Geotechnical Engineering Report
New Parking Lots, Drop-off Lanes
and Basketball Court
Sahuaro Elementary School
12835 North 33rd Avenue
Phoenix, Arizona
RAMM Project No. G23919

Expires 3/31/2019

For:
Alexander Building Co., Inc.
7550 East Main Street
Scottsdale, Arizona 85251

◆◆◆

By:
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Geotechnical Engineering • Construction Materials Testing

R·A·M·M

Alexander Building Co., Inc.
7550 East Main Street
Scottsdale, Arizona 85251

April 10, 2017

Attention: Jeff Keck, Senior Project Manager

Subject: Geotechnical Engineering Report
New Parking Lots, Drop-off Lanes and Basketball Court
Sahuaro Elementary School
12835 North 33rd Avenue
Phoenix, Arizona

RAMM Project No. G23919

Attached to this letter is the Geotechnical Engineering Report for the proposed New Parking Lots, Drop-off Lanes and Basketball Court at Sahuaro Elementary School in Phoenix, Arizona.

The project will include improving an existing parking lot in the southwest part of the school building area, improving an existing larger parking lot in the northwest corner of the site, expanding this parking lot to the east along the south side of Sweetwater Avenue and adding S-shaped two bus/parent drop-off lanes along the south side of the existing northwest parking lot and extending these lanes between the new adjacent parking lot to the north and the existing school building to the south, east to the end of the new parking lot. The east part of the drop-off lanes then curves to the north to exit onto Sweetwater Avenue. The new post-tensioned concrete basketball court will be located in the play field area east of the north building and south of the new drop-off loop lanes. The results of our field explorations; laboratory testing; and engineering analysis, evaluation and recommendations are presented in the report.

The attached report was prepared based on project and site data available at this time and was prepared in a manner and to the standards of the local geotechnical engineering practice. Our services did not include evaluations for the presence of hazardous materials; for concrete durability and corrosion potential with respect to site use water sources; for area subsidence resulting from groundwater withdrawal or other geologic hazards.

If you have any questions, please do not hesitate to call.

Respectfully submitted,
RICKER • ATKINSON • McBEE • MORMAN & ASSOCIATES, INC.

Expires – 3/31/2019

By: Kenneth L. Ricker, P.E.

/dh
Copies to: Addressee (jkeck@abccre.com)

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Registered Professional Engineer (Civil) CERTIFICATE NO. 10971 KENNETH L. RICKER Date Signed 4-10-17 ARIZONA U.S.A.

Expires 3/31/2019

REPORT

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INTRODUCTION

This report presents the results of our geotechnical engineering services for the proposed New Parking Lots, Drop-off Lanes and Basketball Court at Sahuaro Elementary School in Phoenix, Arizona. The scope of our services included performing a field exploration program, laboratory analysis and geotechnical engineering evaluation, analysis and recommendations. The geotechnical recommendations presented herein include those for pavement rehabilitation and design, post-tensioned basketball court design, material use and requirements, and site preparation and grading procedures. We would be pleased to discuss with you any additional recommendations you may require. In addition, we are available to review project specifications and plans for conformance with our recommendations at no charge to you.

This firm should be notified for additional evaluation and recommendations should the project design parameters (traffic type, alignment, etc.), site use or conditions encountered during construction differ from those presented herein.

PROPOSED CONSTRUCTION

The project will include improving an existing parking lot in the southwest part of the school building area, improving an existing larger parking lot in the northwest corner of the site, expanding this parking lot to the east along the south side of Sweetwater Avenue and adding S-shaped two bus/parent drop-off lanes along the south side of the existing northwest parking lot and extending these lanes between the new adjacent parking lot to the north and the existing school building to the south, east to the end of the new parking lot. The east part of the drop-off lanes then curves to the north to exit onto Sweetwater Avenue. The new post-tensioned concrete basketball court will be located in the play field area east of the north building and south of the new drop-off loop lanes.

EXISTING PAVEMENT CONDITIONS

The new northwest parking lot (Test Boring 3) – The surface drainages is downward to the south by sheet flow. In general, the surface of the pavement is moderately weathered with some stripping, several sealed and reopened cracks, open transverse and longitudinal cracking with grass growing in several cracks and with some alligator cracking areas especially along concentrated drainage areas and main perimeter drives.

The southwest parking lot, (Test Boring 5) – The surface drainage is downward to the south by sheet flow. The pavements are lightly to moderately weathered with some block cracking and some areas of alligator cracking.

Existing pavement thickness and subgrade moisture content –

Test Boring	Thickness (inches)		Subgrade Moisture Content (%)
	AC	Base	
1	---	---	19
2	---	---	16
3	2.5	2.5	22
4	---	---	26
5	4.0	5.0	23

Test Borings 1 and 2 were drilled in proposed new pavement areas – these areas are presently occupied by landscaping.

Test Boring 4 was drilled in the proposed post-tensioned basketball court – the areas south of the proposed new drop-off lanes and east of the existing north building. This area was landscaped with grass and trees.

FIELD EXPLORATIONS

Subsurface conditions at the site were explored by drilling five test borings to a depth of 5 feet at the locations shown on the Site Plans in Appendix A. The test borings were drilled with a CME 55 drill rig using 7-inch diameter, hollow-stem augers. The drilling equipment and crew were provided by Wildcat Drilling, Inc. The test boring locations were determined in the field by a field technician from our firm. During the field explorations, representative disturbed samples were obtained, the field explorations logged and soil field-classified by our field technician, who also directed the drill crew. Relatively undisturbed samples of the subsoils were obtained by driving a 3-inch diameter, ring-lined, open-end sampler into the soil with a 140-pound hammer dropping 30 inches. The results of our field explorations are presented in the Test Boring Logs in Appendix A.

LABORATORY ANALYSIS

Representative samples obtained during the field exploration were subjected to the following tests in our laboratory.

Type of Test	Type of Sample	Number of Samples Tested
Percent Passing No. 200 Sieve and Atterberg Limits	Representative	5
Swell	Remolded	5
Moisture Content/Dry Density *	Undisturbed	5

* Reported in the test boring logs.

The results of the laboratory tests are presented in Appendix B.

SUBSURFACE CONDITIONS

The results of each test boring are presented in the Test Boring Logs in Appendix A. In general, the near surface soils encountered in the test borings and extending for the full depth of exploration (5 feet) consisted of firm sandy clay with no to some gravel and medium to high plasticity. In Test Borings 3 and 5 the surface soils were overlain by 2.5 and 4.0 inches of asphalt concrete on 2.5 and 5.0 inches of base material, respectively. Soil moisture contents were described as moist to very damp. No groundwater was encountered during the test drilling.

PAVEMENT IMPROVEMENT RECOMMENDATIONS

Based on the condition and thickness of the existing pavement and subgrade type and insitu moisture content, we recommend that the existing southwest parking lot should be overlaid with a 1.5 inch thick layer of ½" asphalt concrete Marshall mix (MAG Table 710-1) be placed on the existing pavement surface. Prior to placing the overlay the existing asphalt concrete surface should be milled to a depth of 1.0 inch. Cracks over ¾-inch wide should be repaired by saw cutting a 24-inch wide strip (approximately 12 inches either side of the crack); removing the existing asphalt concrete, existing crack seal and any foreign material from the saw cut area during removing the strip areas; compacting the exposed existing aggregate base course surface; placing a tack coat on the asphalt concrete cut faces; and placing and compacting the above referenced hot mix asphalt concrete. When the temperature decreases the following winter, the new joints should be checked and any joint open more than ⅛ inch should be blown clean and crack sealed. Existing cracks less than ¾-inch wide should be blown clean and filled with a flexible crack sealant and checked the following winter after placement of the pavement overlay.

Due to the medium to high plasticity of the subgrade soils, the relatively high moisture content of the subgrade soils and the thickness of the pavement area in the northwest parking lot and the presence of adjoining landscaping areas to the south and east, we recommend that the existing

pavement section be removed and subgrade elevation changed to conform to the adjoining new parking lot to the east and the new S-shaped drop-off lanes to the south and east. The final pavement areas should have good surface drainage. The pavement section should consist of the placement of a nonwoven geofabric (MAG 796.2.2, Class A) directly on the subgrade with the geogrid reinforcement (MAG 796.2.4, Type 2) placed on the geofabric, then an 8-inch compacted thickness of aggregate base course (MAG 702, Table 702-1, Aggregate base course) by end dumping of the aggregate base course onto the exposed edge of the geogrid and spread and compacted in one lift without construction traffic running on the exposed geogrid. A 3-inch thick layer of ¾-inch asphalt concrete Marshall mix ((MAG Table 710-1) should then be placed on top of the compacted, graded aggregate base course.

POST-TENSIONED CONCRETE BASKETBALL COURT RECOMMENDATIONS

The site soils in the basketball court site have medium to high plasticity and, when compacted and wetted, exhibit a moderate to high swell potential and are at relatively high moisture contents. These soils, when scarified and compacted or used as fill, will provide adequate support for the post-tensioned concrete basketball courts and for exterior concrete slabs. Any existing fill and/or disturbed soils should be removed from within and two feet beyond the basketball court areas and adjacent exterior slab areas. The exterior thickened edges should be founded at least 12 inches below lowest adjacent finished grade within two feet of the basketball court perimeter. The thickened edges should have a tapered slope to interior bottom of slab of 0.5H:1V. The basketball court concrete should be at least 6 inches thick. The post-tensioned basketball court should be designed using the Post-Tensioning Institute (PTI) design procedures presented in "Design and Construction of Post-Tensioned Sport Courts (2006)". A modulus of subgrade reaction of 100 pci is recommended for use in design for support of concrete basketball court bearing on a 4-inch thickness of compacted base materials.

The basketball court surface sealing and coatings, if any, should be applied per manufacturer's specifications.

SITE DEVELOPMENT RECOMMENDATIONS

Earthwork Factors:

Earthwork losses due to ground height losses and shrinkage were estimated based on past experience in the area and the laboratory test data. The materials encountered at the site were soft

to stiff. The estimated ground height losses due to subgrade compaction are as follows for previously ungraded areas:

Ground Height Loss *
Existing Pavement Areas
0.2 ft.

* Based on compaction to 95 percent of maximum dry density (ASTM D698), dry densities obtained from samples, and achieving a 10-inch deep compacted zone without stripping natural surface zones.

The estimated shrinkage losses from cut to fill zones are as follows for naturally occurring soils.

Estimated Percent Shrinkage *
Existing Pavement Areas
10% to 15%

* Based on compaction to 95 percent of maximum dry density (ASTM D698), dry densities obtained from samples of natural undisturbed soils from the near surface zone and local experience.

These estimates do not include compaction to greater depths than assumed, losses due to wind or wastage, overexcavation, etc.

Workability:

Some of subgrade soils exhibit moisture contents at or above optimum which may result in some to heavily soil pumping under dynamic loadings such as heavy construction equipment driving over the area. In flexible pavement areas where pumping has occurred the area should be allowed to dry until soils are workable without pumping or place a geogrid on the subgrade surface or remove the wetted areas and replace with drier soils and/or imported granular soils.

MATERIALS SUITABILITY AND REQUIREMENTS

Site Materials:

The near surface soils may be used as fill in all areas, provided these soils are free of organic materials, debris and rubble, and screened to remove oversize material.

Imported Soils:

Additional fill materials to be used in pavement areas should be imported soils having the same or better characteristics as the existing soil.

Base Material:

Base material used below pavements should conform to the requirements of the MAG Specifications for Aggregate Base Course (Section 702). Milled or pulverized asphalt concrete and existing base materials which conform to MAG Section 702 may be used as base material.

Asphalt Concrete Pavement:

Asphalt concrete pavement materials should conform to the requirement of the MAG Specifications Table 710-1.

SITE PREPARATION AND GRADING PROCEDURES

Pavement and Post-Tensioned Basketball Court Areas:

Recommendations presented in the previous sections of this report are based upon the following site preparation and grading procedures. Therefore, all earthwork should be accomplished with observation and testing by a qualified technician under the direction of a registered geotechnical/ materials engineer. The following apply to 5 feet beyond the limits of the pavements, sidewalk and/or post tensioned basketball court areas.

1. Where recommended strip existing pavement section from the subgrade. During stripping observe the surface for evidence of buried debris, vegetation or disturbed materials which will require additional removal. Areas steeper than 5H to IV should be benched and any depressions widened to accommodate compaction equipment.

2. Prepare the ground surface in fill areas and in areas cut to grade by scarifying, moisture conditioning and compacting the exposed surface soils to a depth of 10 inches.

3. Moisture condition and place all fill and backfill materials required to achieve specified grades. Fill materials should be moisture conditioned, placed and compacted in horizontal lifts of thicknesses compatible with the compaction equipment being used.

4. Compact subgrade, fill, backfill, subbase fill or base material to the following minimum percent compaction of the ASTM D698 maximum dry density in each lift:

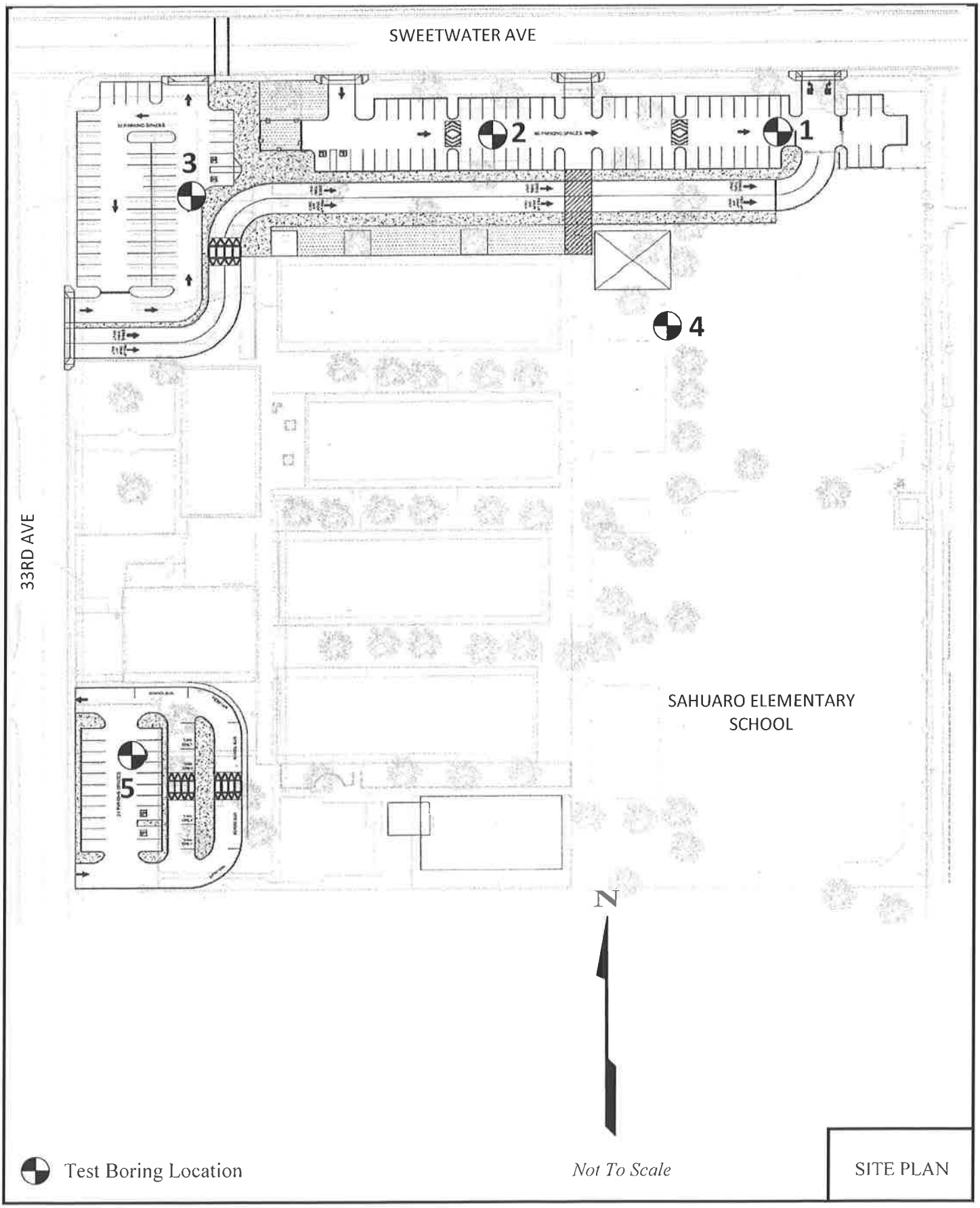
Material	Minimum Percent Compaction
Soil:	
Below pavement sections and basketball court areas	95
Base Material:	
Below pavement sections and basketball court areas	100
Backfill:	90

5. Moisture content of backfill at the time of compaction should be:

Type	Area of Use	Moisture content
On-site or Import	Pavements and Basketball Court	2% below optimum or lower
Base Material	Pavements and Basketball Court	Optimum plus or minus 3%

6. Any soils which are disturbed or overexcavated by the contractor outside the limits of the plans or specifications should be replaced with materials compacted as specified above. The above compaction requirements will also apply to any disturbance occurring within the construction limits, including but not limited to backfilling of trenches inside and outside of the tennis court area.

APPENDIX A
FIELD EXPLORATIONS

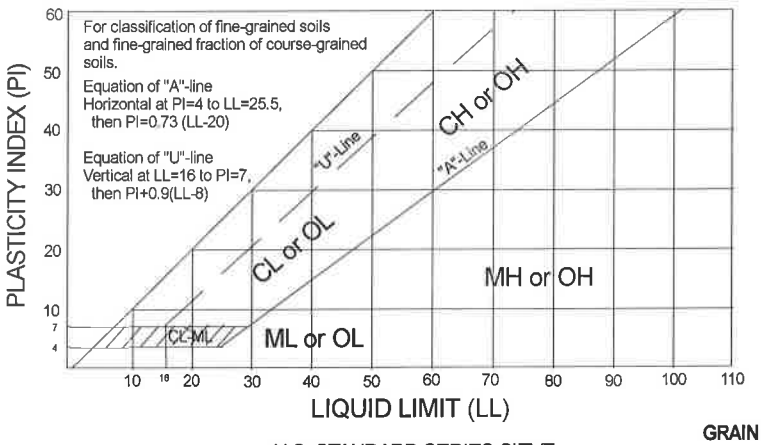

SWEETWATER AVE
33RD AVE
1
2
3
4
5
SAHUARO ELEMENTARY SCHOOL
N
Test Boring Location
Not To Scale
SITE PLAN

LEGEND

ASTM Designation: D2487-11
(Based on Unified Soil Classification System)

CLASSIFICATION OF SOILS

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests					Soil Classification: Group Symbol	Soil Classification: Name
COARSE-GRAINED SOILS More than 50% retained on No. 200 Sieve	Gravels More than 50% coarse fraction retained on No. 4 Sieve	Clean Gravels Less than 5% fines	Cu > 4 and 1 < Cc < 3		GW	Well graded gravel
			Cu<4 and/or 1>Cc>3		GP	Poorly graded gravel
		Gravels with Fines More than 12% fines	Fines classify as ML or MH		GM	Silty gravel
			Fines classify as CL or CH		GC	Clayey gravel
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	Cu > 6 and 1 < Cc < 3		SW	Well-graded sand
			Cu<6 and/or 1>Cc>3		SP	Poorly graded sand
		Sands with Fines More than 12% fines	Fines classify as ML or MH		SM	Silty sand
			Fines classify as CL or CH		SC	Clayey sand
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		CL	Lean clay
			PI<4 or plots below "A" line		ML	Silt
		Organic	Liquid Limit - oven dried / Liquid limit - not dried	<0.75	OL	Organic clay / Organic silt
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line		CH	Fat clay
			PI plots below "A" line		MH	Elastic silt
		Organic	Liquid limit - oven dried / Liquid limit - not dried	<0.75	OH	Organic clay / Organic silt
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor				PT	Peat



TEST BORING LOG DEFINITIONS

Blows per foot using 140 pound hammer with 30 inch free-fall.

Depth, feet	Blows/Foot: C	Blows/Foot: N/R	Sample Type	Dry Density pcf	Water Content, %	Unified Classification	Description

C = Continuous Penetration Resistance (2 inch diameter rod)
N = Standard Penetration Resistance (ASTM D1586)
R = Penetration Resistance (3 inch diameter ring line sampler)

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENINGS			
200	40	10	4	3/4"	3"	12"	
SILTS & CLAYS DISTINGUISHED ON BASIS OF PLASTICITY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

MOISTURE CONDITION (INCREASING MOISTURE ⟶)

DRY — SLIGHTLY DAMP — DAMP — MOIST (Plastic Limit) — VERY MOIST — WET (SATURATED) (Liquid Limit)

CONSISTENCY CORRELATION		RELATIVE DENSITY CORRELATION	
CLAYS & SILTS	BLOWS/FOOT*	SANDS & GRAVELS	BLOWS/FOOT*
VERY SOFT	0-2	VERY LOOSE	0-4
SOFT	2-4	LOOSE	4-10
FIRM	4-8	MEDIUM DENSE	10-30
STIFF	8-16	DENSE	30-50
VERY STIFF	16-32	VERY DENSE	OVER 50
HARD	OVER 32		

*Number of blows of 140 lb hammer falling 30" to drive a 2" O.D. (1-3/8" I.D.) split-spoon sampler (ASTM D1586).

TEST BORING LOG

Project: Sahuaro Elementary School Improvements – Phoenix, Arizona Test Boring: 1

Elevation: Not Determined Datum: --- Date: 2-23-17

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		23	R	100	19	CL/ CH	Sandy Clay, No to Some Gravel; brown, moist to very damp, firm, medium to high plasticity, decreased moisture with depth.
5							Stopped drilling at 5 feet. No groundwater observed.
10							
15							
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: Sahuaro Elementary School Improvements – Phoenix, Arizona Test Boring: 2

Elevation: Not Determined Datum: --- Date: 2-23-17

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		15	R	90	16	CL/ CH	Sandy Clay, No to Some Gravel; brown, moist to very damp, firm, medium to high plasticity, decreased moisture with depth.
5							Stopped drilling at 5 feet. No groundwater observed. Note: Upper 1 foot may be fill.
10							
15							
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: Sahuaro Elementary School Improvements – Phoenix, Arizona Test Boring: 3

Elevation: Not Determined Datum: --- Date: 2-23-17

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							2.5" Asphalt Concrete on 2.5" Base Material
		8	R	95	22	CL/ CH	Sandy Clay, No to Some Gravel; brown, moist to very damp, firm, medium to high plasticity, decreased moisture with depth.
5							Stopped drilling at 5 feet. No groundwater observed.
10							
15							
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: Sahuaro Elementary School Improvements – Phoenix, Arizona Test Boring: 4

Elevation: Not Determined Datum: --- Date: 2-23-17

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
		6	R	84	26	CL/ CH	Sandy Clay, No to Some Gravel; brown, moist to very damp, firm, medium to high plasticity, decreased moisture with depth.
5							Stopped drilling at 5 feet. No groundwater observed.
10							
15							
20							
25							

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

TEST BORING LOG

Project: Sahuaro Elementary School Improvements – Phoenix, Arizona Test Boring: 5

Elevation: Not Determined Datum: --- Date: 2-23-17

Depth, feet	Blows/Foot C	Blows/Foot N/R	Sample Type	Dry Density, pcf	Water Content, %	Unified Classification	Description
							4.0" Asphalt Concrete on 5.0" Base Material
		5	R	93	23	CL/ CH	Sandy Clay, No to Some Gravel; brown, moist to very damp, firm, medium to high plasticity, decreased moisture with depth.
5							Stopped drilling at 5 feet. No groundwater observed.

This boring log represents the conditions encountered on the date of drilling at this particular location. No other warranty is expressed or implied to the actual conditions which may exist within the vicinity of this boring location.

APPENDIX B
LABORATORY ANALYSIS

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LABORATORY TEST RESULTS

Date: 30-Mar-17

SAMPLE SOURCE: As noted below

TESTING PERFORMED: Percent Passing No. 200 Sieve, Atterberg Limits, Percent Expansion (ASTM D1140, D4318, D4546)

SAMPLED BY: RAMM/Durot

RESULTS:

Sample Source	Percent Retained No. 4 Sieve	Percent Passing No. 200 Sieve	Liquid Limit	Plasticity Index	Percent Expansion*	Remolded Dry Density (pcf)	Remolded Moisture Content (%)
1 @ 0'-5'	0	84	43	25	4.3	97	18
2 @ 0'-5'	6	83	36	16	3.2	95	19
3 @ 0'-5'	0	87	42	24	6.9	104	15
4 @ 0'-5'	0	89	45	25	7.1	102	16
5 @ 0'-5'	8	75	33	16	3.9	106	14

* Based upon sample remolded to 95% of the estimated maximum dry density at 2% below the estimated optimum moisture content, with a surcharge pressure of 100 psf.