AGEC
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GEOTECHNICAL INVESTIGATION

PROPOSED TREASURE HILL PROJECT

PARK CITY, UTAH

PREPARED FOR:

MPE, INC.
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ATTENTION: PAT SWEENEY

PROJECT NO. 1160503

NOVEMBER 20, 2017

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APPENDIX

EXECUTIVE SUMMARY

1. Three borings and eleven test pits were drilled and excavated, respectively. Borings B-2 and B-3, as well as Test Pits TP-2 thorugh TP-9 were conducted in the Quit'n Time / Creole roadway which has been cut into the hillside.

   The borings were drilled to depths of up to approximately 104 feet below the natural ground surface. The subsurface materials encountered in the borings consisted of approximately 7½ to 24 feet of silty to clayey gravel with sand overlying Weber quartzite bedrock.

   The subsurface materials in test pits TP-2 through TP-9 consisted of approximately one foot of fill overlying natural silty to clayey gravel with sand. Practical refusals was achieved in the natural gravel in TP-5, TP-7, TP-8 and TP-9 at depths of approximately five to eight feet, while test pits TP-2 though TP-4 terminated in the natural gravel at depths of approximately 11 to 12 feet. Bedrock was encountered in TP-4 at a depth of approximately 4½ feet, corresponding to approximately 8½ feet below the natural ground surface.

   Test pits TP-10 and TP-11 were excavated uphill from the Quit'n Time / Creole roadway. Approximately two feet of topsoil was encountered in these test pits, overlying natural gravel and fat clay. Bedrock was not encountered in either of these test pits.

   Test pit TP-1 was excavated high in the Creole ski run. Fill was encountered in this test pit to the maximum depth investigated of 22 feet.

2. No subsurface water was encountered in the borings or test pits, to the maximum depth investigated of approximately 104 feet below the natural ground surface. Slotted PVC pipe was placed in borings B-1 and B-2 to facilitate future measurement of the water level.

3. Based on our observations and exploration at the site, approximately 8½ to 27 feet of soil, consisting of silty to clayey gravel with sand with pockets of fat clay, is likely to be found above the bedrock on the site.

4. The bedrock consists of the Weber quartzite formation, and appears to be sporadic in competency, with joint frequency ranging from less than one inch to approximately 30 inches. The jointing in the bedrock is favorable for construction of cut slopes, with bedding planes slightly sloping to the northwest and several near vertical joint sets in the portion south of the Creole drainage, and bedding planes sloping moderately to the northwest in the portion north of the Creole drainage.

5. Geotechnical information related to site grading is included in the report.

SCOPE

This report presents the results of a preliminary geotechnical investigation for the proposed Treasure Hill Project to be constructed west of Lowell Avenue, the Town Lift base and Woodside Avenue in Park City, Utah. Subsurface exploration was conducted to obtain information on the subsurface conditions. Samples obtained from the subsurface investigation were tested in the laboratory to determine physical and engineering characteristics of the on-site soil and rock. Information obtained from the field and laboratory was used to define conditions at the site for our engineering analysis and to develop recommendations pertaining to the site grading. This report summarizes our findings and recommendations, and is in general conformance with our proposal dated January 10, 2017.

SITE AND GEOLOGIC CONDITIONS

The site lies to the west of Lowell Avenue, the Town Lift base and Woodside Avenue, and includes the lower portions of the Creole and Quit'n Time ski runs. The majority of the site consists of relatively undisturbed hillside with a gradual to steep slope, sloping down to the northeast. Several abandoned, closed mine shafts and adits are located on the site. A significant amount of fill has likely been placed in the Creole drainage. The upper portions of the site are heavily forested, with grasses and shrubs in the ski runs and lower portions of the site.

The bedrock at the site has been mapped primarily as the Pennsylvanian-age Weber Quartzite formation, with the northwest portion of the site entering the Permian-age Park City formation. The Weber Quartzite consists of medium to thin bedded pale gray to tan fine-grained quartzite and sandstone. The Park City formation consists largely of pale gray, fossiliferous limestone with some chert and sandstone. (Bromfield and Crittenden, 1971; Crittenden et al, 1966)

The bedrock in the Old Town Park City and Deer Valley areas is believed to form a moderate anticline, with faulting at various locations. A fault has been mapped, running in a north-northeast direction, at approximately the upper portion of the Creole drainage. (Bromfield and Crittenden, 1971; Crittenden et al, 1966)

Bill Lund (1979) reported evidence of soil creeping on the site. Soil creep is defined as "the imperceptibly slow downslope flow of surface soil and weathered rock (Shelton, 1966)." Soil creep, along with landslides, is the predominant mechanism that moves material from a mountain side to a stream bed, to be carried away. Unlike a landslide, however, creep is not characterized with a slip plane, and does not rupture catastrophically. Lund (1979) recommended that "cut and fill slopes be designed in accordance with the recommendations of a qualified soils engineer following a detailed stability analysis of the materials involved."

FIELD STUDY

The field study was conducted between August 23 and September 18 , 2017. Eleven test pits were excavated and three borings were drilled at the approximate locations shown on Figures 1 and 2. The test pits were excavated using a track-mounted excavator, and the borings were drilled using coring methods with a rubber track-mounted drill rig. The test pits and borings were logged and soil samples obtained by an engineer from AGEC. Logs of the subsurface conditions encountered in the test pits and borings are presented on Figures 3 and 4 with the legend and notes on Figure 5. Detailed core logs are provided in the appendix.

A downhole camera was used to record the orientation (strike and dip) of a sample of the natural bedrock joints in Borings B-1 and B-2. Results of the measurements are shown on the core logs in the appendix.

SUBSURFACE CONDITIONS

Approximately 1 to 2 feet of fill and/or topsoil was encountered in the upper portions of the test pits and borings. The fill generally consists of silty to clayey gravel with sand.

Natural soil was encountered in the borings and test pits, extending to depths ranging from approximately 8 to 27 feet below the natural ground surface. The natural soil encountered consists predominantly of silty to clayey gravel with sand, with pockets of fat clay. Fat clay with sand was encountered in Test Pit TP-10. Bedrock was found in the base of Test Pit TP-6 and all three borings, extending to the maximum depth investigated of approximately 104 feet below the natural ground surface.

Test Pit TP-1 was excavated in the area of the proposed Creole drainage fill. Fill was encountered in this test pit extending to the entire depth investigated of approximately 22 feet.

A description of the various soils encountered in the test pits and borings follows:

Fill - The fill ranges from silty to clayey gravel with sand. The fill contains subangular to subrounded gravel, cobble and boulders up to approximately 18 inches in size.

Laboratory tests performed on samples of the fill indicate that it has a liquid limit ranging from about 26 to 31 percent and plasticity index ranging from about 11 to 17 percent. Results of a modified Proctor test conducted on a sample of the fill indicate that the sample tested has a maximum dry density of approximately 132 pounds per cubic foot (pcf), with a optimum moisture content of approximately 7 percent, as determined by ASTM D 1557. Results of a direct shear test performed on a portion of a sample of fill that passes a No. 4 Sieve indicate that the portion of the sample tested has secant friction angles ranging from approximately 34 to 28 degrees under effective stresses ranging from approximately 2,000 to 30,000 psf.

Topsoil - The topsoil encountered in the upper potion of test pits TP-10 and TP-11 consists predominantly of silty gravel with sand, which is moist, dark brown and contains roots and organics.

Fat Clay with Sand - The fat clay with sand contains occasional gravel, cobble and boulders up to approximately 24 inches in size. It is stiff to very stiff, moist to very moist and reddish brown to yellowish brown.

Laboratory tests performed on a sample of the fat clay with sand indicate that the sample tested has a natural moisture content of approximately 24 percent, a dry density of approximately 88 pcf, and a friction angle of approximately 31 degrees. The sample tested exhibits a liquid limit of approximately 87 percent and a plasticity index of approximately 60 percent.

Silty to Clayey Gravel with Sand - The silty to clayey gravel with sand is dense to very dense, slightly moist to moist and light brown to reddish brown, with subrounded to subangular cobble and boulders up to approximately 24 inches in size.

Laboratory tests performed on a sample of the silty to clayey gravel with sand indicate that the sample tested has a natural moisture content of approximately 17 percent and dry density of approximately 109 pcf. Laboratory tests performed on several samples indicate that it has a liquid limits ranging from approximately 25 to 56 percent and plasticity index ranging from approximately 12 to 43 percent.

Poorly-graded Gravel with Silt and Sand - The poorly-graded gravel with silt and sand contains subrounded to subangular cobble and boulders up to approximately 24 inches in size. It is medium dense to dense, slightly moist and brown to reddish brown.

Bedrock - The bedrock consists of the Weber quartzite formation. It is medium hard to very hard and whitish gray to brown. The formation, encountered in our borings, appears to be sporadic in competency, with joint frequency ranging from less than one inch to approximately 30 inches. The joints appear to be undulating and rough, with occasional clay or sand infilling up to approximately five inches thick.

Laboratory tests performed on samples of the bedrock indicate that it has a specific gravity of approximately 2.5, an unconfined compressive strength ranging from approximately 8,800 to 23,400 pounds per square inch (psi), and a rock-on-rock joint friction angle of approximately 36 degrees.

A sample of rock was crushed in the laboratory such that the individual aggregates did not exceed 3 inches in diameter. The relative minimum and maximum density of the crushed aggregate was measured to be approximately 87 and 100 pcf, respectively. The crushed aggregate showed an approximate 24 percent loss on the No. 12 sieve when tested for L.A. abrasion as determined by AASTO T 96. The crushed aggregate showed an approximate 2 percent loss for both coarse and fine aggregate when tested for soundness under sodium sulfate attack.

The predominant joint sets, as determined from outcrop jointing surveys and downhole videography, are included in the table below, with a standard deviation of approximately 30 degrees. The jointing measurements for all the locations south of the Creole drainage (Creole Outcrop, B-2, TP-6 and Mine Adit) showed similar jointing with a bedding plane dipping slightly to the northwest, and two near vertical joint sets with strikes in northeast and southest directions, respectively. The jointing measured in boring B-1, which is north of the Creole drainage, shows significantly different jointing, with a bedding plane dipping moderately to the northwest.

Location	Bedding Plane (strike, dip)	Joint Set 1 (strike/dip)	Joint Set 2 (strike/dip)
Creole Outcrop	S75°W, 15°NW	N40°E, 75°SE	S25°E, 85°SW
B-1	S30°W, 65°NW	—	—
B-2	S15°W, 20°W	N15°E, 70°E	S70°E, 75°N
TP-6	S70°W, 20°N	N45°E, 85°SE	S15°E, 85°W
Mine Adit	S10°E, 20°W	N50°E, 90°	S30°E, 85°SW

Results of laboratory testing on a sample of fat clay with sand from a joint at a depth of 97½ feet indicate that the sample has a friction angle of approximately 31 degrees.

Results of the laboratory tests are summarized on Table I and included on the logs of the borings and test pits, Figures 2, 3 and 4.

SUBSURFACE WATER

No subsurface water was encountered in the borings or test pits at the time of drilling, videoing, and excavation to the maximum depth investigated, approximately 104 feet below the approximate natural ground surface. PVC pipe was placed in Borings B-1 and B-2 in order to check for subsurface water as the seasons change.

PROPOSED CONSTRUCTION

We understand that the site is being considered for construction of a mixed use, residential and commercial, development. Excavation to depths of up to approximately 130 feet is currently being considered for the proposed development. Portions of the cut area are proposed to remain as permanent "cliffscapes", while other portions are proposed to be retained adjacent to building foundation walls.

We understand that material excavated from the development area is proposed to remain on site and be placed uphill to the southeast of the proposed development, with a majority of the excavated material to be placed in the upper portion of the Creole drainage.

RECOMMENDATIONS

The following recommendations are based on our exploration and observations on the site, results of laboratory testing, information provided by the client and our experience in the area.

A. Cut Area

Up to approximately 100 and 130 feet of soil and rock is proposed to be cut in the midstation (southeast of Town Lift) and Creole (northwest of Town Lift) lots, respectively. Based on our field exploration, the material to be excavated could consist of approximately 8 to 27 feet of soil overlying Weber quartzite bedrock.

1. Soil Cut Slopes

   The soil is likely to consist mainly of silty to clayey gravel with sand, with occasional pockets of fat clay. Permanent unretained slopes in the natural gravel may be cut to slopes of approximately 2 horizontal to 1 vertical.

Permanent cut slopes in the soil may be steepened with the use of shoring techniques.

2. Bedrock Cut Slopes

The jointing in the Weber quartzite bedrock is favorable for the proposed cuts to be made. The jointing south of the Creole drainage consists of horizontal bedding planes dipping slightly into the hill (to the northwest) and two near-vertical joint sets. The following table gives recommendations for the steepest permanent cut slopes to be excavated into the bedrock to the south of the Creole drainage:

Slope Direction	Slope (horizontal:vertical)
north	1/2:1
northeast	1/4:1
east	1/4:1
southeast	1/2:1
south	1/2:1
southwest	1/2:1
west	1:1
northwest	1:1

The jointing north of the Creole drainage consists predominantly a bedding plane dipping moderately into the hill (to the northwest). The steepest permanent cut slope recommendations to be excavated in the bedrock north of the Creole drainage are shown in the following table:

Slope Direction	Slope (horizontal:vertical)
north	1/2:1
northeast	1/4:1
east	1/4:1
southeast	1/4:1
south	1/4:1
southwest	1/2:1
west	1/2:1
northwest	2/3:1

The bedrock encountered in the borings was sporadic in competency, with joint frequency ranging from less than one inch to approximately 30 inches. Consequently, portions of the bedrock "cliffscapes" will likely need to be supported to prevent shallow failures and/or rock toppling. Support systems could consist of rock bolts and shotcrete or high-strength steel mesh, or other similar systems.

3. Drainage

No subsurface water was found in our borings to the maximum depth investigated of approximately 104 feet below the natural ground surface, during the time of year of the field investigation. However, during wet seasons such as spring runoff, water could be experienced and water pressures could build up within the rock mass. Horizontal drains should be installed to collect and remove water seeping through the joints of the rock. A qualified geotechnical engineer should determine the frequency and penetration depth of the drain system, in order to retain the stability of the rock slope.

A qualified geotechnical engineer should oversee the excavation and shoring of permanent retained cut slopes and "cliffscapes" to ensure proper support systems are implemented where needed.

B. Fill Placement

We understand that the excavated material from the midstation and Creole lots is proposed to be deposited uphill to the southwest, and that the majority of the fill placement is currently proposed to be in the upper portion of the Creole drainage. The fill is planned to be placed up to an approximate elevation of 130 feet above the current elevation.

1. Subgrade Preparation

Due to the manner of construction of the Creole ski run, a significant amount of fill has been placed in the bottom of the drainage. At the location of test pit TP-1, the fill extends to a depth of at least 22 feet, which is the maximum depth investigated in this area. The locations where fill is proposed to be placed should be cleared of topsoil, debris, fill and other deleterious materials prior to the placement of additional fill.

Due to the substantial slope existing on the Creole ski run, the base of the cleared areas should be stepped in order to provide stability for the body of fill and give a flat working platform for compaction. A qualified geotechnical engineer should observe the clearing of topsoil and fill prior to placement of fill in these areas.

2. Compaction

The fill should be placed lifts and compacted to at least 90 percent of a modified Proctor (ASTM D 1557). The moisture of the soil should be

adjusted to within 2 percent of optimum to facilitate compaction. The fill should be periodically tested for compaction.

3. Grading

Unretained fill slopes may be constructed to approximately 2 horizontal to 1 vertical. Slopes of 1½ horizontal to 1 vertical may be considered if soil reinforcing, such as geogrid, is used. A qualified geotechnical engineer should determine the type and frequency of reinforcement to be used.

4. Soil and Rock Expansion

During the excavation and filling process, the final volume of the soil and rock fill will increase, due to voids created by crushing and the compaction process. We estimate that the expansion factor for the combined soil and rock to be excavated could range from 20 to 35 percent. The amount of actual expansion is dependent on the amount of soil that is mixed in with the bedrock. The expansion of the material can remain low through implementing following practices:

- increased compaction effort and decreased lift thicknesses
- mixing of excavated rock with excavated soil during the fill placement, to allow the soil to fill the voids within the excavated rock
- crushing a portion of the excavated rock and mixing it with non-crushed excavated rock, to allow the crushed rock to fill voids

5. Drainage

During wet times of the year, such as spring runoff, water seepage in the filled Creole slope area could reduce the stability of the soil fill. A drainage system, consisting of perforated drain pipe, placed in gravel and surrounded

with a filter fabric, should be installed at the base of the natural soil below and behind the fill placement in this area. The pipe should be allowed to drain by gravity flow.

C. Additional Study

This study has been preliminary in nature, and is intended to be used during preliminary design. Additional geotechnical investigation and analysis should continue to be performed during the design process, to ensure proper stability of slopes. Analysis should also be conducted with regard to other geotechnical considerations, such as foundation support and lateral earth pressures on foundation walls of the proposed buildings.

LIMITATIONS

This report has been preliminary in nature. It has been prepared in accordance with generally accepted soil engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the borings drilled and the test pits excavated at the approximate locations indicated on the site plan and the data obtained from laboratory testing, as well as information from the client. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the proposed construction, subsurface conditions or groundwater level is found to be significantly different from what is described above, we should be notified to reevaluate the recommendations given.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Taylor J. Nordquist E.I.T.

Reviewed by James E. Nordquist, P.E., G.E.

TJN/rs

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Bromfield, C. S. and Crittenden, M.D. (1971). Geologic Map of the Park City East Quadrangle, Summit and Wasatch Counties, Utah. 1:24,000. United States Geological Survey, Washington D.C.

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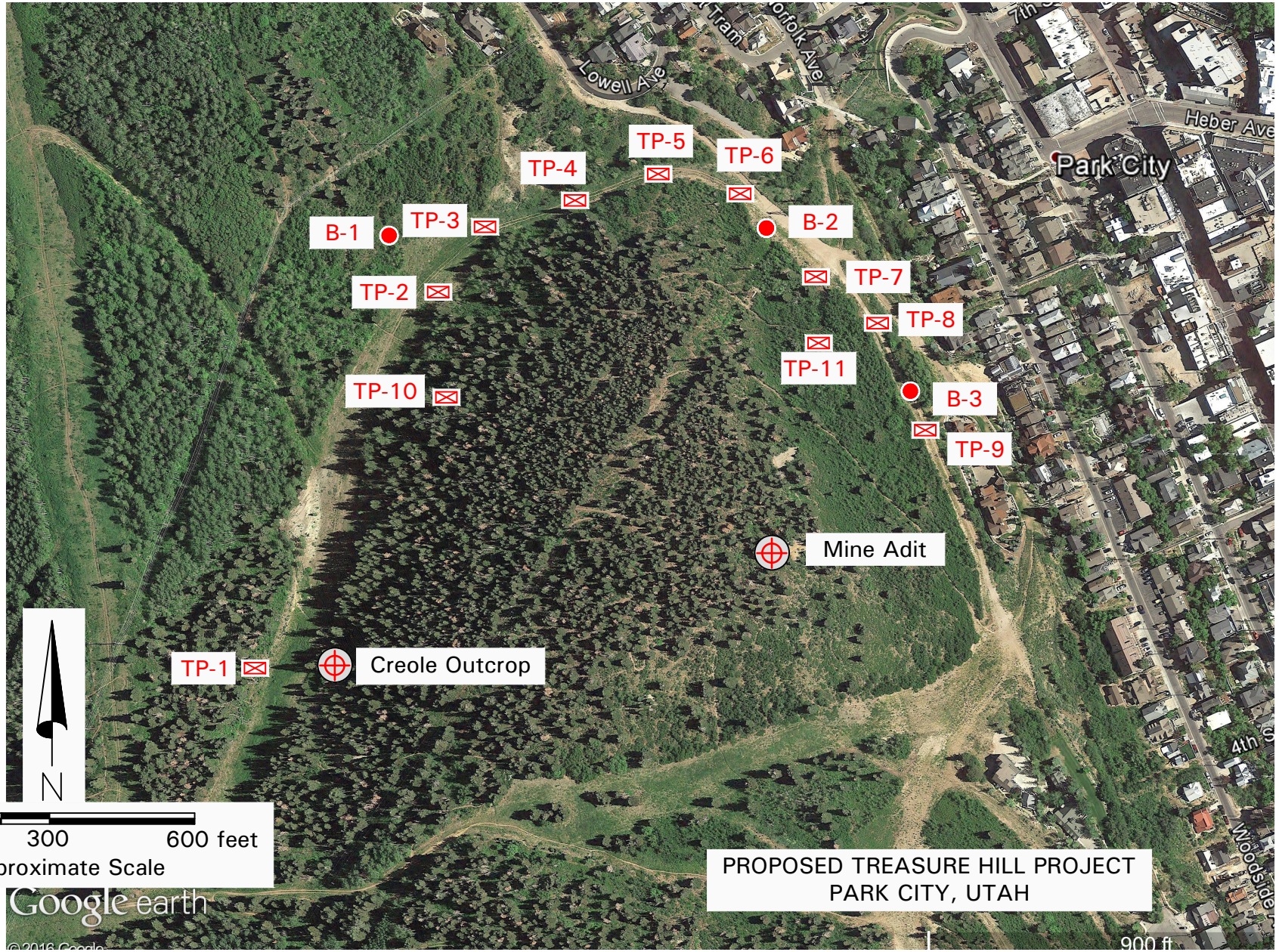
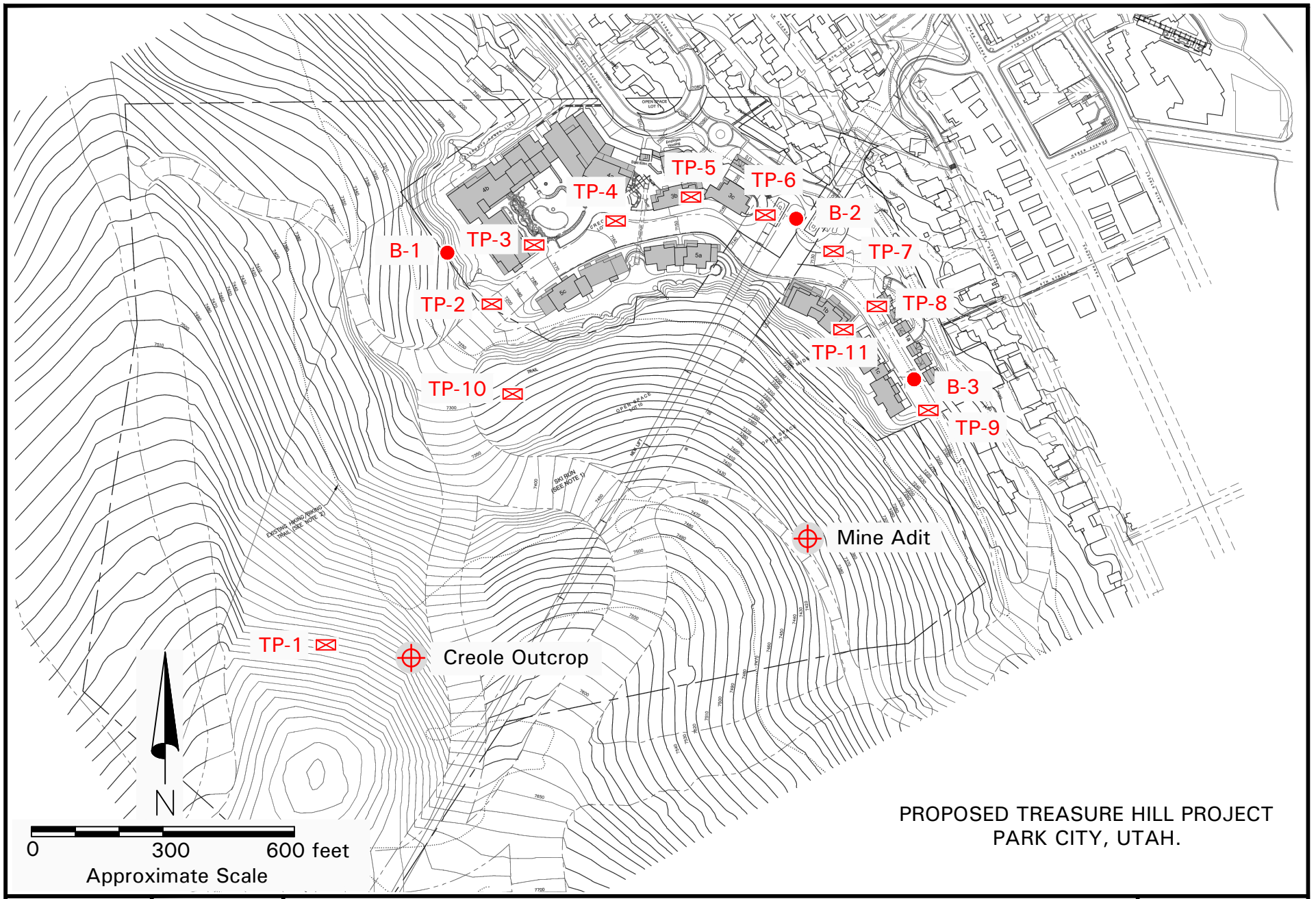
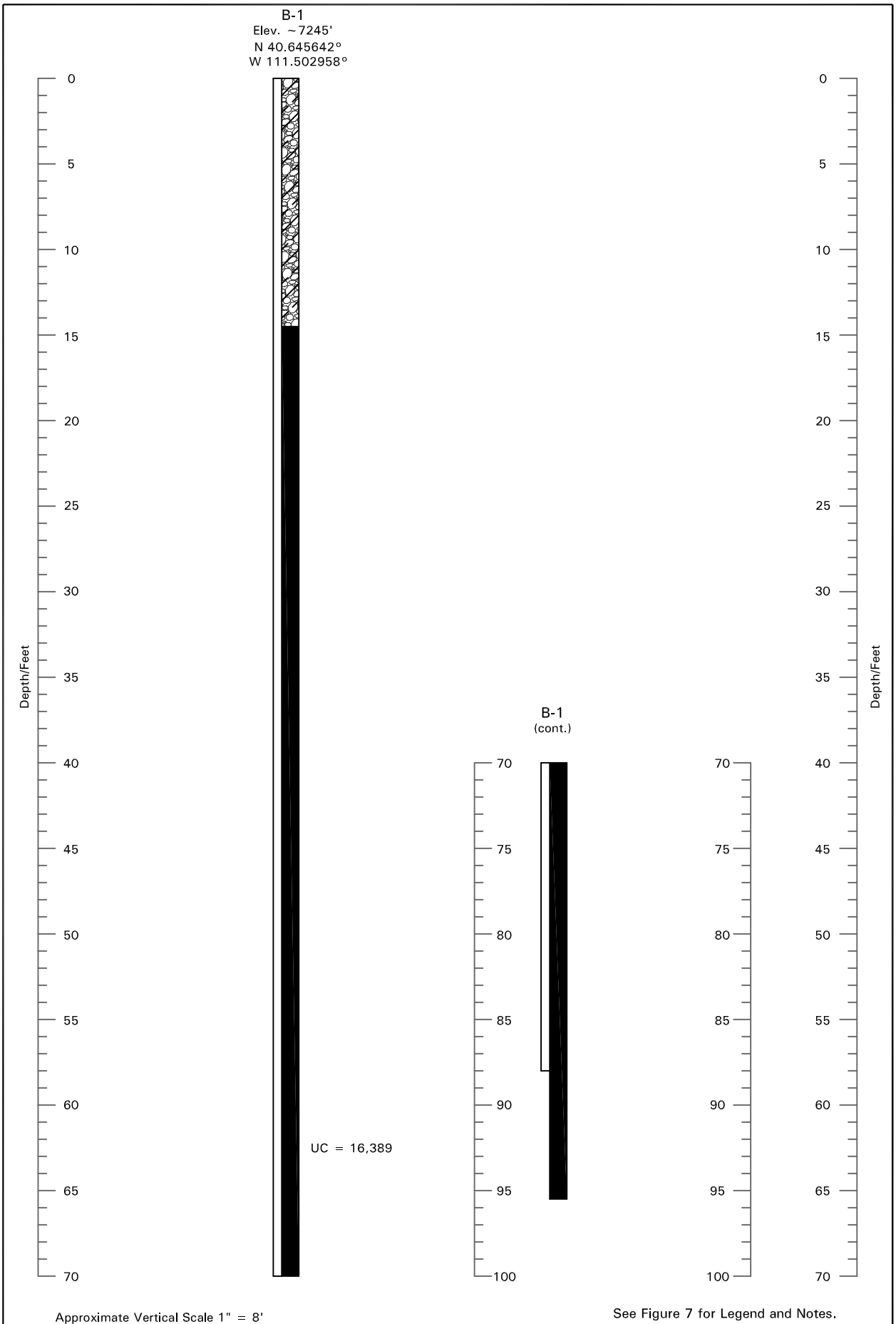


1160503	AGEC	Test Pit and Exploratory Boring Locations	Figure 1



PROPOSED TREASURE HILL PROJECT
PARK CITY, UTAH.

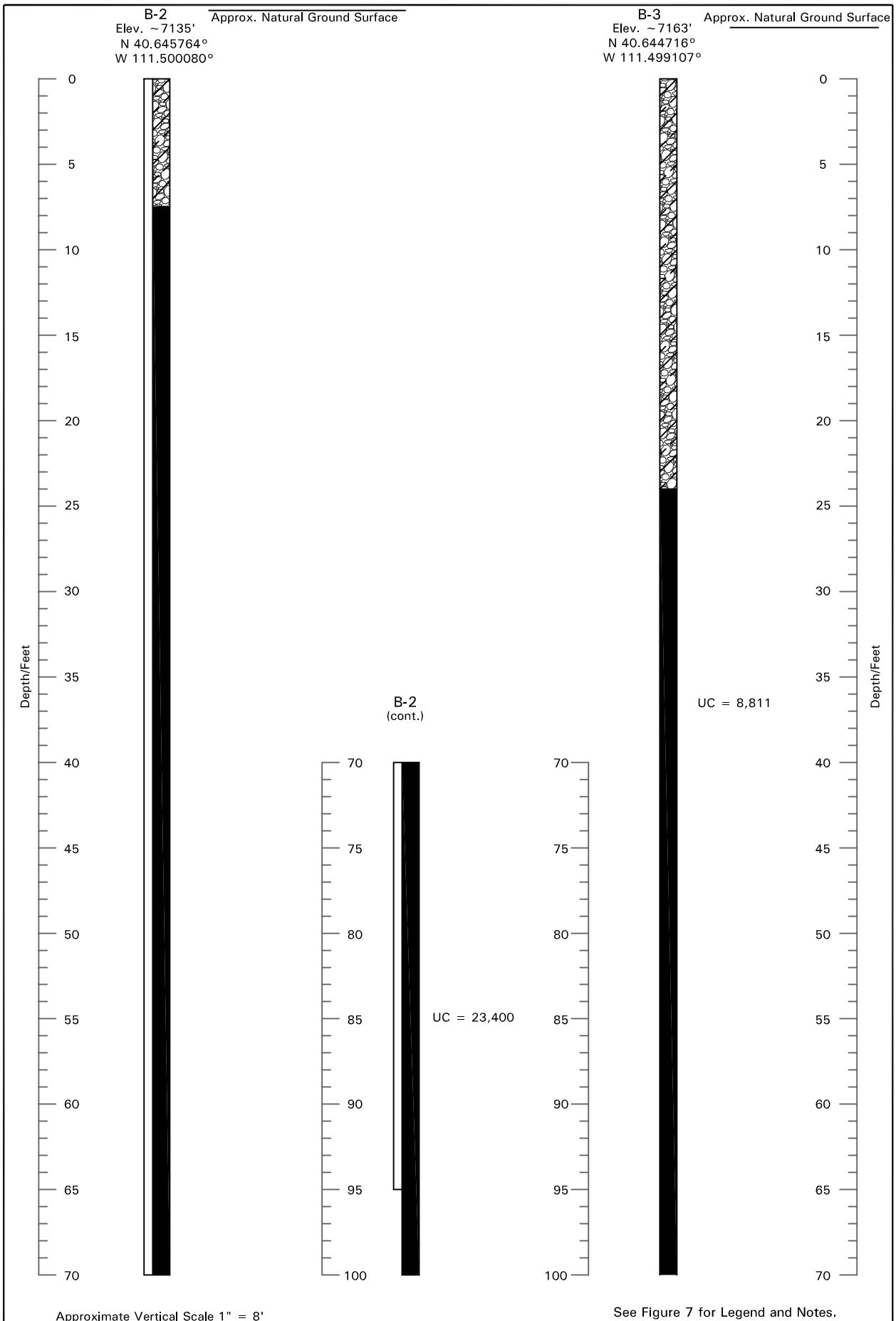
1160503	AGEC	Proposed Grading Plan with Test Pit and Exploratory Boring Locations	Figure 2



Approximate Vertical Scale 1" = 8'

See Figure 7 for Legend and Notes.

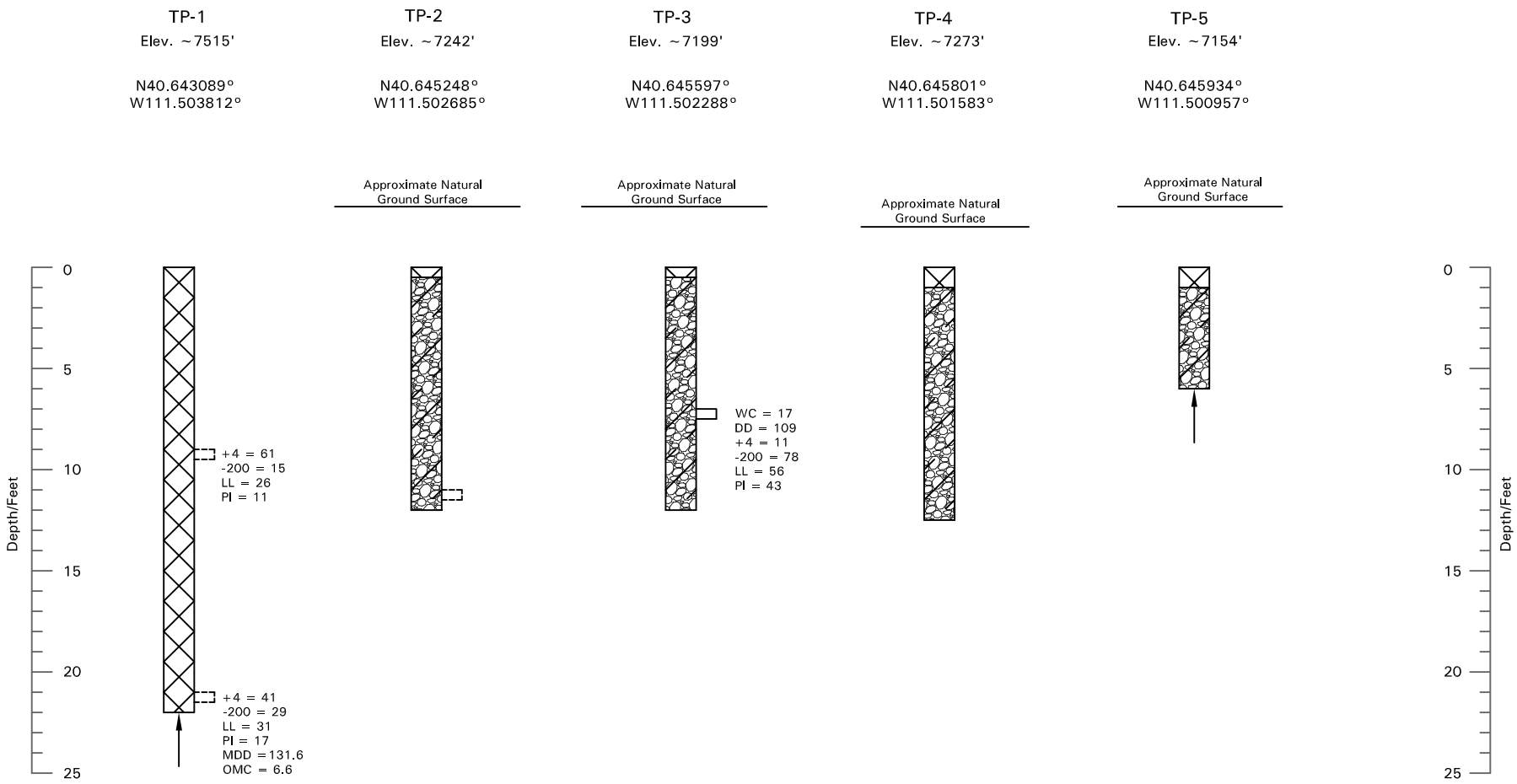
1160503	AGEC	Exploratory Boring Log	Figure 3



Approximate Vertical Scale 1" = 8'

See Figure 7 for Legend and Notes.

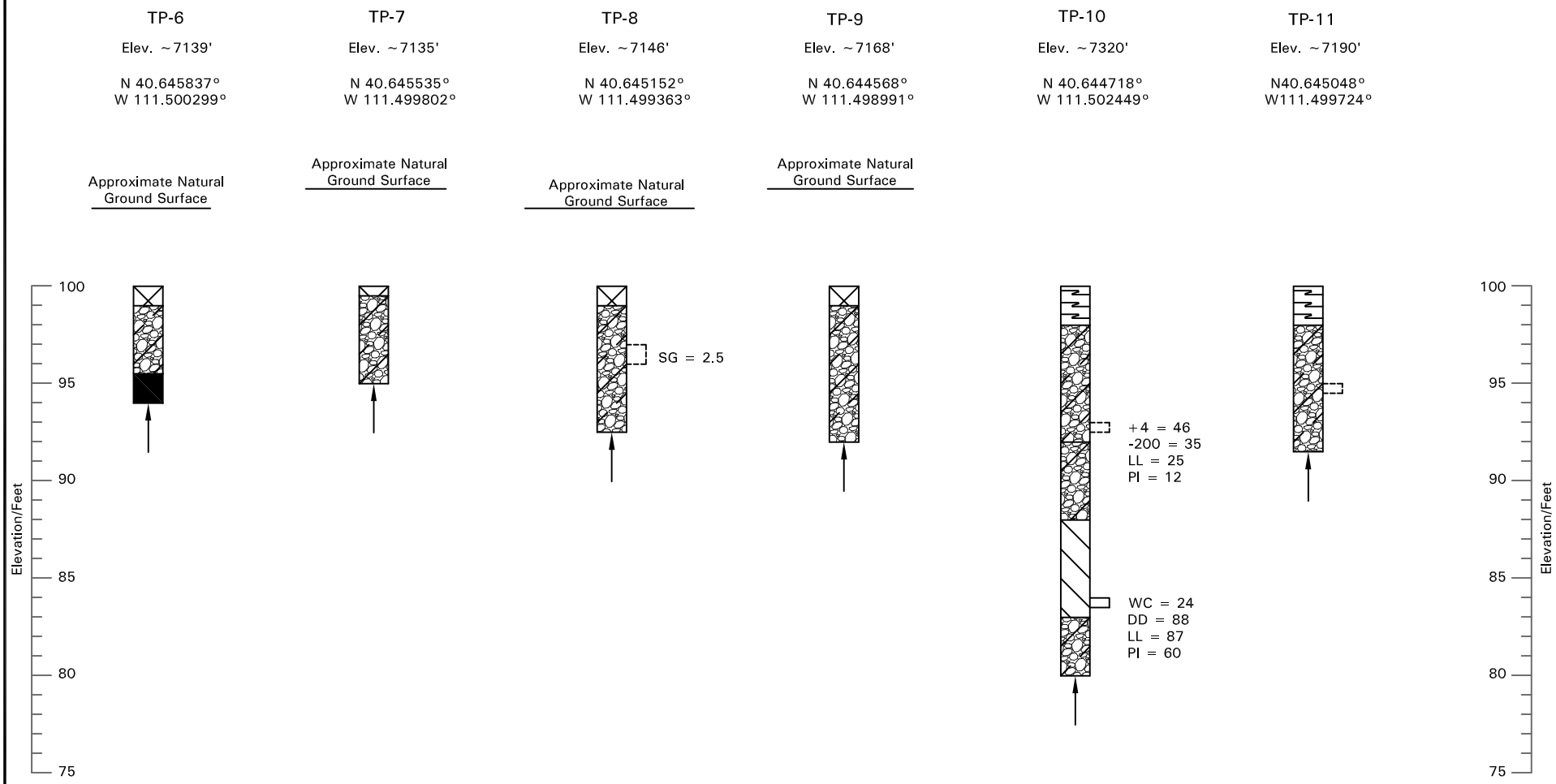
1160503	AGEC	Exploratory Boring Logs	Figure 4



Approximate Vertical Scale 1" = 8'

See Figure 7 for Legend and Notes

1160503	AGEC	Test Pit Logs	Figure 5



Approximate Vertical Scale 1" = 8'

See Figure 7 for Legend and Notes

1160503	AGEC	Test Pit Logs	Figure 6

LEGEND:

Fill; silty to clayey gravel with sand, subangular to subground gravel, cobble and boulders up to approximately 18" in size, moist to very moist, brown to reddish brown.

Topsoil; silty gravel with sand, moist, dark brown, roots and organics.

Fat Clay with Sand (CH); occasional gravel, cobble and boulders up to approximately 24 inches in size, stiff to very stiff, moist to very moist, reddish brown to yellowish brown.

Poorly-graded Gravel with Silt and Sand (GP-GM); subangular gravel, cobble and boulders up to approximately 18 inches in size, medium dense to dense, slightly moist, brown to reddish brown.

Silty to Clayey Gravel with Sand (GM/GC); Subrounded to subangular gravel, cobble and boulders up to approximately 24 inches in size, dense to very dense, slightly moist to moist, light brown to reddish brown.

Bedrock; Weber quartzite, medium hard to very hard, whitish gray to brown, slight to heavy, undulating, rough jointing, with occasional clay or sand infilling.

Indicates disturbed sample taken.

Indicates relatively undisturbed block sample taken.

Indicates slotted 1½ inch PVC pipe installed in the boring to the depth shown.

Indicates practical excavation refusal.

NOTES:

1. The test pits were excavated between August 23 and 25, 2017 with a trackhoe. The borings were drilled between August 28 and September 18, 2017 with a 5-inch diameter HQ Core Barrel.
2. The test pits and borings were located using a handheld GPS.
3. Elevations of the test pits and borings were determined by interpolation between contours shown on the site plan provided.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between materials shown on the logs represent the approximate boundaries between material types and the transitions may be gradual.
6. No free water was encountered in the test pits or borings at the time of excavation and drilling.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   +4 = Percent Retained on the No. 4 Sieve;
   -200 = Percent Passing the No. 200 Sieve;
   LL = Liquid Limit (%);
   PI = Plasticity Index (%);
   UC = Unconfined Compressive Strength (psi);
   MDD = Maximum Dry Density as determined by ASTM D-1557 (pcf);
   OMC = Optimum Moisture Content as determined by ASTM D-1557 (%);
   SG = Specific Gravity.

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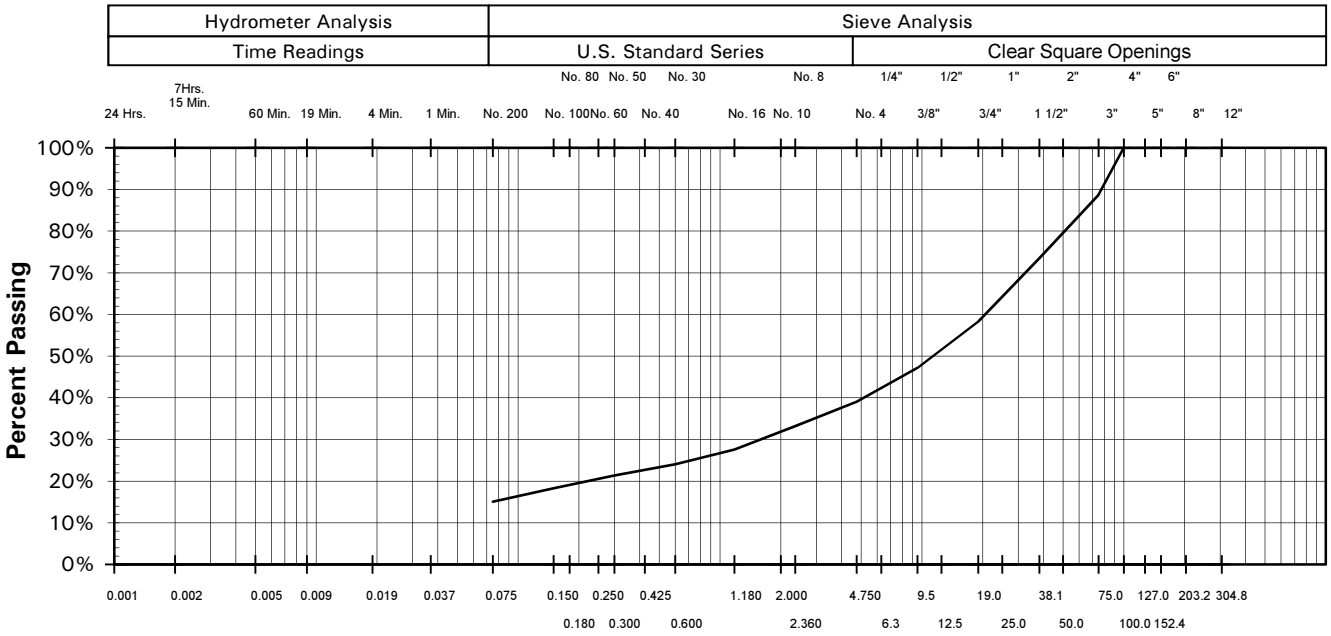
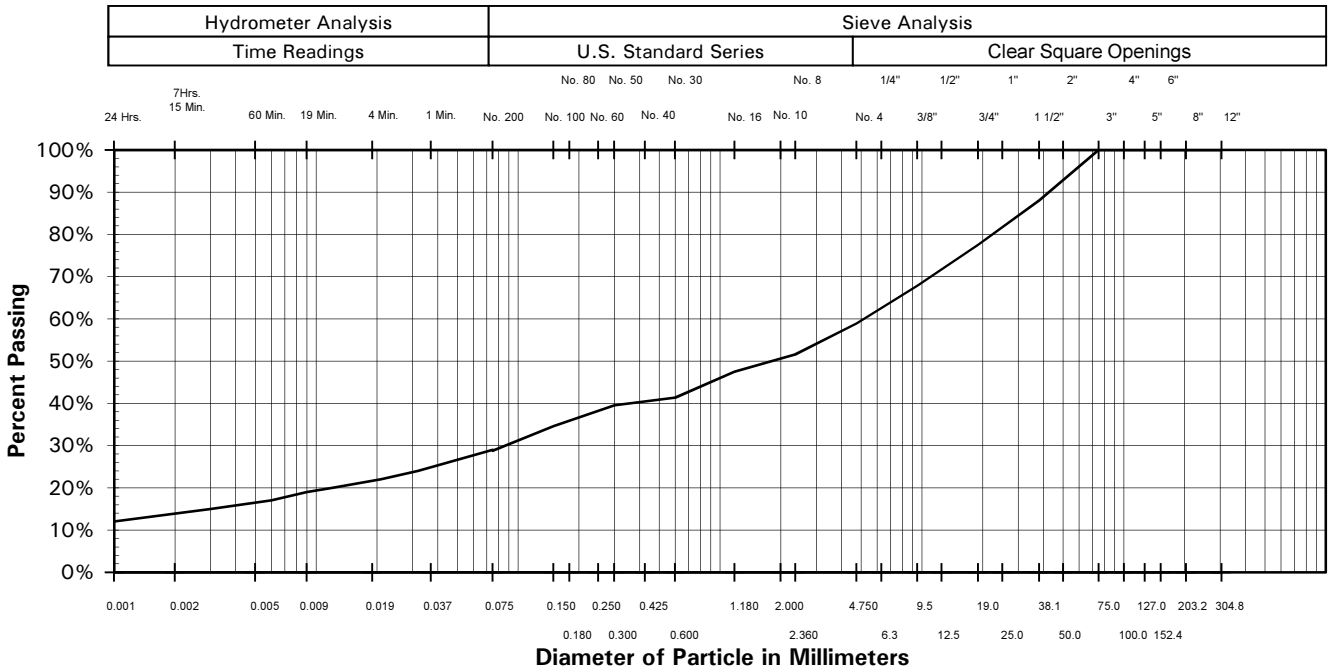


Clay to Silt	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

Gravel	61%	Liquid Limit	26%
Sand	24%	Plasticity Index	11%
Silt and Clay	15%	Sample Location	TP-1 @ 9'
Sample Description	Clayey Gravel with Sand (GC)		



Clay to Silt	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

Gravel	41%	Liquid Limit	31%
Sand	30%	Plasticity Index	17%
Silt and Clay	29%	Sample Location	Tp-1 @ 21'
Sample Description	Clayey Gravel with Sand (GC)		

Project No. 1160503 **GRADATION TEST RESULTS** Figure 8

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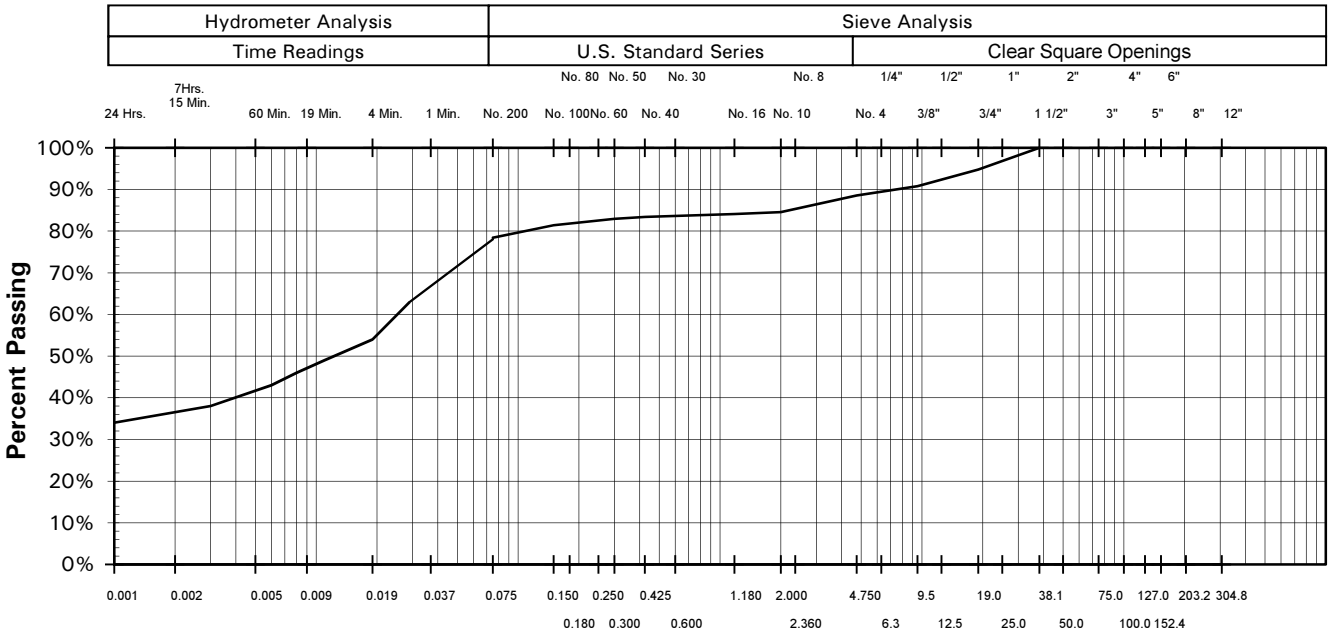
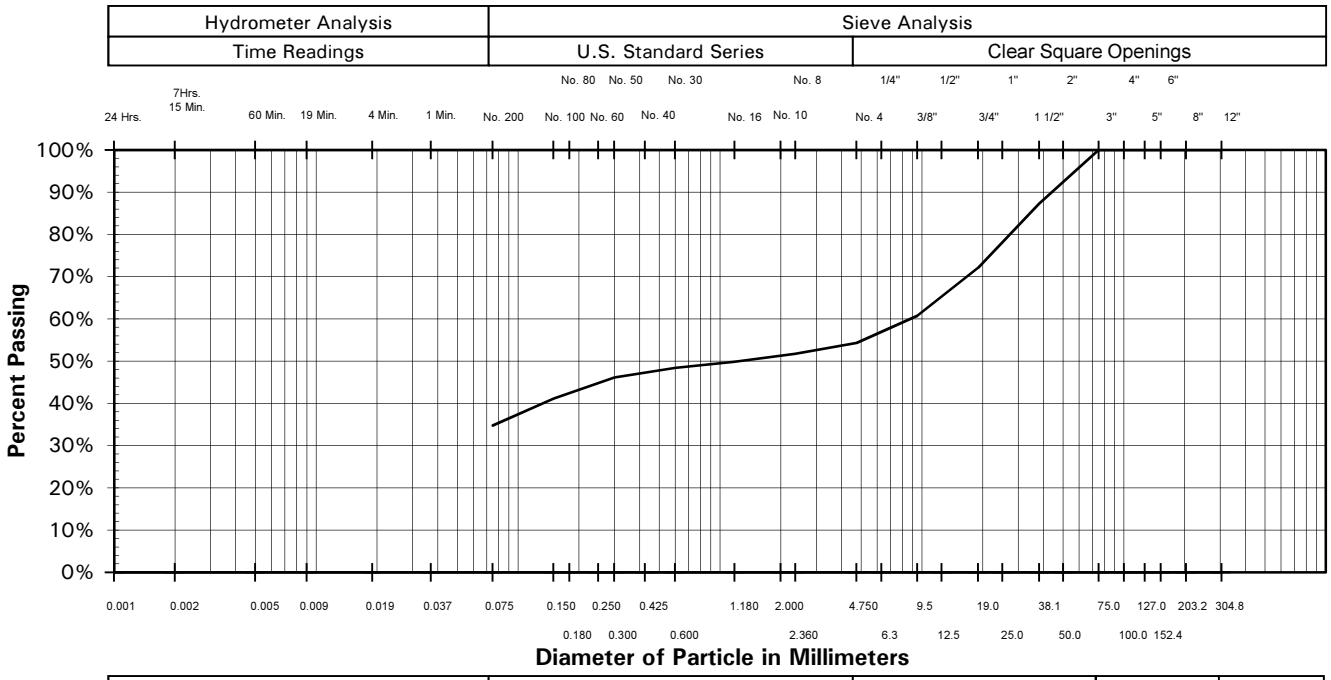


Gravel	11%	Liquid Limit	56%
Sand	11%	Plasticity Index	43%
Silt and Clay	78%	Sample Location	TP-3 @ 7'
Sample Description	Fat Clay with Sand (CH)		



Gravel	46%	Liquid Limit	25%
Sand	19%	Plasticity Index	12%
Silt and Clay	35%	Sample Location	Tp-10 @ 7'
Sample Description	Clayey Gravel with Sand (GC)		

Project No. 1160503 **GRADATION TEST RESULTS** Figure 9

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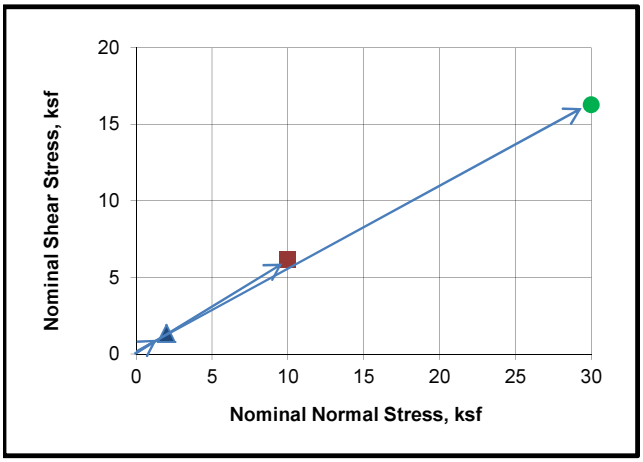
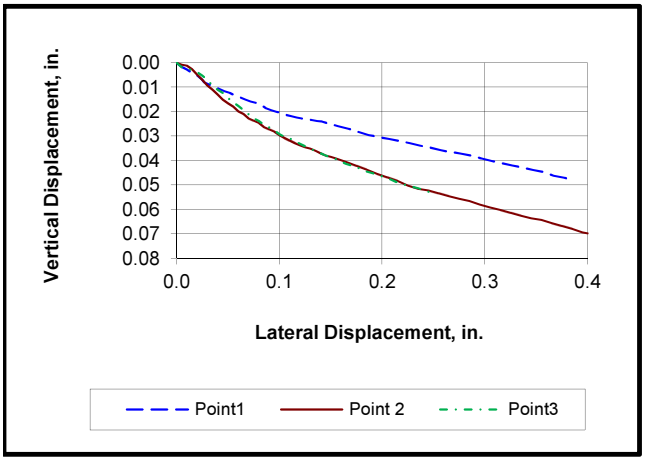
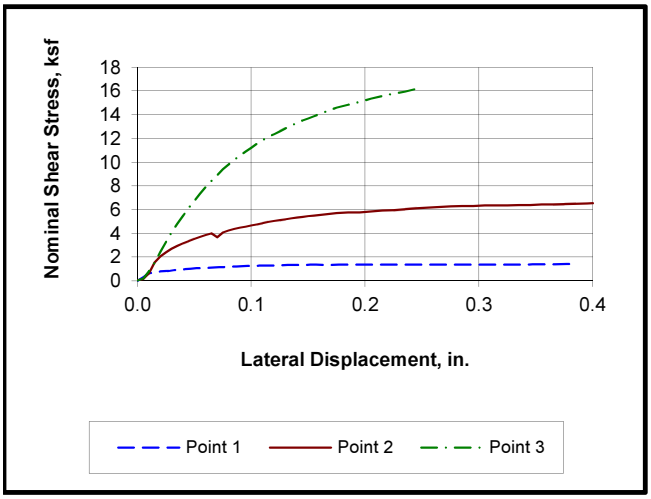






Secant Friction Angles

Nominal shear stress values were determined
lateral displacement of 0.250 inches.

Project and Sample Information			
Project Number		1160503	
Project Name		Treasure Hill	
Sample Identification		TP-1 at 21'	
Bulk Sample Description		Clayey Gravel w/ Sand	
Reduced Sample Description		Clayey Sand	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Test Type	Consolidated Drained Wetted		
Sample Type	Remolded		
Length, in.	1.00	1.00	1.00
Diameter, in.	2.42	2.42	2.42
Dry Density, pcf	111.6	111.3	111.4
Moisture Content, %	10.4	10.4	10.4
Consol. Load, ksf	2.0	10.0	30.0
Normal Load, ksf	1.98	9.98	29.99
Shear Stress, ksf	1.36	6.16	16.26
Secant Friction Angle	34	32	28
Lateral Displacement, in	0.247	0.255	0.250
Relative Lateral Displacement, %	10.20	10.54	10.33
Rate of Strain, in/min	0.001	0.001	0.001
Gap Width, in(mm)	0.187(4.75)	0.187(4.75)	0.187(4.75)

Each sample point consisted of Minus #4 Sieve material remolded to:
approx 90% of the estimated Maximum Dry Density at
approx 100% of the estimated Optimum Moisture Content
per ASTM D-1557.
Each sample point was wetted at the time of loading.

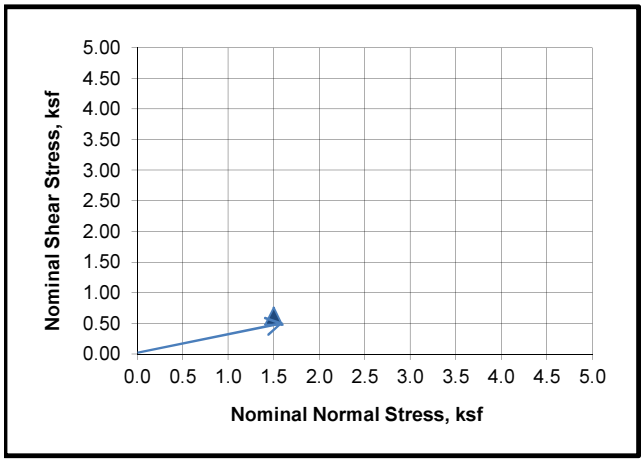
Sample Properties	
Dry Density, pcf	see above
Moisture Content, %	10.4
Liquid Limit, %	31
Plasticity Index, %	17
Clay Fraction, <0.002mm	23
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	12
Percent Medium Sand, 0.425mm-2.000mm	18
Percent Fine Sand, 0.075mm-0.425mm	21
Percent Silt, 0.005mm-0.075mm	22
Percent Clay, 0.001 mm-0.005mm	7
Percent Colloidals, <0.001mm	20

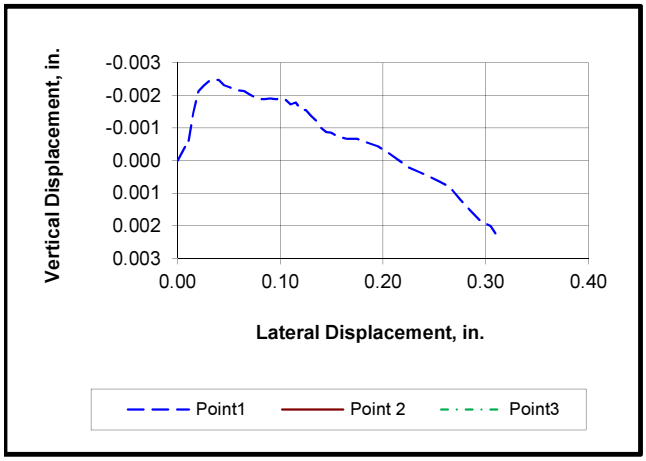
Project No. 1160503

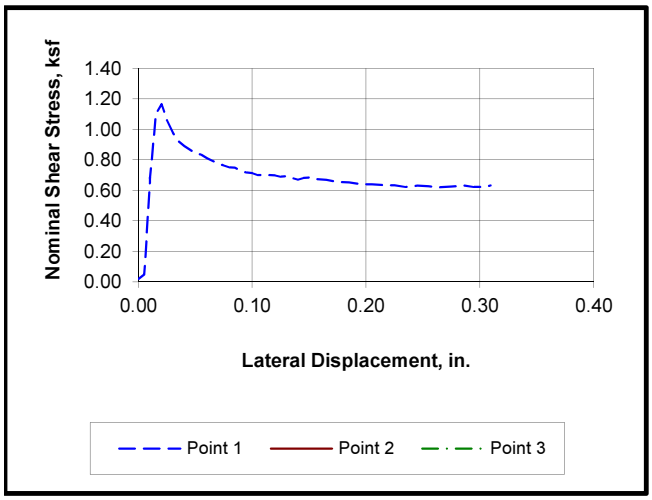
Direct Shear Results

Figure 10

Applied Geotechnical Engineering Consultants, Inc.







Secant Friction Angles

Project and Sample Information			
Project Number		1160503	
Project Name		Treasure HILL	
Sample Identification		TP-3 at 7'	
Sample Description		Fat Clay	
Test No. (Symbol)	1 (▲)	2 (■)	3 (●)
Test Type	Consolidated Drained Wetted		
Sample Type	Remolded		
Length, in.	1.00		
Diameter, in.	2.42		
Dry Density, pcf	109		
Moisture Content, %	17		
Consol. Load, ksf	1.5		
Normal Load, ksf	1.5		
Shear Stress, ksf	0.62		
Post-Peak Secant Friction Angle	22		
Lateral Displacement, in	0.265		
Relative Lateral Displacement, %	10.95		
Rate of Strain, in/min	0.0001		
Gap Width, in	0.08		

The sample point consisted of Minus #10 Sieve Material remolded to approx in-situ dry density & moisture content. The sample point was wetted at the time of loading. Gradation of Minus #10 Sieve Material given below. Atterberg Limits of Minus #40 Sieve Material provided.

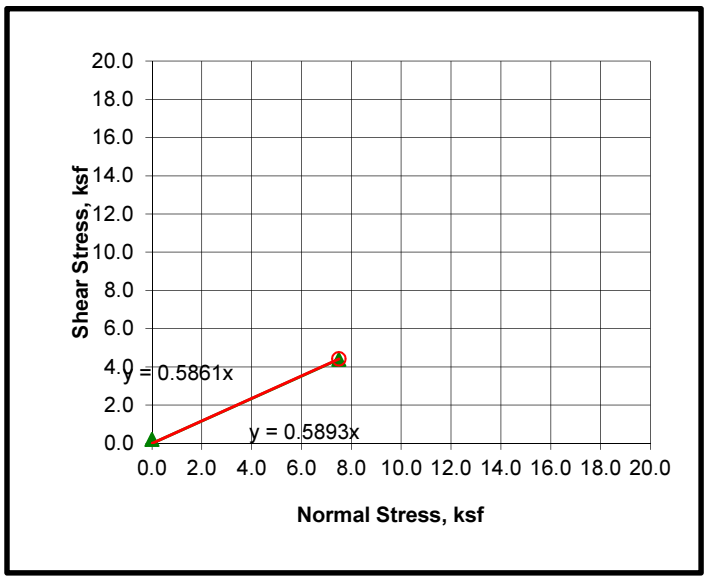
Sample Properties	
Dry Density, pcf	109
Moisture Content, %	17
Liquid Limit, %	56
Plasticity Index, %	43
Clay Fraction, <0.002mm	40.5
Percent Gravel, >4.750mm	0
Percent Coarse Sand, 2.000mm-4.750mm	0
Percent Medium Sand, 0.425mm-2.000mm	6
Percent Fine Sand, 0.075mm-0.425mm	16
Percent Silt, 0.005mm-0.075mm	31
Percent Clay, 0.001 mm-0.005mm	9
Percent Colloidals, <0.001mm	38

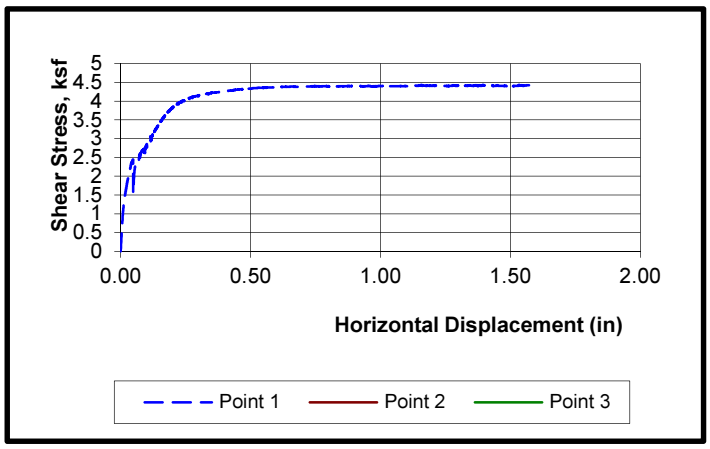
Project No. 1160503

Direct Shear Results

Figure 11

Applied Geotechnical Engineering Consultants, Inc.





Remolded Strengths	
Peak Strength:	**c = 0 psf ϕ = 30 degrees**
Residual Strength:	**c = 0 psf ϕ = 31 degrees**

Project and Sample Information	
Project Number	1160503
Project Name	Treasure Hill
Sample Identification	B-2@97 1/2'
Sample Description	Fat Clay with Sand (CH)

Test No. (Symbol)	1	2	3
Test Type	Consolidated Wetted		
Sampe Type	Remolded		
Dry Density, pcf	106.2		
Moisture Content, %	22.5		
Consol. Load, ksf	7.5		
Normal Load, ksf	7.5		
Peak Shear Stress, ksf	4.40		
Residual Shear Stress, ksf	4.42		
Rate of Strain	0.02mm/min (0.0008 in/min)		

Sample Index Properties	
Dry Density, pcf	
Moisture Content, %	
Liquid Limit, %	
Plasticity Index, %	
Percent Gravel	
Percent Sand	
Percent Passing No. 200 Sieve	

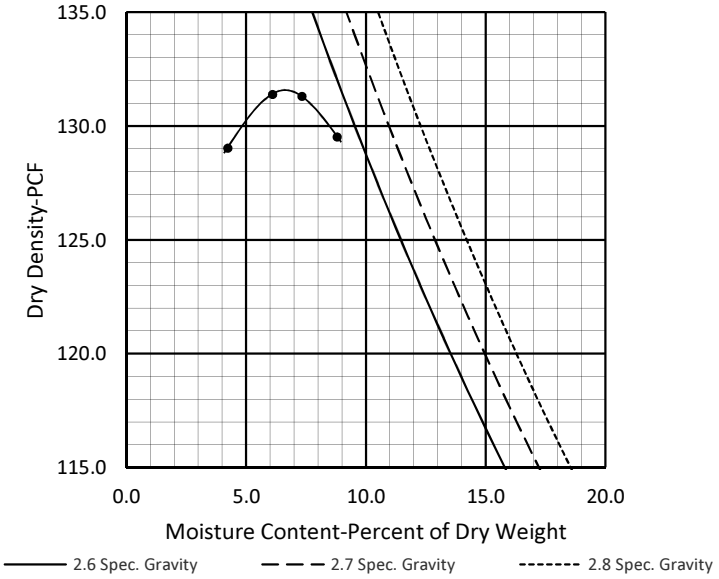
Project No. 1160503

Ring Shear Results

Figure 12

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, Inc.

Moisture - Density Relationship, Gradation, & Classification Results



SAMPLE IDENTIFICATION

Project Name:	Treasure Hill
Project No.	1160503
Sample No.	15220
Sample Location:	TP-1 at 21'
Date Sampled:	08/25/17
Sampled By:	TJN

TESTING INFORMATION

Date Tested:	10/05/17
Tested By:	JG
Reviewed By:	KBB
Test Procedure:	ASTM D1557 C
Specific Gravity:	Assumed 2.5
Moisture Curing:	Not Used

ATTERBERG DATA

Plasticity Determined by ASTM D 2488

PROCTOR RESULTS

Maximum Dry Density (Corrected)	131.6 pcf
Optimum Moisture	6.6 %
Rock Correction	*5.6 pcf*

Final Based on Microwave Oven Moisture Contents

VISUAL-MANUAL DESCRIPTION (ASTM D2488)

Clayey Gravel with Sand (GC)

GRADATION RESULTS

Sieve Designation	Sieve Opening Size (mm)	Percent Passing (%)	Project Specification (%)
5"	127	100	-
3"	76.2	100	-
1 1/2"	38.1	88	-
3/4"	19.1	78	-
3/8"	9.52	68	-
#4	4.76	59	-
#10	2	52	-
#16	1.19	47	-
#40	0.42	41	-
#50	0.297	40	-
#100	0.149	34	-
#200	0.074	29	-

GRAVEL	SAND	SILT & CLAY
41%	30%	29%

Figure 13

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER 1160503

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (PCF)	GRADATION			ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSI)	WATER SOLUBLE SULFATE (%)	SAMPLE CLASSIFICATION
BORING/ TEST PIT	DEPTH (FEET)			GRAVEL (%)	SAND (%)	SILT/ CLAY (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)			
B-1	63								16,389		Weber Quartzite
B-2	85								23,400		Weber Quartzite
B-3	37								8,811		Weber Quartzite
TP-1	9			61	24	15	26	11			Fill; Clayey Gravel with Sand
	21			41	30	29	31	17			Fill; Clayey Gravel with Sand
TP-3	7	17	109	11	11	78	56	43			Fat Clay with Sand (CH)
TP-8	3		156	100							Weber Quartzite boulder
TP-10	7			46	19	35	25	12			Clayey Gravel with Sand (GC)
	16	24	88				87	60			Fat Clay with Sand (CH)

APPENDIX

FIELD CORE LOGS

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 1 of 4

PROJECT: Treasure Hill | GROUND ELEVATION: 7245' | BORING NO: B-1

DATE STARTED: 9/6/17 | DATE COMPLETED: 9/13/17 | BORING LOCATION: 40,645642° N 111.502958° W

FIELD ENGINEER: T. Maughan | DRILLER: N. Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand

Quartzite, Slight to Moderate Jointing

Quartzite, Moderate to Heavy Jointing

Depth in Feet	Graphic Log	Sample Type	CORE DESCRIPTION	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
5		HQ CORE	Silty to Clayey Gravel with Sand. Dense to very dense, slightly moist to moist. Redish brown.	R-1 (6 feet)	42	N/A				
10				R-2 (5 feet)	75	N/A				
15			Weber Quartzite, medium hard to hard, highly weathered, whitish-gray to brown. Moderately steep bedding planes, dipping to the northwest, with jointing ranging from approximately 1-2" spacing. Undulating, rough, tight joints with little to no grayey to sandy infilling.	R-3 (5 feet)	63	0	R			
				R-4 (5 feet)	59	0	R R R R R R			
20			Weber Quartzite, hard to very hard, whitish gray to brown. Moderately steep bedding planes dipping to the northwest with jointing ranging from approximately 1-18" spacing. Undulating to planar smooth to rough joints with no to approximately 12" thick clayey gravel with sand infilling.	R-5 (5 feet)	71	27	R 6 3 R R			
25				R-6 (5 feet)	89	0	R R R 6			*R= Rubblized Core

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 2 of 4

PROJECT: Treasure Hill | GROUND ELEVATION: 7245' | BORING NO: B-1

DATE STARTED: 9/6/17 | DATE COMPLETED: 9/13/17 | BORING LOCATION: 40,645642° N 111.502958° W

FIELD ENGINEER: T. Maughan | DRILLER: N. Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand

Quartzite, Slight to Moderate Jointing

Quartzite, Moderate to Heavy Jointing

Depth in Feet	Graphic Log	Sample Type	CORE DESCRIPTION	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
		HQ CORE					R	S20°W	45°	
				R-7 (5')	98	39	4	S40°E	30°	
							R			
							4			
							R			
35							R			
				R-8 (5')	96	54	6	S30°E	70°	
							R			
							3			
40							4			
							3			
				R-9 (4'3")	85	22	6	N40°W	75°	
							R			
							9	S	50°	
45							R			
				R-10 (2')	75	0	R			
							R			
				R-11 (4'4")	75	18	R			
			~4" thick joint infilled with Clayey Gravel with Sand (~60')				6			
50							R			
							6			
				R-12 (5')	97	13	11	S60°W N10°W	50° 40°	
							R			
			~5" thick joint infilled with Clayey Gravel with Sand (~60')				R			
55							8			
							R			
				R-13 (5'5")	81	36	6			
							R			
							R			

*R = Rubblized Core

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 3 of 4

PROJECT: Treasure Hill | GROUND ELEVATION: 7245' | BORING NO: B-1

DATE STARTED: 9/6/17 | DATE COMPLETED: 9/13/17 | BORING LOCATION: 40,645642° N 111.502958° W

FIELD ENGINEER: T. Maughan | DRILLER: N. Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand
Quartzite, Slight to Moderate Jointing
Quartzite, Moderate to Heavy Jointing

Depth in Feet	Graphic Log	Sample Type	CORE DESCRIPTION	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
							4	S50°W	65°	
							2	S	75°	
			~1" thick joint infilled with clayey gravel with sand (~70°)				4	N80°W	75°	
				R-14 (4'11")	97	56	0			
65							4	S20°W	65°	
							7			
							3	N80°W	45°	
							5	S10°W	50°	
							1	S40°W	80°	
				R-15 (5')	100	60	7	S40°W	70°	
70			~1" thick joint infilled with clayey gravel with sand (~70°)				2	S20°W	75°	
							4	S30°W	75°	
								S30°W	60°	
							1	S20°W	70°	
			~½" thick joint infilled with sand (~60°)				3	N40°W	40°	
				R-16 (5')	99	81	3	S70°W	70°	
							3	N80°W	60°	
75							1	S80°W	50°	
							3	S50°W	60°	
							2	S60°E	85°	
							2	S	80°	
				R-17 (5')	95	47	5			
80							R			
							5	S40°E	55°	
							R	S	65°	
							9	N40°W	70°	
				R-18 (5')	90	10	9			
85							R			
							10	S60°W	70°	
							7			
				R-19 (5')	91	21	R			
							5			

HQ CORE

*R = Rubblized Core

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 4 of 4

PROJECT: Treasure Hill | GROUND ELEVATION: 7245' | BORING NO: B-1

DATE STARTED: 9/6/17 | DATE COMPLETED: 9/13/17 | BORING LOCATION: 40,645642° N 111.502958° W

FIELD ENGINEER: T. Maughan | DRILLER: N. Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand
Quartzite, Slight to Moderate Jointing
Quartzite, Moderate to Heavy Jointing

Depth in Feet	Graphic Log	Sample Type	CORE DESCRIPTION	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
95		HQ CORE	~½' thick joint infilled with clayey gravel with sand (~70°)	R-20 (3')	100	85	7 R 2 3 2			
			R-21 (7")		9	4	4			
			Boring terminated at 95½'							
100										
105										
110										
115										

*R = Rubblized Core

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 1 of 4

PROJECT: Treasure Hill | GROUND ELEVATION: 7135' | BORING NO: B-2

DATE STARTED: 8/28/17 | DATE COMPLETED: 9/5/17 | BORING LOCATION: 40.645764°N 111.500080°W

FIELD ENGINEER: T. Maughan | DRILLER: N.Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand

Quartzite, Slight to Moderate Jointing

Quartzite, Moderate to Heavy Jointing

Depth in Feet	Graphic Log	Sample Type	CORE DESCRIPTION	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
0			Silty to clayey gravel with sand. Dense to very dense, slightly moist to moist. Reddish brown.	R-1 (5')	57	N/A				
5				R-2 (5')	20	0	R R			
10			Weber quartzite, medium hard to hard, whitish gray to brown. Near horizontal bedding planes and steep to vertical jointing, ranging from approximately 1-30" spacing. Undulating to planar, smooth to rough joints with no to approximately 12" thick clayey gravel with sand infilling.	R-3 (½')	0	0	R			No recovery in R-3 due to blocked core barrel shoe
				R-4 (5')	37	5	R R R R	N40°E	35°	
15		HQ CORE		R-5 (3')	100	100	1 R	N25°E N55°W	10° 80°	
				R-6 (3')	100	58	3 2 3	N10°E S75°E N35°E W	90° 20° 70° 0°	
20				R-7 (1')	83	50	R	N5°W	70°	
				R-8 (1')	83	0	4			
				R-9 (2½')	100	77	3 5	N85°W	60°	
25				R-10 (2½')	100	77	1 0	N15°W	75°	
				R-11 (3')	89	24	3 4 5 5	S35°W N15°W S60°W	20° 90° 20°	

*R = Rubblized Core

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 2 of 4

PROJECT: Treasure Hill | GROUND ELEVATION: 7135' | BORING NO: B-2

DATE STARTED: 8/28/17 | DATE COMPLETED: 9/5/17 | BORING LOCATION: 40.645764°N 111.500080°W

FIELD ENGINEER: T. Maughan | DRILLER: N.Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand

Quartzite, Slight to Moderate Jointing

Quartzite, Moderate to Heavy Jointing

CORE DESCRIPTION

Depth in Feet	Graphic Log	Sample Type	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
		HQ CORE	R-12 (2')	96	75	4 5	S30°W S75°W	20° 75°	
			R-13 (3½')	92	75	4 4 3	N25°W S35°W N40°E S40°W N40°E	65° 20° 80° 20° 80°	
35			R-14 (5')	99	63	4 2 6 3 8	S10°W N45°W S35°W N20°W	30° 55° 30° 75°	
40			R-15 (½')	100	0	5			
			R-16 (½')	63	0		N20°E	80°	
			R-17 (4½')	99	59	5 4 6 5	N30°E N20°E S30°W	80° 65° 20°	
45			R-18 (1')	100	40	4	N40°E N40°E	65° 70°	
			R-19 (½')	92	0	5			
			R-20 (2')	90	20	2 R	N30°E N20°E	70° 65°	
50			R-21 (2')	100	64	3 5			
			R-22 (2½')	100	19	4 11 10	N40°E N10°W N50°E	70° 60° 55°	
55			R-23 (2')	95	23	8 R			
			R-24 (5')	100	25	R 5 5 R	N15°W N30°E N30°E	70° 70° 70°	R = Rubblized Core

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 3 of 4

PROJECT: Treasure Hill | GROUND ELEVATION: 7135' | BORING NO: B-2

DATE STARTED: 8/28/17 | DATE COMPLETED: 9/5/17 | BORING LOCATION: 40.645764°N 111.500080°W

FIELD ENGINEER: T. Maughan | DRILLER: N.Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand
Quartzite, Slight to Moderate Jointing
Quartzite, Moderate to Heavy Jointing

Depth in Feet	Graphic Log	Sample Type	CORE DESCRIPTION	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
				R-25 (5')	0^	0^		N30°E S20°E S20°W N25°E S35°W	90° 30° 35° 50° 40°	^ Inner Core Barrel shoe lost - No recovery
65								N80°W S10°E	80° 40°	
				R-26 (4')	72	13	6 R R R	S70°E	90°	
			R-27 (1'1")		100	0	R	S50°E S40°W N50°E	90° 25° 80°	
70				R-28 (5')	85	10	R R 6 R R	S30°E N10°E S70°W N10°E	20° 70° 20° 70°	
75		HQ CORE		R-29 (5')	93	8	R 12 R 6 R	S20°E N N25°E N	25° 70° 70° 75°	
80				R-30 (5')	98	80	5 5 2 6 0	S35°E N10°E S40°W S20°W S30°W	70° 65° 25° 20° 20°	
85				R-31 (5')	93	28	1 3 R 7 8	S30°E N10°E	20° 75°	*R = Rubblized Core

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 4 of 4

PROJECT: Treasure Hill | GROUND ELEVATION: 7135' | BORING NO: B-2

DATE STARTED: 8/28/17 | DATE COMPLETED: 9/5/17 | BORING LOCATION: 40.645764°N 111.500080°W

FIELD ENGINEER: T. Maughan | DRILLER: N.Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand
Quartzite, Slight to Moderate Jointing
Quartzite, Moderate to Heavy Jointing

Depth in Feet	Graphic Log	Sample Type	CORE DESCRIPTION	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
95		HQ CORE		R-32 (4½')	90	42	4 4 5 6 2			
			Joint filled with clayey gravel with sand.	R-33 (3')	99	69	2 9 R			
100				R-34 (2')	96	54	2 5			*R = Rubblized Core
			Boring terminated at 100 feet							
105										
110										
115										

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 1 of 3

PROJECT: Treasure Hill | GROUND ELEVATION: 7163' | BORING NO: B-3

DATE STARTED: 9/14/17 | DATE COMPLETED: 9/18/17 | BORING LOCATION: 40.644716°N 111.499107°W

FIELD ENGINEER: T. Maughan | DRILLER: N.Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand

Quartzite, Slight to Moderate Jointing

Quartzite, Moderate to Heavy Jointing

Depth in Feet	Graphic Log	Sample Type	CORE DESCRIPTION	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
0		HQ CORE	Silty to clayey gravel with sand. Dense to very dense, slightly moist to moist, reddish brown.	R-1 (5')	42	N/A				Camdra was not used on boring, as boring did not remain open upon removal of casing.
5				R-2 (3')	51	N/A				
				R-3 (3')	81	N/A				
10				R-4 (5')	72	N/A				
15				R-5 (5')	73	N/A				
20				R-6 (5')	100	N/A				
25			Weber quartzite, hard to very hard, whitish gray to brown. Near horizontal bedding planes and steep to vertical jointing, ranges from approximately ½ to 24 inch spacing. Undulating to planar, smooth to rough joints with no to approximately 6" thick clayey gravel with sand infilling.			35	4		60°	
							8		80°	
				R-7 (3'10")	54	0	12		80°	
							R			
							R			
							R			

*R = Rubblized Core

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 2 of 3

PROJECT: Treasure Hill | GROUND ELEVATION: 7163' | BORING NO: B-3

DATE STARTED: 9/14/17 | DATE COMPLETED: 9/18/17 | BORING LOCATION: 40.644716°N 111.499107°W

FIELD ENGINEER: T. Maughan | DRILLER: N.Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand
Quartzite, Slight to Moderate Jointing
Quartzite, Moderate to Heavy Jointing

Depth in Feet	Graphic Log	Sample Type	CORE DESCRIPTION	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
			R-8 (1'2")		100	0	R			
				R-9 (5')	93	42	5		60°	
							R		80°	
							6		20°	
							0			
35							6		85°	
				R-10 (5')	94	78	2		80°	
							0		75°	
							4		65°	
							3			
40							2			
				R-11 (5')	100	56	0			
							2			
							3		70°	
							3		60°	
45		HQ CORE					7		70°	
			~½" thick joint infilled with clayey gravel with sand (~50°)	R-12 (5')	100	39	4		50°	
							0			
							R		75°	
							R			
50							R			
				R-13 (3'3")	87	0	8		80°	
							8		70°	
							R		20°	
							R		55°	
							R		75°	
55			R-14 (1'9")		100	0	11		20°	
				R-15 (4'4")	100	0	10		20°	
							9		75°	
							10		25°	
							R		80°	

*R = Rubblized Core

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

FIELD CORE LOG

JOB NO: 1160503 | DRILL TYPE: Geoprobe 3230 | SHEET: 3 of 3

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DATE STARTED: 9/14/17 | DATE COMPLETED: 9/18/17 | BORING LOCATION: 40.644716°N 111.499107°W

FIELD ENGINEER: T. Maughan | DRILLER: N.Salazar | INCLINATION/AZIMUTH: Vertical

Silty to Clayey Gravel with Sand
Quartzite, Slight to Moderate Jointing
Quartzite, Moderate to Heavy Jointing

Depth in Feet	Graphic Log	Sample Type	CORE DESCRIPTION	Core Run (length)	Recovery (%)	RQD (%)	Fractures per Foot*	Camera Log: Joint Strike	Camera Log: Joint Dip	Drilling Comments
65		HQ CORE		R-16 (5')	60	0	R R R R R			
				R-17 (4'8")	68	0	R R R R R			*R = Rubblized Core
70			Boring terminated at 70 feet.							
75										
80										
85										