GEOTECHNICAL INVESTIGATION REPORT
48TH STREET DETENTION BASIN
N.E. CORNER OF 48TH STREET & PECOS ROAD
PHOENIX, ARIZONA

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

GEOTECHNICAL INVESTIGATION REPORT
48TH STREET DETENTION BASIN
N.E. CORNER OF 48TH STREET & PECOS ROAD
PHOENIX, ARIZONA

Submitted To:

HDR Engineering, Inc.
2141 East Highland Avenue
Suite 250
Phoenix, Arizona 85016

Submitted By:

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

February 19, 1999

AEE Job No. 9-117-001014
Report No. 1

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AGRA Earth & Environmental
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February 19, 1999
AEE Job No. 9-117-0001014
Report No. 1

HDR Engineering, Inc.
2141 East Highland Avenue
Suite 250
Phoenix, Arizona 85016

Attention: Jerome J. Zovne, Ph.D., P.E.

Gentlemen:

RE: 48TH STREET DETENTION BASIN
N.E. CORNER OF 48TH STREET & PECOS ROAD
PHOENIX, ARIZONA

Submitted herein is our Geotechnical Investigation Report for the above referenced project. Included are the results of test drilling, laboratory analysis and recommended criteria for the design of foundations, basin excavations, and other earthwork related elements associated with the detention basin complex and pump stations.

Should you have any questions concerning the recommendations presented in this report, please do not hesitate in contacting us.

Respectfully submitted,

AGRA Earth & Environmental, Inc.

Keith H. Dahlen, P.E.
Senior Engineer

Reviewed by:

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

c: Addressee (4)
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APPENDICES

1.0 INTRODUCTION

This report is submitted pursuant to a geotechnical investigation completed by AGRA Earth & Environmental, Inc. (AEE) of a proposed multi-celled storm water detention basin complex for the City of Phoenix, Arizona, located at the northeast corner of 48th Street and the westward extension of Pecos Road. The purpose of the investigation was to examine the geotechnical conditions in order to provide recommendations for design of the basin and associated pump stations.

2.0 PROJECT DESCRIPTION

Details of the project were provided by Jerome J. Zovne, Ph.D., P.E., of HDR Engineering, Inc. (HDR). It is understood that a multi-celled storm water detention basin system is planned for the northeast corner of 48th Street and Pecos Road. Preliminary plans indicate that inflow to the facility will be collected via pipeline in an equalization basin with a bottom elevation of 1,144.0 feet which, when filled, will overtop through a spillway and into a large, 25.5-acre primary basin. The equalization basin will contain 15 feet of water prior to overtopping.

The primary basin will be subdivided into upper and lower basins. Small volumes of water which overtop the spillway will enter the lower basin (bottom elevation of 1,142 feet) and exit the facility through a 42-inch diameter outlet pipe. The upper basin (bottom elevation of 1,152 feet) will be a vegetated park and recreation area, which will be inundated with water only when the lower basin overfills during significant storm events. The basin side slopes will vary from about 4H to 8H:1V (horizontal to vertical). When completely filled, the upper basin will contain 7 feet of water with 1.0 foot of freeboard.

Two pump stations also will be constructed. A water quality pump station with an invert elevation of 1,137 feet will be located adjacent to the equalization basin and will pump water from the equalization basin into twin vegetated cells with invert elevations of 1,157 feet. A basin evacuation pump station (bottom elevation of 1,129 feet) also will be located at the southeast end of the facility. The design loadings were not provided for the pump stations.

3.0 INVESTIGATION

3.1 FIELD INVESTIGATION

Eight test borings were drilled within the limits of the proposed facility with a CME-75 auger drill rig advancing 6-5/8 inch O.D. hollow stem auger to depths of about 15 to 40 feet below existing site grades. Boring No. 7 experienced auger refusal on strongly cemented soils at a depth of 29 feet. An additional boring (Boring No. 7A) was advanced to a depth of 40 feet

using 4-1/2 inch O.D. continuous flight auger. Standard penetration testing and open-end drive sampling was performed at selected intervals within the hollow stem auger borings. Bulk samples of drill cuttings also were collected as needed. Included in Appendix A are logs of the borings and a site plan showing the boring locations. The field investigation was supervised by Elizabeth A. Judd, E.I.T., of AEE.

3.2 LABORATORY ANALYSIS

The moisture content and density of selected samples were determined and are presented on the boring logs. Grain-size analysis, Atterberg limits tests, moisture-density, direct shear, and pH and total soluble sulfates were performed on selected samples. The results of those tests are presented in Appendix B, along with a brief description of sampling procedures.

4.0 SITE CONDITIONS & GEOTECHNICAL PROFILE

4.1 SITE CONDITIONS

The project site currently is a disced field. No vegetation, other than widely scattered wild grass, is present on the immediate site. The site is relatively flat, grading slightly downward to the southeast. An existing City of Phoenix lift station is located in the immediate northeast corner of the 48th Street and the extension of Pecos Road. The I-10 Freeway is located just east of the site and the planned interchange of the I-10/Santan Freeway is located to the north/northeast of the site.

4.2 GEOTECHNICAL PROFILE

In general, the subsurface materials encountered within the test borings consist of somewhat lenticular deposits of silty to clayey sand and silty to sandy clay of low to medium plasticity. Typically, the soils are non-cemented to weakly cemented with calcium carbonate and are moderately firm to firm in the upper 5 to 15 feet, becoming weakly to moderately cemented and firm to hard with depth. Some to considerable gravel was encountered at depths below about 8 to 16 feet in five of the test borings.

4.3 GROUNDWATER & SOIL MOISTURE CONDITIONS

No groundwater was encountered in any of the borings, and the moisture content of selected samples tested was relatively low, varying from 5 to 26 percent. The depth to groundwater

in the general project site vicinity, based on maps presented by Hammet and Herther (1995)*, varies from about 105 to 140 feet below the existing ground surface.

5.0 DISCUSSION & RECOMMENDATIONS

In general, the site is considered to be suited to siting a detention basin facility with relatively deep (below-grade) pump station structures. The presence of relatively thick fine-grained soil layers will limit the amount of percolation from the basins. Relatively shallow perched groundwater, known to be present in the general project vicinity, should not impact construction of the pump stations, provided excavations do not exceed about 45 to 50 feet in depth. The following sections present recommendations for construction of the basins and the pump station structures.

5.1 PUMP STATIONS

5.1.1 Design Criteria for Downward Loads

Contingent upon the performance of site grading as described in Section 5.1.3, a safe bearing pressure of 3.5 kips per square foot (ksf) is recommended for the pump station mat-type foundation. This allowable pressure applies to any foundations on the project, excluding wingwalls, constructed below elevation 1,140.0 feet. Further recommendations for wingwall structures are presented in Section 5.2.

5.1.2 Estimated Settlements

It is estimated that the total settlement of mat-type foundations designed in accordance with the recommendations of Section 5.1.1 will not exceed 3/4 inch for the soil moisture content in the existing soils at the time of test drilling and compaction moisture contents in the case of fills. Substantial moisture fluctuations in the supporting soils could result in additional vertical movements.

5.1.3 Surface Preparation

The exposed surface immediately beneath pump station mat-type footings should be scarified in the upper 8 inches, moisture conditioned to within the range of minus 1 to plus 3 percent of optimum, and recompacted to a minimum of 95 percent of the maximum dry density as

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*Hammet, B. A. and Herther, R.L., 1995, Maps Showing Groundwater Conditions in the Phoenix Active Management Area, Maricopa, Pinal and Yavapai Counties, Arizona - 1992, Department of Water Resources, Hydrologic Map Series Report Number 27, Phoenix, AZ, July.

determined by ASTM D698. Should moderately to strongly lime cemented soils be encountered at the base of the excavation the requirement for scarification and re-compaction may be waived at the discretion of the geotechnical engineer. The exposed surface should also be inspected by the geotechnical engineer for the presence of any soft zones. Such zones should be overexcavated and replaced either with structural fill or a two-sack sand-cement slurry. Structure backfill, if utilized, should be compacted to at least 95 percent of maximum dry density as determined in accordance with ASTM D698, to within 2 percent of the optimum moisture content.

5.1.4 Pump Station Wall Design

Pump station walls likely will be conventional cast-in-place reinforced concrete. The walls will be subjected to earth pressures represented by a hydrostatic load diagram of about 55 pounds per square foot (psf) per foot of depth, assuming free-draining wall backfill as recommended in Section 5.1.5 is utilized. Rigid walls designed to restrain hydrostatic as well as earth loads will be subjected to earth pressures represented by a hydrostatic load diagram of about 100 pounds per square foot per foot of depth.

5.1.5 Pump Station Wall Backfill

Free-draining granular backfill should be utilized behind the walls up to an elevation of 2 feet below adjacent finished grade. The grading requirements for the free-draining backfill material, as determined by ASTM C136, should be as follows:

Sieve Size (square openings)	Percent Passing by Weight
3 inch	100
1.5 inch	80-100
no. 4	10-60
no. 200	0-5

The plasticity index of the fraction of material passing the no. 40 sieve should be nonplastic when tested by ASTM D4318.

It does not appear that granular soils meeting these requirements are available in sufficient quantities on-site. The predominantly finer-grained soil present at the site should be utilized in the upper 2.0 feet of backfill (below finished grade) behind the walls.

Where space permits, granular material should be placed in lifts no thicker than 1.5 feet and mechanically compacted. If the gradation of the fill is generally fine enough to permit testing by conventional means, the fill should be compacted to a density of at least 95 percent of maximum dry density as determined in accordance with ASTM D698.

As an alternative, the on-site soils could be utilized as wall backfill if coupled with the use of synthetic drains. Drainage can be efficiently provided by a grid of geotextile drain products such as Miradrain 6000 or an equivalent approved by the geotechnical engineer.

5.2 WINGWALLS

Wingwalls for box culvert or circular pipe inlets and outlets likely will be conventional cantilever-type walls that may or may not be separated structurally from the conveyance structures. It appears that the wingwalls will be founded on firm native soils or structural fill. It is recommended that a safe soil bearing pressure of 2.5 kips per square foot (ksf) not be exceeded for wingwall footings bearing directly on native soils. Given the existing soil conditions, it is estimated that the total settlement of wingwall foundations will not exceed 3/4 inch for the above recommended soil bearing pressure. However, significant moisture fluctuations in the supporting fine-grained soils (where present) could result in additional vertical movements.

Free-draining granular backfill should be utilized behind wingwalls. This material should meet the requirements for wall backfill presented in Section 5.1.5. This material should be compacted to at least 95 percent of maximum dry density in accordance with ASTM D698, to within 2 percent of the optimum moisture content.

The earth pressures against wingwalls will depend upon the degree of restraint. Rigid, absolutely restrained walls will be subjected to earth pressures represented by a hydrostatic load diagram of about 55 psf per foot of depth. Rotation or lateral translation of the walls equal to about 0.001 times the height will reduce earth pressures to the active state represented by a hydrostatic load diagram of about 35 psf per foot of depth. The recommended fluid pressures are based on the walls having horizontal free-draining backfill. If sloping backfills are used, or if the potential exists for a buildup of hydrostatic forced behind the walls, modified pressures can be provided upon request.

5.3 MASS EXCAVATION

5.3.1 Temporary & Permanent Slopes

It is recommended that temporary cut slopes be made no steeper than 0.75H:1V. Steeper temporary excavations should be made only if based on stability analyses by a registered geotechnical engineer. The analysis should take into account the slope angles, trench geometries, and any surcharge loadings due to equipment and spoil piles. Permanent, unprotected cut slopes should be made no steeper than 4H:1V. Some minor sloughing and raveling should be anticipated for permanent slopes which are left unprotected. It is recommended that the planned 5H:1V outboard slope of the spillway between the Equalization Basin and the Primary Basin be protected against erosion with either shotcrete or concrete.

Permanent fill slopes should be constructed no steeper than 1.5H:1V, for areas which will not be inundated with water. For other areas where water may be impounded against fill slopes, the slope angle should be evaluated on an individual basis, but in no case should be steeper than 3H:1V.

5.3.2 Excavation Conditions

Based on the test borings, conventional earthmoving equipment likely can be utilized to perform the required excavations. However, ripping with a dozer or other means likely will be necessary in numerous areas where moderately to strongly lime cemented soils are encountered. In general, the more-cemented zones typically are less than about 2 to 3 feet in thickness. A site-specific seismic refraction was not performed to determine the approximate seismic velocities within the subgrade. It is estimated however, based on other project completed in the general project vicinity that either Caterpillar D6 or D7 dozers with rippers (or equivalent) or CAT 225 to 235 trackhoes (or equivalent) will be required to excavate the more cemented soils present at depth.

5.3.3 Earthwork Factors

An earthwork factor of 15 percent shrink is estimated for soils excavated within the basin facility to a depth of 10 feet. An earthwork factor of 5 percent shrink is estimated for soils excavated to a depth of more than 10 feet below existing site grades. The estimates are based on very limited test data and assume that the materials will be re-compacted to a density of 95 percent of the maximum dry density in accordance with ASTM D698.

APPENDIX A

FIELD INVESTIGATION

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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 AP-1000 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.

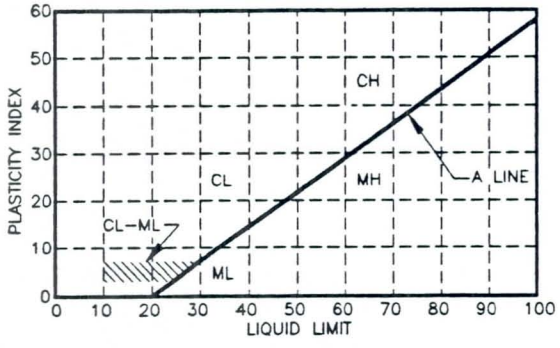
UNIFIED CLASSIFICATION SYSTEM FOR SOILS

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 SYMBOL	GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE-GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (50% or less of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 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.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (More than 50% of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 sieve)			SW	Well graded sands, gravelly sands.
					SP	Poorly graded sands, gravelly sands.
		SANDS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart		SM	Silty sands, sand-silt mixtures.
			Limits plot above "A" line & hatched zone on plasticity chart		SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS (LIMITS PLOT BELOW "A" LINE & HATCH ZONE ON PLASTICITY CHART)	SILTS OF LOW PLASTICITY (Liquid Limit Less Than 50)			ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)			MH	Inorganic silts of high plasticity, silty soils, elastic silts.
	CLAYS (LIMITS PLOT ABOVE "A" LINE & HATCH ZONE ON PLASTICITY CHART)	CLAYS OF LOW PLASTICITY (Liquid Limit Less Than 50)			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More Than 50)			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

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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.

N	Relative Density
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.

N	Relative Consistency	Remarks
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.

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

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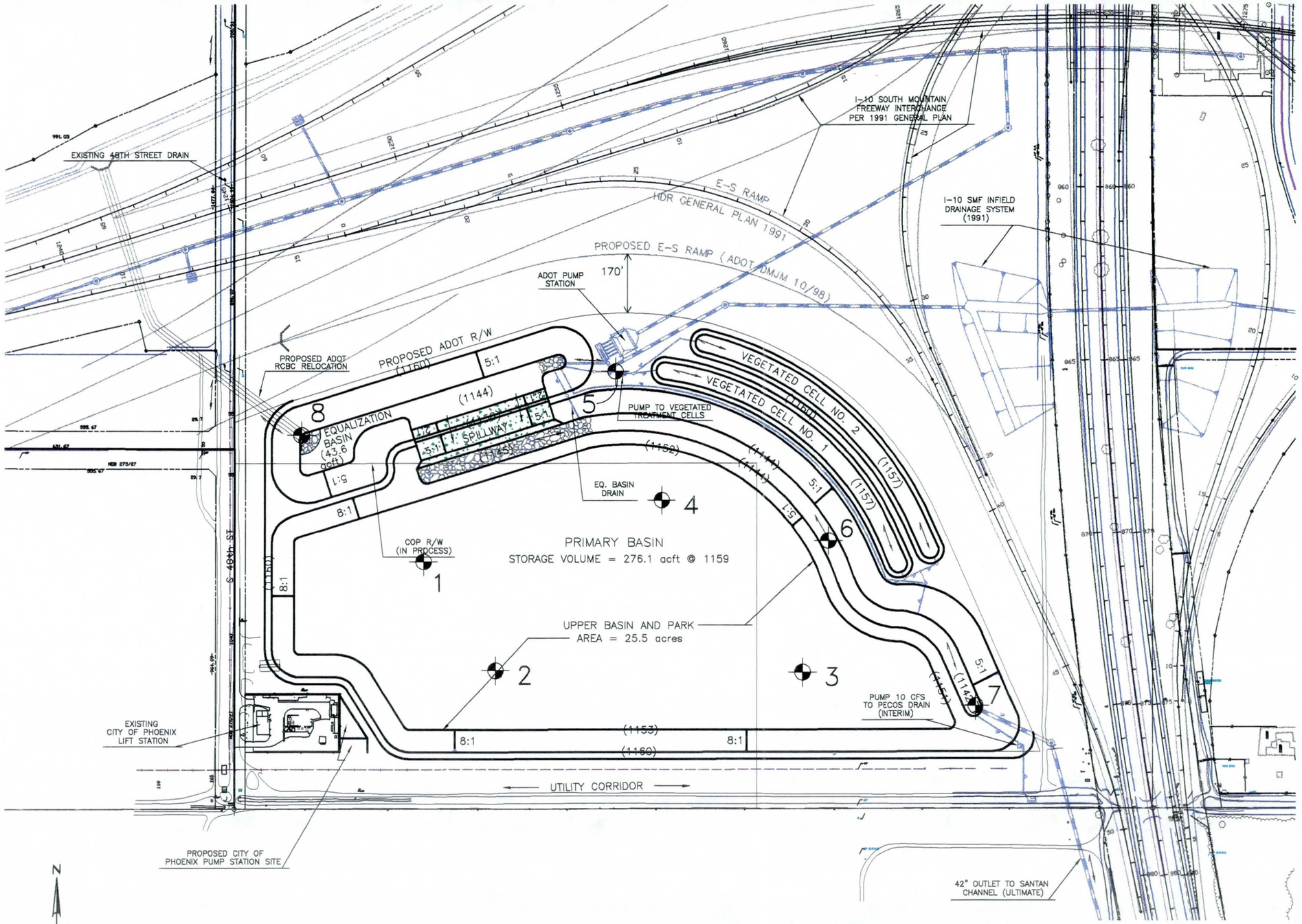

REFERENCE: HDR ENGINEERING, INC., 48th STREET DETENTION BASIN SITE PLAN, FOR CITY OF PHOENIX, ARIZONA, HDR PROJECT NO. 00167-293-044, SHEET NO. 1 OF 6, DECEMBER 1998.

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JOB NO.	9-117-001014
DESIGN	KHD
DRAWN	SLB
DATE	2/99
SCALE	NTS

SITE PLAN
SHOWING BORING LOCATIONS
48th STREET DETENTION BASIN

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PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 1

JOB NO. 9-117-001014 **DATE** 2/3/99

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

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	1-3-6			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained sand, subrounded to subangular, low plasticity, brown
5			X	S	9-13-16			SC	slightly moist firm	**CLAYEY SAND**, predominantly fine grained, weakly lime cemented, low to medium plasticity, light brown
10			X	S	2-4-5			CL	slightly moist moderately firm	**SILTY TO SANDY CLAY**, low to medium plasticity, light brown
15			X	S	13-17-21			SC/CL	slightly moist very firm	**CLAYEY SAND**, predominantly fine grained, weakly lime cemented, low to medium plasticity, light brown
20										Stopped Auger at 15' Stopped Sampler at 16'6"
25										
30										
35										
40										
45										
50										

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GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

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PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 2

JOB NO. 9-117-001014 DATE 2/3/99

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

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	1-4-8			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained, subrounded to subangular, low plasticity, brown
								CL	slightly moist moderately firm	**SANDY CLAY**, weakly lime cemented, low to medium plasticity, light brown
5				S	8-12-15		9			
10				S	6-5-5		11	SC-SM	slightly moist firm to hard	**CLAYEY SAND**, some to considerable silt, predominantly medium to fine grained, subrounded to subangular, weakly lime cemented, low to medium plasticity, brown
15				U	40					Stopped Auger at 15' Stopped Sampler at 16'
20										
25										
30										
35										
40										
45										
50										

GEOTECH_BH 91171014.GPJ AGRA_ALB.GDT 2/16/99

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

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PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 3

JOB NO. 9-117-001014 DATE 2/3/99

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

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0				S	1-5-7			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
								SC	slightly moist firm	**CLAYEY SAND**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
5				S	6-7-9					
								CL	slightly moist firm to hard	**SANDY CLAY**, predominantly fine to medium grained, subrounded to subangular, weakly to moderately lime cemented, medium plasticity, brown
10				U	34		11			
15				S	10-22-50					
										Stopped Auger at 15' Stopped Sampler at 16'6"
20										
25										
30										
35										
40										
45										
50										

GEOTECH_BH 91171014.GPJ AGRA_ALB.GDT 2/16/99

GROUNDWATER

DEPTH	HOUR	DATE
▽	none	
▼		

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

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PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 4

JOB NO. 9-117-001014 DATE 2/3/99

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

Depth in Feet	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	X	S	2-3-4			SC/CL	slightly moist soft	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
						SC	slightly moist firm	**CLAYEY SAND**, poorly graded, subrounded to subangular, low to medium plasticity, brown
5	X	S	12-12-12					
						SC	slightly moist hard to firm	**CLAYEY SAND**, some fine grained gravel, poorly graded, subrounded to subangular, weakly to moderately lime cemented, low to medium plasticity, brown note: some sand (SP) lenses
10		U	52	107	5			
15	X	S	13-13-15		9			Stopped Auger at 15' Stopped Sampler at 16'6"
20								
25								
30								
35								
40								
45								
50								

GROUNDWATER

DEPTH	HOUR	DATE
▽	none	
▼		

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

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ENGINEERING GLOBAL SOLUTIONS

GEOTECH_BH 91171014.GPJ AGRA_ALB.GDT 2/16/99

PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 5

JOB NO. 9-117-001014 DATE 2/3/99

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

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	2-5-6			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SAND CLAY**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
								SC		**CLAYEY SAND**, poorly graded, subrounded to subangular, weakly lime cemented, low to medium plasticity, brown
5			X	S	9-13-18				slightly moist very firm to moderately firm	
10			X	S	7-7-8					
								SC/SM	slightly moist firm	**CLAYEY SAND**, some silt & fine grained gravel, predominantly medium to fine grained, subrounded to subangular, weakly lime cemented, low to medium plasticity, light brown
15			X	S	7-8-12					
20			X	S	14-16-50		13			
								SC	slightly moist hard	**CLAYEY SAND**, predominantly medium to fine grained, subrounded to subangular, weakly to moderately lime cemented, low to medium plasticity, light brown
25			X	S	18-50/4"					
30				U	100/7"					
35			X	S	30-45-25					
										Stopped Auger at 35' Stopped Sampler at 36'6"
40										
45										
50										

GEOTECH_BH 91171014.GPJ AGRA_ALB.GDT 2/16/99

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

AGRA
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PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 6

JOB NO. 9-117-001014 DATE 2/3/99

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

Depth in Feet	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0	X	S	2-5-7			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained sand, subrounded to subangular, low to medium plasticity, brown
5	X	S	9-12-12			SC	slightly moist firm to hard	**CLAYEY SAND**, poorly graded, subrounded to subangular, low to medium plasticity, brown
10	X	S	4-6-11					
15		U	78	113	10			
20		S	50/3"			GP/GC	slightly moist hard	**CLAYEY GRAVEL**, poorly graded, subrounded to subangular, weakly to moderately lime cemented, low to medium plasticity, brown
25		S	50/0"			SC	slightly moist hard	**CLAYEY SAND & GRAVEL**, predominantly medium to fine grained sand, predominantly fine grained gravel, subrounded to subangular, low to medium plasticity, brown Stopped Auger at 25' Sampler refused at 25'
30								
35								
40								
45								
50								

GEOTECH_BH 91171014.GPJ AGRA_ALB.GDT 2/16/99

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

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PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 7

JOB NO. 9-117-001014 DATE 2/3/99

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

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	2-4-8			SC/CL	slightly moist moderately firm	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
								SC		**CLAYEY SAND**, poorly graded, subrounded to subangular, weakly lime cemented, low to medium plasticity, light brown
5			X	S	9-9-8				slightly moist firm to very firm	
10			X	S	6-14-18					
15			X	S	22-30-38		12	SM/GM	slightly moist hard	**SILTY SAND & GRAVEL**, poorly graded sand, predominantly fine grained gravel, angular to subangular, low plasticity, brown
								SC/SM		**CLAYEY SAND**, some silt, predominantly medium to fine grained, subrounded to subangular, weakly to moderately lime cemented, low to medium plasticity, light brown
20			X	S	14-50/5 1/2"				slightly moist hard	
25			X	S	11-15-50/5"		13			
30				S	50/2"					Auger refused at 29' Sampler refused at 29'2"
35										
40										
45										
50										

GEOTECH_BH 91171014.GPJ AGRA_ALB.GDT 2/16/99

GROUNDWATER

DEPTH	HOUR	DATE
▽	none	
▼		

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

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PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 7A

JOB NO. 9-117-001014 DATE 2/4/99

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

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								SC/CL	slightly moist	**CLAYEY SAND TO SANDY CLAY**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown
								SC	slightly moist	**CLAYEY SAND**, poorly graded, subrounded to subangular, weakly lime cemented, low to medium plasticity, light brown
5										
10										
15								SM/GM	slightly moist	**SILTY SAND & GRAVEL**, poorly graded sand, predominantly fine grained gravel, low plasticity, brown
20			A					SC/SM	slightly moist	**CLAYEY SAND**, some fine grained gravel, poorly graded, subrounded to subangular, weakly lime cemented, low to medium plasticity, light brown note: considerable moderately to strongly lime cemented nodules in lenses
25										
30			A							
35										
40										Stopped Auger at 40'
45										
50										

GEOTECH_BH 91171014.GPJ AGRA_ALB.GDT 2/16/99

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

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PROJECT 48th Street Detention Basin

LOG OF TEST BORING NO. 8

JOB NO. 9-117-001014 **DATE** 2/4/99

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

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blow Counts	Dry Density lbs. per. Cubic ft.	Moisture Content Percent of Dry Weight	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0			X	S	1-2-4			SC/CL	slightly moist soft	**CLAYEY SAND TO SANDY CLAY**, poorly graded, subrounded to subangular, low to medium plasticity, brown
								SC		**CLAYEY SAND**, some fine grained gravel, predominantly medium to fine grained, subrounded to subangular, weakly lime cemented, low to medium plasticity, brown to light brown
5				U	58	104	8		slightly moist very firm to hard	
10			X	S	13-18-21					
15			X	S	16-18-22					
20			X	S	16-20-26					
25			X	S	50/5"			SC	slightly moist hard	**CLAYEY SAND**, predominantly medium to fine grained, subrounded to subangular, weakly to moderately lime cemented, low to medium plasticity, brown
30			X	S	28-50/5"					
35			X	S	8-16-24		26	SM	slightly moist to moist very firm	**SILTY SAND**, predominantly medium to fine grained, subrounded to subangular, low to medium plasticity, brown note: thin layers of moderately to strongly lime cemented nodules
40			X	S	8-10-20					
										Stopped Auger at 40' Stopped Sampler at 41'6"
45										
50										

GEOTECH_BH 91171014.GPJ AGRA_ALB.GDT 2/16/99

GROUNDWATER

DEPTH	HOUR	DATE
	none	

SAMPLE TYPE
A - Auger cuttings; NR - No Recovery
S - 2" O.D. 1.38" I.D. tube sample
U - 3" O.D. 2.42" I.D. tube sample
T - 1" O.D. thin-walled tube sample

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APPENDIX B

RESULTS OF LABORATORY TESTS

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AGRA Earth & Environmental, Inc.

PROJECT: 48TH ST DETENTION BASIN
LOCATION: 48TH ST; PHOENIX, AZ

JOB NO: 9-117-001014
WORK ORDER NO: 1
DATE SAMPLED: 2-4-99

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

SIEVE SIZES

				Silt or	SAND								GRAVEL								COBBLES		
				Clay	Fine			Medium			Coarse		Fine				Coarse						
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 #

PERCENT PASSING BY WEIGHT

2 @ 5-15'	GP-GM	37	12	10	13	15	16	17	20	23	23	25	52	82	95	99	100	100	100	100	100	100	6
2 @ 10-11'6"	SC	34	11	48	61	70	75	79	86	91	92	95	98	99	100	100	100	100	100	100	100	100	8
3 @ 5-15'	CL	39	18	52	61	68	71	74	83	91	93	98	99	100	100	100	100	100	100	100	100	100	11
3 @ 10-11'	SM	38	11	44	61	73	77	81	89	94	95	99	99	100	100	100	100	100	100	100	100	100	13
4 @ 15-16.5'	SC	39	16	39	48	57	61	66	78	89	92	98	99	99	100	100	100	100	100	100	100	100	18
5 @ 20-21.5'	SM	39	11	38	48	58	63	69	79	87	89	93	95	98	100	100	100	100	100	100	100	100	23
6 @ 15-16'	SC	34	12	43	56	68	72	77	87	94	96	99	99	100	100	100	100	100	100	100	100	100	30
7 @ 15-16'6"	SM	37	3	29	35	42	46	51	63	74	78	86	89	94	97	100	100	100	100	100	100	100	35
7 @ 25-26'5"	SM	34	10	45	54	62	65	67	73	77	78	82	83	88	90	95	100	100	100	100	100	100	37
8 @ 5-6'	SC	37	15	36	44	52	56	60	71	82	86	94	97	99	100	100	100	100	100	100	100	100	39

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental, Inc.

PROJECT: 48TH ST DETENTION BASIN
LOCATION: 48TH ST; PHOENIX, AZ

JOB NO: 9-117-001014
WORK ORDER NO: 1
DATE SAMPLED: 2-4-99

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

SIEVE SIZES

				Silt or	SAND								GRAVEL								COBBLES		
				Clay	Fine			Medium			Coarse		Fine				Coarse						
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 #

PERCENT PASSING BY WEIGHT

8 @ 35-36'6"	SM	39	12	44	61	75	80	84	90	94	95	98	100	100	100	100	100	100	100	100	100	100	45

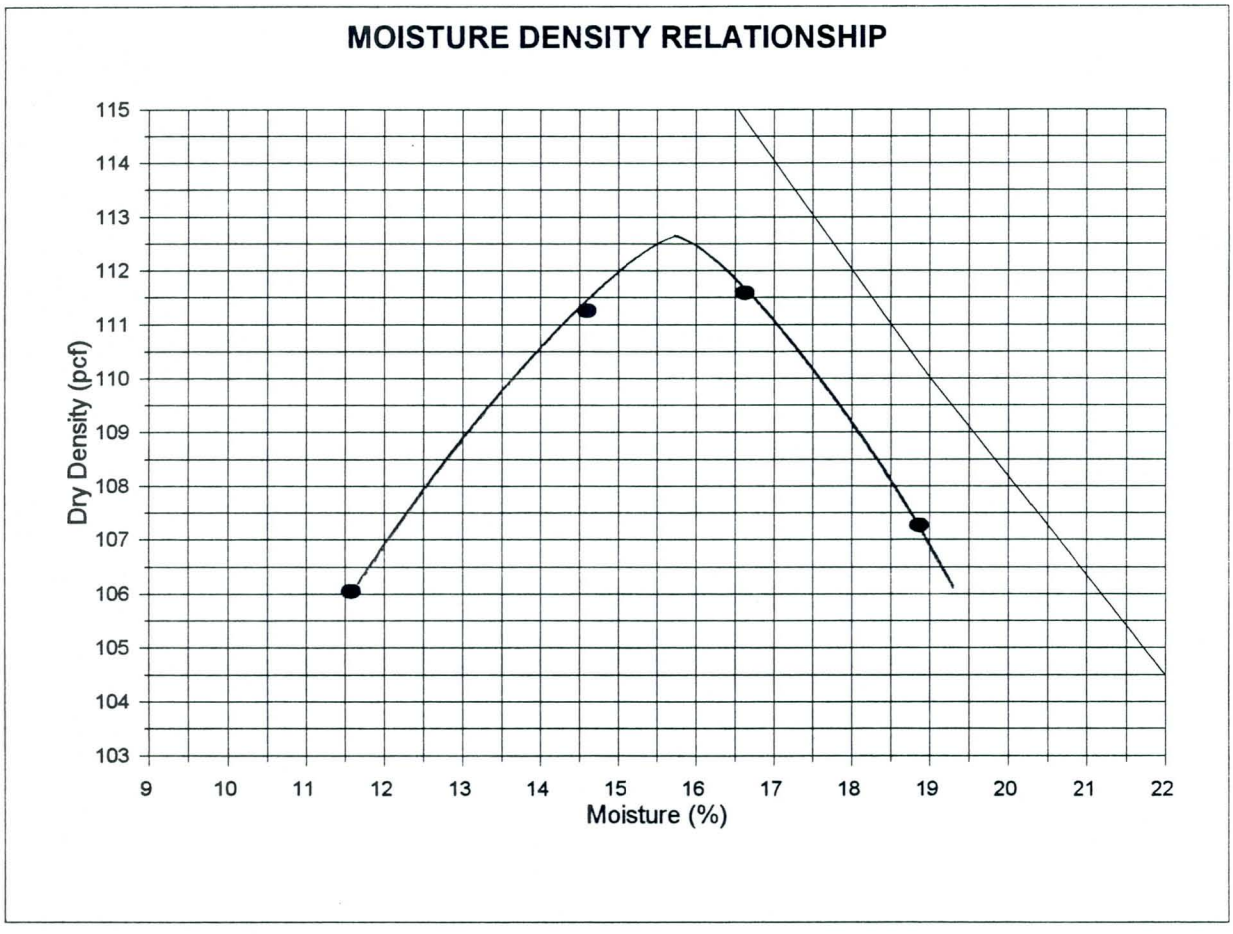
AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental, Inc.

PROJECT:	48TH ST DETENTION BASIN	**JOB NO:**	9-117-001014
LOCATION:	48TH ST; PHOENIX, AZ	**WORK ORDER NO:**	1
MATERIAL:	3 @ 5-15'	**LAB NO:**	11
SAMPLE SOURCE:		**SAMPLE DATE:**	2-4-99

LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING STANDARD EFFORT(12,400 ft-lbft/cu.ft) (ASTM D698A)

MAXIMUM DRY DENSITY (pcf):	112.6
OPTIMUM MOISTURE (%):	15.8



NOTE: THE ZERO AIR VOIDS CURVE REPRESENTS A SPECIFIC GRAVITY OF: 2.651

THIS IS A SUMMARIZED REPORT OF THE REFERENCED PROCEDURES AND DOES NOT INCLUDED ALL REPORTING REQUIREMENTS. ADDITIONAL DATA CAN BE PROVIDED AT CLIENT'S REQUEST.

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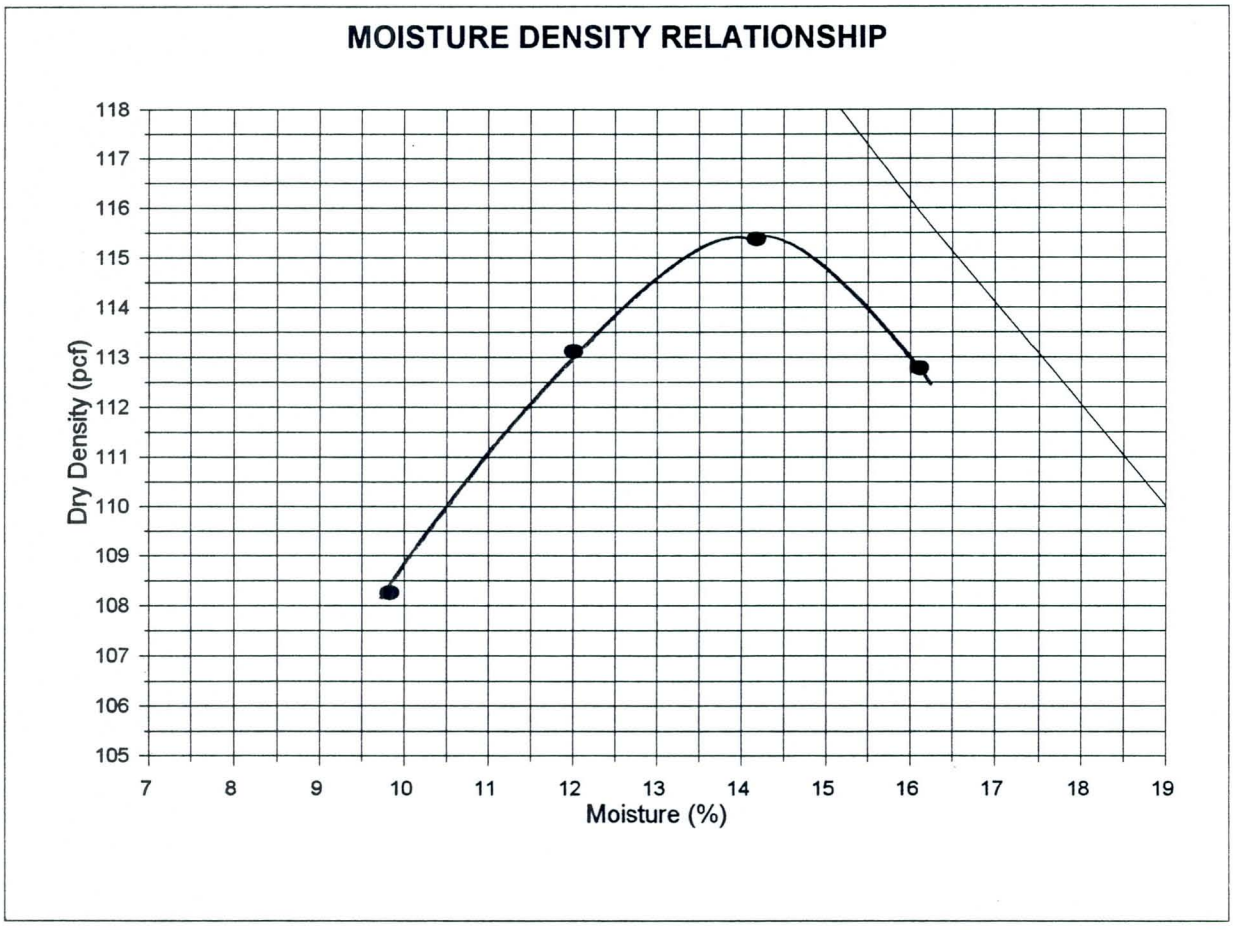
AGRA Earth & Environmental, Inc.

PROJECT:	48TH ST DETENTION BASIN	**JOB NO:**	9-117-001014
LOCATION:	48TH ST; PHOENIX, AZ	**WORK ORDER NO:**	1
MATERIAL:	2 @ 5-15'	**LAB NO:**	6
SAMPLE SOURCE:		**SAMPLE DATE:**	2-4-99

LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING STANDARD EFFORT(12,400 ft-lbft/cu.ft) (ASTM D698A)

MAXIMUM DRY DENSITY (pcf):	115.4
OPTIMUM MOISTURE (%):	14.2



NOTE: THE ZERO AIR VOIDS CURVE REPRESENTS A SPECIFIC GRAVITY OF: 2.651

THIS IS A SUMMARIZED REPORT OF THE REFERENCED PROCEDURES AND DOES NOT INCLUDED ALL REPORTING REQUIREMENTS. ADDITIONAL DATA CAN BE PROVIDED AT CLIENT'S REQUEST.

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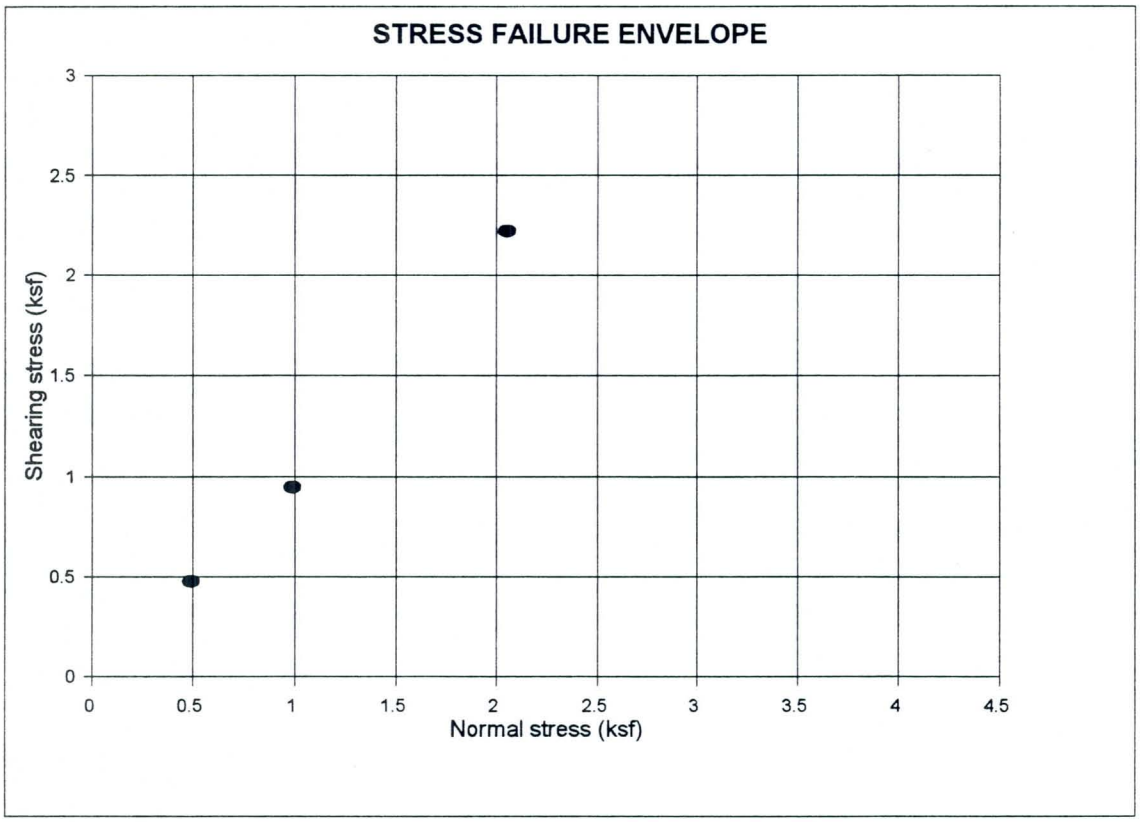
AGRA Earth & Environmental, Inc.

PROJECT:	48TH ST DETENTION BASIN	**JOB NO:**	9-117-001014
LOCATION:	48TH ST; PHOENIX, AZ	**WORK ORDER NO:**	1
MATERIAL:		**LAB NO:**	13
SAMPLE SOURCE:	3 @ 10-11'	**DATE SAMPLED:**	2-4-99
SAMPLE PREPARATION:	INSITU		

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS(ASTM D3080)

Initial thickness of specimen (cm):	2.54		
Initial diameter of specimen (cm):	6.15		
Shearing device used:	Clockhouse, type "K12"		
Rate of deformation (in/min):	0.016		
Direct shear point:	1	2	3
Dry mass of specimen (g):	97.6	106.4	122.7
Initial Moisture Content:	16.4%	15.4%	16.6%
Initial Wet Density (lb per cu.ft):	93.3	100.7	117.5
Initial Dry Density (lb per cu.ft):	80.2	87.4	100.8
Final Moisture Content:	32%	31%	24%
Final Wet Density (lb per cu.ft):	106.5	115.3	125.9
Final Dry Density (lb per cu.ft):	80.9	88.1	101.7
Normal Stress (kips per sq. ft):	0.50	1.00	2.06
Maximum Shearing Stress (kips per sq. ft):	0.5	0.9	2.2
Vertical Deformation @ Max Shear (in):	-0.009	-0.004	0.004
Horizontal Deformation @ Max Shear (in):	0.221	0.330	0.074



AGRA
ENGINEERING GLOBAL SOLUTIONS

IAS Laboratories

2515 East University Drive
Phoenix, Arizona 85034
(602) 273-7248
Fax (602) 275-3836

February 12, 1999

Submitted by: Cliff Metz

Report to: Agra Earth & Environmetal

Report NO: 6607613

Job # 9-117-001014

SOIL ANALYSIS

Sender ID	Lab NO	pH*	SO_4-S** (ppm)
33#7@5'-6.5'	044	8.5	20
41#8@15'-16.5'	045	8.8	15

*Analyses performed on a 1:1 water:soil extract.
pH Reference: Methods of Soil Analysis, ASA, No.9, Part 2, 10-3.3:
** Analysis performed by method referenced in Soil Sampling and Methods of Analysis, 1993, Canadian Society of Soil Science, p.67.

FCD Copy

AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

AGRA Earth & Environmental, Inc.
3232 West Virginia Avenue
Phoenix, Arizona 85009-1502
Tel (602) 272-6848
Fax (602) 272-7239
Toll Free 1-800-248-AGRA

August 2, 1999
AEE Job No. 9-117-001014
Letter No. 2

HDR Engineering, Inc.
2141 East Highland Avenue
Suite 250
Phoenix, Arizona 85016

HDR
REC.: AUG 0 4 1999
PROJ.:
FILE :
DIST.:

Attention: Jerome J. Zovne, Ph.D., P.E.

Gentlemen:

RE: AGRONOMY SOIL LABORATORY ANALYSES RESULTS
48TH STREET DETENTION BASIN
N.E. CORNER OF 48TH STREET & PECOS ROAD
PHOENIX, ARIZONA

Attached are the results of nutrient soil testing, sieve analysis and Atterberg limits testing performed for samples collected from the 48th Street Detention Basin site. A site map presenting the sampling locations also is attached.

The results of the Bio-assay (pot tests) are scheduled for completion on August 19, 1999. Preliminary verbal results will be available on August 6, 1999.

Should you have any questions concerning this submittal, please do not hesitate in contacting us.

Respectfully submitted,

AGRA Earth & Environmental, Inc.

Tony J. Freiman

Tony J. Freiman, P.E.
Senior Engineer

c: Addressee (4)

G:\Transportation\9-117-001014\9-117-001014 Documents\9-117-001014 Ltr 2.wpd

IAS Laboratories

2515 East University Drive
Phoenix, Arizona
85034
(602) 273-7248

ADOT Top Soil Specifications

Submitted by: Cliff Metz

Report to: Agra Earth & Environmental

Report No: 6609010 Job Number: 9-117-001014

Date: 8/2/99

Sender I.D.	Lab No	pH	Soluble Salts PPM	Calcium Carbonates %	Exchangeable Sodium %	Exchangeable Sodium PPM
49#1@3"-10"	563	8.0	4450	2.75	5.8	390
50#2@3"-10"	564	8.3	1260	2.25	3.4	160
51#3@3"-10"	565	8.1	1790	2.25	4.2	200
52#4@3"-10"	566	8.1	2180	4.5	3.7	300
53#5@3"-10"	567	8.3	1540	3.4	3.1	200
54#6@3"-10"	568	8.1	1470	2.0	3.4	160

Analysis	Method	Passing Specification
pH	ARIZ 237b	6.0 - 8.3
Soluble Salts	ARIZ 237b	2000 ppm Max
Calcium Carbonates	ARIZ 732	8 % Max
Exchangeable Sodium %	ARIZ 729	5 % Max
Exchangeable Sodium (ppm)	ARIZ 729	300 ppm Max

Lab # 563 does not pass for soluble salts, % Na, and ppm Na.
Lab # 566 does not pass for soluble salts.
Leaching to reduce soluble salts will solve the problem on both samples.

AGRA Earth & Environmental, Inc.

PROJECT: 48TH ST DETENTION BASIN
LOCATION: 48TH ST; PHOENIX, AZ

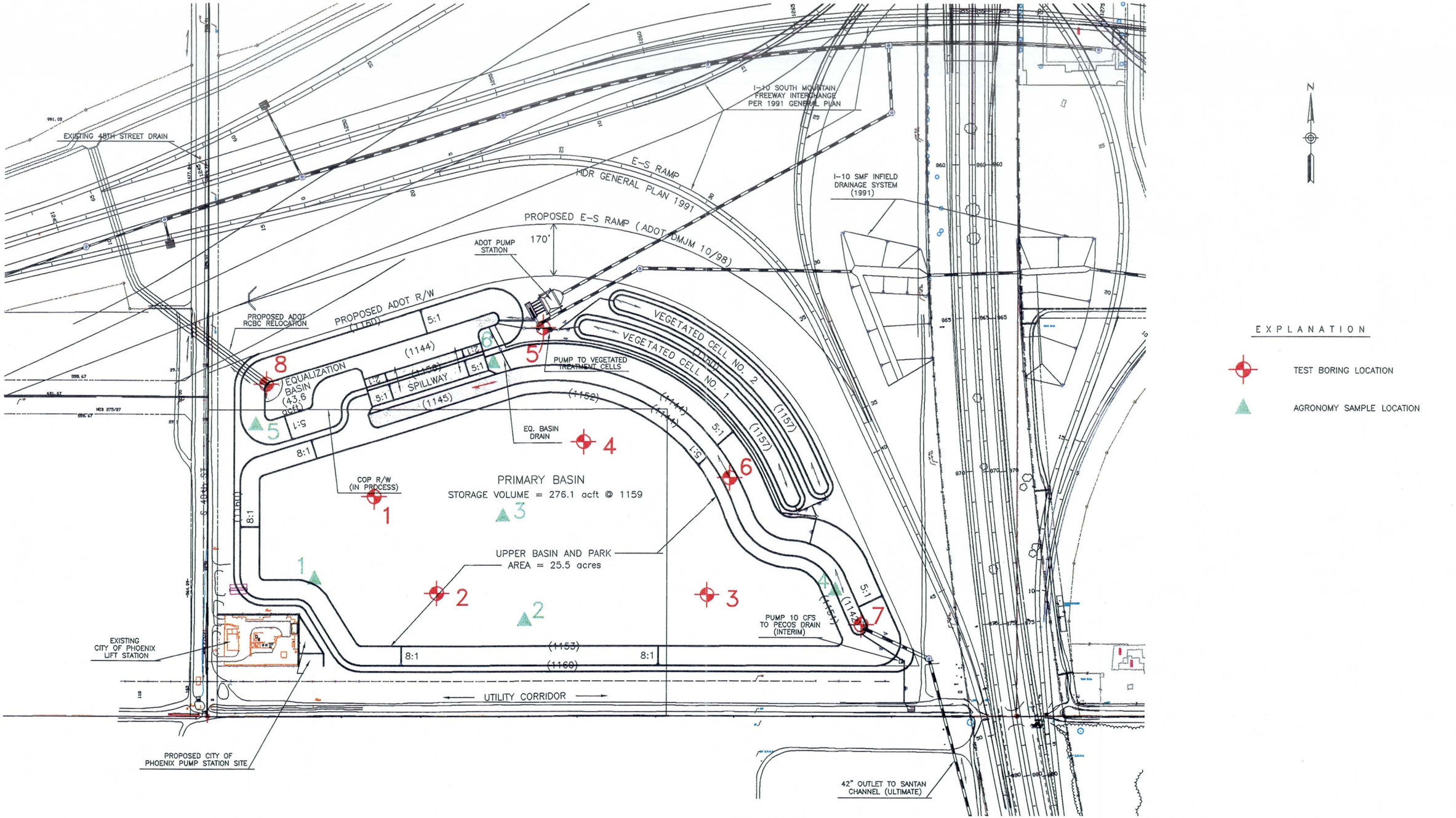
JOB NO: 9-117-001014
WORK ORDER NO: 2
DATE SAMPLED: 7-22-99

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

SIEVE SIZES

				Silt or	SAND								GRAVEL								COBBLES		
				Clay	Fine			Medium			Coarse		Fine				Coarse						
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 #
PERCENT PASSING BY WEIGHT																							
#1 @ 3"-10"	CL-ML	24	4	53	65	74	78	82	91	96	97	99	99	100	100	100	100	100	100	100	100	100	49
#2 @ 3" - 10"	CL-ML	25	4	64	73	81	83	86	93	98	98	100	100	100	100	100	100	100	100	100	100	100	50
#3 @ 3" - 10"	CL-ML	24	4	55	66	74	78	82	91	96	97	99	99	99	100	100	100	100	100	100	100	100	51
#4 @ 3" - 10"	CL	28	8	67	75	81	84	86	91	95	96	98	98	99	99	100	100	100	100	100	100	100	52
#5 @ 3" - 10"	SC-SM	26	7	48	57	66	70	74	83	92	94	98	98	99	100	100	100	100	100	100	100	100	53
#6 @ 3" - 10"	SM	23	2	38	51	64	69	75	86	94	97	99	100	100	100	100	100	100	100	100	100	100	54

AGRA
ENGINEERING GLOBAL SOLUTIONS



REFERENCE: HDR ENGINEERING, INC., 48th STREET DETENTION BASIN SITE PLAN, FOR CITY OF PHOENIX, ARIZONA, HDR PROJECT NO. 00167-293-044, SHEET NO. 1 OF 6, DECEMBER 1998.

AGRA
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Fax: (602)272-7239

JOB NO.	9-117-001014
DESIGN	KHD
DRAWN	SLB
DATE	2/99
SCALE	N.T.S.

SITE PLAN
SHOWING SAMPLING LOCATIONS
48th STREET DETENTION BASIN

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AGRA Earth & Environmental
ENGINEERING GLOBAL SOLUTIONS

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August 24, 1999
AEE Job No. 9-117-001014
Letter No. 3

HDR Engineering, Inc.
2141 East Highland Avenue
Suite 250
Phoenix, Arizona 85016

HDR
REC.: AUG 25 1999
PROJ.:
FILE:
DIST.:

Attention: Jerome J. Zovne, Ph.D., P.E.

Gentlemen:

RE: AGRONOMY SOIL LABORATORY RESULTS
48TH STREET DETENTION BASIN
N.E. CORNER OF 48TH STREET & PECOS ROAD
PHOENIX, ARIZONA

Attached are the results of the "complete" nutrient soil testing performed for bermuda grass, along with agronomist's recommendations for soil amendments. The sample numbers refer to the locations presented on the site plan, which was part of Letter No. 2.

The results of the bio-assay tests are still in progress, scheduled for completion on August 19, 1999.

Should you have any questions concerning this submittal, please do not hesitate in contacting us.

Respectfully submitted,

AGRA Earth & Environmental, Inc.

for Tony J. Freiman

Tony J. Freiman, P.E.
Senior Engineer

c: Addressee (4)

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IAS Laboratories

2515 East University Drive
Phoenix, Arizona
85034
(602) 273-7248

ADOT Top Soil Specifications

Submitted by: Cliff Metz

Report to: Agra Earth & Environmental

Report No: 6609010 Job Number: 9-117-001014

Date: 8/2/99

Sender I.D.	Lab No	pH	Soluble Salts PPM	Calcium Carbonates %	Exchangeable Sodium %	Exchangeable Sodium PPM
49#1@3"-10"	563	8.0	4450	2.75	5.8	390
50#2@3"-10"	564	8.3	1260	2.25	3.4	160
51#3@3"-10"	565	8.1	1790	2.25	4.2	200
52#4@3"-10"	566	8.1	2180	4.5	3.7	300
53#5@3"-10"	567	8.3	1540	3.4	3.1	200
54#6@3"-10"	568	8.1	1470	2.0	3.4	160

Analysis	Method	Passing Specification
pH	ARIZ 237b	6.0 - 8.3
Soluble Salts	ARIZ 237b	2000 ppm Max
Calcium Carbonates	ARIZ 732	8 % Max
Exchangeable Sodium %	ARIZ 729	5 % Max
Exchangeable Sodium (ppm)	ARIZ 729	300 ppm Max

Lab # 563 does not pass for soluble salts, % Na, and ppm Na.
Lab # 566 does not pass for soluble salts.
Leaching to reduce soluble salts will solve the problem on both samples.

IAS Laboratories

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SOIL ANALYSIS REPORT

Today's Date: 8/5/99
Grower: Agra Earth& Environmental
Submitted By: Cliff Metz
Send Report To: Agra Earth& Environmental
Report Number: 6609010
Crop: Bermuda grass
Date Received: 7/28/99

VL = Very Low
L = Low
M = Medium
H = High
VH = Very High

Sender Sample Id	Depth	Lab #	pH	Calcium (Ca) PPM	Magnesium (Mg) PPM	Sodium (Na) PPM	Potash (K) PPM	Iron (Fe) PPM	Zinc (Zn) PPM	Manganese (Mn) PPM	Copper (Cu) PPM	Salinity (EC x K) dS/M	Nitrate Nitrogen (NO3-N) PPM	Phosphorus (Bicarb - Soluble P) PPM	Computed % Sodium (ESP)	Sulfur (SO4-S) PPM	Boron (B) PPM	Free Lime Level
49 #1		563	8.0	4700 VH	360 VH	390 VH	400 VH	4.5 M	1.4 H	18.0 VH	1.6 VH	5.8 VH	158.0 VH	20.0 H	5.8	72 VH	.47 L	Medium
50 #2		564	8.3	3300 VH	300 VH	160 M	190 H	4.4 M	.94 M	12.0 VH	.96 H	1.3 L	56.8 VH	18.0 M	3.4	15 M	.40 L	Medium
51 #3		565	8.1	3300 VH	320 VH	200 M	300 VH	3.8 M	.97 M	16.0 VH	1.2 VH	2.0 L	82.4 VH	12.0 M	4.2	21 VH	.52 L	Medium
52 #4		566	8.1	5800 VH	450 VH	300 H	320 VH	3.9 M	.86 M	15.0 VH	1.6 VH	3.2 M	70.2 VH	14.0 M	3.7	38 VH	.57 L	High
53 #5		567	8.3	4800 VH	320 VH	200 M	250 H	3.3 M	.86 M	15.0 VH	1.1 VH	1.6 L	55.6 VH	10.0 M	3.1	16 H	.43 L	Medium
54 #6		568	8.1	3200 VH	310 VH	160 M	370 VH	3.3 M	.94 M	18.0 VH	1.5 VH	1.7 L	56.6 VH	8.2 L	3.4	17 H	.43 L	Medium

IAS Laboratories

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SOIL FERTILITY RECOMMENDATIONS

Lb/1000 Sq Ft

Grower: Agra Earth& Environmental Send To: Agra Earth& Environmental

Report No: 6609010 Date: 7/28/99 Page: 2

												AMENDMENTS			
Sender Number	Crop	Nitrogen N	Phosphate P2O5	Potash K2O	Magnesium Mg	Sulfur S	Iron Fe	Zinc Zn	Manganese Mn	Copper Cu	Boron B	Elemental Sulfur	Gypsum	Lime	Leaching of Excess Salts
49 #1	Bermuda grass	0*					a					10***			yes
50 #2	Bermuda grass	0*	1**				a					10***			
51 #3	Bermuda grass	0*	1**				a					10***			
52 #4	Bermuda grass	0*	1**				a					10***			
53 #5	Bermuda grass	0*	1**				a					10***			
54 #6	Bermuda grass	0*	2**				a					10***			

* Currently more than adequate.
** Broadcast phosphate and till into the soil where possible.
a. Add one to two ounces iron chelate per 1000 sq.ft. or a product like Ironite to balance the Fe:Mn ratio.
***Till sulfur into the soil to reduce pH. If turf is already established about the best you can do is to work it in when verticutting or aerating.

IAS Laboratories

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Phoenix, Arizona 85034
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Fax (602) 275-3836

August 18, 1999

Submitted by: Agra Earth & Environmental

Report to: Cliff Metz

Report No: 6609010

BIOASSAY FOR HERBICIDES

Sender ID	Lab No	Broadleaf	Grasses
49#1@3"-10"	563	None Detected	None Detected
50#2@3"-10"	564	None Detected	None Detected
51#3@3"-10"	565	None Detected	None Detected
52#4@3"-10"	566	None Detected	None Detected
53#5@3"-10"	567	None Detected	None Detected
54#6@3"-10"	568	None Detected	None Detected

IAS Laboratories

2515 East University Drive
Phoenix, Arizona
85034
(602) 273-7248

Date: 8/19/99

Submitted by: Cliff Metz

Report to: Agra Earth & Environmental

Report No: 6609005

Site: Job# 9-117-001047

SOIL ANALYSIS

Sender I.D.	Lab No	* pH	Sulfate** Sulfur ppm	* Chloride ppm	Electrical* Conductivity dS/M	Redox Potential Eo (mV)	Total Sulfide ppm
89P1@4.5'-6'	532	8.3	9.5	89	0.79	167	<1
95P2@4.5'-5.5'	533	8.5	42	120	0.70	176	<1
100P3@9.5'-11'	534	8.7	44	140	0.88	179	<1
104P4@9.5'-11'	535	8.7	37	120	0.79	171	<1
108P5@4.5'-6'	536	9.2	2.7	24	0.29	182	<1
112P6@4.5'-5'5 1/2"	537	8.5	35	310	1.1	162	<1
119P7@9.5'-10.5'	538	8.7	28	280	0.90	164	<1
123P8@2.5'-4'	539	8.8	54	57	0.62	191	<1
126P9@4.5'-6'	540	9.1	12	12	0.30	175	<1
132P10@4.5'-6'	541	8.7	36	79	0.55	174	<1
137P11@4.5'-5'-11"	542	8.6	4.7	9.9	0.17	188	<1
141P12@4.5'-6'	543	8.6	22	76	0.40	176	<1
147P13@4.5'-5'5"	544	8.8	12	20	0.30	186	<1

* Analysis performed on a 1:1 water:soil extract.
pH Reference: Methods of Soil Analysis, ASA, No.9, Part 2, 12-2.
Electrical Conductivity Reference: Methods of Soil Analysis, ASA, No.9, Part 2, 10-3.3.
Chloride measured using ISE.
**Analysis performed by method referenced in Soil Sampling and Methods of Analysis, 1993, Canadian Society of Soil Science,p.67.
Redox Potential Analysis performed on a Saturated Paste extract.
Eo is the potential developed by the platinum redox electrode. The oxidation-reduction potential of the sample relative to the normal hydrogen electrode (Enhe) can be calculated as follows: Enhe= Eo+C where C is 199mV.