Geotechnical Engineering Report

Candlewood Hotel
Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado
July 10, 2015
Terracon Project Number: B8155021

Prepared for:
Quest Construction, LLC
Aberdeen, South Dakota

Prepared by:
Terracon Consultants, Inc.
Colorado Springs, Colorado

Terracon

July 10, 2015

Quest Construction, LLC
2301 8th Ave NE, Suite 120
Aberdeen, South Dakota 57401

Attn: Mr. John J. Kokales

Re: Geotechnical Engineering Report
Candlewood Hotel
Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado
Terracon Project Number: B8155021

Terracon Consultants, Inc. (Terracon) has performed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our Proposal No. D2315121, dated May 13, 2015. This report presents the findings 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.

COLORADO REGISTERED
RYAN W. FEIST
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EXECUTIVE SUMMARY

A Geotechnical Engineering Report has been prepared for the proposed Candlewood Hotel, located at Eagleridge Boulevard and Dillon Drive in Pueblo, Colorado. Nine borings were advanced to depths of about 5 to 39½ feet below the existing ground surface within the general vicinity of the proposed building and pavement areas. The following geotechnical considerations were identified:

- Approximately 6 to 15 feet of fill materials comprised of clayey sand and sandy lean clay was encountered at this site. It is not known whether this material was placed under the direction and observation of a geotechnical engineer. Based on our field exploration, experience with the adjacent site to the south, and laboratory testing, it is our opinion that the existing fill materials are generally not considered suitable for support of foundations, slabs, and pavements.

- Based on the encountered subsurface conditions, we recommend proposed improvements be supported on deep foundations. If the owner is willing to accept an increased risk of movement, shallow reinforced concrete foundations bearing on newly placed, compacted fill with removal of the underlying fill materials may be considered.

- We also recommend at least partial removal of fill materials within pavement areas and replacement as compacted fill.

- Based on results of remolded swell test results, on-site soils are considered suitable for reuse at depths greater than 2 feet from foundations, at depths greater than 3 feet from slabs, and at depths greater than 12 inches from pavement subgrade.

- The 2012 International Building Code, Table 1613.5.2 IBC seismic site classification for this site is D.

- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to monitor this portion of the work.

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
CANDLEWOOD HOTEL
EAGLERIDGE BOULEVARD AND DILLON DRIVE
PUEBLO, COLORADO

Project No. B8155021
July 10, 2015

1.0 INTRODUCTION

A Geotechnical Engineering Report has been prepared for the proposed Candlewood Hotel, located at Eagleridge Boulevard and Dillon Drive in Colorado Springs, Colorado. Nine borings were advanced to depths of approximately 5 to 39½ feet below the existing ground surface within the general vicinity of the proposed building and pavement areas. Boring Logs along with an Exploration Plan are included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil and bedrock conditions
- groundwater conditions
- foundation design and construction
- pavement thickness design and construction
- floor slab design and construction
- earthwork
- drainage

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site layout	See Appendix A, Exploration Plan
Proposed construction	Construction is anticipated to consist of a 4-story, slab-on-grade, 81 unit hotel, occupying a footprint on the order of 13,000 square feet. Parking areas and drive lanes (119 parking stalls) will be constructed around the proposed building. A trash enclosure is proposed near the southeast corner of the property.
Building construction	Assumed to be wood frame construction supported on either, shallow, reinforced concrete foundations or a deep foundation system, such as drilled piers.

ITEM	DESCRIPTION
Maximum loads (reported)	Columns: 125 kips Walls: 5 kips per lineal foot
Grading	Cuts and fills up to 4 feet are assumed to achieve finished grades
Cut and fill slopes	Anticipated to be flatter than 4H:1V with maximum heights up to 4 feet.
Free-standing retaining walls	None anticipated
Below grade areas	None anticipated
Pavement Traffic Equivalent Single-Axel Loads (ESALs)	Pavement ESALs were not available at the time of our report preparation. We've assumed the following design parameters based on experience with similar projects: Standard Duty: 36,500 ESALs over a 20 year design period Heavy Duty: 110,000 ESALs over a 20 year design period

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The project site is located at Eagleridge Boulevard and Dillon Drive in Pueblo, Colorado.
Existing improvements	The site had been mass graded in the past. An existing sewer line is oriented in a north-to-south direction about 40 to 50 feet east of the proposed building. This same sewer line is about 20 feet east of the Holiday Inn Express and appears to be a potential source for the previous parking lot settlement and movement of the existing building. A landfill is located to the east of the proposed building and the existing Holiday Inn Express. A methane mitigation system was installed along the east property line of the Holiday Inn. The site was bordered to the north by relatively undeveloped land similar in appearance to the subject site, to the south by the existing Holiday Inn Express, and to the west by Dillon Drive.
Current ground cover	Unpaved areas with a sparse to moderate growth of native grasses and weeds.
Existing topography	Ground surface sloped downward to the south.

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:

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency/Density
Stratum 1	5 to 15 feet	Fill materials comprised of sand with varying amounts of clay and clay with varying amounts of sand	Sand: Loose to medium stiff Clay: Medium stiff to very stiff
Stratum 2	5 to 36 feet (Borings B-1 to B-4, B-8)	Weathered claystone bedrock	Firm to medium hard
Stratum 3	39½ feet (Borings B-1 and B-4)	Claystone bedrock	Very hard

Conditions encountered at the boring location are indicated on the attached boring log. Stratification boundaries on the boring log represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Further details of the boring can be found on the boring log in Appendix A of this report.

Laboratory test results indicate that the fill soils exhibit low compression at in-situ water contents. When elevated in water content, these soils exhibit moderate to high compression at increased loading.

The following table lists the results of laboratory compaction testing performed on bulk samples of materials collected from Boring B-1 from 1 to 10 feet below the ground surface. Testing was performed in general accordance with ASTM D698.

Laboratory Compaction Characteristics Test Results

Maximum Laboratory Dry Density (pcf)	Optimum Water Content (%)
121.6	10.7

Bulk samples collected from Boring B-1 from 1 to 10 feet below the ground surface were remolded to about 95 percent of the referenced maximum dry density at optimum water content. The samples were then inundated with water while at a surcharge pressure of 200 and 500 psf. The results are shown below:

Remolded Swell Test Results

Surcharge Pressure	Remolded Swell/Consolidation at Optimum (+/-) (%)	
200 psf	+0.8	+1.5
500 psf	+0.8	+1.0

3.2 Groundwater

Groundwater was observed within Boring B-1 at a depth of 38 feet below the ground surface. Groundwater was not observed in the remaining borings. These observations represent groundwater conditions at the time of the field exploration, and may not be indicative of other times, or at other locations. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Based on the results of our field investigation, laboratory testing program and geotechnical analyses, development of the site is considered feasible from a geotechnical viewpoint provided that the conclusions and considerations provided herein are incorporated into the design and construction of the project.

Approximately 6 to 15 feet of fill materials comprised of clayey sand and sandy lean clay was encountered at this site. Support of foundations, slabs, and pavements on or above existing fill soils is discussed in this report. However, even with the recommended construction testing services, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk cannot be eliminated without completely removing the existing fill, but can be minimized by thorough exploration and testing.

In general, it is common practice of the industry to compact backfill to a minimum of 95 percent of the materials maximum laboratory dry density in general accordance with ASTM D698. In-situ densities of the fill material obtained during our geotechnical exploration range between 97 to 114 pounds per cubic foot (pcf), with an average around 105 pcf. When compared to the maximum laboratory dry density obtained from a bulk sample of fill materials at Boring B-6 between 1 and 10 feet below site grade, the materials appear to have been compacted to approximately 83 to 97 percent, with an average of around 90 percent. Water contents ranged from at optimum to one to four percent below optimum water content.

Based on the results of the subsurface exploration, laboratory testing, and our experience with the Holiday Inn site to the south, it is our opinion that the fill material was not placed with compactive effort and moisture conditioning that is standard for the industry.

We evaluated several foundation alternatives with respect to the proposed building and the encountered subsurface conditions. For this project, we considered drilled pier and grade beams as well as shallow spread footings supported on newly placed compacted fill. Two of our borings (Borings B-1 and B-4) advanced within the northern and southern ends of the proposed building were extended to depths of 39½ feet in anticipation of a deep foundation system. Very hard bedrock suitable for end bearing piers varied from 36 feet deep on the northern portion of the site to 27 feet deep within the southern portion of the site. Two borings advanced within the central portion of the building extended to depths of approximately 30½ feet and did not encounter very hard bedrock suitable for end bearing piers. Based on a linear interpolation between the two borings, very hard bedrock suitable for end bearing piers may begin at average depths of approximately 32 to 33 feet below existing grade, but may be as deep as 36 feet. We recommend bottom of proposed drilled piers extend no deeper than within two pier diameters of the current maximum boring depths (39½ feet). We recommend supplemental exploration be performed if this criteria cannot be met.

If the owner is willing to accept an increased risk of movement, shallow reinforced concrete foundations bearing on newly placed, compacted fill with removal of the underlying fill materials may be considered. We also recommend removal of fill materials within pavement areas and replacement as compacted fill. If the owner is willing to accept an increased risk of movement beyond 1-inch in pavement areas, partial removal and replacement of fill materials may be considered. Partial removal should consist of a minimum of 4 feet of on-site fill materials, but a minimum of 1/3 of the total depth of fill materials.

Based on visual observations within manholes, the top of the existing sewer line appears to be approximately 20 to 25 feet deep. Based on our experience with pavement distress within the vicinity of the existing sewer at the existing Holiday Inn Express, we recommend a minimum of 15 feet of fill be removed and replaced within a minimum 20-foot zone around the sewer.

On-site soils are considered suitable for reuse at depths greater than 2 feet from foundations, at depths greater than 3 feet from slabs, and at depths greater than 12 inches from pavement subgrade.

Geotechnical engineering recommendations for foundation systems and other earth connected phases of the project are outlined herein. 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

4.2.1 Site Preparation

Prior to placing any new fill, existing fill materials, vegetation and any otherwise unsuitable material should be removed from the proposed floor slab, foundation, and pavement areas. The subgrade should also be proof-rolled where possible or probed with a metal T-probe to aid in locating loose, soft, or otherwise undesirable areas. Proof-rolling can be performed with a loaded tandem axle dump truck. Unacceptable soil should be removed or mitigated in place prior to placing fill.

Although evidence of underground facilities was not observed during the site reconnaissance, such features could be encountered during construction. If unexpected underground facilities are encountered, such features should be removed and the excavation benched to expose firm, approved materials prior to backfill placement and/or construction.

4.2.2 Material Types

Engineered fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
On-Site Soils	SC, CL	The on-site soils are considered suitable for reuse as compacted fill at depths greater than 2 feet beneath foundations, at depths greater than 3 feet beneath slabs, and at depths greater than 12 inches from pavement subgrade.
On-Site Bedrock	N/A	The on-site bedrock is not considered suitable for reuse as compacted fill within foundation, slab, and pavement areas. The on-site bedrock may be reused within non-structural areas provided it is processed to a soil-like consistency and material greater than 3 inches is removed.
Imported Soils	Varies	Imported soils meeting the gradation outlined herein can be considered acceptable for use as engineered fill beneath foundations and slabs.

1. Controlled, compacted 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.

Imported soils should conform to the following:

Gradation	Percent finer by weight (ASTM C136)
3"	100
No. 4 Sieve	50-100
No. 200 Sieve	35 (max)

- Liquid Limit.....35 (max)
- Plastic Index.....15 (max)
- Maximum Expansive Potential (%).....1.5*

*Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at optimum water content. The sample is confined under a 200 psf surcharge and submerged.

4.2.3 Compaction Requirements

ITEM	DESCRIPTION
Fill Lift Thickness	8-inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack, plate compactor) is used
Compaction Requirements [1]	95% of the materials maximum dry density (ASTM D698)
Water Content [2]	Within three percent of optimum water content for granular soil. At optimum to three percent above optimum water content for on-site clayey soils.

1. We recommend that engineered fill be tested for water content and compaction during placement. Should the results of the in-place density tests indicate the specified water or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified water and compaction requirements are achieved.
2. Specifically, water levels should be maintained low enough to allow for satisfactory compaction to be achieved without the compacted fill material pumping when proof rolled.

4.2.4 Grading and Drainage

All grades must be adjusted to provide positive drainage away from the structure during construction and maintained throughout the life of the proposed project. Infiltration of water into utility or foundation excavations must be prevented during construction. Landscaped irrigation adjacent to foundation systems should be minimized or eliminated. Water permitted to pond near or adjacent to the perimeter of the structures (either during or post-construction) can result in significantly higher soil movements than those discussed in this report. As a result, any estimations of potential movement described in this report cannot be relied upon if positive drainage is not obtained and maintained, and water is allowed to infiltrate the fill and/or subgrade.

Exposed ground should be sloped at a minimum of 10 percent grade for at least 10 feet beyond the perimeter of the building, where possible. Where possible, asphalt pavement or concrete flatwork should be sloped at a minimum of 2 percent beyond the building perimeter. Where ADA or other requirements or existing site features limit the gradient, slopes on the order of ½ to 1 percent minimum are considered acceptable. Backfill against footings, exterior walls and in utility line trenches should be well compacted and free of all construction debris to reduce the possibility of water infiltration. After building construction and prior to project completion, we recommend that verification of final grading be performed to document that positive drainage, as described above, has been achieved.

Where paving or flatwork abuts the structure, care should be taken that joints are properly sealed and maintained to prevent the infiltration of surface water. Consideration should be given to snow removal practices that will minimize the stockpiling of snow adjacent to structural improvements.

Roof drains should discharge on pavements or be extended away from the structure a minimum of 5 feet through the use of splash blocks or downspout extensions. A preferred alternative is to have the roof drains discharge to storm sewers by solid pipe or other appropriate outfall.

4.2.5 Construction Considerations

Although the exposed subgrade is anticipated to be relatively stable upon initial exposure, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. Should unstable subgrade conditions develop, stabilization measures will need to be employed. Options for subgrade stabilization can include removal of unsuitable material and replacement with approved fill material. An alternative can include the use of geogrid overlain by CDOT Class 5 or 6 aggregate base course. The depth of aggregate base course will depend on the severity of unstable soils.

Upon completion of filling and 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 re-compacted prior to floor slab and pavement construction.

As a minimum, all temporary 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.

4.3 Foundation Systems

4.3.1 Design Recommendations – Drilled Pier Foundations

Drilled pier foundations are also considered suitable for support of proposed improvements. For this project, we recommend the following:

DESCRIPTION	STRAIGHT SHAFT PIERS
Minimum pier diameter	18 inches
Minimum spacing between piers	3 pier diameters
Frost depth for grade beams	30 inches
Pier concrete slump (uncased piers)	5 to 7 inches
Pier concrete slump (cased piers)	7 to 9 inches
Approximate total movement [1]	1 inch

1. The foundation movement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the quality of the earthwork operations, and maintaining uniform soil water content throughout the life of the structure. The estimated movements are based on maintaining uniform soil water content during the life of the structure. Additional foundation movements could occur if water from any source infiltrates the foundation soils; therefore, proper drainage and irrigation practices should be incorporated into the design and operation of the facility. Failure to maintain soil water content and positive drainage will nullify the movement estimates provided above.

A summary of the drilled pier foundation design recommendations is shown below. The maximum end bearing pressures given in the table are based on the cross-sectional area of the tip of the drilled shaft. Skin friction (S_d) should be applied to the surface area of the drilled shaft for that given length interval below a depth of 36 inches. The combination of skin friction and end bearing pressure can be used to determine the vertical compression capacity. The skin friction value should be used to determine the uplift capacity of the soil. For lateral load and overturning design, we have included beam on elastic foundation spring constants, lateral equivalent earth pressures, and more commonly used LPILE parameters. For calculation of lateral deflection using the beam on elastic foundation method, a coefficient of subgrade reaction listed on the table may be used for the analysis. Lateral load design parameters are valid for maximum soil strain of 1 percent for the native soils and ½ percent for bedrock acting over a distance of one shaft diameter. The passive pressure, coefficient of horizontal subgrade reaction, and LPILE parameters are ultimate values; therefore, appropriate factors of safety should be applied in the pier design. All shafts should be reinforced full-depth for the applied axial, lateral and uplift stresses imposed.

DESCRIPTION	MATERIAL TYPE AND DEPTH, FEET		
	Fill Materials (Sand)	Weathered Bedrock	Unweathered Bedrock
Allowable Vertical Parameters:			
Bearing, psf	N/A	N/A	30,000 psf*
Skin friction, psf	N/A	265	3,000 psf
Ultimate Lateral Parameters			
Beam on Elastic Foundation:			
Passive, EFP,psf/ft	200	280	450
Soil Code	4 (Sand)	3 (Stiff clay without free water)	9 (Weak Rock)
Unit Weight above Groundwater (pci)	0.067	0.067	0.072
Undrained Shear Strength, Cu (psi)	N/A	7	100
Angle of internal Friction, ϕ (degrees)	15	---	---
Horizontal Modulus of Subgrade Reaction:			
k (static) pci	25	500	2,000
k (cyclic) pci	25	200	800
Strain at 50% of Maximum Stress, ε_{50}	N/A	0.004	0.004

* We recommend bottom of proposed drilled piers extend no deeper than within two pier diameters of the current maximum boring depths (39½ feet). We recommend supplemental exploration be performed if this criteria cannot be met.

The provided lateral parameter design values do not include a factor-of-safety, which should be applied. We recommend neglecting skin friction and lateral resistance for the upper 30 inches of drilled piers because of the effects of frost penetration.

Piers should be considered to work in group action if the horizontal spacing is less than 6 pier diameters. A minimum practical horizontal spacing between piers of at least 3 diameters should be maintained, and adjacent piers should bear at the same elevation. The capacity of individual piers must be reduced when considering the effects of group action. Capacity reduction is a function of pier spacing and the number of piers within a group. If group action analyses are necessary, capacity reduction factors can be provided for the analyses.

4.3.2 Drilled Pier Construction Considerations

Drilling to design depths should be possible with single-flight power augers equipped with rock teeth. Difficult drilling should be anticipated due to the presence of very hard bedrock. Casing, mud or slurry drilling, and other specialized installation techniques may be required to properly drill and clean piers prior to concrete placement. Pier concrete should be placed soon after completion of drilling and cleaning. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes.

A tremie or casing should be used for concrete placement. If casing is used for pier construction, it should be withdrawn in a slow, continuous manner maintaining a sufficient head of concrete to prevent infiltration of water or the creation of voids in pier concrete. Pier concrete should have a relatively high fluidity when placed in cased pier holes or through a tremie.

Free-fall concrete is not considered acceptable for placement in piers. The use of a bottom-dump hopper, or an elephant's trunk discharging near the bottom of the hole where concrete segregation will be minimized, is recommended. Shaft bearing surfaces must be free of loose materials prior to concrete placement.

4.3.3 Spread Footing Design Recommendations

If the owner is willing to accept an increased risk of excessive movement and possible foundation and wall cracks, spread footings bearing on a minimum of 9 feet of newly placed compacted fill can be considered for support of the proposed hotel. Existing fill should be completely removed prior to placement of newly compacted fill. We recommend a minimum separation of 9 feet between the top of claystone bedrock and the bottom of foundations. Additional over-excavation of approximately 2 to 3 feet may be necessary to remove the existing fill materials and provide enough separation between claystone bedrock and bottom of foundations.

We also recommend that fill materials be removed in the area of the proposed trash enclosure. If the owner is willing to accept an increased risk of movement beyond 1-inch, a minimum partial removal of 5 feet of fill materials below foundations is considered suitable. Additional recommendations are presented herein.

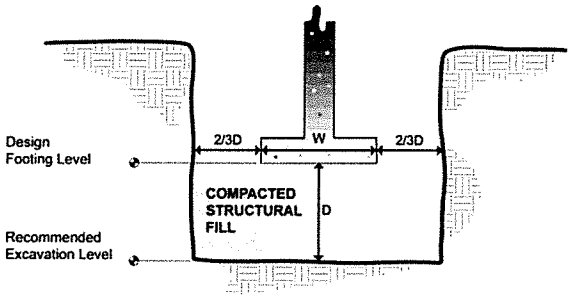
DESCRIPTION	Column	Wall
Net allowable bearing pressure [1]	3,000 psf	3,000 psf
Minimum deal load	1,000 psf	1,000 psf
Minimum dimensions	24 inches	16 inches
Minimum amount of compacted fill beneath footings	9 feet (hotel) 5 feet (trash enclosure)	9 feet (hotel) 5 feet (trash enclosure)
Minimum embedment below finished grade for frost protection [2]	30 inches	30 inches
Approximate total movement [3]	1 inch	1 inch
Estimated differential movement [3]	½ to ¾ of total between columns	½ to ¾ of total over 40 feet

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes fill or unsuitable soils, if encountered, will be undercut and replaced with engineered fill.
2. For exterior foundations beneath continuously heated structures, depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure. The minimum depth for interior footings in continuously heated structures is 12 inches below finished grade.

3. The foundation movement 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, the quality of the earthwork operations, and maintaining uniform soil water content throughout the life of the structure. The estimated movements are based on maintaining uniform soil water content during the life of the structure. Additional foundation movements could occur if water from any source infiltrates the foundation soils; therefore, proper drainage and irrigation practices should be incorporated into the design and operation of the facility. Failure to maintain soil water content and positive drainage will nullify the movement estimates provided above.

4.3.4 Construction Considerations

The base of all foundation excavations should be free of water and loose soil and rock prior to placing concrete. If unsuitable soils are encountered at the base of the over-excavation, supplemental recommendations will be required, such as additional removal and replacement. Over-excavation for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation.



Overexcavation / Backfill
NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

Fill should be placed in lifts of 8 inches or less in loose thickness and compacted to at least 95 percent of the material's maximum dry density (ASTM D698). Compactive effort should be in accordance with recommendations provided in the **EARTHWORK** section of this report. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed or saturated, or frozen, the affected soil should be removed prior to placing concrete. It is recommended that a construction testing laboratory be retained to observe and test the soil foundation bearing materials.

4.4 Seismic Considerations

Code Used	Site Classification
2012 International Building Code (IBC) [1]	D[2]
Mapped Spectral Acceleration for Short Periods, S_s [2]	0.168
Mapped Spectral Acceleration for a 1-second period, S_1 [2]	0.061

1. In general accordance with the *2012 International Building Code,* Table 1613.5.2. The 2012 International Building Code (IBC) requires a site soil profile determination extending a depth of 100 feet for seismic site classification. The current scope requested does not include the required 100

foot soil profile determination as borings for this project extended to a maximum depth of approximately 39½ feet. Additional exploration to deeper depths could be performed to confirm the conditions below the current depth of exploration. Alternatively, a geophysical exploration could be utilized in order to attempt to justify a higher seismic site class.

2. USGS Seismic Hazard Curves, Response Parameters and Design Parameters

4.5 Floor Slab

4.5.1 Design Recommendations

ITEM	DESCRIPTION
Floor slab support[1]	■ Based on the observed subsurface conditions, we recommend the use of structural floor systems, structurally supported independent of the subgrade soils. A minimum clearance of 24 inches should be provided between the bottom of structural supports and the subgrade soils. ■ If the owner is willing to accept an increased risk of excessive movement, floor slabs bearing on a minimum of 9 feet of compacted fill is considered suitable. Existing fill materials should be removed and replaced prior to construction. This will likely require additional over-excavation on the order of 3 to 4 feet in some areas of the hotel to remove the existing fill materials

1. We recommend subgrade be maintained in a relatively moist condition until the floor slab is constructed. If the subgrade should become desiccated prior to construction, the affected material should be removed or the materials scarified, moistened, and re-compacted. Upon completion of grading operations in the building area, care should be taken to maintain the recommended subgrade moisture content and density prior to construction of the building floor slab.

Where appropriate, saw-cut control joints should be placed in the slab to help control the location and extent of cracking. The use of a vapor retarder should be used directly beneath concrete slabs on grade that will be covered with wood, tile, carpet 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.

4.5.2 Construction Considerations

We recommend subgrades be maintained at the proper moisture condition until floor slabs and are constructed. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier, areas where backfilled trenches are located, as well as the backfill zone adjacent to the existing structure. 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.

4.6 Swimming Pool Design and Construction

On-site claystone bedrock should not be used for support of the swimming pool or associated pool decking. We recommend the existing fill materials be removed and replaced as compacted fill prior to swimming pool construction. We recommend a minimum of 4 feet of compacted fill for support of the proposed swimming pool and pool decking.

Consideration should be given to the use of reinforced gunnite concrete for pool construction. Due to potentially expansive claystone bedrock, care should be taken during construction to waterproof the pool so that leakage will not occur.

A drainage system should be provided around and beneath the pool. The drain should consist of a minimum 12 inch layer of gravel (minimum 3/4-inch size, less than 5 percent fines passing the No. 200 sieve) beneath, and along the sides of the pool. The top of the drain layer should be sealed with 18-inches of relatively impermeable soil at the surface. The gravel layer beneath the pool should be sloped so that it will drain into tiles or perforated drain pipe. The layout of the perforated pipe should include at least one pipe running down the center of the pool lengthwise. Cross-connecting pipes, spanning with the pool, should be placed at six-foot centers. The cross-connecting pipes should be joined to the center pipe with solid "tees" or "cross" connections. The center pipes should be sloped to a positive gravity outlet or sloped to a sump located in the equipment room, permitting pump discharge.

The bottom of the excavation beneath the gravel layer and the pipe should be lined with an impervious membrane (polyethylene film or equal) in order to reduce potential water fluctuations in the subgrade soils. Pressure relief valves should be provided in the base of the pool to prevent excessive uplift pressures from developing in the event of failure of the drain system. To reduce the potential for damage, we recommend:

- deck slabs be supported on fill with no or low expansion potential
- strict moisture-density control during placement of subgrade fills
- placement of effective control joints on relatively close centers and isolation joints between slabs and other structural elements
- provision for positive drainage in areas adjoining the slabs
- use of designs which allow vertical movement between the deck slabs and adjoining structural elements

Fill and backfill in the area of the pool should be placed in accordance with the recommendations in the "Earthwork" section of this report. Grading should be provided for diversion of deck surface runoff away from the pool area. Water should not be allowed to pond around the slab perimeter.

4.7 Pavements

4.7.1 Subgrade Preparation

We recommend removal of fill materials within pavement areas and replacement as compacted fill. If the owner is willing to accept an increased risk of movement beyond 1-inch in pavement areas, partial removal and replacement of fill materials may be considered. Partial removal should consist of a minimum of 4 feet of on-site fill materials, but a minimum of 1/3 of the total depth of fill materials.

Based on visual observations within manholes, the top of the existing sewer line appears to be approximately 20 to 25 feet deep. Based on our experience with pavement distress within the vicinity of the existing sewer at the existing Holiday Inn Express, we recommend a minimum of 15 feet of fill be removed and replaced within a minimum 20-foot zone around the sewer.

Prior to placing any fill, the subgrade should be proof-rolled to aid in locating loose, soft, or otherwise undesirable areas. Proof-rolling can be performed with a loaded tandem axle dump truck. Stabilization measures will need to be employed should the proofroll encounter unstable subgrade conditions. Options for subgrade stabilization can include removal of unsuitable material and replacement with approved fill material.

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 materials with properly compacted fills. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to paving. The subgrade should be in its finished form at the time of the final review.

4.7.2 Design Considerations

Design of pavements for the project has been based on the procedures outlined in the National Asphalt Pavement Association (NAPA) Information Series 109 (IS-109). Equivalent single-axle loads (ESALs) were not provided at the time of report preparation. We have based our pavement thickness design based on the following assumed ESALs of 36,500 and 110,000 for the proposed Light Duty and Heavy Duty pavement areas, respectively, over a 20-year design life.

We have based our pavement thickness design by interpolation between the NAPA design traffic classes presented below:

- **Traffic Class II** – Traffic consisting of autos, home delivery trucks, trash pickup, occasional moving vans, and ESAL's up to 27,000.

- **Traffic Class III** – Up to 10 single-unit or 3-axle semi-trailer trucks per day or equivalents: average gross vehicle weight should be less than the legal limit. Considered for ESAL's up to 110,000.

Traffic classifications and/or design ESAL's should be reviewed and approved by the owner prior to commencement of pavement operations. In addition to the flexible pavement design analyses, a rigid pavement design analysis was completed, based upon American Concrete Institute (ACI) 330R-01; Guide for Design and Construction of Concrete Parking Lots. A modulus of rupture of 600 psi was used for pavement concrete.

We recommend that pavements be supported on at least 12 inches of imported soils compacted as outlined in the "Earthwork" section of this report. Where claystone bedrock is within 2 feet of final pavement elevation, we recommend pavements be supported on at least 2 feet of compacted fill. As a minimum, we suggest the following pavement sections be considered:

Traffic Classification	Alternative	Asphalt Concrete (in.)	Portland Cement Concrete (in.)	Base Course (in.)	Compacted imported soils (in.)
Light Duty	A	4	---	4	12 inches (2 feet where claystone is within 2 feet of pavement subgrade)
	B	---	5	---	
Heavy Duty	A	4	---	8	
	B	---	6	---	

Each alternative should be investigated with respect to current material availability and economic conditions. A minimum of 7 inches of rigid concrete pavement is recommended at the location of dumpsters where trash trucks park and load.

4.7.3 Construction Considerations

Asphalt concrete should be composed of a mixture of aggregate, filler and additives, if required, and approved bituminous material. The asphalt concrete should conform to approved mix designs stating the Hveem properties, optimum asphalt content, job mix formula and recommended mixing and placing temperatures and designed to a minimum 50 gyrations as determined by CDOT Superpave. Aggregate used in plant-mixed asphalt concrete should meet Colorado Department of Transportation Grading S or SX specifications. Mix designs should be submitted prior to construction to verify their adequacy. Asphalt material should be placed in maximum 3-inch lifts

and should be compacted to a minimum of 92 to 96 percent of the maximum theoretical density as determined by CP 51.

Where rigid pavements are used, the concrete should be based on an approved CDOT mix design.

Sealing of construction joints is essential to protect the subgrade and promote long term performance of concrete pavement. Joints should be sealed with a sealant designed especially for pavements subject to truck and car traffic. The joints should be sealed as soon as possible (in accordance with sealant manufacturers instructions) to minimize infiltration of water into the soil.

The performance of all pavements can be enhanced by reducing excess water, which can reach the subgrade soils. The following recommendations should be considered at minimum:

- Site grading at a minimum 2 percent grade away from the pavements;
- Compaction of any utility trenches for landscaped areas to the same criteria as the pavement subgrade;
- Install drainage surrounding areas anticipated for snow management and snow banks;
- Snow management plans should be developed designating areas outside pavement and planter areas for stockpiling of snow;
- Sealing or providing area drains and curb cuts in all landscaped areas in, or adjacent to pavements to reduce or prevent water migration to subgrade soils;
- Placing compacted backfill against the exterior side of curb and gutter; and,
- Placing curb, gutter and/or sidewalk directly on subgrade soils without the use of base course materials.

Preventative maintenance should be planned and provided for through an on-going pavement management program in order to enhance future pavement performance. Preventative maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment.

Preventive maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

Recommended preventative maintenance policies for asphalt concrete pavements, based upon type and severity of distress, can be provided. Prior to implementing any maintenance additional engineering observation is recommended to determine the type and extent of preventative maintenance.

4.8 Exterior Slabs

Exterior slabs should be supported on a minimum of 12 inches of water conditioned and compacted fill meeting the requirements presented in Section 4.2.2 of this report. Exterior slabs-on-grade, exterior architectural features, and utilities founded in backfill may experience some movement due to the volume change of the material. Additional recommendations to reduce potential movement are as follows:

- minimizing moisture increases in the backfill
- controlling moisture-density during placement of backfill
- using designs which allow vertical movement between the exterior features and adjoining structural elements
- placing effective control joints on relatively close centers

4.9 Corrosion Considerations

The table below lists the results of laboratory soluble sulfate, soluble chloride, electrical resistivity, and pH testing. These values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Boring	Sample Depth	Soluble Sulfate (Percent)	Soluble Chloride (Percent)	Electrical Resistivity (ohm.cm)	pH
B-1	1-10 feet	1.215	0.0003	837	7.7

Results of soluble sulfate testing indicate that samples of the on-site soils tested possess severe sulfate concentrations when classified in accordance with Table 4.3.1 of the ACI Design Manual. We recommend the use of sulfate resistant concrete at this site. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4. To improve sulfate resistance of concrete in severe sulfate exposure when Type V cement is not available, the following should be considered:

- We recommend the use of Type I-II modified cement for sulfate resistance
- Cement should have a tricalcium aluminate content of not more than 8 percent.
- Concrete mixture should contain at least 20 percent Class F fly ash.
- Provide air-entrainment of 4 to 7 percent by volume.
- Lower the water to cement ratio to 0.4 to 0.45.

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.

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

NOTE: AERIAL SITE IMAGE OBTAINED FROM GOOGLE EARTH ON JUNE 15, 2015, USED AS BASE DRAWING.

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

Project Mngr.	RWF
Drawn By:	RMH
Checked By:	RWF
Approved By:	RWF

Project No.	B8155021
Scale:	NOT TO SCALE
File No.	Fig1-SVM
Date:	06-15-2015

Terracon
Consulting Engineers and Scientists
4172 Center Park Drive Colorado Springs, Colorado 80916
PH. (719) 597-2116 FAX. (719) 597-2117

SITE VICINITY MAP

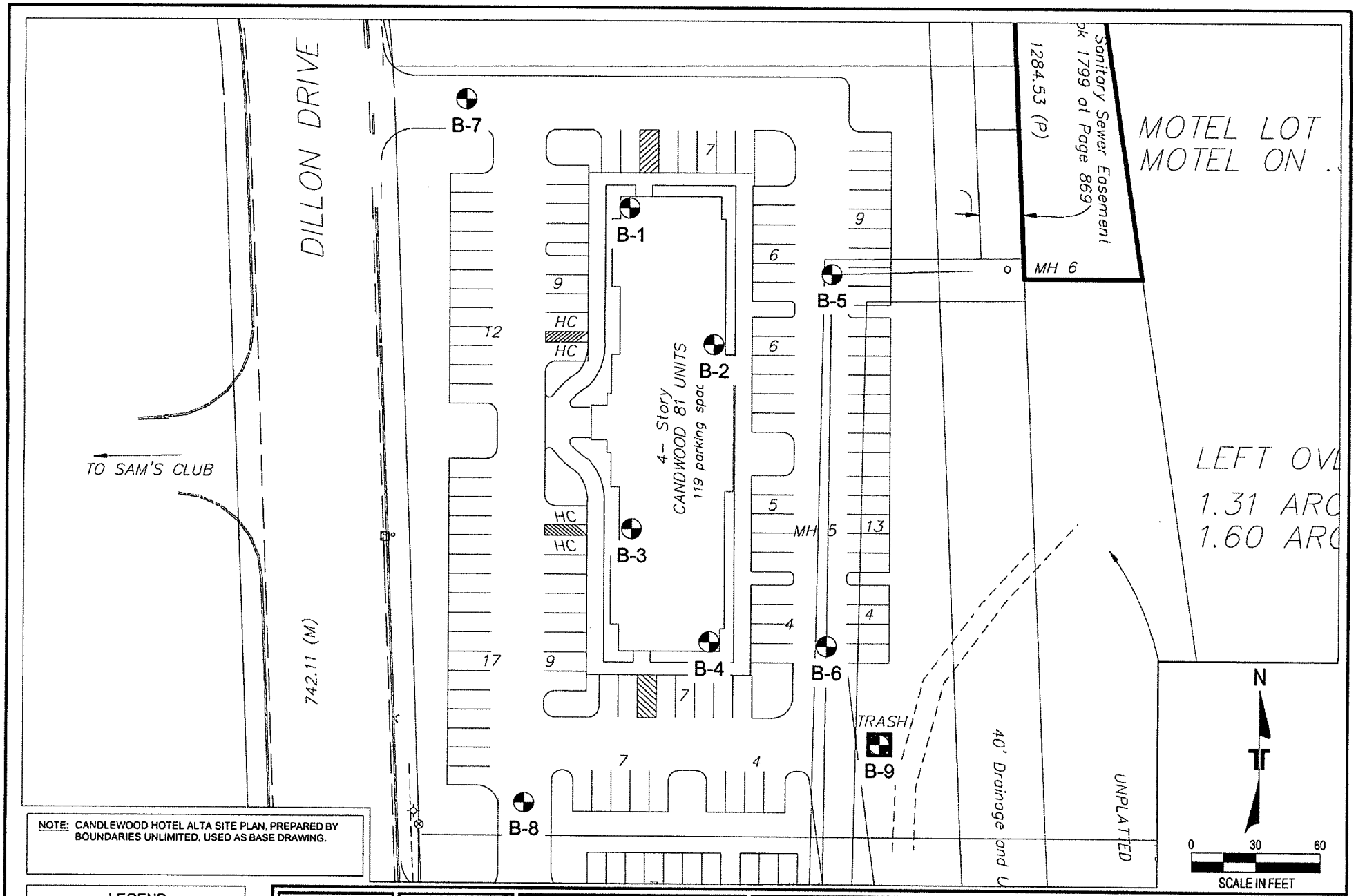
Quest Construction, LLC

CANDLEWOOD HOTEL

SOUTHEAST OF EAGLERIDGE BOULEVARD AND DILLON DRIVE

PUEBLO COLORADO

Ex. No. A-1



NOTE: CANDLEWOOD HOTEL ALTA SITE PLAN, PREPARED BY BOUNDARIES UNLIMITED, USED AS BASE DRAWING.

LEGEND

B-1 — APPROXIMATE LOCATION OF TEST BORING

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

Project Mngr:	RWF
Drawn By:	RMH
Checked By	RWF
Approved By	RWF

Project No.	B8155021
Scale:	AS SHOWN
File No.	Fig1-EXP
Date	06-15-2015

Terracon
Consulting Engineers and Scientists
4172 Center Park Drive Colorado Springs, Colorado 80916
PH. (719) 597-2116 FAX. (719) 597-2117

EXPLORATION PLAN

Quest Construction

CANDLEWOOD HOTEL

SOUTHEAST OF EAGLERIDGE BOULEVARD AND DILLON DRIVE

PUEBLO COLORADO

Ex. No. A-2

Field Exploration Description

Nine test borings were drilled on June 3, 2015, 2015 to depths of approximately 5 to 39½ feet below existing site grade at the approximate locations shown on the Exploration Plan, Exhibit A-2, with a track-mounted drill rig using 3-inch diameter solid-stem auger.

The boring locations were located in the field by referencing existing site features. The accuracy of the boring location should only be assumed to the level implied by the method used.

Lithologic logs of the borings were recorded by the Terracon field representative during drilling operations. At selected intervals, samples of the subsurface materials were taken by driving split-spoon and ring barrel samplers. Representative bulk samples of subsurface materials were also obtained.

Penetration resistance measurements were obtained by driving the split-spoon and ring barrel samplers into the subsurface materials with a 140-pound hammer falling 30 inches. The penetration resistance value is a useful index to the consistency, relative density or hardness of the materials encountered.

An automatic SPT hammer was used to advance the sampler in the boring performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the barrel blow counts, SPT values, and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Groundwater measurements were made in the boring at the time of site exploration. The borings were backfilled with auger cuttings prior to leaving the site. Some settlement of the backfill should be anticipated.

BORING LOG NO. B-1

PROJECT: Candlewood Hotel

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

LOCATION See Exhibit A-2

Latitude: 38.3185° Longitude: -104.6115°

DEPTH	GRAPHIC LOG	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
					6	8-7	7		36-17-19	48
					6	6-5	7	107		
		5							33-18-15	53
					6	12-17	7	110		
					6	12-18	4	114		
		10								
13.0										
					6	12-16	9	105		
		15								
					12	12-18-25 N=43	14			
		20								
					18	12-23-23 N=46	17			
		25								
					14	12-18-20 N=38	15			
		30								
					14	16-17-22 N=39	18			
36.0		35								
39.5			▽		6	N=50/6"	22			

FILL - CLAYEY SAND AND SANDY LEAN CLAY (SC), brown, loose to medium dense, fine to medium grained, trace gravel.
sample disturbed at 2 feet.

WEATHERED CLAYSTONE, brown to dark brown, firm to medium hard, with calcium deposits.

CLAYSTONE, dark brown, very hard

Boring Terminated at 39.5 Feet

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem

Abandonment Method:
Borings 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

▽ *Water observed while drilling*

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

Boring Started: 6/3/2015 | Boring Completed: 6/3/2015
Drill Rig: CME-850 | Driller: Vine
Project No.: B8155021 | Exhibit: A-4

BORING LOG NO. B-2

PROJECT: Candlewood Hotel

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

LOCATION See Exhibit A-2

Latitude: 38.3184° Longitude: -104.6114°

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
				4	5-3	6			
5				6	3-2	6		36-19-17	53
				6	3-2	7	99		
10				6	4-3	8			
				6	12-15	7	104		
15									
20				14	12-15-26 N=41	13			
25				16	12-15-17 N=32	18			
30				14	11-13-22 N=35	15			

DEPTH

FILL - CLAYEY SAND AND SANDY LEAN CLAY (SC), brown, loose, fine to medium grained, trace gravel.

samples disturbed at 2, 4, and 9 feet.

13.0

WEATHERED CLAYSTONE, brown to dark brown, firm to medium hard, with calcium deposits.

30.5

Boring Terminated at 30.5 Feet

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem

Abandonment Method:
Borings 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

No free water observed

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

Boring Started: 6/3/2015 | Boring Completed: 6/3/2015

Drill Rig: CME-850 | Driller: Vine

Project No.: B8155021 | Exhibit: A-5

BORING LOG NO. B-3

PROJECT: Candlewood Hotel

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

LOCATION See Exhibit A-2

Latitude: 38.3181° Longitude: -104.6115°

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
				6	3-4	8	98		
				6	3-2	9		36-17-19	58
5									
				6	3-4	10	97		
				6	10-12	8	106		
10									
				5	50/6"	10	122		
15									
				14	18-28-30 N=58	14			
20									
				18	10-12-19 N=31	14			
25									
				12	22-50/6" N=50/6"	13			
30									

FILL - CLAYEY SAND AND SANDY LEAN CLAY (SC), brown, loose, fine to medium grained, trace gravel.

sample disturbed at 4 feet.

13.0

WEATHERED CLAYSTONE, brown to dark brown, firm to very hard, with calcium deposits.

30.0

Boring Terminated at 30 Feet

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem

Abandonment Method:
Borings 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

No free water observed

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

Boring Started: 6/3/2015 | Boring Completed: 6/3/2015

Drill Rig: CME-850 | Driller: Vine

Project No.: B8155021 | Exhibit: A-6

BORING LOG NO. B-4

PROJECT: Candlewood Hotel

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

LOCATION See Exhibit A-2

Latitude: 38.3179° Longitude: -104.6114°

DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0		**FILL - CLAYEY SAND AND SANDY LEAN CLAY (SC)**, brown, loose to medium dense, fine to medium grained, trace gravel.							
				6	4-4	6	102		
5				6	4-3	7	96		
6.0		**WEATHERED CLAYSTONE**, brown to dark brown, firm to medium hard, with calcium deposits.		6	8-11	9	99	37-17-20	46
		clayey sandstone lens at 7 feet.		6	18-25	10	118		
10									
15				5	22-31	14	114		
20				16	10-16-21 N=37	13			
25				14	17-21-16 N=37	11			
27.0		**CLAYSTONE**, dark brown, very hard							
30				6	N=50/6"	10			
		color change to gray to brownish gray at 32 feet							
35				4	N=50/5"	9			
39.5				5	N=50/6"	10			
		Boring Terminated at 39.5 Feet							

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem

Abandonment Method:
Borings 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

No free water observed

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

Boring Started: 6/3/2015	Boring Completed: 6/3/2015
Drill Rig: CME-850	Driller: Vine
Project No.: B8155021	Exhibit: A-7

BORING LOG NO. B-5

PROJECT: Candlewood Hotel

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

LOCATION See Exhibit A-2

Latitude: 38.3185° Longitude: -104.6112°

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
	FILL - CLAYEY SAND AND SANDY LEAN CLAY (CL), brown to dark brown, loose									
					6	7-8	9	98		
		5			6	10-6	10	105		
					6	3-4	11	106		
		10			5	3-3	17	105		
	15.0				4	6-10	16	106		
	Boring Terminated at 15 Feet	15								

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem

Abandonment Method:
Borings 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

No free water observed

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

Boring Started: 6/3/2015 | Boring Completed: 6/3/2015

Drill Rig: CME-850 | Driller: Vine

Project No.: B8155021 | Exhibit: A-8

BORING LOG NO. B-6

PROJECT: Candlewood Hotel

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

LOCATION See Exhibit A-2

Latitude: 38.3179° Longitude: -104.6112°

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
FILL - CLAYEY SAND WITH GRAVEL (SC), brown to dark brown, loose									
				6	5-7	8	102		
	5			6	6-7	9	106		
								29-16-13	42
				6	3-3	17	106		
	10			6	4-3	16	111		
15.0									
Boring Terminated at 15 Feet	15			6	5-5	8	109		

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem

Abandonment Method:
Borings 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

No free water observed

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

Boring Started: 6/3/2015 | Boring Completed: 6/3/2015

Drill Rig: CME-850 | Driller: Vine

Project No.: B8155021 | Exhibit: A-9

BORING LOG NO. B-7

PROJECT: Candlewood Hotel

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

LOCATION See Exhibit A-2

Latitude: 38.3187° Longitude: -104.6118°

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
	FILL - SANDY LEAN CLAY (CL), brown, medium stiff to very stiff, trace gravel.				6	5-4	15	104	35-18-17	63
	5.0				6	18-20	13	113		
	Boring Terminated at 5 Feet	5								

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem

Abandonment Method:
Borings 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

No free water observed

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

Boring Started: 6/3/2015 Boring Completed: 6/3/2015

Drill Rig: CME-850 Driller: Vine

Project No.: B8155021 Exhibit: A-10

BORING LOG NO. B-8

PROJECT: Candlewood Hotel

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

LOCATION See Exhibit A-2

Latitude: 38.3178° Longitude: -104.6117°

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
	WEATHERED CLAYSTONE, brown to dark brown, firm, with calcium deposits.				6	8-11	15	110	40-20-20	88
	5.0									
	Boring Terminated at 5 Feet	5			6	8-11	16	115		

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem

Abandonment Method:
Borings 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

No free water observed

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

Boring Started: 6/3/2015 | Boring Completed: 6/3/2015

Drill Rig: CME-850 | Driller: Vine

Project No.: B8155021 | Exhibit: A-11

BORING LOG NO. B-9

PROJECT: Candlewood Hotel

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

LOCATION See Exhibit A-2

Latitude: 38.3178° Longitude: -104.6111°

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
	FILL - CLAYEY SAND (SC), brown, loose to medium dense, fine to medium grained, trace gravel.									
					6	9-11	6	106		
					6	6-5	6	102		
		5								
					0	4-5				
					6	4-5	12	108		
		10								
	15.0				3	5-6	18	101		
	Boring Terminated at 15 Feet	15								

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

Hammer Type: Automatic

Advancement Method:
4-inch solid-stem

Abandonment Method:
Borings 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

No free water observed

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

Boring Started: 6/3/2015 | Boring Completed: 6/3/2015

Drill Rig: CME-850 | Driller: Vine

Project No.: B8155021 | Exhibit: A-12

APPENDIX B
LABORATORY TESTING

Laboratory Testing

Samples retrieved during the field exploration were returned to the laboratory for observation by the project geotechnical engineer. An applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials. The field descriptions were confirmed or modified as necessary, and were classified in general accordance with the Unified Soil Classification System described in Appendix C.

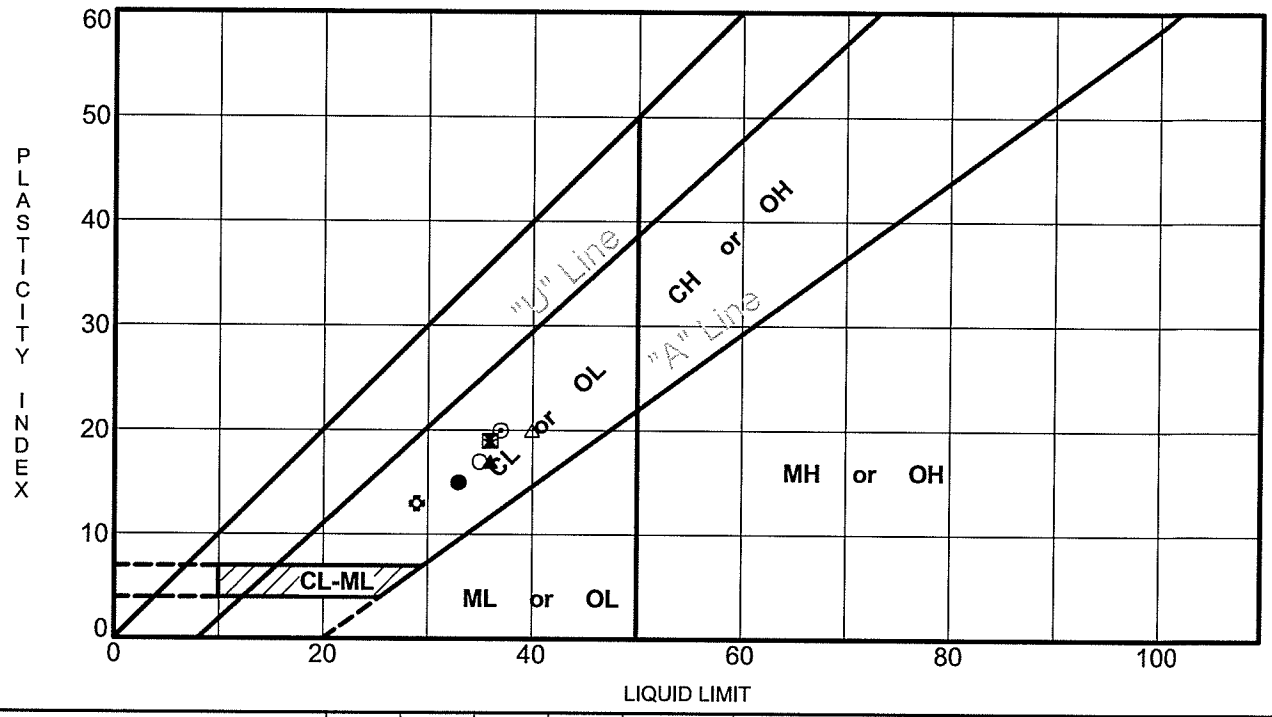
Laboratory test results are presented on the Boring Log and in Appendix B, and were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable Terracon test standards.

Selected soil samples were tested for the following engineering properties:

- Water content
- Dry density
- Grain size
- Plasticity index
- Electrical resistivity
- pH
- Water soluble sulfate content
- Water soluble chloride content

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
● B-1	1 - 10	33	18	15	53	CL	SANDY LEAN CLAY
⊠ B-1	2 - 3	36	17	19	48	SC	CLAYEY SAND
▲ B-2	4 - 5	36	19	17	53	CL	SANDY LEAN CLAY
★ B-3	4 - 5	36	17	19	58	CL	SANDY LEAN CLAY
⊙ B-4	7 - 8	37	17	20	46	SC	WEATHERED CLAYEY SANDSTONE
✿ B-6	1 - 10	29	16	13	42	SC	CLAYEY SAND with GRAVEL
○ B-7	0 - 1	35	18	17	63	CL	SANDY LEAN CLAY
△ B-8	0 - 1	40	20	20	88	CL	LEAN CLAY

PROJECT: Candlewood Hotel

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

PROJECT NUMBER: B8155021

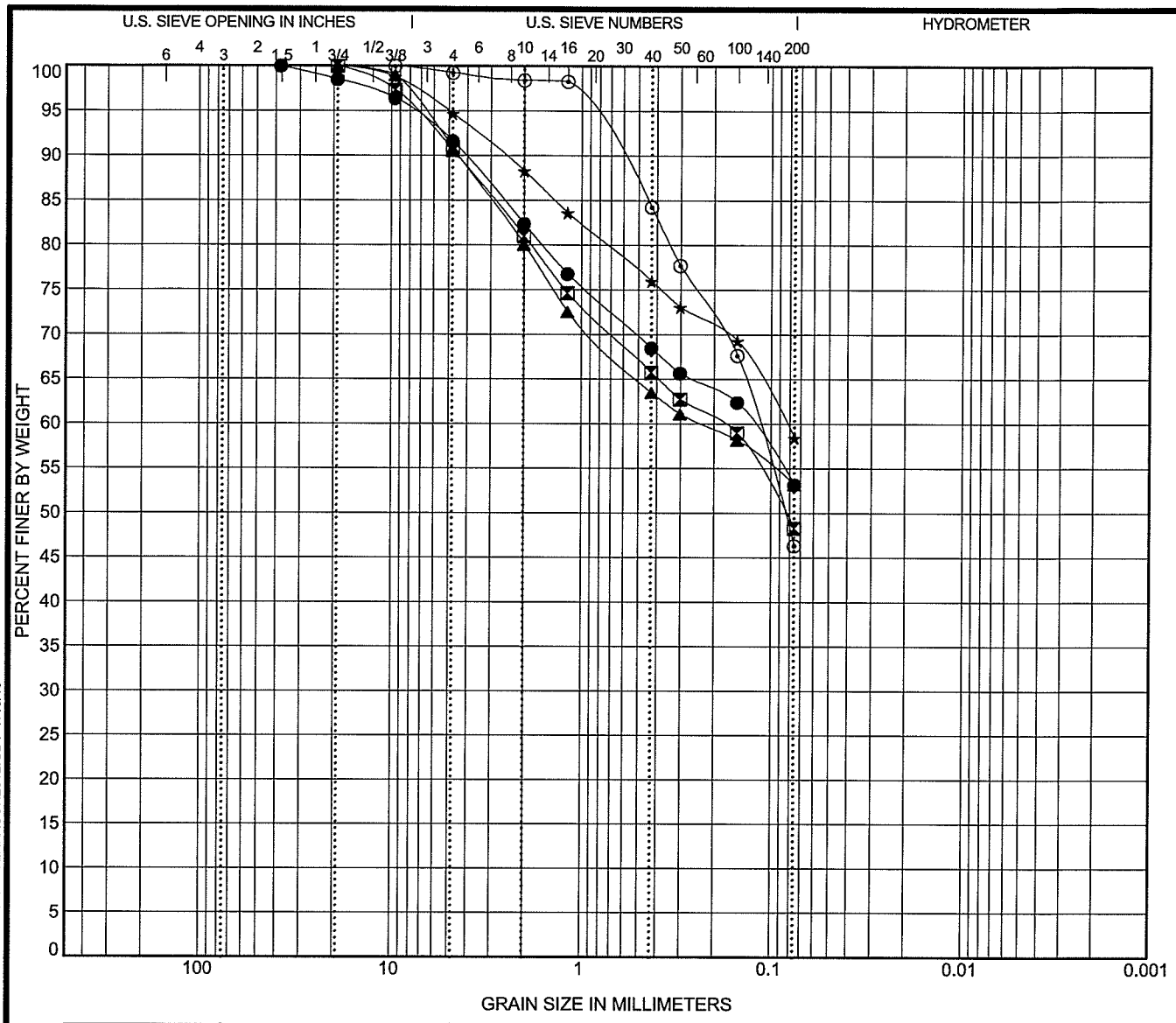
CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

EXHIBIT: B-1

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS B8155021.GPJ TERRACON2012.GDT 7/10/15

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	B-1	1 - 10	SANDY LEAN CLAY(CL)	33	18	15		
⊠	B-1	2 - 3	CLAYEY SAND(SC)	36	17	19		
▲	B-2	4 - 5	SANDY LEAN CLAY(CL)	36	19	17		
★	B-3	4 - 5	SANDY LEAN CLAY(CL)	36	17	19		
⊙	B-4	7 - 8	WEATHERED CLAYEY SANDSTONE	37	17	20		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Clay
●	B-1	1 - 10	37.5	0.125			8.4	38.4	53.2	
⊠	B-1	2 - 3	19	0.181			9.4	42.3	48.3	
▲	B-2	4 - 5	19	0.231			9.2	37.6	53.2	
★	B-3	4 - 5	19	0.083			5.3	36.2	58.5	
⊙	B-4	7 - 8	9.5	0.117			0.7	52.9	46.3	

PROJECT: Candlewood Hotel

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

PROJECT NUMBER: B8155021

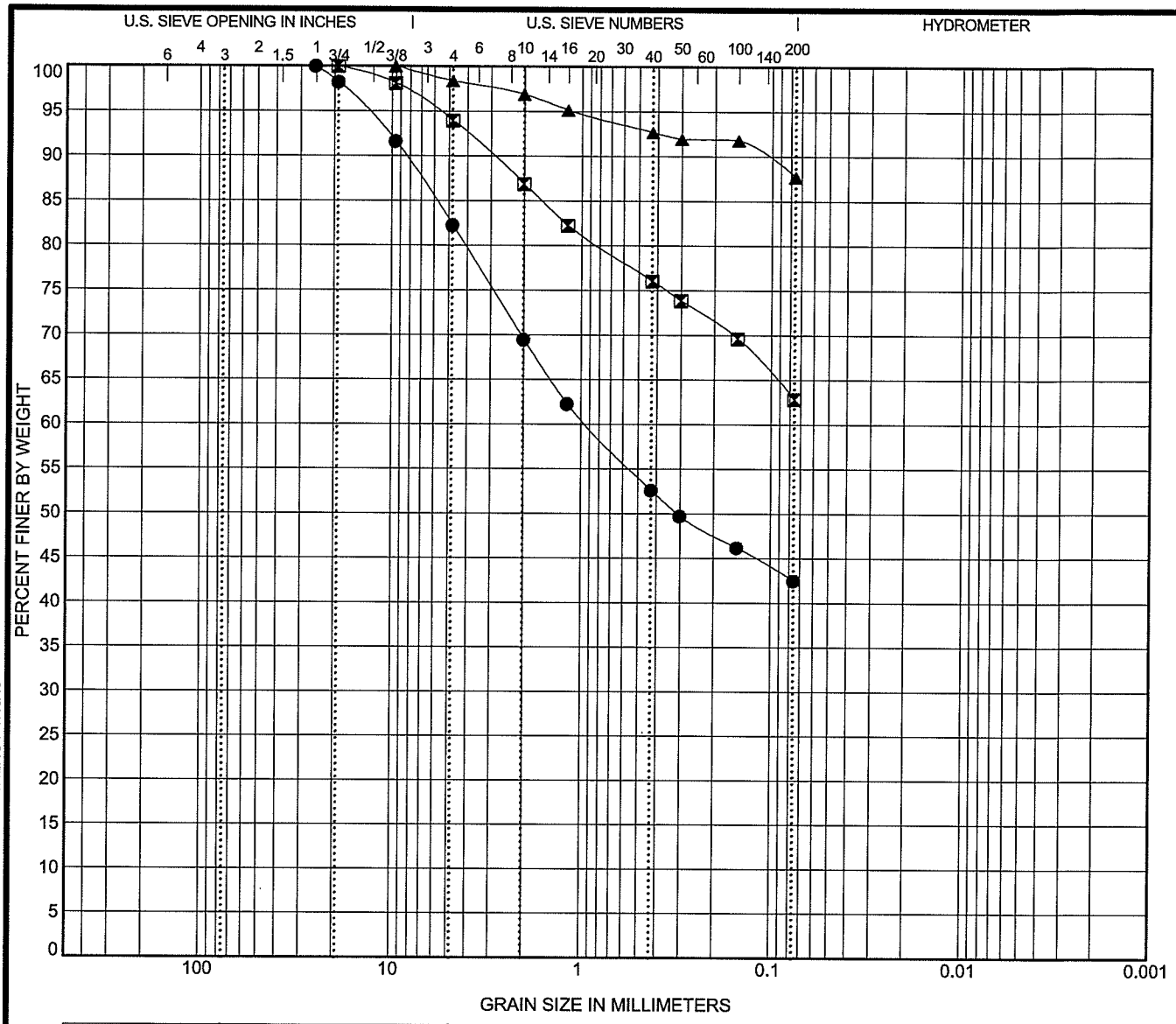
CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

EXHIBIT: B-1

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 B8155021.GPJ TERRACON2012.GDT 7/10/15

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
●	B-6	1 - 10	CLAYEY SAND with GRAVEL(SC)	29	16	13		
⊠	B-7	0 - 1	SANDY LEAN CLAY(CL)	35	18	17		
▲	B-8	0 - 1	LEAN CLAY(CL)	40	20	20		

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Clay
●	B-6	1 - 10	25	0.928			17.7	39.8	42.5	
⊠	B-7	0 - 1	19				6.0	31.2	62.8	
▲	B-8	0 - 1	9.5				1.6	10.7	87.7	

PROJECT: Candlewood Hotel

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

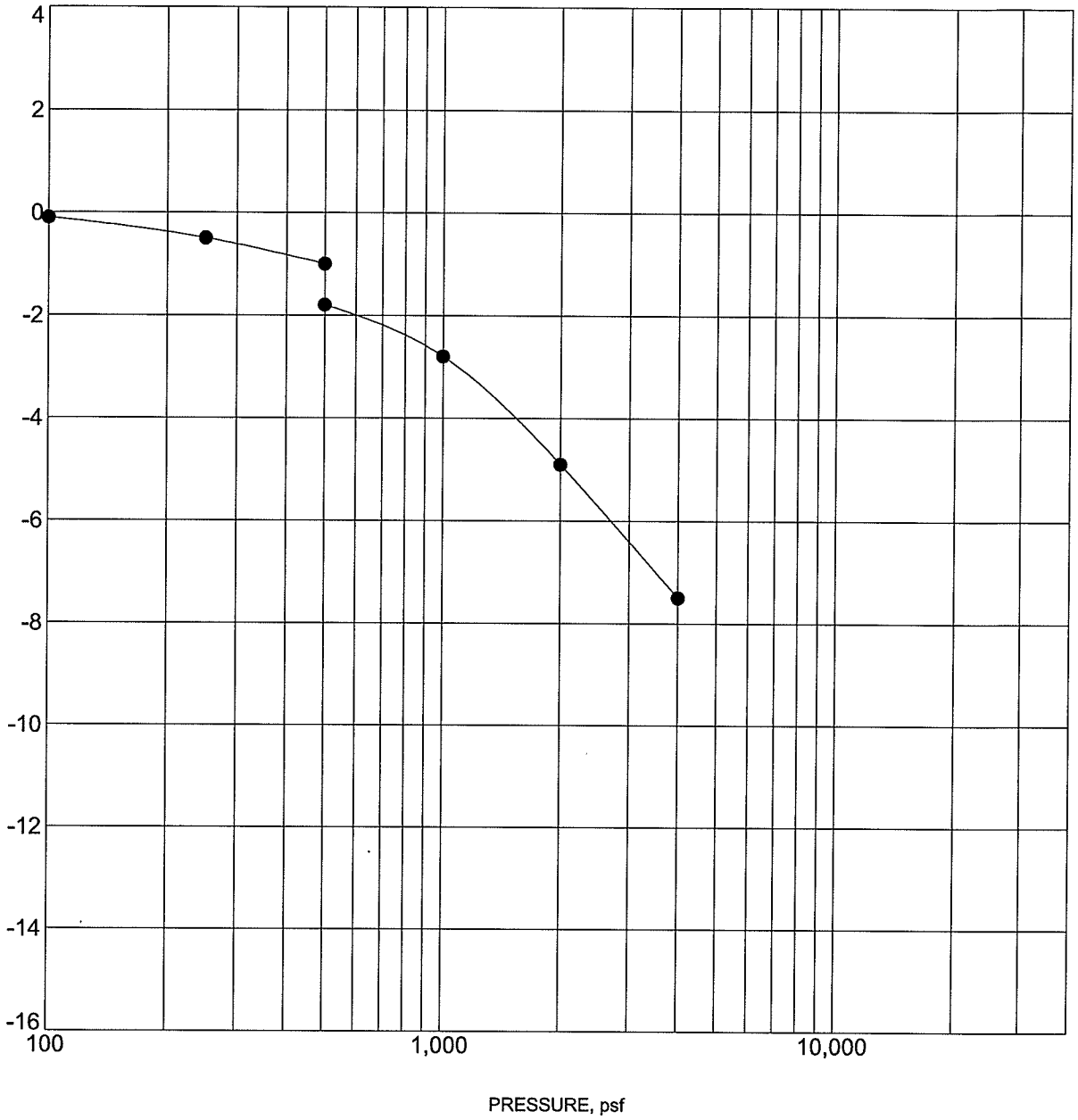
PROJECT NUMBER: B8155021

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

EXHIBIT: B-2

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification			Classification	γ_d, pcf	WC, %
●	B-1	4 - 5 ft	FILL-CLAYEY SAND(SC)	107	7

NOTES: Sample inundated with water at 500 pounds per square foot (psf.)

PROJECT: Candlewood Hotel

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

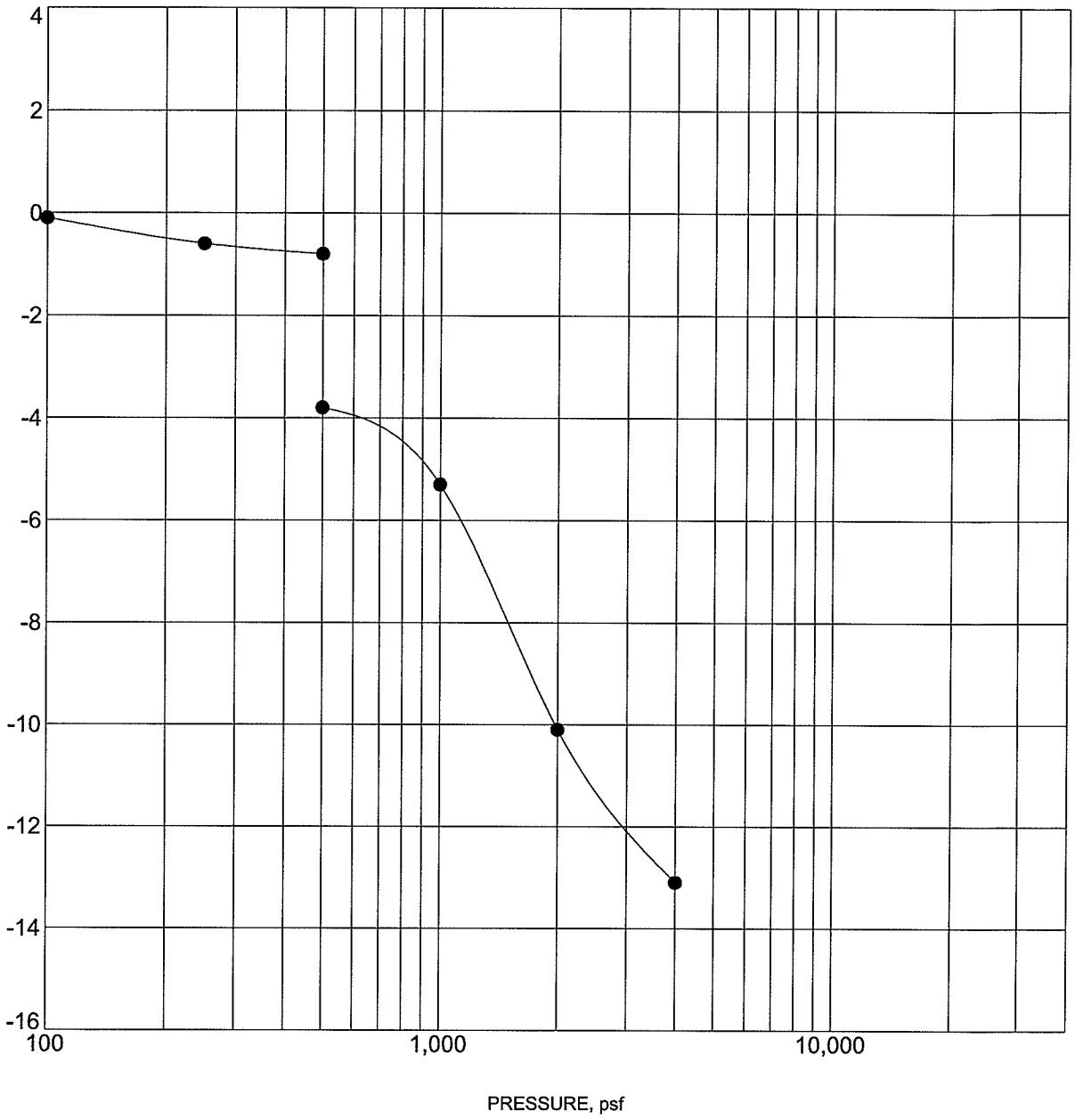
PROJECT NUMBER: B8155021

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

EXHIBIT: B-1

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification			Classification	γ_d, pcf	WC, %
●	B-2	7 - 8 ft	FILL-SANDY LEAN CLAY(CL)	99	7

NOTES: Sample inundated with water at 500 pounds per square foot (psf.)

PROJECT: Candlewood Hotel

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

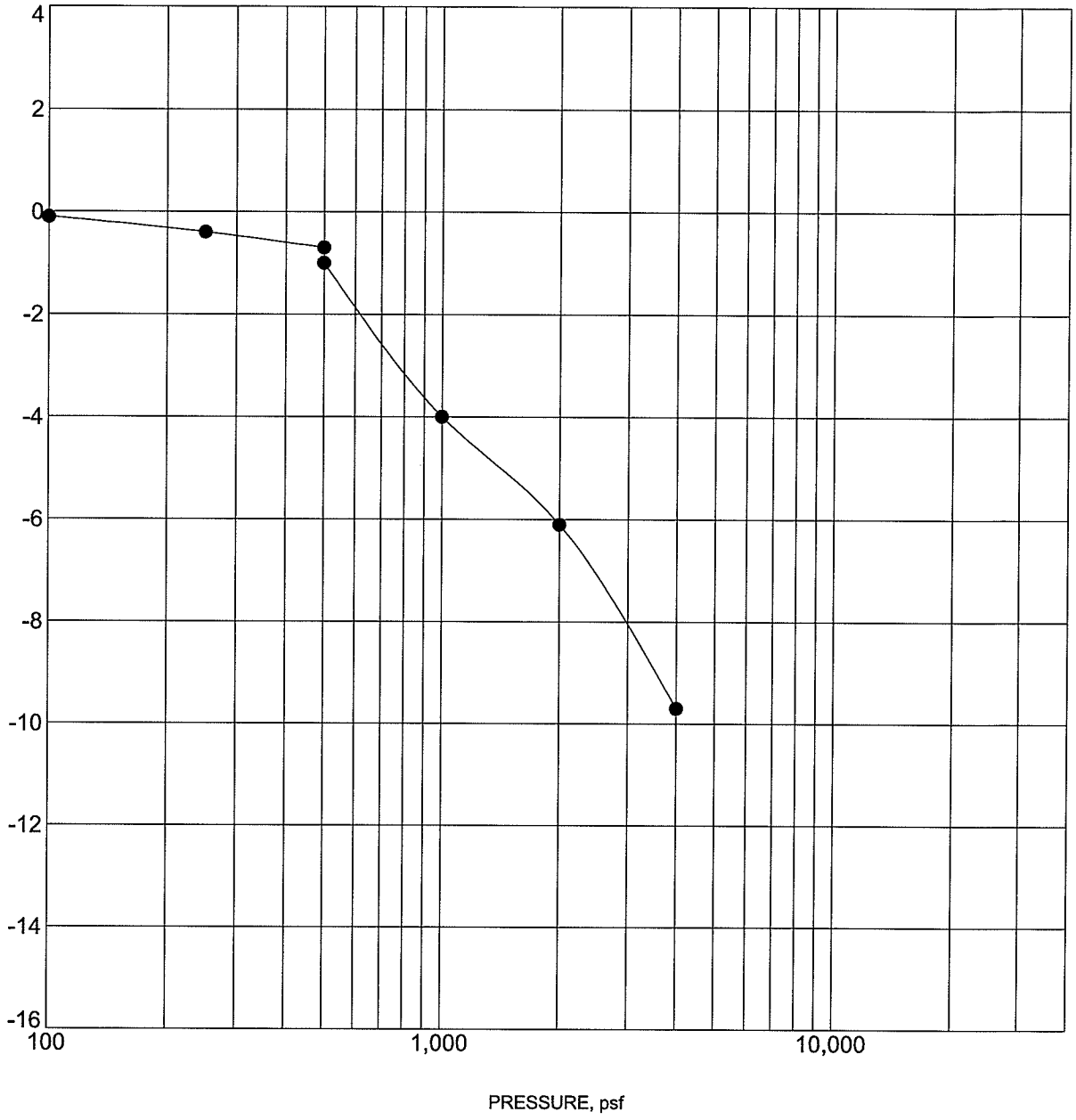
PROJECT NUMBER: B8155021

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

EXHIBIT: B-2

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification			Classification	γ_d, pcf	WC, %
●	B-3	2 - 3 ft	FILL-SANDY LEAN CLAY(CL)	98	8

NOTES: Sample inundated with water at 500 pounds per square foot (psf.)

PROJECT: Candlewood Hotel

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

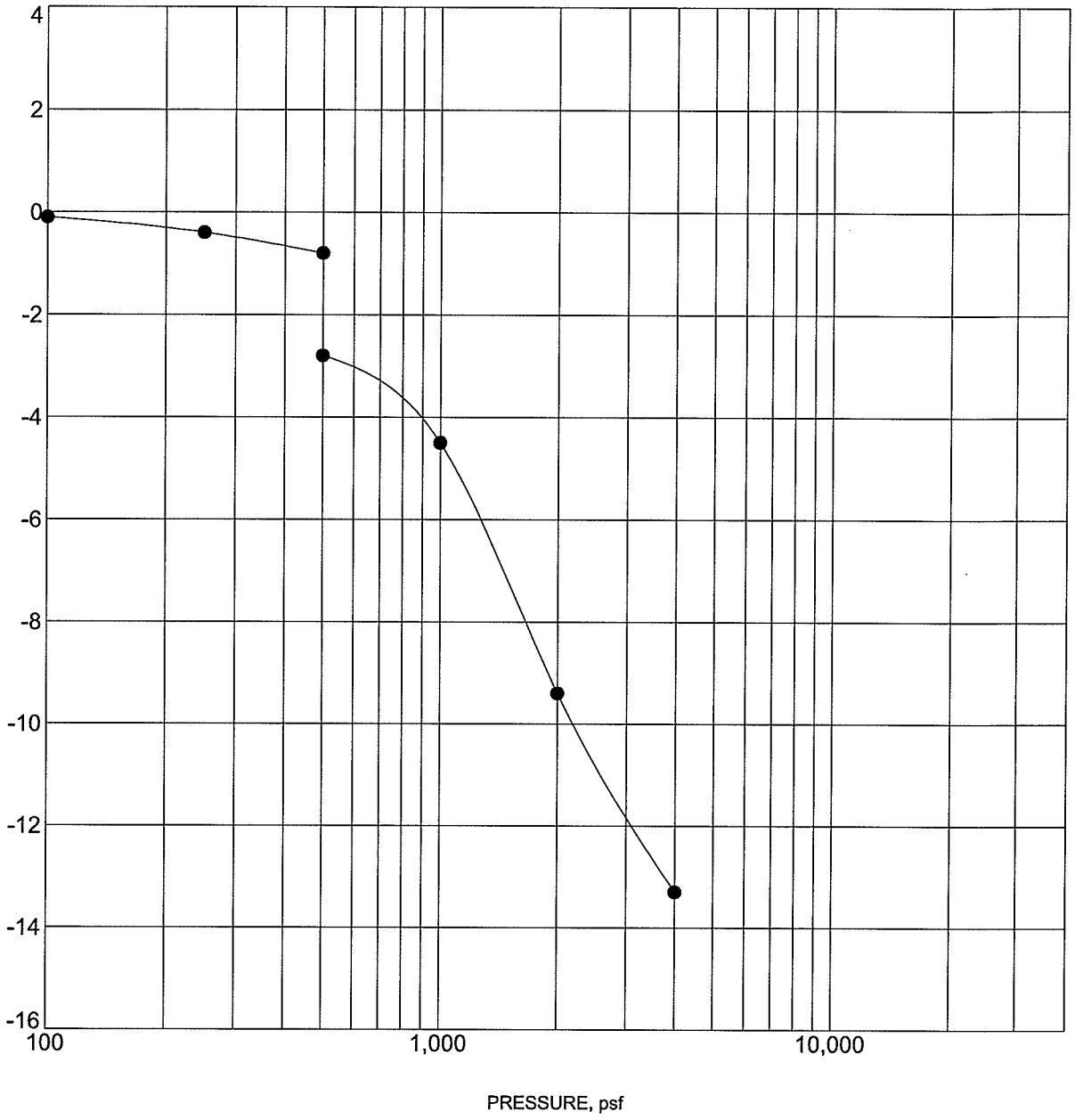
PROJECT NUMBER: B8155021

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

EXHIBIT: B-3

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification			Classification	γ_d, pcf	WC, %
●	B-4	2 - 3 ft	FILL-CLAYEY SAND(SC)	102	6

NOTES: Sample inundated with water at 500 pounds per square foot (psf.)

PROJECT: Candlewood Hotel

SITE: Eagleridge Boulevard and Dillon Drive
Pueblo, Colorado

Terracon
4172 Center Park Drive
Colorado Springs, Colorado

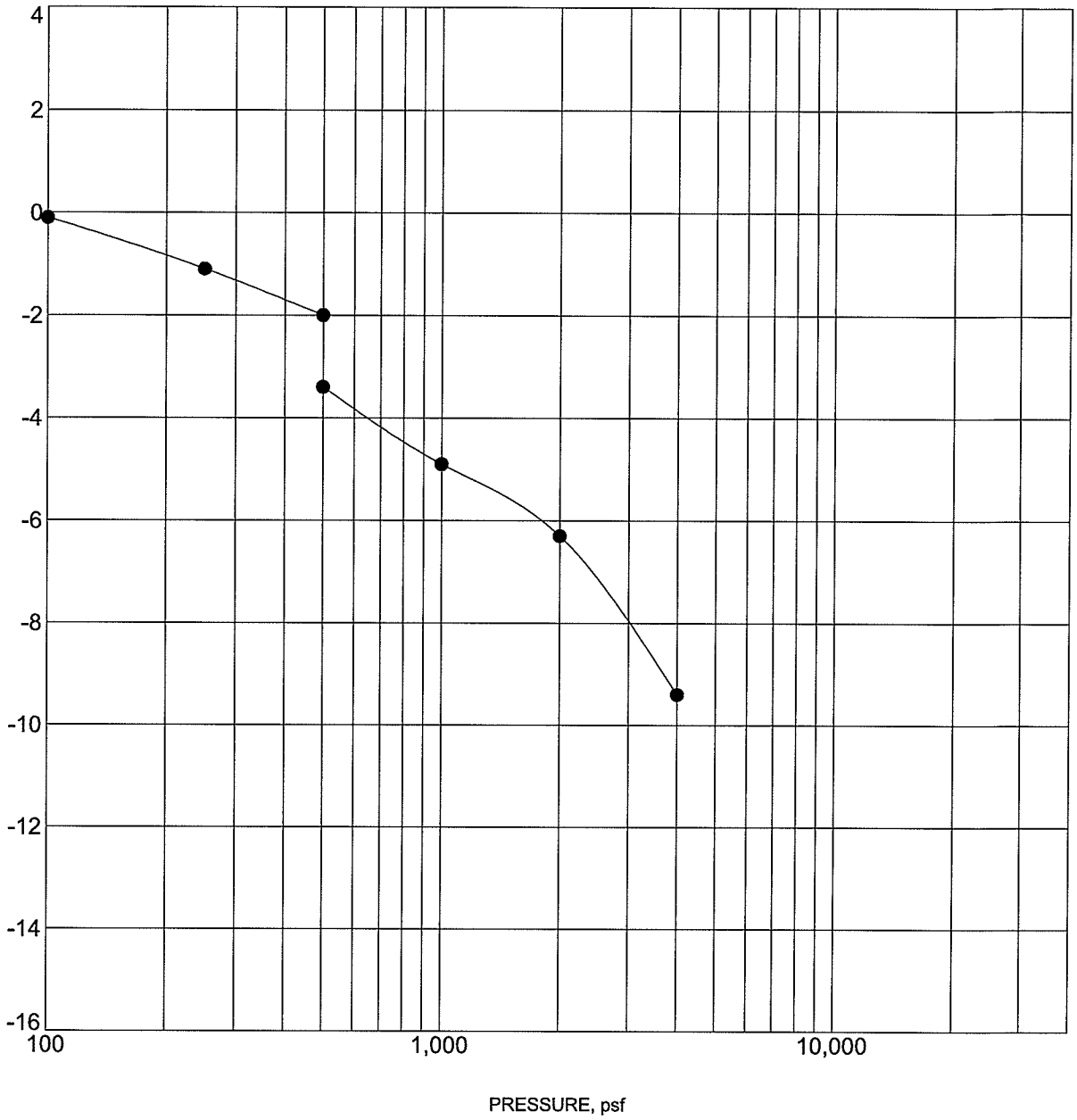
PROJECT NUMBER: B8155021

CLIENT: Quest Construction, LLC
Aberdeen, South Dakota

EXHIBIT: B-4

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification			Classification	γ_d, pcf	WC, %
●	B-4	7 - 8 ft	WEATHERED CLAYEY SANDSTONE	99	9

NOTES: Sample inundated with water at 500 pounds per square foot (psf.)
Sample may have been disturbed during sampling or preparation for laboratory testing.

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CONSOL_STRAIN-USCS B8155021.GPJ TERRACON2012.GDT 7/10/15

PROJECT: Candlewood Hotel	Terracon 4172 Center Park Drive Colorado Springs, Colorado	PROJECT NUMBER: B8155021
SITE: Eagleridge Boulevard and Dillon Drive Pueblo, Colorado		CLIENT: Quest Construction, LLC Aberdeen, South Dakota
		EXHIBIT: B-5

Colorado Analytical LABORATORIES, INC.

Analytical Results

TASK NO: 150609008

Report To: Ryan Feist
Company: Terracon, Inc. - Colo Springs
4172 Center Park Drive
Colo. Springs CO 80916

Bill To: Accounts Payable
Company: Terracon, Inc. - Lenexa
13910 W. 96th Terrace
Lenexa KS 66215

Task No.: 150609008
Client PO:
Client Project: Candlewood Hotel B8155021

Date Received: 6/9/15
Date Reported: 6/16/15
Matrix: Soil - Geotech

Customer Sample ID B8155021 Boring B-1 1-10 Ft.
Lab Number: 150609008-01

Test	Result	Method
Chloride - Water Soluble	**0.0003 %**	AASHTO T291-91/ ASTM D4327
pH	**7.7 units**	AASHTO T289-91
Resistivity	**837 ohm.cm**	AASHTO T288-91
Sulfate - Water Soluble	**1.215 %**	AASHTO T290-91/ ASTM D4327

Abbreviations/ References:

AASHTO - American Association of State Highway and Transportation Officials.
ASTM - American Society for Testing and Materials.
ASA - American Society of Agronomy.
DIPRA - Ductile Iron Pipe Research Association Handbook of Ductile Iron Pipe.

DATA APPROVED FOR RELEASE BY

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING


Auger


Split Spoon


Shelby Tube


Macro Core


Ring Sampler


Rock Core


Grab Sample


No Recovery

WATER LEVEL


Water Initially Encountered


Water Level After a Specified Period of Time


Water Level After a Specified Period of Time

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)
(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				BEDROCK		
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.	Ring Sampler Blows/Ft.	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3	< 30	< 20	Weathered
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4	30 - 49	20 - 29	Firm
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9	50 - 89	30 - 49	Medium Hard
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18	90 - 119	50 - 79	Hard
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42	> 119	>79	Very Hard
			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-in. (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.

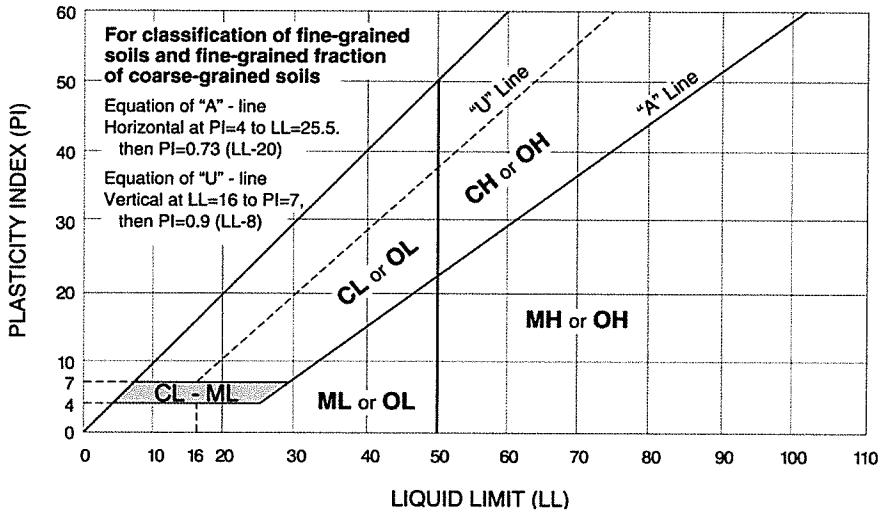


Exhibit C-2

GENERAL NOTES

Description of Rock Properties

WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)

Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding, and Foliation Spacing in Rock [a]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

a. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.

Rock Quality Designator (RQD)		Joint Openness Descriptors	
RQD, as a percentage	Diagnostic description	Openness	Descriptor
Exceeding 90	Excellent	No Visible Separation	Tight
90 – 75	Good	Less than 1/32 in.	Slightly Open
75 – 50	Fair	1/32 to 1/8 in.	Moderately Open
50 – 25	Poor	1/8 to 3/8 in.	Open
Less than 25	Very poor	3/8 in. to 0.1 ft.	Moderately Wide
		Greater than 0.1 ft.	Wide

a. RQD (given as a percentage) = length of core in pieces 4 in. and longer/length of run.

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976.
U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.

Exhibit C-3