

Geotechnical Data

Geotechnical Sampling

The geotechnical investigation was performed on January 31 and February 1, 2020. Prior to the investigation, four test pit locations were designated and Arizona 811 was called to ensure that no public utilities were within the vicinity of the locations. The test pits were excavated in accordance with the Sampling and Analysis Plan (see Page 19). Four locations were excavated, one hand excavated and the other three were excavated with a backhoe (Case 580 with 18-inch bucket). The excavations ranged from about 2 feet to 4 feet below existing site grades at the approximate location shown on Figure 1 and the typical test pit characteristics can be seen in Figure 2. Logs of the test pits are presented on Page 25. Subsoils encountered during excavation were examined visually and sampled at selected depth intervals. In addition, three field infiltration tests were performed in proposed sanitary leach fields and stormwater retention basin. Ring samples and large grab samples were taken at each location. Samples were labeled according to the job, test pit location, and depth that the sample was obtained. For example of a sample label, PRH 1(0-2), PRH would have indicated the job (Pets Return Home), location 1, and the depths of 0 to 2 foot depth.



Figure 1: Test Pit Diagram



Figure 2: Typical test pit after excavation (right) and a test pit with ongoing infiltration test (left).

Ring samples were taken by a hand operated device that drives a sampler that consists of multiple rings. Figure 3 shows the device and typical ring. The rings were constructed out of brass and with dimensions of 1-inch high and an inner diameter of 2.42 inches. After the sampler had been driven into native soil, the bottom six rings were collected as a single cylinder, placed in a plastic bag, and then placed in a protective plastic sleeve with lid and labeled. This protected this type of sample so that in-site characteristics of the soil can be determined in the lab. These ring samples determined the moisture, density, and consolidation/compaction of the existing soils in place.



Figure 3: Collected sample in hand operated device (right) and sample in rings at lab (left).

Bulk or grab samples consisted of placing excavated soil in a bag that has a volume of approximately a 5-gallon-bucket. A bulk sample was collected when soil composition was noticeably different. There was a grab sample of the initial soil from the first excavation depth (approximately 2 feet) and if the field engineer deemed that the soil changed, additional samples were collected and labeled accordingly. Grab samples were collected to determine the soil classification, unit weight, and other soil properties for the design of kennel addition.

A field log was prepared for each test pit by the field engineer during the excavations. These logs contained visual classification of the materials encountered during the excavation as well as interpolation of the subsurface conditions between samples. Final logs, included starting on Page 25, represented our interpretation of the field logs and included modifications based on laboratory observations and laboratory tests of the field samples. These logs, with the results of the infiltration tests, can be found starting on Page 25. Infiltration tests were performed at Locations 2, 3, and 4, at the base of excavation with the presoak on January 31st, and the final test on February 1st.

The ASTM soil classification or Unified Soil Classification System was used to classify soils for the test pit logs. The Soil classification symbols appeared on the boring logs and are briefly described starting on page 25.

Location 1

Test pit of Location 1 was chosen due to its close proximity to the proposed expansion of the concrete slab that was planned to be used for kennel space and was hand excavated. It was located along the center of the south side of the existing kennel space. During the hand excavation, the existing concrete slab was observed (see Figure 3-4) and consisted of a simple 4 to 5 inch thick slab-on-grade (no foundation). The samples taken at this location consisted of two ring samples (one after another) at the base of existing concrete slab, and a grab sample.



Figure 4: Measurement of the existing slab.

Test pit logs indicated the observed soil classification and characteristic was Clay Sand; trace to some gravel; brown, loose, moist to wet, and might be a subbase fill. Due to the kennels being washed daily, these soils generally stay moist to wet. Excavation stopped at 2 feet.

Locations 2 and 3

Test pits at Location 2 and 3 were selected based on ease of access for the backhoe in close proximity to the kennels. A geotechnical investigation at these locations were necessary to determine a solution for the sanitary runoff from the kennels. The test pits were excavated through use of a backhoe to the depth of 4 feet. At the bottom of excavation, infiltration tests were performed according to Arizona Department of Environmental (ADEQ) "Title 18. Environmental Quality Chapter 9. Water pollution Control - R18-9-A310 - Part F" [10]. Ring samples were taken at a depth of 2 feet and bottom of excavation. These samples were used to determine in place moisture and density of existing soils. A total of four grab samples were collected at these locations; two samples were collected at each location at the same depths. First, grab samples were collected of the initial soils from 0 to 4 feet deep, and the second set were taken from the depth of 4 to 5 feet. The second grab samples consisted of the tailorings of the hand excavated soils from the 12 inch cubic pit for the infiltration test.

Test pit log of location 2 indicated visual soil classification and characteristic was Clay Sand; gravel; brown, loose to medium dense, and damp to moist. The amount of fines increased and no gravel was seen with increasing depth. Infiltration test results at location 2 was 68 minutes per inch.

Test pit log of location 3 indicated observed soil classification and characteristic at 0 to 4 feet depth of Sandy Lean Clay; trace of gravel, brown, loose, and moist. Test pit log indicated a soil change at a depth of 4 feet to Clayey Sand; some gravel, white, medium dense, moist (limestone residue soil). Infiltration test results at location 3 was 56 minutes per inch. The excavation was stopped at 4 feet depth at both locations.

Location 4

The test pit at Location 4 was selected based on observed topography and route of flow from rainfall events. This location provided the client with additional information about the soil characteristics that may be used for future projects that were not within the current scope of work. Geotechnical investigation at this location was needed to determine a solution to long-term ponding at the site. It was excavated by a backhoe to the depth of 4 feet. At the bottom of excavation, infiltration tests were performed according to ADEQ standards [10]. Ring samples were taken at the depth of 2 feet and due to the limestone at the base of excavation no ring sample was attempted. The samples will be used to determine in place moisture and density of existing soils. Grab samples were collected of the initial soils from a depth of 0 to 3 feet, from 3 to 4 feet due to an observed soil change, and of the soils that infiltration tests were performed.

Test pit log of location 4 indicated visual soil classification and characteristic of the initial soil was Clay Sand; trace of gravel, red/brown, medium dense to dense, and moist. The soil change at 3 feet consisted of a soil of the underlying limestone residue, and this was the same for the grab

sample of the infiltration test location. Infiltration test results at location 4 was 16 minutes per inch. The excavation was stopped at 4 feet deep at this location.

Geotechnical Testing

Laboratory analyses were performed on representative soil samples to aid in material classification and to estimate pertinent engineering properties of the on-site soils for the site design. Testing was performed in accordance with applicable ASTM and Arizona Methods. The following laboratory tests were performed on the collected field samples:

- Field moisture contents (ASTM D2216) [3]
- In-situ soil density (ASTM D2937) [4]
- Remolded expansion potential (ARIZ 249) [5]
- Consolidation/Compression (modified ASTM D2435) [6]
- Liquid limit and plasticity index (ASTM D4318-17e1) [7]
- Compaction proctor (ASTM D698-12e2) [8]
- Hydrometer (ASTM D7928-17) [9]

Results

Results of the laboratory tests are displayed in tables/figures below. Sample labels are synonymous with the labeling system for sample collection. Test pit #(depth of sample). Depth of samples labeled “PERK” are samples collected from the infiltration tests. Tests with multiple replicates are differentiated by the number of replicates taken.

Soil Classification

ASTM

The soil classification standard ASTM D2487 (soil classification, unified soil classification system) was used to determine the soil classification at all testing locations. Results are shown in Table 4-1. Three replicates were completed for each sample.

From the results in Table 1, it was observed that coarse grained soils (SC) were most commonly present throughout the project site.

Table 1: Soil classification results from samples taken at Locations 1, 2, 3, and 4.

Sample	1(0-2)	2(0-4)	2(PERK)	3(0-2)	3(PERK)	4(0-3)	4(3-4)	4(PERK)
	Soil Classification							
Replicate 1	SC-SM	SC	SC	SC	SC	CL	SC	SC-SM
Replicate 2	SC-SM	SC	SC	SC	SC	CL		SC-SM
Replicate 3	SC	SC	CL	SC	SC	CL		SC-SM
Average	SC-SM	SC	SC	SC	SC	CL	SC	SC-SM

Please note, that test pit four at the depth of 3 to 4 feet was only tested once. The reason is that the excavation tailoring was not enough and was contaminated with upper strata soil layer. The soil that was tested from the infiltration test is a more appropriate sampling of same weather limestone soil strata with lower levels of contamination. Test pit four soil classification from the infiltration test results showed that the soil was of a dule classification of Silty, Clayey SAND (SC-SM).

USDA

The hydrometer test was done in accordance with ASTM D7928-17 [9]. Results of the hydrometer tests performed at Test Pits 2, 3, and 4 are depicted graphically below in Figures 5, 6, and 7. The results of the hydrometer tests were used to determine the USDA soil classifications of the three test pits.

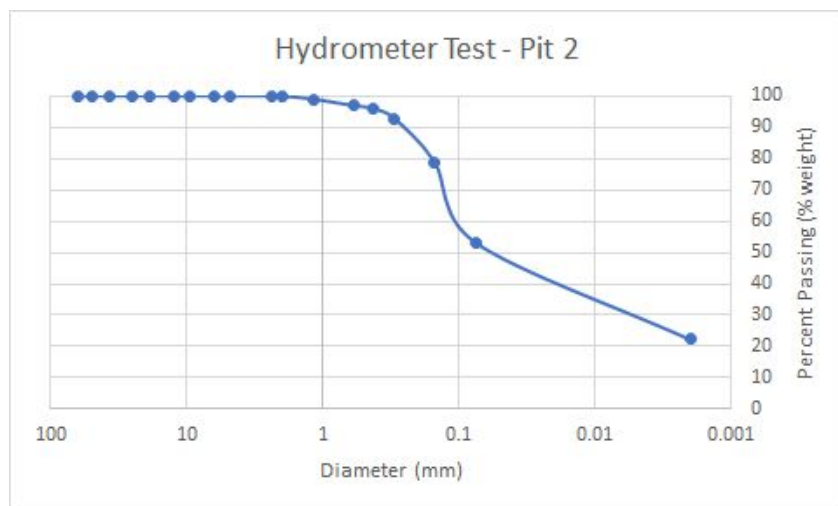


Figure 5: Results of hydrometer test at Test Pit 2.

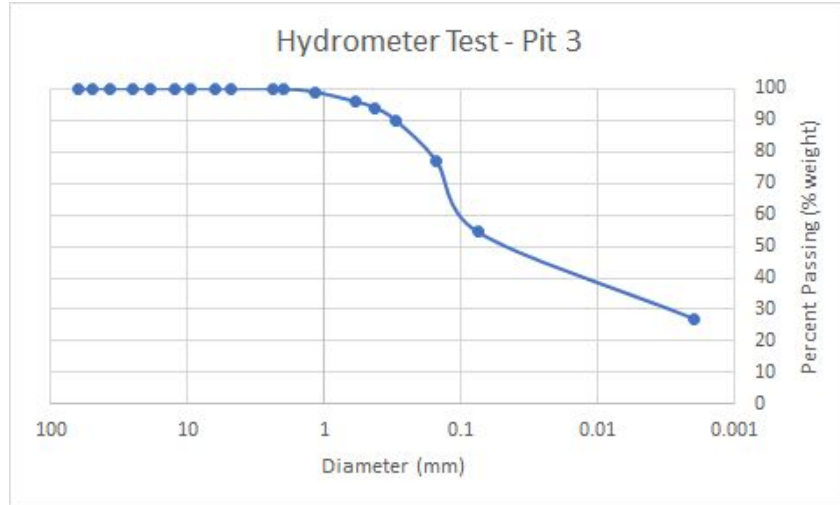


Figure 6: Results of hydrometer test at Test Pit 3.

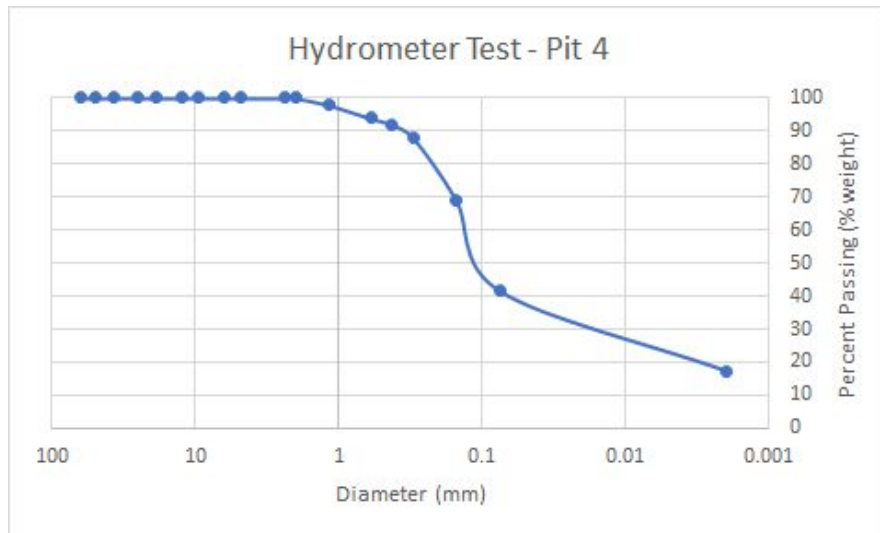


Figure 7: Results of hydrometer test at Test Pit 4.

Table 2 below shows the percentages of sand, silt, and clay for each of the test pits. These percentages were used for the USDA triangles to determine soil classification.

Table 2: Percentage of soil particles

Test Pit	% Sand	% Silt	% Clay
2	55	25	20
3	55	15	30
4	65	15	20

Figures 8, 9, and 10 depict the USDA soil texture chart at the depth of 4 to 5 feet in Test Pits 2, 3, and 4. The USDA soil texture chart results show that the soil at Test Pits 2, 3, and 4 is Sandy Clay Loam.

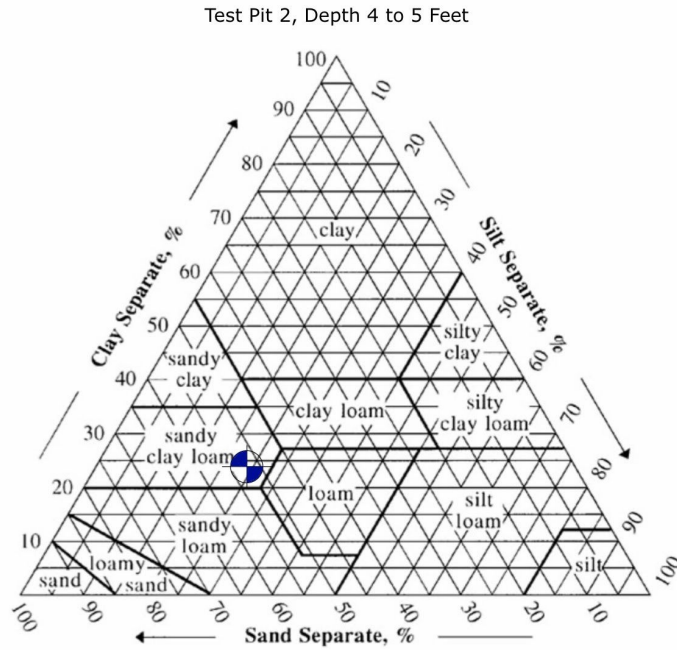


Figure 8: USDA soil texture chart for Test Pit 2 at a depth of 4 to 5 feet.

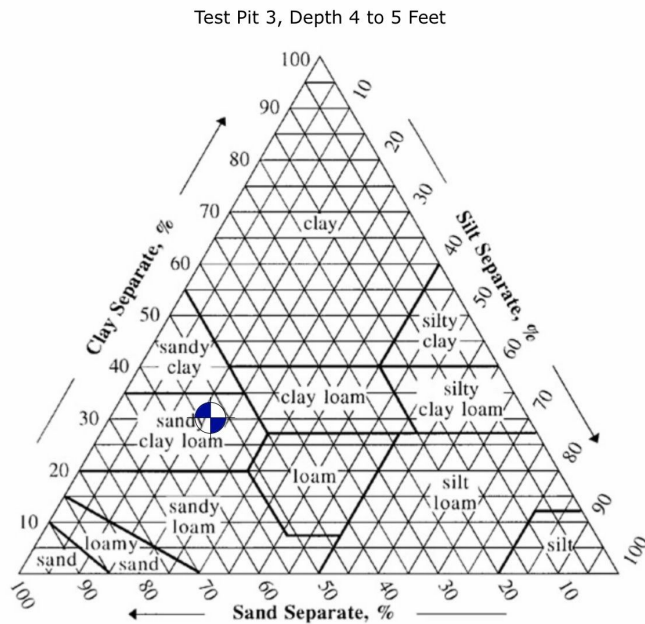


Figure 9: USDA soil texture chart for Test Pit 3 at a depth of 4 to 5 feet.

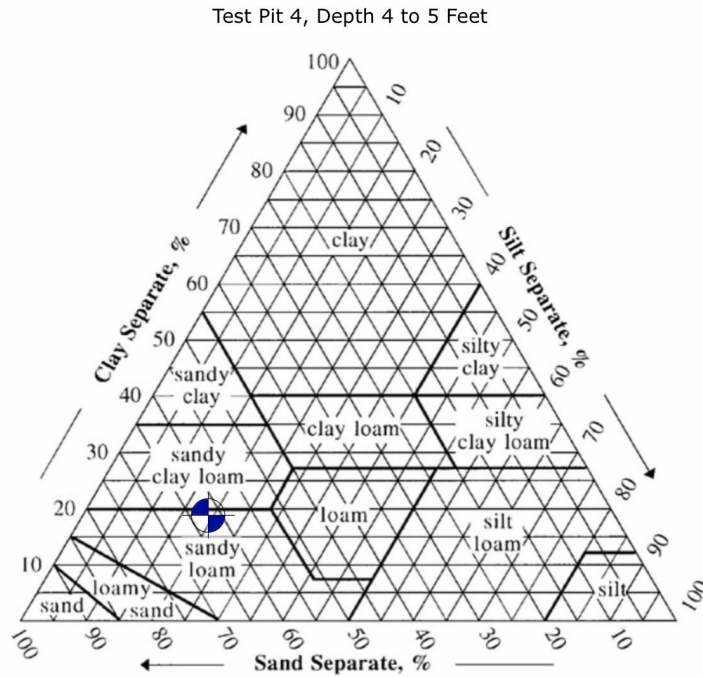


Figure 10: USDA soil texture chart for Test Pit 4 at a depth of 4 to 5 feet.

Field Moisture Contents

Table 3 shows the field moisture content (ASTM D2216 (in-place moisture content)) [3].

Table 3: Field moisture content results from samples taken at Locations 1, 2, 3, and 4.

Sample	1(0-1)	1(1-2)	2(2-3)	2(4-5)	3(2-3)	3(4-5)	4(2-3)
Field Moisture Content (%)	17.8	14.1	10.3	4.7	14.7	16.2	2.9

In-situ Soil Density

Table 4 shows the in-situ soil density (ASTM D2937 (in-place density)) [4].

Table 4: In-situ soil density results from samples taken at Locations 1, 2, 3, and 4.

Sample	1(0-1)	1(1-2)	2(2-3)	2(4-5)	3(2-3)	3(4-5)	4(2-3)
Inplace Density (lb/cu.ft)	105.6	104.5	104.6	108.4	102.3	113.4	98.2

The density observed from the lab results can be considered normal for uncompacted soil near or at surface. Often native soil is found at 85 percent of a common compaction proctor, and the in-place density depicts that. This gives an indication that the onsite soil is relatively consistent and that it is consistent with the type of soil that is encountered on site.

Remolded Expansion Potential

Remolded expansion potential tests were performed on all testing locations according to the standard ARIZ 249 [5]. Figure 11 shows the results of the test. The expansion percentages that are seen in Figure 4-4 are in the zero swell potential, 0% to 1.5%, and moderate swell potential, 1.5% to 3%. These swell potential results would be considered normal to expected from the sandy clay loam soils classifications. The standard is normal within the state of Arizona, but there are other means of determining swell potential such as a test called “expansion index”.

REMOLDED SWELLS							
TEST PIT NO.	DEPTH (FEET)	SOIL CLASSIFICATION	SOIL PROPERTY		EXPANSION		REMARKS
			INITIAL DRY DENSITY (PCF)	INITIAL WATER CONTENT (%)	SURCHARGE (KSF)	EXPANSION (%)	
1	0-2	SC-SM	112.2	10	0.1	2.3	1,2
2	0-4	SC	113.3	12.7	0.1	0	1,2
2	4-5	SC	113.3	12.7	0.1	0.6	1,2
3	0-2	SC	113.3	12.7	0.1	0.2	1,2
3	4-5	SC	111.3	13.5	0.1	0.2	1,2
4	0-3	CL	113.3	12.7	0.1	1.8	1,2
4	3-4	SC	111.3	13.5	0.1	0.7	1,2
4	4-5	SC-SM	113.3	12.7	0.1	0.1	1,2

Remarks:

1. Compacted Density (approximately 95% of ASTM D698 maximum density and -3% below optimum moisture content)
2. Submerged to approximate saturation

Figure 11: Remolded Swells

Modified Consolidation/Compression

The modified consolidation/compression test was done in accordance with modified ASTM D2435 [6] to determine how an in place soil will cope with different loads. Figures 12 and 13 show how the in-situ soil from the ring samples would handle different loads. The loads were added after the soil had stabilized from the previous load. The initial load is called the seating load and is 0.1 kpsf., and the following loads are 0.5 kpsf, 1.0 kpsf, 2.0 kpsf, saturation, and 4.0 kpsf.

The reason why this is considered a modification from a consolidation test is because the sample is not saturated from start to finish, but is saturated subsequent to loading of 2.0 kips per sq. ft. Due to the environment of Arizona soil conditions are not normally saturated but in a few cases, and to better understand how an in-situ soil supports loads with different conditions, hence the reason for the modification. This modification occurs after what would be considered the load required the soil to support a normal structure. Saturating the soil at the point sees what would happen if the footing were inundated with water and observing the hydro collapse for any potential issues.

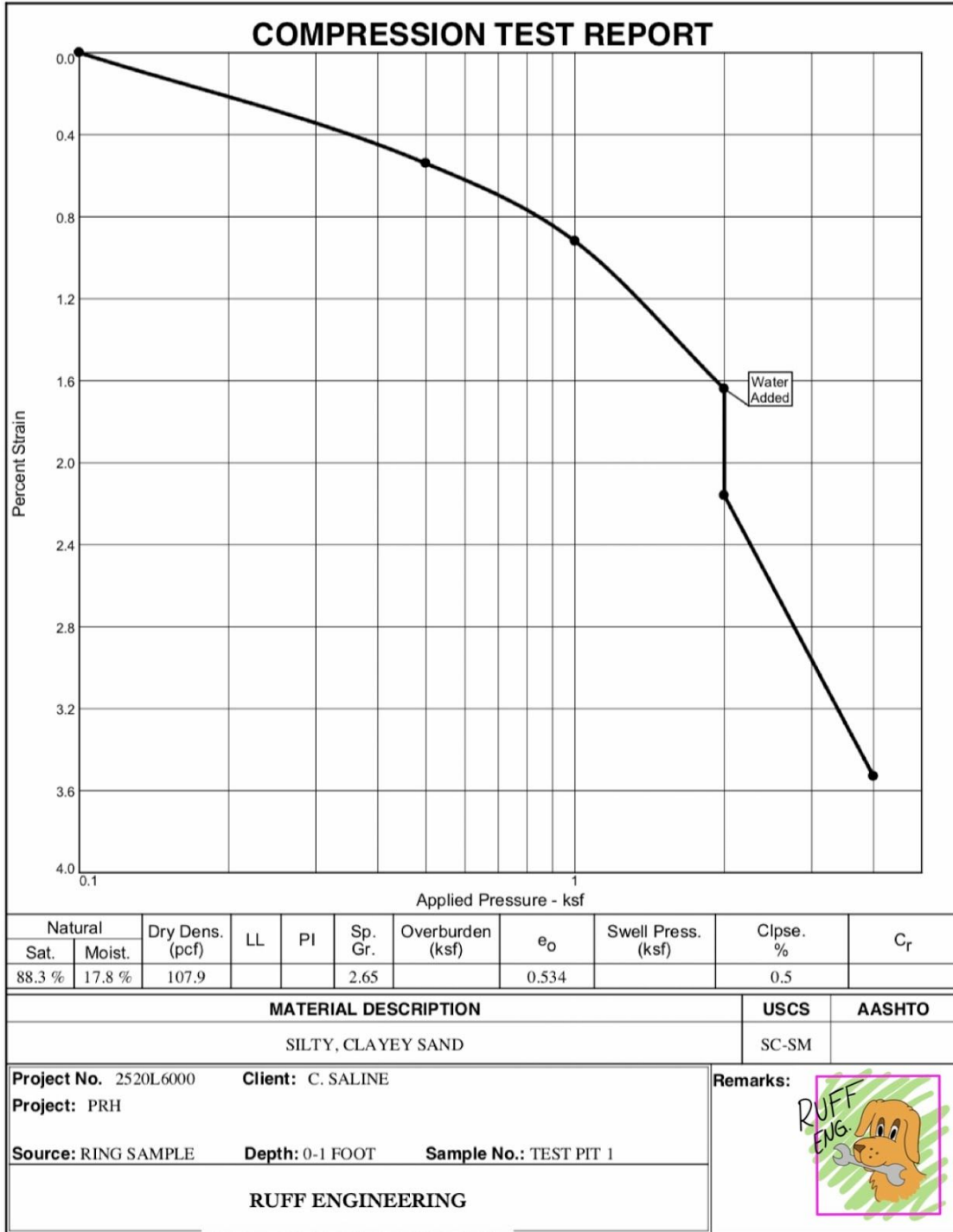


Figure 12: Location 1, 0-1 foot depth

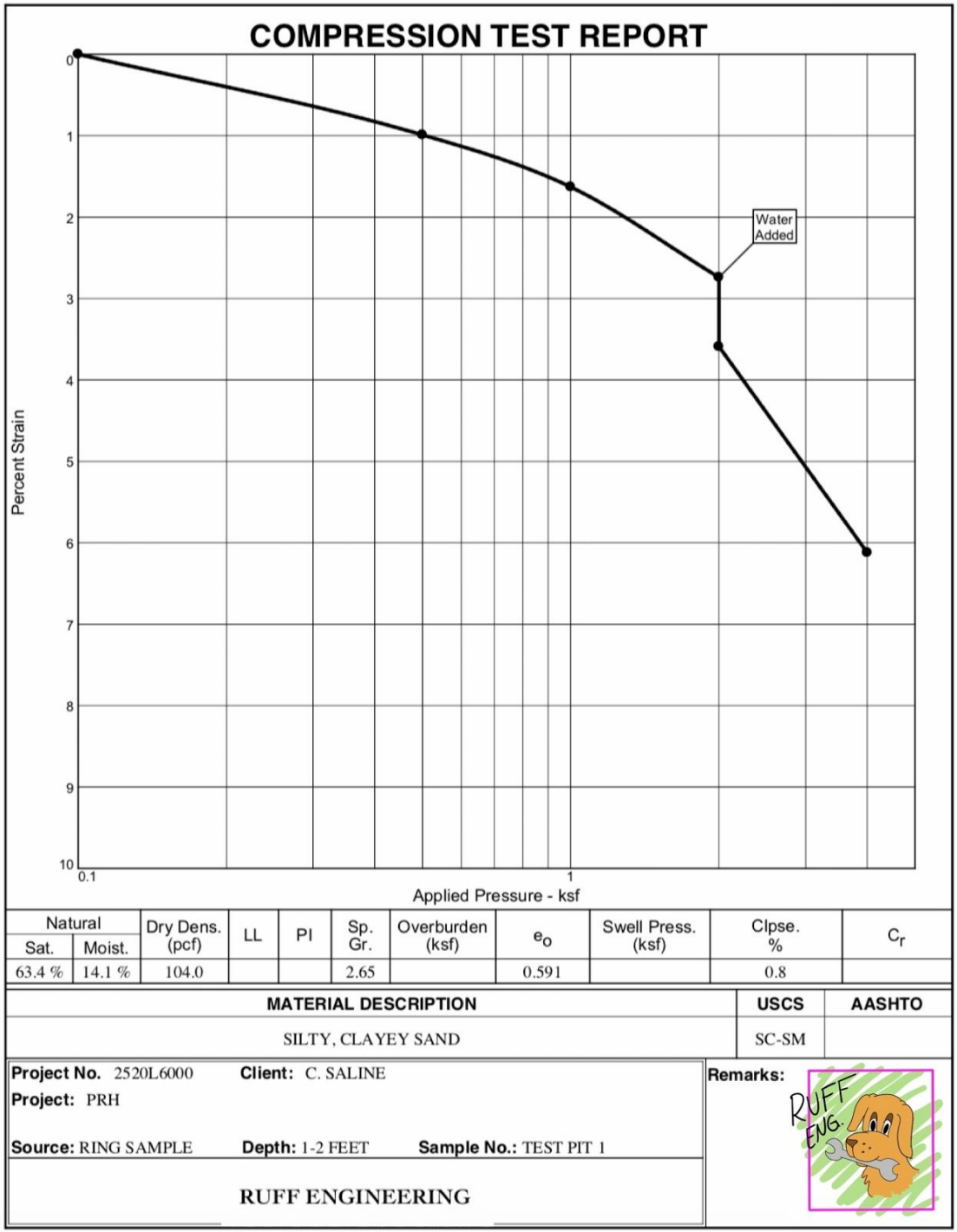


Figure 13: Location 1, 1-2 foot depth

The compaction of the surface soil can be compared to the Compaction Proctor results (see Section 4.1.7 below) and the upper sample had a compaction of 91.4 percent and the lower sample with 88.1 percent. These soils have been disturbed due to the freeze and thaw cycle, and the moisture content exacerbates this freeze and thaw condition. This condition produces gaps

between the particles in the soil causing the soil to collapse when loads are placed on them. This is why it is required to scarify and recompact the top 8” of soil under and extending 5 feet beyond the footprint of the proposed kennel. It is recommended that a large vibrating steel drum roller performs the compaction.

Liquid limit and plasticity index

Tables 5 and 6 show the liquid limit and plasticity index (ASTM D4318-17el.) [7].

Table 5: Liquid limit results from samples taken at Locations 1, 2, 3, and 4.

Sample	1(0-2)	2(0-4)	2(PERK)	3(0-2)	3(PERK)	4(0-3)	4(PERK)
	Average Liquid Limit (%)						
Replicate 1	24.00	25.00	26.00	25.00	26.00	28.00	23.00
Replicate 2	24.00	24.00	22.00	24.00	25.00	31.00	21.00
Replicate 3	24.00	24.00	24.00	25.00	25.00	28.00	23.00
Average	24.00	24.33	24.00	24.67	25.33	29.00	22.33
Standard Deviation	0.00	0.58	2.00	0.58	0.58	1.73	1.15

Table 6: Plasticity index results from samples taken at Locations 1, 2, 3, and 4.

Sample	1(0-2)	2(0-4)	2(PERK)	3(0-2)	3(PERK)	4(0-3)	4(PERK)
	Plasticity Index (%)						
Replicate 1	17.00	15.00	15.00	16.00	14.00	14.00	17.00
Replicate 2	17.00	15.00	14.00	15.00	14.00	14.00	16.00
Replicate 3	16.00	15.00	14.00	16.00	14.00	12.00	17.00
Average	16.67	15.00	14.33	15.67	14.00	13.33	16.67
Standard Deviation	0.58	0.00	0.58	0.58	0.00	1.15	0.58

Both liquid and plastic limits are the percentage of moisture content when the soil meets a particular characteristic. The liquid limit is where the moisture that is contained in the soil is causing the soil to be unstable and liquefied. While the plastic limit is when a soil has enough moisture to be considered plastic. The difference between the liquid limit and the plastic limit is the plasticity index. Despite that two different soil classifications were used they have some similarities. The plastic index results are consistent with soils of sandy clay loam.

Compaction Proctor

Compaction proctor tests were performed on the bulk sample collected from Location 1 and performed in accordance with ASTM D698-12e2 [8]. Samples from Location 1 were the only ones used because Location 1 is where the concrete pad will be. The soil compaction is only needed for a structurally sound concrete pad. Results of the test can be seen in Figure 14. A maximum density of 118.1 lbs/ft³ and optimum moisture content of 13.0% was determined. If no additional soil is used to produce grade under proposed kennel this data can be used to compare field density to determine rate of compaction and moisture content compliance.

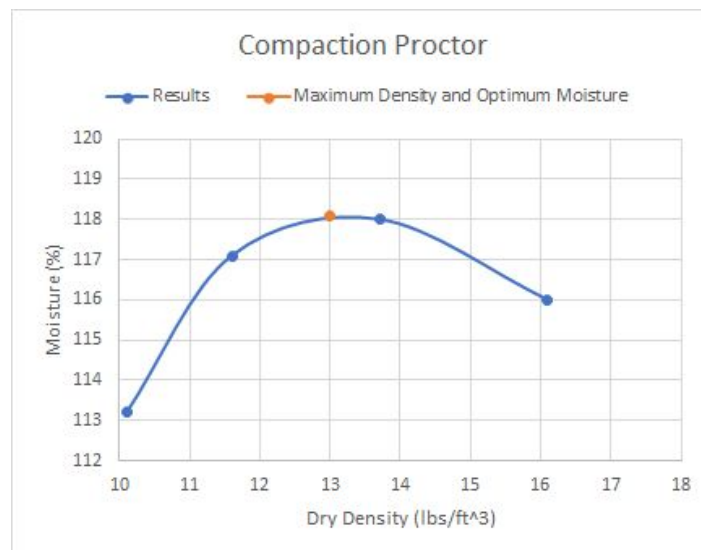


Figure 14: Results of the compaction proctor test.

Summary of Infiltration Test

Infiltration testing was performed in the field during the site visit and soil investigation according to ADEQ standards [10]. The records of the results can be found in sampling plan on Page 19. Table 7 contains the final results of the tests. Based on the results of the testing it is assumed that infiltration rates improve the further south the location is from the slab location.

Table 7: Infiltration Test Results

Infiltration Rates			
Test Pit Location	2	3	4
Percolation (mins./inch)	68	56	16

Geotechnical Evaluation

This geotechnical evaluation includes a discussion of the subsurface conditions found from the field work and laboratory testing performed (see Sections 3 and 4.1) and design recommendations required to satisfy the purpose of the project.

This report is for the exclusive purpose of providing geotechnical engineering and/or testing information and recommendations. The scope of services of this project does not include, either specifically or by implication, identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken.

General

Recommendations contained in this report are based on the understanding of the project criteria described in Section 1.0, Project Introduction, and the assumption that the soil and subsurface conditions are those disclosed by the ring samples and lab testing. Others may change the plans, final elevations, number and type of structures, foundation loads, and floor levels during design or construction. Substantially different subsurface conditions from those described herein may be encountered or become known. Any changes in the project criteria or subsurface conditions shall be brought to our attention in writing.

Slab-on-Grade Support

Meyerhof's shallow foundation equation (Equation 1) was used to determine the bearing capacity of the existing surface.

Equation 1: Meyerhof Shallow Foundation Bearing Capacity

$$q_u = c'N_c F_{cs} F_{cd} F_{ci} + qN_q F_{qs} F_{qd} F_{qi} + \frac{1}{2}\gamma B N_\gamma F_{\gamma s} F_{\gamma d} F_{\gamma i}$$

q_u = Net ultimate bearing capacity (lb/ft²)

C' = Cohesion (lb/ft²)

q = effective stress at the level of the bottom of the foundation (lb/ft²)

γ = unit weight of soil (lbs/ft³)

B = width of foundation (ft)

$F_{cs}, F_{qd}, F_{\gamma s}$ = shape factors

$F_{cd}, F_{qd}, F_{\gamma d}$ = depth factors

$F_{ci}, F_{qi}, F_{\gamma i}$ = load inclination factors

N_c, N_q, N_γ = bearing capacity factors

Equation 2: The Gross Allowable Load

$$q_{all} = q_u / FS$$

q_{all} = Net stress increase on soil (lb/ft²)

q_u = Net ultimate bearing capacity (lb/ft²)

FS = Factor of safety

Due to the project consisting of a slab-on-grade, the soil is required to support the concrete pad when the soils are in their moist or wet condition. This is not considered normal for Arizona, but is necessary due to the daily washing of the kennels. Variables of the Meyerhof's equations are determined by the soil properties determined experimentally and the structure of the slab. Due to the fact that the slab is not underground, a term of " $qN_qF_{qs}F_{qd}F_{qi}$ " is zero. The other two-thirds of the equation determined that the net ultimate bearing capacity is 21,000 psf and applying a factor of three, the net stress is 7,000 psf. A safety factor of three is customary for bearing capacity of shallow foundations. The bearing capacity accounts for how the soil will react at near saturated conditions, and soils in drier conditions are able to support more weight than when they are near their liquid form.

Drainage

The major cause of soil-related foundation and slab-on-ground problems is moisture increase in soils below structures. Properly functioning conventional slabs-on-ground require appropriately constructed and maintained site drainage conditions. Therefore, it is extremely important that positive drainage be provided during construction and maintained throughout the life of the concrete slab. It is also important that proper planning and control of landscape and irrigation practices be performed.

Scuppers and drain pipes should be designed to provide drainage away from the area for a minimum distance of 10 feet. Planters or other surface features that could retain water adjacent to a concrete pad should be avoided if at all possible. If planters and/or landscaping are adjacent to or near the slab, there will be a greater potential for moisture infiltration, soil movement and structure distress.

As a minimum, we recommend the following:

- Grades should slope away from the slab
- Planters should slope away from the house and should not pond water. Drains should be installed in enclosed planters to facilitate flow out of the planters.
- Only shallow rooted landscaping should be used.
- Watering should be kept to a minimum. Irrigation systems should be situated on the far side of any planting and away from the slab to minimize infiltration beneath foundations from possible leaks.
- Trees should be planted no closer than a distance equal to three-quarters of their mature height or 15 feet, whichever is greater.
- It should be understood that these recommendations will help minimize the potential for soil movement and resulting distress, but will not eliminate this potential.

Additional Infiltration Testing

The infiltration tests performed at Testing Sites 2, 3, and 4 show that infiltration increases with distance is from the proposed slab-on-grade location. To prevent moisture increase beneath the slab and improve infiltration, it is recommended that the proposed drainage design be placed further away from the slab than initially observed during the initial site visit. Additional testing in the proposed location is recommended to support this assumption.

Sampling and Analysis Plan

Pets Return Home Project

4555 N. Peyton Place Clarkdale, AZ

Ruff Engineering

**Ryann DuBose, Abigail Autieri, Allyson Fedor, Crockett Saline
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**Northern Arizona University
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January 26, 2020

1.0 Purpose

The plan details tools, safety equipment, test locations (location and depth), sample volume, storage of samples, type of lab tests to be performed, and where the lab testing will occur for the Pets Return Home (PRH) project.

2.0 Tools and Safety Equipment

The following personal protective equipment will be used:

- Hardhat
- Closed-toe shoes (i.e. boots or tennis shoes)
- Leather gloves
- Hearing protection (ear plugs/ear muffs)
- Eye protection (i.e. construction glasses/goggles)

Additionally, a safety officer will be assigned to monitor and correct personnel when a safety violation is observed. This responsibility will rotate throughout the time in both the field and the laboratory. The safety officer will be Crockett.

The following hand tools will be used:

- Shovel
- Ring driving (with appropriate tools)
- Tape measure
- Digging bar
- Infiltration monitors
- Buckets

3.0 Samples

Samples will consist of bulk, ring samples, and if needed a few cobbles or boulders. Bulk samples will be contained in either a 5-gallon bucket or a bag. Ring samples are extracted from the native ground using brass rings. Ring samples are placed in small plastic bags and then placed in a hardened plastic cylinder to ensure that the sample stays in the conditions that it was extracted.

A different bulk sample will be taken for each different soil type that is encountered during the excavation. These samples will be labeled according to job indicator then followed by locations and depth on the side of the bucket or bag. For example, PRH 1(0-4), this indicates that this sample was collected at the job that correlates to that number of PRH and location 1 at the depths

of 0 through 4 feet. The sample size will consist of a full 5-gallon-bucket or bag (approximately 5 gallons) to ensure that a sufficient amount of sample is obtained.

Ring samples consist of six 1-inch thick rings with an inner diameter of 2.42 inches. These samples are forced into undisturbed native soils to a depth of 8 to 12 inches. By forcing the rings into place or virgin soil, the six rings will be filled with samples that consist of soil in close native or onsite conditions. At locations one (adjacent to existing kennels), ring samples will be taken at the base of slab or footing. In location two through four, ring samples are to be taken at depths of 2 feet and at the base of excavation (approximated depth of three to four feet). Ring sample labels will consist of masking tape on the top of the outer ring sample casings lid. The masking tape serves two purposes, showing the orientation of the sample, and a removable surface to act as a label. The rings will be labeled in the same format as the bulk samples with the job indicator first then following location and then depth. For example, PRH 1(2-3) These samples are to indicate the conditions of the existing soils.

During the investigation, if the soil conditions are not suitable to obtain ring samples because the soil is rocky, a cobble or boulder sample will be collected. These samples will be used to perform compressive strength tests in the laboratory.

These samples will be stored at Western Technologies (WT) Flagstaff facilities and will be held until the project is completed. The disposal of soil samples will be through the local trash dump. The disposal of testing materials containing chemical contaminants, such as hydrometers, will be done by WT in a 55-gallon drum that is picked up every 1 to 2 years by a third party.

4.0 Test Locations

There are four proposed test locations. These test locations can move as needed by the client's needs or request, location of utilities, and the discretion of the field engineer. For proposed test locations see in Figure 4.1 below, marked by the circles with crosses.



Location 1: Adjacent To Existing Kennels

This location is to investigate the existing kennel pad. The investigation is needed to see the details of the previous construction of the slab/foundation, and to collect samples of existing fill and its condition. The test pit will be dug excavated by hand and should be no deeper than the depth of slab or footing of foundation. A bulk sample will be taken of every soil type and a ring sample will be taken at the base of slab or footing.

Locations 2, 3, and 4: Additional Development Requiring Infiltration Testing

These locations are to be excavated with a backhoe to the approximate depth of a potential leach field (generally 3 to 4 feet deep) or base of any proposed basins. Bulk Samples will be collected of any soil change during the excavations. These locations will be excavated to a depth of approximately 2 feet to attempt to extract a ring sample. After the 2 foot attempt of the ring sample, excavation will resume to the depth of 3 to 4 feet to again attempt another ring sample. At the base of excavation a 12-inch cube is to be hand excavated to perform an infiltration test according to the Arizona Department of Environmental Quality (ADEQ). Hand excavations of the 12-inch cube space are to be collected as a bulk sample of its own. Additional bulk samples are to be taken of the trench tailoring each soil type excavated with ring samples taken at approximately 2 feet deep and at the base of the excavation. Infiltration tests are generally

performed the following day. This means test pits will remain open overnight and will require backfill after the test is completed.

Other information that will be collected on site Boring/Test logs and Site Checklist will be utilized to record the finding of the field investigations. These logs will document the sample types with their locations and depth, blow counts of ring samples, water table (if encountered), and description of soil encountered (described by field engineer). For an example of a Boring/Test Log form refer to the Appendices, Plate A-1. Site Checklist will be filled out on site, and this form documents relevant information about the site's conditions. For an example of a Checklist form refer to the Appendices, Plate A-2 and A-3.

5.0 Laboratory Test

Following the field investigation a Sample of Receiving Order and Schedule of Tests Sheet will be filled with the inventory of the field samples taken from the field. For an example of a Sample of Receiving Order and Schedule of Tests Sheet form refer to Appendices, Plate B-1

The following laboratory may be tests may be performed on the collected field samples:

- Field moisture contents (ASTM D2216) [3]
- In-situ soil density (ASTM D2937) [4]
- Remolded expansion potential (ARIZ 249) [5]
- Compression (modified ASTM D2435) [6]
- Liquid limit and plasticity index (ASTM D4318-17e1) [7]
- Compressive strength test of rock sample (ASTM C39/C39M) [28]
- Compaction proctor (ASTM D698-12e2) [8]
- Hydrometer (ASTM D7928-17) [9]

The samples collected will be classified by ASTM D2487-17 [29] standards, but the bulk samples from the infiltration test will be classified by United State Department of Agriculture (USDA) [30] standards given the regulations put forth by ADEQ [10].

Tests will be conducted three times to ensure precision of results. Tests such as ASTM soil classifications, remodeled expansion potential, and compressive strength test of rock cores (if samples were obtained in the field) will each be performed in triplicates.

6.0 Experimental Matrix

The experimental matrix below will be used for data collection.

ASTM #:

Test Location	Result 1	Result 2	Result 3	Average	Standard Deviation
1					
2					
3					
4					

7.0 Quality Control and Quality Assurance

To ensure that quality control and assurance will be maintained through the sample collection and soil testing (in field and lab) a QC/QA officer, for this case Abigail, will be assigned to observe and manage one of the members of the team. Quality assurance in the field will be managed by ensuring the samples collected are collected without bias, the mass collected is approximately 5-gallons, and labeled clearly and correctly. In the laboratory, quality assurance will be managed through the review of the ASTM standard testing procedures before, during, and after each test. The responsibility of QC/QA officer will be Abigail throughout both field and laboratory.

Quality control will be maintained through the sample collection and soil testing by completing calculation checks and recording multiple results of the same test for the same sample. Using engineering judgement, a standard deviation of significant value will be used to determine if more replicate tests need to be completed for the sample.

- LOG OF BORING-NO. 2 ^{Test Pit}

Project PRH Job No. PRH Date 1/31
 Elevation Top of Hole 34° 48' 44.01" 112° 3' 11.76" Prepared By OC. Sime
 Type / Size of Boring 180" Bucket Rig Type S80 Driller Case Reviewed By _____ Date _____

DEPTH, FEET	PENETRATION RESISTANCE BLOW / FOOT		SAMPLE TYPE	DRY DENSITY, PCF	WATER CONTENT, %	SOIL CLASSIFICATION	SOIL TYPE DESCRIPTION (Modifier, Color, Density, Moisture, etc.)	MAXIMUM SIZE	PARTICLE SIZE DISTRIBUTION, %			GRADATION	RELATIVE DENSITY	PLASTICITY	CONSISTENCY	CEMENTATION	
	C	N/R							GRAVEL	SAND	SILT & CLAY						
1																	
2			G			SC	Clayey Sand: 1/2 gravel, Brown/ tan, moist damp to moist increase of clay w/ depth No gravel w/ depth Excursion to stopped Cf										
3	25		R														
4																	
5	35		R														
6																	
7																	
8																	
9																	
0																	
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
0																	

GROUNDWATER CONDITIONS: Date _____ No Groundwater Encountered _____
 Date _____ Time _____ Depth _____
 Date _____ Time _____ Depth _____

Results of Infiltration Test at Site 2

	4 1/2	Test		
		2/1		Hour
1.)	8:35	9:35	1"	<u>Hour</u>
2.)	9:41	9:58	1/4	<u>in</u>
3.)	9:59	10:28 10:16	1/4	20 68 <u>mm</u>
				<u>in</u>
4.)	10:19	10:36	1/4	68 <u>mm</u>
				<u>in</u>

Pre Soak 1/31
2:57 PM

Results of Infiltration Test at Site 3

	test 2/1			Per inch
1.)	8:30	9:20	1"	50mm
2.)	9:23	9:43	3/8"	53.3m
3.)	9:45	10:06	3/8"	56.0m
4	10:00	10:21	3/8"	56.0

Pre-soak 1/31
2:15 PM

Results of Infiltration Test at Site 4

9"	test	2/1	
10:32	10:51	1.75	to 11
10:52	10:56	1/4	24 16
10:57	11:01	1/4	34 16
11:01	11:05	1/4	16

Pre-Soak 1/31
3:45