

**GEOTECHNICAL INVESTIGATION REPORT**

**ASSIGNMENT NO. 4**

**TATUM WASH**

**TATUM & SHEA BOULEVARDS**

**CONTACT NO. FCD 96-13**

**PHOENIX, ARIZONA**

2  
Ph



**AGRA**

***Earth & Environmental***

**A580.905**

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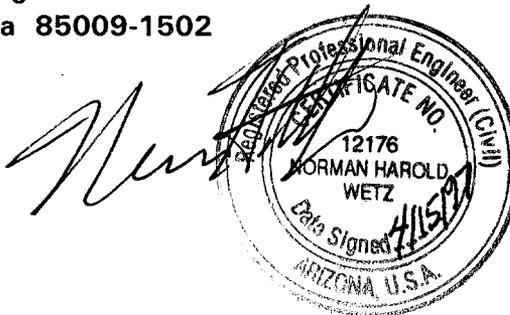
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**Submitted To:**

**Flood Control District of Maricopa County  
2801 West Durango Street  
Phoenix, Arizona 85009**

**Submitted By:**

**AGRA Earth & Environmental, Inc.  
3232 West Virginia Avenue  
Phoenix, Arizona 85009-1502**



**15 April 1997  
AEE Job No. 7-117-000044  
Report No. 1**



AGRA Earth &  
Environmental, Inc.  
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15 April 1997  
AEE Job No. 7-117-000044  
Report No. 1

Flood Control District of Maricopa County  
2801 West Durango Street  
Phoenix, Arizona 85009

Attention: **Warren Rosebraugh, P.E.**  
Project Manager

Gentlemen:

RE: **GEOTECHNICAL INVESTIGATION REPORT  
ASSIGNMENT NO. 4  
TATUM WASH  
TATUM & SHEA BOULEVARDS  
CONTACT NO. FCD 96-13  
PHOENIX, ARIZONA**

Our Geotechnical Investigation Report for the above-referenced project is herewith submitted. The following sections provide the results of exploratory drilling, laboratory analysis, and presents recommended criteria for site grading and excavation.

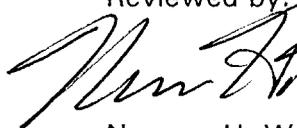
Should any questions arise concerning this report, we would be pleased to discuss them with you.

Respectfully submitted,  
AGRA Earth & Environmental, Inc.

Elizabeth A. Judd, E.I.T.

c: Addressee (3)

met/J6-97/4-14-97

Reviewed by:   


Norman H. Wetz, P.E.  
Senior Geotechnical Engineer

Geotechnical Investigation Report  
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APPENDICES

Appendix A - Field Investigation  
Appendix B - Laboratory Testing



## 1.0 INTRODUCTION

This report presents the results of a geotechnical investigation by AGRA Earth & Environmental, Inc. (AEE) for the site of a proposed retention basin, located in Phoenix, Arizona. The purpose of this investigation was to evaluate the physical properties of the soils underlying the site. Based on this evaluation, recommendations are presented for site grading and mass excavation.

## 2.0 PROJECT DESCRIPTION

Details of the project were provided by Warren Rosebraugh, P.E. of the Flood Control District of Maricopa County. It is understood that a retention basin will be excavated to about 15 to 20 feet below existing grade and will encompass an area of about 325 by 575 feet. The retention basin will collect stormwater runoff from Tatum Wash.

## 3.0 INVESTIGATION

### 3.1 SUBSURFACE EXPLORATION

Three exploratory borings were drilled, one to a depth of 25 feet and the other two, to 20 feet below existing site grade along the basin alignment. The borings were advanced using a CME-75 drill rig equipped with 6 5/8-inch O.D. hollow stem auger. Standard penetration testing and open-end drive sampling were performed at selected intervals in the borings. During drilling, the soils encountered were continuously examined, visually classified and logged. The field investigation was supervised by Elizabeth A. Judd, E.I.T., of this firm.

Results of the field investigation are presented in Appendix A, including a brief description of drilling and sampling equipment and procedures, and logs of the test borings. A site plan showing the location of test borings is also included in Appendix A.

### 3.2 LABORATORY ANALYSIS

The moisture contents of selected samples recovered were determined. The results of these tests are shown on the boring logs. Grain-size analysis and Atterberg limits tests were performed on selected samples. The results of these tests are presented in Appendix B.

## 4.0 SITE CONDITIONS & GEOTECHNICAL PROFILE

### 4.1 SITE CONDITIONS

The site is bordered on the north side by Shea Boulevard and residential lots on all other sides. The area is undeveloped and is dissected by Tatum Wash which flows from the southwest to the northeast. The vegetation consists of palo verde and mesquite trees, small shrubs and

desert grasses. The surface is also littered with some household and construction debris. The site slopes downward to the north (Shea Boulevard), with an elevation change of about 6 feet across the site.

## 4.2 GEOTECHNICAL PROFILE

Based on the test borings, the geotechnical profile underlying the channel alignment can be generalized into a two stratum system as follows:

Stratum A - Silty to clayey sand and gravel, with traces of cobbles, extends to about 9.5 to 13.0 feet below existing grade. The soils of this deposit are firm to hard in consistency, exhibit nonplastic to medium plasticity and are weakly to moderately lime cemented.

Stratum B - Silty to clayey sands were encountered below Stratum A and extend to the full depth of the investigation. The soils of this deposit are hard in consistency, moderately to strongly lime cemented and exhibit low to medium plasticity.

## 4.3 GROUNDWATER & SOIL MOISTURE CONDITIONS

No free groundwater was encountered in the test borings and soil moisture contents were very low, ranging from 1 to 3 percent.

## 5.0 DISCUSSION & RECOMMENDATIONS

### 5.1 EXCAVATIONS & SLOPES

It appears that mass excavation for the upper 5 to 10 feet can be accomplished with conventional earthmoving equipment. Ripping may be necessary for the moderately to strongly cemented material below this depth.

### 5.2 SITE GRADING

#### 5.2.1 Surface Preparation

All vegetation, debris and any man-made fill should be removed from areas designated for the retention basin.

The exposed surfaces upon which fill is to be placed should be scarified in the upper 8 inches, brought to within the range of optimum moisture content to plus 3 percent of optimum moisture content, and compacted to at least 95 percent of maximum dry density as determined by ASTM D698. No scarification and recompaction will be necessary where strongly cemented soils are encountered.

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### 5.2.2 Structural Fill

All fill required to raise the site to subgrade elevation should be free of vegetation, debris and other deleterious materials, and should contain no particles larger than 6 inches in dimension.

All structural fill should be compacted to at least 95 percent of maximum dry density as determined by ASTM D698. The moisture content during compaction should be maintained within 2 percent of the optimum moisture content.

**APPENDIX A**  
**FIELD INVESTIGATION**

## TEST DRILLING EQUIPMENT & PROCEDURES

### Description of Subsurface Exploration Methods

Auger Boring Drilling through overburden soils is performed with 6 5/8" O.D., 3 1/4" I.D. hollow stem auger or 4 1/2" solid stem continuous flight auger. Carbide insert teeth are normally used on bits so they can penetrate soft rock or very strongly cemented soils. A CME-55 or CME-75 truck-mounted drill rig is used to advance the auger. The drill rigs are powered with six-cylinder Ford industrial engines capable of delivering about 7,000 to 8,400 foot-pounds torque to the drill spindle. The spindle is advanced with twin hydraulic rams capable of exerting 16,000 to 20,000 pounds downward force.

Generally, refusal to penetration of the auger is adopted as top of the SGC or river-run material, which normally requires other techniques for penetration. Grab samples or auger cuttings may be taken as necessary. Standard penetration tests or 2.42" diameter ring samples are taken in conjunction with the auger borings as needed, with the sampling interval and type being indicated on the boring logs.

Hammer Drill Drilling with the Hammer drill is accomplished with a Drill Systems AP1000 drill rig advancing a double-walled drive casing with a link-belt 180 diesel pile driving hammer, having a rated energy of 8,100 foot-pounds per blow. Where noted on the boring log, the hammer is equipped with a supercharger which can boost the energy to approximately 12,000 foot-pounds per blow. The supercharger is used only in portions of the boring where blow counts are relatively high. Cuttings are removed with compressed air by a reverse circulation process, and are collected in a cyclone from which grab samples are obtained. The drive casing is either 9" O.D. by 6" I.D. or 6 5/8" O.D. by 4" I.D. and employs an expendable bit of slightly larger diameter than the O.D. of the casing. Hammer blows required to advance the drive casing are recorded in 1' increments, as noted on the boring logs. Standard penetration tests or 2.42" diameter ring samples taken are noted on the boring logs.

Odex System The Odex (overburden drilling with the eccentric method) system, also referred to as the DTH (down-the-hole hammer) system, consists of a pneumatic-rotary percussion down-the-hole hammer operating at the bottom being drilled through a 5" diameter steel casing. The eccentric button percussion bit overreams the boreholes and allows advancement of the casing. The same compressed air or air-detergent (foam) mixture that operates the hammer also serves to expel the cuttings from the borehole, where they can be collected as grab samples. Retraction of the eccentric drill bit allows removal of the hammer from the center of the casing to facilitate standard penetration testing (ASTM D1586) where noted on the boring logs.

## TEST DRILLING EQUIPMENT & PROCEDURES (CONT.)

Schramm Rotadrill The Schramm T64H truck-mounted drill rig is a top drive rotary rig capable of up to 85,500 inches/pounds of torque with a pulldown capacity of 35,000 lbs. Drilling is performed with either 4", or larger, diameter Tricone roller bits or 4" to 6" diameter down-the-hole hammer. Cutting removal is facilitated by compressed air or air/water mixtures and collected in a cyclone. Where noted on the boring logs, grab samples of the cuttings were collected. When casing is required to stabilize the borehole, an Aardvark drill through casing hammer is utilized, permitting simultaneous drilling and driving of the casing. Casing penetration is recorded on the boring logs in feet per minute. Standard penetration, 2.42" diameter ring samples, Shelby tubes, pitcher tube or Denison samples taken are noted on the boring logs.

Sampling Procedures Dynamically driven tube samples are usually obtained at selected intervals in the borings by the ASTM D1586 test procedure. In many cases, 2" O.D., 1 3/8" I.D. samplers are used to obtain the standard penetration resistance. "Undisturbed" samples of firmer soils are often obtained with 3" O.D. samplers lined with 2.42" I.D. brass rings. The driving energy is generally recorded as the number of blows of a 140-pound, 30-inch free fall drop hammer required to advance the samplers in 6-inch increments. However, in stratified soils, driving resistance is sometimes recorded in 2- or 3-inch increments so that soil changes and the presence of scattered gravel or cemented layers can be readily detected and the realistic penetration values obtained for consideration in design. These values are expressed in blows per 6 inches on the boring logs. "Undisturbed" sampling of softer soils is sometimes performed with thin walled Shelby tubes (ASTM D1587), pitcher samplers, Denison samplers or continuous CME samplers. Where samples of rock are required, they are obtained by NQ diamond core drilling (ASTM D2113). Tube samples are labeled and placed in watertight containers to maintain field moisture contents for testing. When necessary for testing, larger bulk samples are taken from auger cuttings. Also, representative samples are obtained from the cuttings from the hammer and Schramm drill rig.

Boring Records Drilling operations are directed by our field engineer or geologist who examines soil recovery and prepares the boring logs. Soils are visually classified in accordance with the Unified Soil Classification System (ASTM D2487), with appropriate group symbols being shown on the boring logs.

**TERMINOLOGY USED TO DESCRIBE THE RELATIVE DENSITY,  
CONSISTENCY OR FIRMNESS OF SOILS**

The terminology used on the boring logs to describe the relative density, consistency or firmness of soils relative to the standard penetration resistance is presented below. The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

1. Relative Density. Terms for description of relative density of cohesionless, uncemented sands and sand gravel mixtures.

<u>N</u>	<u>Relative Density</u>
0-4	Very loose
5-10	Loose
11-30	Medium dense
31-50	Dense
50 +	Very dense

2. Relative Consistency. Terms for description of clays which are saturated or near saturation.

<u>N</u>	<u>Relative Consistency</u>	<u>Remarks</u>
0-2	Very soft	Easily penetrated several inches with fist.
3-4	Soft	Easily penetrated several inches with thumb.
5-8	Medium stiff	Can be penetrated several inches with thumb with moderate effort.
9-15	Stiff	Readily indented with thumb, but penetrated only with great effort.
16-30	Very stiff	Readily indented with thumbnail.
30 +	Hard	Indented only with difficulty by thumbnail.

3. Relative Firmness. Terms for description of partially saturated and/or cemented soils which commonly occur in the Southwest including clays, cemented granular materials, silts and silty and clayey granular soils.

<u>N</u>	<u>Relative Firmness</u>
0-4	Very soft
5-8	Soft
9-15	Moderately firm
16-30	Firm
31-50	Very firm
50 +	Hard

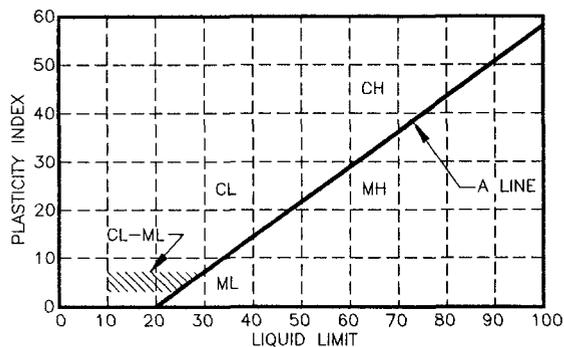
## UNIFIED CLASSIFICATION SYSTEM FOR SOILS

Soils are visually classified by the Unified Soil Classification System on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in classification. The classification system is briefly outlined on this chart. For a more detailed description of the system, see "The Unified Soil Classification System" ASTM Designation: D2487.

MAJOR DIVISION		GRAPH SYMBOLS	GROUP SYMBOL	TYPICAL DESCRIPTION
<b>COARSE-GRAINED SOILS</b> (Less than 50% passes No. 200 sieve)	<b>GRAVELS</b> (50% or less of coarse fraction passes No. 4 sieve)		GW	Well graded gravels, gravel-sand mixtures or sand-gravel-cobble mixtures.
			GP	poorly graded gravels, gravel-sand mixtures, or sand-gravel-cobble mixtures.
			GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	<b>SANDS</b> (More than 50% of coarse fraction passes No. 4 sieve)		SW	Well graded sands, gravelly sands.
			SP	Poorly graded sands, gravelly sands.
			SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
<b>FINE-GRAINED SOILS</b> (50% or more passes No. 200 sieve)	<b>SILTS</b> LIMITS PLOT BELOW "A" LINE & HATCHED ZONE ON PLASTICITY CHART		ML	Inorganic silts, clayey silts with slight plasticity.
			MH	Inorganic silts of high plasticity, silty soils, elastic silts.
	<b>CLAYS</b> LIMITS PLOT ABOVE "A" LINE & HATCHED ZONE ON PLASTICITY CHART		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			CH	Inorganic clays of high plasticity, fat clays, silty and sandy clays of high plasticity.

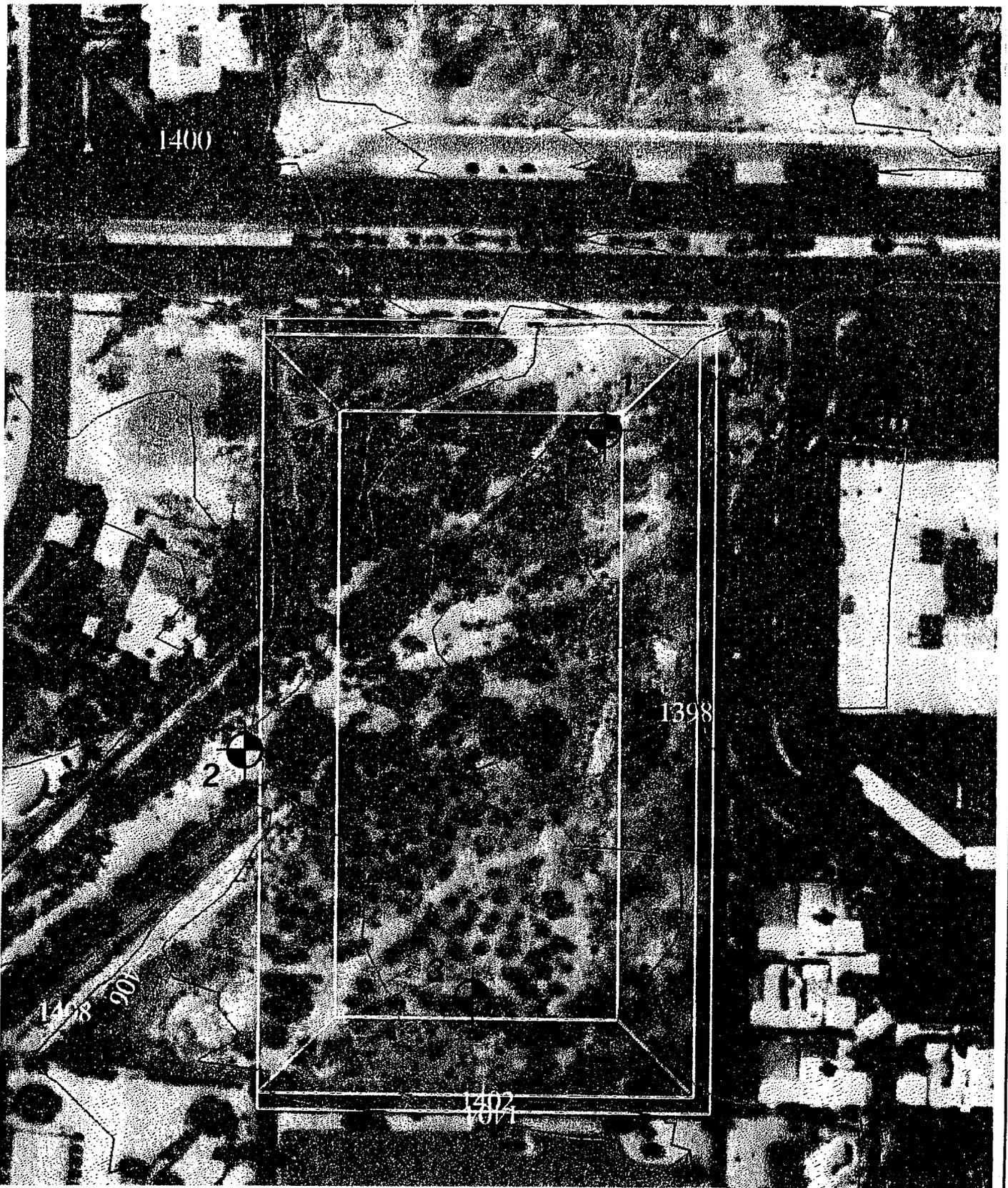
**NOTE:** Coarse-grained soils with between 5% & 12% passing the No. 200 sieve and fine-grained soils with limits plotting in the hatched zone on the plasticity chart to have dual symbol.

**PLASTICITY CHART**



**DEFINITIONS OF SOIL FRACTIONS**

SOIL COMPONENT	PARTICLE SIZE RANGE
Boulders	Above 300mm (12in.)
Cobbles	300mm to 75mm (12in. to 3in.)
Gravel	75mm (3in.) to No. 4 sieve
Coarse gravel	75mm to 19mm (3in. to 3/4in.)
Fine gravel	19mm (3/4in.) to No. 4 sieve
Sand	No. 4 to No. 200
Coarse	No. 4 to No. 10
Medium	No. 10 to No. 40
Fine	No. 40 to No. 200
Fines (silt or clay)	Below No. 200 sieve



L E G E N D



BORING LOCATION AND NUMBER



**AGRA**  
**Earth & Environmental**  
 3232 WEST VIRGINIA AVENUE  
 PHOENIX, AZ, U.S.A. 85009-1502

JOB NO. 7-117-000044  
 DESIGN BAJ  
 DRAWN SPG  
 DATE 3/97  
 SCALE N. T. S.

**SITE PLAN**

Λ-5

PROJECT Tatum Wash LOG OF TEST BORING NO. 1

JOB NO. 7-117-000044 DATE 3-10-97

LOCATION See Site Plan  
 RIG TYPE CME-75  
 BORING TYPE 6 5/8" Hollow Stem Auger  
 SURFACE ELEV. \_\_\_\_\_  
 DATUM \_\_\_\_\_

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S 7-9-11					slightly moist to dry  firm to hard	<b>SILTY SAND &amp; GRAVEL</b> , trace of cobbles, trace of clay, poorly graded, weakly to moderately lime cemented, subrounded to subangular, nonplastic to low plasticity, brown
				S 17-11-9						
5				S 22-17-22		1	GM-GP			
				A						
10				S 17-50/5"						
15				U 100/4"				SC	slightly moist to dry  hard	<b>CLAYEY SAND</b> , some to considerable fine grained gravel, poorly graded, subrounded to subangular, moderately to strongly lime cemented, low to medium plasticity, light brown
20				S 50/1"						Stopped Auger at 20' Sampler refused at 20'1"
25										

7-117-000044.GWH.04/14/97

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE

- A - Drill cuttings.
- S - 2" O.D. 1.38" I.D. Tube Sample.
- U - 3" O.D. 2.42" I.D. Tube Sample.
- T - 3" O.D. Thin-walled Shelby Tube.
- C - 6" O.D. Continuous Core

PROJECT Tatum Wash LOG OF TEST BORING NO. 2

JOB NO. 7-117-000044 DATE 3-10-97

LOCATION See Site Plan  
 RIG TYPE CME-75  
 BORING TYPE 6 5/8" Hollow Stem Auger  
 SURFACE ELEV. \_\_\_\_\_  
 DATUM \_\_\_\_\_

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	9-9-20			GP	slightly moist medium dense	<b>SAND, GRAVEL &amp; COBBLES</b> , poorly graded, subrounded to subangular, nonplastic, brown
				S	10-20-50/5"			GC-GP	slightly moist to dry hard	<b>CLAYEY SAND &amp; GRAVEL</b> , some to trace of cobbles, poorly graded, subrounded to subangular, weakly to moderately lime cemented, low plasticity, brown
5				S	45-50/3"					
10				S	50/3"		3		slightly moist to dry hard	<b>SILTY SAND</b> , some to considerable fine grained gravel, poorly graded, angular to subangular, moderately to strongly lime cemented, low to medium plasticity, light brown
				A						
15				S	50/3"			SM		
20				S	45-34-40					
										Stopped Auger at 20' Stopped Sampler at 21'6"
25										

7-117-000044\_GWH\_04/14/97

GROUNDWATER

SAMPLE TYPE

DEPTH	HOUR	DATE
	none	

- A - Drill cuttings.
- S - 2" O.D. 1.38" I.D. Tube Sample.
- U - 3" O.D. 2.42" I.D. Tube Sample.
- T - 3" O.D. Thin-walled Shelby Tube.
- C - 6" O.D. Continuous Core

PROJECT Tatum Wash

LOG OF TEST BORING NO. 3

JOB NO. 7-117-000044 DATE 3-10-97

LOCATION See Site Plan

RIG TYPE CME-75

BORING TYPE 6 5/8" Hollow Stem Auger

SURFACE ELEV. \_\_\_\_\_

DATUM \_\_\_\_\_

Depth in Feet	Drill Rate Min/Ft.	Graphical Log	Sample	Sample Type	Blow Count	Dry Density lbs. per Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	11-17-33				slightly moist to dry  hard	<b>SILTY SAND &amp; GRAVEL</b> , trace of cobbles & clay, poorly graded, weakly to moderately lime cemented, low to medium plasticity, light brown
				S	37-50/4"			SM/GM		
5				S	45-50/3"		2			
10				S	50/4 1/2"				slightly moist to dry  hard	<b>CLAYEY SAND</b> , some fine grained gravel, poorly graded, angular to subangular, moderately to strongly lime cemented, low to medium plasticity, light brown
15				S	31-50/4"			SC		
				A						
20				S	18-50/5 1/2"					
25										

GROUNDWATER

SAMPLE TYPE

DEPTH	HOUR	DATE
	none	

- A - Drill cuttings.
- S - 2" O.D. 1.38" I.D. Tube Sample.
- U - 3" O.D. 2.42" I.D. Tube Sample.
- T - 3" O.D. Thin-walled Shelby Tube.
- C - 6" O.D. Continuous Core

7-117-000044.GWH.04/14/97



**APPENDIX B**  
**LABORATORY TESTING**

AGRA Earth & Environmental, Inc.

PROJECT: ASSIGNMENT NO. 4 - TATUM WASH  
 LOCATION: TATUM & SHEA BLVD

JOB NO: 7-117-000044  
 WORK ORDER NO: 1  
 DATE SAMPLED: 03-12-97

MECHANICAL SIEVE ANALYSIS  
 GROUP SYMBOL, USCS (ASTM D-2487)

SIEVE SIZES

Location & Depth	USCS	LL	PI	Silt or Clay	SAND								GRAVEL						COBBLES		Lab #
					Fine			Medium			Coarse	Fine			Coarse			4"	6"		
					#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"			1"	

PERCENT PASSING BY WEIGHT

Location & Depth	USCS	LL	PI	#200	#100	#50	#40	#30	#16	#10	#8	#4	1/4"	3/8"	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	Lab #
#1 @ 5.0 - 10.0'	GP-GM	NV	NP	8.4	11	14	16	17	21	25	26	34	38	51	60	76	86	96	98	100	100	100	2
#2 @ 10.0 - 15.0'	SM	34	6	20	26	31	33	36	44	52	55	69	76	87	92	98	100	100	100	100	100	100	9
#3 @ 5.0 - 5.8'	SM	42	16	20	26	30	32	35	41	47	50	63	69	80	88	95	100	100	100	100	100	100	15