-5477
E: bgodfrey@thekeithcorp.com

Re: Geotechnical Engineering Report
Riverton AAP Store
Riverton, Utah
Terracon Project No. 61165053

Dear Ms. Godfrey:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above-referenced project. This study was performed in general accordance with our proposal number P61165053, dated April 13, 2016. This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Charles V. Molthen, E.I.T.
Senior Staff Engineer

Rick L. Chesnut, P.E., P.G.
Principal

Enclosures
cc: 1 – Client (PDF)
1 – File

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APPENDICES

EXECUTIVE SUMMARY

A geotechnical exploration has been performed for the proposed Advance Auto Parts store located at 2200 West 12600 South in Riverton, Utah. Terracon's geotechnical scope of work included the advancement of six soil borings to depths ranging from 6½ to 16½ feet below existing site grade.

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the borings and our current understanding of the proposed development. The following geotechnical considerations were identified:

- **Site Soils:** Existing soil conditions encountered at the site generally consisted of medium stiff to very stiff sandy lean clay, lean clay, and lean clay with sand to a depth of 6½ to 9½ feet, underlain by medium stiff to stiff sandy silt, followed by medium stiff lean clay with sand, followed by dense to very dense silty sand with gravel to the maximum depth explored of 16½ feet. Groundwater was not encountered during the geotechnical exploration. An abandoned car wash structure exists on the site; undocumented fill and existing foundations may exist below proposed footing elevation.

- **Fine Grained Near-Surface Soils:** Fine-grained near-surface soils may be susceptible to pumping and rutting under the weight of construction equipment, especially when wetted. The contractor should be made aware of these conditions and properly protect the subgrade during construction.

- **Foundations:** The proposed building may be supported on lightly loaded, shallow strip and spread footings bearing on properly prepared native soils or properly placed and compacted Structural Fill. The maximum allowable bearing pressure for footing design is 1,800 pounds per square foot (psf).

- **Seismic:** The soil profile is best represented by Seismic Site Class of D, based on criteria presented in the International Building Code (IBC). The site is located near an area mapped with low to very low liquefaction potential. Based on the results of our exploration, liquefiable soils were not encountered at the boring locations.

- **Floor Slabs:** Floor slabs should be placed on a minimum of 4 inches of crushed gravel underlain by properly prepared native soil or properly placed and compacted Structural Fill extending to the suitable native soils.

- **New Pavement Sections:** Automobile parking areas – 3" AC over 6" UBC or 5" PCC over 4" UBC. Heavy duty section – 4" AC over 8" UBC or 5" PCC over 6" UBC. Dumpster pad – 6" PCC over 8" UBC.

- **Infiltration Test:** Percolation rate was recorded at 160 minutes per inch.

- **Earthwork:** Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during construction.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
Riverton AAP
Riverton, Utah
Terracon Project No. 61165053
May 17, 2016

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed Advance Auto Parts store located at 2200 West 12600 South in Riverton, Utah. Six soil borings, designated B-1 through B-6, were drilled to depths ranging from 6½ to 16½ feet below existing site grade. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- estimated settlement of foundations
- seismic considerations
- groundwater conditions
- foundation design and construction
- floor slab design and construction
- percolation results

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION		
Structure	Single-story, 6,889 sq.ft. building		
Building construction	Reinforced Masonry Wall with Steel Roof Joists		
Finished floor elevation (FFE) (assumed)	Near existing site grade (assumed)		
Maximum loads (assumed)	Columns: 40 Kips	Walls: 2 Kips/lf	Slab: 150 psf
Grading	Cut and fills 3 feet or less (assumed)		
Pavements	Passenger Parking Lot: 10,000 ESALs Truck Drive Lanes: 75,000 ESALs		
Free-standing retaining walls	None		
Below grade areas	None		
Liquefaction potential[1]	Low to very low probability based on available published liquefaction maps.		

1. *Special Study Areas Map ,Salt Lake County, Utah*, 2010, Salt Lake County Planning and Development Services

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	2200 West 12600 South, Riverton, Utah
Existing improvements	Abandoned car wash, existing asphalt concrete, and sign.
Current ground cover	Existing building, asphalt concrete, trees, and landscaping.
Existing topography	Relatively level, with general topography sloping to the east toward the Jordan River.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	6½ to 9½	Lean clay, lean clay with sand, and sandy lean clay	Medium stiff to very stiff
2	10 to 13½	Sandy silt[1]	Medium stiff to stiff
3	15	Lean clay with sand[2]	Dense to Very dense
4	16 ½[3]	Silty sand with gravel	Dense to very dense

1. Encountered in borings B-1 to B-3
2. Encountered in boring B-1
3. Maximum depth explored.

Laboratory tests were conducted on selected soil samples and the test results are presented in Appendix B.

Specific conditions encountered at the boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for the borings can be found on the boring logs included in Appendix A of this report.

3.2 Groundwater

Groundwater was not encountered during the subsurface exploration. It should be recognized that fluctuations of the groundwater table may occur due to seasonal variations in the amount of rainfall, runoff, future construction and other factors not evident at the time the borings were performed. Evaluation of these factors is beyond the scope of this exploration.

3.3 Percolation Rate

One percolation test was performed at location B-5 shown on the Exploration Plan. An approximately eight-inch diameter soil boring was drilled to approximately 5 feet below the existing site grade, with percolation occurring at a depth of five feet. A four-inch diameter, solid PVC pipe was inserted, and the holes were backfilled with bentonite hole plug and soil cuttings. The pipe was then filled with water and the soil allowed to saturate. After saturation, the test hole was refilled with water and the time required for the water level to drop incrementally was measured until a stabilized rate was achieved. Rates were considered to be stable when the rate of percolation appeared to be relatively constant. The following table summarizes the results of our percolation test.

Summary of Percolation Test Results

Percolation Test	Percolation Rate (minutes/inch)
B-5	160

The designer should determine an appropriate design percolation rate and factor of safety based on the data provided above and their experience.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Based on the results of our exploration, it is our opinion that the site is suitable for the proposed construction, provided the recommendations presented in this report are followed. Based on the results of our exploration, we recommend that the proposed structure be supported on a lightly loaded shallow strip and spread footing foundation system bearing on properly prepared native soils or properly placed and compacted Structural Fill.

- **Existing Structures:** A portion of the proposed site was previously occupied by a building. Fill and other demolition debris may be encountered during excavations and site preparation. Support of structures on or above existing uncontrolled fill involves risk. Risk associated with construction on existing uncontrolled fill must be assumed by the owner. Foundations supported on or above existing uncontrolled fill that has not been uniformly placed and compacted with strict moisture and density control may not perform

predictably. Further, the composition and amount of existing uncontrolled fill could vary significantly across the site. We recommend that all existing fill be removed from within the proposed building and pavement areas and replaced with properly placed and compacted Structural Fill.

- **Fine Grained Near-Surface Soils:** Fine-grained near-surface soils may be susceptible to pumping and rutting under the weight of construction equipment, especially when wetted. The contractor should be made aware of these conditions and should properly protect the subgrade during construction.

Geotechnical engineering recommendations for foundation systems and other earth-connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of data presented herein, engineering analyses, and our current understanding of the proposed project.

4.2 Earthwork

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth-supported elements, including foundations, slabs, and pavements, are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include the observation and testing of fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

Topsoil, asphalt, deleterious materials, fill, loose or disturbed soil and any other unsuitable materials should be removed from within construction areas and extending outward a minimum of 5 feet from the proposed building.

A building previously occupied a portion of the site. During site preparation, any remaining existing foundations, floor slabs, utilities, and other demolition debris and materials should be completely removed from below the new construction areas. Excavations resulting from the removal of these materials should be backfilled with compacted structural fill.

Although evidence of underground facilities, such as septic tanks, gasoline station components, cesspools, and unknown utilities, was not observed in our borings, such features could be encountered during construction. If unexpected underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

4.2.2 Subgrade Preparation

Following removal of unsuitable materials, the exposed subgrade below foundations and concrete slabs and pavements, including areas which will receive fill, should be proofrolled to aid in assessing the subgrade condition. Proofrolling should be performed using rubber-tired equipment, such as a water or dump truck. Soft, pumping, rutting or otherwise unsuitable conditions, identified during proofrolling, should be removed and replaced with Structural Fill or stabilized using geotextiles and Stabilization Fill.

Backfill of excavations should be completed using properly placed and compacted Structural Fill. The site should be initially graded to create a relatively level surface to receive fill and provide a relatively uniform fill thickness.

For excessively soft and/or pumping soils, a geogrid product, such as those provided by Tensar (TX grid) or Mirafi, should be placed on top of the subgrade soil prior to placement of the Stabilization Fill to improve stabilization support. A separation fabric, such as Mirafi N-series, should be placed between the native soil and the grid and on top of the Stabilization Fill.

The moisture content and stability of subgrade soils should be maintained until slab or pavement construction.

4.2.3 Materials Types

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than three inches in size. Pea gravel or other similar non-cementitious, poorly graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer. Fill material should meet the following requirements:

Fill Type [1]	Application	Requirements		
		Gradation		Plasticity
		Size	Percent finer by weight	
Structural Fill	Required for all fill under foundations, floor slabs and pavements	3 inch No. 4 Sieve No. 200 Sieve	100 35-60 15 max	Liquid Limit 30 max Plasticity Index 6 max
Stabilization Fill	Fill used to stabilize soft, potentially pumping subgrade	6 inch No. 200 Sieve	100 5 max	--

1. All fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.

On-site fine-grained soils may not be considered for reuse as Structural Fill. Materials proposed for use as Structural Fill should be tested to verify conformance with the materials requirements presented above.

4.2.4 Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows:

Item	Description
Fill Lift Thickness	8 inches or less in loose thickness
Compaction [1]	95% of the material's maximum dry density (modified Proctor - ASTM D 1557) in foundation, floor slab, and pavement areas; 92% of material's maximum dry density (ASTM D1557) in other areas of fill and backfill
Moisture Content	Within 2% of optimum moisture content as determined by the modified Proctor test at the time of placement and compaction

1. Fill should be tested frequently for compaction during placement. Should the results of the in-place density tests indicate the specified compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified compaction is achieved. This may require adjustment of the moisture content.

Where light compaction equipment is used, as is customary within a few feet of retaining walls and in utility trenches, the lift thickness may need to be reduced to achieve the desired degree of compaction.

4.2.5 Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction, including backfill placement and compaction. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of cohesive fill in non-pavement areas to reduce the infiltration and conveyance of surface water through the trench backfill.

4.2.6 Grading and Drainage

Any areas of standing surface water should be drained as far in advance of construction as possible. Any saturated soils should be removed prior to placing fill or proceeding with construction.

Surface water should not be allowed to pond on the site and soak into the soil during construction. Construction staging should provide drainage of surface water and precipitation away from the building and pavement areas. Any water that collects over or adjacent to construction areas should be promptly removed, along with any softened or disturbed soils. Surface water control in the form of sloping surfaces, drainage ditches and trenches, and sump pits and pumps will be important to avoid ponding and associated delays due to precipitation and seepage.

Roof gutters and downspouts that drain water a minimum of 10 feet beyond the footprint of the proposed structure are recommended. This can be accomplished through the use of splash-blocks, downspout extensions, and flexible pipes that are designed to attach to the end of the downspout. Flexible pipe should only be used if it is day lighted in such a manner that it gravity-drains collected water. Splash-blocks should also be considered below hose bibs and water spigots. Sprinkler systems should not be installed within five feet of foundation walls. Landscaped irrigation adjacent to the foundation systems should be minimized or eliminated.

4.2.7 Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.

Upon completion of grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction and observed by Terracon.

All excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Construction site safety is the sole responsibility of the contractor who controls the means, methods and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean that Terracon is assuming any responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied or inferred.

4.3 Foundations

In our opinion, the proposed building can be supported by a lightly-loaded shallow, strip and spread footing foundation system bearing on properly prepared native soil or on properly placed and compacted Structural Fill. Design recommendations for shallow foundations for the proposed structure are presented in the following paragraphs.

4.3.1 Design Recommendations

DESCRIPTION	Column	Wall
Net allowable bearing pressure for footing bearing on properly prepared native soil or properly placed and compacted Structural Fill [1]	1,800 psf	
Minimum dimensions	24 inches	16 inches
Maximum dimensions	5½ feet	3 feet
Minimum embedment of external footings below finished grade for frost protection [2]	30 inches	
Minimum embedment of internal footings below finished grade for frost protection [2]	12 inches	
Approximate total settlement [3]	<1 inch	
Estimated differential settlement [3]	<1/2 inch between columns	<1/2 inch over 40 feet
Ultimate coefficient of sliding friction	0.30 (Native Soils) 0.40 (Structural Fill)	

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable fill or soft soils, if encountered, will be undercut and replaced with engineered fill.
2. And to reduce the effects of seasonal moisture variations in the subgrade soils. For perimeter footing and footings beneath unheated areas.
3. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations.

The net allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations. Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

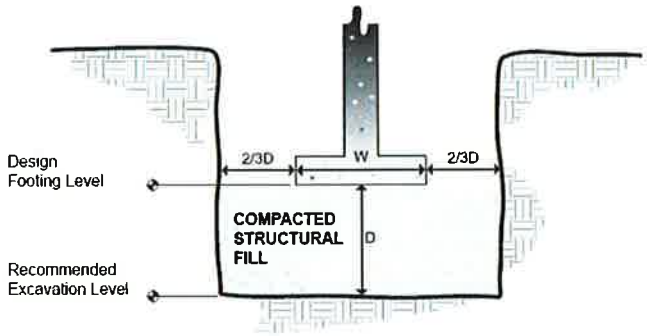
Footings, foundations and masonry walls should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of joints at openings or other discontinuities in masonry walls is recommended.

Foundation excavations should be observed by the geotechnical engineer. If the soil conditions encountered differ from those presented in this report, supplemental recommendations will be required.

4.3.2 Construction Considerations

If unsuitable bearing soils are encountered in footing excavations, the excavations should be extended deeper to suitable soils and the footings bear directly on the suitable soil or on properly

placed and compacted Structural Fill extending down to the suitable soils. Over excavation for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of over excavation depth below footing base elevation. The over excavation should then be backfilled up to the footing base elevation following recommendations provided in this report. The over excavation and backfill procedure is described in the figure below.



Overexcavation / Backfill

4.4 Floor Slab

4.4.1 Design Recommendations

ITEM	DESCRIPTION
Floor slab support	A minimum of 4 inches of crushed gravel underlain by properly prepared native soil or on properly placed and compacted Structural Fill extending to the suitable native soils
Modulus of subgrade reaction	75 pounds per square inch per in (psi/in) for point loading conditions

Where appropriate, saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpeting or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

4.4.2 Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of base rock and concrete and corrective action may be required. We recommend the area underlying the floor slab be rough graded and then thoroughly proofrolled with a loaded

tandem axle dump truck prior to final grading and placement of base rock. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill. All floor slab subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the base rock and concrete.

4.5 Pavements

4.5.1 Pavement Recommendation

Pavement sections were developed using AASHTO 93 design methodology and assumed traffic volumes. Pavement sections were developed for automobile parking and heavy duty sections for truck drives. Design traffic and estimated 18-kip Equivalent Single Axle Loads (ESAL) are summarized in the following table.

Section	Design ESALs
Automobile Parking	15,000
Heavy Duty	75,000

Notes:
1. Design ESALs assumed.

Based on N-values from the SPT tests during the field exploration a design CBR value of 6 percent was chosen.

The following minimum pavement sections, or approved equivalent, should be placed on the properly prepared subgrade soils.

Section	Recommended Pavement Sections (Inches) – Parking Lots Only			
	Asphalt Concrete	Portland Cement Concrete Surfacing	Untreated Base Course	Total
Automobile Parking	3.0	---	6.0	9.0
	---	5.0	4.0	9.0
Heavy Duty	4.0	---	8.0	12.0
	---	5.0	6.0	11.0
Dumpster Pad[1]		6.0	8.0	14.0

1. The trash container pad should be large enough to support the container and the tipping axle of the collection truck.

4.5.2 Construction Considerations

All paved areas should have adequate crown and slope to provide positive drainage and prevent ponding of surface water and infiltration below the pavement section. Water collection devices such as gutters and ditches should be incorporated into the parking lot design to prevent percolation of surface water below the pavement section.

Pavement sections have not been designed to support construction equipment. As such, the contractor should protect pavement areas from damage that may result from construction traffic.

The pavement sections provided in this report are minimums for the given design criteria. Periodic maintenance is critical to the long-term performance of the pavement sections. A maintenance program that includes surface sealing, joint cleaning and sealing, joint grinding, repair and replacement of cracked slabs and timely repair of cracks and deteriorated areas will aid the pavement in meeting its design life.

4.6 Seismic Considerations

Based on the results of our exploration, the subsurface soil profile is best represented by Site Class D according to the 2012 IBC. The National Seismic Hazard Map database was searched to identify the peak ground acceleration (PGA) and spectral accelerations for 0.2 second (Ss) and 1.0 second (S1) periods for a 2% probability of exceedance (PE) in 50 years at the project site for site class B. These values should be adjusted for site effects using appropriate site class factors from the 2012 IBC.

DESCRIPTION	VALUE
2012 International Building Code Site Classification (IBC) [1]	D [2]
Site Latitude	N 40.52259
Site Longitude	W -111.947939
S_o PGA	0.5672 g
S_s Spectral Acceleration for a Short Period	1.316 g
S_1 Spectral Acceleration for a 1-Second Period	0.438 g
F_a Site Coefficient for a Short Period	1.0
F_v Site Coefficient for a 1-Second Period	1.562

1. Note: In general accordance with the *2012 International Building Code*. IBC Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.
2. The 2012 International Building Code (IBC) requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the required 100 foot soil profile determination. Borings extended to a maximum depth of 16½ feet, and this seismic site class definition considers that encountered soils continues below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.

The site is located near an area mapped as having a low to very low potential for liquefaction. Based on the subsurface soil conditions and boring information, the risk of liquefaction induced settlement is negligible.

4.7 Analytical Tests

Chemical testing consisting of pH, resistivity, and soluble sulfates was performed on selected soil samples collected in the soil borings. Results are summarized below.

ANALYTICAL TEST RESULTS

Sample Location	TEST RESULTS		
	pH	Resistivity (ohm-cm)	Sulfate (ppm)
B-2 @ 2.5'	8.74	2,280	84.8

An aggressive subsurface environment where corrosion can deteriorate the buried steel over design life can generally be identified by soil resistivity and pH tests.

On-site soils are considered non aggressive to buried steel based on laboratory test results. Based on the test results, sulfate exposure to concrete appears to be negligible. A corrosion engineer should be retained to provide additional corrosion protection recommendations.

5.0 GENERAL COMMENTS

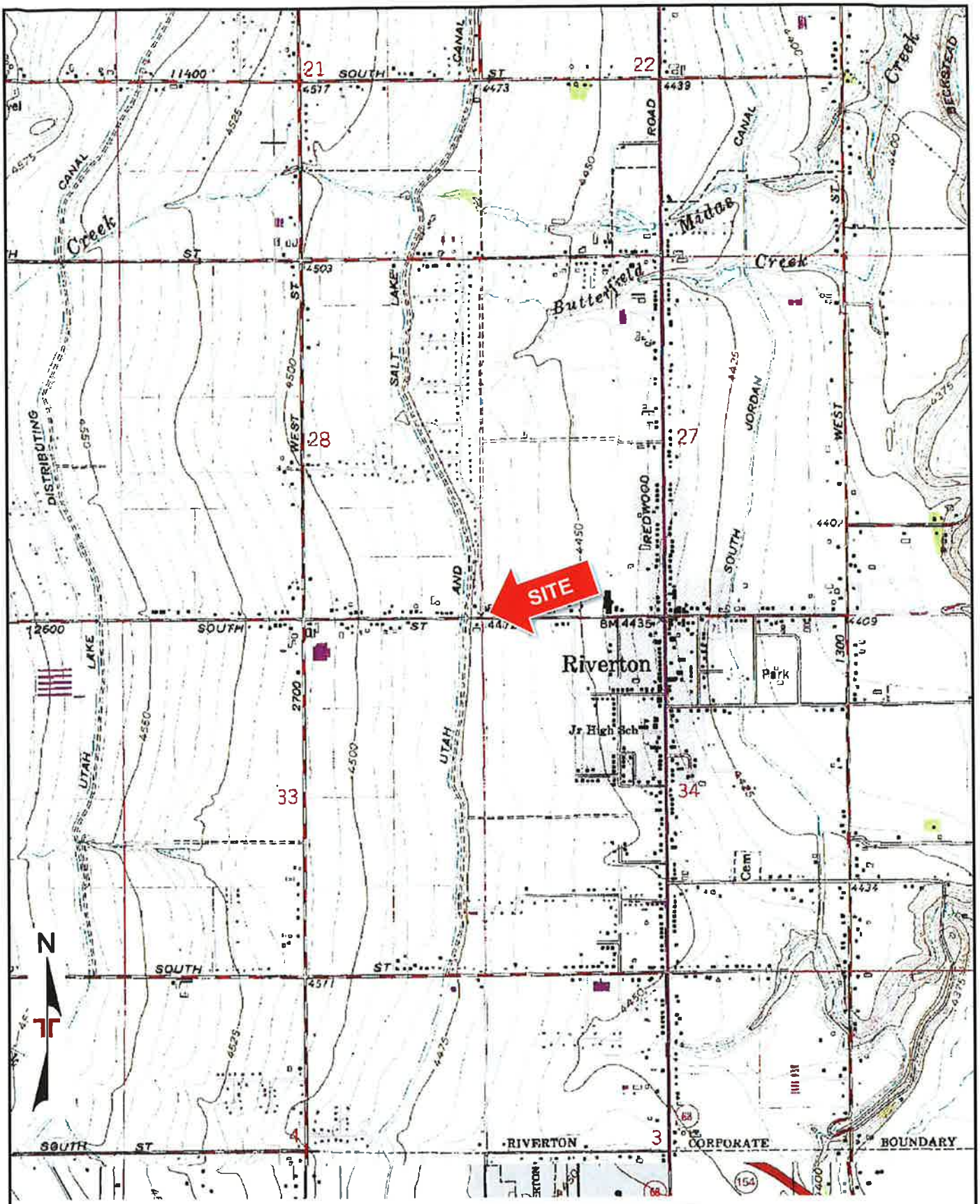
Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: MIDVALE, UT (1/1/1999) and JORDAN NARROWS, UT (1/1/1999).

Project Manager:	CVM
Drawn by:	CVM
Checked by:	RLC
Approved by:	RLC

Project No.	61165053
Scale:	1"=2,000'
File Name:	NA
Date:	5/16/2016

Terracon
6949 S High Tech Dr Ste 100
Midvale, UT 84047-3707

SITE LOCATION

Riverton AAP
2200 West 12600 South
Riverton, UT

Exhibit
A-1

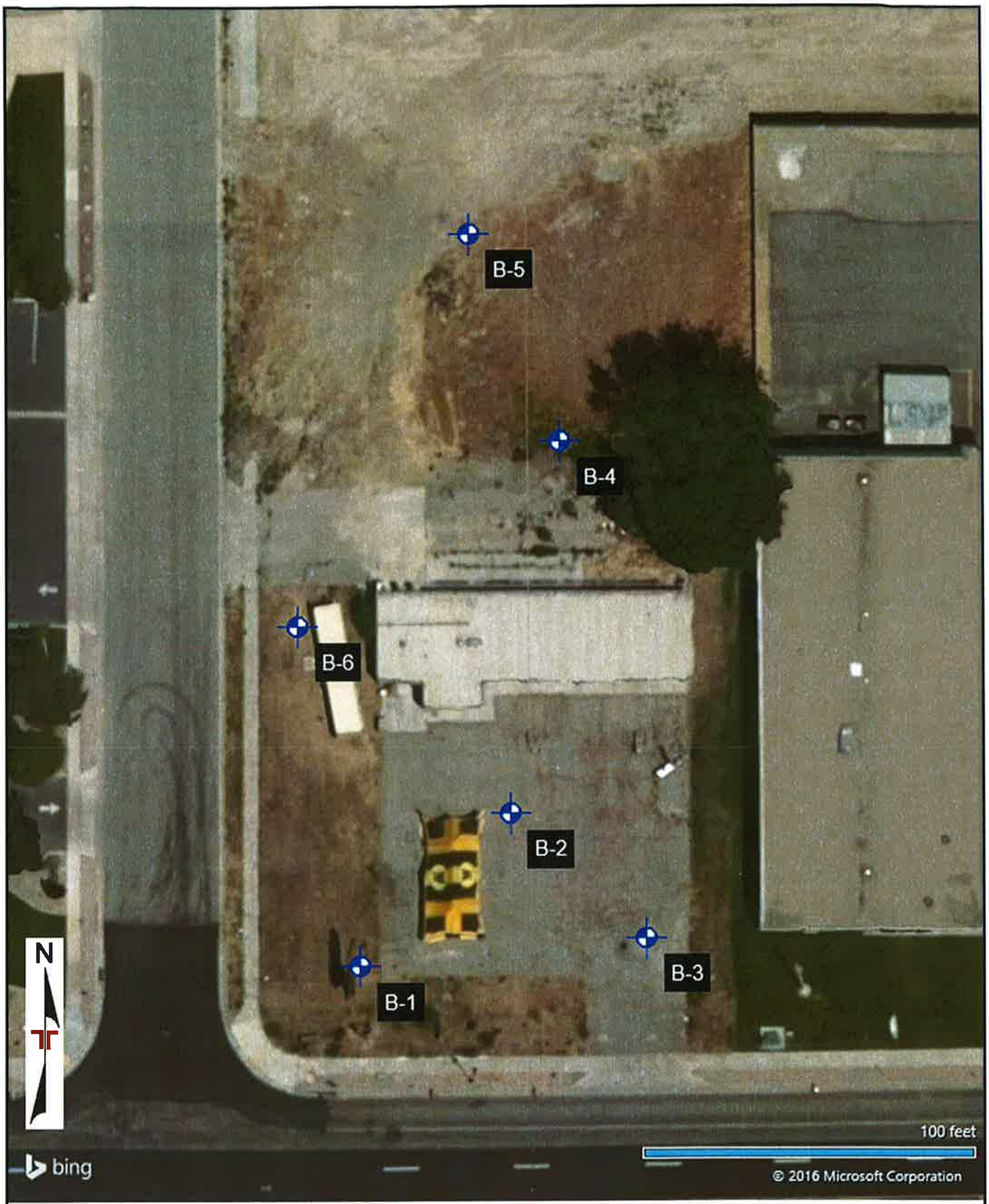


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

Project Manager: CVM	Project No. 61165053	Terracon 6949 S High Tech Dr Ste 100 Midvale, UT 84047-3707	EXPLORATION PLAN Riverton AAP 2200 West 12600 South Riverton, UT	Exhibit A-2
Drawn by: CVM	Scale: AS SHOWN			
Checked by: RLC	File Name: NA			
Approved by: RLC	Date: 5/16/2016			

Field Exploration Description

The boring locations were marked by Terracon personnel based on the supplied site drawings in relation to the existing site features. The locations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled with a truck-mounted rotary drill rig using continuous flight hollow-stem augers to advance the boreholes. Samples of the soil encountered in the borings were obtained using the split barrel sampling procedures.

In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils.

An automatic hammer was used to advance the split-barrel sampler in the borings performed on this site. A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value. The effect of the hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The soil samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings prior to the drill crew leaving the site.

A field log of each boring was prepared by the field engineer. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

BORING LOG NO. B-1

PROJECT: Riverton AAP

CLIENT: TKC Land Development II, LLC
Charlotte, NC

SITE: 2200 West 12300 South
Riverton, Utah

LOCATION See Exhibit A-2

Latitude: 40.522491° Longitude: -111.948121°

DEPTH	GRAPHIC LOG	DESCRIPTION	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), brown to gray, stiff								
				X	14	5-6-5 N=11	17		40-19-21	87
5				X	2	4-5-5 N=10				
7.5		**SANDY SILT (ML)**, grayish-brown to brown, stiff		X	14	5-5-6 N=11	8		NP	64
10.0		**SILTY SAND WITH GRAVEL (SM)**, brown, dense								
10				X	16	7-19-14 N=33				
12.5		**LEAN CLAY WITH SAND (CL)**, gray to brown, medium stiff		X	12	1-1-4 N=5	30		27-19-8	78
15.0		**SILTY SAND WITH GRAVEL (SM)**, brown, medium dense								
15				X	6	13-12-7 N=19				
16.5		***Boring Terminated at 16.5 Feet***								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
6949 S High Tech Dr Ste 100
Midvale, UT

Boring Started: 5/9/2016 Boring Completed: 5/9/2016

Drill Rig: Geoprobe Driller: DPS

Project No.: 61165053 Exhibit: A-4

BORING LOG NO. B-2

PROJECT: Riverton AAP

CLIENT: TKC Land Development II, LLC
Charlotte, NC

SITE: 2200 West 12300 South
Riverton, Utah

LOCATION See Exhibit A-2

Latitude: 40.522618° Longitude: -111.947957°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), brown, light brown, gray mottling, medium stiff									
					X	16	2-2-6 N=8				
			5								
					X	6	3-5-8 N=13	23			
7.5											
		SANDY SILT (ML), gray, brown and yellowish-brown, medium stiff			X	15	2-2-3 N=5	27		27-19-8	76
			10								
					X	14	5-5-7 N=12				
12.5											
		SILTY SAND WITH GRAVEL (SM), gray, dense to very dense			X	14	20-28-25 N=53	5			
			15								
					X	14	6-19-28 N=47	8			
16.5											
		Boring Terminated at 16.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
6949 S High Tech Dr Ste 100
Midvale, UT

Boring Started: 5/9/2016 | Boring Completed: 5/9/2016

Drill Rig: Geoprobe | Driller: DPS

Project No.: 61165053 | Exhibit: A-5

BORING LOG NO. B-3

PROJECT: Riverton AAP

CLIENT: TKC Land Development II, LLC
Charlotte, NC

SITE: 2200 West 12300 South
Riverton, Utah

LOCATION See Exhibit A-2

Latitude: 40.522514° Longitude: -111.94781°

DEPTH	GRAPHIC LOG	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			X	0	2-3-5 N=8				
5			X	18	2-4-5 N=9	23		44-21-23	93
			X	16	1-2-3 N=5				
10			X	14	3-3-4 N=7	22		NP	70
			X	18	3-13-15 N=28				
15			X	12	9-24-16 N=40	4			

LEAN CLAY (CL), grayish-brown to light brown, medium stiff

9.5

SANDY SILT (ML), brown, light brown, reddish-brown, and grayish-brown motlling, medium stiff to stiff

13.0

SILTY SAND WITH GRAVEL (SM), brown, medium dense to dense

-gravel becomes fine grained

16.5

Boring Terminated at 16.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
6949 S High Tech Dr Ste 100
Midvale, UT

Boring Started: 5/9/2016 Boring Completed: 5/9/2016

Drill Rig: Geoprobe Driller: DPS

Project No.: 61165053 Exhibit: A-6

BORING LOG NO. B-4

PROJECT: Riverton AAP

CLIENT: TKC Land Development II, LLC
Charlotte, NC

SITE: 2200 West 12300 South
Riverton, Utah

LOCATION See Exhibit A-2

Latitude: 40.522927° Longitude: -111.947901°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY WITH SAND (CL), brown to light brown, medium stiff to stiff								37-18-19	83
					14	2-5-5 N=10				
		5			14	3-4-3 N=7	29			
	6.5									
	Boring Terminated at 6.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
6949 S High Tech Dr Ste 100
Midvale, UT

Boring Started: 5/9/2016 | Boring Completed: 5/9/2016

Drill Rig: Geoprobe | Driller: DPS

Project No.: 61165053 | Exhibit: A-7

BORING LOG NO. B-5

PROJECT: Riverton AAP

CLIENT: TKC Land Development II, LLC
Charlotte, NC

SITE: 2200 West 12300 South
Riverton, Utah

LOCATION See Exhibit A-2

Latitude: 40.523099° Longitude: -111.947999°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), brown, gray and , and dark brown mottling, medium stiff				12	2-5-3 N=8	16		27-18-9	50
					0	2-5-5 N=10				
	Boring Terminated at 5 Feet	5								
	6.5									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
6949 S High Tech Dr Ste 100
Midvale, UT

Boring Started: 5/9/2016 | Boring Completed: 5/9/2016

Drill Rig: Geoprobe | Driller: DPS

Project No.: 61165053 | Exhibit: A-8

BORING LOG NO. B-6

PROJECT: Riverton AAP

CLIENT: TKC Land Development II, LLC
Charlotte, NC

SITE: 2200 West 12300 South
Riverton, Utah

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LOCATION See Exhibit A-2 Latitude: 40.522773° Longitude: -111.948188°									
	LEAN CLAY (CL), brown, light brown, and dark brown mottling, stiff to very stiff									
				X	16	4-10-7 N=17	16			
		5								
				X	2	3-6-7 N=13				
	6.5									
	Boring Terminated at 6.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
6949 S High Tech Dr Ste 100
Midvale, UT

Boring Started: 5/9/2016 | Boring Completed: 5/9/2016

Drill Rig: Geoprobe | Driller: DPS

Project No.: 61165053 | Exhibit: A-9

Laboratory Testing

As part of the testing program, all samples were examined in the laboratory by experienced personnel and classified in accordance with the attached General Notes and the Unified Soil Classification System based on the texture and plasticity of the soils. The group symbol for the Unified Soil Classification System is shown in the appropriate column on the boring logs and a brief description of the classification system is included with this report in the Appendix.

At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

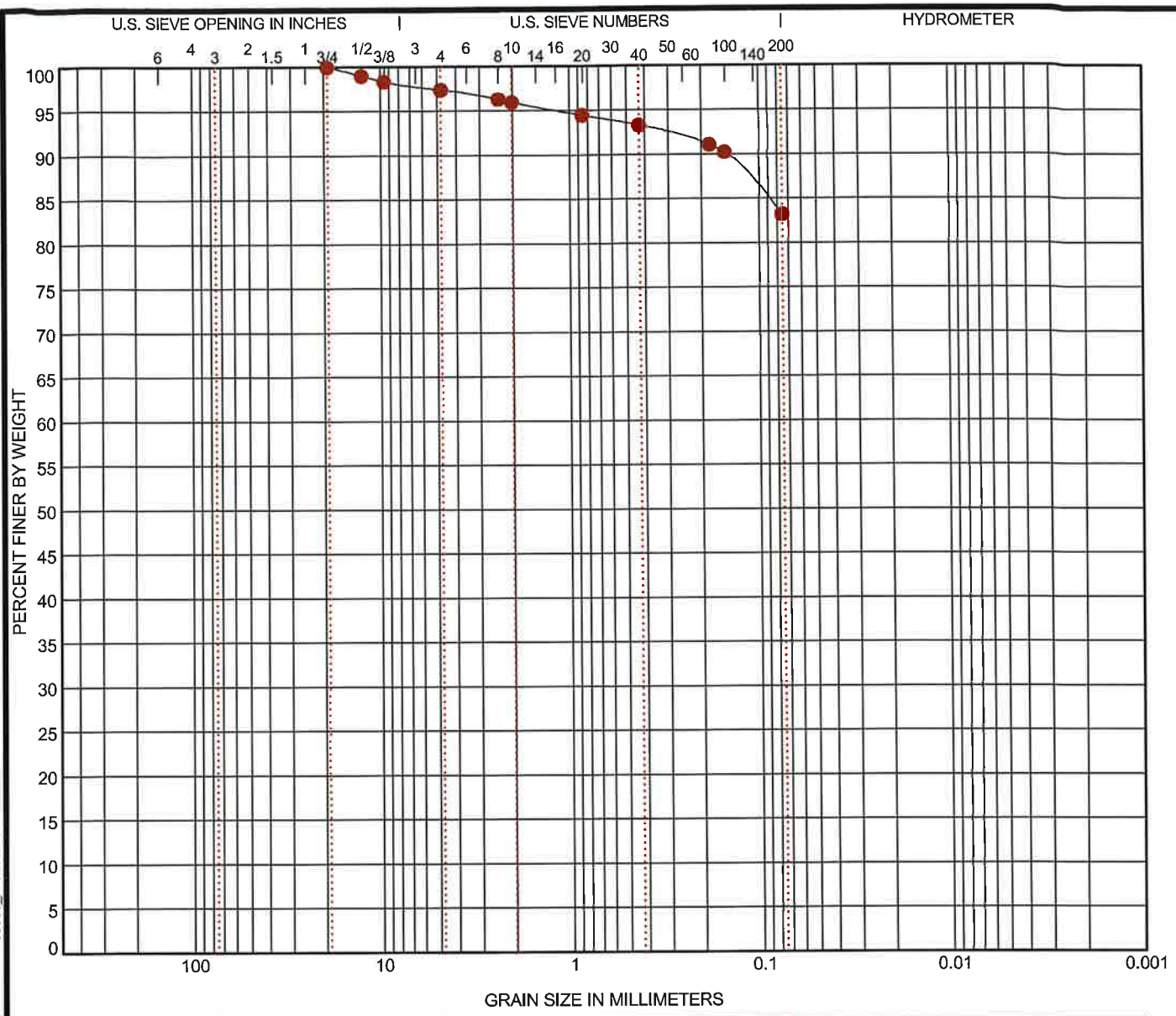
Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- Atterberg Limits
- Grain Size Analysis
- Resistivity
- pH
- In-situ Water Content
- Minus 200
- Sulfate

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
B-4	0 - 5	LEAN CLAY with SAND (CL)	37	18	19		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Fines
B-4	0 - 5	19				2.6	14.2	83.2

PROJECT: Riverton AAP

SITE: 2200 West 12300 South
Riverton, Utah

Terracon
6949 S High Tech Dr Ste 100
Midvale, UT

PROJECT NUMBER: 61165053

CLIENT: TKC Land Development II, LLC
Charlotte, NC

EXHIBIT: B-1

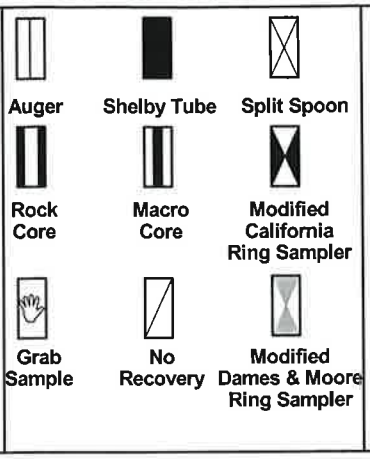
LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 61165053_RIVERTON AAP.GPJ 35159097 - ATTERBERG ISSUE.GPJ 5/16/16

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING



WATER LEVEL

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
N	N value
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

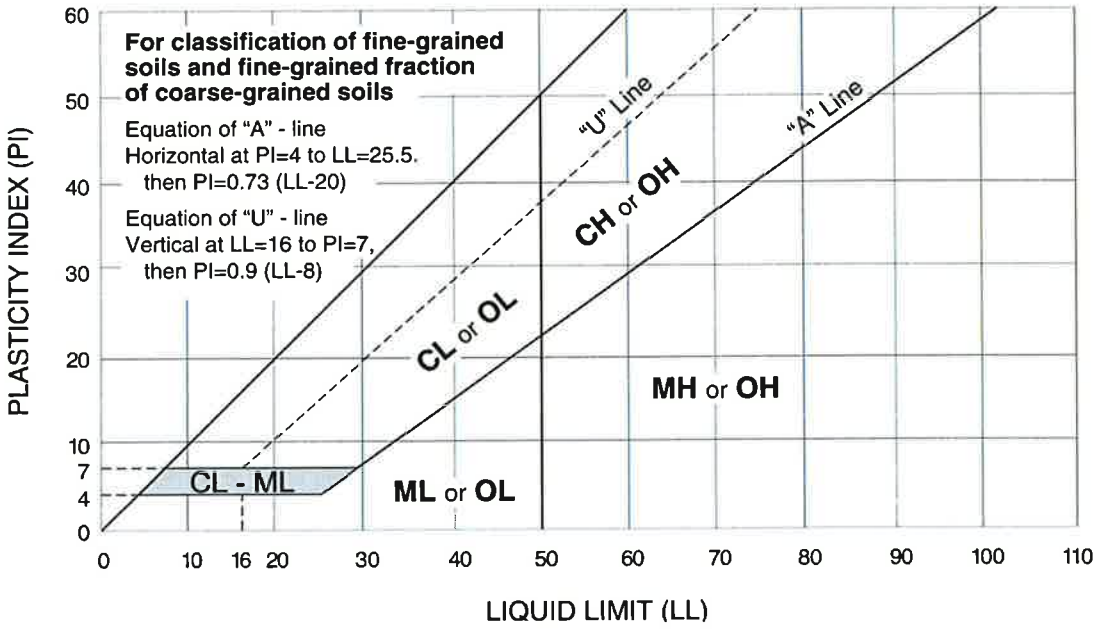
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon